## REQUEST FOR EXPRESSIONS OF INTEREST (CONSULTING SERVICES – FIRMS SELECTION)

**COUNTRY:** Bangladesh.

NAME OF PROJECT: Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project under Bangladesh Private Investment & Digital Entrepreneurship Project (P170688)

Credit No.: IDA-6676 BD

Assignment Title: Selection of Regional Environmental & Social Consultancy Services. Reference No.: PMC16-BSMSN-BEZA (Lot-1)

The Government of the People's Republic of Bangladesh has received financing from the World Bank toward the cost of the Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project under Bangladesh Private Investment & Digital Entrepreneurship Project (P170688), a project of Bangladesh Economics Zones Authority (BEZA). A Master Plan for BSMSN has been prepared and BEZA plans to examine ES risks and impacts associated with implementation of the master plan in the vast area of proposed industrial city and its area of influence and intends to apply part of the proceeds for consulting services for carrying out a Regional Environmental and Social Assessment (RESA) in this regard. The RESA needs to be carried out as per the Terms of Reference following the guide line of the master plan of Bangabandhu Sheikh Mujib Shilpa Nagar.

Implementation period of the Services is from October 01, 2021 to September 30, 2022.

The detailed Terms of Reference (TOR) for the assignment can be found at the following website: <u>www.beza.gov.bd</u>

The Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project under Bangladesh Private Investment & Digital Entrepreneurship Project (P170688) now invites eligible consulting firms ("Consultants") to indicate their interest in providing the Services. Interested Consultants should provide information demonstrating that they have the required qualifications and relevant experience to perform the Services. The shortlisting criteria are:

- The firm(s) should be registered for consultancy service. The firm has to establish an office in Bangladesh (if contract is awarded). The 'age of firm' in in consultancy service is minimum 5 (Five) years. It is preferable to limit the total number of firms/institutes in the association to three.
  - 2) At least 10 years firm experience (years counting backward from the date of publication of REOI in the newspaper to 1<sup>st</sup> assignment of firm) in the field of Regional Environmental & Social

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Consultancy Services etc. with verifiable success in the delivery of high-quality outputs within time and budget constraints (In case of JV, each member shall meet the requirement).

- 3) Experience in Consulting Services Contracts of similar services (Regional Environmental & Social Consultancy Services) in terms of number of Contracts, Contract Value, Contract duration and complexity;
- 4) Staffing of the firm (organization) indicating availability of appropriate skills/ experts in the firm.

Key Experts will not be evaluated at the shortlisting stage.

The attention of interested Consultants is drawn to Section III, paragraphs, 3.14, 3.16, and 3.17 of the World Bank's "Procurement Regulations for IPF Borrowers" July 2016, Revised November 2020 ("Procurement Regulations"), setting forth the World Bank's policy on conflict of interest related to the assignment as per paragraph 3.17 of the Procurement Regulations.

Consultants may associate with other firms to enhance their qualifications, but should indicate clearly whether the association is in the form of a joint venture and/or a sub-consultancy. In the case of a joint venture, all the partners in the joint venture shall be jointly and severally liable for the entire contract, if selected.

A Consultant will be selected in accordance with the **Quality and Cost Based Selection (QCBS) method**; Market Approach-International set out in the Procurement Regulations.

Further information can be obtained at the address below during office hours [i.e., 0900 to 1700 hours].

Expressions of interest may be delivered through postal/courier service or in person (hard copy along with an USB drive) or through email to the address below by 15:00 hours Bangladesh Standard Time, 07 July 2021.

Abdullah Al Mahmud Faruk 67-06-2021. Project Director Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Development Project under Bangladesh Private Investment & Digital Entrepreneurship Project (P170688) Bangladesh Economic Zones Authority (BEZA) Monem Business District, Level-12, 111, Bir Uttam C.R. Datta Road, Dhaka-1205, Bangladesh. Tel: +880 2 9632462 E-mail: pd.bsmsn.pride@beza.gov.bd

### Bangladesh Private Investment and Digital Entrepreneurship Project (PRIDE)

### Terms of Reference (TOR)

### Regional Environmental and Social Assessment (RESA) for Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN)

### 1. BACKGROUND AND CONTEXT

The Government of Bangladesh (GoB) has launched an initiative to provide industrial land and infrastructure to increase private investments. The government plans to reach a goal of \$50 billion of exports in 2021 compared to the close to \$37 billion currently and increase private investment/GDP to reach close to 30 percent from the current below 25 percent. The Government also plans to create 100 economic zones over the next decade using a wide variety of arrangements. It is developing four economic zones with China, India, and Japan under a government-to-government initiative and has licensed 10 private economic zones. The Government has attracted the flagship international developer, Sumitomo, and new industrial plant of Nippon, Asian Paints, Berger, Healthcare, Modern Syntex, Bashundhara at Bangabandhu Shilpanagar and a new Honda plant is operational in the Abdul Monem Economic Zone.

One of the key legislative accomplishments of the Government was to create the Bangladesh Economic Zones Authority (BEZA) to spearhead the push towards industrialization with greater involvement of the private sector under the Bangladesh Economic Zones Authority Act of 2010. BEZA will oversee the expansion of economic zones (EZs) in the country. BEZA mainly relies on private capital and expertise to build and operate the new zones but with important government oversight.

The on-going Private Sector Development Support Project (PSDSP) funded by the World Bank supported the establishment of BEZA. PSDSP also supported the preparation of a master plan to set up Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) that will be built up on an area of around 33,800 acres. The Master plan has been included in Annex A.

### 2. BANGABANDHU SHEIKH MUJIB SHILPA NAGAR (BSMSN) AND THE MASTER PLAN

BSMSN will comprise of an area of about 33,800 acres spread across three Upazilas (Mirsarai, Sitakundu and Sonagazi) of two Districts (Chattogram and Feni). Mirsarai, Sitakundu and Sonagazi are the adjoining Upazilas of Chittagong and Feni Districts (refer to *Annex A for details*). The BSMSN Master Plan sets out parameters and principles for land uses, access and transport networks, precinct boundaries and characteristics, zoning and permitted uses, development guidelines and guiding policies, and environmental rules to follow during implementation of the master plan. As per the Master Plan, BSMSN would comprise of the following precincts:

Precinct	Precinct Name	Size in %	Land Uses
А	Residential and Support Amenities	13.63	For low-scale residential units, convenience retail and educational/health uses.

Precinct	Precinct Name	Size in %	Land Uses	
В	City Center/Business Hub	5.13	For commercial, retail, administrative and technology/ICT related uses, high rise residential towers, and support amenities.	
С	Health and Education Centre	2.48	For health clinics, hospitals, educational uses support amenities, short-term residences/dormitories, hotels, and parking facilities.	
D	Mixed Use/Residential	5.26	For low and medium residential typologie (apartments, dormitories, rowhouses etc.) support amenities, convenient retail, and the alike.	
Е	Administrative/ Institutional Center	2.61	For government buildings, libraries, museums, galleries, shopping/retail, commercial facilities and support amenities etc.	
F	Light/Medium Industrial Area	29.71	For light and medium industries, and a chemical hub only if buffered with landscaped boundaries.	
G	Port and Logistics Hub	5.32	For port and logistics related activities and transport support amenities.	
Н	Forest/Transitional Area	5.26	For forest conservation purposes but transitional to port, logistics and/or heavy industrial uses, if required. Utility facilities are permitted.	
Ι	Heavy Industrial Area	11.70	For heavy industrial uses and associated support amenities.	
J	Open Space	17.69	For active and passive parks and open space. Limited development permitted.	
K	Leisure/Entertainment Area	1.04	For a variety of leisure and entertainment uses and support amenities.	
L	Cultural Center	0.17	For performing arts facilities, a cultural complex, sporting events, festivals, and large outdoor gatherings.	

It is expected that BSMSN, the first planned industrial city of the country, will pave the way for establishing a truly world-class business and industrial centre. For BSMSN, BEZA would like to build strong partnerships with the private sector and local entrepreneurs. The industrial city would contain a Sea Port, Rail Connectivity, Marine Drive, Residential Area, Hospital, School and University etc. Potential investment sectors include garments & garment supporting industries, agro-products and agro-processing products, integrated textiles, leather and leather products, shipbuilding, motorbike assembly, food & beverage, paint & chemical, paper & products, plastics light engineering (including auto-parts and bicycles), pharmaceutical products, power solar park etc.

### 3. REGIONAL ENVIRONMENT AND SOCIAL ASSESSMENT (RESA)

As per Annex 1 of ESS 1 of World Bank ESF, *Regional ESIA (RESIA)* examines environmental and social risks, impacts, and issues associated with a particular strategy, policy, plan, or program, or with a series of projects, for a particular region; evaluates and compares the impacts against those of alternative options; assesses legal and institutional aspects relevant to the risks, impacts and issues; and recommends broad measures to strengthen environmental and social management in the region. RESA pays particular attention to potential cumulative risks and impacts of multiple activities in a region but may not include the site-specific analyses of a specific project.

BEZA plans to undertake this Regional Environmental and Social Assessment for implementation of the master plan of BSMSN to examine associated ES risks and impacts in the vast area of proposed industrial city and its area of influence (henceforth mentioned as the 'Region'). The study would:

- Assess potential ES risks and impacts due to implementation of the BSMSN master plan in the region including cumulative impacts of other planned and/or ongoing projects/activities;
- Recommend broad measures to strengthen ES management in the region
- Assess the present institutional arrangement of BEZA and propose capacity strengthening arrangement for BSMSN to ensure that the implementation of the master plan will meet the environmental and social rules and regulations of the Country and World Bank's ESF during the lifecycle of the industrial city.

The study area will comprise of the proposed area/footprint for BSMSN (33,800 acre; Annex A) and its area of influence (AoI). The area of influence will be initially considered as 10km surrounding the proposed industrial city which will be refined by BEZA (in consultation with the WB) during inception of the study.

### Specifically, the Consultant will

- Collect, review and analyse ES baseline information of the region. Baseline would be mainly captured on the basis of authentic secondary information. Primary data collection would also be required in cases of absence of reliable secondary data. Some primary data collection might also be required to validate secondary information as necessary.
- Analyse the institutional and legal framework for the assessment and management of ES risks and impacts in the region, identify institutional and jurisdictional gaps against the GOB rules and regulations and World Bank's ESF and Environment, Health and Safety Guidelines (EHSG) and recommend measures to address the gaps
- Assess potential ES risks and impacts, including Occupational Health and Safety (OHS) of the proposed activities/land use plan as mentioned in the master plan of BSMSN and recommend mitigation measures
- Assess potential cumulative impacts of other planned and/or ongoing projects/activities in the region and recommend mitigation measures.

- Assess the susceptibility of the region to various natural disaster such as cyclone, earthquake, water surges and/or other climatic events etc, their possible impacts and provide a Disaster Risk Management Plan (DRMP) for combating such event.
- Analyse the existing procedures of BEZA for assessment and management of ES risk and impacts and recommend procedures (including the implementation of a formalised ESMS) to be followed to ensure ES compliance with national laws and ESF. This would include a)screening criteria for the selection of investment in BSMSN (b) setting up of environmental, health and safety standards for the industrial city in line with GoB and the World Bank requirements (c) general guidelines for long-term ES monitoring and evaluation (d) recommendations to strengthen social inclusion aspects for the future investments.
- Assess the present ES management capacity of BEZA and recommend necessary measures/institutional structure for the implementation of the master plan.
- Identify key national, regional and project level stakeholders relevant to the project; organize public consultation meetings at various stages of the preparation of the RESA and incorporate the feedback of these consultations in the final report.

The Consultant will develop detailed methodology and work plan in the inception report, which will be discussed, reviewed, agreed and cleared by BEZA and the World Bank. Consultant will also closely work with the related officials of BEZA for the purpose of this assignment.

### 4. SCOPE OF THE ASSIGNMENT AND ES STANDARDS

The RESA report shall be prepared in light with the GoB rules and regulations and Environmental and Social Framework (ESF) (that includes ten ES standards) and Guidance Notes of the World Bank. A copy of the ESF and ESS Guidance Notes may be found at:

### http://documents.worldbank.org/curated/en/383011492423734099/pdf/114278-WP-REVISED-PUBLIC-Environmental-and-Social-Framework.pdf

### https://www.worldbank.org/en/projects-operations/environmental-and-socialframework/brief/environmental-and-social-framework-resources#guidancenotes

### ESS1: ASSESSMENT AND MANAGEMENT OF ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

The RESA will capture the existing ES baseline conditions of the region and assess impacts of the proposed activities. As mentioned earlier, a combination of secondary and primary data would be used in determining the baseline condition. The assessment will cover:

**Regional physical environment**: Geology; topography; soil type and land use plan; meteorology; surface and groundwater hydrology; water quality and quantity; air quality; potential natural hazards and/or other related climatic events.

**Regional biological environment**: The assessment will include identification of the types of habitats those might potentially be affected and consideration of potential risks to and impacts on the ecological function of the habitats. The study will consider direct, indirect and cumulative project-related impacts on habitats and the biodiversity they support. In planning and undertaking environmental and social assessment related to the biodiversity baseline, the Borrower will follow relevant GIIP utilizing desktop review, consultation with experts, and field-based approaches, as appropriate.

**Regional socioeconomic and cultural environment**: Population estimate; land use and patterns of land ownership and tenure practice; planned development activities; community structure; employment; distribution of income etc. It will also cover identification of the disadvantaged and vulnerable groups (such as female headed households, small ethnic communities etc) including their general characteristics; assessing existing status of gender based violence (GBV) following the World Bank's Good Practice Note (GPN).

**Projection of potential Impacts on physical, biological, socio-economic and cultural environment:** Based on the present baseline situation, the consultant will estimate and assess the probable key risks and impacts of the planned BSMSN on the environment and population of the study area.

**Analysis of Alternative:** The study will include alternative analysis considering a) Options for phasing for the development of the industrial city; b) nature and types of industries & c) No-action alternative

**Cumulative Impacts**: Cumulative impacts of past, present and/or reasonably foreseeable future activities and development in the region following good international practice, including the IFC Good Practice Hand Book on Cumulative Impact Assessment<sup>1</sup>. The consultant will consider the existing, under execution and planned projects/activities within the region with information on status, capacity and their cumulative impact on physical, biological and social environment.

**Capacity Assessment of BEZA**: The consultant will undertake an assessment of the present institutional arrangement and capacity of BEZA to manage ES risks and impacts of the implementation of BSMSN. The assessment will cover the human resources, budgetary allocation for ES management and existing ES policies/management systems of BEZA. The report will suggest practical short term and long-term measures including recruitment of personnel with appropriate skills, training plans; revising existing policies (and developing new policies, where relevant) and; required estimated budget to implement relevant ES measures during the implementation and operation phases of BSMSN that are materially consistent with the requirements of the ESF.

### ESS2: LABOR AND WORKING CONDITION

The RESA will assess existing labor laws, practices and related risks and working conditions in the region against the requirements of the World Bank. The assessment will look at potential risks and impacts from past and present project activities and key labor risks such as hazardous work, child labor and forced labor, migrant or seasonal workers, discrimination against women, vulnerable workers etc, labor influx, occupational health and safety (OHS), possible accidents and emergencies, risks of GBV among

<sup>&</sup>lt;sup>1</sup> (https://www.ifc.org/wps/wcm/connect/topics\_ext\_content/ifc\_external\_corporate\_site/sustainability-atifc/publications/publications\_handbook\_cumulativeimpactassessment).

others. Based on the assessment as well as the baseline information and situation of employment and livelihood options, the study will propose suitable measures for improvement of labor related policy provisions of the region leading to the improvement in the working conditions and OHS2 including policy and regulatory recommendations and setting up of OHS standards, where warranted, based on Good International Industry Practice (GIIP) Specific attention will need to be paid on how to maximize the skills and employment opportunities for study area residents in BSMSN.

### ESS3: RESOURCE EFFICIENCY AND POLLUTION PREVENTION AND MANAGEMENT

The study will broadly assess potential impacts on various environmental parameters such as air, surface and ground water and soil, hydrology, drainage etc. due to the land use plan/activities proposed in the master plan and recommend measures to reduce/mitigate such impact. RESA will address the issue of sustainable sourcing of construction material throughout the implementation of the master plan of BSMSN and provide guidelines for sustainable material sourcing in line with internationally accepted standards. The study will analyse various physical-chemical features of the region through soil and ground water sampling as well as secondary data sources to identify any significant legacy environmental issues (e.g. soil or water contaminated with heavy metals or other hazardous materials) and/or epidemiological information that suggests such a legacy. It would also suggest various international environmental certification such as LEED which the future industries may obtain to ensure ES sustainability and recommend various resource efficiency measures and actions that the industrial city can take forward in its future operation. The study would also consider the impact of climate change on the implementation of the master plan.

### ESS4: COMMUNITY HEALTH AND SAFETY

The RESA will assess the impacts of the proposed land use plan, growth of population (including potential labors, employees, service providers like teachers, utility workers and family members) and other activities on the health and safety of the communities in the region. The study will assess proper housing, sanitation and other ancillary facilities such as schools, hospitals etc of the potential future workforce related to BSMSN. RESA will also study the potential of the local communities to be employed in the industrial city and put forward recommendations to increase such employment opportunity. The study will recommend measures and actions to efficiently handle the issue of universal access and community health and safety concerns (especially those emanating from potential labor influx, i.e. GBV etc) of the upcoming industrial city. Reference may be made to the documents mentioned in ESS 2 above.

### ESS5: LAND ACQUISITION, RESTRICTION ON LAND USE AND INVOLUNTARY RESETTLEMENT

The assessment should study land acquisition practice in the region and propose measures to fill the gaps between the country laws and policies and ESS5 to manage the land acquisition related impacts

<sup>&</sup>lt;sup>2</sup> Reference may be made to the World Bank Group General Environmental Health and Safety Guidelines (EHSG) and Industry Sector Guidelines for Construction Material Extraction. Other Bank guidance notes can be referred to as well including the Go od Practice Note on Labor Influx Management, Good Practice Note on Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works, Environment and Social Incident Response Toolkit (formerly SIRT) and integrating ESHS into procurement process as per the Bank's Procurement Framework.

and risks for future programs and projects in the region. The consultant will carefully review the land use plan of the BSMSN and conduct detailed review and reconnaissance of the study area to identify and assess risks and impacts related to land acquisition in the region. In addition, the consultant will also identify types and approximate number of project affected people (PAP) leading to a preliminary estimate of cost of resettlement and further recommend preparation of RPF and RAP including development of their TORs.

# ESS6: BIODIVERSITY CONSERVATION AND SUSTAINABLE MANAGEMENT OF LIVING NATURAL RESOURCES

The assessment will include: (i) broad level habitat mapping (terrestrial and aquatic) and the identification of the level of disturbance from proposed land use plan/activities (including those to ecosystem services); (ii) presence/absence of terrestrial/aquatic species of conservation importance, including endemic/restricted range species, threatened unique ecosystems etc. (iii) assess the impact of the proposed land use plan/activities under BSMSN and cumulative impact of other on-going/planned activities on terrestrial and aquatic ecosystem including impact on various ecosystem services and; iv) recommend necessity of preparing biodiversity management plan for the region due to establishment of the industrial city and include guideline for preparing such plan.

The study would recommend the need for further detailed Critical Habitat Assessment focusing on the identified areas/locations and species. The RESA should also assess if the natural (non-critical) habitats would require any offset measures to achieve No Net Loss condition. It also would cover Ecosystem Services which are important to the population of the region; parks and reserves; significant natural sites; and species of commercial importance.

## ESS7: INDIGENOUS PEOPLE/ SUB-SAHARAN AFRICAN HISTORICALLY UNDERSERVED TRADITIONAL LOCAL COMMUNITIES

The study will collect baseline information both by primary data collection and secondary data studies, on presence of IPs and/or ethnic minority communities in the region meeting the definition of ESS7. The RESA will also analyse potential risks and impacts on IPs/ethnic communities, if present in the area, due to any potential activities/ future investment in the region and suggest ways how any future investments will meet the interests and concerns of these groups fully cognizant of their social, economic, religious and similar aspect as well as how they may have the opportunities to share in the benefits emanating from these investments. The study will also suggest if free prior and informed consent will need to be taken from these communities following the criteria mentioned in the ESS7.

### **ESS8: CULTURAL HERITAGE**

The consultant will identify any significant archaeological and historical resources (including nontangible cultural heritages such as belief, experience, knowledge, traditional practice etc.), assess how these could be impacted due to implementation of the master plan and recommend steps to follow to address such impacts if found due to implementation of the master plan.

### **ESS9: FINANCIAL INTERMEDIARY**

This standard is not relevant to the project.

### ESS10: STAKEHOLDER ENGAGEMENT AND INFORMATION DISCLOSURE

The consultant would identify the key stakeholders related to the implementation of the BSMSN and carryout stakeholder consultation starting from the beginning of the assignment till finalization of report.. The consultations will be in the form of workshop, face to face meeting, online collaboration as well field visits. The aim of the consultation will be to convey present, planned and potential projects/ activities' ES risk and impacts and incorporate their feedback in finalizing the report.

### 5. INDICATIVE OUTLINE OF THE RESA AND BRIEF DESCRIPTIONS

### **EXECUTIVE SUMMARY**

This should provide a summary of the findings of the study on present ES conditions of the region, impact on various ES parameters due to proposed land use plan/activities under master plan and cumulative impact of other ongoing/ planned activities, the policy and regulatory frameworks, summary of consultations with key stakeholders, key recommendations to reduce/avoid the negative impacts, recommendations of the tasks to be undertaken to establish an effective ES management and administration structure for the region etc.

### CHAPTER 1: DESCRIPTION OF THE REGION AND THE PROJECT

The chapter should describe the region in question as well as the broad aspects of the master plan for BSMSN. This would clearly explain the boundary of the region which might be impacted by any potential activities and other ongoing and future projects. The Consultant will develop detail inventory of the existing, under execution and planned projects within the region with information on status of the project and its impact on the physical and social environment. This chapter should contain maps and planned activities.

### CHAPTER 2: LEGAL AND INSTITUTIONAL FRAMEWORK

This Chapter will present and analyse the legal and institutional frameworks, within which BSMSN will be developed and operated (including gaps against the World Bank ESF), as well as the issues set out in ESSs.The Chapter should also refer to World Bank Group Environment, Health and Safety Guidelines (EHSG) as well as Good International Industry Practice (GIIP) to address sustainable sourcing of construction material (for indicative idea guidelines of US Environmental Protection Agency, EPA may be consulted). It should also include relevant laws, regulations and institutions on labor & working conditions and health & safety aspects.

### CHAPTER 3: ES BASELINE OF THE REGION

The Consultant shall present baseline data on relevant environmental characteristics of the region more broadly. This will include both physical and biological environment and data on biodiversity. Assessment of ES baseline would be mostly based on secondary data. However, primary data collection might also be necessary in absence of reliable secondary data. Primary data collection might also be necessary to validate secondary information if deemed necessary. The baseline socio-economic information will provide a foundation for evaluation of any future projects and related mitigation measures to avoid and/or reduce negative impacts and to enhance positive impacts and opportunities on the local communities. The data may include, among others, basic demographic summary (data on gender, age, educational background, livelihood, housing etc), status of land use and tenure arrangements, identification of squatters, common social facilities and buildings (CPR), status of GBV, availability and types/capacity of labor, presence of ethnic minorities, vulnerable groups etc. Data may be obtained from a combination of secondary sources and suitable primary data, such as personal interviews and household or community surveys as relevant.

### CHAPTER 4: STAKEHOLDER MAPPING AND PUBLIC CONSULTATIONS

This chapter will document the key stakeholder mapping and public consultation. The stakeholder mapping must include, among others, decision makers, potential investors, potential project affected people (PAP), vulnerable and disadvantage populations (vulnerable due to their gender, age, ethnicity, disability, faith etc). Present and future project/activities need to be communicated to obtain inputs from the stakeholders that may be used to address potential risks, impacts and investment screening.

### **CHAPTER 5: POTENTIAL ES RISKS AND IMPACTS**

The report will address potential ES impacts of any project/activities in the region including environmental risks and impacts (i) defined by the GOB, World Bank Group EHSG and ESF; (ii) those related to community safety; (iii) those related to climate change and other trans-boundary or global risks and impacts; (iv) any material threat to the protection, conservation, maintenance and restoration of natural habitats and biodiversity; and (v) those related to ecosystem services and the use of living natural resources, such as fisheries and forests; and social risks and impacts (i) threats to human security through the escalation of personal, communal or crime or violence, if any; (ii) risks and impacts on the disadvantaged or vulnerable; (iii) any prejudice or discrimination toward individuals or groups in providing access to development resources and project benefits; (iv) negative potential economic and social impacts relating to the involuntary taking of land or restrictions on land use, if any; (v) risks or impacts associated with land and natural resource tenure and use, including, as relevant, potential project impacts on local land use patterns and tenurial arrangements, land access and availability, food security and land values, and any corresponding risks related to conflict or contestation over land and natural resources; (vi) potential impacts on the health, safety and well-being of workers and projectaffected communities; (vii) potential impacts of labor from other regions; (viii) effects on the communities due to negative impact on ecosystem services; (ix) effects on communities due to design of infrastructure (x) generation of wastes and its communal affect; (xi) any risk due to potential change of demographic pattern since a large number of migrants will settle in the area in the long term and (xii) risks to cultural heritage.

### **CHAPTER 6: CUMULATIVE IMPACT ASSESSMENT**

This chapter would include assessment of cumulative impacts of implementation of the master plan in the context of previous, existing and reasonably foreseeable future developments in the surrounding area of BSMSN. Cumulative impact assessment can include an evaluation of changes in various physical and biological environmental parameters, changes in land/seascape (e.g. landscape hydrology, coastal stability), natural resource quality and availability (e.g. water, energy, habitat for important plant and animal species), social and community dynamics (e.g. size of human population, traffic volumes) and economic conditions (e.g. industry development, job opportunities, cost of living)

### CHAPTER 7: ALTERNATIVE ANALYSIS

This chapter will include an analysis of the potential alternatives with regards to types of industries that should be developed in the BSMSN and phasing of development of such industries to ensure mitigation of adverse environmental and social impacts caused by such development. Location wise alternative analysis will not be possible as there is scarcity of suitable alternative land for such a huge industrial city. However, the chapter will include an analysis with a no-action scenario.

### CHAPTER 8: DISASTER RISK ASSESSMENT AND DISASTER RISK MANAGEMENT PLAN [DRMP]

This chapter will assess the susceptibility of the region to various natural disaster such as cyclone, earthquake, water surges and/or other climatic events etc, their possible impacts and plan for combating such disasters.

### **CHAPTER 9: ES MANAGEMENT PROCEDURE**

This chapter will include outline of a proposed ES management system indicating principles and decision making process to address ES risk assessment and management issues for establishment and operation of BSMSN. The ES management system would include screening criteria for selection of investment in BSMSN, setting up of environmental, health and safety standards for the industrial city in line with GoB and the World Bank requirements, procedures to be followed to ensure that ES impacts of any potential project/activity are adequately addressed, general guidelines for long-term ES monitoring and evaluation, recommendations to strengthen social inclusion aspects for the future investments etc.

### CHAPTER 10: INSTITUTIONAL ARRANGEMENTS AND STRENGTHENING

This chapter will include a description of existing institutional arrangement and policies for ES risk assessment and management in BSMSN and provide recommendations for any improvement if found necessary for proper implementation of the ES procedures during construction and operation phase of the BSMSN. This will also include various capacity building measures which need to be considered. This section will also include recommendations for policy and regulatory instruments.

### CHAPTER 11: CONCLUSIONS AND RECOMMENDATIONS

This chapter will summarize all potential ES risks and impacts and recommended procedures to be followed and institutional arrangement to be put in place for ensuring ES planning management during the implementation of the master plan of BSMSN.

### 6. EXPERTISE REQUIRED AND QUALIFICATIONS

A consulting firm, with proven experience implementing similar studies for WB/ MDB shall be hired to conduct the RESA and will comprise, at the minimum, of the following members and expertise:

**Environmental Specialist (ES)**. Either ES or SDS will take charge of coordinating the RESA, integrating the inputs of each specialist, putting together the RESA and managing the consultation processes. The ES should have at least 10 years of experience in leading and/or conducting ESIAs and have a proven track record with the WB ESF and Performance Standards or similar MDB requirements.

<u>Social Development Specialist (SDS)</u>. Either ES or SDS will be the team leader and SDS will also oversee socio-economic baseline, including any cultural heritage, social assessment and measures in the RESA. S/he will also conduct screening of the study area for ethnic minorities, labor practice, cultural heritage assessment etc. S/he should have at least 10 years of experience in conducting similar studies from a social perspective and have a proven track record with the WB ESF and Performance Standards or similar MDB requirements.

<u>Climate Change Specialist (CCS)</u>. Will collect, collate and analyse secondary data to assess the susceptibility of the region to various natural disaster such as cyclone, earthquake, water surges and/or other climatic events, their possible impacts and finally provide a comprehensive Disaster Risk Management Plan for combating such disasters. The CCS should have graduation in Environmental science/engineering with Master degree in Disaster Risk Management/Climate Change. She/he should have at least 10 years of experience in working in project dealing with impact, mitigation and adaptation to climate change.

<u>Waste Management Specialist</u> (WMS): Will assess the waste generation, pollution prevention and resource efficiency aspect related to implementation of BSMSN. An 8 years of experience in similar assignment is required.

**Biologist/Biodiversity Specialist.** Will oversee collecting baseline data, assessing impacts and developing management measures on biology, ecosystems and species. He/she will apply the mitigation hierarchy (avoidance, minimization, mitigation, compensation/offset) when developing reports to address biodiversity and ecosystems impacts. S/he should have at least 8 years of experience in conducting biological impact assessment and is familiar with the application of mitigation hierarchy.

**Labor Laws Expert.** Will oversee the conduct of a detailed assessment of the application of ESS2 to the project with inputs from the Health & Safety Specialist on OHS. The Expert should have a very good knowledge of the labor laws of Bangladesh and international labor laws and standards such as ILO's. An 8 years of experience in similar assignment is essential.

<u>Occupational Health & Safety (OHS) Specialist.</u> Will assess and develop measures and plans to meet the requirements of ESS2 (occupational health & safety) and ESS4 (community health & safety). S/ he should have practical and clear understanding of the safety and health standards, health hazard identification, industrial hygiene, occupational safety and hazardous materials and waste management. Preference should be given to candidates with OHS professional certifications (i.e. American Board of Industrial Hygiene (ABIH), Board of Certified Safety Professionals (BCSP), Certified Industrial Hygienist (CIH), Certified Safety Professional (CSP)) etc.

Minimum 8 years of experience is required in assessing, planning, implementing OHS plans in large industrial operation.

<u>Gender Expert</u>. Will be responsible for analyzing and integrating the gender related issues, including GBV, in the RESA and to provide input for the Gender Action Plan for any potential project. S/he will also work with the Labor Expert and H & S Expert to provide inputs for the Labor Management Procedures (LMP). An 8 years of experience in similar assignment is essential.

**Stakeholder Engagement Specialist.** Will identify and liaise with various stakeholders for providing inputs about the potential projects and activities and obtain inputs to assess stakeholders' ideas, c0oncerns and aspirations. An 8 years of experience in similar assignment is essential.

In addition, the firm will recruit adequate number of quantitative and qualitive field researchers to collect data and analysts to analyse the collected data.

### 7. TIMETABLE AND DELIVERABLES

This study is expected to be completed within 15 (fifteen) months after acceptance of the assignment. The draft report should be submitted including comments/suggestion from stakeholders and the World Bank in English and Bangla, with two (2) hard copies and two (2) electronic copies at the times as agreed in the Work Plan. A PowerPoint Presentation of the report to be made to the Client and the Bank upon delivery of the draft report and also at the delivery of the final report. The consultant will deliver the reports according to the following timeline:

Ser	Products/ Deliverables	Timeline (months)
1	Inception Report including detail methodology, timeframe and budget. This report has to be reviewed and approved by the Bank before moving in to the preparation of RESA report	3 (from contract signing)
2	First draft RESA	10
3	Final RESA	2

### 8. REPORTING REQUIREMENT

The Consultants will be required to work closely with BEZA and will report to the Project Director of the PRIDE project of BEZA.

### 9. REFERENCES

The World Bank Environmental and Social Framework (ESF) The World Bank's Environmental and Social Standards (ESS) World Bank Group General Environmental Health and Safety Guidelines (EHSG) World Bank Group Industry Sector Guidelines for Construction Materials Extraction IFC Guidelines on Cumulative Impact Assessment (CIA) Good Practice Note on Labor Influx Management Good Practice Note on Addressing GBV in Investment Project Financing involving Major Civil Works Environment and Social Incident Response Toolkit (ESIRT) Guidance Notes for Borrowers (ESS 1-10)

# PART IV. THE MASTER PLAN FOR BANGABAMDHU SHEIKH MUJIB SHIPANAGAR (BSMSN)

## September 2020

Prepared by Sheltech Consultants (PVT) Ltd, Sheltech Engineering, and STUP Consultants (PVT) Ltd in Association with the World Bank Group

For the Government of the People's Republic of Bangladesh Prime Minister's Office BANGLADESH ECONOMIC ZONE AUTHORITY

(Please visit beza website for latest version of rep[ort)

## The Master Plan Regime for Bangabandhu Sheikh Mujib Shilpa Nagar

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### List of Abbreviations

BDT	Bangladeshi Taka
BEZA	Bangladesh Economic Zones Authority
BM	Benchmark
BREB	Bangladesh Rural Electrification Board
BWDB	Bangladesh Water Development Board
CHEC	China Harbour Engineering Company Ltd.
DLRS	Department of Land Record and Surveys
DOE	Department of Environment
EIA	Environmental Impact Assessment
EIP	Eco Industrial Park
EMF	Environmental Management Framework
ESMF	Environmental/Social Management Framework
EZ	Economic Zone
FDI	Foreign Direct Investment
FPS	Frames per Second
FTPP	Framework for Tribal Peoples Plan
GCP	Ground Control Point
GIS	Geographic Information System
GPS	Global Positioning System
IEE	Initial Environmental Examination
ISO	International Organization for Standardization
IWM	Institute of Water Modelling
JDI	Japan Development Institute
JICA	Japan International Cooperation Agency
LGED	Local Government Engineering Department
NGO	Non-Governmental Organization
PSDSP	Private Sector Development Support Project
PTMC	Project Technical Management Committee
PWC	PricewaterhouseCoopers Pvt Ltd
PWD	Public Works Department
RHD	Roads and Highways Department
RS	Revised Survey/ Revenue Survey
RSMF	Resettlement & Social Management Framework
RTK	Real Time Kinematic
SA	State Acquisition
SCPL	Sheltech Consultants (Pvt.) Ltd.
SEZ	Special Economic Zone
SIA	Social Impact Assessment
SOB	Survey of Bangladesh
SRDI	Soil Resource Development Institute
TCP	Temporary Control Point
ToR	Terms of Reference
UNO	Upazila Nirbahi Officer
USD	United States Dollar

# I. Chapter One – Report Overview

## 3.1 1.0 Background

In Bangladesh, Export Processing Zones (EPZs) were a successful tool to boost the country's economy. The EPZ model was used as a "strategic instrument" to attract Foreign Direct Investment (FDI) and deal with shortcomings of the overall investment climate in the country. Bangladesh's EPZ model however, had its limits - both in terms of its cumulative impacts and spill-over effects into the domestic economy. As an exporting enclave, EPZs provided little in the way of backward or forward linkages with the domestic economy, resulting in low technology and efficiencies, which normally accompanied foreign investment. In addition, investments in other sectors beyond the RMG segment, did not materialize.

To address these challenges, the Government of Bangladesh (GoB) examined the more modern regime of Economic Zones (EZs) and drew upon numerous successful examples from around the world. In August 2010, the Bangladesh Economic Zone Act was passed in Parliament, providing an overall framework for establishing EZs throughout Bangladesh. Under this Act, the Economic Zone Authority (BEZA) was established under the Prime Minister's Office (PMO) and is governed by a Board chaired by the Prime Minister. The EZ law provides the legal coverage for attracting and leveraging private sector investment in the development of zones, (as a zone developer or operator), and in the provision of providing infrastructure services, such as power, water, drainage, sewerage, effluent treatment, wastewater treatment etc. The law also allows for the development of EZs and infrastructure through a Public-Private Partnership (PPP) mechanism.

### 3.1.1

At present, the GoB with the support of the World Bank Group (WBG) is implementing the *Private Sector Development Support Project* (PSDSP), which pilots EZ projects under the new EZ model. The program aims to create viable EZs and promotes the removal of key barriers and constraints facing the private sector. The project also supports: i) off-site infrastructure for EZs, ii) the creation of serviced industrial land, and iii) the use of good social and environmental practices.

## 3.2 1.1 Introduction

The objective of the Bangabandhu Sheikh Mujib Shilpa Nagar (BSMSN) Master Plan is to: i) examine the BSMSN site, ii) document its existing conditions, iii) identify the sites opportunities and constraints, and iv) prepare a best practice, 20- year master plan and a planning regime for the zone. The scope of work includes:

- Review of all policies, studies and plans previously prepared for a Feni and Mirashorai EZ and meet relevant stakeholders,
- Prepare base maps for the BSMSN area/area of influence in order to accurately document the existing physical conditions/features of the land, community, infrastructure /utilities, land uses and moveable/non-moveable property etc.,

- Prepare/validate/revise the development program for BSMSN and undertake a transport assessment,
- Prepare a Master Plan, Land Use Plan, Zoning Plan, and Phasing Plan for the BSMSN project utilizing green and resilient technology and mechanisms to mitigate impacts of natural disasters and climate change,
- Conduct stakeholder workshops to vet the master planning and regime for BSMSN and incorporate feedback,
- •
- Prepare two investment promotion videos for the BSMSN.

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#### Table 0-1: Location of BSMSN

The following is Report IV, which is the BSMSN Planning Regime and Master Plan.

## 3.3 1.2 Existing Location and Conditions of BSMSN

### 1.2.1 Locational Overview



Figure 1.1. Location of the BSMSN Site Source. Sheltech Consulting/ Engineering



Figure 1.2. The BSMSN Site Source. Sheltech Consulting/Engineering

The BSMSN site (Figure 1.1) is located 200 kilometers (km) from Dhaka, 60 km from Chattogram, 70 km from Chattogram Port and the Shah Amanat International Airport and 330 km from Sylhet. It is situated in the following districts, upazilas, and unions and is comprised of 26 mouzas.

BSMSN has a total land area of 30,173.6 acres or 122.11

square kilometres (km2) (mostly reclaimed land) with a 25 km coastline along the Sandeep Channel in the Bay of Bengal. (Figure 1.2) The land elevation on the site varies from the site's lowest point at -3.33 meters (m) MSL to the highest point at +8.71 m MSL.

Before development of the BSMSN, the site was comprised of: i) 27.6% idle/barren lands, ii) 31.65% mangroves/forest/vegetation, iii) 8.71% water bodies/canals and iv) 6.53% under development. The site location is a moderate to high monsoon climatic area with an average annual rainfall of 500mm. The average temperature on the site varies between 15-25 degrees Celsius annually.

Power and gas are on site, though capacity is limited at present. This will be rectified in the coming years, when numerous energy projects will come on board. Power is currently provided by the Rural Electrification Board (REB). Water in the area is limited as it is muddy and saline. The depth of the water table varies throughout the site from a few meters to 20 m. Fresh water is available 2.5 km upstream from the Feni River. At present, the Department of Public Health Engineering (DPHE) provides water to the area through deep sink wells to BSMSN's area of influence. Ground water within the BSMSN boundaries is not suitable for drinking.

Under disaster conditions such as the 1991 cyclone in the region, the highest storm surges within the site registered 6m or 20ft. Today, for the BSMSN zone to be viable, the land must be raised, new roads and infrastructure/utility networks need to be established, serviced plots must be created, and green/resilient measures must be incorporated into the planning and design of the economic zone.

# II. Chapter Two - The BSMSN Planning Regime

## 3.4 2.0 The BSMSN Planning Regime

The BSMSN Planning Regime is a policy framework, which directs and manages the planning, design, and implementation of the BSMSN zone in the short, medium and long-term. This Planning Regime sets out: i) a vision, ii) value proposition and iii) structure plan for the BSMSN region as well as for the specific BSMSN site. It also provides: i) planning principles, ii) guiding policies, iii) a master plan with accompanying land use/zoning/precinct and transport maps, and iv) development guidelines to help shape the urban/industrial economic, environmental, social, and natural environment of the economic zone. Lastly, the Regime outlines the appropriate green technology and environmental and resilience measures, which need to be introduced into the BSMSN Master Plan to make the zone sustainable from natural disasters and climate change.

Beyond being a statement of intent and direction, the BSMSN Planning Regime and Master Plan is a legal document, defined under the Bangladesh Economic Zone Act 2010 and its implementing regulations. This report lays out the basis for the planning and design of BSMSN and the necessary development requirements for the approval of future development applications.

## 3.5 2.1 Methodology

The following international best practice methodology was used to prepare the Planning Regime and Master Plan for BSMSN:

- Undertook a survey and assessment of BSMSN's location, physical characteristics and attributes of the site and its surrounding area of influence, as well as the existing infrastructure in and around the zone. This included a review of the land's topography, physical features, hydrology, access/proximity to infrastructure/utilities, environmental/social/climate change conditions, transport and quality of life factors etc<sup>3</sup>.
- Prepared a transport assessment, development program and demand projections for BSMSN over a 20-year period<sup>4</sup>. This included a review/due diligence and revision of past development programs for BSMSN, an examination of the short, medium and long-term transport and logistics patterns and modal-split requirements for the zone as the urban and industrial environment expands, and a 20-year demand forecast for all land use designations and industrial sectors proposed within BSMSN.

<sup>&</sup>lt;sup>3</sup> Part 1 Final Report of the BSMSN Master Plan

<sup>&</sup>lt;sup>4</sup> Part II and Part II: Final Reports of the BSMSN Master Plan

- Reviewed the environmental and social issues existing and related to the development of the BSMSN site. This included an examination of the environmental/social legislation and requirements which the economic zone project must comply with, as well as, an assessment of the existing environmental/social issues and concerns on the site.
- Held workshops and stakeholder engagement on reports Part I-III and key aspects (opportunities, constraints, weaknesses, and threats) for the BSMSN Master Plan. A series of stakeholder workshops and engagement meetings were held to discuss the planning, design and implementation of BSMSN and its Master Plan.
- **Develop**ed a comprehensive Planning Regime and Master Plan for BSMSN, which will be used to guide zone development over a 20-year period. The planning regime includes: i) a vision, ii) a value proposition, iii) planningrinciples, iv) guiding policies, v) structure plan, vi) a master planvii) a land use plan, viii) a zoning plan, ix) a precinct plan, transportplan, and xi) development guidelines. This regime lays out the comprehensive planning for the development of the BSMSN over a 20-year period.

## 3.6 2.2 The Vision for BSMSN

Over a two-year period, a number of workshops and meetings were undertaken with relevant public and private stakeholders to discuss the vision and development direction for BSMAN and its surrounding region. From these series of stakeholder engagements, a vision was prepared for BSMSN, which is intended to: i) maximize the development potential of the project, ii) create more value for BSMSN, and iii) provide greater economic, social and environmental benefits for the region and Bangladesh.

Stakeholders determined that BSMSN's vision must be '**bold**, **innovative and competitive**' to be successful. Hence, it was decided that BSMSN will be more than just an economic zone. It will be the first, **large-scale**, **mixed use**, **combined urban/industrial city and economic zone** in Bangladesh, and will be unlike any other location in the country. It will incorporate and highlight smart, green, and resilient technology within its urban and industrial facilities, so it will be on the forefront of economic zone design. It is intended to directly compete on an international platform with top tier zones in China, South Korea and the Middle East. The vision for BSMSN, is as follows:

Strategically located 60 km from Chattogram, BSMSN will become the 'premier' destination in a new economic corridor in Bangladesh – BSMSN – Chattogram – Mosheshkhali. As the 'flagship urban/industrial city' in Bangladesh, BSMSN will become the third largest and first comprehensively planned city in the country. BSMSN will be a smart city with a vibrant urban core and an innovative business hub, which will support international finance, commerce, and ITC. Surrounding the core, BSMSN will have residential, health, education and government precincts. In addition, BSMSN will have a dedicated industrial component, which will house light and medium industries, a port, and a separate heavy industrial area to support all types of warehousing/manufacturing/production activities within the zone.

BSMSN has been planned/designed to attract a variety of foreign and domestic investors and provide seamless, multi-transport/logistics (sea, air, road, rail) to support a broad range of industrial sectors and urban activities. BSMSN will be constructed with state-of-the art infrastructure and utilities, focusing on green technology and resilience measures to elevate the zone to an environmentally-friendly level, which tackles climate change and sustainability head on. The zone will spearhead new industry trends, sponsor value added production, and employ new cutting-edge technologies to put BSMSN at the forefront of

'excellence' around the world. In addition, the zone will offer a One-Stop Shop (OSS) with streamlined and fast-tracked services and after-care facilitation to its investors. BSMSN will allow an investor live, work and play in the city and be able to do business how and when they like, within a safe and secure environment. For Bangladesh, BSMSN will attract new investment opportunities, growth in exports, diversification in industry sectors, transfer of knowledge, and a variety of new exciting jobs for the local population.

To realize this vision and all its backward and forward benefits, the GoB must: i) stand firm on its commitment to prioritize and support this project, ii) honor the BSMSN concept, master plan and development guidelines, and iii) work with relevant stakeholders to seamlessly implement the economic zone so it becomes a world class zone. The GoB must also engage the private sector, civil society, and the local community early on to keep them informed and updated on the development progress of BSMSN,<sup>5</sup> as their support for the project will be critically important.

## 3.7 2.3 The Value Proposition for BSMSN

A value proposition traditionally outlines the elements of a vision, which will attract/bring investors to the economic zone in the future. These elements help brand the zone and assist in identifying how the Master Plan should be designed/prepared.

The following is BSMSN's value proposition:

- BSMSN is the flagship, 'smart city/economic zone' project for Bangladesh and a 'game changer' in economic zone design and development.
- To be the premier, international work, live, play location and an urban/industrial hub in South Asia.
- Strategically located for easy access to domestic and international markets.
- Offering a multi-modal transport and logistics platform incorporating a port, rail, roads and airport connectivity to reduce congestion, delays, costs and increase efficiencies as well as strengthen supply chains.
- Spearheading state-of-the-art, green and resilient infrastructure, utilities and technology to make BSMSN competitive, efficient, sustainable and resilient.
- Targeting innovative foreign and domestic investors.
- Promoting exports, clean industry/manufacturing, value addition production utilizing cuttingedge technology, and supporting new industry trends and enhanced creativity.
- Aids in transferring knowledge, technology and innovation to local entrepreneurs, professionals and workers

<sup>&</sup>lt;sup>5</sup> A communication program for BSMSN stakeholders and the community should be introduced.

- Offering a safe and secure environment, which is monitored on a 24/7 basis for investors, residents, workers, and visitors
- Offering an OSS with streamlined and fast-tracked processes and procedures as well as aftercare facilitation
- Offering a competitive labour pool with new types of professional, technical, skilled and unskilled jobs for Bangladeshi

## 3.8 2.4 The Structure Plan for BSMSN

A Structure Plan is a planning tool, which examines and highlights the existing opportunities and constraints of a development site within the context of its surrounding region. The Structure Plan is an important part of any master plan process as it allows planners to study current development issues in a comprehensive manner - at the regional and site-specific level -, in order to rectify constraints, weaknesses and/or threats, as the new project is planned, designed and implemented.

### 3.8.1 2.4.1 The Regional Structure Plan for BSMSN



3.8.1.1.1 Because the BSMSN project is so large and will be exceptionally impactful in a positive economic/social/environmental manner, it must be first examined in its regional context. Hence, the following is an overview of the key opportunities and constraints in the region:

### i) Key Opportunities

- An opportunity to plan BSMSN within its larger context examining the development opportunities of the area of influence and the Chars adjacent the site.
- An opportunity to introduce improved, multi-modal transport and logistics (road, rail, sea, air) to the area, which is intended to reduce congestion and improve linkages to existing national infrastructure and to Chattogram and beyond.
- An opportunity to introduce long-term, comprehensive regional planning in Bangladesh focusing on introducing smart, green and resilient technology to the region.
- An opportunity to upgrade/improve core infrastructure and utilities in BSMSN, the area of influence and the surrounding areas to enhance the living conditions/daily lives of the local communities and better connect the area.
- An opportunity to formalize and enhance investments and businesses outside BSMSN.
- Figure 2.1. Regional Structure Plan for BSMSN Source. Sheltech Consulting/ Engineering

### 3.8.1.1.3

### ii) Current Key Constraints

- Comprehensive regional planning has not been prioritized to date.
- Access to the BSMSN site, areas of influence and adjacent Chars is difficult.
- Portions of the road along the waterfront the Old Embankment Road to Chattogram is missing and requires development. If connected, the BSMSN site could be better linked with the Chattogram airport, port, and rail.
- Paved roads, water and power in the region (BSMSN and beyond) is limited.
- The regional area is often inundated with water during the monsoon season.
- The shipbuilding sector has a strong presence south of the BSMSN site.
- Roads leading to the Chattogram Port are congested.

### 3.8.2 2.4.2 The BSMSN Site – Specific Structure Plan

The BSMSN Structure Plan examines the specific site and identifies its key opportunities and current constraints. By listing these elements, the issues can be addressed and rectified in the BSMSN Master Plan.



## Figure 2.2. The BSMSN Structure Plan Source. Sheltech Consulting/Engineering

i) Key Opportunities

- The BSMSN is a greenfield site, which allows unlimited opportunities for development.
- An opportunity to provide and improve access into/out of BSMSN from the national Dhaka Chattogram highway.
- An opportunity to separate industrial and vehicular traffic to reduce congestion and improve road safety within BSMSN.
- An opportunity to introduce a short, medium and long-term multi-modal transport plan for BSMSN. This plan will allow for transport right-of-ways to be protected, so long-term transport innovations like light

rapid transit can be implemented in the future.

- An opportunity to provide a rail spur into BSMSN to support industry and the proposed port.
- An opportunity to connect BSMSN to Chattogram via the Old Embankment Road by building the 15 km of missing road and by bringing the rail within BSMSN along the waterfront to connect with Chattogram port, airport and railway station.
- An opportunity to upgrade the rail station near BSMSN to make it an efficient bus/rail transfer station for residents, workers or visitors.
- An opportunity to upgrade infrastructure and utilities to the site and introduce green and resilient technology and measures to make BSMSN environmentally-friendly, sustainable and able to withstand impacts from climate change.

### ii) Current Constraints

- Road and rail access into/out of the BSMSN site and connectivity to the char islands is currently limited.
- Core infrastructure is not yet available on the BSMSN site to support the future urban/industrial population.
- The BSMSN site needs to be significantly raised and protected from the impacts of the Bay of Bengal/climate change.
- The site is located in a sensitive area, which can be affected by natural disasters like floods, earthquakes and cyclones.
- A large portion of the site is covered with mangroves and/or forest.
- The site is vast and parts of it are difficult to reach because there are few internal roads within BSMSN.
- Not all the land for BSMSN has been acquired in order to implement a comprehensive Master Plan.
- There is a lack of water, power, and waste treatment facilities (solid, effluent, and water) within BSMSN.

- With shipbuilding to the south of the BSMSN site, only medium and heavier industries should be permitted in the southern end of the BSMSN site. This way there will not be any conflicting adjacencies.
- Some land within BSMSN has been allocated to investors before a comprehensive master plan has been legally adopted.

## 3.9 2.5 Planning Principles for BSMSN

Planning principles are a set of statements derived from the Structure Plan analysis, which are developed to guide planning decisions for the BSMSN Master Plan. Although planning principles are stated in 'general terms', they are created to provide: i) consistency, ii) value for the project, and iii) economic growth for the region and country. The key planning principles for the site are:

- BSMSN is to be developed as a world-class city and one of the largest and most innovative urban/industrial areas in Bangladesh.
- BSMSN is to amalgamate the Feni and Mirashorai lands to create a single urban/industrial entity, which will have its own governance/management structure.
- BSMSN is to be developed within the context and consideration of its area of influence and surrounding water bodies.
- BSMSN is to be branded Bold, Innovative and Competitive. The urban/industrial city will become a leading investment hub for the country.
- BSMSN is to be planned to attract the greatest mix of foreign, domestic and Tier 1 investors.
- BSMSN is to be comprehensively planned and strategically implemented, separating and buffering urban, residential, institutional, light and heavy industrial uses in order to mitigate inappropriate adjacencies and promote good development.
- BSMSN is to be an environmentally-friendly, green and resilient city, with a full array of land uses and supporting amenities to keep it vibrant and attractive to the largest group of investors, residents, workers and visitors.
- BSMSN is to be developed in a phased manner to optimize land and infrastructure/utility networks, reduce capital costs, and maximize the sustainability and viability of the urban/industrial city.
- BSMSN is to approve only high-quality real estate/industrial projects, developments and buildings to keep the keep the zone's global competitiveness.
- BSMSN is to be constructed using international standards in order to create a dependable,

safe, and secure environment.

- BSMSN is to be designed to incorporate beautifully planned, erected and maintained streetscapes (the public realm) with seasonal landscaping, public spaces, public art and street furniture to be used and enjoyed by the general population.
- BSMSN is to include a variety of parks and open spaces throughout the zone, which are well planned, designed and maintained in order to create a better quality of life for residents, workers and visitors.
- BSMSN is to be designed to create new jobs, transfer technology and support economic growth in Bangladesh and along the BSMSN Chattogram Mosheshkhali corridor.
- BSMSN is to have two resettlement areas near the boundary with the area of influence so relocated households can remain close to their Feni and Mirashorai communities.

## 3.102.6 The BSMSN Master Plan

The Master Plan is a short, medium and long-term, comprehensive development plan for BSMSN, which prescribes how the urban/industrial city is intended to grow and expand over time. To support this master



plan, guiding development policies have been prepared to reinforce the 'Planning Regime' for BSMSN. These policies follow the phasing section in this report.

### 3.10.1 2.6.1 Inputs to the Master Plan

The BSMSN Master Plan takes in to account the: i) inputs from Reports Part I-III (specifically urban/industrial demand projections over a 20year period), ii) vision and value proposition, iii) stakeholder and local community comments and recommendations, iv) Regional and Site Specific Structure Plan, and v) Planning Principles.

### 3.10.2 2.6.2 The Master Plan

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

According to this Master Plan, BSMSN has been planned into the following 11 Precincts:

Table 2. Precincts By Size		
Precincts	Size in Acres	
Residential/Supporting	5,266.15	

Land within each Precinct will be further divided into development projects or individual plots for investment. The land will be sold or leased depending on the Precinct and location within BSMSN. Land costs will be reassessed on a yearly basis, with increases dependent on market values.

## 3.112.7 The BSMSN Land Use Plan



Figure 2.4. BSMSN Land Use Plan Source. Sheltech Consulting/ Engineering



Amenities	
City Centre/Technology Hub	1,779.84
Health and Education Centre	814.30
Mixed Use/Residential	2,020.39
Administrative/Institutional	874.08
Light and Medium Industrial	10,092.72
Port and Logistics	1,798.28
Transitional	1,760.45
Heavy Industrial	3,956.35
Open Space	5,052.38
Leisure and Entertainment	350.89

### 3.11.1 2.7.1 Land Uses

Land use designations for BSMSN are used to: i) guide short, medium and long-term development, ii) strengthen the vision and value proposition for the zone, iii) organize the activities within the site, iv) ensure/promote compatibility between land uses and sectors, v) limit adjacency and environmental issues/conflicts, vi) protect land values, and vii) promote economic growth.

# 3.11.2 2.7.2 Diverse Land Use Designations

Table 3. Precincts and Land Uses			
Precincts	Land Uses		
Residential/ Supporting Amenities	Low-scale residential units, convenience retail and educational/health uses.		
City Centre/Technology Hub	Commercial, retail, administrative and technology/ICT related uses, high rise residential towers, and support amenities.		
Health and Education Centre	Health clinics, hospitals, educational uses, support amenities, short-term residences/dormitories, hotels, and parking facilities.		
Mixed Use/Residential	Low and medium residential typologies (apartments, dormitories, rowhouses etc), support amenities, convenient retail, and the alike.		
Administrative/ Institutional	Government buildings, libraries, museums, galleries,		

number of land use		shopping/retail, commercial facilities and support amenities etc.
	Light and Medium Industrial	Light and medium industries, chemical hub only if buffered with landscaped boundaries.
	Port and Logistics	Port and logistics related activities and support amenities.
	Transitional	For forest conservation purposes but transitional to port and logistics uses, if required.
	Heavy Industrial	For heavy industrial uses and support amenities.
Residential/ Retail/ Educational City Center (Commercial/ Retail/ Tech Hub) Educational/ Health	Open Space	For active and passive parks and open space. Limited development permitted.
Mixed Use/ Residential Administrative/ Institutional Light/ Medium Industrial	Leisure and Entertainment	For a variety of leisure and entertainment uses and support amenities.

**BSMSN** Transport Plan

BSMSN is comprised of a number of land use designations:

3.122.8 The

3.12.1

- 3.12.2 2.8.1 A Multi-Modal Platform
- 3.12.3
- 3.12.4 A comprehensive short, medium and long-term Transport Plan has been developed for BSMSN.

Educational/ Health Mixed Use/ Residential Administrative/ Institutional Light/ Medium Industrial Port/ Logistics Transitional Heavy Industrial Leisure/ Entertainment Cultural Facilities

Open Space

3.12.5 The Transport Plan is multi-modal and is comprised of: i) road, ii) rail, iii) sea, and iv) air plans.



### 3.12.6 2.8.2 Roads

A hierarchy of roads has been designed for BSMSN. The intent is to: i) separate urban and industrial traffic to improve safety within BSMSN, ii) introduce an arterial road network to reduce congestion, and iii) secondary roads to improve access to investor projects and plots. All road networks have utilities integrated into their design.

The road network for BSMSN is as follows:
Access Road (Off-site)
Arterial - Type A
Arterial - Type B
Sub Arterial - Type A
Sub Arterial - Type B
Super-Dike/ Emergency Road

······ Railwav

**Arterial Roads** (100m-60m ROW) – For through traffic on a continuous route/Used to maintain traffic flows. Incorporates carriageways, landscaped traffic medians and lighting, dedicated public transit lanes, light rail, cycle lanes, wide, treelined sidewalks and utility corridors. These are the central spines of BSMSN.

• **Sub Arterial Roads** (40m-30m ROW) – For collection and distribution of traffic connecting to the arterial road network. Incorporates carriageways, landscaped traffic medians and lighting,

cycle lanes, treelined sidewalks and utility

Figure 2.5. Transport Network corridors. Source. Sheltech Consulting/Engineering

• **Local Streets** (20m ROW) – For direct access to investment projects or within Precincts A-F and K. Incorporates carriageways, cycle lanes, treelined sidewalks and utility corridors.

- A Bridge A bridge will be required to connect Precincts A with Precinct B and the remainder of BSMSN. It will be constructed over the Feni River.
- **Emergency Roads** (80m ROW) For emergency situations only in order to move traffic quickly through or out of BSMSN. Incorporates carriageways, landscaped road edges and utility corridors.
- Light/Mass Transit Routes In the long-term, a road or mass transit option should be constructed along the waterfront from BSMSN to Chattogram to support the city, its port and airport. The ROW has been planned within the BSMSN Master Plan and must be respected. In the interim, this route may act as open space for BSMSN and its population.
- Access Roads into BSMSN (varying ROWs) A number of off-site roads have been planned in the BSMSN Master Plan in order to access the zone from a number of locations. This is strategically done to: i) optimize the modal split, ii) minimize congestion and iii) permit access to various Precincts within BSMSN. Each off-site road is to be constructed in parallel with the development of the Precinct, the road supports. The following are the proposed off-site roads leading into BSMSN: i) Feni Sonagazi Road, ii) Sonagazi- Muhuri Road, iii) Muhuri Road, iv) Bamonsundar Road, v) Sheikh Hasina Saroni, and vi) Barodarogarhat to Mohanagar Road.
- Road infrastructure requirements are further outlined in the Green and Resilience Section of this report.

#### 3.12.7 2.8.3 Rail

A railway spur is planned for the zone in order to seamlessly facilitate the movement of goods in/out of BSMSN. The rail link is a priority for the zone and must be constructed in the first phase of the project. The rail link is planned/designed from the Barotakia Railway Station, which will undergo a significant upgrade to facilitate the increased movement of people and goods in a programmed, safe and secure manner. At the Barotakia Station, two-transport options will be available: i) a series of buses, taxis, rickshaws etc. to transport people, workers and residents to various urban/industrial Precincts within BSMSN, and ii) a rail spur/corridor for the movement of goods/products, which will begin at the Dhaka -

Chattogram highway and will meet Sheikh Hasina Saroni and then directly enter the Port and Logistic Precinct. In the long-term, this rail line will be expanded along the waterfront to Chattogram, Chattogram Port and International Airport and may facilitate both people and products/goods. This will help expedite the movement of good from BSMSN to their international/domestic markets. The rail corridor must have a 100-m ROW to keep BSMSN safe and secure. This rail corridor must be landscaped to beautify the zone.

#### 3.12.8 2.8.4 A Seaport and Logistics Centre

A public port within BSMSN - bulk or container – with logistics facilities would bring significant value to the zone. This could help minimize the congestion and delays currently experienced at the Chattogram Port – 60 km away, and decrease transport and logistics costs for investors within the zone. Any port and/or logistics centre within BSMSN must be available (at an additional cost) to all tenants of the zone. For the seaport to function efficiently, the draft in the port must be increased to 9.5m from 6.5m and maintained to allow for 30,000-ton capacity ships to use the port facilities. A detailed feasibility study for the port and logistics centre must be undertaken to determine the required needs and costs of the project. Land adjacent the Seaport and Logistics Centre Precinct has been reserved for the possible expansion of these facilities. In addition, sea connectivity to the Char Islands should also be investigated as this will increase the value of the region.

#### 3.12.9 2.8.5 Airport

In the short term, the Chattogram International Airport – Shah Amanat International Airport, in its current configuration should be used to support BSMSN. In the medium-term, the Chattogram Airport should be expanded and upgraded to support the movement of people and goods/products from BSMSN and Mosheshkhali. In the long-term, when BSMSN has a population over 1,000,000, should an airport be incorporated into the Master Plan for BSMSN. The airport should be located outside the boundaries of BSMSN but in proximity to the zone. Although an airport is not recommended in the short-term, helicopter pads should be part of the core infrastructure within many of the Precincts within BSMSN.



Because of the size and complexity of the BSMSN site, the Master Plan has been divided into Precincts to better outline the: i) physical, ii) environmental and iii) social characters and qualities of each area within the plan.

The Table below, sets out the BSMSN Precincts by name and the percentage of land within the zone, which they contain.

Precinct	Name	Percentage
А	Residential/Supporting	16%
	Amenities	
В	City Centre/Technology	5%
	Hub	
С	Health and Education	2%
	Centre	
D	Mixed Use/Residential	6%
Е	Administrative/Institutional	3%
F	Light and Medium	30%
	Industrial	
G	Port and Logistics	5%
Н	Transitional	5%
Ι	Heavy Industrial	12%
J	Open Space	15%
K	Leisure and Entertainment	1%

## 3.142.10 Precinct Descriptions/Development Guidelines

The following is a detailed overview of each Precinct within BSMSN. It prescribes the: i) vision, ii) value proposition, iii) land use designation, iv) zoning, and v) special features of the Precinct. Appendix A is a version of this section, which should be reproduced and provided to potential developer and investors in lelines will ensure that the zone is planned, designed and constructed in

Figure 2.6. Precinct Plan Source. Sheltech Consulting/Engineering ournames and environments unoughout BSMSN.

## 3.152.11 Precinct A: Residential and Support Amenities



#### 3.15.1 2.11.1 Vision Overview

The vision for Precinct A is:

• Precinct A is an urban oasis adjacent the downtown core of BSMSN. The precinct is comprised of eco-friendly residential neighbourhoods incorporating lush landscaping and natural water features. To support the residents of the neighbourhoods, small health clinics, primary and secondary schools, shopping, convenient retail, and entertainment/leisure areas will be strategically located in the precinct to support daily living.

#### 3.15.2 2.11.2 Value Proposition

The value proposition for Precinct A is:

- Precinct A is minutes from the central business district/technology hub of BSMSN. It is easily accessed via a new bridge connecting Precincts A and B. There are superb views of the downtown core from Precinct A. Precinct A also has a direct access route to the Chattogram Highway.
- Precinct A will have spectacular views of the sea and the rest of BSMSN.
- Precinct A will have linear green space along the waterfront for the public and residents of BSMSN to enjoy. To be planned with passive and active green/landscaped areas with water features and urban design features. Will be developed with resilience and sustainability in mind.
- A mix of international housing typologies will be introduced in Precinct A from villas and boutique housing for mid-senior management, foreign investors and corporations to low-rise apartment buildings with affordable units. All residential designs/construction will be focused on introducing/using green technology and resilience attributes to make the neighbourhoods smart, modern and sustainable.
- Precinct A will have appropriate facilities and amenities such as educational/health/retail/entertainment to support the neighbourhoods, which are in close proximity.

- Precinct A's neighbourhoods will incorporate water bodies/features and be heavily landscaped to pay tribute to the origins of the site.
- Precinct A will have a main arterial road around the perimeter of the precinct to ensure that traffic runs smoothly and so the neighbourhoods stay quiet and unaffected by traffic.
- Precinct A will have a direct access to Precinct J, which is a self-contained ecoentertainment/leisure centre.

#### 3.15.3 2.11.3 Land Use Designation

The land use for Precinct A is:

• Residential

#### 3.15.4 2.11.4 Zoning

The permitted uses for Precinct A are:

- A variety of international housing typologies (single family houses, villas, duplexes, boutique apartments/hotels, green apartment buildings). Densities and height limits in this Precinct are lower than other areas of the urban/industrial city/zone.
- An appropriate amount of convenient retail/restaurants/shopping/leisure facilities to support Precinct A residents.
- Primary and secondary schools to support the residential mix.
- Health clinics and small medical facilities to support Precinct A's community but not compete with Precinct C.
- All types of religious buildings/facilities as required, are permitted in Precinct A.
- Open space for passive or active activities is permitted in Precinct A. Formal restaurants and cafes etc, designed to open space guidelines, permitted in specific open space areas.

#### 3.15.5 2.11.5 Special Features

The special features of Precinct A are:

- A bridge connecting Precinct A to downtown core.
- Direct road access to/from the Chattogram Highway.
- From an upgraded BSMSN rail station, a bus system/route into Precinct A will be provided.

- Public open space along the waterfront of Precinct A for the enjoyment of residents and visitors.
- Ring road around the Precinct so neighbourhoods experience reduced traffic congestion and improved traffic flows.
- The Precinct will have 20m wide roads throughout for local traffic. Main or arterial roads may be 30m wide, if necessary.
- Streets will be tree lined with pedestrian and vehicular lighting and street furniture. A wayfinding system for signage will be developed specifically for Precinct A.
- Parking designed to minimize impacts on the Precinct.
- Views to the water (sea or water features) will be prioritized.
- The existing canals in Precinct A will be redesigned to create water features for the use of the residential communities. The canals will become lakes/creeks/water features but will also remain water catchment areas for the surrounding lands. Precinct A will be lushly landscaped and will incorporate a number of green/resilient initiatives.
- No land shall be allotted to any type of industry/manufacturing/production within Precinct A.
- Heavy vehicles and cargo transport are not permitted in Precinct A.

## 3.162.12 Precinct B: City Center/Business Hub



#### 3.16.1 2.12.1 Vision Overview

The vision for Precinct B is:

• Precinct B is the vibrant, urban core of BSMSN. It is a world-class business and IT hub incorporating smart city/green/resilience technology to attract Tier 1 - foreign and domestic investors. Precinct B will be comprised of tall, architecturally significant, commercial buildings designed by leading architects from around the world. It will be an area of finance, technology, trade, services as well as home to a variety of Corporation's South Asian headquarters. In the future, Precinct B's skyline will be globally recognizable and will be synonymous with innovation, technology and progress. It is this Precinct, which will help change the image of Bangladesh from a low-cost manufacturing hub to a dynamic business/opportunity hub for international and domestic players from all sectors.

#### 3.16.2 2.12.2 Value Proposition

The value proposition for Precinct B is:

- Precinct B will be designed to be the third largest city in Bangladesh and the first city in the country to be designed using smart city/green technology/resilience initiatives.
- Precinct B will be designed to take advantage of the unprecedented views of BSMSN and the sea.
- Precinct B will be an international business/IT hub for foreign and domestic investors offering state-of-the-art technology and facilities found nowhere else in South Asia. Also, Precinct B will be a business-friendly environment.
- Precinct B will have a green perimeter. This open space will have a mix of active and passive areas to be used by investors, visitors and residents of BSMSN. To the north, this allows for future expansion of Precinct B in the long-term, if required.
- Directly south of Precinct B is a green area, which will be a cultural hub with nationally important buildings such as a symphony/ballet hall and sports area. These architecturally distinct buildings will be surrounding by well-designed green areas/hard and soft landscaping and large gathering areas for public use and enjoyment. Public events/festivals etc. will also take place in the area. This green area will also be resilient and sustainable.
- Precinct B has direct access to the Chattogram Highway and has an arterial road network, which surrounds the downtown core to reduce traffic congestion.
- Precinct B is adjacent to both a residential community (Precinct A) and a health and education hub (Precinct C).
- Precinct A will have a main arterial road around the perimeter of the precinct to ensure that traffic runs smoothly and so the neighbourhoods stay quiet and unaffected by traffic.
- A large, tree lined boulevard with a dedicated public transportation lane will link the downtown core with the rest of BSMSN and the other precincts.
- A large, public park will denote the southern border of Precinct B.

#### 3.16.3 2.12.3 Land Use Designation

The land use designation for Precinct B is:

• Commercial/Retail/Services - Central Business District

#### 3.16.4 2.12.4 Zoning

The permitted uses in Precinct B are:

- Commercial (financial, banking, business, services, trade, IT facilities, hotels or similar).
- Retail (convenient retail, restaurants, main street shopping, retail/wholesale stores or similar).
- Entertainment (cinemas, play and innovation centres, art galleries or similar).
- Social services (business centres, incubators, libraries, or similar).
- All types of religious buildings/facilities are permitted in Precinct B.
- Open space for passive or active activities are permitted within specific areas of Precinct B.

#### 3.16.5 2.12.5 Special Features

The special features for Precinct B are:

- Creation of an architecturally distinct skyline within Precinct B, which will make BSMSN globally recognizable.
- Monumental architecture utilized in Precinct B.
- Business friendly environment is critically important in Precinct B.
- A Precinct with state-of-the-art technology, green infrastructure/buildings, and a resilient design.
- Tree-lined streets, pedestrian lighting, international signage, inspiring views, and well- defined open spaces and public gathering areas.
- Parking designed to minimize impacts on the Precinct.
- Direct connection to cultural hub south of the core.
- Easy access to/from the Chattogram Highway.
- From an upgraded BSMSN rail station, a bus system/route into Precinct B will be provided.
- No land shall be allotted for any type of industrial activity within Precinct B.
- Heavy vehicles or cargo transport shall not be permitted in Precinct B.

## 3.172.13. Precinct C: Health and Education Centre



3.17.1 2.13.1 Vision Overview

The vision for Precinct C is:

• Precinct C is an international health and education centre for BSMSN and Bangladesh. It will contain international-level hospitals, universities, primary/secondary schools, research and development facilities, international schools, and appropriate medical and educational support services/facilities to make Precinct C the country's foremost health, wellness, and education centre. Precinct C will be designed as an integrated complex with state-of-the-art technology, significant amounts of open/landscaped space and areas for social gatherings/intellectual exchanges.

#### 3.17.2 2.13.2 Value Proposition

The value proposition for Precinct C is:

- Precinct C is strategically located between the downtown core (Precinct B) and the largest, mixed-use residential area (Precinct D) on the BSMSN site.
- Precinct C supports the country's newest international medical and educational facilities, making BSMSN the most attractive location for foreign investment in Bangladesh because of its world-class support facilities and amenities.

- Precinct C will use smart city/green technology and incorporate high tech/resilient infrastructure/utilities.
- The universities and health facilities should be twinned with international health and educational facilities around the world.
- Precinct C will also have direct access to the Chattogram Highway as well as views of the Bay of Bengal and the rest of BSMSN.
- Precinct C will have a number of health and educational facilities designed to create campuses with landscaped areas where academics and professionals can relax, be inspired, and meet to interact and share/nurture ideas.
- Precinct C will have training facilities for business and vocational colleges/training for industry.
- Precinct C will have appropriate support facilities and amenities such as convenient retail/restaurants/entertainment areas as well as the open spaces.
- Precinct C will incorporate water bodies/features to help create the serene/innovative/thought provoking environments.
- The Precinct will be walkable with some 20m wide roads throughout for vehicle access
- Precinct C will be accessible from the main boulevard of BSMSN, which has a dedicated bus lane and a number of bus routes leading throughout the site.

#### 3.17.3 2.13.3 Land Use Designation

The land use designations for Precinct C are:

• Health and Education

#### 3.17.4 2.13.4 Zoning

The permitted uses for Precinct C are:

- Health facilities. This includes international level hospitals, research and wellness labs/clinics/facilities, doctor's offices, or similar.
- Educational facilities. This includes international level schools (primary/secondary), universities, training facilities, vocational colleges, or similar.
- Housing. Short term housing/hotels/dormitories are permitted to support health care and educational facilities.
- An appropriate amount of convenient retail/shopping/leisure facilities to support Precinct C.
- All types of religious buildings/facilities are permitted in Precinct C.

• Landscaped/resilient open space for passive or active activities are permitted in Precinct C.

#### 3.17.5 2.13.5 Special Features

The special features of Precinct C are:

- Campus type setting of Precinct C sets up a creative environment, limits roads/traffic and allows for greater pedestrian movement and larger, dynamic gathering spaces.
- Parking designed to minimize impacts on the Precinct.
- The existing canals in Precinct C will be redesigned to create lakes/creeks/water features and expansive landscaped, green open space areas to help promote synergizes between the health and educational facilities.
- Arterial road networks with bus transportation to service all areas of BSMSN.
- Direct access to/from the Chattogram Highway.
- From an upgraded BSMSN rail station, a bus system/route into Precinct C will be provided.
- No industrial activities are permitted in Precinct C.
- No trucks or cargo transport is permitted in Precinct C.

## 3.182.14 Precinct D: Mixed Use/Residential



#### 3.18.1 2.14.1 Vision Overview

The vision for Precinct D is:

Precinct D is a

mixed-use, residential area comprised of a variety of modern, international level, high-rise apartment buildings with at-grade retail/restaurants. The streets will be tree-lined, landscaped with pedestrian lighting and street furniture, with a wayfinding signage system throughout. Open space/parks will be regular features of the residential neighbourhoods with a large park at the south end of the Precinct.

#### 3.18.2 2.14.2 Value Proposition

The value proposition for Precinct D is:

- Precinct D is in close proximity to Precincts B, C and E and appropriately linked by the road network and bus system in order to conveniently access the all areas of BSMSN, including the industrial locations. This allows international investors, professionals and factory workers to reside in this strategic residential location.
- A variety of medium and high-rise apartment buildings will be present in this Precinct to support the needs of all residents of BSMSN. All buildings will have retail at-grade, as well as views of the larger site and the Bay of Bengal.
- The existing canal system will be upgraded, re-enforced and landscaped to support the resilience of the Precinct. Water bodies/features will be an integral part of the Precinct D design.
- Precinct D will have appropriate facilities and amenities such as small scale, convenient retail/restaurants/shopping/entertainment facilities to support the residential community.
- Precinct D will have a large park on its southern boundary, which will also denote the entry to the City Centre.
- Precinct D will have 20m roads within to minimize the vehicular traffic in the neighbourhoods and a larger 30m arterial roads surrounding the Precinct to aid the flow of traffic and reduce congestion.
- Precinct D will have a shared access to the Chattogram Highway.

#### 3.18.3 2.14.3 Land Use Designation

The land use designation for Precinct D is:

• Mixed-Use/Residential

#### 3.18.4 2.14.4 Zoning

The permitted uses within Precinct D are:

- A variety of international housing typologies (medium/high apartments or similar)
- An appropriate amount of convenient retail stores/restaurants/banking to support the mix of Precinct D residents.
- Primary and secondary schools to support the residential mix.
- Doctor's offices/health clinics to support Precinct D but not compete with Precinct C.
- All types of religious buildings/facilities are permitted in Precinct D.
- Open space for passive or active activities are permitted in Precinct D.

#### 3.18.5 2.14.5 Special Features

The special features for Precinct D are:

- A number of mixed-use, residential neighbourhoods with views constructed to international standards.
- Tree-lined streets, pedestrian lighting, street furniture, and wayfinding signage.
- Large and small public open spaces/parks/landscaped canals for active and passive use.
- Sports facilities for residents/visitors.
- Parking designed to minimize impacts on the Precinct.
- Arterial road network surrounding the Precinct with smaller interior roads.
- Shared access to/from the Chattogram Highway.
- From an upgraded BSMSN rail station, a bus system/route into Precinct D will be provided.
- No industrial activities are permitted in Precinct D.
- No trucks or cargo transport is permitted in Precinct D.

## 3.192.15 Precinct E: Administrative/Institutional Centre



#### 3.19.1 2.15.1 Vision Overview

The vision for Precinct E is:

• Precinct E is the institutional/administrative centre of BSMSN. It is located adjacent the main entryway into BSMSN and contains all government and BEZA buildings/offices as well as, support services and amenities for the project. The Precinct features monumental and stately structures featuring large public gathering spaces, parks, fountains, meandering walkways and hard/soft landscaping. The Precinct also supports the major shopping/retail area for BSMSN as well as public buildings such as museums, art galleries, libraries etc.

#### 3.19.2 2.15.2 Value Proposition

The value proposition for Precinct E is:

- Precinct E will have direct access from the main road into BSMSN, which leads from the Chattogram Highway.
- Precinct E is adjacent the mixed-use residential community (Precinct D) and in close proximity to the health and educational area (Precinct C) as well as the City Centre (Precinct B). It will also overlook the light industrial area of BSMSN (Precinct F).
- Precinct E will have views of the Bay of Bengal and the rest of BSMSN.
- Precinct E will house all the institutional/administrative buildings in BSMSN, including BEZA offices and support facilities.
- Precinct E will also contain the main shopping centre in BSMSN as well as all the national public buildings.
- Precinct E will host festivals, events and will contain public gathering space and park land.
- The interior road system within Precinct E will be based on a 20m wide network with arterial roads being 30m wide to help control congestion.

#### 3.19.3 2.15.3 Land Use Designation

The land use designation for Precinct E is:

• Institutional/Administration

#### 3.19.4 2.15.4 Zoning

The permitted uses within Precinct E are:

- All government and public buildings (offices for Government of Bangladesh/BEZA or similar).
- Museums, art galleries, cultural facilities, theatres or similar.
- Main shopping and entertainment centre for BSMSN. (retail shopping centre, cinemas, entertainment facilities or similar.)
- Support facilities such as convenient retail, restaurants, banking or similar.
- All types of religious buildings/facilities are permitted in Precinct E.
- Open space for passive or active activities are permitted in Precinct E.

#### 3.19.5 2.15.5 Special Features

The special features of Precinct E are:

- Direct access to/from the Chattogram Highway.
- From an upgraded BSMSN rail station, a bus system/route into Precinct E will be provided.
- Location of all public buildings and offices for BSMSN.
- The main shopping centre and entertainment facilities for BSMSN.
- Public parks and gathering spaces are a key element of this Precinct.
- Parking designed to minimize impacts on the Precinct.
- No industrial activities are permitted in Precinct E.
- No trucks or cargo transport is permitted in Precinct E.

## 3.202.16 Precinct F – Light/ Medium Industrial Area



3.20.1 2.16.1 Vision Overview

The vision for Precinct F is:

• Precinct F is the light industrial area of BSMSN. It is intended to house only light and medium industry sectors in order to properly separate, buffer and protect the area from heavier, more polluting industries. The Precinct will be constructed to international standards, ensuring proper truck/cargo movements and easy access to arterial roads leading in and out of BSMSN. The area will be designed to provide state-of-the-art infrastructure and utility networks, which are eco-friendly, sustainable and resilient.

#### 3.20.2 2.16.2 Value Proposition

The value proposition for Precinct F is:

- Only light and medium industrial projects (manufacturing, processing, warehousing etc.) is permitted in Precinct F to ensure compatible development.
- Precinct F will have direct access from the main road into BSMSN, which leads from the Chattogram Highway.
- Automated/digital customs will be available within Precinct F.
- Precinct F will have a tiered road network (public roads 100m, 80m, and 40m wide) and 30m and 20m roads within industrial investment projects.
- All roads within Precinct F will have tree-lined sidewalks.
- Precinct F will be designed with eco-friendly/resilient infrastructure/utility networks specifically for light and medium industries. All infrastructure/utilities will be integrated under the road sidewalks.
- The existing canal system will be upgraded and expanded to comprehensively channel the water from the region through the Precinct into the Bay of Bengal.
- Large areas of land will be available for private or Government to Government developers/operators.

#### 3.20.3 2.16.3 Land Use Designation

The land use designation for Precinct F is:

• Light/Medium Industrial

#### 3.20.4 2.16.4 Zoning

The permitted uses within Precinct F are:

- Only light and medium industries, which cause minimal pollution and require a clean environment.
- Limited support facilities such as convenient retail, restaurants, banking or similar in designated areas.
- All types of religious buildings/facilities are permitted in designated areas.
- Open space for factory employees is mandatory in designated areas.

#### 3.20.5 2.16.5 Special Features

The special features for Precinct F are:

- Direct access into Precinct F from the Chattogram Highway.
- From an upgraded BSMSN rail station, a bus system/route into Precinct F will be provided.
- Precinct F will provide a bus system to deliver workers to their factories.
- Only available for light and medium industries.
- Core infrastructure/utility networks designed to be eco-friendly, sustainable, and resilient.
- Support amenities and open space provided for industry workers in designated areas.
- Focus on implementing/ integrating green technology into the Precinct.
- Customs will be available 24/7 within Precinct F to support all investors.

#### 3.20.6 2.16.6 Special Environmental Guidelines

The following are special environmental guidelines for Precinct F:

- No heavy industry, (chemical, hazardous, or polluting factories/businesses) are permitted in Precinct F.
- The existing chemical hub and all heavy industry must be properly buffered from all Precincts. A minimum, 20m landscaped buffer is required.
- All utilities such as Gas Plants, Water/Wastewater Treatment Plants, Effluent Treatment Plants or alike must be properly buffered/landscaped from the streetscape. A minimum planted setback of 10m must be provided from the street.
- All light/medium industry's truck/cargo transport is required to use the truck route/spine within BSMSN.

## 3.212.17 Precinct G – Port and Logistics Hub



#### 3.21.1 2.17.1 Vision Overview

The vision for Precinct G is:

• Precinct G is the port and logistics hub within BSMSN. The Precinct will be designed as a multi-modal, transport platform to provide improved logistics for the country. Precinct G will have a new port and a special access road to/from the Chattogram Highway in order to better facilitate trucks and separate cargo/vehicular traffic. Precinct G will also have a rail spur from the main line railway line adjacent the Chattogram Highway. In the future, an additional railway line will be available from BSMSN directly to the Port of Chittagong and the Chittagong International Airport along the waterfront of the Bay of Bengal. All industrial tenants of BSMSN will be able to utilize these port and logistics facilities.

#### 3.21.2 2.17.2 Value Proposition

The value proposition for Precinct G is:

- Precinct G will be a multi-modal, transport platform road, rail, sea, and air.
- Precinct G will have a new port, direct access/connectivity to/from the Chattogram Highway, and a rail spur to connect to two railway lines, which stretch north to Sylhet/Dhaka and south to Chittagong.
- Precinct G is bounded by 80m and 100 m wide roads to assist in the movement of goods on/off BSMSN.

- Synergies will be aligned between the port, the logistics hub and the light and heavy industrial areas within BSMSN, which will help reduce costs and increase transport, supply chain and distribution efficiencies.
- The port in BSMSN will be public so all tenants will have the opportunity to utilize it, if required.

#### 3.21.3 2.17.3 Land Use Designation

The land use designation in Precinct G is:

• Port/Logistics

#### 3.21.4 2.17.4 Zoning

The permitted uses within Precinct G are:

- All port and logistics facilities or similar. IE. Bulk or container. Hazardous goods are not permitted.
- Port/Logistics hub headquarters building or similar.
- Customs/stevedore facilities.
- Maintenance facilities/operating buildings.
- Paved open areas for storage of cars, cargo, materials or similar.
- Factories for warehousing, storage, cold storage, distribution, pick or packing, labelling, or similar.
- Open warehouses or similar.
- Rail station/loading facilities or similar.

#### 3.21.5 2.17.5 Special Features

The special features of Precinct G are:

- Direct road/rail access into Precinct G from the Chattogram Highway.
- Future rail/people mover/light rail transit link to Chittagong along Bay of Bengal.
- New port and logistics hub for all tenants of BSMSN.

• Improvement of port and logistics services/facilities in the region.

#### 3.21.6 2.17.6 Special Environmental Guidelines

The special environmental guidelines for Precinct G are:

- No heavy industry, (chemical, hazardous, or polluting factories/businesses) are permitted in Precinct G.
- The existing chemical hub and all heavy industry must be properly buffered from all Precincts. A minimum, 20m landscaped buffer is required.
- All utilities such as Gas Plants, Water/Wastewater Treatment Plants, Effluent Treatment Plants or alike must be properly buffered/landscaped from the streetscape. A minimum planted setback of 5m must be provided from the street.
- All light/medium industry's truck/cargo transport is required to use the truck route/spine within BSMSN.

## 3.222.18 Precinct H – Forest/Transitional Area: Additional Port/Logistics



#### 3.22.1 2.18.1 Vision Overview

The vision for Precinct H is:

• Precinct H is a forest conservation area, where no development is currently permitted. It is comprised of mangroves and similar plant material, which must remain – in accordance with the Forest Department. In the future however, this site could become a port/logistics or heavy industrial area depending upon demand within BSMSN.

#### 3.22.2 2.18.2 Value Proposition

The value proposition for Precinct H is:

In the short term, this Precinct is to remain undeveloped. However, in the medium to long-term, the Precinct could be an extension of Precinct's G or I.

#### 3.22.3 2.18.3 Land Use Designation

The land use designations for Precinct H are transitional:

- Forest Conservation/Transitional Lands Short-Term
- Port and Logistics/Heavy Industrial Medium to Long-Term

#### 3.22.4 2.18.4 Zoning

The permitted uses on Precinct H are transitional:

- No development is permitted in this Precinct in the short term.
- Port and logistics related uses are permitted in the medium to long-term.
- Permitted uses are the same as Precinct G.

## 3.232.19. Precinct I – Heavy Industrial Area



#### 3.23.1 2.19.1 Vision Overview

The vision for Precinct I is:

• Precinct I houses the heavy industrial area within BSMSN. It houses the larger industries, which tend to create higher pollution, consume greater amounts of energy and require additional utility systems to mitigate their waste and water. Precinct I will be specially designed for these types of industries and will utilize modern/ resilient technology to mitigate impacts.

#### 3.23.2 2.19.2 Value Proposition

The value proposition for Precinct I is:

- Precinct I will be designed specifically for heavy industry and will be the location within BSMSN for polluting sectors.
- Precinct I will have access to/from the Chattogram Highway via public, arterial road networks within BSMSN, which are 80-100m in width to support large trucks and heavy cargo loads and movements.
- Special infrastructure and utilities will be constructed within Precinct I to minimize negative impacts on other heavy industries or within BSMSN.

#### 3.23.3 2.19.3 Land Use Designation

The land use designation for Precinct I is:

• Heavy Industry

#### 3.23.4 2.19.4 Zoning

The permitted uses within Precinct I are:

- Limited heavy industry (cement, iron/steel, chemicals, fertilizer, minerals, paints or similar) except for hazardous, explosive or dangerous sectors/activities.
- Support offices/facilities for the above.
- Convenient retail/restaurants in designated areas.
- Religious facilities in designated areas.
- Plots must be significantly buffered to limit the exposure of the heavy industries. The plots must have landscaping around its plot boundaries.
- Landscaped open space for workers.

#### 3.23.5 2.19.5 Special Features

The special features within Precinct I are:

- Direct access into Precinct I from the Chattogram Highway.
- Heavy industry is clustered to minimize environmental conflicts with light and medium industries.
- Large arterial roads (60-100m in width) within Precinct I to support transport requirements of heavy industry.

- Landscaped buffer areas surrounding plots to mitigate pollution.
- Specialized infrastructure/utility networks to support heavy industry.
- Larger plots to facilitate the needs of heavy industries and loading requirements.
- Environmental mitigation measures are part of the infrastructure systems within this Precinct.

## 3.242.20 Precinct J – Open Space



#### 3.24.1 2.20.1 Vision Overview

• Precinct J is the area between the super dike and the Bay of Bengal, which has been reserved for forest, mangroves and a variety of open space (passive/active areas with landscaped/hard/soft as well as canals/creeks/water features etc) for investors, residents and visitors to BSMSN to enjoy. This area will be a mix of conservation, new mangrove planting and forests to keep the BSMSN resilient and protected from cyclones or natural disasters. In the area closest to the City Centre, a cultural and/or sports facility will be situated with large, public gathering spaces surrounding the buildings to take advantage of the views and vast parkland along the Feni River.

#### 3.24.2 2.20.2 Value Proposition

The value proposition for Precinct J is:

- Precinct J will be comprised of passive/active open space and conservation/forest areas.
- Precinct J will be designed to minimize effects of climate change and to protect the BSMSN project.
- Precinct J will add value to the BSMSN project by creating a linear park around the site to support a variety of activities.

• Precinct J will contain a cultural and sport facility on the waterfront to be enjoyed and utilized by the public. These facilities will be modern in nature with architectural distinguishing features, which will make the skyline of BSMSN globally recognizable.

#### 3.24.3 2.20.3 Land Use Designation

The land use designation for Precinct J is:

• Open Space

#### 3.24.4 2.20.4 Zoning

The permitted uses for Precinct J are:

- Only passive/active/linear park land, forest/mangrove conservation, landscaped (hard/soft) areas or similar are permitted within Precinct J.
- Special public buildings with gathering spaces are permitted under special circumstances but in designated areas only.
- No residential/commercial/industrial/utilities or administrative facilities are permitted in this area.
- Small maintenance buildings are permitted in designated areas.
- Water features, park and street furniture are encouraged.

#### 3.24.5 2.20.5 Special Features

The special features of Precinct J are:

- Precinct J will be accessible from controlled locations within BSMSN only in order to promote safety and security.
- The Precinct will be monitored by CCTV.
- A variety of park types, which highlight the regions bio-diversity and natural beauty will be prioritized within BSMSN.



3.25.1 2.21.1 Vision Overview

The vision for Precinct K is:

• Precinct K is a leisure and entertainment destination in BSMSN. It will be designed to have parks, gathering spaces, marinas, restaurants, cafes, as well as golf and entertainment facilities such as a water park or outdoor cinemas.

#### 3.25.2 2.21.2 Value Proposition

The value proposition for Precinct K is:

- Precinct K will be accessible from Precinct A.
- A boat shuttle service will be available for day travellers.
- A variety of leisure and entertainment facilities will be located in Precinct K for residents/visitors of all ages.
- Precinct K has spectacular city and sea views.
- Cars/vehicles will not be permitted in Precinct K. The area will have its own transport system consisting of electric cars/carts, buses, and/or trams.
- Precinct K will have a combination of indoor and outdoor facilities/activities.

#### 3.25.3 2.21.3 Land Use Designation

The land use designation for Precinct K is:

• Leisure/Entertainment

#### 3.25.4 2.21.4 Zoning

The permitted uses for Precinct K are:

- All leisure/entertainment facilities (marinas, restaurants, cafes, sports activities etc) or similar as long as they are not hazardous or dangerous.
- Support amenities such as small-scale retail, restaurants, cafes, marinas, water/sailing sports, golf course, or similar.
- Open space for passive and/or active activities.

#### 3.25.5 2.21.5 Special Features

The special features for Precinct K are:

- Precinct K is an island, which is a unique destination and experience for residents and visitors.
- The island will be accessible from Precinct A.
- A boat shuttle service will be available for day/evening travellers.
- Precinct K will use local varieties of plants and vegetation per guidelines from the Forest Department.
- Safety guidelines/rescue plans for water sports/transport will be developed for the island.

# 3.262.22 General Environmental Guidelines for All Precincts Within BSMSN

BSMSN must have all environmental clearance before any development is permitted. In addition, the following environmental considerations must be met along with all other mandatory environmental rules and regulations:

- Within BSMSN, a minimum of 10% of the total land area must be reserved for open space.
- All roads within BSMSN must have footpaths, pedestrian and street lighting and must be lined with a single or double row of trees depending upon the location of the road and how wide the road is. All trees shall be planted no more than 4 meters apart.
- Heavy vehicles and cargo transportation shall not be permitted in Precincts A, B, C, D, E and K.
- BSMSN should be designed to be eco-friendly, environmentally sensitive and resilient.
- Where possible, solar, renewable energy, recycling, and green technology should be incorporated into the design of the project.

- Within BSMSN, an uninterrupted supply of potable water (maintaining drinking water quality, as per DOE, GOB or WHO) is mandatory as well as grey water. Water plants, transmission and distribution networks and wastewater treatment plants must be constructed in accordance to international standards.
- All sewage within BSMSN must be properly-managed/treated. Hence a Sewage Treatment Plant (STP), (per DOE, GOB, and STP guidelines) must be constructed within the zone in accordance with international standards.
- Land adjacent to or outside BSMSN must be reserved for a Municipal Solid Waste Management Treatment Plant/Disposal / Sanitary Landfill site for the project.
- BSMSN should be a plastic-free zone. The use of polythene bag / plastic bag shall be prohibited within BSMSN.
- Solar lighting is mandatory within BSMSN. Hence, street lighting / boundary lighting etc should be solar technology.
- To promote energy conservation, the use of energy efficient lights / high efficiency light systems (IE. T5 Tri phosphor Fluorescent, LED etc) should mandatory within BSMSN.
- Fire services/emergency services for fire-fighting and medical facilities must be present in each Precinct.
- All power sub-stations must be properly fenced and buffered with landscaping to reduce impacts on the road and improve security of the infrastructure.
- As much as possible, green and resilient technology should be used for all large buildings/plots within BSMSN.
- All water channels within BSMSN must be designed to capture and drain water from the surrounding areas outside BSMSN into the Bay of Bengal. These channels shall be kept active and shall be lined, planted and enlarged to become water features/lakes/streams, and water reservoirs/harvesting/collection within BSMSN.
- A rainwater harvesting system designed to capture roof run off from a minimum of 200m<sup>2</sup> (or 50% of the available roof catchment area for roof areas less than 400m<sup>2</sup>) during regular rainfall events must be incorporated into each building. The collected rainwater shall be plumbed to supply a seasonally independent water use. IE. Toilet flushing and landscaping etc.
- Most of the components in BSMSN require environment clearance from DOE, GOB (Orange B category) as per The Environment Conservation Rules, 1997 and its amendments.
- No construction / developmental activities within BSMSN shall be permitted until environment clearance is granted/received from DOE.

## 3.272.23 Phasing of BSMSN

Because all the land within BSMSN has not yet been acquired and some lands have been allocated to investors, it is more complicated to accurately phase the site according to best practices. However, to maximize the land values and minimize capital costs within the urban/industrial city/zone, the following phasing rules should be followed in BSMSN:

•



- Develop land which has been acquired and where investors want to construct.
  - Develop core infrastructure and utility networks incrementally within BSMSN/ Precincts so only the required networks/systems are built to support each phase of development.
  - Infrastructure/utility networks should never be constructed without demand as they will erode and will need to be replaced, at a later date. This will substantially increase the infrastructure/utility costs within BSMSN.

- It is imperative that all public infrastructure such as access roads and utility networks be constructed within Precincts before investment projects are implemented by investors.
- All public roads and associated utilities (power, water, drainage, sewerage, telecom etc.) should be constructed in an integrated manner with sufficient right-of-ways (ROWs) in order to support maintenance.

#### Figure 2.7. Phasing Map Source. Sheltech Consulting/ Engineering

- Try to cluster development so one or a few adjacent Precincts are constructed in parallel. Only construct main public roads between existing Precincts and investment projects. Main roads should be expanded only when new Precincts are to be implemented.
- Larger investment projects within a Precinct should be divided into smaller, phased components, where possible. IE. Similar to Zone 2A/B in the Light and Medium Industrial Precinct F. New phases within investor projects should not begin until 70% of the first or previous phase of a project is sold out/leased.
- Resettlement of the identified Feni and Mireshorai communities should be undertaken early on in the development process, as resettlement is the first step in development.
- All Precincts are to be planned and implemented as per this Master Plan.
- The BSMSN must have secure fencing around the entire site and be monitored with CCTV.

## III. Chapter Three - Guiding Policies for the BSMSN Master Plan

## 3.283.0 Guiding Policies for the BSMSN Master Plan

The following are guiding policies to support the BSMSN's Master Plan. The Guiding Policies, Planning Principles and the Master Plan Maps for BSMSN are to be read together as they provide a clear design rationale for all development projects envisioned within the zone. (These guiding policies are to be utilized by both the public and private sectors.)

The purpose of these guiding policies for BSMSN is to help create an attractive and safe urban/industrial city, which has:

- Vibrant Precincts with clear land uses to minimize any planning conflicts,
- A variety of housing choices affordable, medium and high end which meets the needs of the BSMSN population,
- Attractive, tree-lined streets with various activities, which are at a low-scale, so streets are walkable,
- A comprehensive and high quality, affordable, transit system, which allows people to move around the zone and from Precinct to Precinct, quickly and conveniently,
- A strong and competitive economy with a vital central business district/technology hub, which creates and sustains well-paid, innovative, stable, safe and fulfilling employment opportunities for Bangladeshi's and foreigners alike,
- A healthy natural environment, which promotes clean air, soil, energy and water, green infrastructure/utilities and socio-economic systems, which are resilient to disruptions and climate change,
- A connected system of natural features and ecological functions, which supports biodiversity and contributes to civic life,
- Green spaces of all sizes and shapes as well as public squares, which bring people together and supports public celebrations,
- A wealth of recreational options throughout the zone, which promotes health and wellness,
- A spectacular waterfront, which is healthy, diverse, public and beautiful,

- Cultural facilities, which celebrates the best of BSMSN living and Bangladesh,
- Inspiring architecture and excellent urban design, which astonishes, motivates and excites.

## 3.293.1 City Core/Central Business District

The BSMSN Master Plan has been designed to have a central business district (CBD), which will play a vital role in the zone's growth management strategy. A dynamic central core is critical to the health and economic welfare of an economic zone and the region surrounding it. BSMSN's CBD will be a commercial and financial centre, as well as a business/ICT hub with supporting amenities. The area will be known for its innovative and creative tenants. It is intended that the CBD will host a variety of restaurant/retail/entertainment facilities to ensure the Precinct remains lively after working hours. High rise apartment buildings/condominiums with expansive views will be permitted within the CBD to keep the area safe and secure 24/7. The CBD will have a dramatic skyline with recognizable architectural buildings and features, so BSMSN's landscape can be easily identified around the world. The CBD will be divided into numerous real estate projects for investors.

#### 3.29.1 3.1.1 Guiding Policies

- The CBD will be developed into consistent streets and blocks.
- A variety of real estate projects will be available within the CBD for private or PPP investment.
- New real estate projects will provide at-grade amenities and open spaces to make these development projects within the Precinct attractive, interesting, comfortable and functional. They will have:
  - sustainable street design elements, which may include one or more of the following: trees, shrubs, hedges, plantings or other ground cover, permeable paving materials, street furniture, curb ramps, waste and recycling containers, lighting and bicycle parking facilities,
  - coordinated landscape improvements in setbacks to create attractive transitions from the private to public realms,
  - weather protection such as canopies and awnings,
  - landscaped open space within the development site,
  - landscaped surface parking lots near large scale development and parks,

- safe, landscaped and lit pedestrian routes,
- public art, to make the buildings and its open spaces more attractive and interesting.
- High rise residential projects within the CBD will provide indoor and outdoor amenity space for residents. Each resident will have access to outdoor amenity spaces such as balconies, terraces, courtyards, rooftop gardens and other types of outdoor spaces.
- Street ROWs for this area will be 20m-30m depending if the streets are arterials or secondary roads.
- Transit will be conveniently located and abundantly available throughout the CBD.
- The CBD will promote and support prestige, commercial and landmark office buildings/space, which will help shape the skyline of BSMSN. Areas surrounding these buildings will be landscaped with public squares/gathering spaces, which are filled with pedestrian lighting fixtures and furniture.
- The CBD will be a premier employment area in BSMSN to attract investment.
- Higher height limits and more density is permitted in the CBD to obtain views over the zone and across the Bay of Bengal.
- Support amenities and services along with high rise residential units will be available within the CBD so it remains safe and secure 24/4 eyes on the street.

## 3.303.2 Tall Buildings

The BSMSN Master Plan only permits tall buildings in the CBD area/ Precinct B. When appropriately located and designed, tall buildings can support and draw attention to the city structure, visually reinforcing BSMSN's financial/technology/civic centre and other areas of civic importance. In the context of BSMSN's relatively flat topography, tall buildings will help define the zone's image. When the quality of architecture and site design is emphasized, tall buildings become important city landmarks. By concentrating development on a small part of the zone (Precinct B), tall buildings will provide high quality, publicly accessible, open spaces and areas for community services and amenities.

#### 3.30.1 3.2.1 Guiding Policies

Tall buildings come with larger civic responsibilities and obligations. To ensure that tall buildings fit within the planned context of BSMSN's Master Plan, the following must be followed:

• Tall buildings should consist of three parts, carefully integrated into a single whole:

- A base building which provides definition and support at an appropriate scale for adjacent streets, parks and open spaces. A base must fit into the context of its surroundings and minimize impacts of parking and service uses,
- A middle shaft the design the floor plate size and shape with appropriate dimensions for the site. The tall building must be located and oriented for the site, in relationship to the base building and adjacent buildings.
- A top the design the top of tall buildings should be designed to contribute to the skyline character of BSMSN and should integrate roof top mechanical systems into the design of the building, so mechanical areas are not visible.

## 3.313.3 Residential Areas

Diversity of neighbourhoods, in terms of scale, amenities, local culture, retail services and demographic make-up will help define the character of residential communities within BSMSN. The BSMSN Master Plan has four types of residential areas within the zone. In Precinct A, the housing is low density with low height limits. New types of villas, single family residents and bungalows surrounding water features and landscaped areas are the predominant housing typology here. In Precinct B, the housing is tall apartment buildings with numerous amenities and expansive views. In Precinct D, the residential area is a mixed use community. This is low to medium apartment buildings and dormitories with at-grade retail to support the local population. In the resettlement areas, (which need to be well integrated into BSMSN) must have similar housing and infrastructure/utility networks, as the remainder of the zone.

#### 3.31.1 3.3.1 Guiding Policies

- Residential neighbourhoods in the BSMSN Master Plan vary depending upon their location and population requirements/needs. The most important aspect of residential neighbourhoods within BSMSN is to ensure they have proper infrastructure/utility networks, are connected to local transport routes, contain support amenities, and remain stable and secure.
- The residential areas within BSMSN will ensure compatibility and compliance with: i) scale and density of the surrounding area and prioritize a transition from adjacent Precincts, ii) adequate light and privacy for residents in Precincts, iii) the screening of services, loading and parking facilities for residential and retail buildings in order to minimize impacts on residents.

- Promote a variety of residential building typologies, which are new to Bangladesh but are used within the South East Asian/South Asia region.
- Integrate resilient water features and landscaping into the design of residential communities.

## 3.323.4 Administrative/Institutional/Health/Education Areas

The BSMSN Master Plan has been designed to have distinct government, health and educational precincts. The intent is three-fold: i) so BSMSN can be self-sufficient, ii) to bring international level institutional facilities to BSMSN so the schools, universities, health care facilities and government entities can attract foreign and top tier investors, and iii) so institutional facilities can become major contributors to the high quality of life within the zone. In the Master Plan, supporting amenities such as libraries, daycares/nurseries, places of worship, community centers, restaurants, convenience retail etc. have been woven into the Precincts to support the administrative/institutional/health/education areas.

Administrative/Institutional/Health/Education areas are important for many reasons within BSMSN, including: i) they are large employers and attract thousands of employees, patients, students and visitors every day, ii) these major institutions are home to research, cultural and educational institutions that are fundamental to emerging economic sectors, and iii) the clustering and interaction of university, hospital and associated research facilities plays a critical role in innovation and the creation of new products and services for BangladeshIn BSMSN, major institutionswill have the opportunity anthe flexibility to patner with the private sector to create joidevelopment projects, research facilities, and/or to house private research and development facilitiesSupport for these different types of international level institutional facilities have been prioritized whin the BSMSN Master Plan

#### 3.32.1 3.4.1 Guiding Policies

- Institutional Areas within BSMSN will be made up of major educational, health and governmental uses with their ancillary uses, cultural, parks and recreational, religious, supporting small-scale commercial and retail facilities, as well as utility uses. The major health and educational institutions within BSMSN are important employers and service providers and will continue to grow over time, to serve the needs of the growing/developing zone and its surrounding regional population.
- Strong linkages between major international institutions and the private sector to fuel innovation and the creation of new products and services will be encouraged within BSMSN.
- Institutional facilities must only be located within their designated Precinct as outlined in the BSMSN Master Plan.
- All buildings and structures in the vicinity of hospitals and/or heliports must be sited and massed to protect the continued use of flight paths to hospital and/orheliports.

## 3.333.5 Cultural Areas

Today, economic zones offer residents, workers and visitors an opportunity to participate in a vibrant sporting and cultural life by recognizing the contribution, which sports and the visual/performing arts makes to improve the quality of life of its population. BSMSN will be the first city/zone in Bangladesh to

plan, construct innovative, green sporting and cultural buildings along its waterfront (in accordance of the BSMSN Master Plan) and support large-scale sporting, performing arts and cultural events throughout the year.

Hence, sport activities like professional soccer and cricket matches as well as performing arts activities - theatre, film, music, and dance will enrich the day-to-day experience within the zone and quality of life in BSMSN as a whole. By prioritizing and supporting sporting, performing arts and cultural activities within BSMSN, it will contribute to a healthier zone economy, promote cultural tourism, and help BSMSN to be competitive in attracting and keeping new and foreign businesses, investors and residents.

#### 3.33.1 3.5.1 Guiding Policies

- A sports and cultural complex will be developed within BSMSN to support local, regional and international events and collectively draw visitors to a specific area around the waterfront, as per the Master Plan.
- The buildings will be architecturally relevant with significant gathering space and public art surrounding the facilities. These areas should be landmarks within BSMSN and must be carefully planned and designed. Attention will be given to keeping the visitors to the sporting and cultural complex safe and secure.
- The sports and cultural complex will be designed using green, energy/water efficient and resilience principles and technology in order to be environmentally-friendly and sensitive to the adjacent park land.
- A full range of sporting events, visual/performing arts and cultural activities from not-forprofit/community/national-based groups to internationally prominent institutions will be promoted and supported in BSMSN.
- The arts and cultural community will be encouraged to participate in the local beautification efforts of BSMSN.

## 3.343.6 Light and Medium Industrial Area

The BSMSN Master Plan supports healthy industrial investment within the zone. To attract the largest number of foreign investors and Tier 1 players, BSMSN has been separated into two distinct, industrial Precincts – one for light/medium industries (Precinct F) and another for heavy industries (Precinct I). This allows for clean environments within Precinct F and the construction of special infrastructure to minimize environmental contamination in Precinct I.

However, because the BSMSN Master Plan was delayed, some lands in Precinct F were sold/leased to investors who will undertake heavier industrial projects. As such, the Master Plan has recommended mitigation measures to protect the surrounding light and medium industries and supporting amenities from heavier, industrial activities. In addition, to protect Precinct F from the chemical projects, a small area has been carved out for existing/promised Chemical investors. It will be buffered from the rest of Precinct F to mitigate adjacency issues. (New chemical projects are not be permitted within Precinct F.)

#### 3.34.1 3.6.1 Guiding Policies

- Only light and medium industries are permitted within Precinct F. Clean environments are prioritized in this area of BSMSN.
- Precinct F will have its own access road into/out of BSMSN from the Dhaka-Chattogram Highway to ensure the separation of truck and motor vehicle traffic. This will increase the safety in this Precinct.
- All industrial lands within BSMSN must have serviced plots. Integrated infrastructure and utility networks are required to be in place before site specific development may occur.
- Roads within investment projects should have 40m, 30, and/or 20m ROWs. Larger roads 60m ROW should only be to connect investment projects to main arterial roads.
- If heavy industrial activities are within Precinct F, the factories must be set back from the property line with a fence and a landscaped, buffer area around the plot boundary.
- A Chemical Hub within Precinct F has been identified. The size of the Chemical Hub area within the BSMSN Master Plan may not be expanded.
- A 170 acre or more, public park with a lake is required adjacent the Chemical Hub in order to mitigate any negative impacts on Precincts D, E and F. The lake within the Park may be used for solar infrastructure. No buildings, hotels, bungalows or other residential structures are permitted in the park.

## 3.353.7 Port and Logistics Area

The BSMSN Master Plan supports the development of a public port and logistics facilities within the zone. A wide range of logistics facilities should be available within BSMSN. A study is required to determine the scope of the port and logistics requirements in the short, medium and long-term within the BSMSN Master Plan.

#### 3.35.1 3.7.1 Guiding Policies

- The BSMSN Master Plan supports only one port within the zone.
- If other investment projects within the zone require jetties or piers etc, the location of these elements should be studied, and their placement should be strictly evaluated, so they do not interfere or undermine the location or benefits of the port.
- The port either a bulk or container port or both– should be available to all tenants within the zone, at a cost.
- Expansion of the port and logistics area may only occur south of the existing port.
# 3.363.8 Heavy Industrial Area

In accordance with the BSMSN Master Plan, the area at the south end of the zone (Precinct I) has been identified for heavy industrial sectors and their associated activities. These activities however, should not be hazardous, dangerous or explosive and the environmental contamination from manufacturing and production must be limited, mitigated and monitored. Precinct I is dedicated to heavy industry because the wind patterns on the BSMSN site blow north to south, so the zone will not be affected by any negative impacts from the heavy industry.

#### 3.36.1 3.8.1 Guiding Policies

- Only heavy industrial sectors and activities are permitted in Precinct I. All activities within this Precinct must not be hazardous, dangerous or explosive.
- All activities must be environmentally mitigated and monitored.
- Precinct I must have its own, dedicated access road to the Dhaka Chattogram Highway so the heavy trucks and cargo do not interact with motor vehicles.
- There must be roads with 80m and 60m ROWs within this Precinct to support the safe movement of goods.
- The safety of this area must be monitored via CCTV.

# 3.373.9 Parks and Open Space Areas

Parks and open spaces within BSMSN must be designed to offer residents, workers, and visitors to the zone a range of recreational and leisure experiences – everything from the expansive mangrove and plantation areas, meandering, landscaped water canals, to urbane and intimate community parks. These distinctly different green spaces within BSMSN have been proposed so the general population can take a break from the bustle of zone life, participate in local sporting activities, and/or play/relax/enjoy formal and informal, passive and active, hard and soft open spaces. The parks and open spaces within BSMSN contain many of the zone's natural habitat areas, recreation trails, storm water management facilities and waterfront lands.

#### 3.37.1 3.9.1 Guiding Policies

- Parks and open space areas are defined by public parks and open spaces, lakes, ponds, watercourses, canals, portions of the waterfront, and the entertainment Precinct within BSMSN.
- Canals and watercourses should be enlarged, lined and landscaped in order to provide improved water catchment ability within BSMSN and/or to act as water features within the various Precincts in the zone.
- Development is generally prohibited within Parks and Open Space Areas except for recreational, sporting, cultural and religious facilities, conservation projects, cemetery facilities, public transit and essential public works and utilities, where supported by appropriate assessments.

- Only compatible recreational, cultural, religious and sporting uses and facilities, which minimize adverse impacts on the natural features and functions are permitted in parks and open spaces within BSMSN,
- Only conservation projects, public transit, public works and utilities for which no other reasonable alternatives are available are permitted in park and open spaces. These must be designed to have only minimal adverse impacts on the natural features and functions, and that restore and enhance existing vegetation and other natural features.
- Protect, enhance and/or restore trees, vegetation and other natural environment features and maintain or improve connectivity between the Precincts, development projects and the natural environment.
- Preserve and/or improve public visibility and access, except where access will damage sensitive natural features or areas, or unreasonably restrict private property rights.
- Where possible, maintain and create linkages between parks and open spaces to create continuous recreational corridors.
- Maintain, expand or improve the size of publicly owned Parks and Open Space Areas for public leisure, recreational and/or cultural purposes.
- Provide comfortable and safe pedestrian conditions within Parks and Open Space Areas for all within BSMSN.
- The sale or disposal of publicly owned lands designated for Parks and Open Space Areas within the BSMSN Master Plan is discouraged.

# 3.383.10 Multi-Modal Transport Platform

The integration of transportation and land use planning is critical to achieving the overall aim of increasing accessibility throughout the BSMSN Master Plan. The Guiding Policies for BSMSN's Transport Platform are intended to protect the integrity of the Zone's multi-modal transportation network and provide for planned, phased expansion through the designation of public rights-of-way (ROW) and transit corridors.

#### 3.38.1 3.10.1 Guiding Policies

- Integrate different types of transport systems road, rail, sea so each can be used to its full potential and people can move easily throughout BSMSN.
- Integrate the transport networks with the environment so that transport choices support a better environment.

- Integrate transport networks with BSMSN land use planning at national, regional and local level, so that transport and physical planning works together to support more sustainable travel choices.
- Integrate transport with policies for education, health, economic growth, gender and social equity and poverty reduction so that transport helps to make a fairer, more inclusive society.
- Transport and land uses are inter-related issue. Since land use generates transport movements, it is crucial that BSMSNs transport systems are well planned in order to handle the needs that various land uses generate.

# 3.393.11 Utility Corridors

Utility corridors (utility/rail rights-of-ways) play a vital role within BSMSN as corridors for the transmission of energy, communications and the movement of people and goods. These linear corridors are a defining element of the urban/industrial fabric of BSMSN. Rail corridors within BSMSN lead to strategic areas, like the port and industrial areas of the zone. To honor the Master Plan, utilities like power/gas/water stations and/or treatment plants may not be located along main roads or be situated on the highest valued real estate within BSMSN. In addition, the areas around the utilities should be properly landscaped in order to buffer them from the public realm. When possible, the utility corridors with networks underground/buried can serve as linear parkland, pedestrian and cycling trails, and transit facilities. Utility corridors should also be secured and protected for the future/expansion of public transit routes or the introduction of mass transit opportunities and used in the short-term as parks or public spaces.

#### 3.39.1 3.11.1 Guiding Policies

- Utility Corridors are utility and rail rights-of-ways, primarily used for the movement and transmission of energy, communication, people and goods.
- Where possible, utility/distribution lines should be placed underground to not clutter the urban/industrial environment. If they need to be above ground, utility plants should be buffered from sight either through fencing or soft landscaping.
- Utility networks should be placed within the road right-of-way and designed for easy maintenance.
- Utilities or their associated treatment or power plants should not be located on prime land or immediately along the street front of main arterials or secondary roads. These locations should be available for private investment.
- Utility networks and corridors should be sustainable, efficient, stable, reliable and resilient within BSMSN and constructed to international standards.
- Power, water, drainage, sewerage, telecom and wastewater/solid waste treatment is required within BSMSN. The networks must be modern, stable, reliable, consistent and utilize green and resilient technology, where possible.

- Utility networks must be implemented in a strategic manner and only in size/quantities to support short-term demand. Utilities should be incrementally increased to optimize the capital costs of the networks.
- Utility plants or above grade networks should be set back from the property line, fenced and landscaped to provide a clear buffer area between the building and the streetscape.

# 3.403.12 The Public Realm

Good planning, design, and implementation makes a great economic zone. Great zones have well thought out/quality Public Realms – streets, squares, parks, public spaces and public buildings. Investors flock to 'specific zones' around the world, not just to enjoy serviced industrial land, reliable infrastructure/utilities, and financial incentives and benefits, but to live, work and play in a rich and bountiful location, where the natural environment is respected and elevated and international leisure and support amenities are available to create a higher quality of life than norm.

Because of this, the Public Realm will be prioritized and faithfully maintained within BSMSN. Beautiful, comfortable, safe and accessible streetscapes, parks, canals, open spaces and public buildings will become key shared assets in the zone. These public spaces and structures will draw people together within BSMSN and help create strong social bonds at the precinct, zone and regional levels. The Public Realm will also help convey BSMSN's public image to the world.

#### 3.40.1 3.12.1 Guiding Policies

Quality architecture, landscaping, urban design and international construction standards will be promoted by within BSMSN:

- Identify funding to create and maintain high quality public buildings, streetscapes and public parks, which reflect the broad goals and objectives of this Master Plan.
- Where appropriate, explore the use of international design competitions to seek design excellence and promote international public interest in the design of public projects within BSMSN.
- Prioritize the quality of the Public Realm and ensure all new development projects enhance it.

Design measures, which promote pedestrian safety and security in the Public Realm will be applied to streetscapes, parks, other public and private open spaces in BSMSN. In addition:

- Streets within Precincts A-K will ensure: i) the safe and efficient movement of pedestrians, vulnerable groups such as women, seniors and people with disabilities, cyclists, transit vehicles and users, goods and services vehicles, emergency vehicles, and motorists,
- Streets will incorporate elements, such as utilities and services, trees and landscaping, green/resilient infrastructure, stormwater management, wayfinding, boulevard cafes, and street furniture.

- Public buildings will be located and designed to promote their public status on prominent, visible and accessible sites, including street intersections and sites that end a street view or face an important natural/cultural feature. They will have view corridors, sky views and access to sunlight.
- Open space associated with public buildings will be designed to enhance the quality setting for the building and support a variety of public functions associated with its program.
- Provide sidewalks and boulevards within BSMSN, which will be designed to provide safe, attractive, interesting and comfortable spaces for pedestrians. This will include street trees, landscaping, pedestrian-scale lighting, quality street furnishings and decorative paving as part of street design.

# 3.413.13 Public Art

Traditionally public art, both publicly and/or privately owned, makes the experience of traveling through a zone's streets, open spaces and parks more pleasurable for residents, workers and visitors alike. Hence, because public art has a broad international and local appeal and many documented social benefits, it should be incorporated into BSMSN so public art can help contribute to the identity and character of the zone - create a number of landmarks, special places, as well as start a conversation with residents within the zone. To achieve this goal, a partnership between the public and private sectors should be established, in order to support public art within BSMSN.

#### 3.41.1 3.13.1 Guiding Policies

The creation of public art, which reflects Bangladesh culture, heritage and creativity will be promoted within BSMSN by:

- Developing and adopting a Public Art Master Plan to coincide with the Master Plan Precincts,
- Encourage public and private funding for public art installations, without conflict of interests,
- Actively promote art installations by local artists,
- Promote public art in front of government and private sector buildings and structures, where appropriate,
- Encourage the inclusion of public art in all significant private sector developments across BSMSN.

# 3.423.14 Secondary Plans for BSMSN Precincts

At present, BSMSN only has a high level Master Plan, but Secondary Plans – more detailed local level plans - are needed for each Precinct within the zone. Secondary Plans may be prepared on an incremental basis by the public sector, but must be created/adopted before developers/investors bring projects for approval.

The purpose of Secondary Plans are to establish the detailed land use plan, block and street patterns, plot dimensions, open space design, streetscape, transport locations etc., which guides detailed physical growth, as well as, change and improvements in each Precinct. Secondary Plans are based on the vision of the BSMSN Master Plan, and ensure adequate public infrastructure, environmental/resilience protection and social benefits for the Precincts. Secondary Plan policies implement the goals and objectives, land use designations and overall planning approaches set out in the BSMSN Master Plan. Note: All Precincts within BSMSN require detailed Secondary Plans.

# 3.433.15 Monitoring and Assessment of BSMSN

The Master Plan for BSMSN is a high level document intended to guide development and decision making over the short, medium and long term. As BSMSN develops, the master plan and its guiding policies may require updates or adjustments in response to the changing economics, industrial demand, urban growth, and/or environmental/social conditions within BSMSN. Monitoring the Master Plan over time in order to respond quickly to potential changes can greatly improve BSMSN and make it more successful. As such, it is vital to monitor and track development within BSMSN over time.

BSMSN will benefit greatly from regularly scheduled assessments of its Master Plan. These periodic assessments will aim to look at: i) the success of the growth management strategies of the Plan, ii) the quality of the living and working environments created, and iii) examine BSMSN's evolving relationship with the broader urban region. These assessments may reveal new emerging priorities, which should be addressed in updated Secondary Plans, strategic investment strategies, and/or changes to the Master Plan itself. As such, every five years the BSMSN Governing Agency must review the BSMSN Master Plan and associated guiding policies and determine whether there is a need to update portions of the documents.

# IV.Chapter Four - Resilience Infrastructure for BSMSN

# 3.444.1 BSMSN Fueled by Next Generation Infrastructure

From serving man's basic needs to enabling business activities and innovation, infrastructure supports the well-being of people and the development of economies. Reliable transport, energy, water, sanitation, and telecommunication services are essential for raising the quality of life of people. Additionally, access to basic infrastructure services is a central factor in the productivity of firms and economic zones, making it a key enabler of developing competitive industries. And in this time of rapid climate change and intensifying natural disasters. infrastructure networks are under pressure to deliver resilient and reliable services<sup>6</sup>, which is a key concern for coastal developments such as the BSMSN site.

**Investing in resilient infrastructure is sound, profitable, and urgent.** Global studies<sup>7</sup> have shown that disruption to infrastructure costs, households and firms in low- and middle-income countries is at least \$390 billion a year, and the indirect effects place a further toll on households, businesses, and communities. The same study also finds that the extra cost of building resilience into these systems is only 3 percent of the overall investment needs. Because of fewer disruptions and reduced economic impacts in developing countries, the overall net benefit of investing in resilience infrastructure turns out to be \$4.2 trillion over the lifetime of new infrastructure. This is a \$4

<sup>&</sup>lt;sup>6</sup> From Hallegatte, Stephane; Rentschler, Jun; Rozenberg, Julie. 2019. Lit Infrastructure;. Washington, DC: World Bank. © World Bank. License: ( <u>https://openknowledge.worldbank.org/handle/10986/31805</u>



(Common Hollogotta at al 2010)

<sup>&</sup>lt;sup>7</sup> From Hallegatte, Stephane; Rentschler, Jun; Rozenberg, Julie. 2019. Lifelines : The Resilient Infrastructure Opportunity. Sustainable Infrastructure; Washington, DC: World Bank. © World Bank. License: CC BY 3.0 IGO. For more information see: https://openknowledge.worldbank.org/handle/10986/31805

benefit for each dollar invested in resilience. (Figure 1 illustrates a framework for analysing how natural shocks affect people and firms through impacts on infrastructure systems.)

Developing resilient infrastructure is about adjusting the way we plan, design, construct, monitor and manage infrastructure assets and systems, by considering climate and disaster risks, as well as creating a system to quickly and effectively respond to disaster events, so that when disasters strike, disruptions of infrastructure services and the lives, which rely upon them can be avoided or minimized. It's about building and managing bridges, which can withstand more frequent or stronger floods, water pipes, which can resist earthquakes, or electric poles, which are sturdier in the face of more intense hurricanes. And it is also about making sure people will not lose their jobs because they cannot get to work, that they can get urgent medical care, and that their children can get to school<sup>8</sup>.

Resilient infrastructure is often green infrastructure, and vice versa. Infrastructure services, which are resilient to climate and disaster risks are often environmentally sustainable. Similarly, infrastructure, which is resource efficient and low emitters of greenhouse gases and pollutants can also withstand or recover quickly from disaster events. For example, a resilient water supply system would require a combination of traditional and nature-based solutions, including freshwater intake, wastewater recycling, (solar-powered) desalination, rainwater harvesting and utilization, etc. With good management and coordination, these infrastructure systems, which rely on a variety of sources enable redundancies which could disperse or minimize risks, as well as mitigate climate and environmental footprints. Further more, investing in green and resilient infrastructure could reduce waste, improve resource and energy efficiency within economic zones and industrial production, and in turn, cut operations and maintenance costs. (Often these costs for green and resilient infrastructure can be paid off before a disaster strikes.<sup>9</sup>) This creates opportunities to deliver these economically viable green and resilient infrastructure services through attracting private investment, expertise and financing including through public private partnership (PPP) models.

For these reasons, enhancing the resilience of the foundational/core infrastructure within BSMSN is critically important to developing a sustainable and competitive industrial city. Bangladesh is one of the most vulnerable countries in the world to cyclones and floods, particularly in the country's coastal areas where BSMSN is located. Cyclones and associated storm surges and floods have led to nearly 520,000 natural disaster deaths recorded over the past 40 years. These events also have the potential to cause significant economic damage. Cyclone Sidr in 2007 cost an estimated \$1.7 billion in damages and losses. The country's extreme vulnerability to hydro-meteorological hazards, including storm-induced tidal flooding, is likely to increase due to climate change. (Zones inability to be prepared for the impacts of extreme weather events.) This increasing vulnerability to climate change may significantly reduce Bangladesh's industrial competitiveness, which heavily relies on labour-intensive and export-oriented manufacturing. Without adequate measures, the operations of economic zones and zone tenants could be

<sup>&</sup>lt;sup>8</sup> From Hallegatte, Stephane; Rentschler, Jun; Rozenberg, Julie. 2019. Lifelines: The Resilient Infrastructure Opportunity. Sustainable Infrastructure; Washington, DC: World Bank. © World Bank. License: CC BY 3.0 IGO. For more information see: https://openknowledge.worldbank.org/handle/10986/31805

<sup>&</sup>lt;sup>9</sup> There is increasing evidence that also demonstrates that investment in resilient infrastructure and services pays off, even before a disaster strikes. Integrating multi-purpose designs into green and resilient infrastructure investments can save money and attract private investment\*(examples include: i) a micro-grid system that provides back up power supply to tenant firms and local evacuation shelters during disasters, and at the same time, increases energy efficiency and reduces GHG emissions during normal operation or 2) a retention pond protected with improved coastal and river embankment designs, which also provides serviced low-risk industrial area for placing floating solar). It serves broad beneficiaries including tenant firms, workers and local communities, and can justify high capital costs by increasing usability, amenity and value of industrial land, revenues from land sales/ lease, energy efficiency, utility cost savings, private investment, and GHG emissions reductions.

<sup>\*</sup>Tanner, Thomas; Reid, Robert Curle Jesse; Wilkinson, Emily; Rajput, Sumati; Surminski, Swenja; Maruyama Rentschler, Jun Erik. 2018. The triple dividend of resilience: realizing development goals through the multiple benefits of disaster risk management. Washington, D.C.: World Bank Group. <u>http://documents.worldbank.org/curated/en/993161515193991394/The-triple-dividend-of-resilience-realizing-development-goals-through-the-multiple-benefits-of-disaster-risk-management</u>

disrupted for a prolonged period of time with repeated damages. Such disruptions can increase perceived business risks amongst global buyers, which may in turn, negatively affect Bangladesh's competitiveness in global markets.

Analysis shows that the location of the BSMSN site potentially faces significant climate and disaster risks – namely floods, earthquakes and subsidence. At the same time, there are a number of opportunities and options to have cost-effective, structural and non-structural solutions for key infrastructure assets and services within BSMSN against climate and disaster risks. A desktop technical analysis<sup>10</sup> of BSMSN was undertaken to review the key climate and disaster risks, their impacts on proposed critical infrastructures, and to highlight potential solutions and options to enhance their resilience, drawing upon good practices and lessons learned in Bangladesh and internationally. The following sections summarize the key findings from the analysis on the risks and resilient infrastructure options applicable to BSMSN.

# 3.454.2 Climate Change and Natural Hazard Risks Facing BSMSN

The BSMSN site is situated in an area subject to significant risks of climate change and natural hazards, particularly floods and earthquakes. BSMSN is located at the mouth of the Feni River and has a 25 km border with the Bay of Bengal. The +/- 30,000-acre site is strategically located 200 km from Dhaka and 60 km from Chittagram, home to the country's largest port and one of the busiest ports in South Asia. BSMSN will be developed on previously uninhabited, reclaimed land protected by a recently constructed coastal, super dyke and river embankments. Given the site's location, geological conditions, and climate change position, BSMSN is susceptible to a number of disaster risks, including but not limited to;: i) coastal, pluvial and fluvial floods and strong winds caused by heavy rains, ii) cyclones, and storm surges, etc., iii) earthquakes, iv) land subsidence, and v) heat waves and water shortages caused by long periods of high temperatures and a lack of rain.

#### 3.45.1 4.2.1 Floods

Flooding is considered the most critical natural hazard for the BSMSN site, given its proximity to bodies of water and its elevation, which is at or below sea level. Sea-level changes/increases due to climate change is expected to produce flood damage on the site without mitigation. As shown in Figure 4.1, the coastal area proposed for development in BSMSN is subject to a variety of types of flood hazards including: i) coastal floods caused by high tides and storm surges, ii) fluvial or river floods caused by river overflow, and iii) pluvial or urban floods caused by poor drainage of heavy rain on the site. Although different causes trigger these hazards, their consequences (such as inundation) as related to infrastructure assets and services, are similar.

<sup>&</sup>lt;sup>10</sup> The World Bank Group in partnership with Bangladesh Economic Zone Authority commissioned a study, "Enhancing Competitive, Green and Resilient Industries in Bangladesh: Integrating resilience within the design and costing of BSMSN Economic Zones 2A & 2B," (Miyamoto International, 2020).



Figure 4.1. Flood Hazards for the Target Area

BSMSN's first development initiative was to raise its land and build a super dyke in order to protect the site against various flood risks. The super dykes are designed and constructed with crest elevations at MSL11+9.0 m to protect the site against a 100-year return period coastal flood<sup>12</sup>. River embankments are designed and constructed with crest elevations at MSL+8.0 m to protect the site against river overflow from a 25-year return period river flood<sup>13</sup>. The land plots are being raised from initial ground levels from an average of MSL +4m to MSL +6.5 m, in order to protect all development/investment from inundation from historical maximum water levels at the coast line and rivers<sup>14</sup>.

#### 3.45.2 4.2.2 Earthquakes

**BSMSN is located in a highly seismic region, which can experience significant ground shaking and disruption.** In Bangladesh, the building code divides the country into four seismic zones, as shown in Figure 4.2. The project area is located on the border of Seismic Zones 2 and 3. Zone 3 is considered a severe seismic zone, with a seismic coefficient of 0.28.

<sup>11</sup> Equivalent to PWD/PWDB which is the datum used by the Bangladesh government set by the Public Works Department (Yachiyo Engineering Co. Ltd., 2020)

<sup>12</sup> Source of Information: Technical Discussion with China-Harbor and China Civil Engineering Construction Corporation

<sup>13</sup> Source of Information: Technical Discussion with China-Harbor and China Civil Engineering Construction Corporation

<sup>14</sup> Source of information: Based on the calculation files provided by the consultant through World Bank



Figure 4.2. Seismic Map of Bangladesh (Source: BNBC, 2015)

#### 3.45.3 4.2.3 Land Subsidence

**BSMSN is also susceptible to land subsidence due to its geological foundation.** As seen in the geological map in Figure 4.3, BSMSN is categorized as coastal deposits, beach, and dune sand. This type of underlying soil has an adverse impact on infrastructure because: i) it is susceptible to liquefaction, ii) it can undergo settlement and particularly, differential settlement<sup>15</sup>, and iii) it will amplify seismic waves. As shown in Figure 4.4, the site's region has low Standard Penetration Test (SPT) counts or has a soft soil thickness of 5m to 10 m. Hence, the project's initial investment phase included the construction of dykes, site infill of close to 4 m, and regional water catchment areas with a system of canals to prepare the low-lying lands for development.

<sup>&</sup>lt;sup>15</sup> For infrastructure, settlement denotes the subsidence of soil under the foundation. For sites where there is different underlying soil, or when there is a significant difference in applied loading at various parts of the infrastructure, differential settlement can occur. As a result, the subsidence is more pronounced for some parts of the structure compared to adjacent sections. This, in turn, imposes high demand on structural member spacing between the two



Figure 4.3. Geological Map (Source: BWDB, 2013)



(Source: Hore et al., 2019)

3.45.4

3.45.5

### 3.464.3 Key BSMSN Infrastructure

3.46.1

#### 3.46.2 4.3.1 Approaches to Enhance Resilience Through the Master Plan

Various types of infrastructure/utilities will be developed to international standards within BSMSN to provide world-class networks, structures and services, which will make BSMSN a competitive, sustainable, and resilient zone. These infrastructures/utilities differ in their structural characteristics, services and functions, and performance standards. However, the key approach to enhancing their resilience<sup>16</sup> is equally dependent upon their structural and operational robustness to minimize damages, losses, and service disruptions in face of the significant risks climate change and natural hazards faced at the BSMSN site.

Table 5 below, provides an overview of the types of general infrastructure envisioned for BSMSN. The infrastructure has been organized by the types of key functions and services they provide:

Table 5. Key Types of Infrastructure Services and Assets Planned for BSMNS				
Key Infrastructure, ServicesTypes of Infrastructure/Utility Assetsand Functions				
Flood Protection and	Coastalembankments, Riverdykes, Pumps, Gates, Storm water			
Management	drainage, etc.			
Transport	Roads, Bridges, Ports, etc.			
Buildings	Factory shells, Administration building, Residential buildings, Fire service, Schools, Medical centres, Commercial areas, Residential areas, etc.			
Telecommunication	Towers, Cables, etc.			
Water Supply and Sanitation	Sewage treatment plants (STP), Water treatment plant (WTP), Water reservoirs, Desalination plants, etc.			
Energy	Power plants, Sub-stations, Solar (including floating solar) etc.			

<sup>&</sup>lt;sup>16</sup> defined as infrastructure's abilities to: 1) avoid or minimize loss and damage; 2) continue or resume operations quickly; and 3) maintain and enhance competitiveness of the city and economic zones as a result of minimal disruption of infrastructure assets and services.

Waste Management	Waste treatment plants (CETP), Bio-gas plants etc.
(Source: Modified from PwC, 2016)	

The key approach to enhancing infrastructure resilience within BSMSN is to consider disaster and climate change risks within the initial process of planning, design, construction, maintenance, and monitoring of infrastructure/utilities, as well as putting in place capacities and mechanisms to respond quickly to disaster events. Therefore, the Master Plan, where planning decisions are first defined for BSMSN, is where infrastructure/utility resilience is initially introduced and outlined.

Hence, the key principles of resilient infrastructure/utilities for BSMSN are:

- **Infrastructure**<sup>17</sup> **planning and siting.** Where possible, critical infrastructure is developed in locations with lower climate and disaster risks. In case of floods, this means locating critical infrastructure assets, equipment and facilities on higher elevations or away from water bodies. For earthquakes and liquefaction, the overall disaster risks (based on available risk assessment information) are uniform throughout the site. As such, there are no special areas, which require unique resilience considerations within BSMSN.
- Structural design and construction. Due to the location and geological condition of the BSMSN site, as well as to provide the required infrastructure services, siting critical infrastructure completely away from climate and disaster risks may be difficult. Therefore, as part of the infrastructure design phase of the project or any of its components, it is important that site-specific infrastructure risk assessments be undertaken for flooding, earthquakes, and subsidence. (IE. Flood risk modelling, geotechnical analysis, etc.) For core infrastructure within BSMSN, this assessment should be undertaken either at the feasibility stage or during the structural design process. For floods and earthquakes, general structural measures to enhance resilience are to: i) ensure compliance of design and construction with national and international standards and good practices, ii) assess critical aspects of infrastructure assets and services and take advanced measures for core infrastructure assets and services (IE. applying higher standards for seismic and flood resilience for higher value buildings or equipment, etc.), and iii) ensure proper quality controls on construction methods, techniques and supervision.
- Maintenance and monitoring. A lifecycle management approach is essential for infrastructure resilience, as it enables infrastructure assets to sustain higher levels of performance throughout their lifecycle, including in times of disaster events. For all types of climate and disaster risks, including floods and earthquakes, resilience can be improved through developing enhanced maintenance plans, as well as, real-time infrastructure asset monitoring, management, and warning systems. These management plans should also include financing plans and options for regular monitoring and maintenance work, as well as repair and replacement work, which will be required throughout the design life of the infrastructure to ensure and sustain its peak performance.
- Emergency response and business continuity planning. In addition to the planning/investing in measures to strengthen infrastructure against disasters and climate change, putting in place a plan and system to respond to emergency situations and continue and/or resume operations is a critical infrastructure resilience measure. Therefore, the development of: i) flood hazard maps, ii) emergency evacuation plans, and iii) business continuity and management mechanisms to minimize infrastructure disruption in face of various types of climate and disaster events is important. These plans should include or be informed by an analysis of financing options and

<sup>&</sup>lt;sup>17</sup> Infrastructure refers to all roads and utility networks required for BSMSN.

mechanisms to cover the repairs, recovery, and reconstruction work required to ensure continuity and minimize disruption of infrastructure assets and services.

• Resilience measures may add to the initial cost of development in BSMSN, however, it can significantly reduce long-term life cycle costs and save lives. The initial cost of resilient infrastructure is not the proper index to assess the suitability of design alternatives for infrastructure due to the long service life and recurring service costs. Thus, resilience measures are to be assessed with a life cycle cost assessment (LCCA). LCCA's for conventional and resilient design will usually show the lowest overall costs to the funding/implementing agency for the increased resiliency. The comparison becomes even more favourable when users and third-party costs are included in the analysis. Based on finite resources, initial and life cycle costs can be used to prioritize both infrastructure classes and candidate enhancement alternatives for each type of infrastructure.

# 3.474.4 Resilience Options for BSMSN's Infrastructure

Based on overall resilience considerations and principles highlighted above, specific infrastructure measures have been developed for BSMSN. The following infrastructure resilience options must be integrated into the design and implementation of all infrastructure within BSMSN.

#### 3.47.1 4.4.1 Infrastructure for Flood and Earthquake Protection and Management

Given that BSMSN is a new, large, coastal development located on previously uninhabited reclaimed lands facing the Bay of Bengal, flood and earthquake protection and management are three of the most critical core infrastructure requirements needed to support the BSMSN's development, operations, sustainability and viability. Therefore, understanding and enhancing the ability to protect and manage floods and earthquakes, as well as, implement measures, which can minimize the potential loss and damages in the face of growing climate and disaster risks are critical resilience options to consider within BSMSN.

- **Risk Considerations.** Flood and earthquake protection infrastructure and its management must be designed so that the BSMSN site is protected against earthquakes and floods. For floods, to the level of a 1 in 100-year coastal flood, a 1 in 25-year river flood, and to historical maximums of pluvial floods. Given its function for protection, resilient infrastructure must be developed in high flood-prone areas along the sea and rivers in BSMSN, which may be vulnerable to extreme weather events and measures must be taken throughout the site to minimize impacts of earthquakes.
- **Resilience Measures.** Various detailed measures to enhance resilience against flooding and earthquakes within BSMSN, as well as, further enhance performance are illustrated in Appendix Tables B1 and B2.

#### 3.47.2 4.4.2 Coastal Embankments and River Dyke Guidelines

Key resilience measures for BSMSN include:

- **Capacity Design.** Apply a higher design level for floods in BSMSN. IE. River dykes must be engineered to a 25-year return period based on historical observations. This could be enhanced, in order to take in to account unexpected high tides, river flooding and /or increasing sea levels due to global warming.
- **Redundancy Design**. Prepare for unexpected failures. Impose high redundancy to mitigate unexpected or extreme high tides, river flooding, as well as seismic events.
- **Structural Design**. Monitor the actual settlement anticipated by the installation of PVDs to ensure that design capacity has been met. Resilience could be enhanced, particularly for unexpected high tides and river flooding.
- **Real Time Monitoring Systems.** Develop real-time monitoring systems for water levels and the collection of geo-technical data. This could reduce the impact of heavy floods and earthquakes on zone inhabitants and facilities and improve/promote site-specific and more accurate water levels and soil stability /liquefaction estimates.
- Enhanced Maintenance. Monitor the movement of concrete blocks on the oceanside of the coastal embankment area and install bigger blocks and/or add more concrete blocks, if the integrity of the dyke is compromised.

#### 3.47.3 4.4.3 Pumps and Gates Guidelines

Key resilience measures for BSMSN include:

- Installation of Flap Valves/Gates or Pump Stations. In order to prevent water backflow from the outfall and to make the drainage systems within BSMSN more flood resilient, installing flap valves/gates at the outfall or constructing a pumping station may be an option to be considered.
- Utilization of Mobile Pumps. For BSMSN, a mobile pump or a pump vehicle is proposed for instances when rainfall intensity exceeds the capacity of the drainage network. Emergency pumping equipment is a useful counter-measure against local, water inundations due to heavy rainfall (IE. Inundation of water around the base of buildings).
- Measures Against High Water Levels. Provide gates and water retention ponds, when needed at drainage outfalls to control water discharge into channels and to prevent water backflow/ subsequent inland flooding due to high water levels of the channels caused by heavy rainfall, strong storms or high tides.

#### 3.47.4 4.4.4 Stormwater Drainage Guidelines

Key stormwater drainage resilience measures for BSMSN include:

- **Earthquake Resilient Drain Joints.** Earthquake resilient drain joints (flexible and/or expandable joints) are recommended for underground drain pipes or box-culverts in order to resist large ground movement caused by earthquakes.
- **Real-Time Monitoring Systems.** Develop real-time monitoring systems for rainfall to enhance location-specific information and analysis of rainfall, return period, etc.
- Rainwater Harvesting, Storage, and Utilization. Rainwater harvesting, storage, and utilization through the installation of water retention ponds, tanks, and permeable surfaces in parks, open spaces, parking lots and road networks etc. can temporary hold, store and reduce the concentration of stormwater, which could overflow drainage systems in BSMSN during a sudden and/or long, consecutive-days of heavy rainfall. These water sources and open spaces can also serve as disaster resilience measures in case of earthquakes or drought events, as well as, general evacuation sites.
- Maintenance. Develop a regular maintenance plan to keep the drainage network, pond, retention areas, permeable surfaces etc. in BSMSN clean and to remove debris and obstructions in order to secure the expected water flows throughout the site.

3.47.4.1

# 3.484.5 Transport Within BSMSN

#### 3.48.1 4.5.1 Roads, Bridges and Ports

Enhancing the resilience and reliability of transport infrastructure is crucial to ensuring that investors, residents, and businesses within BSMSN have reliable and direct access to markets, jobs and social services. Transport infrastructure within and adjacent BSMSN - roads, bridges, and ports - are expected to be properly designed and implemented to support the zone's growth through time. Because it is possible that at some point, infrastructure networks along the transport corridors within BSMSN will be exposed and/or become vulnerable to natural hazards, where damages in one segment of the network could cause disruptions to the entire transport network and potentially, negatively affect all/other transport services enhanced resilience measures are advisable. Resilience measures will limit transport disruptions, which can negatively affect firms and households, indirectly cripple supply chains and the movement of goods, hinder employees from commuting to work, and/or inhibit shipments of finished products to the market<sup>18</sup>.

• **Risk Considerations.** Transport infrastructure should be sited in areas with low inundation risks. Construction of transport infrastructure must use national and international standards for flood and seismic resilience. The most protective standard should be used within BSMSN. Flood resistance of a 1 in 100-year coastal flood, 1 in 25-year river flood, and protection from historical maximums for pluvial flooding should be used for all transport infrastructure within BSMSN.Note: Seismic and subsidence risks need further assessment when designing roads, bridges and ports.

<sup>&</sup>lt;sup>18</sup> From "Rozenberg, Julie; Espinet Alegre, Xavier; Avner, Paolo; Fox, Charles; Hallegatte, Stephane; Koks, Elco; Rentschler, Jun; Tariverdi, Mersedeh. 2019. From A Rocky Road to Smooth Sailing: Building Transport Resilience to Natural Disasters. Background paper for Lifelines;. World Bank, Washington, DC. © World Bank. License: CC BY 3.0 IGO." For more information see: <a href="https://openknowledge.worldbank.org/handle/10986/31913">https://openknowledge.worldbank.org/handle/10986/31913</a>

• **Resilience Measures.** Various measures to enhance resilience against floods, earthquakes and transport infrastructure are included in "Enhancing Competitive, Green and Resilient Industries in Bangladesh: Integrating Resilience Within the Design and Costing of BSMSN Economic Zones 2A and 2B Report", Miyamoto International, 2020.

#### 3.48.2 4.5.2 Road/Transport Guidelines

Key measures for road/transport resilience for BSMSN include:

- **Structural Design**. Structural design must meet international standards to ensure a longer service life. Ensure structural design complies with AASHTO provisions for: i) the thickness of asphalt, ii) the pavement design, and iii) better performance during flooding. Use highest reliability requirements or higher flood probability for increased design life of pavement.
- **Hydraulic Path**. Use moisture resistant materials in BSMSN for improved drainage in order to reduce submersion depths and durations during floods.
- Maintenance. Develop a pavement maintenance system, including preventive care/maintenance to extend the design and life cycle of the road pavement throughout BSMSN.
- **Traffic and Truck Load Planning and Management.** Restrict traffic loads during floods in order to reduce the impacts of flood on road pavement. For truck loading, use large axle loads and truck volumes for design of roads. (Note: Account for heavier loads in the future.) This can minimize wear and tear on BSMSN roads, reduce cracking, ruts, and increase the smoothness of pavement.
- **Pavement Type**. The use of a composite or rigid overlay has been proven to reduce flood risks and should be used throughout BSMSN.
- **Structural Monitoring**. The use of sensors to monitor and record performance in service and during extreme events is required. This will enable a rapid response in the event of an emergency.
- **Response Planning**. Develop a Disaster Response Platform, where information from rapid assessments of damaged roadways could expedite the faster opening of undamaged roads to aid the public. Pre-arranged responses for post disaster road repairs with local contractors could also be integrated within the disaster response and continuity plans.
- **Evacuation Routes.** Locate evacuation routes above ground and on publicly accessible land. Ensure their visibility during floods. Provide proper signage to demarcate the location of the evacuation routes. Vertical posts may also be positioned on opposite sides of the roads (at regular intervals), which may be used as marker during emergencies. Establish evacuation time requirements for workers and staffs in BSMSN.

#### 3.48.3 4.5.3 Bridge Guidelines

Key measures for bridge resilience for BSMSN include:

- Apply International Standards and Good Practices for the Design of Bridges. Ensure design complies with AASHTO provisions and ensure all bridges meet the seismic requirements of modern codes for the design of bridges. Use pile foundation for piers and ensure they extend below the scour and liquefiable levels. Ensure adequate capacity, excluding the resistance of the weak layers. For durability and smoothness of ride, apply a layer of polyester concrete overlay, with a minimum thickness of 25 mm to the concrete deck.
- Construction and Quality Management. Ensure a robust Construction, Quality Management and Supervision Program is implemented throughout BSMSN.
- **Operations and Maintenance** Develop a rigorous Bridge Maintenance Program for BSMSN and maintain all records in a digital format. Address preventive maintenance issues as they arise. Rate the bridge and ensure trucks heavier than the nominal bridge rating are not using the structure.
- Monitor and Collect Data for Improved Design and Planning of Bridges. Conduct geotechnical and hydraulics testing on bridge designs, as part of the design process.

#### 3.48.4 4.5.4 Seaport Risks and Resilience Measures

- **Risk Considerations.** Seaport infrastructure is vulnerable to floods, cyclones, strong winds, and earthquake risks due to its location by the water. As a consequence of its vulnerabilities, seaports can experience damages and disruptions, which can have significant economic consequences. Structural damages may include losses and damages to wharfs, jetties, piers, container cranes, and warehouses from floods, earthquakes and/or strong winds.
- **Resilience Measures.** Given the importance of the seaport to the economic viability of BSMSN, the ports structure and resilience is critical for the zone's competitiveness and emergency and recovery plan. The redundancy of transportation to the seaport and power supply for seaport facilities is a vital component of BSMSN in order to make the seaport functional during a post-disaster situation.

#### 3.48.5 4.5.5 Seaport Guidelines

Key port related resilience measures include:

- **Site Design**. Ensure the soil surrounding the port's wharfs, piers, and container cranes is not liquefiable and has been compacted. Consider the dynamic interaction between the wharf, piers, and cranes and design the port connections to resist applied loading.

- **Application of International Good Practices.** Use international good practices and the most appropriate international standards when constructing the port in BSMSN. At minimum, a developer should use battered piles with seismic isolators for all wharfs/piers and ensure that the wharf/pier foundation is embedded in competent soil.
- **Higher Seismic and Flood Design Standards.** Ensure that the key port building structures within BSMSN are designed using higher importance and reliability factors for an extreme event such as earthquakes or floods. Ensure that conveyors, such as grain or bulk conveyors are designed to withstand extreme earthquakes and wind forces on the site.
- **Redundancy and Continuity Planning.** Provide redundancy in roadways connected to the seaport. Provide redundancy and robustness for power supply to seaport facilities against floods and earthquakes.
- **Monitoring.** Use sensors to gather real-time data and monitor water levels, wave heights, wind speeds and directions, etc. and inform the early-warning system in the port area.
- **Disaster Risk Finance and Insurance.** Clarify within the contracts of port operators and owners and between the private and public sectors on mechanisms to finance normal and emergency inspections, repairs and reconstruction costs.

# 3.494.6 Energy, Water, Drainage, Sanitation, and Waste Management Within BSMSN

Core infrastructure within BSMSN includes power, water, drainage, sanitation, and waste management and this core infrastructure is needed to support the daily economic and social activities within the zone. Hence, resilience of these networks must be prioritized within BSMSN. Power, water, drainage, sanitation, and waste management infrastructure are often vulnerable to natural hazards and climate risks such as flooding, earthquakes, and subsidence. Because of potential natural disasters or climate change events within BSMSN: i) drought may reduce the water supply or interfere with desalination, ii) too little sun may negatively affect the solar power generation capacities, iii) temperature fluctuations may influence the efficiency of bio-gas generation from landfills, and/or iv) high precipitation may stress the design capacities of the wastewater or effluent systems. This infrastructure is also subject to hazards risks such as flooding may render a sub-station inoperable or an earthquake may destroy a pipeline. Waste management sites may be flooded, contaminating surrounding areas. If large-scale disaster events occur there could be zone-wide damages, which increases waste generation volumes, often above the daily or overall waste management capacities<sup>19</sup>.

• **Risk Considerations.** There are disruption risk considerations associated with core infrastructure such as effluent treatment plants, desalination plants, rooftop and floating solar systems, steam networks, landfills, bio-gas plants, waste sorting areas, and material recovery facilities. Earthquakes, hurricanes, and ensuing floods have caused significant damage to water supply,

<sup>&</sup>lt;sup>19</sup> From Stip, Clementine; Mao, Zhimin; Bonzanigo, Laura; Browder, Greg; Tracy, Jacob. 2019. Water Infrastructure Resilience : Examples of Dams, Wastewater Treatment Plants, and Water Supply and Sanitation Systems. Background paper for Lifelines;. World Bank, Washington, DC. © World Bank. License: CC BY 3.0 IGO. For more information, see: <u>https://openknowledge.worldbank.org/handle/10986/31911</u>

drainage, sanitation, energy and waste management plants<sup>20</sup>. The issue of flooding is a concern for coastal areas also as they are subject to sea level rises due to climate change<sup>21</sup>.

• **Resilience Measures.** For the power, water, drainage, sanitation, and waste management plants in BSMSN such as centralized effluent treatment plant, desalination plant, rooftop and floating solar, steam network, landfill, biogas, waste sorting, and material recovery facility, etc. various flood and earthquake resilience measures can be implemented to continue and improve performance in the face of flooding and earthquakes by reducing losses, damages, and disruption to core infrastructure.

#### 3.49.1 4.6.1 Power, Water, Drainage, Sanitation, and Waste Management Guidelines

Key resilience measures for core infrastructure include:

- **Structural Design.** Elevate key plant buildings and structures above HFL to prevent flood inundation. Use dry floodproofing methods to prevent flood waters from coming into contact with key plant equipment or assets. Dry floodproofing involves constructing flood barriers or shields around individual pieces of equipment or areas that contain essential equipment. The barrier must be high enough to protect critical equipment from floodwater, strong enough to resist flood forces, and sealed properly to control leakage and intrusion of floodwaters. Dry floodproofing measures must also comply with other applicable national codes and standards, such as BNBC 2015.<sup>22</sup>

Ensure that all buildings in the treatment plant meet the seismic requirements of the National Code for high-importance categories. Improve the capacity of other infrastructure facilities, especially the power network, which can adversely affect the function of plants, a wastewater pumping system, or a water pumping system.

- **Equipment Design**. Avoid placing pumping systems on loose sandy soil with a high groundwater table such as near rivers or waterfronts. Power outages are less likely to severely affect pumping systems or to cause them to fail, if such systems are not in these areas. Ensure that a seismic switch is installed to allow the safe shutdown and restart of systems.
- Monitoring and Maintenance. Perform routine and regular maintenance on core infrastructure and promptly fix any observed problems.

#### FEMA, 2013. Reducing Flood Effects in Critical Facilities. https://www.fema.gov/media-library-data/1381404651877-881a2cf70a90ac63b9c067100ffccace/SandyRA2CriticalFacilities\_508\_FINAL2.pdf

<sup>&</sup>lt;sup>20</sup> For example: Hurricane Harvey in 2017 damaged hundreds of water and waste treatment facilities (Sebastian et al., 2017). Similarly, the 2011 earthquake in Japan damaged a treatment plant. Examples of this damage are presented. (Miyamoto International, 2020)

<sup>&</sup>lt;sup>21</sup> EOS (2017) writes the following for coastal areas of the US, and the same concerns are applicable for BSMSN:

<sup>•</sup> Flooding from sea level rise disables wastewater treatment plants by filling tanks and critical components with water. That water takes up more and more space in the tanks until it causes the worst kind of traffic jam. Effluent that normally would have been cleaned by the plant gets redirected to the local overflow destination. In New York City, Hurricane Sandy sent 10 billion gallons of sewage into the East River, the Hudson River, and New York Harbor.

<sup>•</sup> Permanent inundation from sea level rise remains on the horizon, but storm surges and coastal flooding are becoming more frequent today. This year, Hurricane Harvey shut down 40 wastewater treatment plants in the Houston, Texas, area. Increased coastal erosion is rasping away what is often a thin strip of land separating many of these facilities from the water.

<sup>&</sup>lt;sup>22</sup> Reference:

<sup>\*</sup> Dry flood proofing technique is recommended in the American Society of Civil Engineers (ASCE) 24-14, which is a referenced standard in the 2015 International Building Code® (IBC) and the 2015 International Residential Code® (IRC). <u>https://www.fema.gov/media-library-</u> <u>data/1436288616344-93e90f72a5e4ba75bac2c5bb0c92d251/ASCE24-14\_Highlights\_Jan2015\_revise2.pdf</u>

- **Redundancy and Continuity Planning**. Increase the redundancy of components like treatment plants through the addition of backup systems. IE. Harvest rainwater to source a back-up water supply. Minimize the possibility and effect of, cascading failures by introducing emergency shutdown procedures for different failure scenarios. Ensure that components of treatment plants cannot be so severely damaged that they then affect the function of an undamaged treatment plant. IE. Minimize the amount of pressure pipes exposed to flood waters. If a natural disaster occurs, conduct an intensive post-inspection to detect all damage to power, water, drainage, sanitation and wastewater pipelines within the affected area of BSMSN.

# 3.504.7 Telecommunications Within BSMSN

Telecommunications and the internet have become essential infrastructure within economic zones. Therefore, the disruptions of telecommunication services will cause significant negative economic and social impacts for BSMSN. Telecommunication systems for zones are often comprised of expansive backbone networks with cables, internet exchange points, data centres, and wireless transmission infrastructure such as towers and antennas, etc. Data centres and landing stations are particularly vulnerable to flooding and earthquakes because of the large quantities of ICT equipment involved in their operations. Similarly, cables, which often run along existing connectivity routes (energy and transport) can also be at risk of inundation. Given that telecommunication networks often carry important data and information, in case of disasters, they can serve as important tools for decision-making related to emergency response and business continuity. Therefore, the ability of telecommunication infrastructure to avoid disruptions and continue its services under growing climate and disaster risks is an important resilience measure.

- **Risk Considerations.** Earthquakes, hurricanes, and ensuing floods have caused significant damage to telecommunication infrastructure and have caused operational downtime and financial losses. In 2012, Hurricane Sandy caused significant damage to telecommunication hubs in the eastern part of the United States. Similarly, the 2011 earthquake in Japan destroyed/ damaged over 40 central offices, 6,000 aerial cables, and 65,000 telephone poles (EMI, 2013).
- **Resilience Measures.** Given the importance of the telecommunication sector to the development, operational capacity, and economic viability of BSMSN, measures to support flood and earthquake resilience of its telecommunication infrastructure is very important. Especially, if an emergency power facility is connected to other infrastructure networks. In this instance, it is important that sufficient power for continuous service of the telecommunication system, urgent communications, and emergency data backup networks are secured.

#### 3.50.1 4.7.1 Telecommunication Guidelines

Key telecom measures for resilience for BSMSN include:

- **Structural Design.** Treat buildings as critical structures, (considering their importance factor) which must remain operational in the aftermath of a natural disaster. Elevate these key telecommunication buildings above the high flood level (HFL).

- **Equipment Design**. Implement special requirements for the design of all equipment and their anchorage to the building. Provide robust conduits for cables against flood and earthquake. Place all electrical equipment in the buildings above the HFL. For underground cables, use seismic resilient conduits with flexible joints to allow for the movement of the ground without failure. Only use seismically-qualified electrical components. Ensure all cable trays, racks, and duct banks are designed for forces of extreme events. When concrete conduits are used, ensure they are reinforced. When the ground water is high, add additional weight at the bottom of the conduit to counteract buoyancy forces.
- **Redundancy and Continuity Planning.** Provide redundancies in the system in order to keep continuous telecommunication service open. Develop a disaster response protocol, including an early warning system for BSMSN's telecommunication system.

# 3.514.8 Buildings Within BSMSN

Enhancing the resilience of buildings is critically important within BSMSN. Traditionally, buildings are designed and erected as structures to protect people and assets from the external environment. Depending upon the function of a building, it is important to implement targeted or fit-for-purpose resilience measures and options. The ability of core buildings to withstand and provide shelter in the face of increased climate and disaster risks is important.

Within BSMSN, various types of buildings for various sectors/uses are expected, including, but not limited to, factory shells, warehouse and manufacturing facilities, administration buildings, residential buildings, fire stations, schools, medical centres, commercial and retail areas, etc. Buildings in the precincts of BSMSN all have different functions and user groups, and consequently, their needs and objectives for resilience will vary. For example, school buildings in Precinct A will need to provide safe and comfortable learning environments for their students but may also need to serve as evacuation centres for other precincts within BSMSN when facing a disaster event. Therefore, to enhance resilience, it is important for school buildings throughout BSMSN be designed in ways in which residents, workers, and visitors alike can safely take refuge if faced with a climate or natural hazard episode. Large factory buildings need to be built at the highest resilience standard with advanced flood protection measures or land stabilization measures. Hence, understanding and prioritizing the risks and resilience requirements are very important when it comes to designing effective solutions to the enhance resilience of buildings.

• **Risk Considerations.** For buildings, both flood and earthquake hazards are important and require consideration. The building code in Bangladesh, (BNBC 2015), is a robust code based on international standards (such as ASCE 7-10). Accordingly, buildings designed and built according to the code provisions are expected to perform satisfactorily when subjected to the level of hazard (wind or earthquake) for which they are designed. The code provides prescriptive requirements for structural design of buildings, including loads to be considered. For floods, the code considers two design floods for computing the maximum flood elevation, surge height, and wind velocities: i) a 100-year return period for essential structures and ii) a 50-year flood for other structures.

Regarding earthquake-resistant construction, BNBC (2015) states: "The purpose of earthquake-resistant design provisions in this Code is to provide guidelines for the design and construction of

new structures subject to earthquake ground motions in order to minimize the risk to life for all structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential structures to function after an earthquake." It further sets forth structural guidance on enhancing the design and construction of earthquake resistance buildings.

• **Resilience Measures.** Various technical analysis and measures to enhance flood and earthquake resilience of building are included in "Enhancing Competitive, Green and Resilient Industries in Bangladesh: Integrating Resilience Within the Design and Costing of BSMSN Economic Zones 2A and 2B Report," Miyamoto International, 2020.

#### 3.51.1 4.8.1 Building Guidelines

Key resilience measures for buildings within BSMSN include:

- Site Design. Site design should comply with the latest version of the Bangladesh Economic Zones Rules, 2017 (Construction of Buildings or S.R.O No. 46-Law/2017). Rainwater harvesting systems must be incorporated into all building design in BSMSN to ensure continued water supply in buildings and facilities during disasters, while also using collected rainwater during normal times to decrease utility costs.
- Structural Design. Ensure that the structural design of buildings for earthquakes and floods within BSMSN complies with the BNBC 2015 provisions for longer building service cycles. Use the higher performance (such as flood with a higher return period) for designing against natural disasters. Use stronger materials for better performance, which may initially be a higher investment but will lower the lifecycle costs by requiring less need for reconstruction or retrofitting at a later date.
- **Site Improvement.** Ensure that soil compaction, deep foundations, and soil improvements are undertaken in BSMSN in order to reduce settlement and liquefaction. Provide anchorage and bracing for non-structural components. Use deep foundations for liquefiable sites within BSMSN.
- Enhance Functionality. Place all sensitive electrical equipment above flood elevations/levels in BSMSN and add non-structural components such as anchorage and bracing. This will keep buildings operational, achieve higher occupancy standards, and enable buildings to serve as shelters, in face of disaster events.
- Monitoring and Maintenance. Within BSMSN, schedule regular building/infrastructure/utility reviews and monitor inspections of construction in order to reduce maintenance costs and create a safer building structure. Develop a preventive maintenance program for all buildings, including periodic inspections. Ensure all records are maintained electronically and create an asset management system for all projects. Use sensors to monitor and record performance in service and during extreme events.
- Emergency Response and Continuity Planning. Rapid response in the event of an emergency can reduce downtime in BSMSN. Hence, it is mandatory to develop a Post-

Disaster Damage Assessment and Recovery Program for BSMSN and train staff on how to undertake post-disaster damage assessments.

3.51.1.1.1

Appendix A: The Development Guidelines for All Precincts Within BSMSN TO BE INSERTED

#### 3.51.1.1.2

#### 3.51.1.1.3

3.51.1.1.4 Appendix B: Detailed Resilience Measures to be Adapted Throughout BSMSN

# 3.51.1.2 Table B1: Analysis of Flood and Seismic Resilience of Flood Protection & Management infrastructure and Site Development

Infrastructure Type	Specifications	Risk Management Level	Validity of Existing Disaster Risk Management Level	Additional Measures and Considerations to Enhance Resilience	
Coastal Embankment	Flood Crest Elevation: MSL <sup>23</sup> +9.0 m	Coastal Flood Risk Level: High Risk Management level- 100-year return period coastal flood <sup>24</sup>	The design flood level was determined based on frequency analysis using the years (2010-2017) of recorded water level at Karnafuli Station. Additional components such as: tidal surges, wind set-ups, waves, and subsidence, as well as, a freeboard were	Additional information that could enhance coastal flood resilience analysis of existing structure:         • Exact location of the Karnafuli observation Station         Recommended additional structural measures:         • Cover the entire dyke with concrete blocks, geotextile, etc.         • Place additional blocks along the dyke toe to protect from scouring in case of overtopping.         • Monitor the movement of the rand om	
			considered.	<ul> <li>Information memory differences of the function of</li></ul>	
	<b>Earthquake</b> : n/a	Seismic Risk Level of Site: Moderate Risk (Seismic coefficient = 0.2) Risk Management	Due to lack of geo- technical information of the fill material and existing soil, it is difficult to validate the seismic resilience of the dyke against slope	Additional information that could enhance seismic resilience analysis of existing structure:       • Collection of geotechnical data         • Result of slope stability and liquefaction analyses         • Depth of PVD installed on site	

<sup>23</sup> Equivalent to PWD/PWDB which is the datum used by the Bangladesh government set by the Public Works Department

<sup>24</sup> Source of Information: Technical Discussion with China-Harbor and China Civil Engineering Construction Corporation

Infrastructure Type	Specifications	Risk Management	Validity of Existing Disaster Risk	Additional Measures and Considerations to Enhance
		Level: 2475-year return period event <sup>25</sup>	Management Levelfailureandliquefaction.Nonetheless, due tothe site developmentlevel being set at 6.5meters above meansea level, even if thecoastal dyke was tocollapse due to anearthquake event,storm surge up to6.5 meters couldstill be managedwithoutcausinginundation to the	Resilience Recommended additional measures: • Conduct monitoring on the movement of the dike structure by installation of movement sensor, regular survey, and observation via satellite data (IE. SAR data).
River Dyke	Flood Crest Elevation: MSL+8.0 m	River Flood Risk Level: Moderate Management Level: 25- year return period river flood <sup>26</sup>	Due to lack of information regarding water levels (from Feni River, Icchakhali Channel, etc.) and frequency analysis methodology, it is difficult to validate whether MSL+80 m crest height of the river dyke can provide protection against 1 in 25-year river flood. However, based on water level information and frequency analysis used for the super dyke, the design water level without considering freeboard is still 7.5m, less than the height of the river dyke.	<ul> <li>Additional information that could enhance flood resilience analysis of existing structure: <ul> <li>Engineering basis for the selection of the management level as 25-year return period.</li> <li>Historical water level observation data from Feni River, Icchakhali Channel, etc., and the frequency analysis methodology.</li> <li>Engineering design basis for the non- installation of PVD in many upstream sections a long the river dyke.</li> </ul> </li> <li>Recommended additional measures: <ul> <li>Area wide river flood risk analysis and management plan considering the effects of the present and future development is necessary.</li> <li>Study on river/channel improvement including the design of the regula tor, installation of pumps, or provision of diversion channels, considering future development is necessary</li> </ul> </li> </ul>
	Earthquake: n/a	Seismic Risk Level of Site: Moderate Risk (Seismic coefficient = 0.2) Risk	Due to lack of geotechnical information of the fill material and existing soil, it is difficult to validate the seismic resilience of the	<ul> <li>Additional information that could enhance seismic resilience analysis of existing structure:</li> <li>Collection of geotechnical data.</li> <li>Result of slope stability and liquefaction analyses.</li> </ul>
		Management	dyke against slope	• Depth of PVD installed on site.

<sup>25</sup> Source of Information: Bangladesh Building Code

<sup>26</sup> Source of Information: Technical Discussion with China-Harbor and China Civil Engineering Construction Corporation

Infrastructure	Specifications	Risk	Validity of Existing	Additional Measures and
Туре		Management	Disaster Risk	<b>Considerations to Enhance</b>
		Level	Management Level	Resilience
		Level: 2475-year return period event <sup>27</sup>	failure and liquefaction. Nonetheless, due to the site development level being set at 6.5 meters above mean sea level, even if the river dyke was to collapse due to an earthquake event, river flood up to 6.5 meters could still be managed without causing inundation to the industrial	Recommended additional measures: Conduct monitoring on the movement of the dike structure by installation of movement sensor, regular survey, and observation via satellite data (i.e. SAR data).
Stormwater	Floods	Pick	Zone.	Additional information that could anhance
Drainage	Maximum	Management	information	flood resilience analysis of existing
	Design	Level:	regarding the design	structure:
	Capacity of	~5-year	basis, it is difficult	Rainfall analysis and drainage design
	Drainage Management	return	to validate the	report containing design basis,
	110 mm /	pendu	design.	faintail, ictuin period, etc.
	hour <sup>28</sup>			Recommended additional measures:
			Nonetheless, the	• Provision of flap valves/gates at the
			outfall is situated	outlet to prevent backflow in case of
			higher than the	nign-water level along the
			water levels, so	nver/enamer.
			drainage can still	• Equipment of mobile pump in case of
			facilitate even under	emergency situation.
	Farthquake•	Seismic Risk	In general drainage	Recommended additional measures:
	Open channel	Level of Site:	structures are small	• The open channel can be easily
	design <sup>30</sup>	Moderate	that seismic analysis	maintained but for the underground
		Risk (Seismic	is not needed. <sup>32</sup> In	drainage components, such as the
		coefficient = 0.2	case of damages, the	dramage route from the tenant to
		0.2)	significant.	measures like earthquake-resistant
		Risk		joint can be utilized.
		Management	However, due to the	
		Level:	lack of information	
		return period	the risk of	
		event <sup>31</sup>	liquefaction cannot	
			be discounted.	
Site	Floods	Historical	The height of the	Recommended additional measures:
Development		maximum	site is above the	• Differential settlement should be well monitored during the construction to
	avtiage	waterieverat		

<sup>27</sup> Source of Information: Bangladesh Building Code

<sup>28</sup> Source of Information: Assumption based on the calculation files provided by the consultant through World Bank

<sup>29</sup> Source of Information: Based on the document published by Bangladesh University of Engineering and Technology; Pourashava, Mi mensingh uses a 5-year return period for all types of drains

<sup>30</sup> Source of Information: Based on the drawings provided by the consultant through World Bank

<sup>31</sup> Source of Information: Bangladesh Building Code

<sup>32</sup> In a case study in Japan, during the Great East Japan Earthquake 2011, drainage channels affected by the earthquake were displaced but didn't collapsed and could still facilitate the flow of water

<sup>(</sup>https://www.maff.go.jp/j/council/seisaku/nousin/gizyutu/h24-2/pdf/ref-data2-6.pdf)

Infrastructure Type	Specifications	Risk Management Level	Validity of Existing Disaster Risk Management Level	Additional Measures and Considerations to Enhance Resilience
	ground level: MSL +4 m Elevated Ground Level After Site Development:	coast and river <sup>33</sup>	water level at the site, recorded over 8 years.	a void local inundation within the EZ.
	MSL+6.5 m			
	Earthquake:	Seismic Risk	Due to lack of	Additional information that could enhance
	N/A	Level of Site: Moderate Risk (Seismic coefficient = 0.2)	geotechnical information of the fill material and existing soil, it is difficult to validate the seismic	<ul> <li>seismic resilience analysis of existing structure:</li> <li>Collection of geotechnical data.</li> <li>Result of liquefaction analysis.</li> </ul>
		<b>Risk</b> Management Level: 2475-year return period event <sup>34</sup>	resilience of the site against liquefaction.	<ul> <li>Recommended additional measures:</li> <li>Conduct monitoring of settlement.</li> <li>Provide subsidy for the soil improvement or use of pile foundation for building construction within the EZ.</li> </ul>

(Source: Yachiyo Engineering Company, 2020)

#### 3.51.1.3 Table B2: Infrastructure Resilience and Performance Enhancement Measures

3.51.1.4				
Stage	Resilience Measures	Performance Enhancement	Costs	Savings
Coastal Emb	bankment and River Dykes			
Design	-Meet international standards and apply higher demand.	-Longer service life and higher capacity.	Medium	High
Construction	-Ensure proper quality control of construction.	-Prevent a dverse effects during heavy flooding.	Medium	Med
Maintenance	-Develop enhanced maintenance plan.	-Maintain extend service life.	Low	Med
Monitoring	-Develop real-time monitoring network and warning system.	-Reduce impacts of heavy flooding on people and facilities.	Medium	Low
Response	-Develop flood hazard map and response protocol.	-Mitigate damage, prevent secondary impacts and expedite recovery.	Low	Low
Pumps and (	Gates			
Planning	-Apply higher demand.	-High capacity for unexpected heavy rainfall and flooding.	Medium	High
Design	-Meet international standards.	-Longer service life and more robustness.	Medium	High
Construction	-Apply cement grouting or soi compaction.	-Strengthen and improve soft and liquefiable soil.	Medium	High
Maintenance	-Develop operation maintenance plan.	-Maintain expected water discharge, extend service life.	Low	Med
Monitoring	-Develop real-time monitoring system for WL and flooding.	-Reduce impacts of heavy rainfall and flood on people and facility.	Medium	Low
Stormwater	Drainage			
Planning	-Meet international standards and apply higher demand.	-Longer service life and higher capacity.	Medium	High

<sup>33</sup> Source of information: Based on the calculation files provided by the consultant through World Bank

<sup>34</sup> Source of Information: Bangladesh Building Code (BNBC, 2015)

Stage	Resilience Measures	Performance Enhancement	Costs	Savings
0	-Control water discharge flow.	-Prevent adverse effect during heavy	Low	Low
	_	rainfall and flooding.		
Design	-Build retention pond, reservoir	-Store excess water during heavy rainfall	Medium	High
	or underground storage.	and flooding.		
Maintenance	-Develop an enhanced maintenance plan.	-Maintain expected water discharge, extend service life.	Low	Med
Monitoring	-Develop real-time monitoring network	-Reduce impacts of heavy rainfall and	Medium	Low
U	and warning system.	flood on people and facility.		
Response	-Develop flood hazard map and	-Mitigate damage, prevent	Low	Low
_	response protocol.	secondary impacts and expedite recovery.		
Roads				
Planning	-Meet international standards.	-Longer service life	Low	High
	-Use large axle load and truck volume for	-Less wear, reduce cracking, rut,	Low	Low
	design.	increase smoothness of pavement.		
	-Specify higher reliability.	-Increased design life pavement.	Medium	Medium
Design	-Use stronger and thicker asphalt.	-Better performance during flooding.	Low	Medium
Construction	-Moisture resistant material, improved	-Reduce submersion depth and duration	Low	High
	drainage.	during flooding.		
	-Compositeorrigid overlay.	-Reduce flood risk.	Medium	High
Maintenance	-Develop PMS, including preventive	-Identify weak sections, extend design life.	Medium	Medium
	maintenance.		_	
	-Restrict traffic loading during floods.	-Reduce impact offlood on pavement.	Low	Medium
Monitoring	-Develop real-time monitoring network and	-Reduces impacts on people.	Medium	Low
	warning system.		<b>.</b>	-
Response	-Develop response protocol.	-Mitigates damage and expedite recovery.	Low	Low
Bridges			I	
Planning	-Use earthquakes and floods with	-Less damage, faster return to operation.	Medium	Medium
	longer return period in design.			
	-Design the bridge for the large	-Extent the useful life of the bridge.	Low	Low
	trucks anticipated in the future.			
	-Provide 600-900 mm of freeboard.	-Avoid future inundation.	Low	Low
	-Perform geo-technical and	-Reduce damage from flood and	Low	Medium
	hydraulic studies.	earthquake during the service life.		
Design	-Follow National or international	-Design bridge for all loads in the code.	Low	High
	best practice.			
	-Use ductile detailing; redundant design;	-Controlled damage in earthquakes,	Low	Medium
		rapid recovery.		
	-Place 25 mm of polyester concrete on	-Extend service life of a bridge.	Low	Low
	the bridge deck.		_	
Construction	Inspect the site and monitor activities	-Ensure a high-quality structure	Low	High
	Ensure material certification.	is constructed.	т	N/ 11
	-Use circular columns, place riprap	-Reduce the impact of local scour.	Low	Medium
	Extend piles below seemend	Foundation stability	Madium	High
	-Extend piles below scoul and	-Foundation stability.	Medium	nigli
Maintanana	Provide pier protection, when peeded	Drawant direct hit to bridge gupports	Low	Low
wrannenance	Pata the bridge for construction and	Prevent direct int to blidge supports.	Low	Low
	heavy trucks	-Flevent overloading of bridge.	LOW	LOW
	Inspect the bridge and document findings	Preventive maintenance prevention	Low	Low
	inspectine onage and document indiligs.	of major future expenses	LOW	
	-Post the maximum truck height that	-Prevent high-load hits	Low	Low
	can cross under the bridge	rieventingn ioau nus.	LOW	
Monitoring	-Develop real-time monitoring network	-Reduce impact allow for rapid response	Medium	Low
	and warning system.			20.11
Response	-Develop response protocols.	-Mitigate damage and expedite recovery.	Low	Low
Buildings				
Planning	-Consider hazard with longer return	-Less damage.	Low	Low

Stage	Resilience Measures	Performance Enhancement	Costs	Savings
	period. Use stronger materials.			
Design	Meet BNBC requirements.	-Longer service life.	Low	High
	-Use anchorage and bracing.	-Keep building operational, serve as	Low	High
	Locate equipment above HFL.	shelter.		
Construction	-Soil compaction, deep foundation,	-Reduce settlement and lique faction.	Med	High
	soil improvement.			
	-Plan review and construction inspection.	-Reduce maintenance cost, safer structure.	Low	High
Maintenance	-Develop and an implement	-Reduce the need for expensive	Low	Low
	maintenanceprogram.	future repairs.		
Monitoring	-Develop a real-time monitoring network	-Reduce impact allow for rapid response.	Med	Low
	and warning system.			
Response	-Train staff for post-disaster assessment.	-Mitigate damage and expedite recovery.	Low	Low

(Source: Miyamoto International, 2020)

3.51.1.4.1

3.51.1.4.2

3.51.1.4.3

3.51.1.4.4

3.51.1.4.5

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3.51.1.4.11

3.51.1.4.12

3.51.1.4.13

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