



Implemented by:



Khulna City Corporation, Local Government Engineering Department



CLIMATE CHANGE ADAPTED URBAN DEVELOPMENT (CCAUD) PROJECT-PHASE II

Environmental Impact Assessment Report

JUNE 2025

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
ADSL	Associates for Development Services Ltd.
AH	Affected Household
AP	Affected Person
ARIPA	Acquisition and Requisition of Immovable Property Act
BARC	Bangladesh Agriculture Research Council
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BDT	Bangladeshi Taka
BMZ	German Ministry for Economic Cooperation and Development
BWDB	Bangladesh Water Development Board
CCA	Climate Change Assessment
CCAUD	Climate Change Adapted Urban Development
CDIA	Cities Development Initiative for Asia
CI	Corrugated Iron
CRA	Climate Risk Assessment
CRDP	City Region Development Project
CRI	Climate Risk Index
DC	Deputy Commissioner
DEM	Digital Elevation Model
DoE	Department of Environment
DPP	Development Project Proposal
EMP	Environment Management Plan
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ESS	Environmental and Social Standards
EU	European Union
FS	Feasibility Study
GDP	Gross Domestic Product
GHG	Green House Gases
IC	Implementation Consultants
IEE	Initial Environmental Examination
KCC	Khulna City Corporation
KDA	Khulna Development Authority
KfW	Kreditanstalt für Wiederaufbau
KWASA	Khulna Water Supply and Sewerage Authority
LGED	Local Government Engineering Department
LGRDC	Local Government Rural Development and Cooperatives
MCA	Multi-criteria analysis
MOL	Ministry of Land
MOLGRDC	Ministry of Local Government Rural Development and Cooperatives
PEA	Project Executing Agency
PIC	Project Implementation Committee
PIU	Project Implementation Unit
PMU	Project Management Unit
RCC	Reinforced cement concrete
RP	Resettlement Plan
RPF	Resettlement Policy Framework
SLR	Sea-level rise
SOB	Survey of Bangladesh
SPS	Sewerage Pumping Station
STS	Secondary Transfer Station
TNC	Third National Communication
WaL	Water as Leverage
WB	World Bank

EXECUTIVE SUMMARY

This document comprises the Environmental Impact Assessment (EIA) for the “Climate Change-Adapted Urban Development (CCAUD)”, Phase II – Khulna Component and is prepared as part of the Feasibility Study in Khulna including Climate Risk Assessment and Environmental Impact Assessment. The study is funded by a grant from the German Ministry for Economic Cooperation and Development (BMZ) and will recommend priority improvements to the urban storm-water drainage network, flood protection, riverbank protection, and communal infrastructure that increase the climate resilience in the city of Khulna for funding under a subsequent KfW loan to Bangladesh.

Following a multi-criteria assessment and decision-making workshops with key stakeholders to determine the measures to be included in the Feasibility Study, a total of nine subprojects have been developed which include comprehensive drainage solutions for two sub-catchments ([Catchment- 10 Via Nirala Khal drainage path & Catchment-11 Via Bastuhara Khal drainage path and Diana Choudhury Khal drainage path](#)) to Mayur River outfall for preservation of existing hydrology in combination with public space, and public inclusive river fronts.

Legal and Institutional Framework

The EIA reviews the national policy, legal, and regulatory framework relevant to the environmental and social aspects of the project, including applicable environmental standards. It also presents key provisions of the applicable international standards. A summary of the relevant GoB laws and policies are presented along with the assessment standards of KfW, which include the World Bank’s Environmental and Social Standard (ESS). Gaps between the relevant government laws and World bank ESS have been analyzed and in a tabular format the measures required of the project under each ESS to meet the standard are presented.

Baseline Data

The baseline data and information are provided for (1) Physical environment (topography, geology and soils, climate and meteorology, surface and underground water, landscape and visual amenity, ambient air quality, noise levels), (2) biological environment (bio-ecological zones, floral diversity, faunal diversity, fisheries resources, protected areas and critical habitats), (3) socioeconomic settings (livelihoods, demographics, employment, education, and infrastructure).

The Baseline Data Section was prepared on the basis of a literature review including available social and environmental impact assessments conducted in Khulna. Primary data collection was conducted to analyze quality of sediments in the Khals and the quality of the water of the Nirala [Khal](#). This was collected to fill gaps in knowledge resulting from the review of secondary data and to provide site-specific data relevant for the assessment. In December 2020 and January 2021 environmental field surveys of the subproject sites were conducted to identify important environmental and social receptors and issues in the subproject areas, including settlements, habitat types, drainage patterns, and situation with respect to surface water quality, air quality, and noise.

Environmental and Social Risks and Impacts

An assessment of likely significant environmental and social risks and potential impacts of the project and nine subprojects has been carried out as part of the EIA, which included identification of potentially affected local communities and sensitive resources and receptors. A detailing of likely and planned subproject activities has been prepared by the engineering team of the Feasibility Study assignment. On that basis subproject activities have been listed in an interaction matrix with the resources and receptors identified as relevant at the scoping stage on the other axis of the matrix. The activities have been analysed with respect to their potential to impact

and interact with the resources and receptors in the interaction matrix. Following prediction of impacts a multicriteria analysis to evaluate the impact significance was carried out.

The implementation of the project and subprojects will result in negative construction related impacts and positive impacts that will be realized in the operations phase following completion of construction of the subprojects. The negative impacts include physical and economical displacement, environmental impacts associated with construction work, and community health and safety issues. The positive impacts or benefits to Khulna are related to the strengthening of the climate resilience of the city achieved through the subprojects, which will include the drainage measures that will improve the drainage system, reduce flooding and waterlogging in combination with blue-green infrastructure that will improve the aesthetics of the drainage system and provide amenity features alongside waterbodies, amenity and income generating measures that will protect water bodies and reduce heat island effect, and lastly erosion reducing measures at embankments that will protect the communities.

The environmental and social impacts, which will need consideration during the detailed design and implementation includes the following:

- Changes to topography and drainage patterns may occur through changes to topographical characteristics by excavating or raising land or changes to the existing drainage infrastructure. Raising of land at the embankments at Daulatpur and Rupsha will potentially cause ponding behind the new embankment and appropriate drainage is included in the design. Works on the drainage system will be timed in the dry season to minimize disruption of system operation, starting from the downstream to the upstream, and bypass dewatering used to maintain drainage capacity during construction. Levels will be restored to original level, where not specified otherwise in the design.
- Soil quality may be impacted from the construction activities through compaction/erosion and contamination of soil from storage of waste materials. Waste materials should not be stored on agricultural land and topsoil should be stored for reapplication.
- Surface and groundwater resources may be impacted through construction works in and near water bodies, earthworks, and disposal of construction solid and liquid wastes. Construction activity in the river may degrade the water quality due to accidental spills, waste disposal, wash out and sedimentation.
- Land use and land cover may be impacted through clearance of sites for construction and at sites used temporarily during construction. Construction activities should only take place on allotted land and any temporary use of land outside construction area should be negotiated and agreed with current users. Land and roads should be restored to previous or better state and landscaping used to improve land cover following construction.
- Air quality will be impacted from construction activities through increase of particulate matter and dust in the ambient air near construction sites and due to construction traffic. Construction is best suited for the dry season where the ambient air in Khulna does not comply with the GoB air quality standards for PM. Various mitigation measures will be required including water spraying, coverage of loads, and temporary barriers / dust screens.
- Noise levels will be impacted from construction activities, in particular piling and sheet piles installation are noisy and from the construction traffic and machinery. Construction activities should be scheduled in the daytime, noise activities located away from sensitive receptors, use of acoustic screens, consider use of grid electricity rather than diesel generators if practical to reduce noise and exhaust fumes.
- Traffic – construction traffic will increase traffic loads while drainage system will be constructed along roads likely causing traffic disruption. The Rupsha and Daulatpur are busy sites. A traffic management plan for the sites should be prepared and the following measures are recommended: only open trench equivalent to one-day's work at any one time, cover the trenches at night for safety, to provide safe access to properties, keeping at least one lane open, and ensure daily access to properties along the construction sites,
- Solid waste – there will be significant amounts of waste generated such as: dredged and excavated sediments, water hyacinths biomass removed from the Khals, in addition to construction waste and municipal solid waste, generated from works and cleaned out of the drainage system. The sediment quality

analyses have not identified concentrations of heavy metals that would restrict reuse. Composting of the water hyacinth at a local facility in Khulna may be a reuse option. A waste management plan will need to be prepared including identification of types, estimated quantities, qualities, segregation, reduction, recycling, reuse, and disposal options.

- Water quality and biodiversity – construction in the river or water body may degrade water quality and thus aquatic habitat. Clearing and excavation of the Khals and their banks may disturb vegetation and habitats. However, the area is considered a highly modified habitat with low sensitivity and the impact is not considered significant.
- Impact to infrastructure and services may include impact to roads and transportation networks, including waterways during construction as well as potential impact to utilities such as power, water supply, or drainage system. Services detection prior to construction is recommended. Alternative road connectivity or traffic diversion should be provided especially at the demolition of gates and bridges across the Khals.
- Resettlement- physical & economic displacement – based on the resettlement screening the subprojects will result in permanent and temporary relocation of commercial and residential structures, where most of the owners of the structures do not have titles to the land. There is limited land purchase required for the pumping station and the Rupsha riverfront development, while the remainder of the subprojects are located on public, or state-owned land. Based on the screening 64 businesses and 44 households need to permanently relocate, while 225 businesses and 4 households need to temporarily relocate during construction. These figures are based on the conceptual designs and will be updated at detailed design and preparation of the resettlement action plan.
- Livelihood and jobs - during the relocation of businesses, formal and informal workers of these are potentially affected until the business can resume operation at the relocation site. Businesses may lose customers due to the relocation of the business. Allowances and entitlements are included under the RPF.
- Community health and safety hazards relate to traffic loads and disturbance, noise and dust emissions, and influx of a construction work force. Local expertise, services, and labour should be used to the extent possible for construction workers from other districts proper housing shall be provided.
- Hazards to occupational health and safety are associated with the use of construction machinery, excavation and trench work, working in the drainage system (confined space) and canals that receives wastewater, work in a noisy and dusty environment, working with electrical equipment, etc. Incident reporting, OHS risk assessment, and a construction Health & Safety Plan should be developed before start of construction.
- Landscape, visual & aesthetic – landscaping will improve the amenity and reestablish and improve land cover following construction, and reduce soil erosion.
- Restoration and landscaping will ensure that land use and land cover can return to their previous state or better.
- Cultural resources – while impacts have not been identified, a “chance find procedure” needs to be put in place for the construction phase. The subproject 1 will protect cultural heritage including a mosque and a crematorium from riverbank erosion.

The environmental and social benefits associated with the subprojects have also been analysed to identify enhancement measures that should be given consideration in design, construction, and operation to increase the benefits.

- Livelihood and jobs – the subprojects will generate jobs and opportunities during construction that will benefit the local communities and businesses. Local expertise, services, and labour should be used to the extent possible. Various permanent business opportunities are provided through the subprojects with amenity and income generating measures.
- Based on the flood modelling the drainage subprojects will reduce the area flooded based on the scenarios. The rehabilitation and construction of new drainage systems will improve stormwater conveyance while the re-excavation of the Khals will increase the capacity of the waterways. The gates and pumping station will increase the discharge capacity.

- Water quality of the Khals and ponds will improve due to the removal of existing water hyacinth and waste and installation of gross pollutant and silt trap at the upstream of the Khals, although wastewater will remain to be discharged into the drainage system until the sewerage project is completed.
- Riverbank erosion will be reduced at Daulatpur and protect the current land use. The land use at Rupsha Ghat will change to higher value multipurpose use with public amenities.
- Improved public facilities will be provided at the Daulatpur and Rupsha embankments and along the Khals and the ponds.
- The embankments will create public access along the shoreline, the paths and boardwalks along the Khals and ponds, will create public amenity and open space for recreation.
- Riverbank protection work under the subproject will protect cultural heritage including a mosque and a crematorium.

Analysis of Alternatives

The Analysis of Alternatives summarizes the outcome of the process that concluded with the selection of subprojects for the study and presents the various “within-subproject-alternatives” that are analysed in the study. The process that led to the selection of subprojects was primarily carried out to select between different subprojects that were included in a long list of measures. Following the preparation of a shortlist the measures were organized into subprojects and an analysis of “within subproject alternatives” carried out.

Environmental Management Plan

The mitigation, management and enhancement measures identified in the assessment to manage adverse impacts and enhance benefits are included in the Environmental Management Plan (EMP), which covers the Pre-Construction/Design, Construction, and Operations phases of the project. The EMP presents the measures, assigns responsibility, and lists verification and monitoring procedures.

To address physical and economical displacement potentially resulting from the implementation of the subprojects, a Resettlement Policy Framework (RPF) has been carried out with the purpose to clarify resettlement and compensation principles, organizational arrangements, and describe the principles of how the RPF will be expanded into specific plans proportionate to potential risks and impacts, during the detailed design stage.

1. INTRODUCTION

This document comprises the Environmental Impact Assessment (EIA) for the “Climate Change-Adapted Urban Development (CCAUD)”, Phase II – Khulna Component and it was prepared as EIA Study in Khulna including Climate Risk Assessment and Environmental Impact Assessment in September 2021 during the feasibility study of the project. Now the EIA report has been revised and updated in the April 2025. The previous study was funded by a grant from the German Ministry for Economic Cooperation and Development (BMZ) and had recommended priority improvements to the urban storm-water drainage network, flood protection, riverbank protection, and communal infrastructure that increase the climate resilience in the city of Khulna for funding under a subsequent KfW loan to Bangladesh. The project area includes 31 administrative wards of KCC and its proposed extension area and covers an approximate area of 85 km².

Based on the multi-criteria assessment and decision-making workshops with key stakeholders to determine 8 different types of sub-projects was prepared. A key consideration in the selection of sub-projects was potential resettlement impact and site visits and surveys of potentially affected people was undertaken in August-September 2020 during feasibility study and updated in November-December 2024, where the Embankment at Daulatpur, was found to be potentially associated with significant resettlement impacts based on the assumed corridor of impact associated with the designs. Redesign options were identified for the embankment and Nirala Khal subprojects and relocation sites identified.

The screening of measures undertaken as part of the Multi-Criteria Assessment in May-June 2020 (updated in November-December 2024) categorized the measures as Category “Red” according to the Bangladesh regulation (ECR, 2023 Schedule 1 (as amended) and as Category “B+” or “B” according to the KfW Sustainability Guidelines (2019). None of the measures were identified as being on KfW’s exclusion list. Following the resettlement screening undertaken in August-September 2020, and with the redesign options identified for the embankment and Nirala Khal subprojects and relocation sites identified, it was assessed that the individual measures could be kept below threshold of involuntary resettlement of 200 people and thus be maintained as Category “B+”. The Khal upgrading sub-projects are found to be associated with potentially significant environmental impact due to handling of potentially contaminated dredged sediments.

The EIA assesses the environmental impacts of the proposed measures to improve Khulna’s storm-water drainage, flood control, and climate resilience. A scoping of the EIA was conducted in 2024 with the purpose to identify the matters that should be covered and assessed in the EIA as significant and important risks and impacts.

1.1 Brief Objective of the EIA

The objective of the EIA study is to assess the environmental impacts, identify avoidance and mitigation measures, and develop an environmental management plan. Specifically, this involve:

- Conduct a regulatory framework review and describe the legal and institutional framework
- Describe the project and subprojects
- Prepare an environmental and social baseline and profile of the project and the project area
- Assess environmental impacts of the project and subproject
- Develop avoidance, mitigation, and enhancement measures and prepare and Environmental Management Plan
- Assess alternatives and recommend the preferred alternatives.

It is to be noted that separately the following has been carried out and prepared:

- ✦ A Resettlement Policy Framework (RPF) has been prepared with the purpose to clarify resettlement and compensation principles, organizational arrangements, and describe the principles of how the RPF will be expanded into specific plans proportionate to potential risks and impacts, during the detailed design stage.
- ✦ A Stakeholder Engagement Plan (SEP) has been prepared to identify project-affected people and communities as well as other interested parties, obtain an overview of previous consultations and engagements and lessons learned, describe engagement methods in project phases, identify resources and responsibilities, and propose a grievance redress mechanism.
- ✦ A Target Group Analysis has been carried out using Focus Group Discussions as the key method and reported in the Report No. 4. A total of six sharing and group discussion sessions divided in two parts were conducted involving project-affected persons and relevant stakeholders as outlined in the SEP. In the first part, a general presentation about the project were made followed by presentations on the subprojects including discussion on opportunities and benefits, significance of subprojects to stakeholders, and possible impacts of subprojects. Following these, the participants were divided into subproject-wise focus groups with a facilitator/moderator and asked to work on the topics of identifying and describing affected groups, people's attitudes and opinions on flooding, expectations & possibility of involvement, willingness to play any role in flood protection, willingness to pay charges for O&M, effective information communication tools (with KCC), avoidance, minimization, and mitigation of impacts.

1.2 Detailed Objective and core elements

- ❖ The objective of environmental impact assessments (EIA) and climate change assessments is to anticipate and appraise any foreseeable impact a project may have on the environment, the climate and/or on social factors (including human rights), and to identify and prevent any negative impact, or limit it to a tolerable level and (provided that the negative impact is inevitable but still tolerable) introduce compensation measures. In addition, the assessments should identify, monitor and manage any residual risks.
- ❖ The objective of the climate change assessment is also to recognize climate change impacts that may impair the achievement of objectives in due time so that, if applicable, required adaptation measures can be taken into consideration in the project conception.
- ❖ Apart from assessing individual project, EIA and climate change assessments are designed to demonstrate to partner countries the need to appraise projects and explore opportunities to make them environmentally, climate and socially compatible; they are also intended to raise awareness of development approaches that are eco- logically and socially sustainable.
- ❖ By aligning EIA with internationally recognized environmental and social standards (e.g. World Bank Safeguard Policies, IFC Performance Standards, Environmental, Health and Safety Guidelines of the World Bank Group, ILO Core Labour Standards, EU Environmental Legislation), KfW Development Bank aims to improve donor harmonization in accordance with the Paris Declaration.
- ❖ EIA and climate change assessments are a core element of the assessment procedure of KfW Development Bank. They are, first and foremost, intended as a management tool to steer and shape projects over their entire life cycle (i.e. from planning to completion).
- ❖ The essential steps of an EIA and climate change assessment include:

a preliminary appraisal, called **screening**, to determine the environmental, climate and social relevance of a project;

and, if the project has been found to be environmentally and/or socially relevant:

the definition of the assessment scope (**scoping**), in close cooperation with the executing agency, in order to identify and assess the project's environmental, climate and social consequences and risks more accurately; and the design and implementation of an environmental and social impact study (**ESIS**), cli-

mate change adaptation assessment and/or climate change mitigation assessment in order to examine all or individual aspects of the project, including participatory approaches to involve affected local groups and keep the public in the partner country in- formed.

- ❖ The steps mentioned above must cover the entire programme or project; they must not be limited only to those parts of the project which are financed by KfW Development Bank. This also applies to the rehabilitation and/or expansion of existing facilities. Moreover, it is important to consider relevant alternatives to reach the project objective. One possible outcome of an EIA or climate change assessment may be that the original project design or the location has to be modified.

1.3 Structure of The EIA Report

The structure of the report is as described in **Table 1.1**.

Table 1.1 Structure of the Environmental Impact Assessment Report

Section	Title	Description
1	Introduction (this section)	Introduction to the project and the EIA
2	Legal and Institutional Framework	Discussion of the applicable national and international environmental and social regulatory framework
3	Project Description	Description of the project and detailed description of the subprojects
4	Baseline Data	Outline and summary of the baseline of the physical, environmental, ecological, and socio-economic setting.
5	Environmental and Social Risks and Impacts	Identification and assessment of the environmental and social risks of impacts and identification of avoidance and mitigation measures.
6	Analysis of Alternatives	Discussion of between and within subproject alternatives considered and recommendations of preferred alternatives.
7	Environmental Management Plan	Outline of the Environmental Management Plan for the Pre-Construction/Design, Construction, and Operations Phases, including mitigation, management and enhancement measures, Responsibility, and verification and monitoring procedures.

1.4 Approach and Methodology of the EIA Study

The primary approach of the EIA is to investigate and describe impacts of the proposed sub-projects to the existing environmental elements. Specifically, the study aims to predict the potential impacts of the project activities and recommend mitigation and abatement measures for impacts (in the pre-construction, construction, after completion of work and operational stages of development) that are considered potentially adverse to the surrounding environment and society.

In general, this EIA intends to:

- Examine and describe the existing status of the various ecological, physical and human related components surrounding the sub-project areas;
- Predict the potential significant impacts of the project on the surrounding environment and society during the pre-construction, construction, after completion of work, operations and maintenance stages and recommend appropriate mitigation and abatement measures; and
- Identify residual impacts of the sub-projects and recommend appropriate short-term and long-term management plans.

1.5 The EIA Team Composition Under CCAUD Project

Table 1.2 The Environmental Impact Assessment Team

Sl. No.	Name of Expert	Position	Contribution to this report
1	Dr. Wolf Meinken	International Environmental Specialist/Team Leader, Water Supply and Sanitation, Fichtner GmbH & Co. KG	Overall Monitoring Preparation as well as submission of EIA Report
2	Dr. Md. Kabil Hossain	Environmental Safeguard Expert	Revised and updated the existing EIA report
3	Dr. Md. Towhidul Islam	Climate Change Specialist	Oversite and Addressing the Climate change Issues
4	Dr. Asit Kumar Mohanty	Hydrologist, Water Supply and Sanitation, Fichtner Water & Transportation	Addressing the Hydrological issues
5	Md. Dabir Uddin	Drainage Engineer	Drainage design part
6	Md. Abdul Mannan	Deputy Team Leader/ Ecologist	Coordination among the experts and addressing the biodiversity aspect
7	Ms. Helen Rahman	Social and Resettlement Specialist	GRM and Social Part
8	Mr. Nessar Uddin Ahmed	GIS Expert	GIS related data & maps
9	Mr. Hasibul Hossain	Jr. Environmental Professional	Data collection, Modeling and assist the Environmental Safeguard Team
10	Christian Koopmann	Regional Director, Fichtner Water & Transportation GmbH	Provided KfW's relevant document, necessary suggestion and guidance
11	Dr. Luksmi N. Uniyal	Environment & Social Safeguards Specialist (International)	Social safeguard part reviewed
12	Dipl. Engr. Angeli Buttner	Landscape Architect (International)	Architectural design part reviewing
13	Md. Mozammel Hossain	Embankment Engineer	Embankment design part
14	Subrina Islam	Landscape Architect	Architectural design part

2. LEGAL AND INSTITUTIONAL FRAMEWORKS

This chapter reviews the national policy, legal, and regulatory framework relevant to the environmental and social aspects of the Project, including applicable environmental standards. It also presents key provisions of the applicable international standards.

2.1 National Environmental and Social Laws, Rules, Policies and Guidelines

Key legislation governing the environmental approvals process for the proposed Project is the Bangladesh Environment Conservation Act, 1995 (BECA, 1995)¹ and the Environment Conservation Rules (ECR, 1997)². According to Rule 7 of the ECR, proposed developments within Bangladesh are classified as one of four categories, as follows:

- Green;
- Yellow;
- Orange; and
- Red

These categories define proposed developments according to their potential environmental impact. Section 12 of the ECA states that 'No industrial unit or project shall be established or undertaken without obtaining an Environmental Clearance Certificate from the Director General, in the manner prescribed by the Rules'.

This section summarizes the National Laws and describes the procedure for obtaining environmental permits

¹ The Act was amended by Act Nos 12 of 2000, 9 of 2002, and 50 of 2010.

² The ECR was amended in 2002, 2005, 2010 and 2017.

to allow project implementation. Over the years, the Government of Bangladesh has enacted environmental acts, rules, policies and regulation toward imposing restrictions facilitating minimization / mitigation of likely impacts due to development projects. The most important Act is Environmental Conservation Act, 1995 (ECA, 1995) and Environmental Conservation Rules (ECR, 1997, subsequently 2023).

2.2 Screening and classification of projects

According to the KfW sustainability guidelines the part of the screening process, the planned project will be appraised at an early stage in order to determine its relevance in terms of environmental and social aspects and risks, as well as in terms of substantial greenhouse gas reduction potential and substantial need of adaptation to possible climate change. The screening process is designed to identify and appraise the type and scale of any negative consequences or risks that may arise from the planned project (environmental impacts), potentials for reducing greenhouse gas emissions and possible climate change impacts on the project that may impair the achievement of objectives. The next step, once the relevance of such consequences or risks has been established, is to define the type and scope of additional studies which need to be conducted as part of project preparations. Appendix 2 includes a checklist to assess the environmental and climate change relevance.

All projects will be classified into one of the following three **categories A, B or C**, according to the relevance of their potentially negative environmental and social impact.

Category A – Projects will be classified as category A, if they may have a severe negative impact on the environment and/or the social conditions of those concerned. A potentially severe negative impact means that the consequences are manifold, irreversible or unprecedented. Such consequences may affect a larger area beyond the site of the facility under construction, the site of the facility itself or the project area in a narrower sense. As a matter of principle, any projects that are considered sensitive must be classified as category A; this applies to projects which may, for example,

- affect important protected habitats or sites (tropical forests, coral reefs, nature reserves, wetlands, historic cultural sites etc.);
- violate international treaties (such as conventions on international waste management regulations or on marine conservation);
- lead to a high consumption of resources, and of large areas of land or large quantities of water in particular;
- constitute a major hazard to human health (e.g. facilities located in residential areas or handling hazardous substances; noise pollution or harmful emissions); or require the resettlement of a large number of people.

For **category A** projects, it is mandatory to analyze and appraise any negative ecological and social consequences as part of an independent environmental and social impact study (ESIS) and to draw up an environmental management plan (EMP). The EMP should describe all measures that need to be taken to avert, mitigate, offset and monitor any negative consequences that have been identified by the ESIS; it should also assign responsibilities for implementing such measures and list the costs involved. For category A projects, KfW Development Bank requires the executing agency to operate an appropriate monitoring system; if the projects are run by private operators, they are required to have their own environmental and social management system. Any such management system must comprise the following elements: (a) adequate organizational capabilities, (b) environmental and social assessment procedures, (c) management programmes, (d) specific environmental and social training measures, (e) well-structured relations with the target group, (f) monitoring and (g) reporting procedures.

Category B – Projects will be classified as category B if they may have a potentially negative impact on the environment and on the social conditions of those concerned, which, however, is less severe than that of

category A projects and can usually be mitigated through state-of-the-art countermeasures or standard solutions (cf. appendix 1). Typically, the potential consequences of category B projects are limited to the local area, are in most cases reversible and are easier to mitigate through appropriate measures. For category B projects, the need for and the scope, priorities and depth of an ESIS have to be determined on a case-by-case basis.

Category C – Projects will be classified as category C if they are expected to have no or only minor negative environmental and social consequences and if the implementation and operation of the project does not require any particular protection, compensation or monitoring measures. Category C projects usually do not require any additional analysis within the meaning of this Guideline or any further EIA procedures. However, category C projects should be monitored for any relevant changes over their life cycle.

For the elements of the climate change assessment (adaptation assessment and mitigation assessment), the checklist in appendix 2 is used to determine if the measure may have a substantial climate change relevance or not (also see the definition of the relevance criteria in appendix 2). If relevance is expected, then a detailed climate change assessment is carried out as follows.

- The assessment and consideration of the aspects in terms of **climate change adaptation** (Climate Proofing) should ensure that the desired developmental impacts of the strategy or measure are not endangered despite the forecasted effects of climate change. Furthermore, the assessment should analyze whether the partner country's capacity for adaptation can be further increased in the framework of the strategy or measure. In this regard the expected climate changes and their consequences for the strategy or measure will be analysed. This includes both direct effects (e.g. more frequent flooding or drying out of agricultural areas) and indirect effects of climate change (e.g. revenue losses in agriculture). The analysis will also examine the longer targeted period of impacts beyond the formal period of the strategy or measure. On this basis options will be developed and implemented to increase the capacity of the target groups or ecosystems to adapt.
- The assessment and consideration of the potential for **greenhouse gas reduction** (Emission Saving) serves to avoid substantial greenhouse gas emissions and to tap potentials for reducing greenhouse gases. First, the expected development of greenhouse gases in the project area/sector will be described. This is followed by a presentation of whether the planned strategy or measures contribute to higher or lower greenhouse gas emissions and if there are potentials for reducing greenhouse gas emissions. On this basis options to contribute to greenhouse gas reduction will be developed and if applicable taking into consideration the developmental impacts and costs – integrated into the strategy or measure.

The climate change assessment only examines the relevance, which if applicable then entails a more in-depth assessment; the result is described in the programme proposal or in internal KfW proposal documents.

2.3 Environmental Clearance Certificate General Procedure in Bangladesh

Step 1: Submit application with supporting documents.

Step 2: Verification of application and supporting documents by DOE

Step 3: Inspection by the authorized officer after verification of all report and documents. [Then make decision about the clearance (Only Green and Yellow)]

Step 4: Meeting of Environmental Clearance Committee (for Orange and Red Category)

Step 5: Meeting Decision

Environmental Clearance Certificate's shall be issued to all existing industrial units and projects and to all proposed industrial units and projects falling in the Green Category. For industrial units and projects falling in the Yellow, Orange, first a Site Clearance Certificate and thereafter an Environmental Clearance Certificate shall be issued. In case of "Red" category industries, firstly a Location Clearance Certificate, then Environment

Impact Assessment (EIA) approval and thereafter an Environmental Clearance Certificate shall be issued. General Environmental Clearance Procedure of DoE is shown through **Figure 2.1**. Department of Environment (DoE) has approved the TOR for the EIA study of the project through issuing a TOR approval letter ([Appendix X](#) and [Appendix XI](#)).

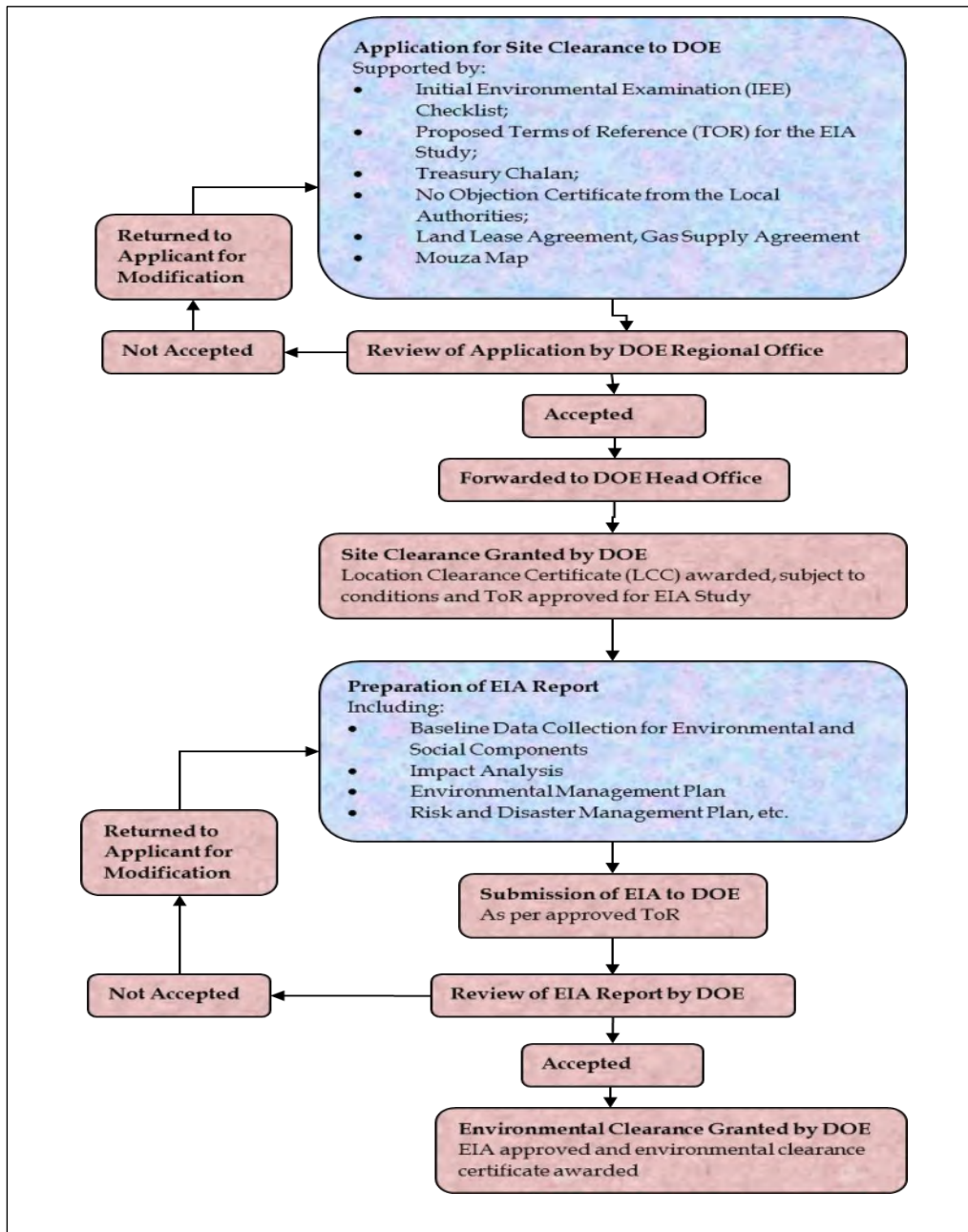


Figure 2.1 General Environmental Clearance Procedure of DoE

Documents Required for Different Categories of Industrial Units or Projects for Environmental Clearance Certificate.

Red Category: Documents Required for Red Category for Environmental Clearance Certificate.

- Application through prescribed form-3 under Environment Conservation Rules 1997

- Prescribed fees under schedule-13 under Environment Conservation Rules 1997 (Amended 2002)
- Report on the feasibility of the industrial unit or project (applicable only for proposed industrial unit or project)
- Report on the Initial Environmental Examination (IEE)
- Environmental Impact Assessment (EIA)
- Process Flow Diagram (showing location of Effluent Treatment Plant)
- Layout Plan (showing location of Effluent Treatment Plant)
- Design and Time Schedule of the Effluent Treatment Plant (ETP)
- Report on the Environmental Management Plan (EMP)
- No objection certificate (Prescribed Form) of the local authority
- Emergency plan relating adverse environmental impact and plan for mitigation of the effect of pollution
- Outline of relocation, rehabilitation plan (where applicable)
- Other necessary information (where applicable)

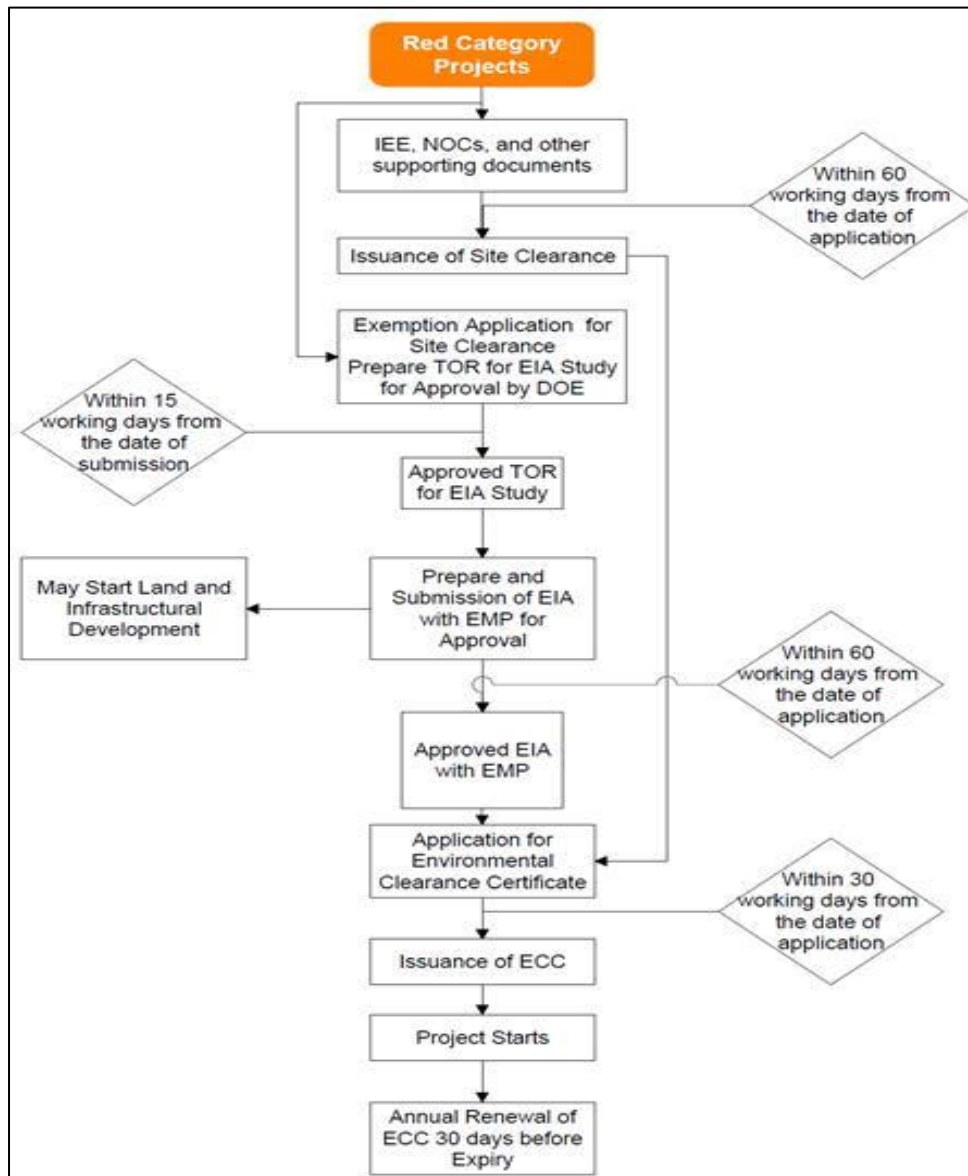


Figure 2.2 Environmental Clearance Procedure for Red Category Project

In addition to ECA 1995 and ECR 1997 (subsequently ECR 2023), there are a number of other policies, plans, and strategies, which need to be considered in the project. The detailed description of all these relevant legislations is provided afterward in Section 2 of this report.

2.4 Legislation, Rules, Order/ Ordinance and Acts in Bangladesh

Relevant environmental laws and regulations which are adopted by the People’s Republic of Bangladesh (GoB) as a legislative framework related to protection of the environment are described below.

Bangladesh Environmental Conservation Act, 1995 and amended in 2010: The Environmental Conservation Act (ECA) of 1995 is the main legislative framework related to environmental protection in Bangladesh. This umbrella Act includes laws for conservation of the environment, improvement of environmental standards, and control and mitigation of environmental pollution. This Act has established the Department of Environment (DoE) and empowers its Director General to take measures as he considers necessary which includes conducting inquiries, preventing probable accidents, advising the Government, coordinating with other authorities or agencies, and collecting and publishing information about

environmental pollution. According to this act (Section 12), no industrial unit or project shall be established or undertaken without obtaining, in a manner prescribed by the accompanying Rules, an Environmental Clearance Certificate (ECC) from the Director General of DoE. In accordance with this Act, the proposed Project will need to be cleared by DoE before commencing the project following procedures given in the Environment Conservation Rules (ECR) 1997.

The ECA 1995 was amended in 2010, which provided clarification of defining wetlands as well as Ecologically Critical Areas and included many important environmental concerns such as conservation of wetlands, hill cutting, ship breaking, and hazardous waste disposal. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance to the affected person.

Bangladesh Environment Conservation Rules (ECR), 2023: Empowers the GoB to declare ecologically critical areas, classification of industries and projects into various categories, procedures for issuing the environmental clearance certificate, and determination of environmental standards. According to the Rule 7(1) of the Environmental Conservation Rules 2023; for the purpose of issuance of Environmental Clearance Certificate (ECC), every industrial unit or project, in consideration of their site and impact on the environment, will be classified into the four categories and they are: Category I (green), Category II (Orange-A), Category III (Orange B) and Category IV (Red). A detailed description of these four categories of industries has been given in Schedule-1 of the ECR. Apart from general requirement, for every Red category proposed industrial unit or project, the application must be accompanied with feasibility report, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) based on approved TOR by DOE, Environmental Management Plan (EMP). The ECR also provides environmental standards for quality of air, water, noise, vehicle emissions, odor, and sewerage discharge.

Bangladesh Environment Court Act, 2010: Has been enacted to resolve the disputes and establishing justice over environmental and social damage raised due to any development activities. This act allows the government to take necessary legal action against any parties who create environmental hazards/ damage to environmentally sensitive areas as well as human society.

The Acquisition and Requisition of Immovable Property Act (ARIPA), 2017: The basic principles for the compensation of property in Bangladesh are founded in Articles 42 and 47 of the Constitution. The current legislation governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Act (ARIPA), 2017. This Act (henceforth, the Act 2017) repealed the Acquisition and Requisition of Immovable Property Ordinance 1982 (subsequent amendments of it up to 1994) and is used as the legal support for land acquisition and requisition in Bangladesh. The Act 2017 requires that compensation be paid for (i) land and assets permanently acquired (including standing crops, trees, houses); and (ii) any other damage caused by such acquisition. The Act 2017 provides certain safeguards for the owners and has provision for payment of “fair value” for the property acquired. The Act 2017, however, does not cover Project-affected persons without titles or ownership record, such as informal settler/squatters, occupiers, and informal tenants and leaseholders (without document) and does not ensure replacement value of the property acquired. The Act has no provision of resettlement assistance and transitional allowances for restoration of livelihoods of the non-titled project affected persons. Places of worship, graveyard and cremation grounds are not to be acquired for any purpose, unless the acquisition of these places is deemed unavoidable for the best of interest of the people. The proponents will be allowed to acquire such areas given that it funds the replacement and rebuilding of such places.

The Acquisition and Requisition of Immovable Property Ordinance, 1982: This Ordinance is the basic instrument governing land acquisition in Bangladesh. It is restricted to “legal” owners of property as supported by records of ownership such as deeds, title or agreements to compensating for land as well as any business, structure, trees and crops on the land. The law specifies methods for calculation of market value of property based on recorded prices obtained from relevant Government departments such as Registrar (land), Public

Works Department (structures), Department of Forest (trees), Department of Agriculture (crops) and Department of Fisheries (fish stock). Khas (government owned land) lands should be acquired first when a project requires both Khas and private land. If a project requires only khas land, the land will be transferred through an inter-ministerial meeting following the acquisition proposal submitted to DC or MOL as the case may be. The DC is empowered to acquire a maximum of 50 standard bigha (6.75 ha) of land without any litigation where the Divisional Commissioner is involved for approval. Acquisition of land more than 50 standard bigha is approved from the central land allocation committee (CLAC) headed by the chief executive of the Government of Bangladesh proposed by the MOL.

Water Act 2013: The recently published Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. As per this Act, all forms of water (e.g., surface water, ground water, sea water, rainwater and atmospheric water) within the territory of Bangladesh belong to the government on behalf of the people. The private landowners will be able to use the surface water inside their property for all purposes in accordance with the Act. A worthwhile initiative is the requirement for permits/licenses for large scale water withdrawal by individuals and organizations beyond domestic use. Without prior permission issued by the Executive Committee, no individuals or organizations will be allowed to extract, distribute, use, develop, protect, and conserve water resources, nor they will be allowed to build any structure that impede the natural flow of rivers and creeks. However, the maximum amount of surface water or groundwater that can be withdrawn by individuals or organizations is not mentioned in the Act. Setting up a priority order for water usage in an area where the water resources are in critical condition is also a significant step.

Natural Water Bodies Protection Act 2000: According to this Act, the character of water bodies i.e., rivers, canals, tanks, or floodplains identified as water bodies in the master plans or in the master plans formulated under the laws establishing municipalities in division and district towns shall not be changed without approval of concerned ministry.

Bangladesh Wildlife (Protection and Safety) Act 2012: Protects 1,307 species of plants and animals; and mandates imprisonment and fines for wildlife poaching, capturing, trapping, and trading.

Bangladesh Wildlife (Preservation) Order (1973) and Act (1974): Regulates the hunting, killing, capture, trade and export of wildlife and wildlife products. It designates a list of protected species and game animals. It empowers the Government to declare areas as game reserves, wildlife sanctuaries, and national parks to protect the country's wildlife.

Protection and Conservation of Fish Act (1950): Provides power to the government to: make and apply rules to protect fisheries; prohibit or regulate erection and use of fixed engines; and construction of temporary or permanent weirs, dams, bunds, embankments and other structures. The Act prohibits destruction of fish by explosives, guns, and bows in inland or coastal areas, and destruction of fish by poisoning, pollution, or effluents. The Act prescribes the seasons during which fishing is allowed, prohibits fishing during spawning periods, and specifies officials having authority to detect breaches of this Act.

The Private Forest Act of 1959: Allows the Government to take over management of improperly managed private forest lands, any private lands that can be afforested, and any land lying fallow for more than three years.

Embankment and Drainage Act, 1952: Consolidates the laws relating to embankments and drainage providing provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from floods, erosion or other damage by water.

Bangladesh National Building Code, 2006: The Bangladesh National Building Code (BNBC) clearly sets out the requirements for buildings in flood prone and coastal regions of Bangladesh. According to Section

1.26 of Part 3, "The habitable floors of a building located in the flood prone area shall be elevated above the design flood level". The planning and development control authority of the city, township, municipality or region where this Code is intended to be applied shall delineate any area having a potential for being flooded under at least 1 m deep water due to flooding as Flood Prone Area (FPA). The provisions of Sec 1.26.1 shall be applicable to areas designated as FPA. There shall be a design flood level in the FPAs which shall be recommended by the Authority to be used in interpreting the provisions of this Section. Similar delineation shall be made in the coastal regions based on expected occurrence of a surge or wave run-up of 1 m or higher. Such areas shall be designated as Surge Prone Area (SPA). The provisions of Sec 1.26.2 shall be applicable to buildings located in the SPAs. There shall be a design surge height in the SPAs which shall be recommended by the Authority to be used in interpreting the provisions of this Section.

The Bangladesh Labor Act, 2006: Provides the guidance of employer's extent of responsibility and workmen's extent of right to get compensation in case of injury by accident while working. As per Section 150, if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act; and (2) Provided that the employer shall not be so liable - (a) in respect of any injury which does not result in the total or partial disablement of the workman for a period exceeding three days; (b) in respect of any injury, not resulting in death or permanent total disablement, caused by an accident which is directly attributable to - (i) the workman having been at the time thereof under the influence of drink or drugs, or (ii) the willful disobedience of the workman to an order expressly given, or to a rule expressly framed, for the purpose of securing the safety of workmen, or (iii) the willful removal or disregard by the workman of any safety guard or other device which he knew to have been provided for the purpose of securing the safety of workmen. Section 151 delineates the subject to the provisions of this Act, the amount of compensation shall be as follows, namely :- (a) where death results from the injury, an amount equal to fifty percent of the monthly wages of the deceased workman multiplied by the relevant factor; or an amount of fifty thousand taka, whichever is more; (b) where permanent disablement results from the injury an amount equal to sixty per cent of the monthly wages of the injured workman multiplied by the relevant factor.

2.5 National Policies and Plans in Bangladesh

The Government of Bangladesh (GoB) has developed a policy framework that requires environmental issues to be incorporated into development planning. The key policies are the National Environmental Policy of 1992, the National Environmental Management Action Plan (NEMAP) of 1995, and the National Conservation Strategy of 1992. The national policies relevant to the proposed project and its environmental and social assessment are briefly described below.

➤ National Environmental Policy, 1992

The Bangladesh National Environmental Policy was approved in May 1992. It sets out the basic framework for environmental action together with a set of broad sector guidelines. Under the National Environmental Policy, the Department of Environment is directed to review and approve all Environmental Impact Assessments.

➤ National Environmental Management Action Plan, 1995

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

➤ National Conservation Strategy, 1992

The National Conservation Strategy provides recommendations for sustainable development in the industrial sector. This conservation strategy describes that all industries shall be subject to EIA and adoption of pollution prevention/control technologies shall be enforced. And dependence on imported technology and machinery should gradually be reduced in favor of sustainable local skills and resources.

➤ **National Agriculture Policy, 1999**

The overall objective of the National Agriculture Policy is to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure Environmental management Framework (EMF). The policy particularly stresses research on the development of improved varieties and technologies for cultivation in water-logged and salinity affected areas. The policy also recognizes that adequate measures should be taken to reduce waterlogging, salinity and provide irrigation facilities for crop production.

➤ **Bangladesh Climate Change Strategy and Action Plan of 2009**

The Government of Bangladesh has prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009. The BCCSAP is built on six pillars are food security, social protection & health, comprehensive disaster management, infrastructure development, research & knowledge management, mitigation and low carbon development and capacity building & institutional strengthening.

➤ **Dredging and Dredged Material Management (Draft) Policy 2013**

This policy is in draft form as has not yet been formally adopted by Government of Bangladesh. Therefore, it is not formally applicable to the project. Nonetheless, salient features of the draft policy with respect to dredging are Project must be formulated after identifying location of dredging and location for projecting/dumping of dredged materials; in dry season, in no way dredged material shall be projected into flowing water. However, in south and southeast region, where tidal influence is very strong, material can be thrown into the river based upon recommendations from proper study; and in rainy season, material might be disposed into river flow based upon recommendations from proper study with hydro-morphological considerations. With respect to dredged material management, the policy says no agricultural land is hampered/damaged, might be dumped plan-wise in shallow places in river upon technical considerations, connection channels (Khals) are not disconnected etc.; and best way of management to fill-in up low land (following Conservation Act 2000) or pile in government owned khas (waste) land.

➤ **Amendment of local government (municipality) ordinance, 2009 and 2010, The Pourashava Ordinance, 1977 Municipal Administration Ordinance 1960**

These ordinances have clearly assigned responsibilities to the Pourashava to ensure urban health for their residents. It has given them the mandate to ensure and provide a wide range of primary and public health services including primary health care, sanitation, water supply, drainage, food and drink, birth and death registration, vector and infectious disease control, etc. As independent autonomous bodies, the Pourashava, as necessary, may take all required actions to ensure good health for tourist and concerned population within its jurisdiction. They have the authority to address all related issues with their legal and administrative mandate.

➤ **National Water Policy (1969)**

Ambition is to provide guidance to the major players in the water sector for ensuring optimal development and management of water.

➤ **National Water Management Plan, 2001 (Approved in 2004)**

Envisions to establish an integrated development, use and management plan for water resources in Bangladesh over a period of 25 years.

➤ **The National Land Use Policy, enacted in 2001**

Aims at managing land use effectively to support trends in accelerated urbanization, industrialization and diversification of development activities.

➤ **National Fisheries Policy, 1996**

Focuses on aquaculture and marine fisheries development and includes the following mandates: (i) Maintaining biodiversity in all natural water bodies and in marine environment, (ii) Ensuring that chemicals harmful to the environment will not be used in fish shrimp farms; (iii) Using environment friendly fish shrimp culture technology; (iv) Expanding fisheries areas and integrating rice, fish and shrimp cultivation; (v) Undertaking control measures against activities that have a negative impact

on fisheries resources and vice-versa; and (v) Formulating laws to ban the disposal of any untreated industrial effluents into the water bodies.

2.6 International Treaties Signed by Bangladesh

Bangladesh is a signatory to several international environment-related treaties, conventions, declarations and protocols. The following are the relevant international treaties and conventions to which Bangladesh is a party:

Table 2.1 Treaty or Convention and Responsible Agency

Treaty	Year	Brief Description / Relevance for CCAUD	Relevant Department
Ramsar Convention	1971	Protection of wetlands.	DoE/DoF
World Cultural and Natural Heritage (Paris)	1972	Protection of major cultural and natural monuments.	DoArch
Occupational safety and health in working environment (Geneva)	1981	Prevent accidents and injuries to health by minimizing hazards in the working environment.	MoH
Occupational Health services	1985	To promote a safe and healthy working environment.	MoH
UN Framework convention on Climate Change (Rio de Janeiro)	1992	Regulation of greenhouse gases (GHGs) emissions.	DoE
Convention on Biological Diversity (Rio de Janeiro)	1992	Conservation of biodiversity, sustainable use of its components and access to genetic resources.	DoE
International Convention on Climate Changes (Kyoto Protocol)	1997	International treaty on climate change and emission of greenhouse gases.	DoE

2.7 Applicable GOB Regulation and Legislation

The National legislation that will be triggered by the activities under nine subprojects has been analyzed as shown in **Table 2.2**.

Table 2.2 Applicable National Regulation and Legislation for CCAUD Sub-projects

Regulation	Applicability	Relevance to sub-projects
Bangladesh Environmental Conservation Act, 1995 as amended in 2010	Triggered	The ECA makes it mandatory to obtain environmental clearance for industrial units and projects. Ecologically Critical Areas in coastal zone, defined by DoE under this act, will not be covered by any of the CCAUD Sub-projects. But other important environmental concerns described by this Act, such as conservation of wetlands and hazardous waste disposal are relevant with few sub-projects.
Bangladesh Environment Conservation Rules (ECR), 2023	Triggered	Considering the scope of works involved with the sub-projects in CCAUD, it can be considered that, embankment construction, riverfront development, dredging of different Khals & Nirala Branch of Mayur, improvement of unlined link canals and construction of sluice gates along with establishment of new pumping station will fall in to 'Red' category and rest of the sub-projects will fall in to 'Orange B' category. Therefore CCAUD 'Red' category sub- projects require Feasibility Study, IEE, EIA and EMP for environmental clearance from DOE while 'Orange B' category sub-projects require Feasibility Study, IEE and EMP only to obtain ECC. The application for ECC from the DOE has two steps: (i) site clearance certificate is obtained at the initial stage and (ii) the ECC at the advanced stage. A site clearance and ECC are required for the categories (i.e., Orange A, Orange B, and Red) where the Green category only requires ECC. Provides environmental standards for quality of air, water, noise, vehicle emissions, odor, and sewerage discharge.

Regulation	Applicability	Relevance to sub-projects
The Acquisition and Requisition of Immovable Property Act (ARIPA), 2017:	Triggered	Construction of Riverfront development at Rupsha, Labonchara outlet gates upgrading & pumping station, Alutola gate and Rehabilitation of 18 ponds will cause potential relocation or a significant number of resettlements of buildings, unofficial housing/dwellings and business are located along this stretch of the proposed site.
Water Act 2013	Triggered	The sub-project activities will take place to distribute, use, develop, protect, and conserve water resources through directing waste or storm water using drainage systems into the wetlands, dredging, lining & bank protection works and restoring aquatic environment through rehabilitation of 18 ponds respectively.
Natural Water Bodies Protection Act 2000	Triggered	Few sub-projects may change the character of water body i.e., rivers, canals, or ponds identified as water bodies in the master plans.
Bangladesh Wildlife (Protection and Safety) Act 2012	Not triggered	The CCAUD sub-projects are implemented in an urban setting and highly modified habitat. They will not take place in any wildlife sanctuary, game or reserve forest.
Bangladesh Wildlife (Preservation) Order (1973) and Act (1974	Not triggered	The CCAUD sub-projects are implemented in an urban setting and highly modified habitat. They will not take place in any wildlife sanctuary, game or reserve forest.
The Private Forest Act of 1959	Not triggered	Within the project area, improperly managed private forest lands or any private lands that can be afforested or any land lying fallow for more than three years have not been identified.
Embankment and Drainage Act, 1952	Triggered	CCAUD sub-projects are mostly relevant with drainage improvement & embankment construction to protect the city area from flooding.
Bangladesh National Building Code, 2006	Triggered	Usually, CCAUD project area or new development area of KCC satisfies the criteria of Flood Prone Area mentioned in BNBC. Riverfront development at Rupsha Ghat.
The Bangladesh Labor Act, 2006	Triggered	Broadly applicable during the construction and O&M activities under the project. Appropriate mitigation and protective measures will be included in the EMP.

2.8 Applicable International Standards

The KfW Development Bank assessment standards are the Environmental and Social Standards of the World Bank Group. For public agencies such as KCC these comprise the Environmental and Social Standards (ESS), relevant Operational Policies, and the General and sector-specific Environmental, Health and Safety (EHS) Guidelines. The KfW Sustainability Guidelines (2019) refers the World Bank ESS and classifies developments in four categories according to their potentially adverse environmental and social impacts and risks, namely "A" (high risk), "B+" (substantial risk), "B" (moderate risk), and "C" (low risk). Classification is carried out on the basis of the illustrative list of the guidelines and further screening criteria related to potential impacts. In addition, there are exclusion criteria. Category A and B+ are required to conduct EIA and develop EMP, while this need is assessed on a case by case basis for category B.

The WB ESS requirements and their relevance to the subprojects are analysed in the **Table 2.3** below along with a brief statement of the actions required by the project to comply with the ESS.

Table 2.3 World Bank ESS Requirement and Relevance to the Subprojects

WB ES Standards	Requirements	Relevance to subprojects / Actions Required
ESS-1: Assessment and Management of Environmental and Social Risks and Impacts	<ul style="list-style-type: none"> Assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project Documents: environment and social assessment, contractor's environment and social commitment plan 	<ul style="list-style-type: none"> E&S risks and impacts of subprojects identified and assessed in the EIA. EMP prepared based on the assessment to manage identified risks and impacts.

WB ES Standards	Requirements	Relevance to subprojects / Actions Required
	<ul style="list-style-type: none"> • Avoid, minimize, mitigate and compensate the environmental and social risks • Classify projects according to four categories (depending on type, location, sensitivity, scale, potential environmental impacts) 	
ESS-2: Labor and Working Conditions	<ul style="list-style-type: none"> • Employment creation and income generation • Providing safe and healthy working conditions • Terms and conditions of employment, non-discrimination and equal opportunity and OHS • Provision of contracted workers, grievance redress mechanism and worker's organization • Protect project workers, including vulnerable workers • Prevent the use of all forms of forced labor and child labor 	<ul style="list-style-type: none"> ▪ Grievance mechanism to be established. ▪ OHS plan to be prepared. ▪ Contractor to sign up to compliance with forced labour and child labour provisions.
ESS-3: Resource Efficiency and Pollution Prevention and Management	<ul style="list-style-type: none"> ▪ Promote the sustainable use of resources, including energy, water, and raw materials. ▪ Avoid or minimize adverse impacts on human health and the environment caused by pollution from project activities. ▪ Avoid or minimize project-related emissions of short and long-lived climate pollutants. ▪ Avoid or minimize generation of hazardous and non-hazardous waste. ▪ Minimize and manage the risks and impacts associated with pesticide use. 	<ul style="list-style-type: none"> ▪ EIA process to identify risks and impacts. ▪ EMP prepared based on the assessment to manage identified risks and impacts.
ESS-4: Community Health and Safety	<ul style="list-style-type: none"> ▪ Anticipate and avoid adverse impacts on the health and safety of project-affected communities during the project life cycle ▪ Promote quality and safety, and considerations relating to climate change, in the design and construction of infrastructure ▪ Avoid/ minimize community exposure to project-related traffic and road safety risks, diseases and hazardous materials ▪ Effective emergency response 	<ul style="list-style-type: none"> ▪ Community health and safety risks and impacts assessed under the EIA. ▪ Management measures proposed under the EMP.
ESS-5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	<ul style="list-style-type: none"> ▪ Avoid/ minimize involuntary resettlement by exploring project design alternatives ▪ Avoid forced eviction 	<ul style="list-style-type: none"> ▪ Physical and economic displacement have been identified associated with the subprojects.

WB ES Standards	Requirements	Relevance to subprojects / Actions Required
	<ul style="list-style-type: none"> ▪ Mitigate unavoidable adverse social and economic impacts from land acquisition ▪ /restrictions (through compensation) 	<ul style="list-style-type: none"> ▪ A Resettlement Policy Framework has been prepared, including provisions for: <ul style="list-style-type: none"> ▫ Preparation of resettlement plan ▫ Impact avoidance when possible by exploring alternatives ▫ Compensation or assistance to those who do not have formal legal claim to the land; ▫ Transitional allowances for restoration of livelihoods for informal settlers; ▫ Valuation of lost asset based on "replacement cost" standard
ESS-6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	<ul style="list-style-type: none"> ▪ Protect and conserve biodiversity and habitats ▪ Apply mitigation hierarchy and precautionary approach in design and implementation of projects ▪ Promote sustainable management of living natural resources, ▪ Support livelihoods of local communities, including Indigenous Peoples, ▪ Inclusive economic development, through the adoption of practices that integrate conservation needs and development priorities. 	<ul style="list-style-type: none"> ▪ The subprojects are located in urban areas and highly modified habitats. ▪ Site clearance activities for riverfront development, rehabilitation of Khals, construction of sluice gate & pumping stations and rehabilitation of ponds will involve removal of vegetation and felling of trees. ▪ Avoidance and mitigation included in the EMP
ESS-7: Indigenous Peoples/ Historically Underserved Traditional Local Communities	<ul style="list-style-type: none"> ▪ Ensure that development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples/Historically Underserved Traditional Local Communities ▪ Avoid adverse impacts of projects on Indigenous Peoples/ Historically Underserved Traditional Local Communities, or when avoidance is not possible, to minimize, mitigate and/or compensate for such impacts. 	<ul style="list-style-type: none"> ▪ The policy is not triggered as the geographical areas in consideration are not likely to have indigenous people as defined by the Bank policy.
ESS-8: Cultural Heritage	<ul style="list-style-type: none"> ▪ Protect cultural heritage from the adverse impacts of project activities and support its preservation, to address cultural heritage as an integral aspect of sustainable development, ▪ Promote meaningful engagement with stakeholders regarding cultural heritage, 	<ul style="list-style-type: none"> ▪ Riverbank protections work under the subprojects will protect the Daulatpur Market Jame Mosque and Moheshwarpasha Crematorium prone to be eroded. ▪ Change Find Procedures to be established.

WB ES Standards	Requirements	Relevance to subprojects / Actions Required
	<ul style="list-style-type: none"> Promote the equitable sharing of benefits from the use of cultural heritage. 	
ESS-9 Financial Intermediaries (FIs)	<ul style="list-style-type: none"> Sets out how Financial Intermediaries (FIs) will assess and manage environmental and social risks and impacts. 	<ul style="list-style-type: none"> Not relevant as there is no financial intermediary in the project organization.
ESS-10: Stakeholder Engagement and Information Disclosure	<ul style="list-style-type: none"> Engage stakeholders throughout project life cycle and determine how they wish to be engaged Assess the level of stakeholder interest and support for the project Enable stakeholders' views to be considered in project design and environmental and social performance, Promote and provide means for effective and inclusive engagement with project-affected parties throughout the project life cycle Ensure that appropriate project information on environmental and social risks and impacts is disclosed to stakeholders in a timely, understandable, accessible and appropriate manner and format. 	<ul style="list-style-type: none"> The subprojects involve a wide variety of stakeholders. A Stakeholder Engagement Plan has been prepared, which includes stakeholder engagement during project implementation.

2.9 Collection of No Objection Certificate (NOC) from Respective Authorities

3. DESCRIPTION OF THE PROJECT (8 SUBPROJECTS)

This section provides a description of the project, the subprojects, size and layout of the project area, as well as associated facilities including a brief description of the project phases and related activities.

Under the "Climate Change-Adapted Urban Development Programme (CCAUDP) Phase II - Khulna Component" (the "Project"), KfW will provide a loan to Bangladesh for investments in KCC's storm-water drainage and flood control. A Feasibility Study including Climate Risk Assessment and Environmental Impact Assessment (EIA) is carried out to identify priority measures in urban drainage and flood protection for implementation. The selection of measures was informed by a Baseline Scenario and Climate Risk Assessment and a Multi Criteria Assessment (MCA) conducted in 2020. On that basis a total of eight subprojects have been developed which include measures ranging from comprehensive drainage solutions for two Mayur sub-catchments, to preservation of existing hydrology combined with public space, and public inclusive river front park.

The project area is 85 km² including the current Khulna City Corporation (KCC) administration area and an area proposed for extension of the KCC administration area. The budget available from KfW for implementation of all adaptation measures is estimated to be around €30 million. The Study will also develop detailed investment proposals for a national budget of €30-40 million, with a concept for phasing according to available budget.

Under the “Climate Change-Adapted Urban Development Programme (CCAUD) Phase II - Khulna Component” (the “Project”), KfW will provide a loan to Bangladesh for investments in KCC’s storm-water drainage and flood control. The priority subprojects are identified through a Feasibility Study including Climate Risk Assessment and Environmental Impact Assessment (EIA). A total of eight subprojects have been developed which include comprehensive drainage solutions for two sub- catchments of the Mayur River, preservation of existing hydrology in combination with public space, and public inclusive river front park.

The Project consists of eight sub-projects and their related consulting services in Khulna. The eight final interventions are the result of a city-wide climate vulnerability analysis and a prioritization of suitable adaptation measures. They are in some of the most affected city wards of Khulna.

The eight sub-projects to be financed under the Project are:

- 1) Embankment at Daulatpur (726m) and Moheshwarpasha (119m);
- 2) Rupsha Riverfront Park (Phase 1);
- 3) Drainage improvements in sub-catchments 17 and 21, (in the Nobinagar area) including Sonadanga Bypass Road and outlet drain;
- 4) Drainage improvement at Bastuhara Khal sub-catchment 11 and Deana Chowdhury Khal upgrading;
- 5) Upgrade of Labonchara Khal outlet gate and construction of Labonchara pumping station;
- 6) Upgrade of Alutola outlet gates;
- 7) Nirala Khal revitalization and link park;
- 8) Rehabilitation of approximately 18 ponds.

A key consideration in the selection of sub-projects was potential resettlement impact and site visits and surveys of potentially affected people was undertaken in August-September 2020, where the Embankment at Daulatpur, the river front development at Rupsha Ghat, and the Nirala Khal and link park were found to be potentially associated with significant resettlement impacts based on the assumed corridor of impact associated with the designs. Redesign options were identified for the embankment and Nirala Khal subprojects and relocation sites identified.

The priority adaptation measures selected based on the Baseline Scenario and Climate Risk Assessment and the Multi Criteria Assessment (MCA) conducted in 2020 have been combined as part of 8 subprojects as presented briefly in **Table 3.1** and described in detail in the following sections.

Table 3.1 Description of Eight Subprojects under CCAUD

SL. No.	Subproject	Description of the Subprojects
1	Embankment at Daulatpur (726m) and Moheshwarpasha (119m): These embankments will provide flood and erosion protection along critical riverbank stretches,	<ul style="list-style-type: none"> ➤ Implement 726m of embankment from BL College along Daulatpur Bazar to Flour Mill to control erosion and flooding along the Rupsha. ➤ 119m of shore/erosion protection along banks of the Rupsha at Daulatpur (Moheshwarpasha) Hindu crematorium. ➤ Includes improving publicly accessible through provision of a path. ➤ Ground levels are around +3.50 to 4.05 m SOB at the location of the embankment.

SL. No.	Subproject	Description of the Subprojects
	safeguarding nearby communities and infrastructure.	➤ The embankment elevation will have a minimum height of +4.105m SOB to ensure resilience to SLR up to 2050. (Ward 1,2,3,4, 5 & 6)
2	River front development at Rupsha Ghat: Rupsha Riverfront Park (Phase 1): A key urban green space designed for public recreation and climate resilient, enhancing the ecological value of the riverfront while contributing to flood management.	<ul style="list-style-type: none"> ➤ Riverfront development with 100 m long and 25 m wide promenade and raising of flood wall at Rupsha Ghat North. ➤ The development includes a tourist boat terminal building with kiosks for tourist activities such as boat hire/tours, food stalls, and shelters with seating. ➤ It is envisaged to engage the private sector for the operation and maintenance of the promenade, the kiosks and the stalls. ➤ The existing flood wall has an elevation of +2.55mSOB, it is proposed to raise the floodwall to +4.05mSOB to provide resilience against SLR until 2050, and to raise the actual site by 0.5m to at least +3.5 m. (Ward 22)
3	Drainage Improvements in Sub-Catchments 17 (beside Sonadanga Bypass Road) and 21 (Nobinagar Area): Upgrading the stormwater drainage infrastructure, including Sonadanga Bypass Road and outlet drain, will alleviate flood risks in these high-vulnerability areas.	<ul style="list-style-type: none"> ➤ Drainage rehabilitation at Nobinagar area and establishment of access paths along the Khal (sub-catchment 21, Ward 18) ➤ Urban drainage system upgrading and extension with a total length of 4560m at sub-catchment 21 and Urban drainage system upgrading and extension with a total length of 1191m at sub-catchment 17 in Ward 18 ➤ Reconstruction of Sonadanga Bypass Road with construction of road side drains
4	Drainage Improvement at Bastuhara Khal Sub-Catchment 11 and Deana Chowdhury Khal Upgrading: This sub-project addresses drainage challenges in flood-prone areas, ensuring improved water flow and reduced flood impacts.	<ul style="list-style-type: none"> ➤ Rehabilitation of Bastuhara Khal incl. dredging/lining and establishment of a link park along the banks with access paths, lighting (sub-catchment 11, Ward 6 & 9) ➤ Rehabilitation of Deana Chowdhury Khal incl. dredging/lining and establishment of access paths along the Khal (Ward 4, 6 & 9) ➤ Urban drainage system upgrading and extension in Bastuhara Khal Sub-catchment (Ward 4, 5, 6, 9, 10, 11, 12) over a total length of 9654m
5	Upgrade of Labonchara Khal Outlet Gate and Construction of Labonchara Pumping Station: This will improve water discharge and control, especially during high tide and storm surge events, to protect the surrounding areas from flooding.	<ul style="list-style-type: none"> ➤ Labonchara Khal 2 outlet gate upgrading and reconstruction of the concrete superstructure, complete with concrete guide walls and bottom erosion protection and installation of new motorized gates, as well as power supply (Naihati, KCC extension area) ➤ Labonchara pumping station will ensure that excess stormwater can be discharged during high tide reducing flooding and water logging within the catchment when rain events coincide with high tide. The pumping station structure will comprise a reinforced concrete structure and brick building to house pumping equipment, standby power supply will be provided in the form of generators. ➤ Guide walls to guide the flow and channel erosion protection will be part of this solution. ➤ The pumping station will be designed with additional capacity to deal with an increase of 15% in rainfall up to 2050 as a result of climate change.
6	Upgrade of Alutola Outlet Gates: Reinforcing these gates will help manage stormwater discharge more effectively, reducing the flood risk in adjacent areas.	➤ Alutola outlet gates upgrading of the existing structure and reconstruction of the concrete superstructure, complete with concrete guide walls and bottom erosion protection and installation of new motorized gates as well as power supply (Jalma, KCC extension area)
7	Nirala Khal Revitalization and Link Park: Revitalizing this Khal will improve water flow from	➤ Nirala branch revitalization and link park including foot path along both banks and divert dry weather flow (Ward 24 & Jalma, KCC extension area)

SL. No.	Subproject	Description of the Subprojects
	Catchment- 10 and provide adjacent green space, contributing to flood control and enhancing urban ecology.	
8	Rehabilitation of 18 ponds: These ponds serve as crucial water retention basins, reducing surface runoff and providing recreational and ecological benefits.	➤ Rehabilitation of 18 ponds owned by KCC (11), BL College Authorities(1), Talimul Millat Rahmatia Fazil Madrasha Authority (1), Lions School and College authority (1), Boyra High School (1), Pabla Moddhya Para Sarbojanin Temple authority (1), Khalishpur High School authority (1) Govt. Majid Mamerial City College authority (1), dredging and beautification of public space around the ponds (Citywide - Ward 03, 06,10, 12, 13, 16, 17, 18, 25, 26, 29, 31 25, 29, 30, 31)

3.1 Subproject 1: Embankment at Daulatpur (726m) and Maheshwarpasha (119m)

Subproject Location: The site is located on the western bank of the Bhairab and Rupsha Rivers, at a bend in the river near Daulatpur (**Figure 3.1**). The bend is located close to the Khulna-Jashore-Dhaka Highway and the North South railway which connects Khulna with Jashore and the rest of the country. The shoreline is prone to bend scour and erosion, which over the years has impacted the stalls and buildings along the shoreline at the Daulatpur Bazar (**Figure 3.2, Figure 3.3, Figure 3.4, Figure 3.5 and Figure 3.6**).

Existing Conditions: Erosion of the riverbanks at the Daulatpur area has been a continuing problem over the last years. This erosion is now threatening at least 22 buildings mostly housing market stalls located along the embankment, a mosque, as well as the grounds of BL College. Ground levels at the site are around +3.50 to 4.05 m SOB at the location of the embankment, but the area is not prone to flooding. The Daulatpur Moheshwarpasha Crematorium (**Figure 3.4**) next to DC Road was also identified as a site requiring riverbank protection measures. This is a site with religious and cultural significance used for Hindu religious festivals throughout the year serving about 30,000 Hindu residents in Wards 1-6. It is about 65 years old (established in 1955) by the local Hindu Community leader of Maheshwarpasha. 5-6 cremations take place on a typical day. Currently, the total area of the Crematorium site is about 200m² however when the centre was established the site was 400 m². Located very close to the Bhairab riverbank, this site has already lost about the same quantity of land into the river due to chronic riverbank erosion. Large cracks have appeared at the Crematorium site, and especially in the areas around the cremation pyres and the tub due to erosion. The premise is flooded regularly during high tides. Sometimes, it even inundates by more than 1' of water. At the time of flooding, cremation becomes impossible. The riverfront arm of the site is about 30m long. If no protection measures are taken, Crematorium site may be lost in the river due to erosion. A similar solution as at the Daulatpur Market site is proposed for this, comprising fill, geotextile, a granular filter layer and one layer of concrete blocks.





Figure 3.1 Existing site condition of Daulatpur Embankment Area (2021)

Components and Scope of Works: The subproject includes the implementation of an embankment along a 726m stretch from BL College along Daulatpur Bazar & bank at Moheshwarpasha Crematorium Site of Length=119m to the Flour Mill as shown in Figure 3.2 & in Figure 3.3. Preliminary investigation recommended three types of embankment as the most suitable solutions. The option of constructing the embankment approx. 10m away from the shoreline to reduce resettlement impact was found to obstruct the river flow too much and was abandoned. Instead the embankment was moved back as close as possible to the existing building on the shore and a concrete wall included. The proposed embankment design is with a falling or flexible toe, which can move down in case there is some erosion at the toe of this embankment, this avoids the embankment being undermined.

The scope of the project apart from eradicating bend scour and erosion of the shoreline will also include provisions for publicly accessible promenade with amenities along the embankment, as well as Ghats and jetties to provide access to the river.

Construction issues and sequence

- The riverbank would be reprofiled (where required) to form a smooth slope surface at 1 in 2 which would be carried out in sections along the entire length of the site.
- The concrete retaining wall, where required, would be installed on the landside of the embankment over a bedding layer and blinding.
- Suitable interfaces would be installed for transitions between the new retaining wall and existing structures.
- Fill material would be installed to form the core of the revetment riverward of the wall or at the crest of the revetment.
- A geotextile fabric would be installed with the filter layer on top of the core.
- Starting at the toe, a granular layer would be placed on top of the geotextile fabric to act as levelling layer for the main armor.

- The toe of the revetment would be installed to support the concrete blocks along the slope of the bank to form a smooth and continuous surface.



Figure 3.2 Location of Daulatpur Embankment on Google Map

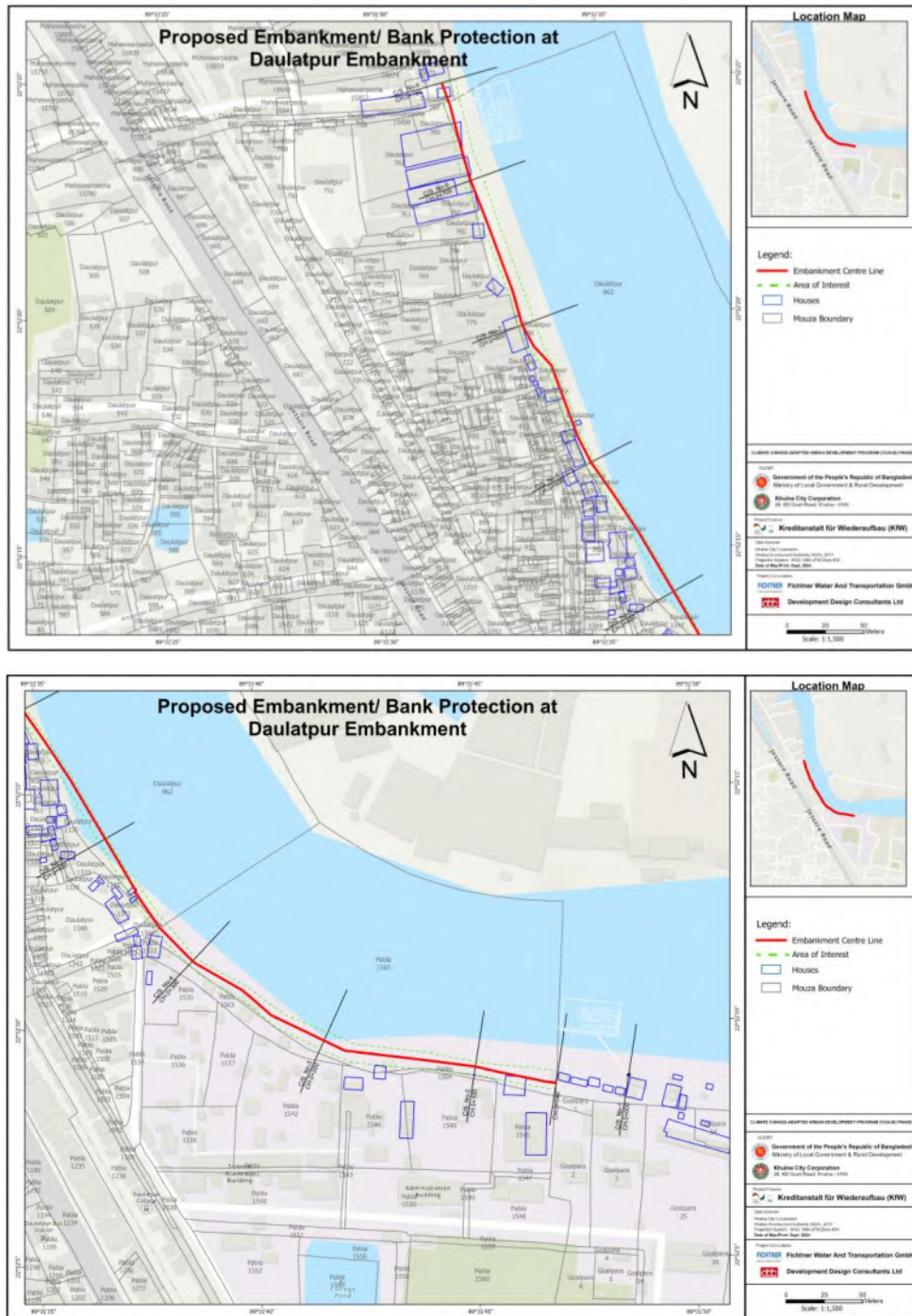


Figure 3.3 Conceptual Design of Proposed Embankment/ Bank Protection at Daulatpur



Figure 3.4 Location of Erosion protection area at Moheshwarpasha on Google Map



Figure 3.5 Existing Condition along the shoreline at Daulatpur Bazar (2021)



Figure 3.6 Drone Footage of Shoreline Showing Existing Condition at Subproject 1 (2021)





Figure 3.7 Drone Footage of Shoreline Showing Existing Condition of Subproject 1 (2021)



Figure 3.8 Moheshwarpasha Crematorium Country Side View (2021)

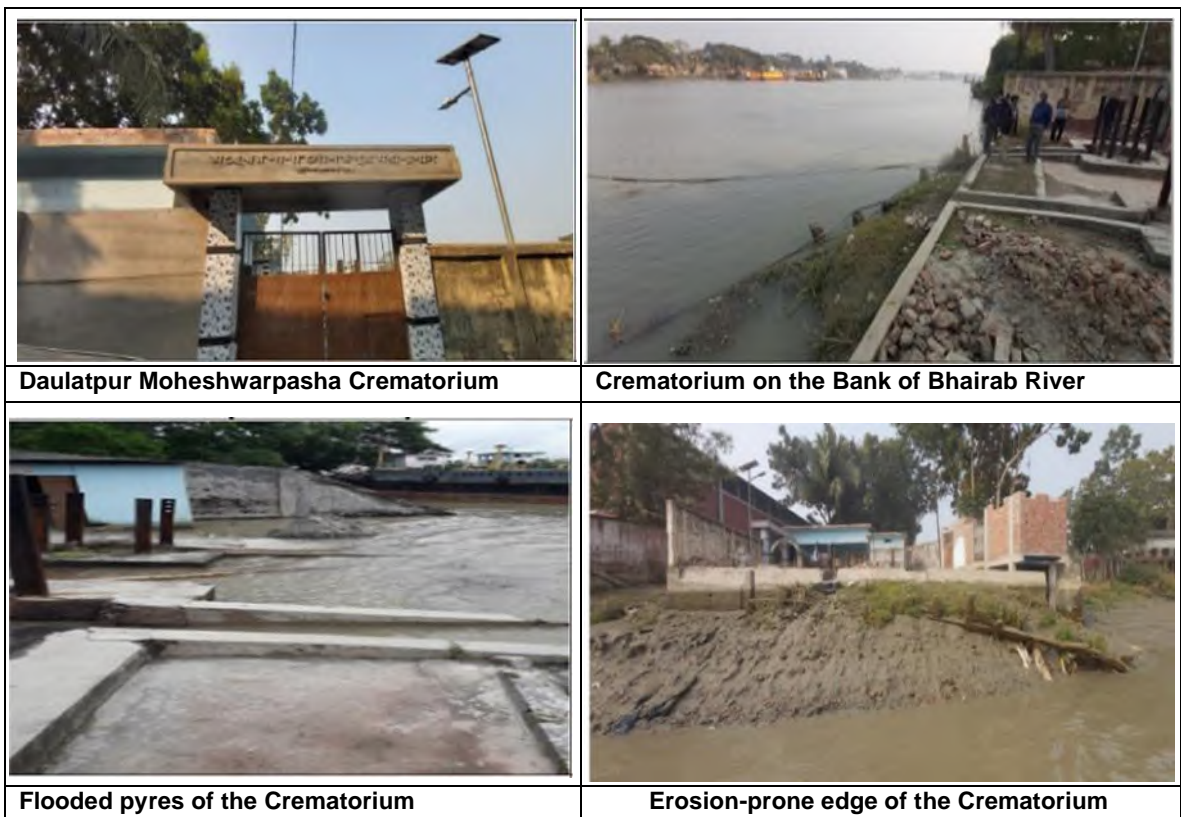


Figure 3.9 Existing conditions of the Moheshwarpasha Crematorium Site (2021)

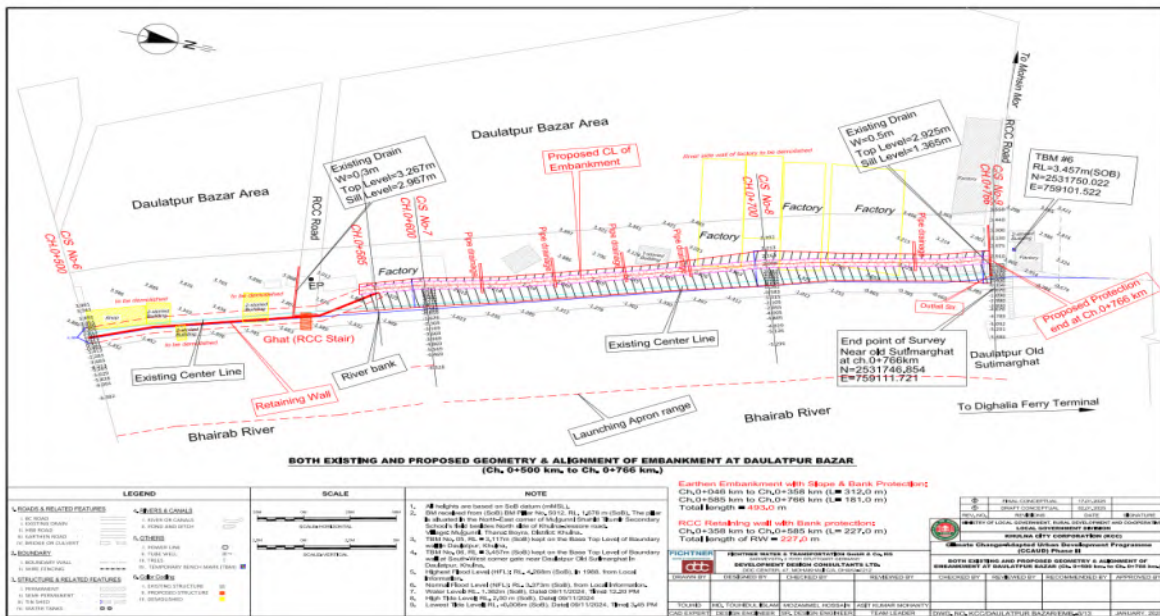


Figure 3.10 Final Recommended Concept Design of Daulatpur Embankment

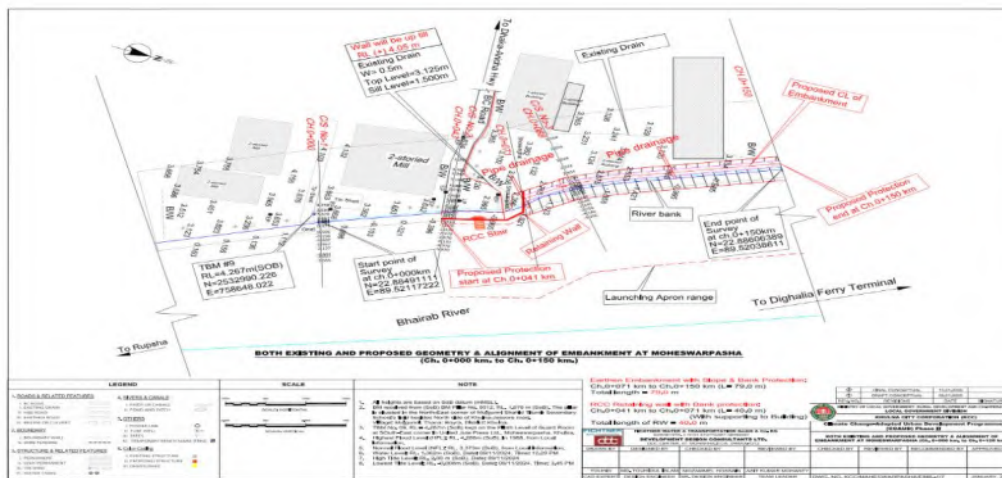


Figure 3.11 Final Recommended Concept Design of Moheshwarpasha Crematorium Site

3.2 Subproject 2: Rupsha Riverfront Park (Phase 1)

Subproject Location: The subproject site is located north of Rupsha Ghat adjacent to the bus terminal. Rupsha Ghat area is a transport hub with a bus terminal and ferry Ghat. Rupsha Ghat is popular having the fish and vegetable wholesale market (Figure 3.12).

Existing conditions: Approximately 30% of the site is currently not utilized, the remaining 70% is used by sand supplier businessmen for the off-loading of boats transporting sand, as well as stock piling. At this location the existing flood wall and improved embankment was constructed under CRDP. The site identified

for this subproject is just north of the bus terminal, sand supply businesses using jetties along the shore and stock piling sand have established over the years on land just north of the bus terminal (**Figure 3.11 & Figure 3.12**). They lease some of the land but also have encroached on Khas land. The sand supply business is not compatible with the adjacent land use and currently there are already time restrictions on sand transport through the city to minimise impact.

The existing flood wall has an elevation of +2.55m. The existing site elevation is +3.0m SOB, it is recommended to raise the site by filling to +3.5m SOB as well as raising the flood wall to +4.05m SOB, the building floor elevation will also be at 4.05m SOB, in line with the recommended embankment levels for Khulna to address climate change up to 2050. The area in the vicinity is categorized as a medium to high climate risk according to the climate risk assessment carried out during the baseline study.



Figure 3.12 Existing Site Condition of Proposed Rupsha Riverfront Park Area (2025)

A total of four buildings (small site offices) are present and will be affected by the development. The project will also disrupt daily business activities of 4 jetties used by sand suppliers. A total of 7 businesses with 127 employees are currently operating at the site, including 4 sand/gravel businesses and 3 sawmills.

A significant number of poor communities in the vicinity including the biggest slum in Khulna (Rupsha Char Bastee), which is home to more than 10,000 people are located right beside this proposed development and will certainly benefit from this measure. The adjacent area is also home to a very high- density middle and lower middle-class residential area, and regional head office of important service providing departments like LGED.

Components and Scope of Works: Sub-project 2 comprises phase 1 of a river front park on a site of 100 by 25 m (**Figure 3.12**). It includes publicly accessible riverfront promenade adjacent to existing public area created as part of the new bus terminal (previously funded by KfW) and alongside the floodwall which was constructed under CRDP. KCC has plans to make the Rupsha Ghat area more pedestrian friendly, to increase public amenities as well as improve tourist facilities, since many boat tours depart from Khulna

to visit the Sundarbans. Therefore, the development further includes a tourist boat terminal, with kiosks that can be leased for tourism related business, a jetty for boat tours and public Amphitheatre /cultural zone. The whole development works has been split into 4 phases with future phases to be include adjacent lands.

This sub-project complements the existing newly developed (through CRDP), and successful public space and food court behind the bus terminal. It thus complements the earlier investments/developments made through CRDP (by KfW) project, and its successes.

The land is owned by government (Khas land), while some parts of it is leased out and some portions being encroached by a few local businesses (sand/gravel and sawmills). This would require negotiation, approval and initiatives from the District Commissioner (DC) for the change of land use from its present use as small private manufacturing and processing activity to public space cum climate resilient public infrastructure.

Construction issues and sequence:

- Clearance of site and **removal** of existing structures and disposal of waste
- Raise the land and floodwall to above recommended flood level
- Construct jetty in front of shore
- Install seating/shading
- Install septic tank & piped water supply & power supply
- construction of foot paths
- Landscaping (piloting of water absorbing landscape and tree pits should be considered).



Figure 3.13 Location of Subproject 2 - River front development at Rupsha Ghat



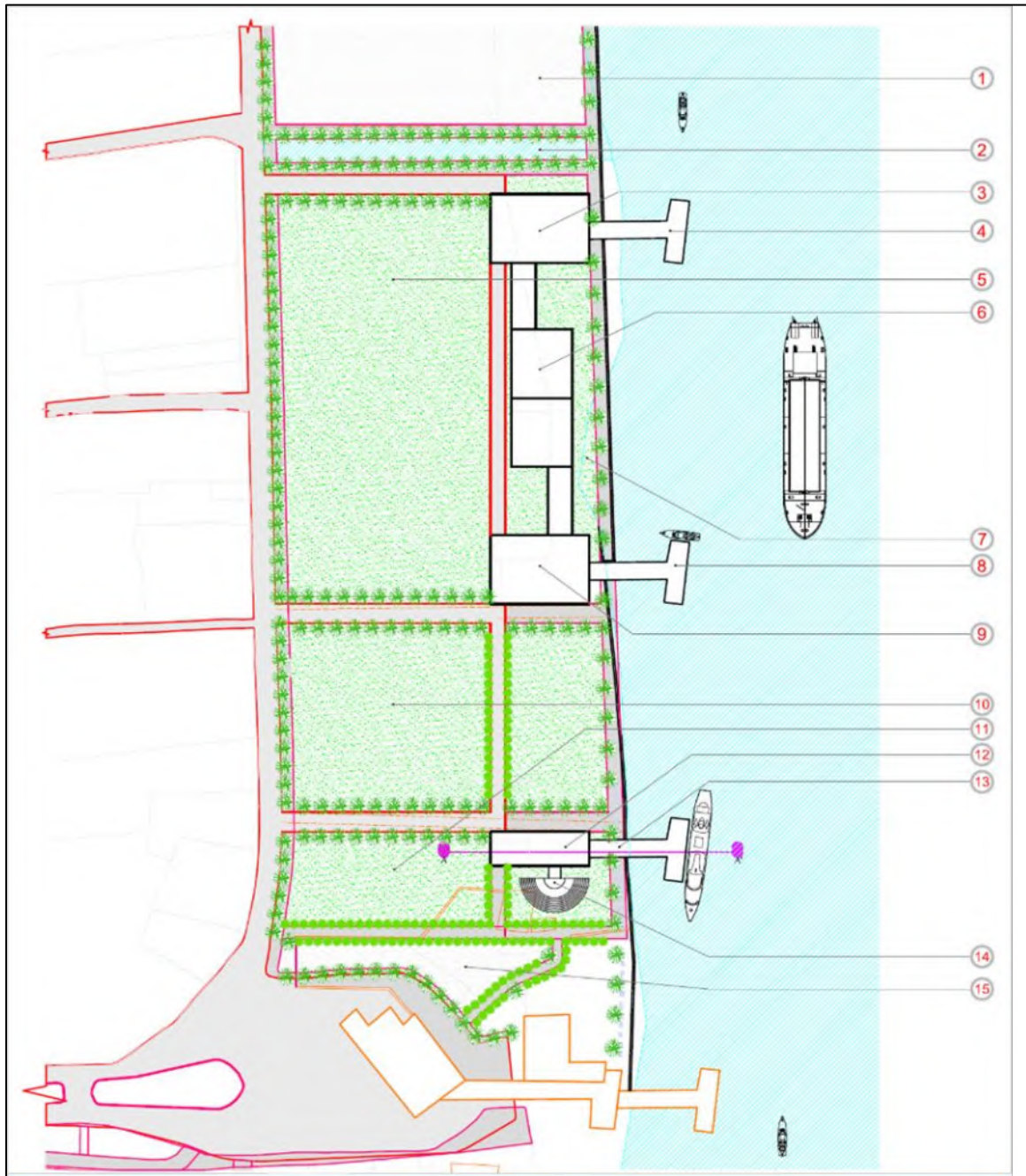
Figure 3.14 Existing site condition for Subproject 2



Figure 3.15 Current Situation of Riverfront North of Rupsha Ghat (2021)



Figure 3.16 Proposed Design Perspective for Sub-project 2 (Phase 1)



Legend

Site Area-1600 sqm

Total Shops – 50 permanent shops and 170 temporary shops

- | | |
|--|---|
| <ul style="list-style-type: none"> 1. Future Extension area (Phase 4) 2. Artificial Khal 3. Terminal 3 (Tourist Vessels) (Phase 3) 4. Jetty 3 (Tourist Boats) (Phase 3) 5. Land to be leased as future tourism-focused business park (Phase 3) 6. Tourist Accommodation (Phase 2 & 3) 7. Green vegetation (Phase 2) 8. Jetty 2 (Phase 2) | <ul style="list-style-type: none"> 9. Terminal 2 (Tourist Vessels) (Phase 2) 10. Land to be leased as future tourism-focused business park (Phase 3) & parking (Phase I) 11. Land to be developed as future cultural Zone (Phase 3) 12. Terminal 1 (River cruise) (Phase 1) 13. Jetty 1 (Phase 1) 14. Amphitheatre/cultural zone (Phase 1) 15. Land to be developed as market zone (Phase 3) |
|--|---|

Figure 3.17 Concept Design of Rupsha River front Park (as per feasibility study)

3.3 Subproject 3: Drainage Improvement in Sub-Catchments 17 and 21 including Sonadanga Bypass Road

Subproject Location: The subproject covers the area in Nobinagar and Sonadanga bypass road sub-catchments (**Figure 3.18**). The Nobinagar (17) and Sonadanga Bypass Rd (21) Sub-catchments are inner city catchments with an area of 83.3 ha. and 47.8 ha. respectively, and include part of Ward 18, as well as smaller areas of Ward 19 and 20 and is intersected in the north east by KDA Avenue and in the south west by MA Bari Street and bound by the Sonadanga bypass road in along its north-west boundary. The sub-catchments cover inner city areas with relatively high urban density.

Existing Condition: Nobinagar sub-catchment has two outlets that discharge to the Mayur River, the Nobinagar Khal and the Tomizuddin Khal (**Figure 3.18**). The primary drain serving this sub-catchment runs more or less through the centre of the sub catchment from upstream to downstream but when it reached MA Bari Street it follows this street on the east side. The primary drain also continues along MA Bari Street and then discharges into the Tomizuddin Khal which was converted into a box drain under the CRDP project with an access road on top.

The Sonadanga Bypass Rd sub-catchment currently has no outlet to the Mayur and small rain events cause extensive flooding near the intersection of Sonadanga bypass road and MA Bari Street.



Figure 3.18 Existing Site Condition of Sonadanga Bypass Road

Components and Scope of Works: This subproject comprises Upgrading of the drainage system.

Construction issues and sequence:

- Re-excavate sediment from drain and dispose,
- Construction of box drain
- Construction of gross pollutant and silt trap upstream of Khal,

Drainage Upgrading

The drainage network will comprise a predominantly grey infrastructure solution such as closed box drains which has co-benefits by allowing footpaths on top of the drain improving pedestrian safety while at the same time ensuring that waste cannot be dumped in drains. Silt traps will be incorporated on all major outlet drains to improve the ease of maintenance and sediment removal, and to reduce the silting up of the Khals. This subproject will allow implementation of a comprehensive drainage improvement solutions, which will ensure that flooding is reduced/minimized in the existing residential areas.

The design consideration includes the impact of climate change - an increase of 15% in rainfall up to 2050. Silt traps will be incorporated in the design for the easy removal of sediment in the drainage system. This subproject will provide direct improvement of the water logging/flooding situation to the residents living in the catchment of which a large proportion are moderate to extremely poor.

Construction issues and sequence:

- Site clearance and demolition of existing drains and disposal of waste,
- Breaking up road surface, and additional excavation to widen drains and disposal of waste,
- Diversion of existing services (water supply & power) where required,
- Construct new box drain and culverts,
- Construct gross pollutant and sediment traps.

Construction activities required for the road improvement include: Breaking up of existing road and removal and disposal of debris in line with solid waste management plan, Earth filling were necessary, Box cutting and hard bed preparation, Sand filling, Subbase preparation, Stone aggregate placement, Placing of plastic to receive reinforced concrete, Placement of reinforcement rebar, Installation of cork sheets at joints, Installation of kerb stones, Pouring of concrete, install tree-pits and landscaping.



Figure 3.19 Existing Dense Urban Development in Sub-catchment 17 and 21



Figure 3.20 Existing Situation of Sub-catchment 17 and 21 (2021)

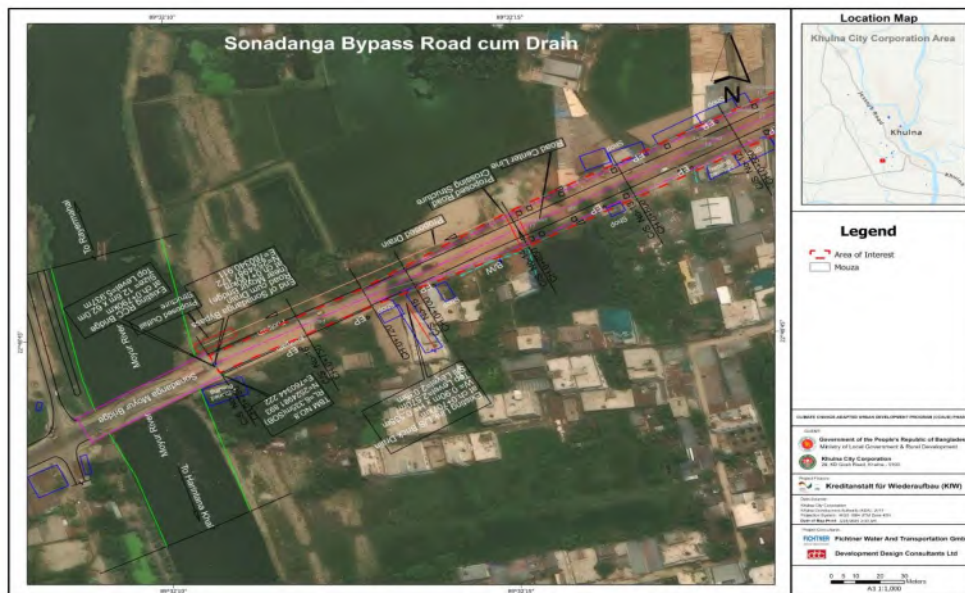


Figure 3.21 Location of Sonadanga Bypass Road Cum Drain

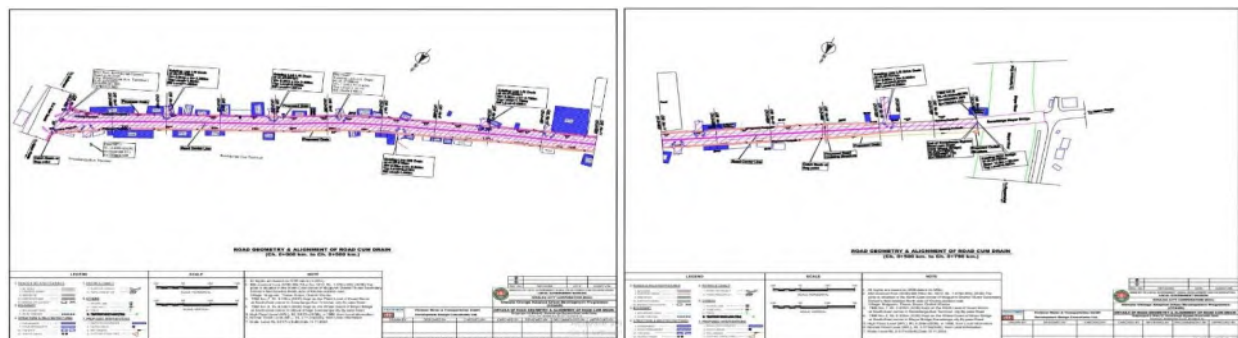


Figure 3.22 Concept Design of Sonadanga Bypass Road Cum Drain

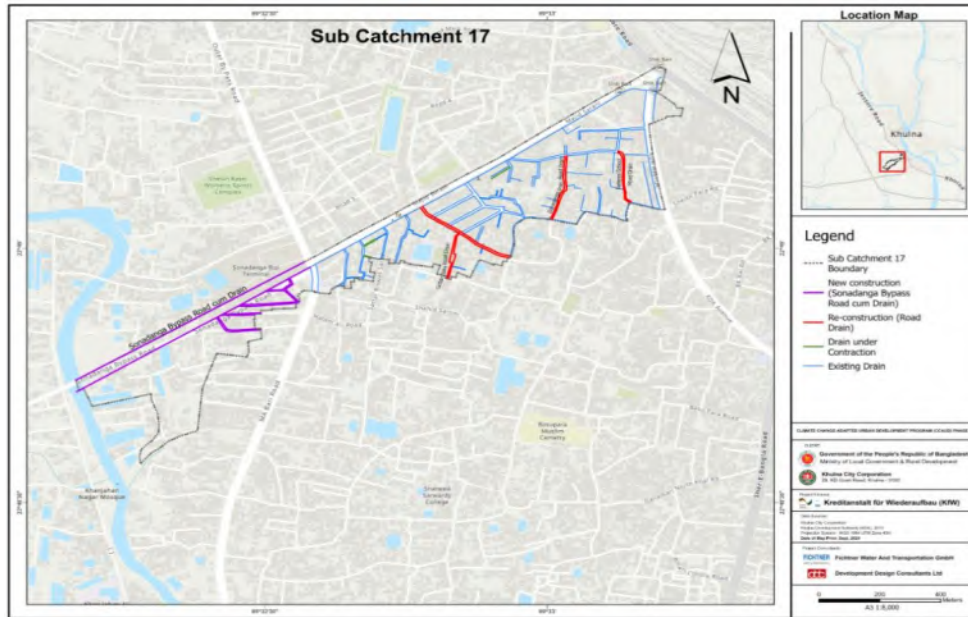


Figure 3.23 Sub-catchment 17 with the Drain Layout

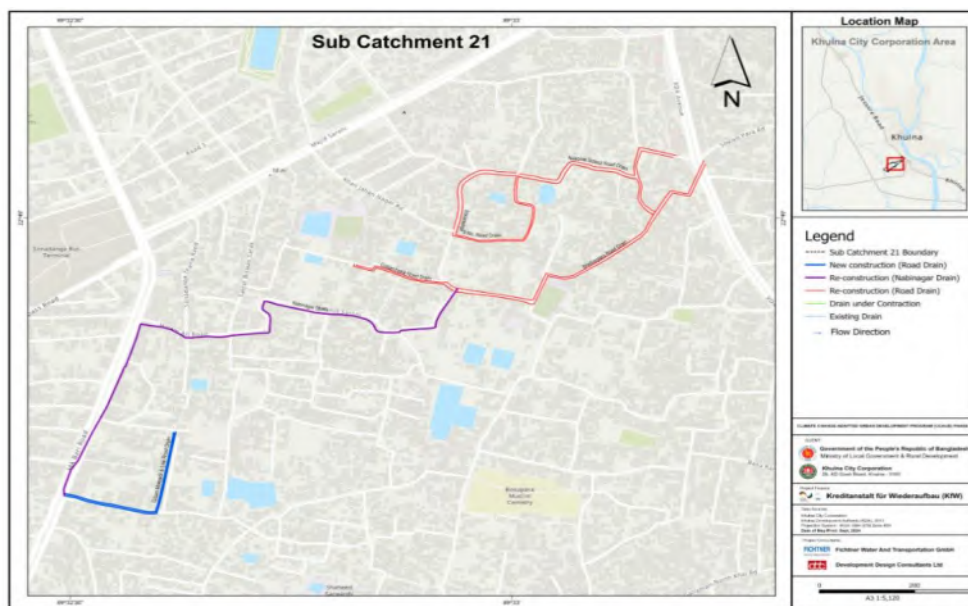


Figure 3.24 Sub-catchment 21 with the Drain Layout

3.4 Subproject 4: Drainage Improvement at Bastuhara Sub- Catchment 11 and Deana Chowdhury Khal Upgrading

Subproject Location: The Bastuhara sub-catchment, which covers an area of 279.6 ha has seen rapid urban development of the last couple of years especially in the upstream areas and land filling is now being deployed to develop the lower parts of the area. The Bastuhara Khal is the main outlet channel of the Bastuhara sub-catchment and Deane Chowdhury Khal is a branch of the Bastuhara Khal (**Figure 3.24 & 3.26**). The Bastuhara and the Deana Chowdhury Khal have silted up and currently overgrown with aquatic vegetation.

Existing Situation: At present sub-catchment 8, which is just south of sub-catchment 11 still discharges into the Bastuhara Khal which has caused overloading of this outlet and flooding of the low-lying areas of sub-catchment 11. Flooding in the urban areas occurs along Keshablal Road on a regular basis due undersized primary drain along the road. A new dedicated outlet drains for sub-catchment 8 along Bastuhara bypass road is currently being implemented under the KCC drainage improvement project 2019 and should reduce the overloading of the Bastuhara Khal.

Although the land in this sub-catchment is currently 70% built up, predominantly residential, 20% is still agricultural, which is undergoing rapid development and conversion to residential use.

The catchment includes a large number of moderate to very poor communities with some of them located near the Khals which will benefit from this subproject. The general accepted public behaviour of dumping waste in drains needs to be addressed to make this subproject more effective.



Figure 3.25 Existing Site Condition of Bastuhara Sub-Catchment 11 (2021)

Component and Scope of Works: This subproject includes drainage improvement over a total length of nearly 10 km. This subproject is divided into three parts: Bastuhara Khal Rehabilitation, D. Chowdhury Khal Rehabilitation, and Drainage system improvement.

Bastuhara Khal and Deana Chowdhury Khal Rehabilitation: The Khal rehabilitation includes the dredging and clearance of water hyacinth at Bastuhara Khal with a total length of 1900m, including re-establishment of green embankment using green lining methods. The rehabilitated Bastuhara Khal will be within the reserve indicated by bollards on site. It is proposed to incorporate link parks with 3m wide public access paths on both sides of the Khal which also functions as a KCC maintenance access. Benches and solar lighting will be installed along the Khal. The land for the link park is outside the drainage reserve and will partially overlap with the 6.0m wide KDA road reserve that has been planned along both banks of the Khal. This park proposal will require the current land use plan to be amended.

For the Deana Chowdhury Khal similar improvements are proposed over a total length of 1055m.

Drainage system improvement: The subproject comprises mostly grey/conventional drainage infrastructure, although the incorporation of green infrastructure opportunities will be investigated. The closed box drains proposed has co-benefits and will be provided with footpaths on top improving pedestrian safety at the same time ensuring that waste cannot be dumped in drains. Gross pollutant & silt traps will be incorporated on all major outlet drains to improve the ease of maintenance and sediment removal, and to reduce the silting up of the Khals.

This subproject will allow the implementation a comprehensive drainage improvement solution, while the yet undeveloped agricultural land provides opportunities for the incorporation of green infrastructure measures such as detention storage. The design consideration includes the impact of climate change - an increase of 15% in rainfall up to 2050.

Construction issues and sequence

Construction activities are proposed for the *Bastuhara and Deana Chowdhury Khal Rehabilitation*:

- Demolition of temporary buildings in drainage reserve
- Clear water hyacinth, and solid waste from Khal and dispose in line with solid waste management plan
- Re-excavate sediment from Khal and dispose in line with solid waste management plan
- Earthworks to form Khal cross section
- Lining of banks of the Khal
- Construction of box drain at upstream end
- Construction of gross pollutant and silt trap at outlet to Khal
- Construction of public path and boardwalk along Khal
- Installation of seats/benches, solar lights and pavilions, kiosks along banks
- Landscaping

Construction activities are envisaged for the drainage system upgrading:

- Site clearance and demolition of existing drains and disposal of waste in line with solid waste management plan
- Breaking up road surface, and additional excavation to widen drains and disposal of waste in line with solid waste management plan
- Diversion of existing services (water supply & power) where required
- Provide temporary access across construction site to buildings
- Construct new box drain and culverts
- Construct gross pollutant and sediment traps
- Pumping out of drainage water entering the construction site
- Backfilling and road reinstatement where required

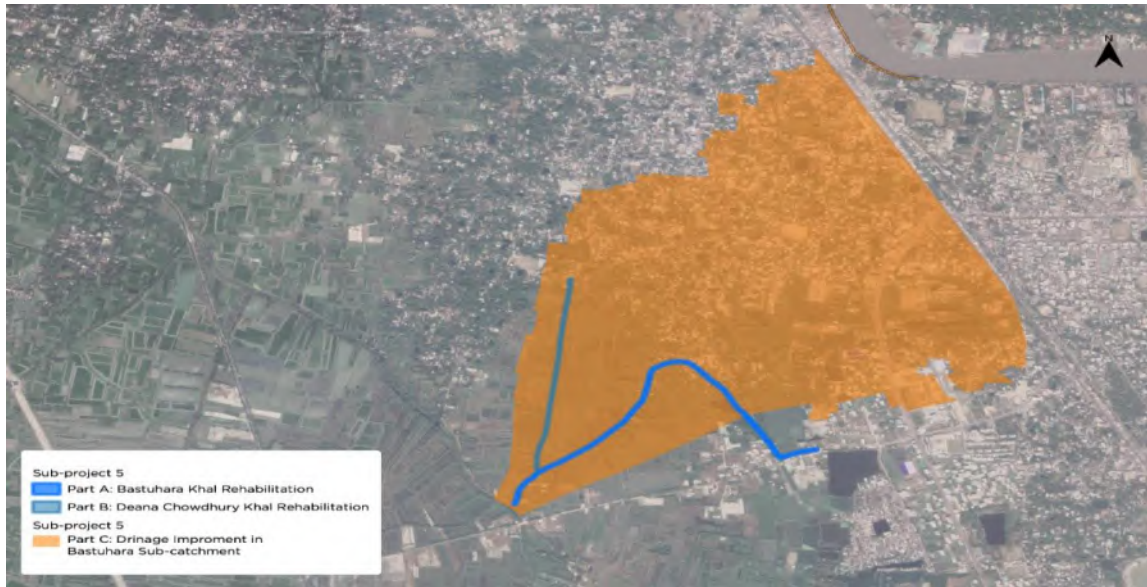


Figure 3.26 Location of Subproject 4 - Drainage Upgrading at Bastuhara Sub-catchment



Figure 3.27 Existing Condition of Bastuhara Khal at Downstream End (Nov 2020)



Figure 3.28 Existing situation near bridge across Bastuhara Khal (Nov 2020)



Figure 3.29 Existing condition of Deana Chowdhury Khal at the downstream end (Nov 2020)

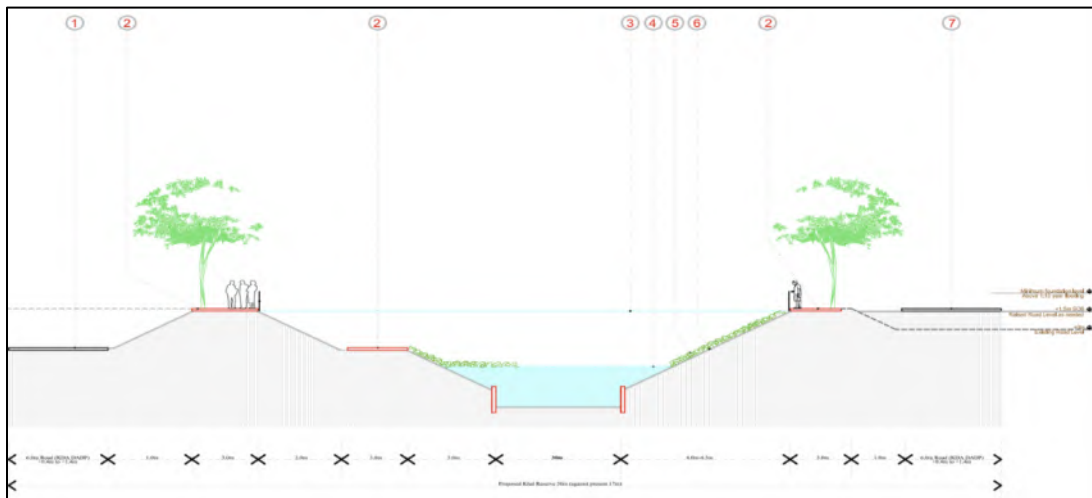


Figure 3.30 Proposed upgraded Khal cross section for Bastuhara Khal

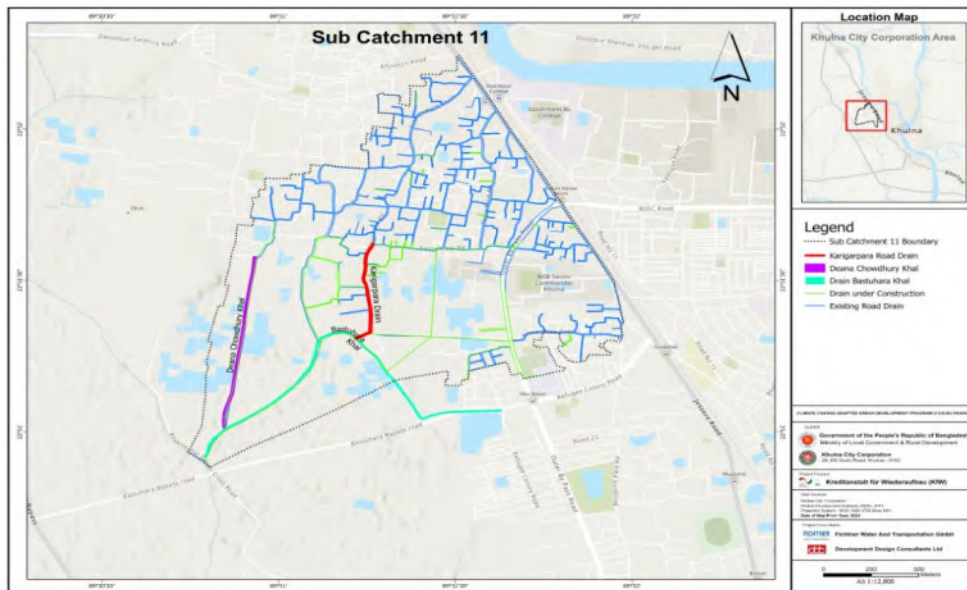


Figure 3.31 Proposed Drains to be Upgraded in Bastuhara Sub-catchment

3.5 Subproject 5: Upgrade of Labonchara Khal Outlet Gates and Construction of Labonchara Pumping Station

Subproject Location: The Labonchara outlet gates are located in the southeast of the KCC area. The Labonchara outlet is the main outlet drain for catchment 5 and can currently only spill excess stormwater over a 4-hour period during low tide.

Existing Situation: The existing outlet gates comprise two penstocks on the upstream side which are no longer present and two flap gates at the downstream side which are in a half open position, as a result Rupsha River water can enter during high tide and causes water logging along the Khals and at low lying areas. The outlet flap gates in Labonchara Khal 2 are currently not operational and in a half open position, as a result Rupsha River water can enter during high tide and causes water logging along the Khals and low-lying areas.

The land use upstream of the gates is currently residential and agricultural but in the future land use plan designated as residential land use. Downstream of the gates the land is designated for manufacturing and processing activity. This land is state-owned and DC approval will be required. A large number of poor settlements which includes climate migrants, are located in the catchment which will benefit indirectly from this measure. In addition, there are also many poor livings in low lying areas in the catchment that frequent waterlog which will directly benefit from this measure.



Figure 3.32 Existing Site Condition of Labonchara Khal Outlet Gate (2025)

Components and Scope of Work: The sub-project includes expansion of the outlet gates and a pumping station to ensure that excess stormwater can be discharged during high tide reducing flooding and water logging within the catchment when rain events coincide with high tide. The outlet gates and pumping station will be designed with additional capacity to deal with an increase of 15% in rainfall up to 2050 as a result of climate change. The new pump house and gates are proposed to be constructed on the Rupsha

River site of the Labonchara Road. The existing gates can therefore remain operational until the new gates are ready to take over the function. A new bridge will be required to be constructed in stages across the width of Labonchara No.2 Khal.

The design of the subproject comprises upgrading of the gate structure and outlet gates including 4 vents outlet gates with 3.0m x 2.5m motorized gates and the construction of a 30m³/s pumping station at the Labonchara Khal 2 outlet. Standby pumping capacity will be provided as well as emergency power supply in the form of diesel generators.

The pumping station structure will comprise a reinforced concrete structure and brick building to house pumping equipment, standby power supply will be provided in the form of a generator. Guide walls to guide the flow and channel erosion protection will be part of this solution. Upgrading includes demolition of the existing structure and reconstruction of a new bored piled concrete superstructure, complete with concrete guide walls and bottom erosion protection and installation of new motorized penstocks and flap gates.

Construction issues and sequence

- Site clearance and disposal of waste in line with waste management plan
- Provide temporary road crossing across construction site
- Install sheet pile cofferdam and anti-seepage screen
- Excavation pit for pumping station/gate structure and disposal of waste in line with waste management plan
- Dewatering of pit to allow construction
- Piling of foundation
- Construction of reinforced concrete PS/gate structure
- backfilling and reinstatement around structures
- Install screens, stop logs, gates
- Install pumps with controls
- Install transformers
- Install power supply cables from tap off point to site
- Install back-up generators
- Construct operator room and house for operator
- Site reinstatement and landscaping
- Excavate approach and discharge channel and dispose of waste
- Placing of geotextile
- Placing of concrete blocks for erosion protection up and downstream
- Close one lane and demolish part of the existing old gate structure
- Construct new bridge across the Khal complete with foundation and transfer plates
- Complete for the other half of the bridge complete with foundation and transfer plates.
- Reseal road



Figure 3.33 Khal Network Upstream of the Outlet at Labonchara 2 Khal



Figure 3.34 Site Condition of Labonchara 2 Khal (upgrading of outlet gate and a new PS)



Figure 3.35 Labonchara Gate and Pumping Station Layout Options

Power supply: An 11kV feeder line is available in 40 m distance from main road and 100 m distance from the nearest tap off point, while the proposed pump station is approximately 25 m distance from the main road. At Alutola a 11kV feeder line is available 30 m distance from main road and 50 m distance from the nearest tap off point. The proposed gates are approximately 45 m distance from the main road.



Figure 3.36 Location for Power Supply tap off Point at Labonchara and Nearest Point at Alutola

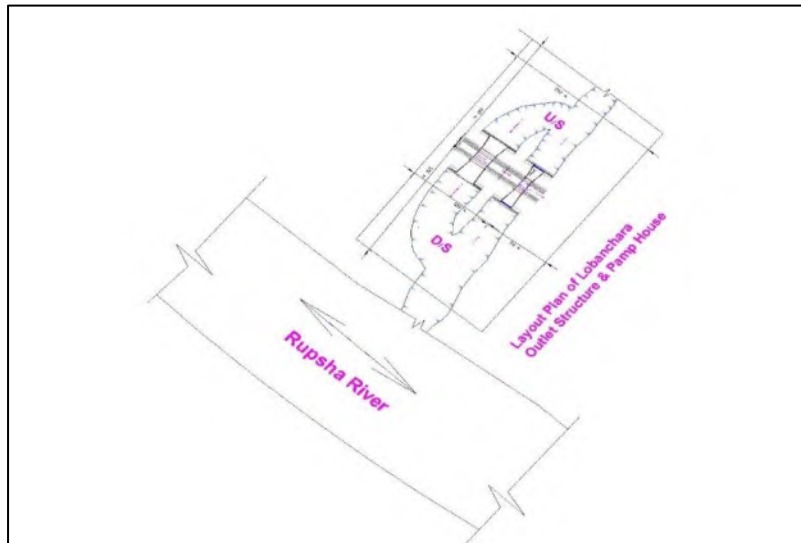


Figure 3.37 layout Plan of Labonchara Outlet Structure and Pump House

3.6 Subproject 6: Upgrade of Alutola Outlet Gates

Subproject Location: The Alutola outlet gates are located in the south of the KCC area as shown in Figure 3.37.

Existing Condition: The existing gates although still operable are in a bad condition (Figure 3.35, 3.37 & 3.38). The gates can only discharge excess stormwater for a four-hour period during high tide. When heavy rainfall coincides with high tide water levels in the Mayur will rise, causing upstream flooding in low lying areas in the city. Settlements located along the Mayur and in low-lying areas that frequently waterlog will directly benefit from this measure.



Figure 3.38 Existing Site Condition of Alutola Outlet Gates (2025)

Components and Scope of Work: The subproject includes the demolition of the existing structure and reconstruction of the concrete superstructure, complete with concrete guide walls, bottom erosion protection and installation of new motorized gates. It is proposed to construct the new gates downstream of the existing gates, and the existing gate will be able to be operational until the new gates have been completed. Once the new gates are completed and the road is re-aligned, and the traffic diverted on the new outlet gates structure the existing gates can be demolished. It is proposed to carry out the upgrading in following two phases:

Phase 1 - upgrading of the Alutola outlet gates of the existing gate structure and the construction of an 11 vent 3.0 x 2.3m motorized gates (**Figure 3.37**). The outlet gates will be designed with additional capacity to deal with an increase of 15% in rainfall up to 2050 as a result of climate change. The outlet gates will be designed with additional capacity to deal with an increase of 15% in rainfall up to 2050 as a result of climate change. The outlet gate upgrading at Alutola is a standalone drainage measure which will improve the discharge capacity during low tide. However, this subproject would be more effective if conveyance in the Khals and Mayur River was improved. The waterway rehabilitation is proposed as part of the KCC drainage project 2019.

Phase 2: construction of a new pumping station and will be included as part of the investment proposal.

Construction issues and sequence

- Site clearance
- Install cofferdam and anti-seepage screen
- Excavation pit for gate structure and disposal of waste in line with solid waste management plan
- Dewatering of pit to allow construction
- Piling of foundation
- Construction of reinforced concrete gate structure, including road
- backfilling and reinstatement around structures
- Install, stop logs, gates
- Install transformer and power supply cables from tap off point to site
- Install backup generator
- Construct operator room and house for operator
- Site reinstatement and landscaping
- Excavate approach and discharge channel and dispose of waste
- placing of geotextile
- placing of concrete blocks for erosion protection up and downstream
- Redivert traffic over new outlet structure
- Site clearance



Figure 3.39 Subproject 7- Location of Alutola Outlet gates



Figure 3.40 Existing Conditions of Alutola Outlet Gates (2021)



Figure 3.41 Proposed Layout of Alutola Outlet Gates with Re-aligned Road

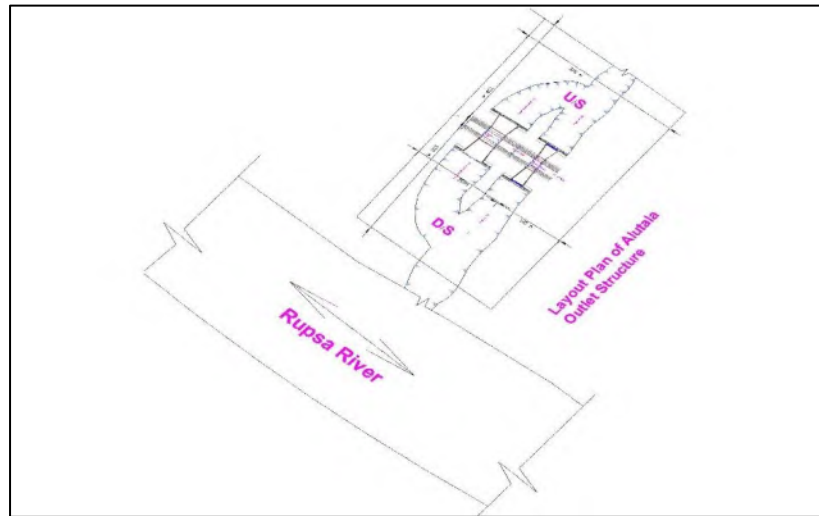


Figure 3.42 Layout Plan of Alutala Outlet Structure

3.7 Subproject 7: Nirala Khal Revitalization and Link Park

Subproject Location: The Nirala Khal is a branch of the Mayur river (Figure 3.40).

Existing Condition: The Nirala Khal is currently silted up and heavily overgrown with water hyacinth. Bridges have been installed by local communities across the Khal which is impeding the flow.



Figure 3.43 Nirala Khal Revitalization and Link Park (2025)

Components and Scope of Work: Subproject 7 consists of the development of a link park along the Nirala Khal, a branch of the Mayur. A public foot paths will be installed along the bank to provide connectivity along both banks of the Nirala comprising public access paths, board walks and foot bridges. The paths will also provide access to the Khal for maintenance activities. The western part of this branch flows towards the Mayur while the eastern section flows east into catchment 5 towards Labonchara. The project will be implemented within the drainage reserve boundary markers located on site, and no additional land needs to be acquired.

It is envisaged to construct a weir at the catchment boundary to separate the flows. An interceptor will be incorporated along the banks of the branch to collect the currently still polluted stormwater drainage water and divert this to the Mayur (See **Figure 3.41**). This will create a clean water section which ensures that the surface water is not polluted by sewage. The Nirala pond overflow could potentially be treated in a wetland and discharged into the clean water section of the branch. The Nirala pond rehabilitation will provide a continuation of the link park to create additional public amenities. Kiosks and food outlets will be incorporated along the park connector. The concept of the link park is shown in **Figure 3.42, Figure 3.43 and Figure 3.45**.

While opening up the riverfront and making it accessible to communities will certainly create an impetus to save it from further deterioration, the commonly practiced behaviour of dumping waste into drains needs to be addressed simultaneously to make this measure effective. The park will require regular maintenance and waste collection from bins, where private sector involvement could be explored. This sub-project has synergies with measure 15 Nirala Pond upgrading and 14b Mayur River regeneration. Alternative ways of providing connectivity such as boardwalk can also be explored to reduce the resettlement.

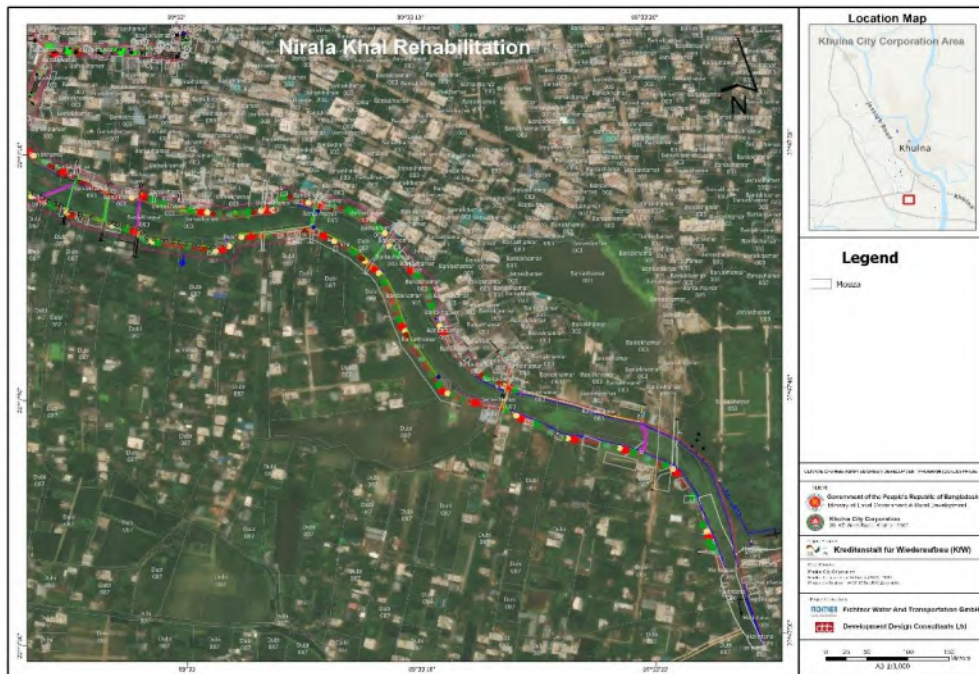
Nirmala branch link park is considered as a pilot-project, consisting of a blue-green spatial interface along a tributary of the Mayur, which should foster co-benefits such as reducing runoff and the heat island affect, diverting greywater from drains/Khals resulting in a clean river water section and create connectivity among neighboring communities by provisioning pedestrian-friendly riverfront tracks. Public amenities and recreational facilities have to be incorporated along this track, based on the availability of land and ward-specific demand analysis. A vibrant river bank hence will be created that would, at the same time, save the waterfront from further encroachment (KCC has already done this quite successfully in cases like Mollapara Khal; similar has been done earlier in Dhanmondi lake regeneration in Dhaka), and be used for the improvement of health, sociability, recreation, employment and income generation for local residents.

Construction issues and sequence

- Demolition of temporary buildings in drainage reserve
- Clear water hyacinth, and solid waste from Khal and dispose in line with waste management plan
- Re-excavate sediment from Khal and dispose in line with waste management plan
- Earthworks to reinstate Khal cross section
- Lining of banks of the Khal
- Construction of piled box drain and boardwalk/path
- Construction of gross pollutant and silt trap at outlet to Khal
- Installation of seats/benches, solar lights and pavilions, kiosks along banks
- Construction of bridges
- Landscaping



Part A



Part B

Figure 3.44 Location of Subproject 7 (Part A & B) - Nirala Khal Revitalization and Link Park



Figure 3.45 Existing Conditions of the Nirala Khal (2021)

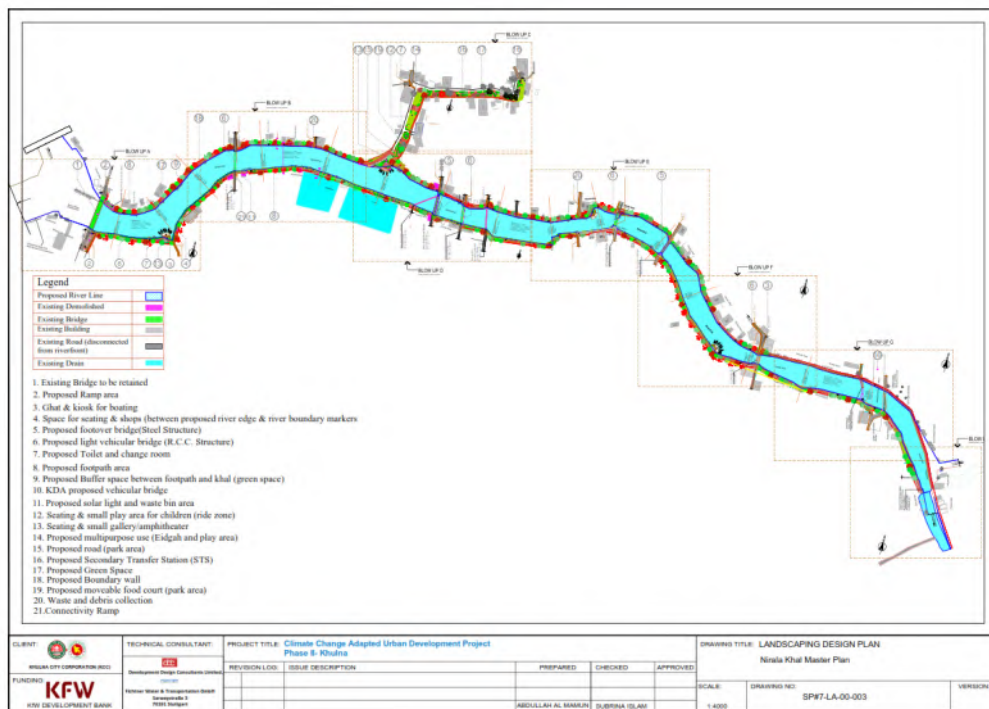


Figure 3.46 Conceptual site plan of Nirala Khal

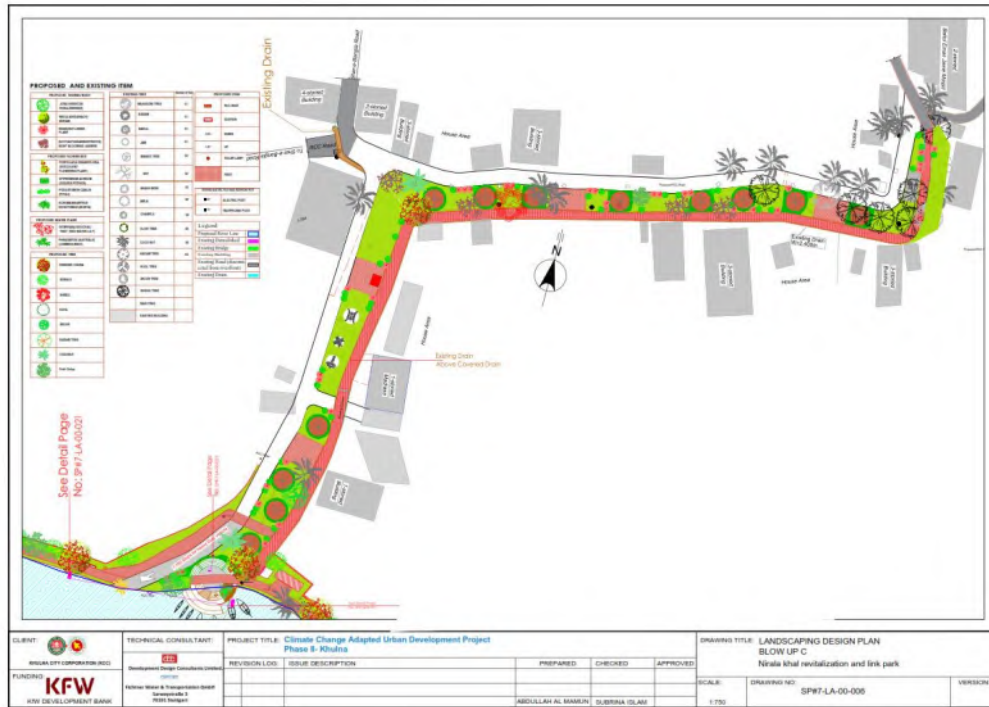


Figure 3.47 Landscaping Design Plan of Nirala Khal



Figure 3.48 Existing Conditions of Bridge Location of the Nirala Khal (2025)

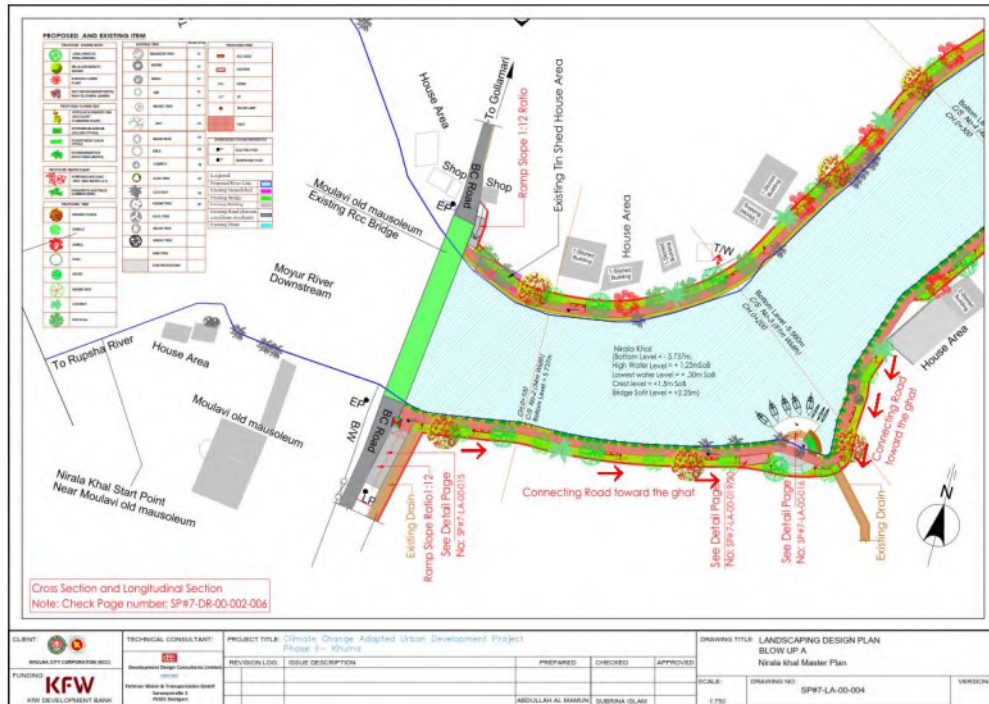


Figure 3.49 Landscaping Design Plan Blow Up A

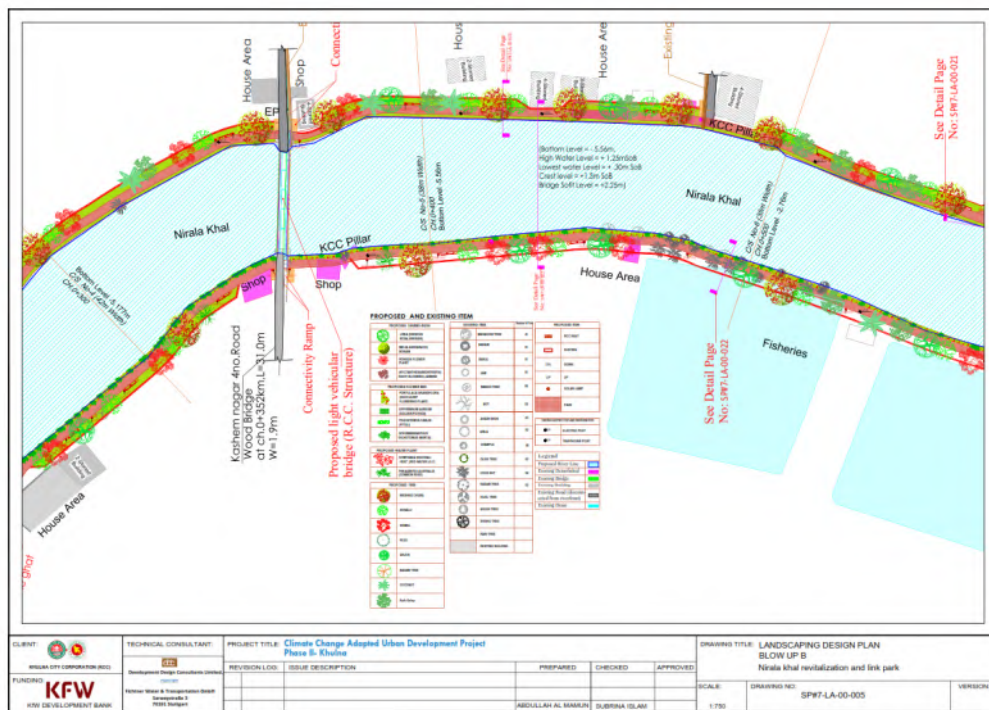


Figure 3.50 Landscaping Design Plan Blow Up B

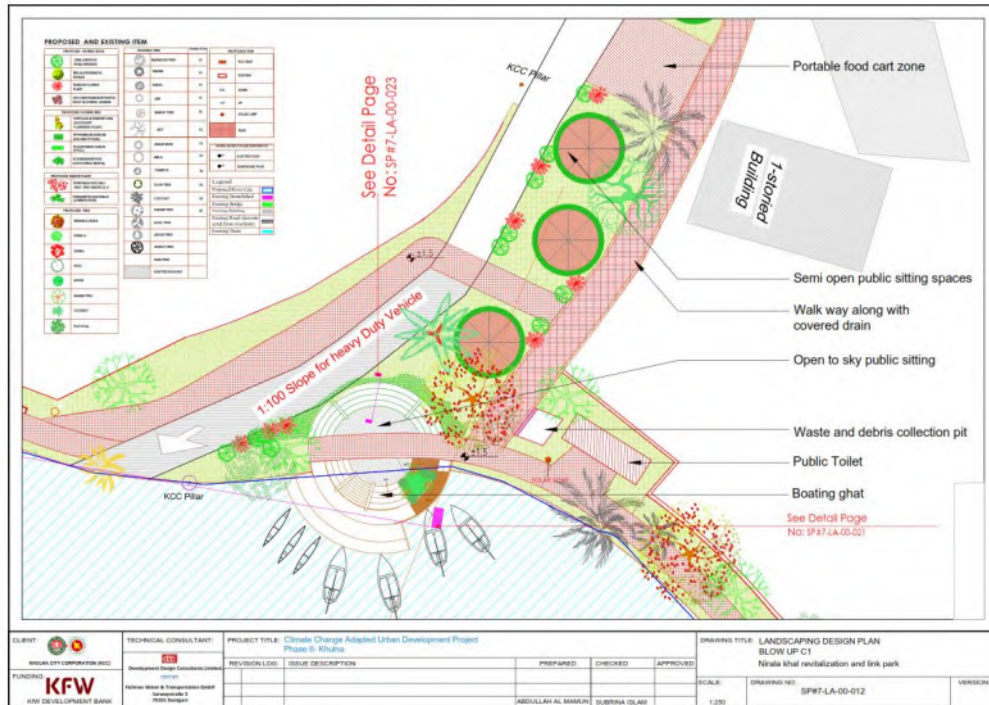


Figure 3.51 Landscaping Design Plan Blow Up C1

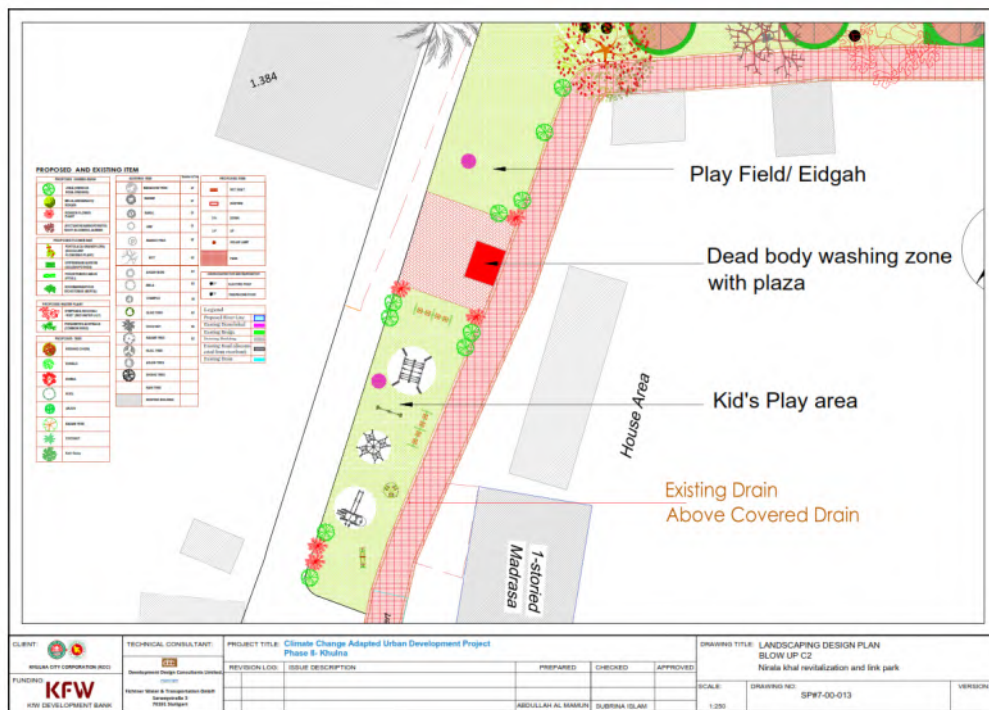


Figure 3.52 Landscaping Design Plan Blow Up C2

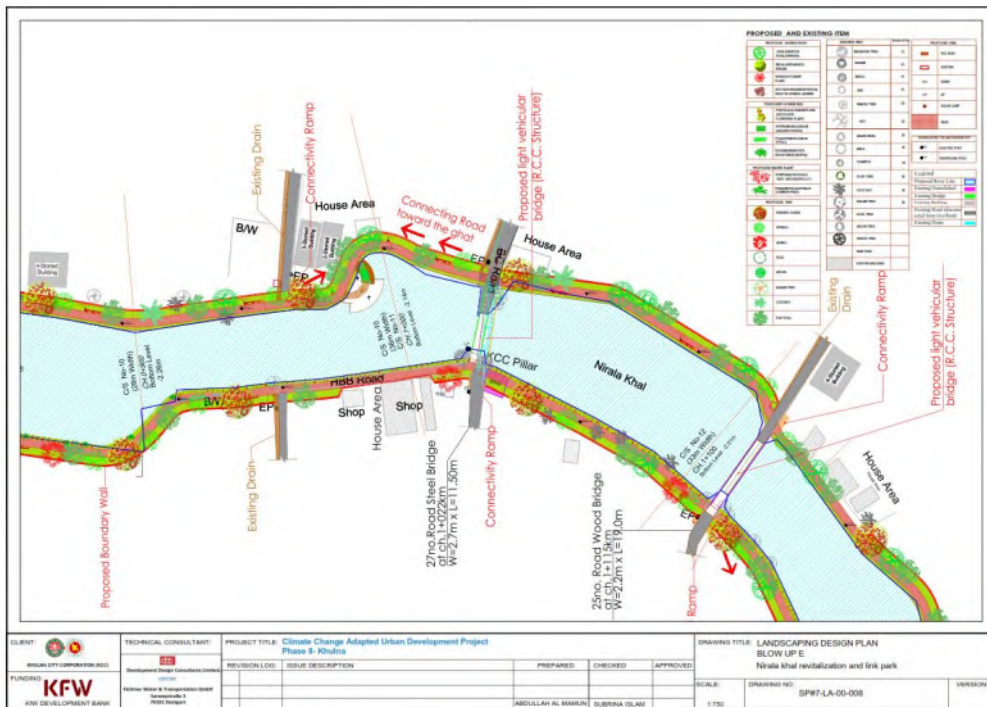


Figure 3.55 Landscaping Design Plan Blow Up E

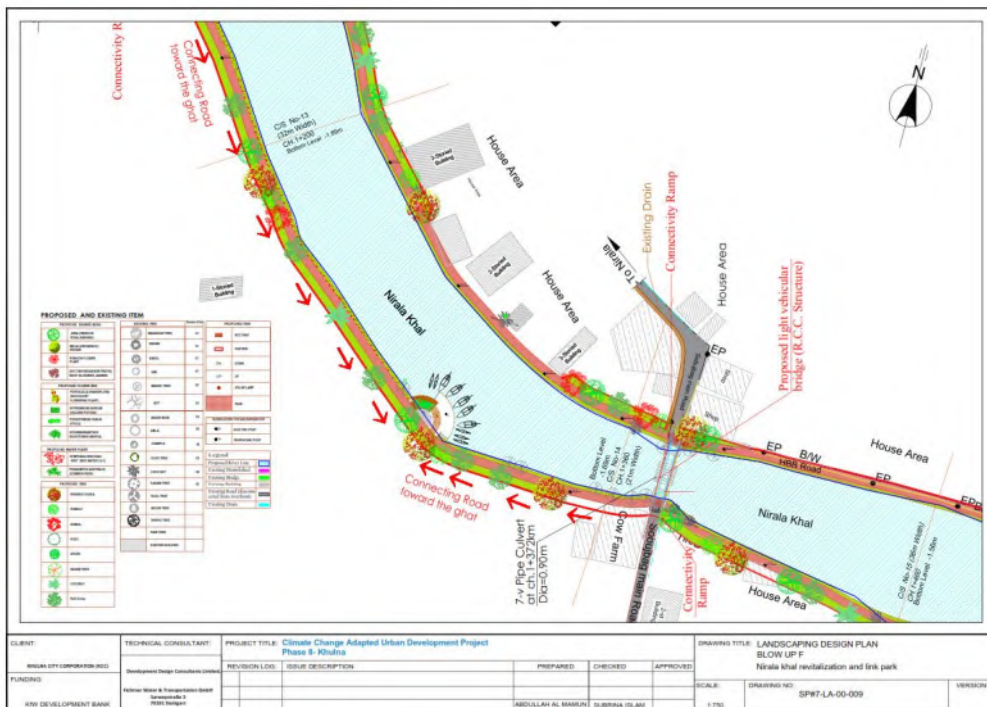


Figure 3.56 Landscaping Design Plan Blow Up F

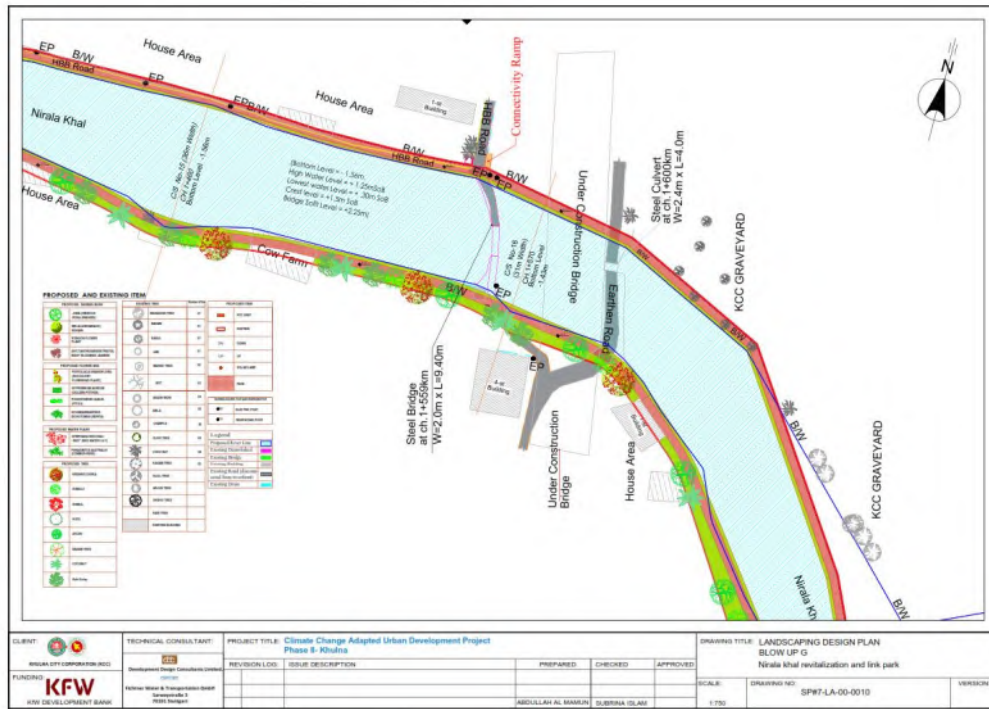


Figure 3.57 Landscaping Design Plan Blow Up G

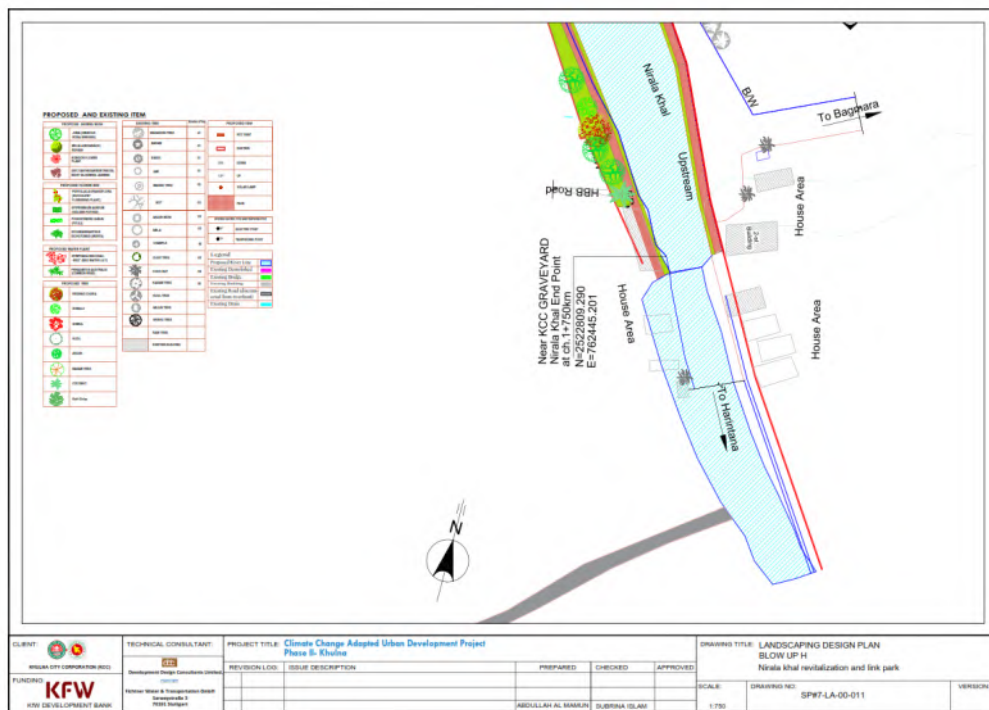


Figure 3.58 Landscaping Design Plan Blow Up H

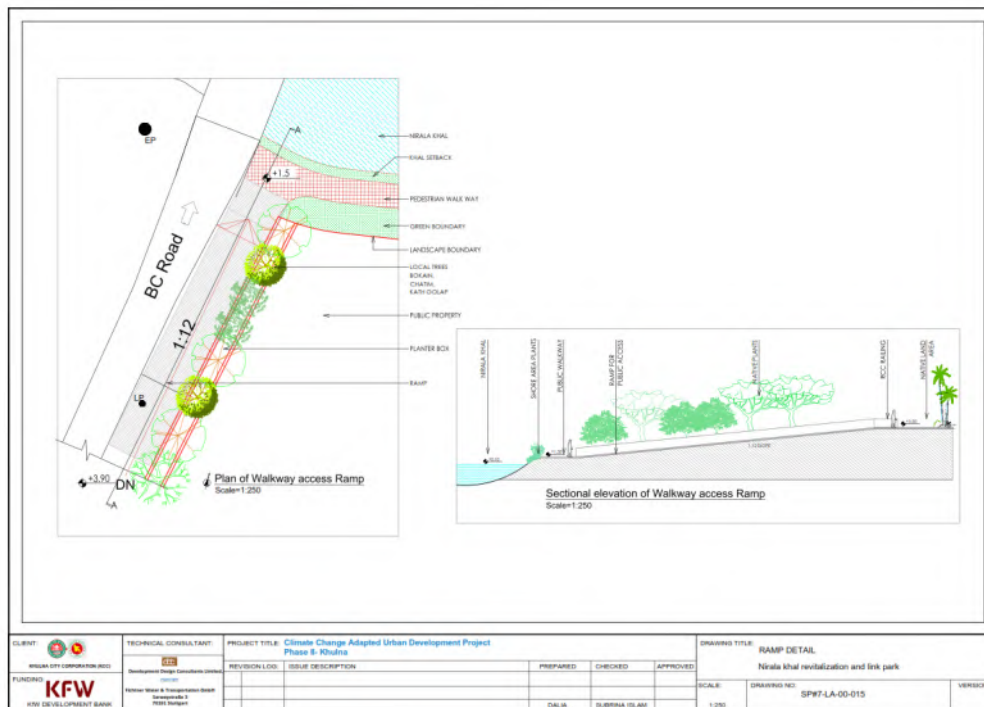


Figure 3.59 RAMP DETAIL -Nirala Khal Revitalization and Link Park

3.8 Subproject 8: Rehabilitation of Approximately 18 Ponds

Components and Scope of Work: Subproject 8 includes improvement of 18 ponds. The ponds have been categorized in small, medium and large ponds. The improvements proposed include dredging and removal of water hyacinth where necessary, reconstruction of pond edge, improvement of access road, provision of toilet and bathing facilities, beautify the area around the ponds by creating public spaces in the form of parks which can include amenities such as exercise tracks, benches, small shops/kiosks, concrete boardwalks and paths, Ghats, overflow drain, seating, solar lighting, waste bins, and drain improvement. The ponds will be converted into a recreational space where bathing & sitting arrangements will be ensured. KCC may benefit from the revenue generated by leasing the shops/kiosks. Ponds will not be expanded; however, a circular pedestrian paths and boardwalks will be constructed around the ponds. On that basis no resettlement or land acquisition is required.

The rehabilitation of the ponds will follow nature base solution e.g., local runoff from the parks will be filtered through water absorbing landscape, including trees, and treated before discharged into the ponds. Sign boards will be erected to create awareness of the rules and regulation at the ponds such as the once associated with the pond’s use and littering. Proper management procedures will need to be implemented to make pond improvements sustainable. The ponds and parks will ensure that blue-green spaces are created within the city which at the same time reduces the heat island effect as a result of increasing temperatures due to climate change.

Construction issues and sequence:

- Removal of water hyacinth and solid waste and dispose in line with waste management plan
- Re-excavate sediment from ponds and dispose in line with waste management plan
- Lining of banks of the ponds

- Site clearance of land adjacent to ponds (where necessary)
- Construction of public paths/semi paved areas and boardwalks
- Isolate/divert drainage outlet away from ponds or provide non-return or flap valve
- Construction of Ghats and handrails
- Installation of seats/benches, solar lights and pavilions, along banks
- Installation of public toilets/changing rooms/including septic tank & water supply
- construction of kiosks/shops
- New planting and landscaping

Subproject Location: Under this project a total of 18 ponds have been selected for rehabilitation. The locations of ponds are presented in **Figure 3.46** and the ownership in **Table 3.2**.

Table 3.2 Details of the 18 Ponds Under Subproject Eight

S.N.	Name of the ponds	KCC Ward Number	Ownership	Expected Rehabilitation Work	Remarks
1	Moheshwarpasha Graveyard Pond	3	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Several Ghats • Protection Wall • Land Development • Change room • Deep Tube well • Dredging required (according to water level) • Existing Depth (tentatively 7/8') • Walk way, sitting, street light 	
2	BL College Pond	6	BL College authority	<ul style="list-style-type: none"> • Walk way, sitting, street light • Multiple Ghats • Change room Male/Female • Protection wall • Depth (tentatively 10') 	
3	Pabla Moddhya Para Sarbojanin Temple	6	Pabla Moddhya Para Sarbojanin Temple Authority	<ul style="list-style-type: none"> • Dredging required • Multiple Ghats • Walk way, sitting, street light • Boundary requires • Change room Male/Female • Multiple Ghats 	
4	Wonderland Park Pond	10, 12	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • The retaining wall of 20 no. Khalishpur Road is okay. • The Eid gah Road boundary wall has to be renovated • The retaining wall of 16 no. road needs to be renovated • Change room Male/Female • Multiple Ghats 	
5	Khalishpur High School (Chorer Hut) Pond	13	Khalishpur High School (Chorer Hut) Authority	<ul style="list-style-type: none"> • Park in renovated area • Change room Male/Female • Walk way, sitting, street light • Gaming size pond • Existing depth (almost filled with garbage) • Multiple Ghats for Male/Female 	
6	16 no. Ward Office Pond	16	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Park in renovated area • Change room M/F • Walk way + sitting + street light • Protection wall repairing • Existing depth (tentatively 10'-12') 	

S.N.	Name of the ponds	KCC Ward Number	Ownership	Expected Rehabilitation Work	Remarks
				<ul style="list-style-type: none"> • Around 1000 people use the pond daily • Different Ghats for Male/Female 	
7	Horijon Koloni Pond	17	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Change room M/F • Walk way + sitting + street light • Common toilet Male/Female • Waste Management (secondary point) • Protection wall + railing 	
8	Solar park Pond	17	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Boundary wall renovation • Protection wall • Small bridge • Ghat with sitting • lighting in walkway • swimming learning point for kids 	
9	Boyra High School Pond	17	Boyra High School Authority	<ul style="list-style-type: none"> • Walk way, sitting, street light • Protection wall • Park facilities • Multiple Ghats • Gaming standard Pond • Change room Male/Female 	
10	Sonadanga Bus Stand Pond	18	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Protection wall • Walk way (West side), sitting, street light • Change room Male/Female • Existing depth (tentatively 10') 	
11	Talimul Millat Rahmatia Fazil Madrasha Pond	18	Madrasha Authority	<ul style="list-style-type: none"> • Protection wall in west side • Ghats with sitting • Change room Male/Female 	
12	Banargati Bot tola Temple Pond	25	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Multiple Ghats • Change room Male/Female • Renovation work in west side of pond • Extremely polluted water 	
13	Lions School & College Pond	25	Lions School & College Authority	<ul style="list-style-type: none"> • Gaming pond required • Ghats with sitting • Change room Male/Female • Protection wall • Dredging is mandatory 	
14	Government Majid Memorial City College, Hostel adjacent Pond	26	Government Majid Memorial City College Authority	<ul style="list-style-type: none"> • Renovation and water purifying mandatory • Multiple Ghats • Walk way, sitting, street light • Protection work 	
15	Municipal Tank Road Pond	29	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Protection wall required in South/ West • Railing work • Partly walkway, street light • Multiple Ghats 	
16	Taltola Hospital Pond	30	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Retaining Wall • Change room Male/Fem • Washing zone for dead body • Dredging required • Multiple Ghats 	
17	Haji Malek Jannatul Baki Graveyard Pond	31	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Retaining Wall • Walk way, sitting, street light • Change room Male/Female 	

S.N.	Name of the ponds	KCC Ward Number	Ownership	Expected Rehabilitation Work	Remarks
				<ul style="list-style-type: none"> • Common toilet renovation • Washing zone for dead body • Dredging required • Multiple Ghats 	
18	Maheshtank Pond	17	KCC (Khulna City Corporation)	<ul style="list-style-type: none"> • Preservation • Development • Renovation 	

Existing Condition: Ponds are currently used for many purposes e.g., washing and bathing (source of non-potable domestic water), and aquacultures. Most of the ponds are associated with pollution and poor maintenance. Pollution is caused by dumping of waste, unbalanced fish feeding practices and the connection of ponds with artificial open drains which are poorly maintained.

The existing ponds are gradually filled up due to population growth and rising land prices in Khulna. The rising demand for land makes it attractive for pond owners to sell their land to real estate developers, who fill up the ponds for the construction of buildings. Most of the ponds in Khulna doesn't play role in reducing localized runoff and retention of rainwater, since not all the ponds are directly connected to the drainage system. As the drainage system contains diluted wastewater, it would not be consistent with the recreational use of the ponds to drain into the pond water. The ponds can therefore not play a significant role in flood storage, but ponds do play a role in reducing localized runoff and allow harvesting of this runoff from areas around the pond.

3.8.1 Moheshwarpasha Graveyard Pond (Pond No. 1)



Figure 3.60 Existing Condition of Moheshwarpasha Graveyard Pond (2025)

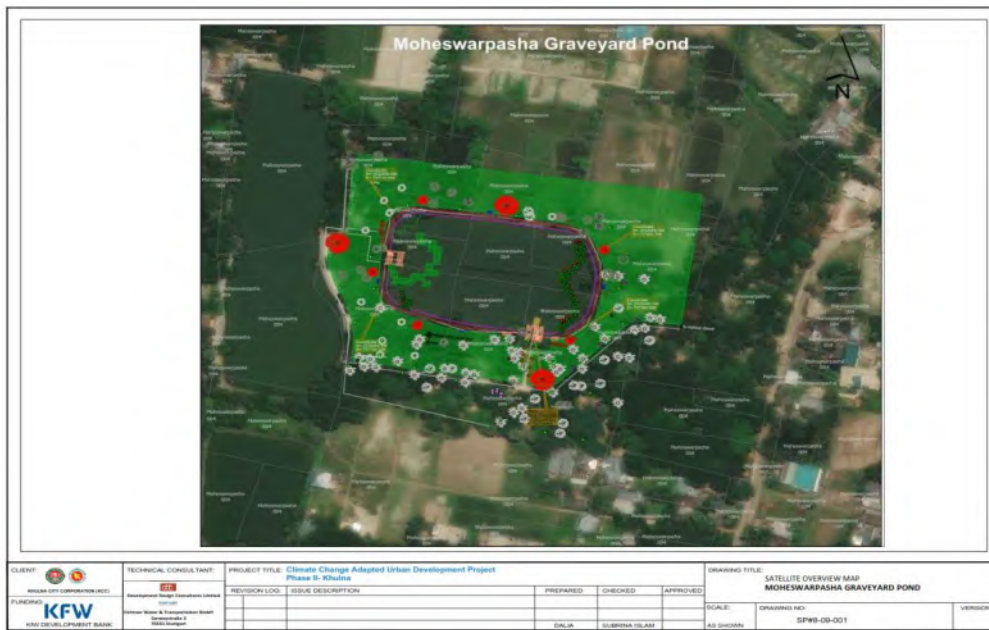


Figure 3.61 Location of Moheshwarpasha Graveyard Pond on Google Map

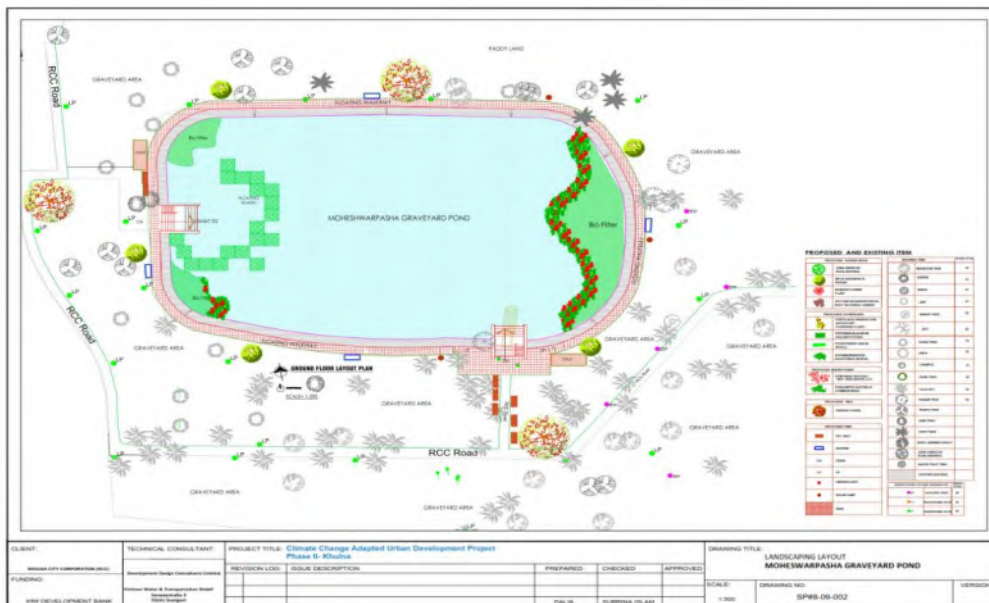


Figure 3.62 Concept Design of Moheshwarpasha Graveyard Pond

3.8.2 BL College Pond (Pond No. 2)

Area: 3162 sqm

Pond location:

The BL College Pond is situated within the campus of Khulna Brajendra Lal College, commonly referred to as BL College, located at the 6.no ward Daulatpur area of Khulna city, specifically in Ward 6. Positioned centrally within the campus,

Existing Plants Observed: Mahogany Tree (*Swietenia macrophylla*), Coconut Tree (*Cocos nucifera*), Banyan tree (*Ficus benghalensis*), Chambal (*Artocarpus chama*), Black Berry (*Rubus subg. Rubus*), Bokul (*Mimusops elengi*), Olive (*Olea europaea*), Mango (*Magnifera indica*), Amla, Akashmoni, Badam Tree

Stakeholder's requirement:

- Absence of protective railings poses a risk, particularly for children and due to lack of light it is difficult to move around in the area at night.
- The water level decreases to 4–5 feet during winter, becoming polluted.
- The shallow surface hinders adequate rainwater retention.
- Only one Ghat (bathing area) exists, primarily used by men, limiting accessibility for women.
- Absence of a separate Ghat and changing rooms for women.
- Lack of a walkway around the pond reduces its usability and visual appeal.

Proposed landscape Features/ Infrastructures:

- Paved walkway
- Waste bin for waste management
- Storm water drain
- Local plantation for vegetation in pond shore area
- Sitting arrangement
- Guide wall
- Ghat renovation & new proposal
- 250mm Gravel bed in pond periphery
- Solar Lamp shades



Figure 3.63 Location Image of Google and Existing Condition of BL College Pond (2025)

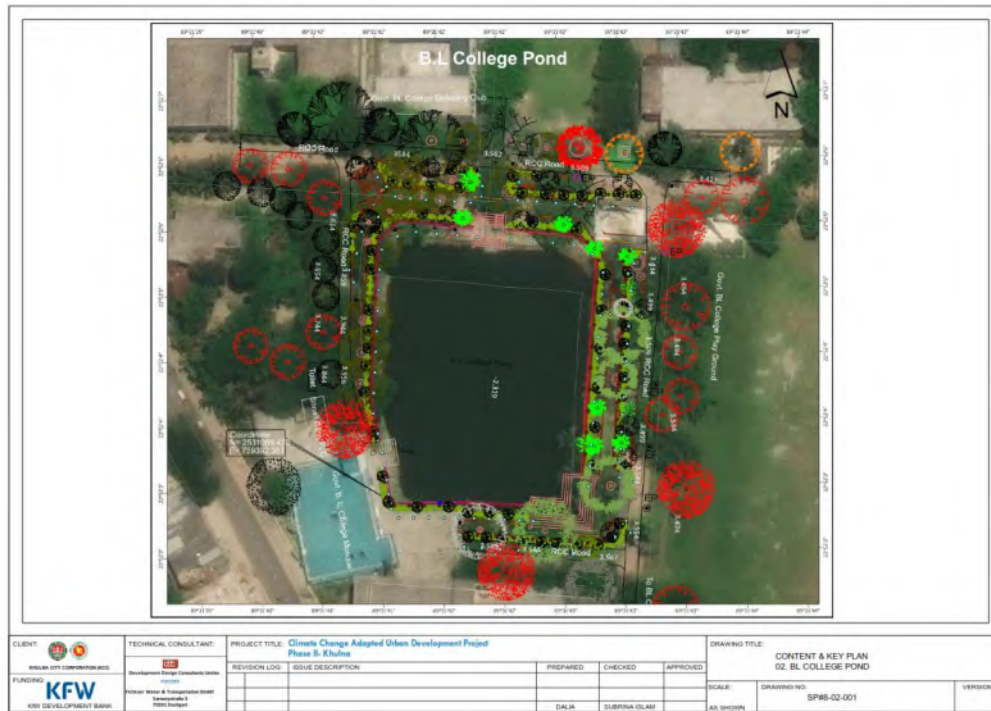


Figure 3.64 Location of BL College Pond on Google Map

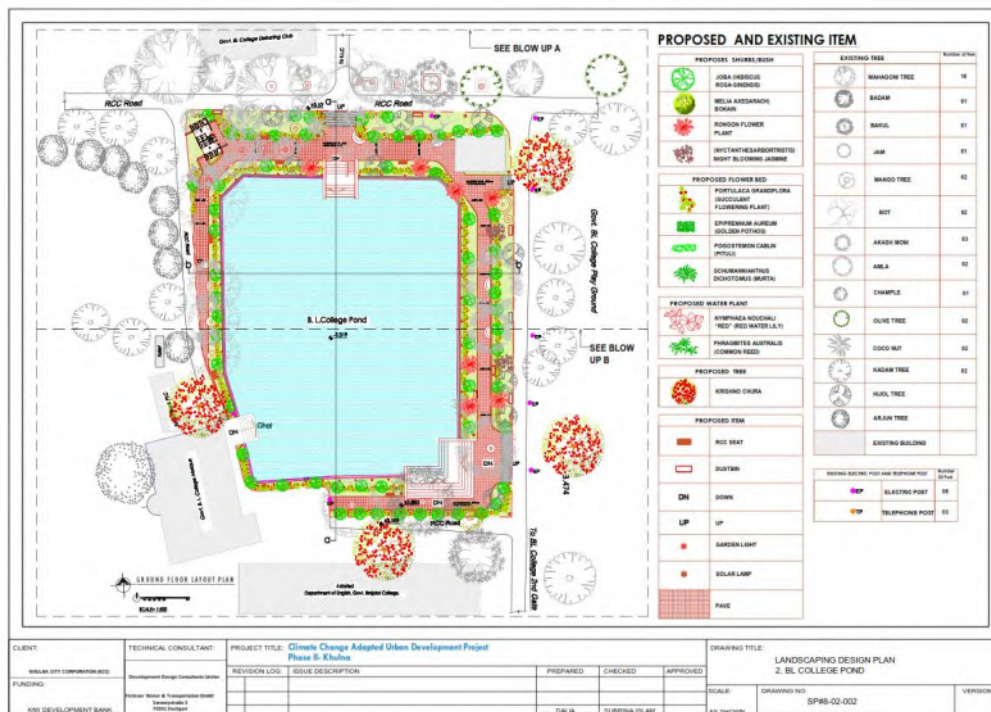


Figure 3.65 Concept Design of BL College Pond

3.8.3 Pabla Moddhya Para Sarbojonin Temple (Pond No. 3)



Figure 3.66 Existing Condition of Pabla Moddhya Para Sarbojonin Temple (2025)



Figure 3.67 Location of Pabla Moddhya Para Sarbojonin Temple Pond

3.8.4 Wonderland Park Pond (Pond No.4)

Area: 22000 sqm



Figure 3.68 Google Location and Existing Condition of Wonderland Park Pond (2025)

Existing Plants Observed:

Waste dumping on the east bank. There is an STS on the east side of the pond

Accessible space around Pond (Area/percentage): 2200 sqm

Perimeter overall(m)/Build up (m): 900m

Pond edge constructed or natural:

Repair & Re construction required

Connections between drains and Khals:

Drain on south side of the pond (flows into the pond)

Stakeholder's requirement:

- For bathing purpose, the pond area needs change room for male & female.
- Ghats need to be repaired/ remake
- The boundary of 12 no. road needs to be repaired along with retaining work.
- The pond sides need to be treated with landscape, lighting. Raising work required to prevent storm water from get into the pond directly.

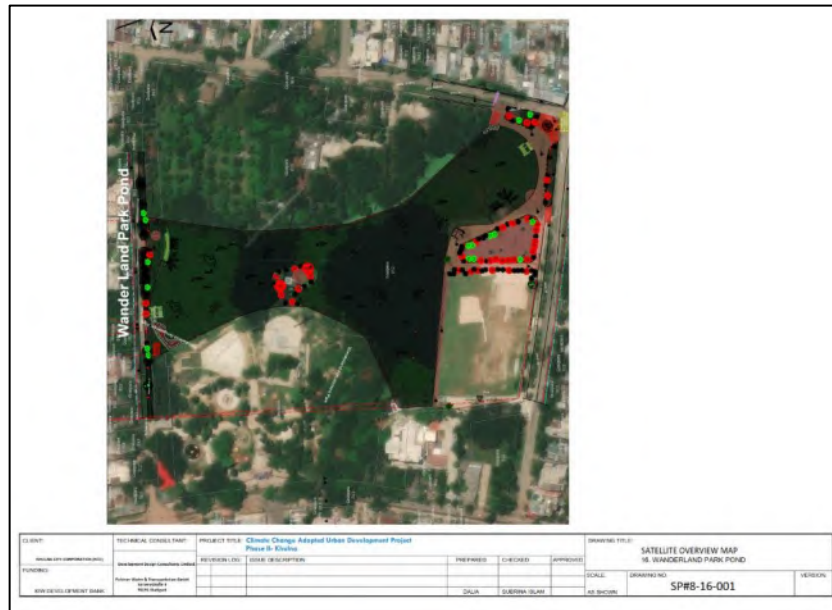


Figure 3.69 Location of Wonderland Park Pond on Google Map



Figure 3.70 Concept Design of Wonderland Park Pond

3.8.5 Khalishpur High School (Chorer Hut) Pond (Pond No. 5)

Area: 2600sqm

Pond location: 13 no. Ward of KCC.



Figure 3.71 Existing Condition of Khalishpur High School (Chorer Hut) Pond (2025)

Existing Plants Observed: Reasonable
 Accessible space around Pond (Area/percentage):100%

Pond edge constructed or natural:

Waste dumping observed

Connections between drains and Khals:

No connectivity

Stakeholder's requirements:

- Change room for male & female.
- Multiple Ghats need to be constructed according to number of user group.
- Protection works required as per peripheral land condition.
- The pond sides need to be treated with proper landscape work, walk area, lighting, sitting, and waste management.
- The pond needs derezzing
- Park area has to be accommodated in pond periphery.

Plays a role in flood control: Yes, retention basin for the school premises

Accessibility: Accessible from South accessway

Existing facilities/ infrastructure: Play ground in south side,
 An abandoned factory building is in north side just adjacent the pond site

Proposed landscape Features/ Infrastructures:

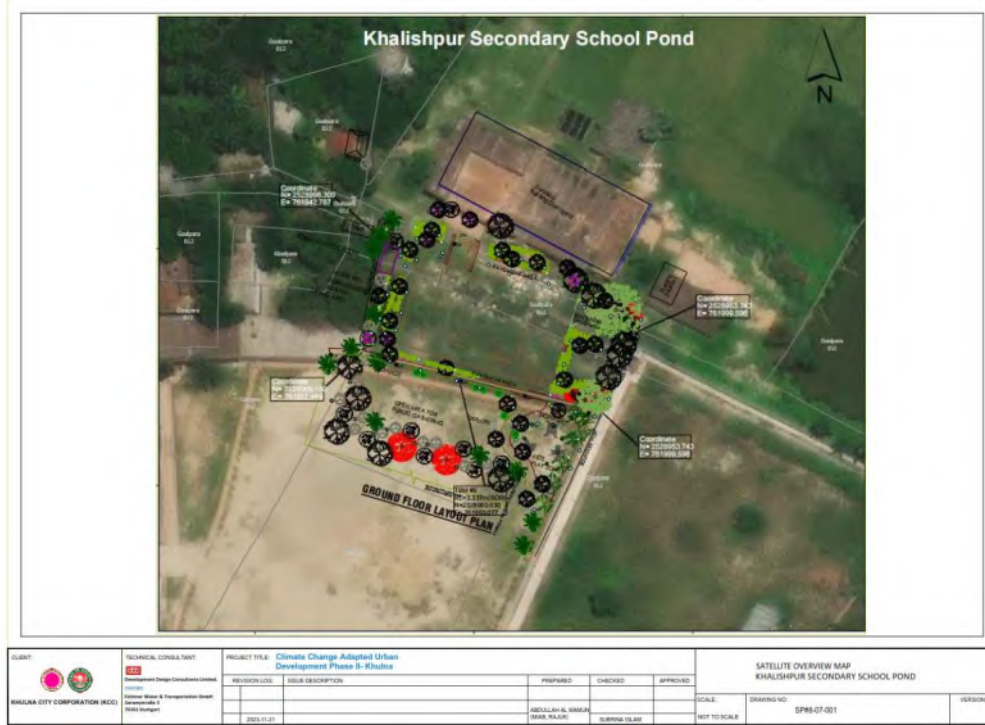


Figure 3.72 Location of Khalishpur Secondary School Pond on Google Map

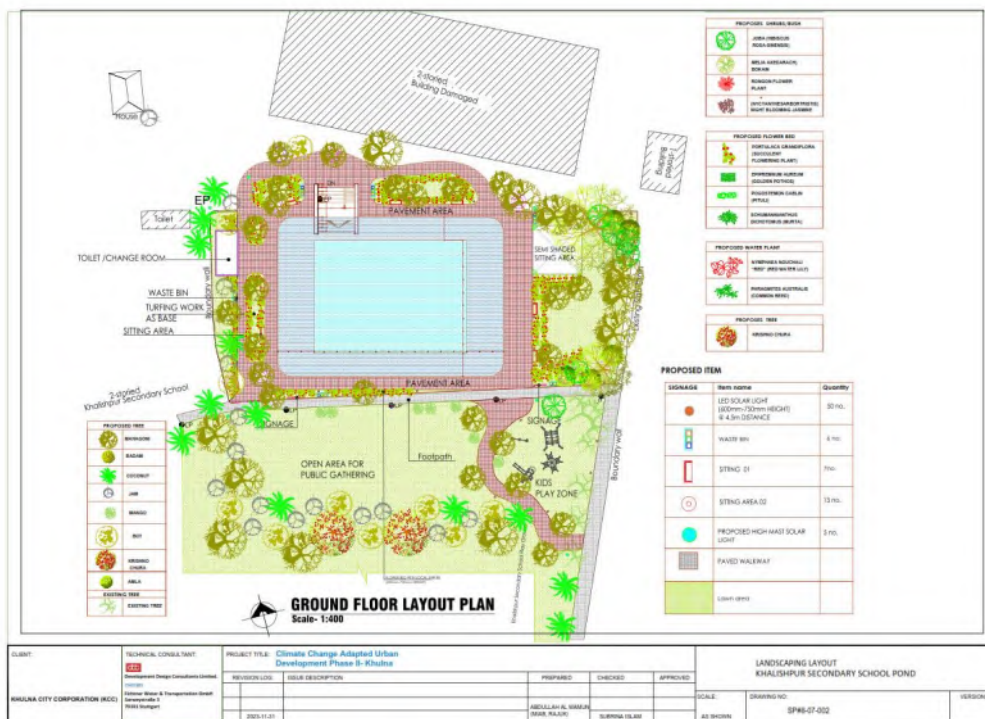


Figure 3.73 Concept Design of Khalishpur Secondary School Pond

3.8.6 16 no. Ward Office Pond (Pond No. 6)



Figure 3.74 Existing Condition of 16 No. Ward Office Pond of KCC (2025)



Figure 3.75 Location of KCC 16 No. Ward Office Pond



Figure 3.76 Concept Design of KCC 16 No. Ward Office Pond

3.8.7 Horijon Colony Pond (Pond No. 7)



Figure 3.77 Existing Condition of Horizon Colony Pond (2025)



Figure 3.78 Location of Horizon Colony Pond

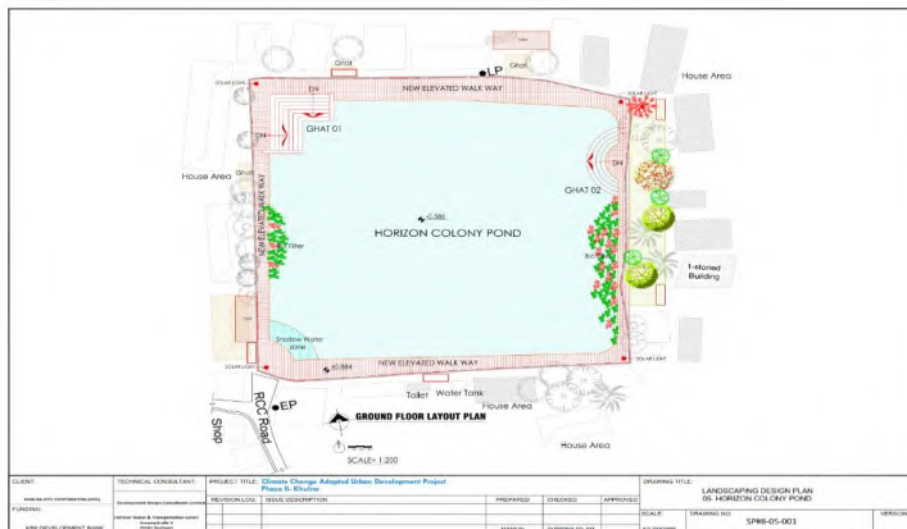


Figure 3.79 Concept Design of Horizon Colony Pond

3.8.8 Solar Park Pond (Pond No. 8)

Area: 8880 sqm

Pond location: The Solar Park Pond is situated at Ward No. 17 of KCC.



Figure 3.80 Existing Condition of Solar Park Pond (2021)

Existing Plants: Reasonable

Accessible space around Pond (Area/percentage): 14506 sqm (100%)

Perimeter overall(m)/Build up (m): 474/474

Pond edge constructed or natural: Entire 474m constructed

Connections between drains and Khals: No

Stakeholder's requirement:

- Multiple change room for male & female.
- Ghats need to be repaired/ remake
- Protection work needs to be repaired in some places.
- The pond sides need to be treated with landscape work, lighting, proper drainage and waste management.
- Boundary wall of the park needs to be repaired
- Swimming facilities for kids

Accessibility: 2 access roads are on the north and south west corner

Existing facilities/ infrastructure: Walking, sitting and 6 Ghats

Proposed landscape Features/ Infrastructures:



Figure 3.81 Location of Solar Park Pond on Google Map

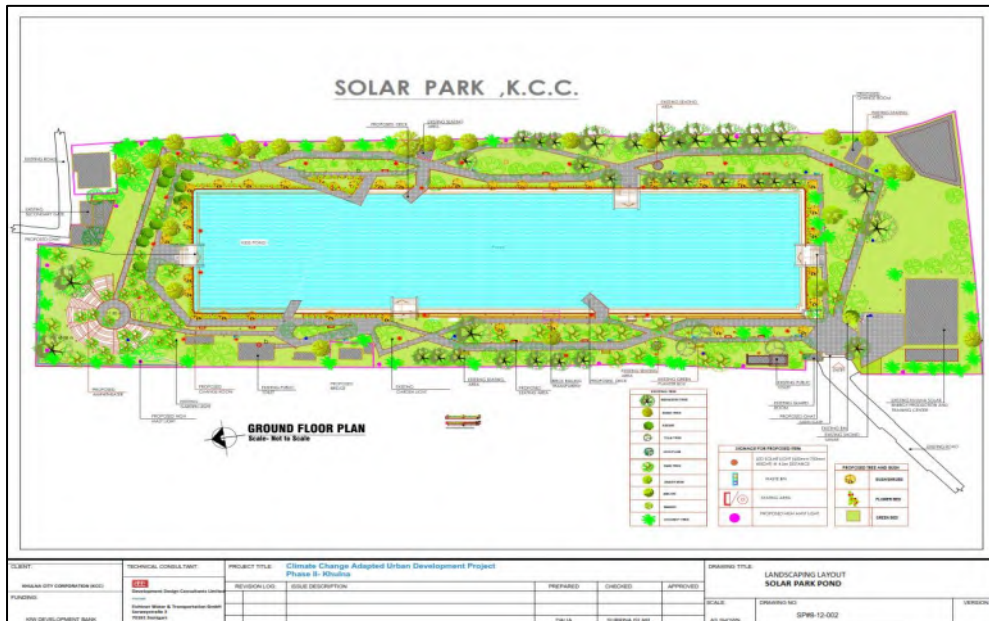


Figure 3.82 Concept Design of Solar Park Pond

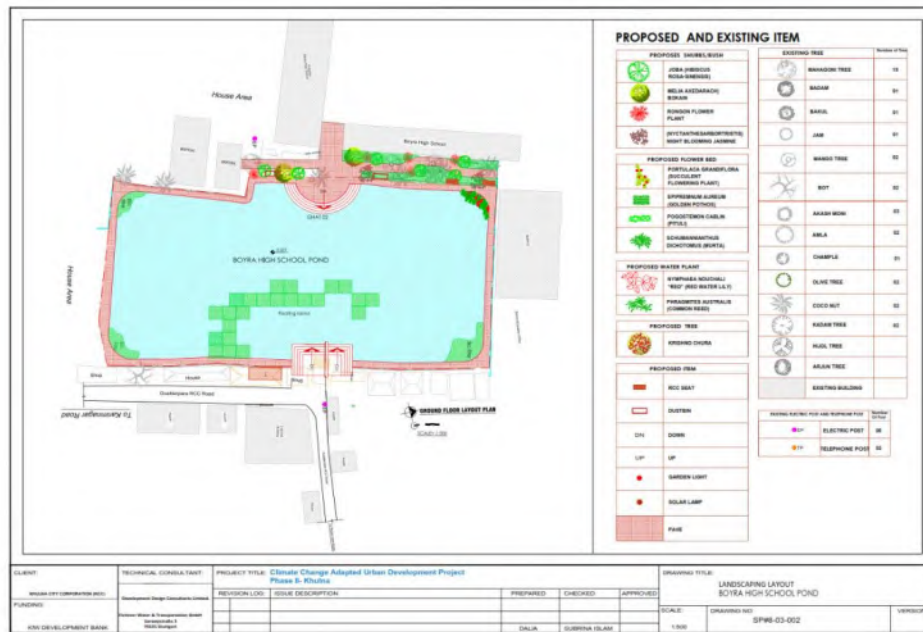


Figure 3.85 Concept Design of Boyra High School Pond

3.8.10 Sonadanga Bus Stand Pond (Pond No. 10)



Figure 3.86 Existing Condition of Sonadanga Bus Stand Pond (2025)



Figure 3.87 Location of Sonadanga Bus Stand Pond on Google Map

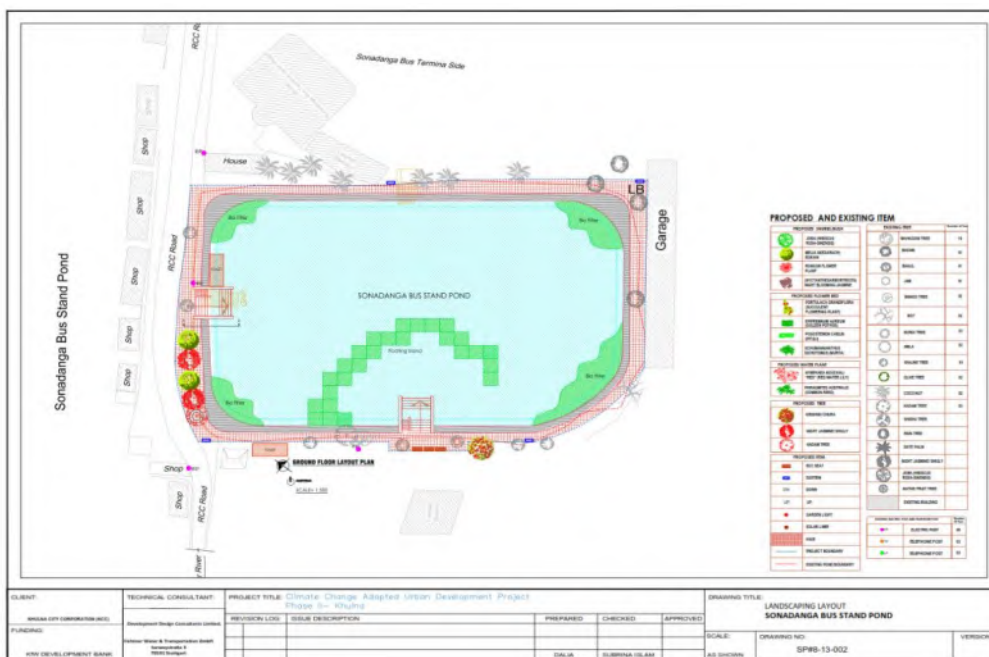


Figure 3.88 Concept Design of Sonadanga Bus Stand Pond

3.8.11 Talimul Millat Rahmatia Fazil Madrasa Pond (Pond No. 11)



Figure 3.89 Existing Condition of Talimul Millat Rahmatia Fazil Madrasha Pond (2025)



Figure 3.90 Location of Talimul Millat Rahmatia Fazil Madrasha Pond



Figure 3.93 Location of Banargati Bottola Temple Pond on Google Map

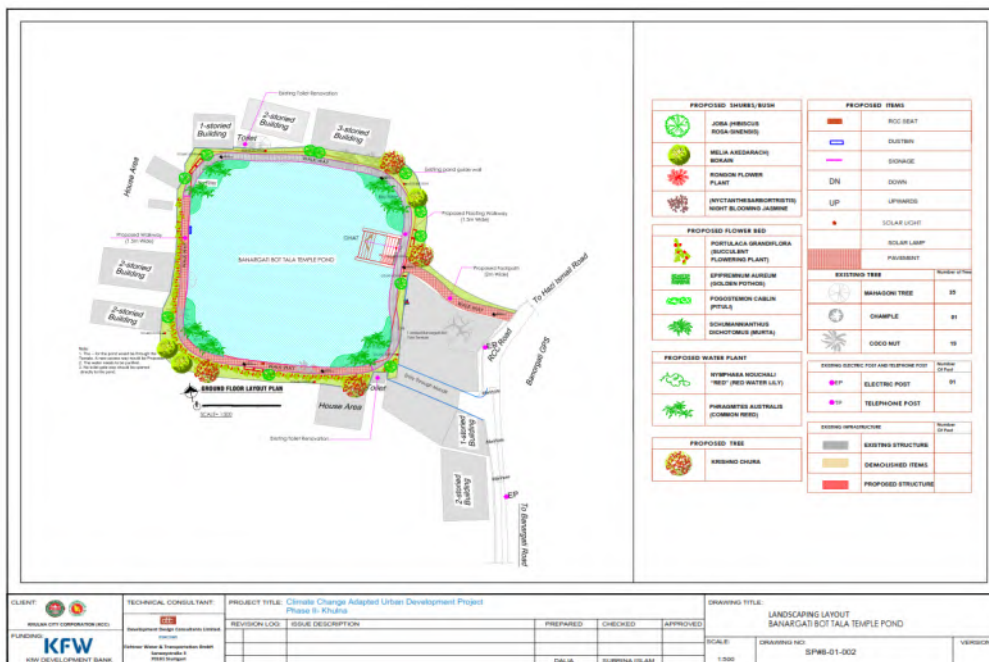


Figure 3.94 Concept Design of Banargati Bot Tala Temple Pond

3.8.13 Lions School & College Pond (Pond No.13)

Area: 1350 sqm
 Pond location: 25 no. Ward of KCC.

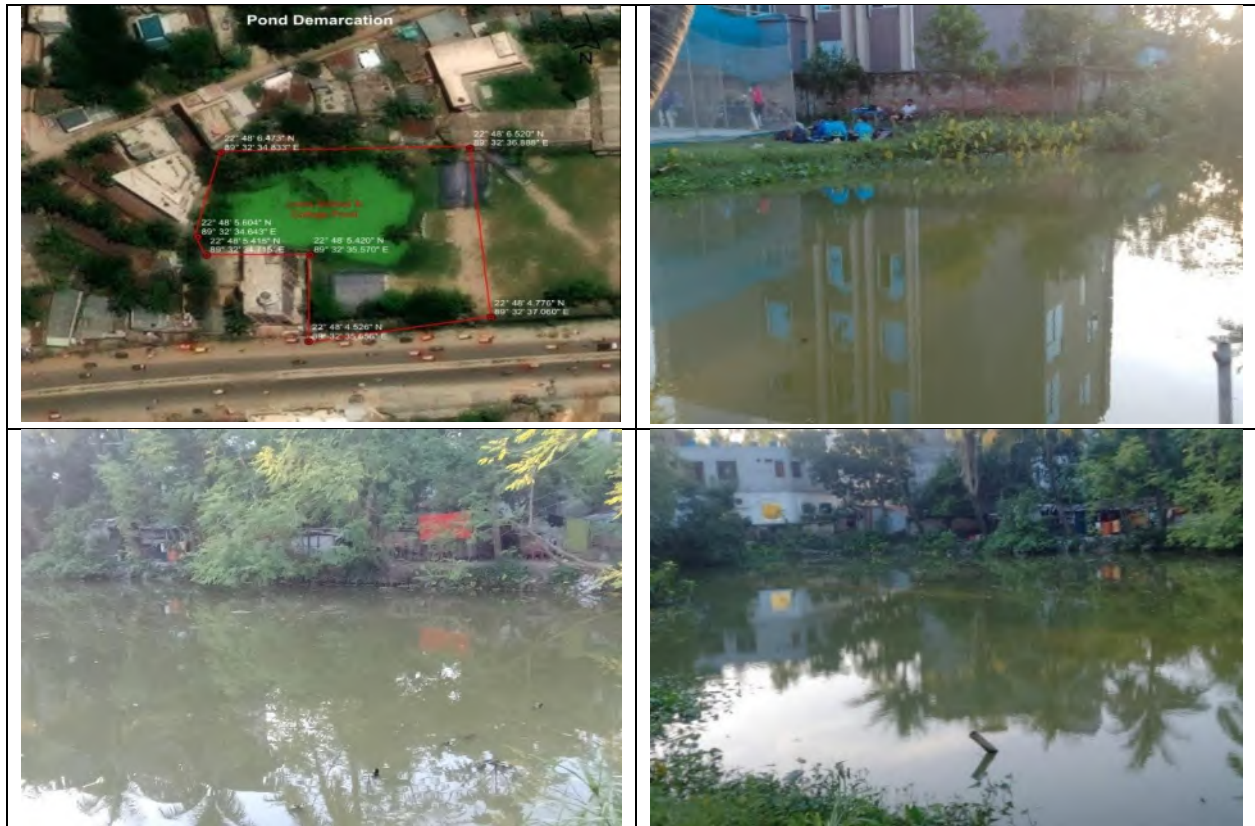


Figure 3.95 Existing Condition of Lions School & College Pond (2021)

Existing Plants: Reasonable

Accessible space around Pond (Area/percentage): 607 sqm/100

Perimeter overall(m)/Build up (m):150/0

Pond edge constructed or natural: Entirely natural (150m). A boundary wall is located adjacently on the west & south bank of the pond.

Connections between drains and Khals: No

Stakeholder's requirements:

- Change room for male & female.
- Multiple Ghats need to be constructed according to number of user group.
- Protection works required in all side.
- The pond sides need to be treated with proper landscape work, walk area, lighting, sitting and waste management.
- The special requirement of pond is to consider the standard size for swimming competition.

Plays a role in flood control: Yes, retention basin for the school premises

Accessibility: 1 access road on south

Existing facilities/ infrastructure: No Ghat, school playground



Figure 3.96 Location of Lion School and College Pond

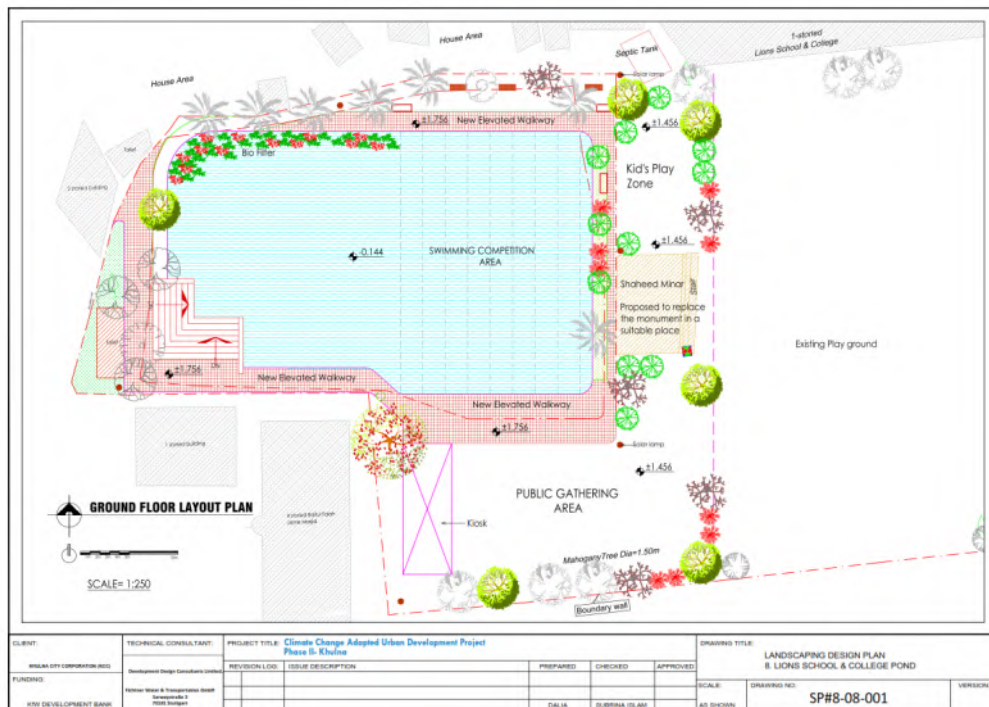


Figure 3.97 Concept Design of Lion School and College Pond

3.8.14 Government Majid Memorial City College Hotel Adjacent Pond (Pond No.14)



Figure 3.98 Existing Condition of Govt. Majid Memorial City College Hostel Adjacent Pond (2025)



Figure 3.99 Location of Govt. Majid Memorial City College Hostel Adjacent Pond



Figure 3.100 Concept Design of Govt. Majid Memorial City College Hostel Adjacent Pond

3.8.15 Municipal Tank Road Pond (Pond No. 15)



Figure 3.101 Existing Condition of Municipal Tank Road Pond (2025)



Figure 3.102 Location of Municipal Tank Road Pond on Google Map



Figure 3.103 Concept Design of Municipal Tank Road Pond

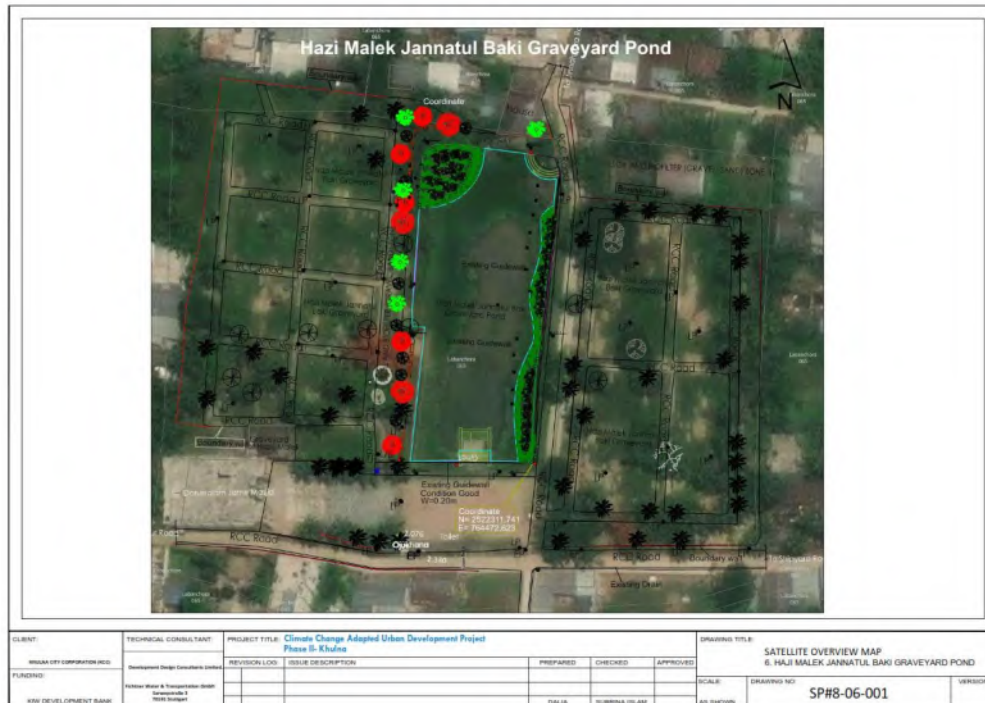


Figure 3.108 Location of Haji Malek Jannatul Baki Graveyard Pond



Figure 3.109 Concept Design of Haji Malek Jannatul Baki Graveyard Pond

3.8.18 Maheshtank Pond (Pond No. 18)

Maheshtank Pond is located at Shibbari (New Market), Jashore Road in Ward No. 17, and owned by Khulna City Corporation (KCC). The pond will be preserved and developed/renovated under the following conditions:

- **Infrastructure Consideration:** The infrastructure for the preservation and development/renovation of the pond must be built according to the design approved by Khulna City Corporation (KCC).
- **Public Accessibility:** After the completion of the preservation and development/renovation work, all necessary arrangements must be made to ensure that the general public can access and benefit from the pond.



Figure 3.110 Existing Condition of Maheshtank Pond (2025)

4. DESCRIPTION OF BASELINE ENVIRONMENT

4.1 Physical Environment

This section covers the information on the baseline environmental status of the Project area to provide a context within which the impacts of the Project are assessed. The baseline data includes the existing physical environment including topography, geology, soils, meteorology & climate, surface & underground water resources, ambient air quality and noise levels, land use and land cover, and landscape and visual amenity.

4.1.1 Topography of Khulna

Khulna belongs to the lower Ganges-Brahmaputra River floodplain as per the national classification. The physiography of Khulna is broadly characterized by tidal flood plains having lower relief and crisscrossed by innumerable river channels. The area is generally flat and poorly drained. The elevation of the flood plain area, on an average is about 1.22m SOB (Survey of Bangladesh). The general slope of the City area is from north to south along the bank of the river and the lateral slope is away from the riverbank. The elevation sharply decreases towards the west. The urban area along the Rupsha river embankment has a maximum elevation of 3.5 to 4.0 m SOB decreasing to 1.5 m at the Mayur River, and its extensions to the north Khudir Khal and south Hatia River.

The spatial growth of Khulna City is explained by its topography. The original Khulna City grew up near the southern end of the levee and extended towards northwest. In the north-south direction, the city finds its way to expand naturally on moderately high lands. From topographic point of view, it was anticipated that the city's growth will follow the levee and flood plains, north ward and southwest. But after the construction of bypass, the city tends to grow towards the west up to the Bypass. Topography of Khulna City is presented on **Figure 4.1** which is prepared based on the DEM collected from DHI GRAS in 2020.

4.1.2 Geology of Khulna

The geology of Khulna consists of late Holocene to Recent Alluvium of the Ganges deltaic plain in north and tidal plain in south. The subsurface of the city area consists of alluvium to a depth of 40 meter or more, composed of sand, silt, clay, organic clay, and peat in varied proportions with small amount of coarse sand. Stratigraphic cross-sections and panel diagram through the KCC area indicate presence of *seven sedimentary cycles* in which each cycle resembling fining upward sequence. Channels (tidal as well as fluvial), natural levee, flood plain, flood basin, ox-bow lake, abandoned channels, bars, swamps/ flood basins and estuarine plain have been recognized as geomorphological units within the KCC area. The surface geology of the city consists of deltaic deposits, which are composed of tidal deltaic deposits, deltaic silt deposits and mangrove swamp deposits.

4.1.3 Soils of Khulna

Khulna city is situated in the southern region of Bangladesh bounded by rivers. The soils formed in these areas are mainly alluvial deposits. Geologically, the area can be grouped into four units and soils in this region are mostly composed of silt, clay, sand and organic soil with peat. The classification of soil of Khulna City and the shrouding is presented in **Figure 4.1**. The soil composition of the city area can be described as follows:

- Northern and southern part are mainly composed of clay with silt and organic deposits
- Middle-eastern part comprises of sand with some clay
- Middle-western part is mainly dominated by intermediate type of soil which is mainly silt with clay and sand.
- Major part of the region contains fine-grained soil with some organic deposit. Having lower bearing capacity, the soil is not good for shallow foundations.

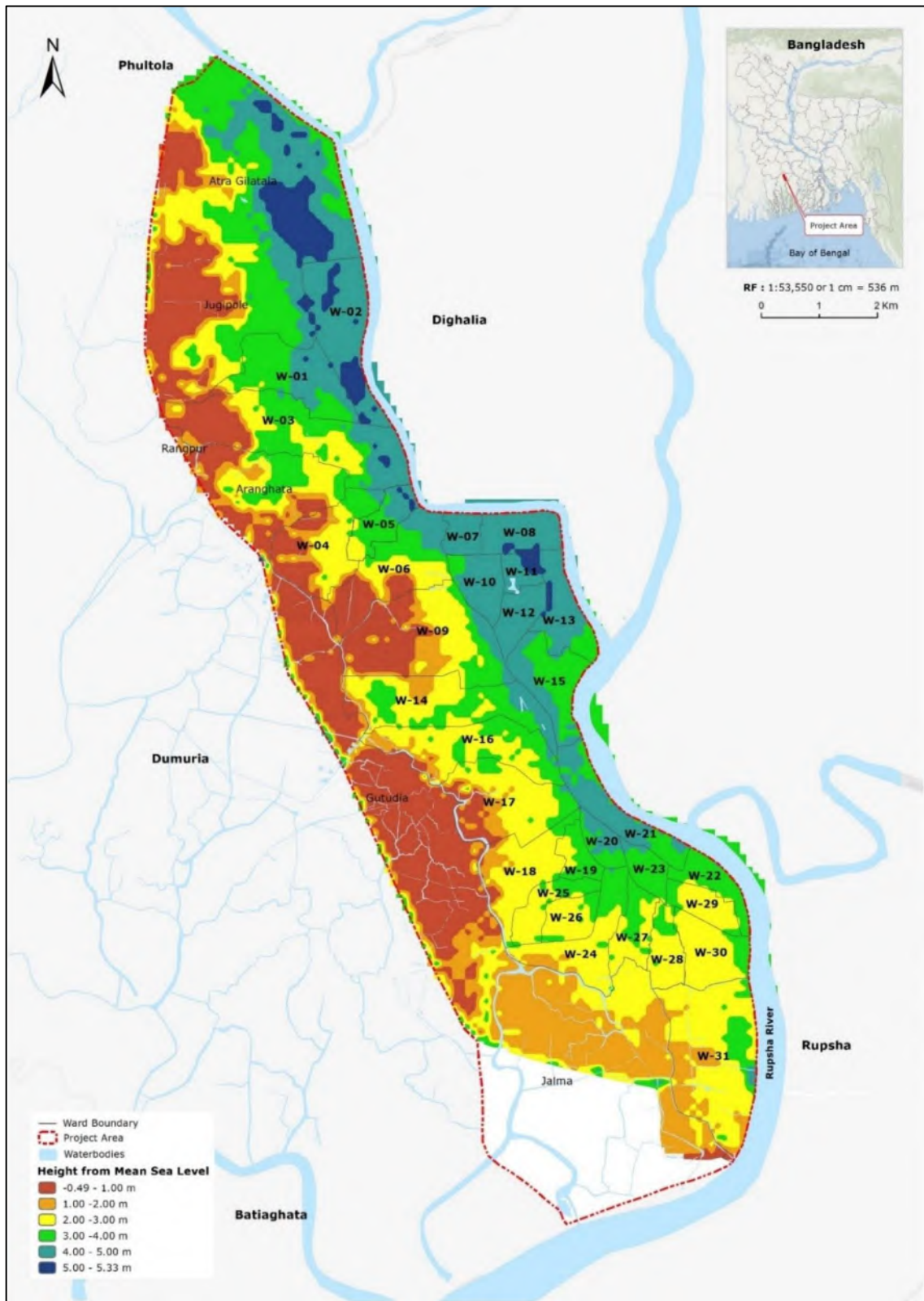


Figure 4.1 Topographical map (Source: DHI GRAS, 2020)



Figure 4.2 Soil Classification Map of Khulna (Source: BARC)

4.1.4 Climate and meteorology of Khulna

Bangladesh is located in the sub-tropical monsoon climate regime. Based on the analysis of pressure, rainfall and temperature, the climate of Bangladesh can be described under the following four seasons:

- **Winter or Northeast Monsoon (from December to February)**
 - Coolest time of the year with mean minimum temperatures falling below 10°C in some areas
 - Reduced humidity and cloud cover
 - Rainfall is scarce
- **Summer or Pre-Monsoon (March to May)**
 - Characterized by the highest temperatures of the year up to 36°C
 - Some rainfall may occur, with tropical cyclones occasionally affecting coastal areas
- **Southwest Monsoon (from June to September)**
 - Period of highest rainfall, humidity and cloud cover
 - Up to 80% of the annual rainfall occurring during this time
 - Increased rain and cloud cover generally cause a small reduction in mean daily temperature.
- **Autumn or Post-Monsoon (October to November)**
 - Temperatures remain hot and humid, though cloud cover reduces.
 - Limited tropical thunderstorms may still occur during this period, particularly in coastal areas.

Despite the general predictability of the seasons in Bangladesh, local conditions still vary widely across the country. Bangladesh can be divided into seven climactic sub-zones based on differences in a range of factors including rainfall, temperature, evapotranspiration, and local seasonality. **Figure 4.3** shows that the Project Area is located mainly in the South-Western region, also slightly covers adjacent South- Central part. Wind roses for Khulna city³ are presented below.

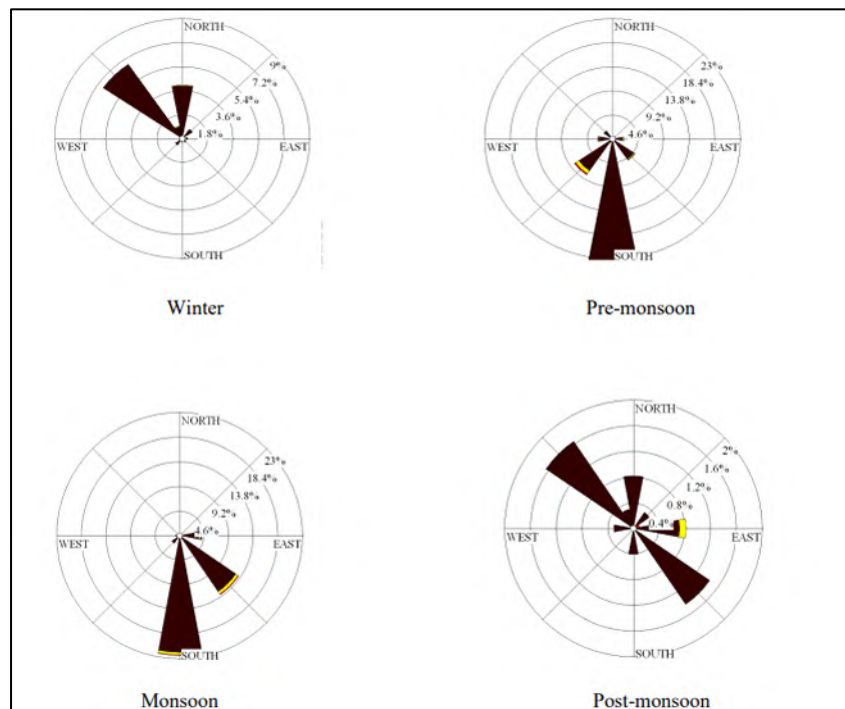
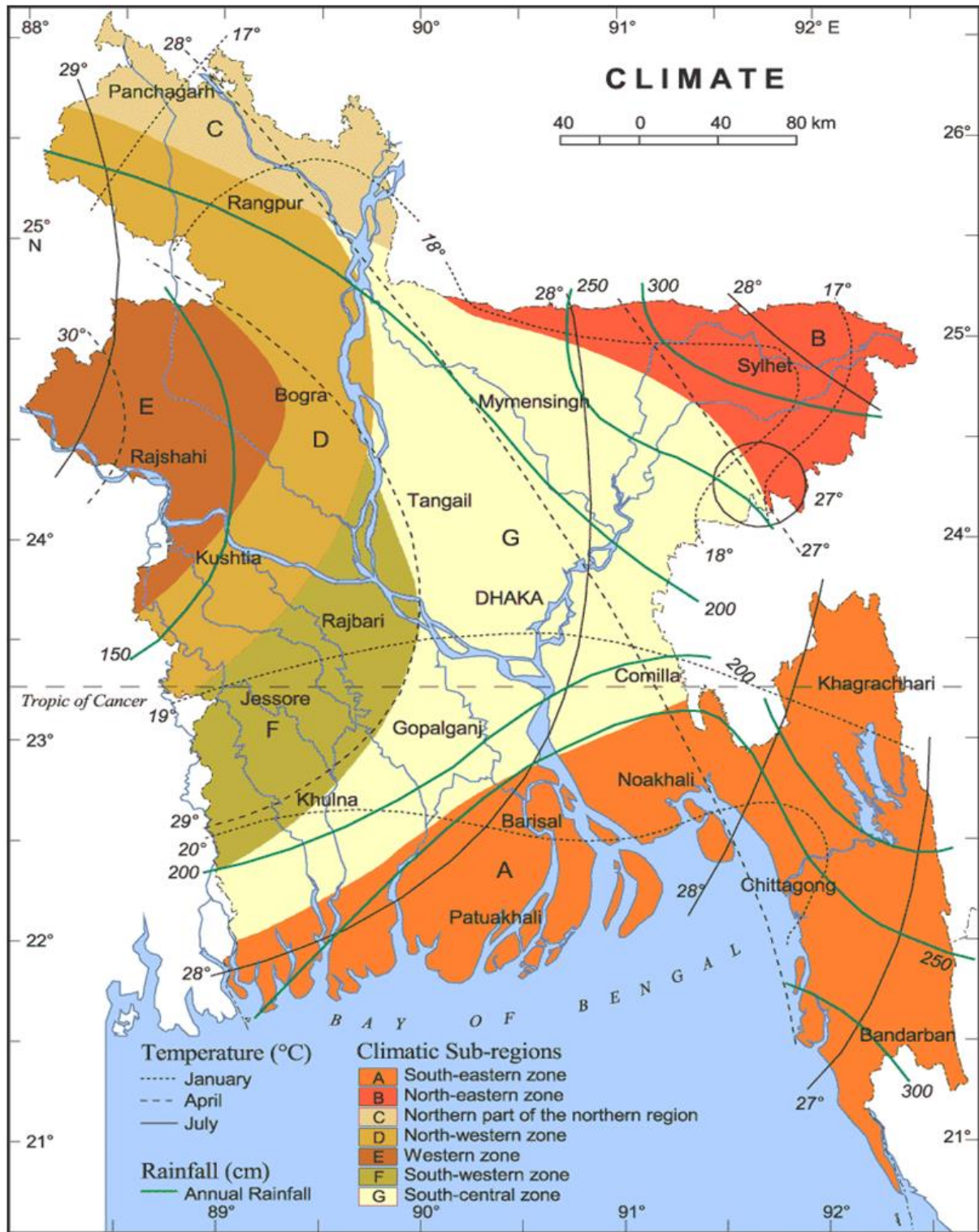


Figure 4.3 Winter with other seasons respectively for Khulna

³ http://case.doe.gov.bd/index.php?option=com_content&view=article&id=5&Itemid=9



Source: <https://pubs.sciepub.com/jfs/7/1/2/figure/1>

Figure 4.4 Climatic Zone Map of Bangladesh



Figure 4.5 Climatic Zone Map of Khulna (Banglapedia, 2014)

Long-term average climatic data (2008-2019) collected from Khulna weather stations (Bangladesh Meteorological Department) reflect the expected South-Western and South-Central Zone weather pattern as outlined below.

4.1.5 Temperature of Khulna

The mean annual temperature in Khulna is approximately 25.6°C. The analysis of temperature data from 1964 to 2014 indicates that Khulna's annual average temperature shows a clear upward trend. This trend is also confirmed when looking at the seasonal distribution of the measured temperature data where temperatures are either stagnant or increasing, except for the winter temperature which shows a slight downward trend.

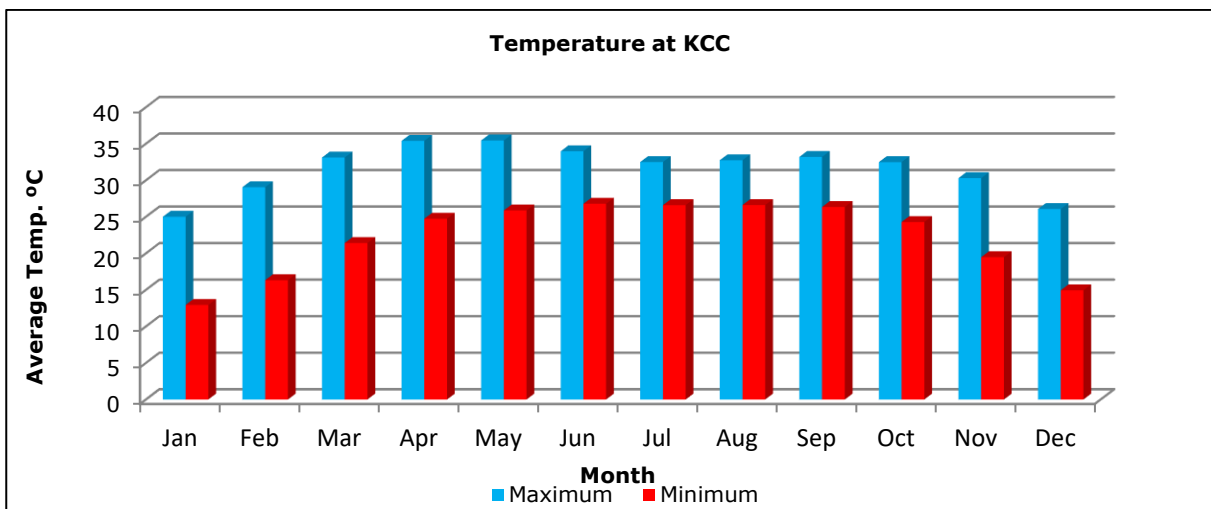


Figure 4.6 Average Temperature (°C) at Project Area (Khulna Meteorological Station)

4.1.6 Rainfall in Khulna

The average annual rainfall for Khulna (approx. 1,800 mm), is lower than the average annual precipitation for the whole of Bangladesh (2,436 mm). Maximum rainfall occurs in May to October during monsoon and the lowest rainfall occurs in November to February during winter season. Rainfall varies considerably from year to year and month to month. The 12-Yearly (2008-2019) precipitation analysis indicates that the average monthly rainfall of Khulna is approximately 148.3 mm and about 87% of the mean annual rainfall occurring during the period from May to October, and 54% during June to August (**Figure 4.6**). The analysis also indicates that the average precipitation in winter, pre-monsoon and autumn season follows downward trend whereas precipitation in monsoon season follows strong upward trend. Furthermore, the average annual rainfall in Khulna shows an increase in the average annual precipitation. The driver for the increasing trend in annual precipitation is mainly the monsoon season where a very clear upward trend is found. The seasonal trends indicate a decreasing precipitation for all seasons except for the monsoon season. However, the scattered data points to high uncertainty levels which makes it difficult to be conclusive of these trends.

4.1.7 Relative Humidity of Khulna

Humidity level is consistently very high during the monsoon season and drop significantly for a relatively short period at the end of the dry season. Sunshine level is low during the monsoon, but from November to

May is consistently high. There is a significant relationship in between humidity & sunshine. In Khulna, the relative humidity increases steadily from April till August (**Figure 4.7**).

During the baseline assessment a range of different potential climate change scenarios have been performed, where projections on key parameters like temperature and precipitation are clearly indicating the rate of change for the future development in Khulna. Both temperature and precipitation will increase in magnitude, and will unfold in several challenges for Khulna, including, not the least, higher occurrence of extreme rainfall (where temperature is an important driver) and the potential impact of more frequent flooding/waterlogging, if physical conditions regarding drainage and flood control are not improved. Overall, the projections show a general trend towards higher temperatures, especially in the monsoon months, corresponding with the patterns of locally observed data. The projections for precipitation are also indicating similar trends, with negative trends for the winter season. Annual rainfall will, based on local observations, increase, and this trend will continue, based on the projections coming from different sources.

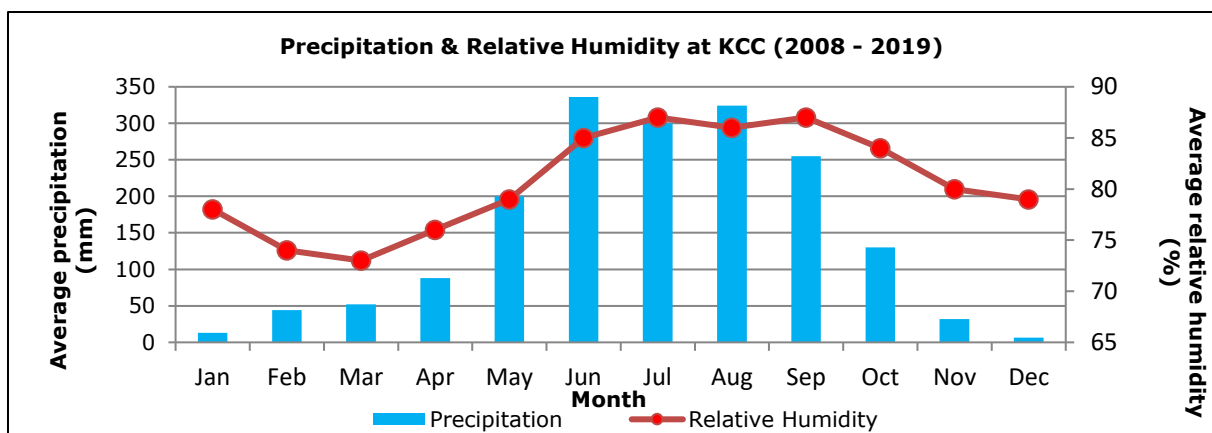


Figure 4.7 Average Precipitation & Relative Humidity at Khulna

4.1.8 Hydrology of Khulna

Khulna City, the downstream Ganges Floodplain is a trail of depositional tract left by the Ganges river system on its way to the Bay of Bengal. The landforms originated in these areas are a clear response to the depositional activities of the Ganges and its distributaries and tributaries. The surface drainage of the area is dominated by the Rupsha-Bhairab River complex. Khulna City is drained mainly by the Bhairab, Rupsha, Mayur River and numerous minor tidal streams. The Rupsha, Bhairab are actually the same river course but have different names in different locations during their courses and gradually find their way by a southerly route to the Bay of Bengal. The Bhairab is the most important river for Khulna City, enters the project area from the north near Phultala and follows a south-easterly course in the northern part of Khulna City. Then it passes to the south discharging a major portion of its water into the Rupsha or Pasur, while the main channel runs to the southeast part of Fakirhat and Bagerhat and joins with the Madhumati at Kachua. Near Khulna the Bhairab is joined by the Atharabanki which conveys the surplus water of the Madhumati into the Bhairab. **Figure 4.9** shown the hydrological setting of the Ganges and its distributaries and tributaries.

The project area falls under characterization of tidal conditions, salinity intrusion and the influence of cyclones and storm surges. Khulna is affected by all these phenomena except storm surges, as the city is largely protected against this by the world's largest contiguous mangrove forests, the Sundarbans. While the Sundarbans are a natural coastal protection against cyclones and storm surges, they continue to suffer due to over-exploitation of natural resources as well as salinity, erosion and industrialization. Based on the "Khulna as a Water Inclusive Enclave" Report, the South West Delta can be divided into three zones. The upstream freshwater zone is naturally fed by river water from the Gorai River, while the coastal zone faces to the Bay of Bengal.

Khulna is located in the zone where the fresh water to saline water transition occurs. This has previously prompted the construction of polders in Khulna to create and protect agricultural land from salinization. Additionally, considering the effects of climate change (sea level rise), Khulna will be increasingly prone to riverine tidal flooding.

The hydrological and hydraulic conditions described above have a profound impact on the drainage conditions in Khulna. Much of the urbanized area in Khulna sits below the water level of the Rupsha River during high tide conditions, causing a large part of the urbanized area to suffer from very limited drainage capacity. Water level data of Rupsha River was collected at the water level measurement station SW241, located at the outlet of Mayur River. The water level at Rupsha River is measured daily (Figure 4.8) below shows daily high tidal levels since 1950. The presented water levels in the graph reveal an increasing trend of high tide water levels at station SW241. The highest water level observed from 2004 to 2007 and from 2013 to 2019, which crossed the recorded highest level (3.48 mPWD or 3.02m) of Rupsha River. Also, in the year range of 1983 to 2019, in several years the water level crossed the danger level (3.04 mPWD or 2.58m SOB) at station SW241. The water level during the low tide for the same period is shown in Figure 4.8. The illustrated water levels in the graph disclose a decreasing trend of low tide water levels at station SW241.

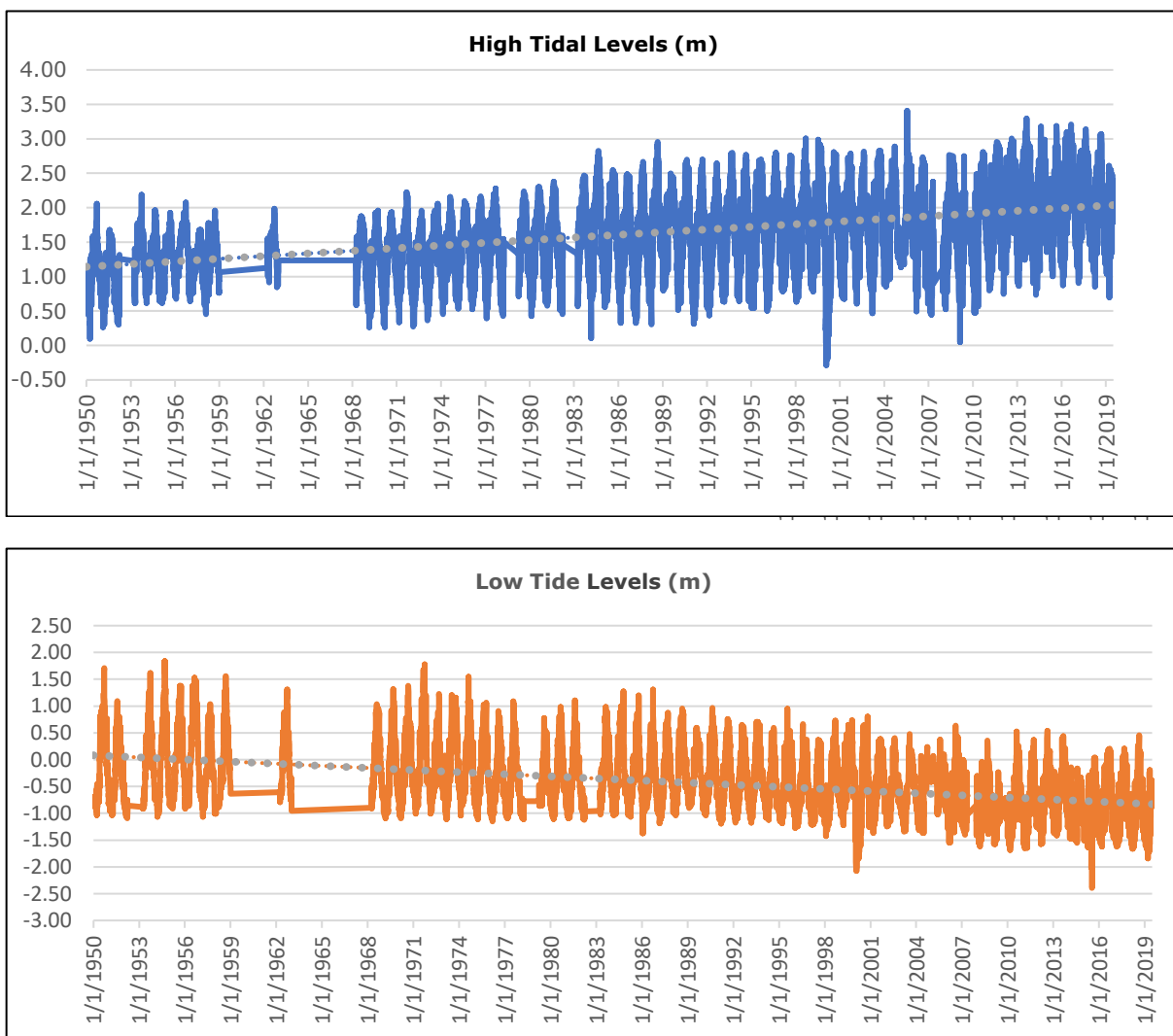


Figure 4.8 Yearly Tide Level Measurements (Source: BWDB)



Figure 4.9 Hydrological Setting of the project area

4.1.9 Drainage Patterns of Khulna

Drainage pattern of an area mainly depends on the available natural channels & rivers and the existing drainage networks. Natural channels and rivers in the project area have been shown in **Figure 4.11**. Natural drainage areas include marshes, natural channels, beels, haors, baors etc. A short description on some of the existing natural channels and drainage networks are given below:

Nirala Khal: A tributary of Mayur River, Nirala Khal runs from the north and is divided into two branches. One of these branches running towards the west direction and connected with Baniakhmar Khal (near the present Tablig Mosque). This Khal was also connected with Bagmara Khal near Harintana and discharges water from west Baniakhmar and Musalman para, once this Khal was navigable and used to travel through. A major portion of this Khal lost its existence due to unplanned development and lost its connection with Bagmara and Musalman para. At present, the Khal has virtually squeezed into a narrow drain with lesser discharge capacity.

Purbo Nirala Khal: Purbo Nirala Khal falls into Mayur River – straight from the north - connects the Main Nirala Khal. This Khal used to discharge water from Bagmara, Musalman para and part of Iqbalnagar. The Khal was in full operation till 1974-75. But since then, it gradually lost its appearance due to encroachment and turned into its present condition like as a narrow drain.

MotiaKhal Khal: MotiaKhal Khal starts from Tootpara Ghat and falls into river Rupsha flowing through the southern part of greater Tootpara. This is the largest Khal, which served the city core area to discharge storm and wastewater for decades. This is a wide Khal varying in width from 30 to 40 feet at different locations and it runs from west towards east. Before falling into the Rupsha River, this Khal travels approximately 1.7 Km.

Chori Chora Khal: At present this Khal served Mistiripara and Dolkhola area and runs towards the south and finally joins Bagmara Khal before falling into Mayur River. The width of the Khal is about 20 to 30 feet at different parts. According to the of local people, this Khal was in function till 1975-76. Over the time the Mistiripara Khal has narrowed down to 5 feet only due to illegal encroachment. The rest of the Khal is being used for road or has gone under the ownership of nearby landowners.

North Khal: It is one of the longest Khals of Khuina City originating from Baniakhmar Khal, runs over a large area of west Baniakhmar area and finally falls into Gollamari River near Gollamari Bridge. The width of the Khal at different locations used to vary between 30 to 40 feet. This Khal drains out water from a large area of Khuina City specifically of the mid-town area. Presently, North Khal has turned into a 10 feet wide small surface drain.

Mayur River: Goliamari-Mayur River runs along the western part of Khuina City and connects with the Rupsha River on the south. MotiaKhal Khal and Kajibacha River are also connected with this river on the south-west. Gollamari-Mayur River is the major drainage channel through which a large volume of water both from Khulna City and adjacent Beel Pabla & Beel Dakatia area, discharged into the river Rupsha. The Mayur River is the main drainage channel of the eastern part of Polder 28/2, via 10-vent sluice at Alutola. Moreover, a number of outlets of KCC are connected to this river. Therefore, this river is playing an important role to drain out excess water from most of the urban areas as well as from the vulnerable Beel Dakatia.

Existing Drainage Network: Physical Feature Survey 2010 shows that there are 1165.48 km of man-made drains within the project area of which 1124.00 km are pucca and 41.48 km are katcha. Most of these are Reinforced Cement Concrete (RCC) drains while the rest being brickworks. These man-made drains have varied widths ranging from less than 0.1 m to 9.0 m. About 155 km of pucca drains have width less than 0.5 m; about 270 km of pucca drains have width ranging from 0.05 m to 2.0 m; and about 1.16 km of pucca drains have width greater than 5.0 m.

4.1.10 Water Resources of Khulna

a) Surface Water Quality of the Project Area

The surface water bodies receive untreated sewage and industrial liquid wastes and municipal waste through the major canal systems or drainage outlets. Samples were collected along the Nirala Khal by the study team. The water quality data presented in **Table 4.1** indicates that the water quality in the Nirala Khal is very poor and contaminated with various pollutants. **Figure 4.10** shows the sampling locations of the water quality.

Table 4.1 Water Quality Data of Nirala Khal

Sl. No	Water Quality Parameter	Units	Sampling Location (Nirala Khal)			Bangladesh Standard
			WQ1	WQ2	WQ3	
1	pH	-	7.64	7.71	7.70	6.5-8.5
2	Turbidity	NTU	27.8	31.8	118	10
3	Electrical Conductivity (EC)	μS/cm	1282	1239	1304	-
4	Dissolved Oxygen (DO)	mg/l	Nil	Nil	Nil	6.0
5	Biochemical Oxygen Demand (BODs)	mg	90	96	102	2
6	Chemical Oxygen Demand (COD)	mg/l	102	107	205	4
7	Total Dissolved Solids (TDS)	mg/l	760	750	630	1000
8	Total Suspended Solids (TSS)	mg/l	80	230	850	150
9	Phosphate (PO ₄)	mg/l	6.8	7.4	4.7	6
10	Chloride (Cr) ion concentration	mg/l	165	175	207	150-600
11	Nitrate (NO ₃)	mg/l	1.3	1.3	1.3	10
12	Ammonia (NH ₃)	mg/l	Nil	Nil	Nil	0.5
13	Fecal Coliform (FC)	N/100ml	07	09	10	0
14	Total Coliform (TC)	N/100ml	15	17	27	0

Location
WQ01 - Nirala Khal - Upstream, Near Nirala Pond (GPS: 22.79407, 89.55462)
WQ02 - Nirala Khal - Near Road 13, Prantik, (GPS: 22.7964, 89.54995)
WQ03 - Nirala Khal - Downstream, Near Buro Moulavir Darga (GPS: 22.79719, 89.54506)
Sample collection Date: 01/12/2020

Source: CCAUD Study Team, 2020

Secondary data confirms that wastewater is being discharged to the drainage system in the project area. under the CRDP-II water quality analyses was conducted of samples collected from nine existing drain discharge points. The sample were collected for analysis of pH, Biochemical Oxygen Demand (BOD₅) 20°C, Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Dissolved Oxygen (DO), Fecal Coliform (FC). Average concentrations are presented below **Table 4.2**.

Table 4.2 Wastewater Quality Parameter Monitoring Data

Sl.	Sample ID	Sampling Location	Coordinates	Wastewater Quality Parameters					
				pH	BOD ₅	COD	TSS	DO	FC
				-	mg/L	mg/L	mg/L	mg/L	CFU/100ml
1.	WWQ_01	Karim Nagar	22°49'31.9"N 89°32'23" E	8.34	78	124	36.2	0.61	TNC
2.	WWQ_02	Alir Club	22°47'43.2"N 89°33'10.3" E	7.83	115	200	62.3	0.63	TNC
3.	WWQ_03	Soto Boyra	22°49'35.6"N 89°31'46.6" E	8.27	80.67	155.5	45.5	0.67	TNC
4.	WWQ_04	Alamin Moholla	20°48'41.3"N 89°32'11.0"E	8.49	108.2	256.2	256.5	0.44	TNC
5.	WWQ_05	Gollamari Bus Stand	22°48'1.9"N 89°32'24.2"E	8.26	93.7	200.8	55.5	0.47	TNC

Sl.	Sample ID	Sampling Location	Coordinates	Wastewater Quality Parameters					
				pH	BOD5	COD	TSS	DO	FC
				-	mg/L	mg/L	mg/L	mg/L	CFU/100ml
6.	WWQ_06	1 No. Custom Ghat	22°48'44.5"N 89°37.9"E	8.53	104.7	190.8	204	1.04	TNC
7.	WWQ_07	Sadar Hospital Ghat	22°50'55"N 89°33'23"E	8.78	140.8	264.8	63	2.35	TNC
8.	WWQ_08	Charer Hat	22°50'55"N 89°33'23"E	8.77	120.7	311	72.8	0.8	TNC
9.	WWQ_09	Newsprint Mill	22°49'35.6"N 89°31'46.6"E	8.52	87	221.8	39.8	1	TNC
GoB Wastewater Quality Standards*									
IFC EHS Guidelines for sanitary sewage discharge***									
TNC- Too Numerous to Count									
*Effluent Discharge Standards (Schedule 10 Standards for Waste from Industrial Units or Projects Waste [See Rule 13])									
** Sewage Discharge Standards (SCHEDULE – 9: Standards for Sewage Discharge; [See Rule 12])									
*** IFC Environmental Health and Safety Guidelines, 2007, Wastewater and Ambient Water Quality									
**** Total coliform									

Source: CRDP-II

BOD₅, DO & FC concentrations of all wastewater samples exceed the effluent quality standard of Bangladesh. The quality of the water is close to characteristics of domestic wastewater where BOD₅ ranges from 78-140.8 mg/l; while DO ranges from 0.44 to 2.35 mg/l which is lesser than the lower limit of standard. Fecal Coliform concentration for all samples reveal too numerous to count. Except samples collected from Alamin Moholla & 1 No Custom Ghat area, all the samples satisfied the GoB standards for TSS. Also, except samples collected from Karim Nagar, Alir Club, Soto Boyra & Gollamari, rest of the samples shown higher concentration of COD, ranges from 200.8-311 mg/l. The quality of the water is not suitable for direct discharge to surface water bodies as per the effluent quality standard of Bangladesh and IFC EHS guidelines for sanitary sewage discharge. Discharging wastewater directly to water bodies has already deteriorated the water quality of surrounding rivers.

b) Ground Water Quality of the Project Area

Water aquifers are present beneath the vast majority of Bangladesh, which are being recharged by the major river systems and by infiltration of rainwater. Most ground water is available within 5 m of the surface. This level fluctuates seasonally, approaching the ground surface over most of the country during the months July to September. Local ground water represents a stable source of water for various activities including irrigation (both shallow and deep tube wells), domestic purposes (hand pumps) and industrial applications (deep tube wells).

The KCC groundwater level is lowered to approximately 3-5 m below ground level during the dry seasons, with levels returning to their normal position before end of the monsoon. This fall in ground levels is an entirely natural process that arises because of the hydrological link with the river. The primary source of water supply in KCC area is mainly from the groundwater extracted through production and hand tube wells. In the fringe and non-municipal areas, residents rely mostly on private and some public tube wells. Only 30% of the households in KCC area have access to the piped water supply; 64% have access to the hand tube wells and only 6% use water from secondary sources. In areas outside KCC, 89% of the households have access to the hand tube wells and only 11% use water from secondary sources.

Currently 32 big tube wells (6-inch diameter) and 22 small tube wells (3-inch diameter) have been operated by KWASA within KCC Area for potable water supply. Also, huge numbers of deep tube well & shallow tube wells are operated by KWASA, which are decreasing in numbers day by day, are assumed to be due to the fact that temporal groundwater level might decline temporally in dry season. Many private organizations, factories, schools and other educational institutions have their own tube wells due to lack of reliable municipal water supply. There is no legislation to control the exploitation of groundwater in Khulna. Private tube wells can be installed without a permit.

4.1.11 Sediment Quality of Different Subprojects Areas in Khulna

Under the EIA Study of CCAUD, thirteen sediment samples were collected from the Nabinagar Khal, Deana Chowdhury Khal, Bastuhara Khla & Nirala Khal (3 samples from each Khal) and one control sample from a clean site or source (Khulna University Canal). The test results and the location of sediment sampling points are presented in **Table 4.3**. The sediment quality test results reveal that the concentrations of the tested parameters for all the samples are within the standards limit of Canadian Environmental Quality Standards & EU Directive for Land Application. **Figure 4.10** show the sampling locations of the sediment quality.

Table 4.3 Sediment Quality Monitoring Data of Different Subprojects

Sample ID	Sediment Quality Monitoring Data								
	Pb	Cd	Cr	Cu	Ni	Zn	As	Mn	Hg
	Unit (mg/kg)								
SQ01	0.136	0	0.336	0.371	0.361	0.791	0.101	6.41	0
SQ02	0.19	0.047	0.256	0.454	0.482	0.89	0.134	5.19	0
SQ03	0.163	0.037	0.247	0.409	0.403	0.618	0.112	5.18	0
SQ04	0.19	0.037	0.305	0.531	0.514	1.437	0.158	4.261	0
SQ05	0.181	0.016	0.204	0.457	0.327	1.238	0.122	3.89	0
SQ06	0.264	0.068	0.268	0.558	0.48	1.476	0.185	3.24	0
SQ07	0.199	0.063	0.161	0.319	0.301	0.859	0.106	3.78	0
SQ08	3.11	0.105	0.234	0.829	0.377	4.404	0.142	3.87	0
SQ09	3.93	0.271	0.21	0.889	0.343	5.187	0.126	3.47	0.002
SQ10	0.199	0.016	0.091	0.15	0.237	0.572	0.079	2.18	0
SQ11	0.117	0.084	0.28	0.376	0.422	0.815	0.0119	3.51	0
SQ12	0.264	0	0.228	0.381	0.409	1.211	0.096	2.99	0
SQ13	0.09	0.053	0.238	0.288	0.431	0.664	0.138	2.72	0
Standards									
ISQG*	35	0.6	37.3	35.7	-	123	5.9	-	0.17
PEL**	91.3	3.5	90	197	-	315	17	-	0.486
EU Directive for Land Application	1200	40	-	1750	400	4000	-	-	25
<p>*Canadian Environmental Quality Guideline for freshwater (Interim Sediment Quality Guideline) **Canadian Environmental Quality Guideline (Probable Effect Level) SQ01= Deana Chowdhury Khal (Upstream); SQ02= Deana Chowdhury Khal; SQ03= Deana Chowdhury Khal (Downstream); SQ04= Bastuhara Khal (Upstream); SQ05= Bastuhara Khal; SQ06= Bastuhara Khal (Downstream); SQ07= Nabinagar Khal (Upstream); SQ08= Nabinagar Khal; SQ09= Nabinagar Khal (Downstream); SQ10= Nirala Khal (Upstream); SQ11= Nirala Khal; SQ12= Nirala Khal (Downstream); and SQ13= KU Khal.</p>									

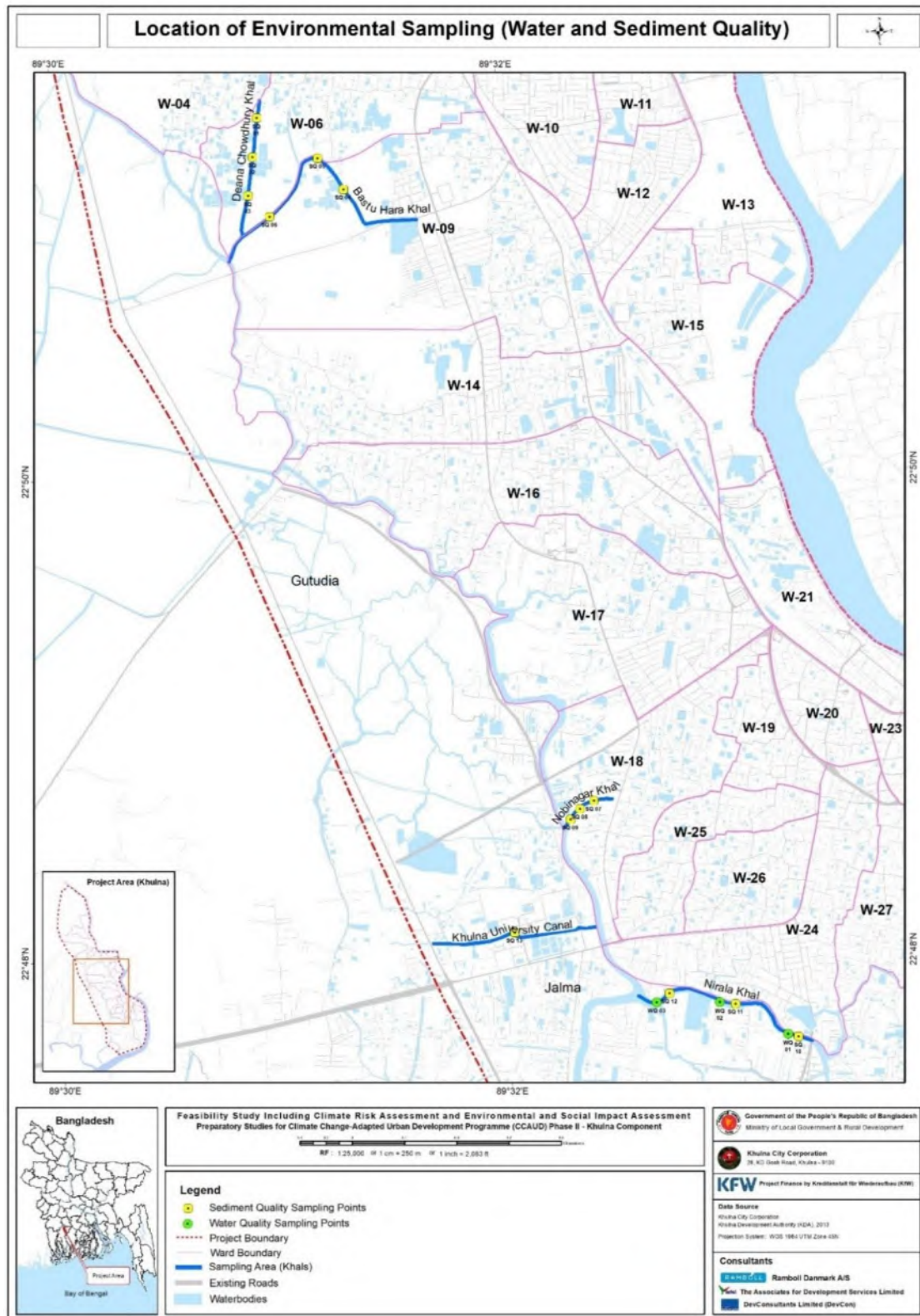


Figure 4.10 Environmental Sampling Map (Sediment and Water Quality)

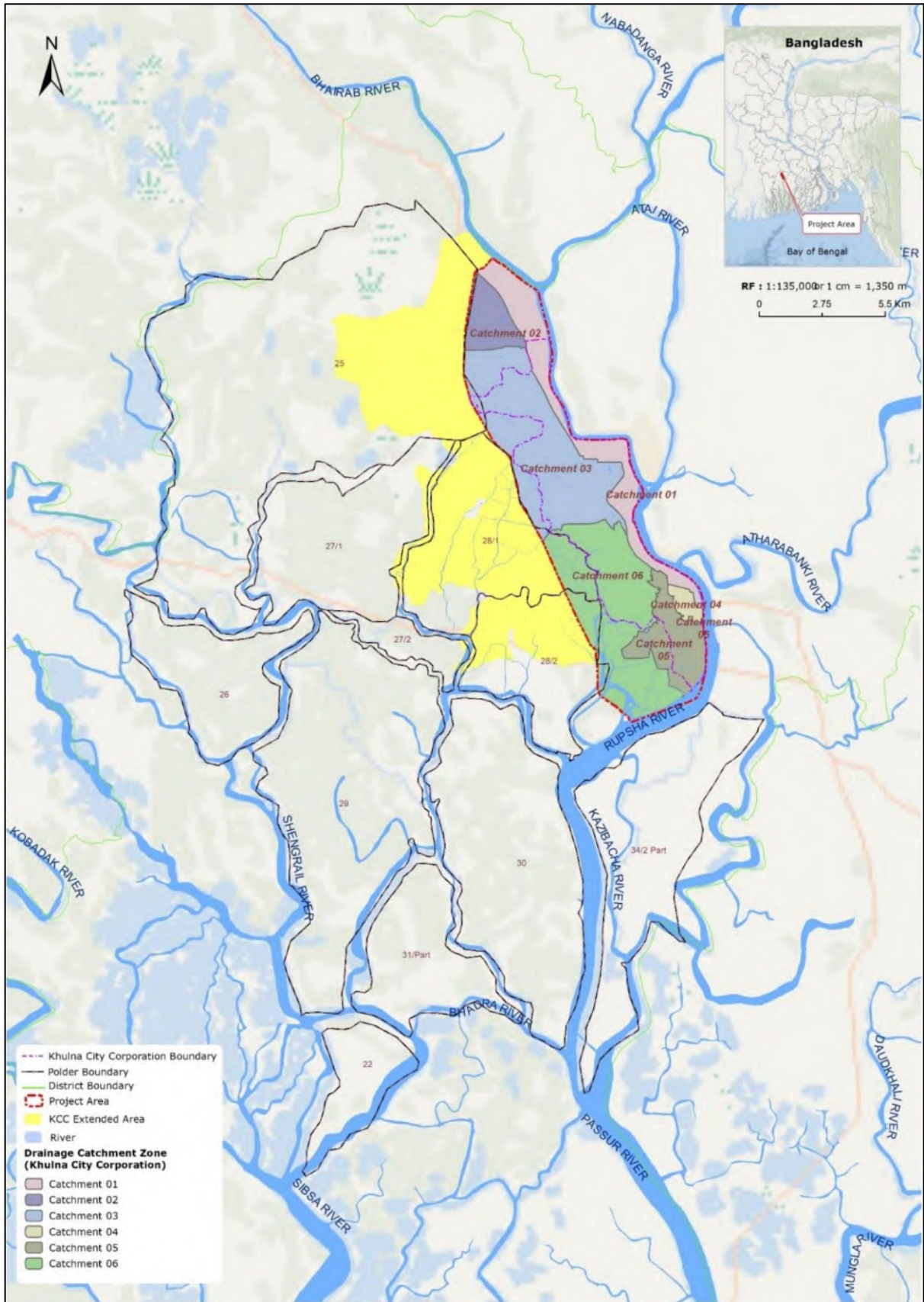


Figure 4.11 Natural channels and rivers in the project area

4.1.12 Ambient air quality of Khulna City Corporation Area

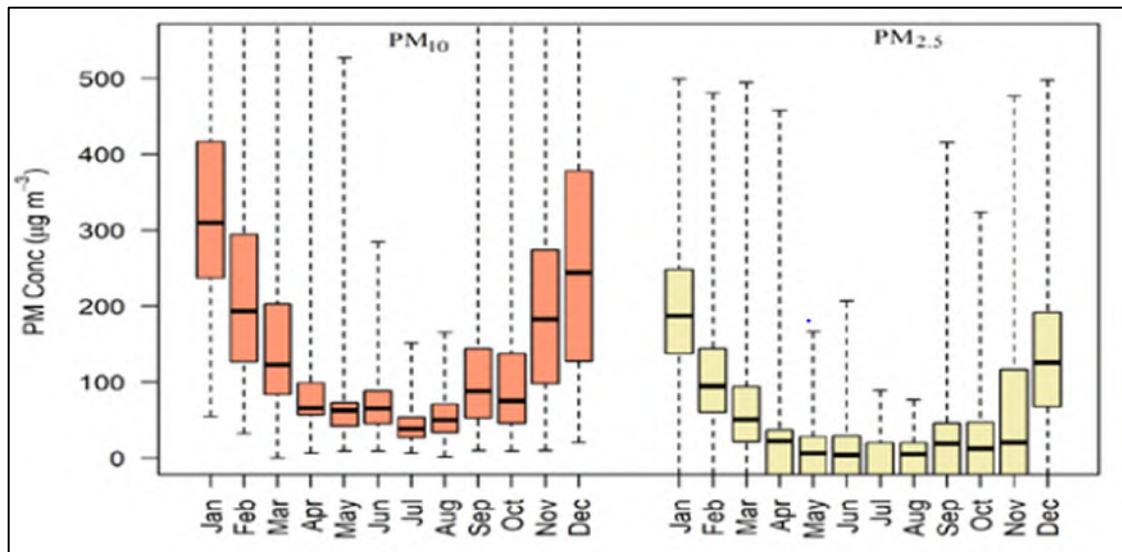
Air quality in the Khulna city and its neighbouring areas is deteriorating with rapid urbanization and industrialization. In the rural areas however, the ambient air quality is relatively good. DoE has been carrying out the Clean Air & Sustainable Environment (CASE) project in the major cities in Bangladesh. The main objective of the CASE Project is to provide reliable information to the authorities and to the public about the air quality. In KCC, DoE is operating an Air Quality monitoring Network (CAMS-9, Baira, Khulna) to conduct real-time measurements of pollutants in the ambient air. Data of ambient air quality (AAQ) captured from CAMS-9 for the month of July 2020 to February 2021 are presented in **Table 4.4**.

Table 4.4 Ambient Air Quality Monitoring Data of Different Locations of KCC

Station ID	Location (GPS)	Monitoring Period (Month and year)	Parameters (Monthly Average Data)							
			SO ₂ 24 hr	NO _X 24 hr	CO 1 hr	CO 8hr	O ₃ 1 hr	O ₃ 8 hr	PM _{2.5} 24 hr	PM ₁₀ 24 hr
			ppb	ppb	ppm	ppm	ppb	ppb	µg /m ³	µg /m ³
Baira, Khulna	22.48N ^o 89.53 ^o	February 2021	3.55	18.00	1.77	1.27	DNA	DNA	123.38	249.03
		January 2021	3.33	35.98	0.94	0.86	DNA	DNA	154.70	195.02
		December 2020	2.01	28.55	DNA	DNA	DNA	DNA	149.65	190.58
		November 2020	2.65	0.17	1.42	1.39	DNA	DNA	43.49	97.02
		October 2020	2.36	DNA	0.95	0.92	DNA	DNA	30.26	49.21
		September 2020	0.72	0.91	1.27	1.26	DNA	DNA	12.12	50.95
		August 2020	1.54	13.31	0.36	0.37	6.36	5.84	13.57	28.52
		July 2020	0.04	1.08	0.17	0.02	18.00	6.39	4.69	26.71
National Ambient Air Quality Standards for Bangladesh			140	53*	35	9	120	80	65	150
DNA – Data not available										
*Standard for Annual Data										

PM₁₀ and PM_{2.5} are the most critical pollutants. 24-hour average for both PM₁₀ and PM_{2.5} concentrations were found lower in the reporting period (July to February 2021). In February 2021, the standards for PM₁₀ and PM_{2.5} were exceeded 15 and 16 days respectively; in January 2021, 17 and 23 days respectively; in December 2020, 8 and 18 days respectively; in November 2020, 3 and 4 days respectively.

It should be noted that trends in PM concentration are influenced by seasonal impacts – very high PM concentration in dry season and low concentration in wet season. Like other urban areas in Bangladesh, December to January is the polluted time in Khulna followed by February, March and November (refer **Figure 4.12** below).



Source: Ambient Air Quality in Bangladesh, Department of Environment, 2018

Figure 4.12 Box-Whisker Plots of PM Concentrations in Different Months in Khulna

4.1.13 Noise Levels in Project Area

The project area covers the third largest city of Bangladesh, so there are good sources of noise pollution. As part of the study “Status of Noise Pollution in Khulna City: A GIS Approach” (Mostafizur Rahman, 2017) sound level data were measured from 7 am to 8 pm in one-hour intervals. The results of the noise level measurement period have been divided in Morning (7.00 AM-11.00 AM), Afternoon (12.00 PM-6.00 PM), & Evening (7.00 PM-8.00 PM). The average, maximum and minimum values have been calculated based on the data of the study to present it more concisely.

Table 4.5 shows that the noise level varies from morning to night. The noisiest places in KCC area are Sonadanga Bus Stand and Gollamari More. Except for the average morning data of Picture Palace More & Boro Bazar, measured average data for the rest of the locations exceed the GoB Standards (daytime) stated for the commercial & mixed zone. Within the KCC area, the maximum noise level was found at Sonadanga Bus Stand (96 dBA) in the afternoon and the minimum noise level was measured at Boro Bazar (58 dBA) in the morning. The ambient noise levels are higher than the levels specified in ECR 1997.

Table 4.5 Noise Levels Monitoring Data of Project Area

Sampling Location	Morning (7.00 AM-11.00AM)			Afternoon (12.00PM-6.00PM)			Evening (7.00PM-8.00 PM)			Zone	Standard dBA
	Avg.	Max	Min	Avg.	Max	Min	Avg.	Max	Min		
	dBA										
Picture Palace More	68.4	74	64	86.0	90	80	90.0	91	89	Commercial Zone	70
Dakbangla More	76.6	82	73	87.9	92	83	88.0	88	88		
Boro Bazar	67.0	78	58	77.6	81	72	76.5	78	75		
New Market	74.0	82	64	87.1	92	81	87.5	88	87		
Sonadanga Bus Stand	75.2	82	67	92.0	96	86	92.5	93	92		
Royal More	70.6	76	66	79.1	85	72	84.0	85	83		
Gollamari More	75.8	85	68	88.6	92	84	92.0	92	92	Mixed Zone	60
Daulatpur	71.0	79	63	81.9	85	79	85.0	86	84		

* The amended schedule-4, 2006, of (Noise Measurement Standard) Environmental Conservation Rules, Day Time (from 6 am to 9 pm)
 Source: “Status of Noise Pollution in Khulna City: A GIS Approach (2017)” by Mostafizur Rahman

4.1.14 Land use and land cover in the project area

The project area covers an area of 85.38 km², which includes 31 wards (local community units). The land uses of the project area are shown in **Table 4.6**. In the land use pattern, 17 types of land uses are found based on a review of data and GIS files in comparison with review of satellite images and data from Google Earth and Open Street Map. It is evident from the **Table 4.6** that, two types of land uses are dominant in Khulna City Corporation; residential land use occupies 36.89%, followed by agriculture which is 30.08%. Water bodies cover 6.29%, cultural network, transport & communication covers about 10.14% and Community service only 0.60%. Generalized land-use scenario of the project area has been presented in **Figure 4.13**.

Industrial units are located mostly on bank of the Rupsha and the Bhairab River. Approximately, 350 industrial units are located within KCC area, of them, 230 including jute mills, power plants, soybean mills, sawmills, shrimp processing plants and cement factories are located on the banks of the Bhairab & Rupsha.

Table 4.6 Existing Land Use Classification of the Project Area

SL. No.	Land use Categories	Area in Acres	Area in Sq. km	Area (%)
1	Residential area	7780.50	31.50	36.89
2	Agricultural	6345.43	25.69	30.08
3	Cultural network, transport & communication	2139.02	8.66	10.14
4	Water body	1326.39	5.37	6.29
5	Manufacturing & processing	837.33	3.39	3.97
6	Restricted Area	741.00	3.00	3.50
7	Education and research	550.81	2.23	2.62
8	Mixed use	397.67	1.61	1.89
9	Commercial	279.11	1.13	1.33
10	Vacant land	163.02	0.66	0.77
11	Community service	128.44	0.52	0.60
12	Government services	111.15	0.45	0.53
13	Recreational facilities	108.68	0.44	0.52
14	Service activity	96.33	0.39	0.46
15	Urban green space	59.28	0.24	0.29
16	Miscellaneous	12.35	0.05	0.06
17	Non-government services	12.35	0.05	0.06
	Total	21088.86	85.38	100

Source: Baseline Study-CCAUDP, 2020

4.1.15 Landscape and Visual Amenity of KCC

The landscape of KCC has been substantially developed by the flow of the Rupsha and Bhairab Rivers. Due to physiographic setting, Khulna has grown along the west bank of the river Bhairab and Rupsha in a linear pattern. The length of north-south direction of the City is approximately four times longer than the east-west direction. The ground elevation of this narrow strip decreases towards west and south direction and gradually turns into a flood plain and swampy lands/beels comprising flat and low-lying areas, crisscrossed by numerous tidal rivers and channels. Because of those floods plain and swampy lands/beels, the westward growth of the city has been restricted. The linear shape is also influenced by transport route that is Khulna-Jessore highway and it may expand north up to Jessore. Thus, the recent trend of growth towards southeast and southwest seems to be encouraging for a more balanced and integrated spatial development of the City because of the Rupsha Bridge is constructed with the approach road running west of Khulna.

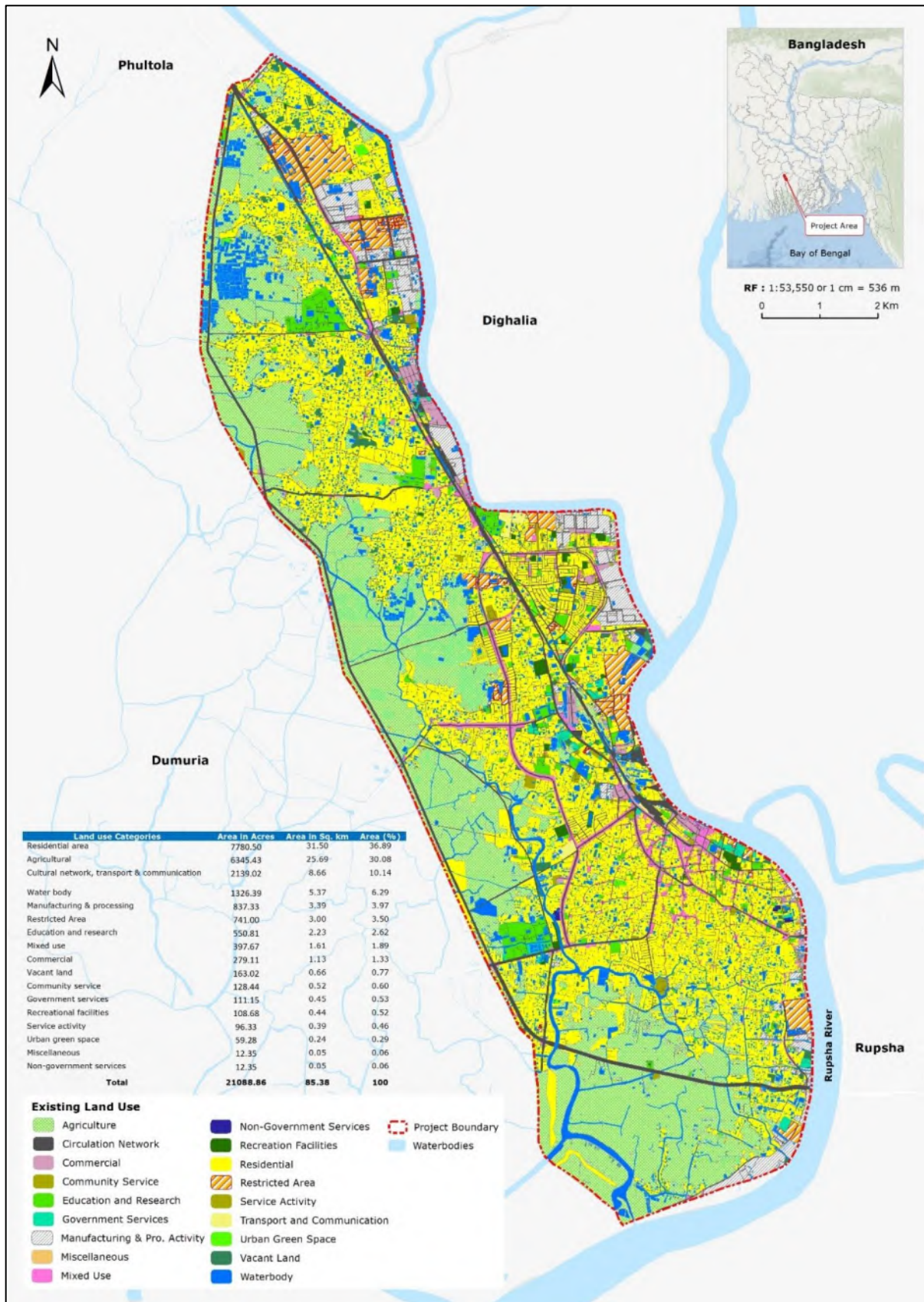


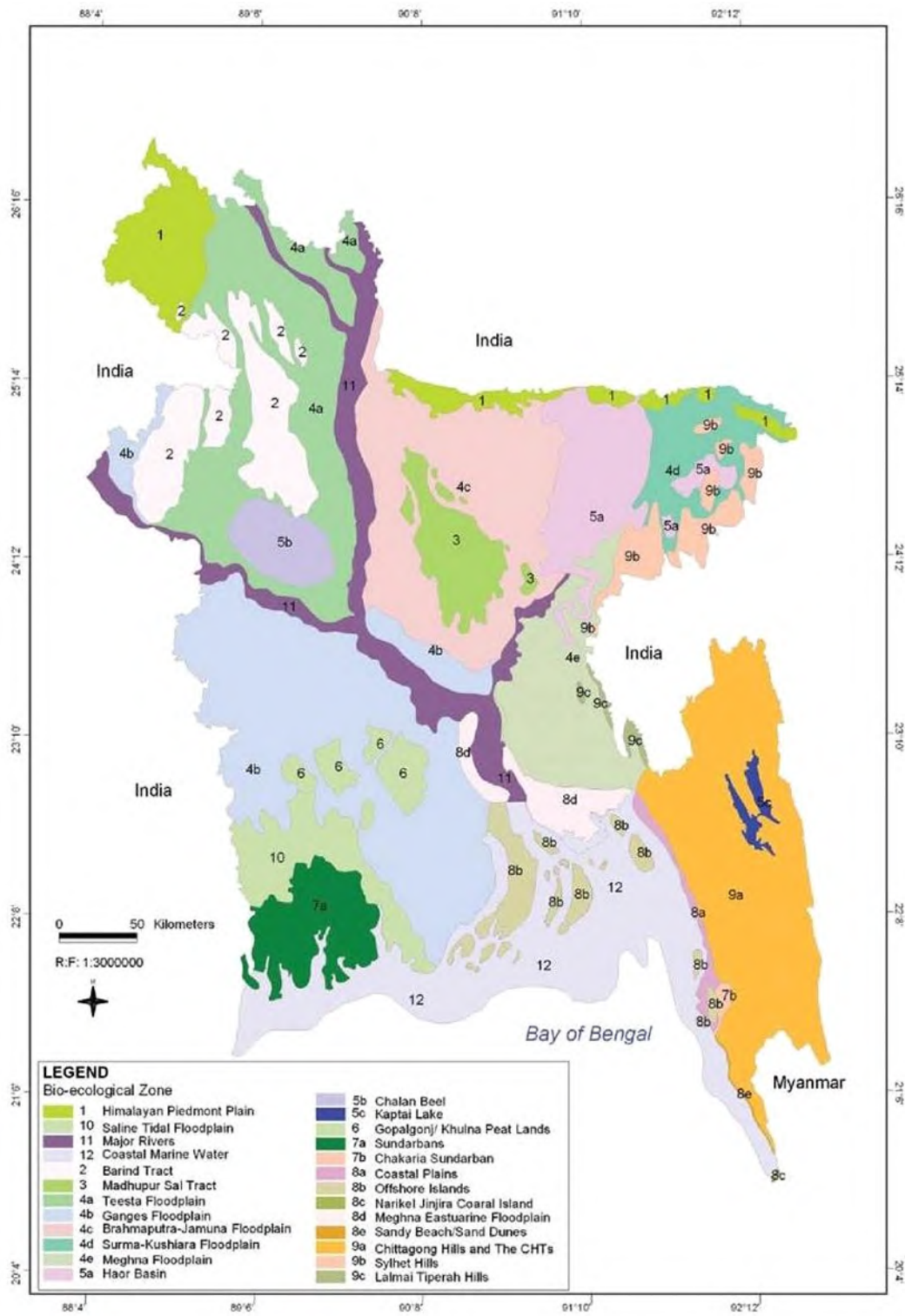
Figure 4.13 Generalized Land use of the Project Area

4.2 Biological Environment of Khulna City Corporation Area

This section contains the status of biological environment of the proposed project area. Overall status of the biological settings is presented by inventory list of plant, wildlife & fish species with their scientific names, local bangle names and English names (if available). Also, conservation significant species, threatened plants and red list categories are provided.

4.2.1 Bio-ecological Zone

The International Union for Conservation of Nature (IUCN) has divided Bangladesh into 25 bio-ecological zones within the context of physiographic units and biological diversity. Each of the bio-ecological zones represents the overall ecological situation of an area in the country. The study area is within two different bio-ecological zones: Ganges floodplain, and Saline tidal floodplain (**Figure 4.14**).



https://www.researchgate.net/figure/Bio-ecological-Zones-of-Bangladesh-SourceIUCN-2002_fig5_327691767

Figure 4.14 Bio-ecological Zoning Map of Bangladesh

4.2.2 Floral Diversity of the Project Area

Terrestrial flora of the project area mainly consisted of plantation trees, natural growing trees, herbs, shrubs, climbers, epiphytes and parasites. Whereas, aquatic flora comprise species belongs to submerged, free floating, rooted floating, sedges & meadows category. Among the presented species 82% are terrestrial plant species and 18% are aquatic flora (**Figure 4.15**).

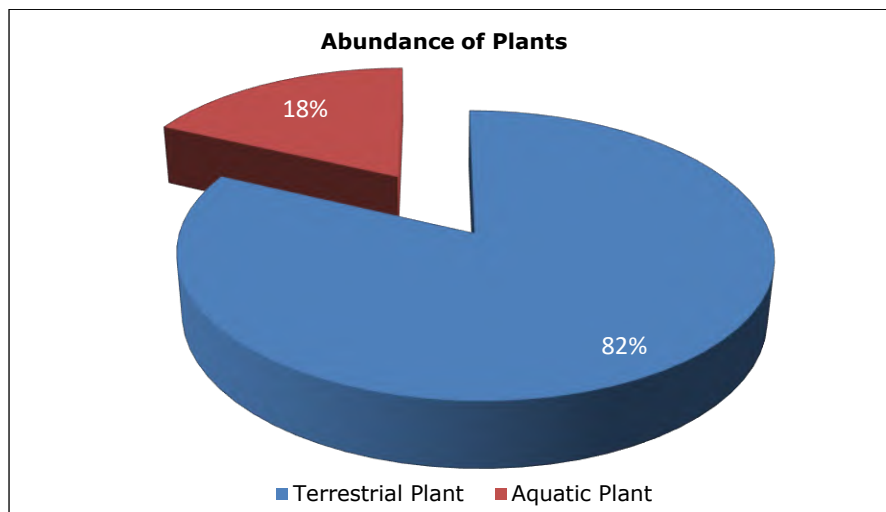


Figure 4.15 Aquatic and terrestrial plants found in KCC

4.2.3 Terrestrial Flora of the Project Area

In the study area, terrestrial floras are present mainly in the homestead regions, roadsides, village groves, parks or picnic spots, and upland or high cultivated lands. Homestead vegetation is characterized by fruit-bearing trees, timber trees, and vegetable. The common cultivated plants are Betel nut palm (*Areca catechu*), coconut (*Cocos nucifera*), Indian Lilac (*Azadirachta indica*), West Indian mahogany (*Swietenia macrophylla*), Jackfruit (*Artocarpus heterophyllus*), etc. Homestead vegetation provides good shelter and habitat for local animals like birds, reptiles and amphibians. Roadside plantations include: date palm, road chambol, koro, Krishnachura, rain tree, banyan, shisoo, babla, akashmoni, eucalyptus, mango, blackberries, raj koro, etc. **Table 4.7** presents the plant species commonly found within the project area.



Figure 4.16 Bio-ecological Zoning Map of KCC

Table 4.7 List of Terrestrial Plant Species in Khulna Area

Sl. No.	Local Name	English Name	Scientific Name	IUCN Status (Global)	IUCN Status (Bangladesh)
1	Ata	Custard Apple	<i>Annona reticulata</i>	NE	NE
2	Amra	Golden Apple	<i>Spondias dulcis</i>	NE	NE
3	Akashia	Earleaf Acacia	<i>Acacia auriculiformis</i>	NE	NE
4	Arjun	Arjun	<i>Terminalia arjuna</i>	NE	NE
5	Aam	Mango tree	<i>Mangifera indica</i>	DD	NE
6	Bohara	Belliric Myrobalan	<i>Terminalia bellirica</i>	NE	NE
7	Mehogonii	Mahogany	<i>Swietenia macrophylla</i>	VU	NE
8	Baroi	Berry	<i>Ziziphus mauritiana</i>	NE	NE
9	Batabi Lebu	Pomelo	<i>Citrus grandis</i>	NE	NE
10	Bel	Bael Fruit	<i>Aegle marmelos</i>	NE	NE
11	Bilati Gab	Velvet Apple	<i>Diospyros blancoi</i>	NE	NE
12	Bot	Banyan Tree	<i>Ficus benghalensis</i>	NE	NE
13	Chhatim	Devil's Tree	<i>Alstonia scholaris</i>	NE	NE
14	Chalta	Elephant Apple	<i>Dillenia indica</i>	NE	NE
15	Debdaru	Indian Mast Tree	<i>Polyalthia longifolia</i>	NE	NE
16	Dewa	Monkey Jack	<i>Artocarpus lakoocha</i>	NE	NE
17	Jumrul	Black Berry	<i>Syzygium cumini</i>	NE	NE
18	Jamrul	Java Apple	<i>Syzygium samarangense</i>	NE	NE
19	Kala	Banana	<i>Musa sapientum</i>	NE	NE
20	Kadam	Burflower Tree	<i>Neolamarckia cadamba</i>	NE	NE
21	Katbadam	Indian Almond	<i>Terminalia cattapa</i>	NE	NE
22	Khegur	Wild Date Palm	<i>Phoenix sylvestris</i>	NE	NE
23	Katgolap	Frangipani	<i>Plumeria rubra</i>	NE	NE
24	Karoi	Lebbeck Tree	<i>Albizia lebbeck</i>	NE	NE
25	Khanthal	Jackfruit	<i>Artocarpus heterophyllus</i>	NE	NE
26	Kamranga	Starfruit	<i>Averrhoa carambola</i>	NE	NE
27	Narikel	Coconut	<i>Cocos nucifera</i>	NE	NE
28	Tentul	Tamarind-tree	<i>Tamarindus indica</i>	NE	NE
29	Sagun	Teak	<i>Tectona grandis</i>	NE	NE
30	Royel Plam	Royel Plam	<i>Roystonea regia</i>	NE	NE
31	Raindee Koroy	Raintree	<i>Samanea saman</i>	NE	NE
32	Safoda	Sapodilla	<i>Manilkara zapota</i>	NE	NE
33	Sajna	Drumstick	<i>Moringa oleifera</i>	NE	NE
34	Jalpai	Olive	<i>Olea europaea</i>	NE	NE
35	Peara	Guava	<i>Psidium guajava</i>	NE	NE
36	Ulatkambol	Devil's Cotton	<i>Abroma augusta</i>	NE	NE
37	Supari	Betel Nut Palm	<i>Areca catechu</i>	NE	NE
38	Neem	Neem Tree	<i>Azadirachta indica</i>	NE	NE
39	Shimul	Silk Cotton Tree	<i>Bombax ceiba</i>	NE	NE
40	Tal	Palmyra Palm	<i>Borassus flabellifer</i>	NE	NE
41	Papya	Papaya	<i>Carica papaya</i>	NE	NE
42	Sisso	Indian Rosewood	<i>Dalbergia sissoo</i>	NE	NE
43	Krishnochura	Flame Tree	<i>Delonix regia</i>	NE	NE
44	Eucalyptus	Eucalyptus	<i>Eucalyptus sp</i>	NE	NE
45	Gamari	White Teak	<i>Gmelina arborea</i>	NE	NE
46	Jarulul	Pride of India	<i>Lagerstroemia speciosa</i>	NE	NE
47	Ipil	Leucaena	<i>Leucaena leucocephala</i>	NE	NE
48	Lichu	Lychee	<i>Litchi chinensis</i>	NE	NE

DD= data deficient; NE = not evaluated; VU = vulnerable

4.2.4 Aquatic Flora of Khulna

The project area includes seasonal water bodies. Aquatic flora consisted of true aquatics, seasonally growing natural marshy plants and flood plain flora. Vegetation commonly observed in freshwater ditches including

water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), floating fern (*Salvinia natans*), common duckweed (*Lemna perpusilla*), and water velvet (*Azolla pinnata*). Different types of aquatic flora within the study area are listed in **Table 4.8**.

Table 4.8 List of aquatic plant species in the study area

SL. No.	Category	Local Name	English Name	Scientific Name
1	Submerged	Jhangi	Hydrilla	<i>Hydrilla verticillata</i>
2	Submerged	Bicha	Eelgrass	<i>Vallisneria spiralis</i>
3	Submerged	Ghechu	Water Hawthorn	<i>Aponogeton natans</i>
4	Free floating	Kachuripana	Water Hyacinth	<i>Eichhornia crassipes</i>
5	Free floating	Topapana	Water Lettuce	<i>Pistia stratiotes</i>
6	Free floating	Tetulpana	Floating Fern	<i>Salvinia natans</i>
7	Free floating	Khudipana	Duckweed	<i>Lemna perpusilla</i>
8	Free floating	Azola	Mosquito Fern	<i>Azolla pinnata</i>
9	Rooted floating	Sada sapla	White Water Lily	<i>Nymphae nouchali</i>
10	Sedges	Kolmi	Water Spinach	<i>Ipomoea aquatic</i>
11	Meadows	Dhol kolmi	Bush Morning Glory	<i>Ipomoea fistulosa</i>
12	Meadows	Keshordam	Water Primrose	<i>Ludwigia adscendense</i>
13	Meadows	Helench	Alligator Weed	<i>Alternanthera philoxiroides</i>

4.2.5 Faunal Diversity of Khulna

Wildlife (mammals, birds, amphibians and reptiles) were not normally categorized as aquatic or terrestrial except dolphins. So, they are presented in the report without this type of categorization. A total of 46 species of wildlife were observed in the proposed project area. Among them, 13 were mammals, 18 were birds, 5 were amphibians and 10 were reptiles, none of these species are listed as Threatened or Rare in the IUCN Red List. **Table 4.9** shows the summary of the various species found in the city.

Table 4.9 List of Faunal Species in the Study Area

SL. No.	Local Name	English Name	Scientific Name	IUCN Bangladesh (2015)	CITES Appendices
Mammals					
1	Kalo Indur	Common House Rat	<i>Rattus</i>	LC	NL
2	Nenggti Indur	House mouse	<i>Mus musculus</i>	LC	NL
3	Math-er Indur	Field Mouse	<i>Mus booduga</i>	LC	NL
4	Chika	Grey Musk Shrew	<i>Suncus murinus</i>	LC	NL
5	Bad beji	Common mongoose	<i>Herpestes edwardsi</i>	LC	III
6	Bonu Biral	Jungle Cat	<i>Felis chaus</i>	NT	NL
7	Bucha-nak Kola Badur	Greater Short nosed Fruit Bat	<i>Cynopterus sphinx</i>	LC	NL
8	Gandha gokul Khatas	Small Indian Civet	<i>Viverricula indica</i>	NT	NL
9	Khatash	Indian Palm Civet	<i>Paradoxurus hermaphroditus</i>	LC	III
10	Shicdu Shiyal	Asiatic Jackal	<i>Canis aureus</i>	LC	III
11	Boro Badur	Indian Flying Fox	<i>Pteropus giganteus</i>	LC	NL
12	Khekshiyal	Bengal Fox	<i>Vulpes bengalensis</i>	VU	III
13	Shushuk	Gangetic River Dolphin	<i>Platanista gangetica</i>	VU	I
Birds					
14	Doyel	Magpie Robin	<i>Copsychus saularis</i>	LC	NL
15	Pechha	Barn Owl	<i>Tyto alba</i>	LC	NL
16	Benebou	Black-hooded Oriole	<i>Oriolus xanthornus</i>	LC	NL
17	Jalali kobutor	Rock Dove	<i>Columba livia</i>	LC	NL

SL. No.	Local Name	English Name	Scientific Name	IUCN Bangladesh (2015)	CITES Appendices
18	Rajghughu	Oriental Turtle-Dove	<i>Streptopelia Orientalis</i>	DD	NL
19	Tila Ghughu	Spotted Dove	<i>Streptopelia chinensis</i>	LC	NL
20	Machranga	Common Kingfisher	<i>Alcedo atthis</i>	LC	NL
21	Choto bhujongo	Bronzed Drongo	<i>Dicrurus aeneus</i>	LC	NL
22	Kak	House Crow	<i>Corvus splendens</i>	LC	NL
23	Shalik	Common Mynah	<i>Acridotheres tristis</i>	LC	NL
24	Chorui	Choroi	<i>Passer domesticus</i>	NO	NL
25	Doyel	Doyel	<i>Copsychus saularis</i>	NO	NL
26	Shalik	Shalik	<i>Sturnus contra</i>	NO	NL
27	Tuntuni	Tuntuni	<i>Orthotomus sutorius</i>	NO	NL
28	Machranga	Machranga	<i>Halcyon smyrnensis</i>	LC	NL
29	Bulbul	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC	NL
30	Shonkho chil	Brahminy Kite	<i>Haliastur indus</i>	LC	NL
31	Bhubon Chil	Black Kite	<i>Milvus migrans</i>	LC	NL
Amphibians					
32	Kola beng	Bull Frog	<i>Hoplobatrachus tigerinus</i>	LC	II
33	Kunu Beng	Tree Frog	<i>Rana temporalis</i>	LC	NL
34	JhiJhi beng	Cricket Frog	<i>Rana limnocharis</i>	LC	NL
35	Kunonbeng	Common Toad	<i>Bufo melanosticus</i>	LC	NL
36	Sobuj Beng	Green Frog	<i>Euphlyctis hexadactylus</i>	LC	II
Reptiles					
37	Tiktiki	House Lizard	<i>Hemidactylus brooki</i>	LC	NL
38	Tiktiki	House Lizard	<i>Hemidactylus frenatus</i>	LC	NL
39	Roktochosha	Common Garden Lizard	<i>Calotes versicolor</i>	LC	NL
40	Boro Guishap	Water Monitor	<i>Varanus salvator</i>	VU	II
41	Bangla Guishap	Bengal Monitor	<i>Varanus bengalensis</i>	NT	I
42	Dagi Dora	Stripes Keelback	<i>Amphiesma stolata</i>	LC	NL
43	Mete Sap	Olive Keelback	<i>Atretium schistosum</i>	LC	III
44	Darash	Rat Snake	<i>Ptyas mucosus</i>	LC	II
45	Anjila	Anjila	<i>Mabuya carinata</i>	NO	II
46	Gui Shap	Gui Shap	<i>Varanus bengalensis</i>	VU	I

DD= data deficient; LC = least concern; NE = not evaluated; NL = not listed, VU = vulnerable; EN=Endangered; NT= near threatened.

4.2.6 Fisheries Resources of Khulna

Major rivers within the project area are Bhairab River, Atrai River, and Rupsha Rivers, which are tidal in nature. These rivers function as fish habitat for major carp, catfish, bagda, galda and other inland freshwater fishes. A number of Khals maintain connectivity with these rivers. Most of the connecting Khals are seasonal which function only during the wet season. Water availability in these Khals varies from mid-May to mid-October. Fish habitats of the study area are classified into two broad categories: capture fisheries and culture fisheries. The capture fisheries comprise mainly of river and Khal, whereas culture fisheries are represented by brackish water aquaculture (Bagda Gher) and freshwater aquaculture (Galda Gher). **Table 4.10** shows the list of fish species and their conservation status.

Table 4.10 Capture and Culture Fish Species in Khulna Area

SI. No.	Local Name	English Name	Scientific Name	IUCN Global	IUCN Bangladesh
Capture Fishes					
1	Icha	Leander shrimp	<i>Leander styliferus</i>	NL	NL
2	Golda	Giant freshwater prawn	<i>Macrobrachium spp.</i>	NL	NL
3	Bagda	Giant tiger prawn	<i>Penaeus monodon</i>	NL	NL

SI. No.	Local Name	English Name	Scientific Name	IUCN Global	IUCN Bangladesh
4	Chaka chingri	Indian prawn	<i>Penaeusindicus</i>	NL	NL
5	Harinachingri	Greasyback shrimp	<i>Metapenaeusensis</i>	NL	NL
6	Rui	Rohu	<i>Labeo rohita</i>	LC	LC
7	Catla	Catla	<i>Catla catla</i>	NE	LC
8	Mrigel	Mrigal	<i>Cirrhinuscirrhosus</i>	VU	NT
9	Bata	Mullet	<i>Liza Persia</i>	LC	LC
10	Tit punti	Ticto barb	<i>Puntius ticto</i>	LC	LC
11	Bele	Tank goby	<i>Glossogobiusgiuris</i>	LC	LC
12	Tengra	Tengara catfish	<i>Mystustengara</i>	LC	LC
13	Taki	Spotted snakehead	<i>Channa punctatus</i>	LC	LC
14	Shol	Striped snakehead	<i>Channa striates</i>	LC	LC
15	Baim	Zig-zag eel	<i>Mastacembelusarmatus</i>	LC	EN
16	Shing	Stinging catfish	<i>Heteropneustes fossilis</i>	LC	LC
17	Khalisa	Banded gourami	<i>Colisafasciata</i>	LC	LC
18	Gutum	Guntea loach	<i>Lepidocephalusguntea</i>	LC	LC
19	Koi	Climbing perch	<i>Anabas testudineus</i>	DD	LC
20	Pabda	Pabdah catfish	<i>Ompok pabda</i>	NT	EN
21	Golsha	Gangetic mystus	<i>Mystus cavasius</i>	LC	VU
22	Puti	Rosy barb	<i>Puntius conchoniis</i>	LC	NO
23	Fali	Bronze featherback	<i>Notopterus notopterus</i>	LC	VU
24	Kachki	Ganges river sprat	<i>Corica soborna</i>	LC	NO
25	Mola	Mola carplet	<i>Amblypharyngodon mola</i>	LC	NO
26	Kakila	Needlefish	<i>Xenentodon cancila</i>	LC	NO
27	Chapila	Indian river shad	<i>Gudusia chapra</i>	LC	NO
28	Kholisha	Banded gourami	<i>Colisha fasciatus</i>	DD	NO
29	Kalibaush	Orange-fin labeo	<i>Labeo calbasu</i>	LC	EN
30	Boal	Boal catfish	<i>Wallago attu</i>	VU	NO
31	Ayre	Long-whiskered catfish	<i>Sperata aor</i>	LC	VU
32	Bain	Zig-zag eel	<i>Mastacembelus armatus</i>	LC	VU
33	Chital	Clown knifefish	<i>Chitala chitala</i>	NT	EN
34	Gozar	Giant snakehead	<i>Channa marulius</i>	LC	EN
35	Chela	Razorbelly minnow	<i>Salmostoma acinaces</i>	LC	DD
36	Magur	Walking catfish	<i>Clarius batrachus</i>	LC	NO
37	Dari	Stone loach	<i>Nemachelius scaturigina</i>	DD	NO
38	Fasha	Gangetic hairfin anchovy	<i>Setipinna phasa</i>	LC	NO
Culture Fish					
39	Rui	Rohu	<i>Labeorohita</i>	LC	LC
40	Bagdachingri	Giant tiger prawn	<i>Penaeus monodon</i>	NL	NL
41	Catla	Catla	<i>Catlacatla</i>	NE	LC
42	Mrigel	Mrigal	<i>Cirrhinus cirrhosus</i>	VU	NT
43	Silver carp	Silver carp	<i>Hypophthalmichthyes molitrix</i>	DD	Exotic
44	Grass carp	Grass carp	<i>Ctenopharyngodon idela</i>	DD	Exotic
45	Mirror carp	Mirror carp	<i>Cyprinus carpio</i>	DD	Exotic
46	Tilapia	Tilapia	<i>Oreochromis mossambicus</i>	DD	Exotic

DD= data deficient; LC = least concern; NE = not evaluated; NL = not listed, VU = vulnerable; EN= Endangered; NT= near threatened.

Table 4.11 Extinct Mammalian Species of Bangladesh, 2015

Sl. No.	Scientific Name	Local Name	Place of occurrence	Tentatively lost since
1	<i>Hyaena hyaena</i>	Striped Hyena	Northwestern part of the country	20 th Century
2	<i>Canis lupus</i>	Grey Wolf	In all abundant tree covered areas	Mid-20 th Century
3	<i>Boselaphus tragocamelus</i>	Nilgal	Dinajpur, Rangpur, Forests.	1930s
4	<i>Bos javanicus</i>	Banteng	Chittangong & CHT	1940s
5	<i>Bubalus amee</i>	Wild Buffalo	Chittangong & CHT	1940s
6	<i>Dicerorhinus sumatrensis</i>	Sumatran Rhinoceros	North of existing Sundarbans	1930s
7	<i>Rhinoceros sondaicus</i>	Javan Rhinoceros	North of existing Sundarbans	1930s
8	<i>Rhinoceros unicornis</i>	Indian Rhinoceros	North of existing Sundarbans	1930s
9	<i>Rucervus duvaucelii</i>	Swamp Deer	Sundarbans	1950s
10	<i>Antilope cervicapra</i>	Blackbuck	Northern region	End of 19 th Century
11	<i>Melursus ursinus</i>	Sloth Bear	Chittagong Hill Tracts	Beginning of 21 th Century

Table 4.12 Extinct Wildlife Species of Bangladesh (IUCN, 2015)

Sl. No.	Class	Bangla Name	English Name	Scientific Name
1	Reptilia	Mitha Panir Kumir	Marsh Crocodile	<i>Crocodylus palustris</i>
2	Aves (Bird)	Moyur	Indian Peafowl	<i>Paro cristatus</i>
3	Aves (Bird)	Sobuj Moyur	Green Peafowl	<i>Pavo muticus</i>
4	Aves (Bird)	Golapi Shir Hans	Pink-headed Duck	<i>Rhodonessa caryophyllacea</i>
5	Aves (Bird)	Badi Hans	White-winged Duck	<i>Asarcornis scutulata</i>
6	Aves (Bird)	Saros	Sarus Crane	<i>Antigone antigone</i>
7	Aves (Bird)	Raj Shokun	King Vulture	<i>Sarcogyps calvus</i>
8	Aves (Bird)	Ispotbil Pelican	Spot-billed Pelican	<i>Pelicanus philippensis</i>
9	Aves (Bird)	Boro Madan Tak	Greater Adjutant	<i>Leptoptilos dubius</i>
10	Aves (Bird)	Bangla Florican	Greater Florican	<i>Houbaropsis bengalensis</i>
11	Aves (Bird)	Choto Florican	Lesser Florican	<i>Sypheotides indicus</i>
12	Aves (Bird)	Baro Tailed Tree Creeper	Bar-tailed Tree Creeper	<i>Certhia himalayana</i>
13	Aves (Bird)	Kalobuck Parrotbill	Black-breasted Parrotbill	<i>Paradoxornis flavirostris</i>
14	Aves (Bird)	Spot Breasted Parrotbill	Spot-breasted Parrotbill	<i>Paradoxornis guttaticollis</i>
15	Aves (Bird)	Boro Parrotbill	Greater Rufous-headed Parrotbill	<i>Paradoxornis ruficeps</i>
16	Aves (Bird)	Dhusor Titir	Grey Francolin	<i>Francolinus pondicerianus</i>
17	Aves (Bird)	Rasti fronted Barwing	Rufous-throated Barwing	<i>Actinodura egertoni</i>
18	Aves (Bird)	Rufous Throated Partridges	Rufous-throated Partridges	<i>Arborophila rufogularis</i>

Sl. No.	Class	Bangla Name	English Name	Scientific Name
19	Aves (Bird)	Swamp Titir	Swamp Francolin	<i>Francolinus gularis</i>
20	Aves (Bird)	Sada Bok	White-bellied Heron	<i>Ardea insignis</i>
21	Mammalia	Varotiyo Gondar	One-horned Rhinoceros	<i>Rhinoceros unicornis</i>
22	Mammalia	Sumatran Gondar	Sumatran Rhinoceros	<i>Rhinoceros sumatrensis</i>
23	Mammalia	Javan Gondar	Javan Rhinoceros	<i>Rhinoceros sondaicus</i>
24	Mammalia	Baroshingo	Swamp Deer	<i>Cervus duvauceli</i>
25	Mammalia	Dagi Hyena	Striped Hyena	<i>Hyaena hyaena</i>
26	Mammalia	Banteng	Banteng	<i>Bos javanicus</i>
27	Mammalia	Krishna Shar	Black Buck	<i>Antilope cervicapra</i>
28	Mammalia	Dhusor Nekra Bagh	Grey Wolf	<i>Canis lupus</i>
29	Mammalia	Nil-gai	Blue Bull	<i>Boselaphus tragocamelus</i>
30	Mammalia	Shloth Valluk	Sloth Bear	<i>Melursus ursinus</i>
31	Mammalia	Buno Mohish	Wild Buffalo	<i>Bubalus arnee</i>

4.2.7 Ecological Resources of Khulna

Ecological resources are natural resources that provide certain necessary but overlooked system maintenance functions within ecosystems. Environmental economics is in search of an appropriate analysis framework to determine economic values of such resources. Natural resources are important because they supply us with the things we need to live: food, shelter, and energy. Without natural resources, we would not be able to survive on this planet. They provide us with the food necessary for survival and fuel used in our everyday lives.

4.2.8 Ecologically Critical Areas of Bangladesh

Biodiversity is defined as the number and types of plants and animals that exist in a particular area or in the world generally. Protecting the biodiversity is of utmost importance in today's world. Similarly, in Bangladesh, the biodiversity of which is in fact an excellent combination of forestry, hills and aquatic ecosystems, the issue of conservation has become essential. Since the advancement of industrial activities, a sharp decline has been recorded in the number of species living in this beautiful country. The worrying state of such destruction has become apparent when the 2015 IUCN Red list of Bangladesh declared that, among 1619 species of seven wildlife groups, 31 species are already extinct and 390 others are threatened with extinction.

In this context, the flagship legislation on environmental protection, the Bangladesh Environment Conservation Act (BECA) of 1995 has empowered the Government to declare an area facing environmentally critical situation to be an Ecologically Critical Area under Section 5. To make such a declaration, the Government must be satisfied that due to degradation of environment, the ecosystem of that given area has reached or is threatened to reach a critical state or condition. Therefore, an Ecologically Critical Area (ECA) is an area in Bangladesh, which, being enriched with unique biodiversity or being environmentally significant, needs protection from destructive activities or conservation and is basically an environmentally protected zone defined by the legal authorities.

The legal mandates under the BECA empower the Ministry of Environment, Forests and Climate Change to determine which of the territories require this special recognition in order to be protected. Rule 3 of the

Environment Conservation Rules, 1997 (Amended in 2023), therefore, determines that the following factors must be considered while declaring any ECA: a) human habitat, b) ancient monument, c) archeological site, d) forest sanctuary, e) national park, f) game reserve, g) wild animals' habitat, h) wetland, i) mangrove, j) forest area, k) biodiversity of that area along with other relevant factors. Through the years 1999, 2001, 2009, 2015 and 2016 the following areas have been declared as ECAs in the country (**Table 4.13 & Table 4.14**):

Table 4.13 Declared Ecologically Critical Areas (ECAs) of Bangladesh

Name of the ECA	Category of Ecosystem	Location (Zilla)
Sundarbans	The outside of Sundarbans Reserved Forest at 10 km extent	Bagerhat, Khulna, Saatkira, Pirojpur, Borguna
Cox's Bazar–Teknaf Sea beach	Village, Agricultural Land, Hills, Forest	Cox's Bazar
Saint Martin's Island	Coastal Waterways, Oceanic Island with Corals	Cox's Bazar
Sonadia Island	Mangrove forests	Cox's Bazar
Hakaluki Haor	Haor (Watershed)	Sylhet, Moulvibazar
Tanguar Haor	Haor (Watershed)	Sunamganj
Marjat Baor	Oxbow Lake	Jhenaidah
Gulshan-Baridhara Lake	Urban Lake	Dhaka
Buriganga River	River	Beside Dhaka Metropolitan
Turag River	River	Beside Dhaka Metropolitan
Balu River	River	Beside Dhaka Metropolitan
Sitalakshya River	River	Beside Dhaka Metropolitan and Narayanganj
Jaflang-Dauki River	River and the surrounding area of 500 metres	Sylhet
Halda River	River and the surrounding area of 500 metres	Chattogram, Khagrachhari

The legal requirements under BECA compel the concerned authorities to ban certain activities within the ECAs, which are: - felling or collecting trees, hunting, catching or killing wildlife, industrial establishment, fishing, and other activities that might affect fish or aquatic life. In general, any activity that could destroy the natural characteristics of soil or water in these areas are to be prevented under this law.

To address the extreme events of extinction, the Government of Bangladesh has also taken some institutional steps which include area-based observation, project implementations and awareness-raising programme. The Department of Environment, which is the technical arm of the Ministry, reports quite a few engaging activities that have been undertaken to protect and conserve the ECAs of Bangladesh.

Table 4.14 Bangladesh Ecologically Critical Areas with Their Ecosystem Type

No	Name of the ECA	Type of Ecosystem	Location	Areas(ha)	Year of Declaration
1.	Cox's Bazar- Teknaf Peninsula	Coastal-Marine	Cox's Bazar	20,373	1999
2.	Sundarbans (10 km landward periphery)	Coastal-Marine	Bagerhat, Khulna Barguna, Pirojpur and Satkhira	292,926	1999
3.	St. Martin's Island	Marine Island with coral reefs	Teknaf Upazila, Cox's Bazar	1,214	1999
4.	Hakaluki Haor	Inland Freshwater Wetland	Sylhet and Moulvibazar	40,466	1999
5.	Sonadia Island	Marine Island	MoheshKhali, Cox's Bazar	10,298	1999
6.	Tanguar Haor	Inland Freshwater Wetland	Tahirpur, Sunamganj	9,727	1999

No	Name of the ECA	Type of Ecosystem	Location	Areas(ha)	Year of Declaration
7.	Marjat Baor	Oxbow Lake	Kaliganj Upazila of Jhenaidah and Chaugacha Upazila of Jashore	325	1999
8.	Gulshan-Baridhara Lake	Urban Wetland	Dhaka city	101	2021
9.	Buriganga	River	Around Dhaka	1336	1009
10.	Turag	River	Around Dhaka	1184	2009
11.	Sitalakhya	River	Around Dhaka	3771	2009
12.	Balu including Tongi canal	River	Around Dhaka	1315	2009
13.	Jaflong-Dawki	River	Jaflong, Sylhet	1493	2015

Source: Department of Environment (2015)

4.2.9 Protected Areas of Bangladesh

Protected areas – also known as designated sites – help to ensure that their natural features of special interest remain in good health for all to enjoy, now and in the future. International directives and treaties, domestic legislation and policy, or local needs and interests may call for the designation of sites.

Wildlife sanctuaries, National parks, and Biosphere are the three types of protected areas that have been earmarked for the conservation of forest and wildlife.

Effectively managed protected areas are a critical tool for safeguarding biodiversity, maintaining ecosystem balance, preserving important habitats, building resilience to climate change, providing global food security, maintaining water quality, conserving natural resources, driving economic success, curbing the spread of diseases and pests, and providing many other benefits to wildlife and human health. Map of protected area of Bangladesh is given in **Figure 4.17**.

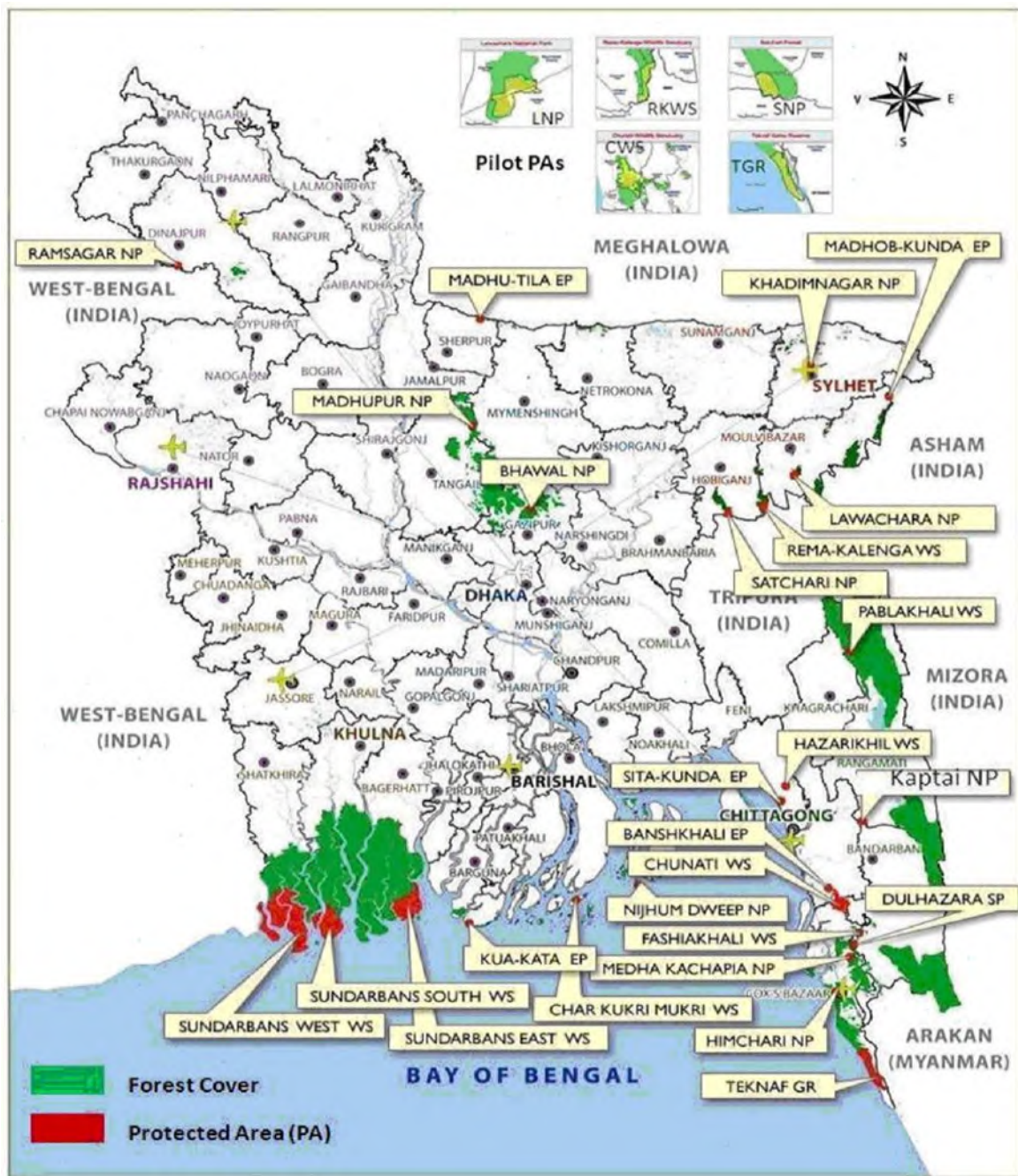


Figure 4.17 Map of Bangladesh Showing the Protected Areas (PAs)

As of 2022, the World Database of Protected Areas list of 51 protected areas in Bangladesh (Table 4.15):

Table 4.15 List of Protected Area of Bangladesh

SL No.	Protected Areas	Upazila	District
1	Alta Dighi National Park	Dhamoirhat	Naogaon
2	Bangabandhu Safari Park Cox Bazar	Chakaria	Cox's Bazar
3	Bangabandhu Safari Park Gazipur	Gazipur Sadar	Gazipur
4	Baroiyadhala National Park	Sitakunda	Chattogram
5	Barshijora Eco-Park	Moulvibazar Sadar	Moulvibazar
6	Bhawal National Park	Gazipur Sadar	Gazipur
7	Chadpai Wildlife Sanctuary	Mongla	Bagerhat

SL No.	Protected Areas	Upazila	District
8	Char Kukri-Mukri Wildlife Sanctuary	Char Fasson	Bhola
9	Chunati Wildlife Sanctuary	Lohagara, Chakoria, BanshKhali	Chattogram
10	Dhangmari Wildlife Sanctuary		Bagerhat
11	Dudhmukhi Wildlife Sanctuary	Sarankhola	Bagerhat
12	Dudpukuria-Dhopachari Wildlife Sanctuary	Rangunia	Chattogram
13	FasiaKhali Wildlife Sanctuary	Chakaria	Cox's Bazar
14	Hazarikhil Wildlife Sanctuary	Sitakunda	Chattogram
15	Himchari National Park	Cox's Bazar Sadar	Cox's Bazar
16	Inani National Park	Ukhia	Cox's Bazar
17	Kadigarh National Park	Bhaluka	Mymensingh
18	Kaptai National Park	Kaptai	Rangamati
19	Khadim Nagar National Park	Sylhet Sadar	Sylhet
20	Kuakata Eco- Park	Kalapara	PatuaKhali
21	Lawachara National Park	Kamalganj	Moulvibazar
22	Madhupur National Park	Mathupur	Tangail
23	Madhutila Eco Park	Nalitabari	Sherpur
24	Aquatic Reserve		Bay of Bengal
25	Medhakachhapia National Park	Chakaria	Cox's Bazar
26	Mirpur Botanic Garden	Dhaka Mirpur	Dhaka
27	Nagarbari-Mohanganj Dolphin Sanctuary	Bera	Pabna
28	Nawabganj National Park	Nawabganj	Dinajpur
29	Nazirganj Dolphin Sanctuary	Sujanagar	Pabna
30	Nijhum Dweep National Park	Hatiya	NoaKhali
31	PablaKhali Wildlife Sanctuary		Rangamati
32	Rajeshpur Eco-Park	Cumilla Sadar	Cumilla
33	Ramsagar National Park	Dinajpur Sadar	Dinajpur
34	Rema-Kalenga Wildlife Sanctuary	Chunarughat	Habiganj
35	Sangu Matamuhari	Thanchi	Bandarban
36	Satchari National Park	Chunarughat	Habiganj
37	Shilanda-Nagdemra Dolphin Sanctuary	Santhia	Pabna
38	Singra National Park	Birgonj	Dinajpur
39	Sitakunda Eco-Park	Sitakunda	Chattogram
40	Sonarchar Wildlife Sanctuary	Rangabali	PatuaKhali
41	The Sundarbans		Khulna
42	St. Martin's Island Aquatic Protected Area		Cox's Bazar
43	Sundarbans East Wildlife Sanctuary		Khulna
44	Sundarbans South Wildlife Sanctuary		Khulna
45	Sundarbans West Wildlife Sanctuary		Khulna
46	Sundarbans Reserved Forest		Khulna
47	Swatch of No Ground Aquatic Protected Area		Bay of Bengal
48	Tanguar Haor	Dharmapasha & Tahirpur	Sunamganj
49	Teknaf Game Reserve	Teknaf	Cox's Bazar
50	Tengragiri Wildlife Sanctuary	Taltali	Barguna
51	Tilagor Eco Park	Sylhet Sadar	Sylhet

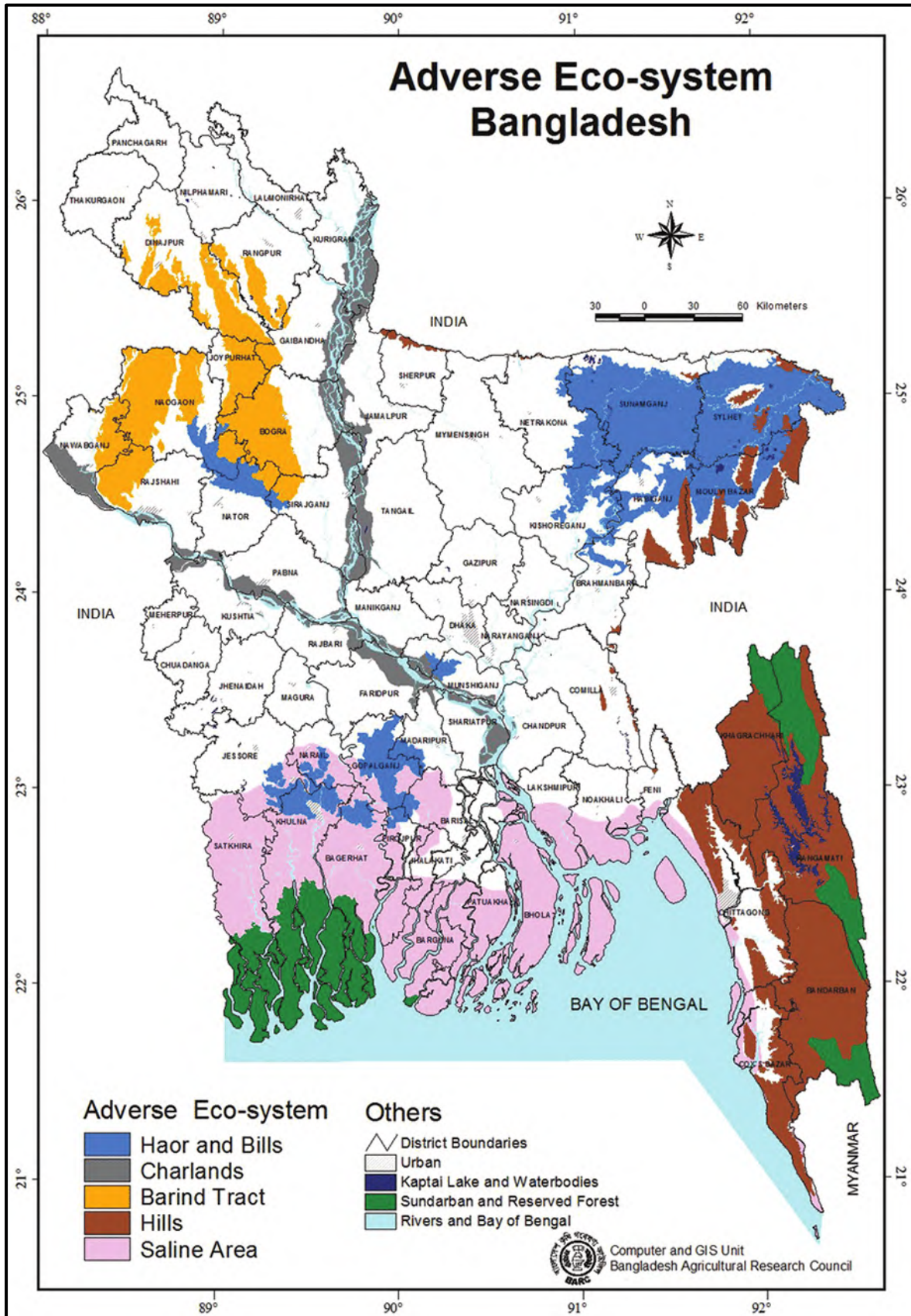


Figure 4.18 Figure Adverse Eco-system of Bangladesh

4.2.12 Birds of Khulna Region

1) Brahminy Kite (*Haliastur indus*)



Frequently forages in urban areas, rubbish dumps, aquatic habitats, and grassland, but usually avoids heavily forested areas. Sometimes solitary, but also gathers in large flocks on migration and at good feeding areas.

2) Black Kite (*Milvus migrans*)



Generally found in pairs or small groups in gardens, orchards, forest edge, and open forests. Pleasant song consists of rich warbled phrases; calls include high-pitched pips, a long buzzy note, and a sharp “pik-pik-a-wew.”

3) Velvet-fronted Nuthatch (*Sitta frontalis*)



Forages by creeping along trunks and branches, often upside down. Often moves in groups, frequently as a member of mixed-species flocks. Song is a high-pitched chittering trill; calls like isolated fragments of song.

4) Eurasian Curlew (*Numenius arquata*)



Scimitar-billed large shorebird of varied open habitats. Breeds mainly in grasslands, from coastal marshes to upland moors; winters mainly in coastal lowlands, especially mudflats and adjacent marshes.

5) Eastern Cattle-Egret (*Ardea coromanda*)



Small, compact white heron with relatively short yellow bill. More often seen in dry habitats than other egrets, but also frequent in rice paddies and shallow wetlands. Often gathers in flocks, frequently following large animals and field machinery.

6) Red Collared-Dove (*Streptopelia tranquebarica*)

Often forages in pairs, but may congregate in large flocks, particularly in agricultural fields where seeds have been spilled. Song is a hoarse and muffled-sounding series of three or four hoots.

7) Bronze-winged Jacana (*Metopidius indicus*)

Gangly inhabitant of well-vegetated wetlands, especially ponds and lakes with floating vegetation. Adult's dark neck and bright white eyebrows are unmistakable.

8) Common Snipe (*Gallinago gallinago*)

Inhabits a wide range of wetland habitats, from damp meadows to saltmarshes. Mostly inconspicuous, feeding in muddy ground by probing with its bill, usually near reeds or other grassy cover.

9) Green Sandpiper (*Tringa orchropus*)

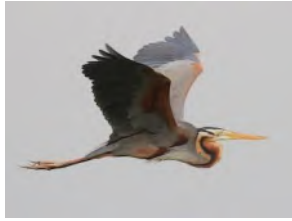
Breeds in clearings and marshes in wet forest and woodland; migrants occur in fresh and brackish wetland habitats, especially on muddy shores of lakes and small ponds. Mainly found as singles or small groups, not mixed with other species.

10) Asian Openbill (*Anastomus oscitans*)

Asian Openbills inhabit wetland habitats including shallow marshes, flooded agricultural fields, and lakes. From a distance they could be confused with herons, but they can be clearly distinguished from herons by their feeding habits—wading slowly through shallow water.

11) Gray Heron (*Ardea cinerea*)

Generally, quite common and conspicuous in wetland habitats from marshes and tidal flats to small ponds, ditches, and wet fields; nests colonially in tall trees. Like other herons and egrets, flies with neck pulled in to form a bulge.

12) Purple Heron (*Ardea purpurea*)

Favors fresh marshes with tall reeds and other vegetation. Often more retiring than Gray Heron and rarely seen in open situations.

13) Stork-billed Kingfisher (*Pelargopsis capensis*)

Massive kingfisher with a large scarlet bill. Wings and tail bluer, with rump even paler blue, obvious in flight. Prefers large streams, rivers, and the edges of large water bodies with vegetated banks.

14) Streak-throated Woodpecker (*Picus xanthopygaeus*)

Lime-green woodpecker with a gray face and finely scaled underparts. Crown is blood red in males and black in females. Streak-breasted Woodpecker is extremely similar. Laced Woodpecker is also similarly colored. Streak-throated inhabits open forest from lowlands up into the foothills, usually in drier areas.

15) Baya Weaver (*Ploceus philippinus*)

Occur as flocks, particularly in breeding season. Advertising calls of males are an easy way to detect the species as several males in the flock call together creating a cacophony of a series of rasping chatters followed by a buzzing whistle interspersed with long chatters.

16) Medium Egret (*Ardea intermedia*)

A stocky egret that is larger than Eastern Cattle and Little Egrets, but smaller than the Great Egret. Things to look for include a yellow bill that is shorter than Great Egret but longer than Eastern Cattle Egret. Like most egret species, associates with all types of water bodies including wet fields, often flocking with other egrets.

17) Orange-headed Thrush (*Geokichla citrina*)

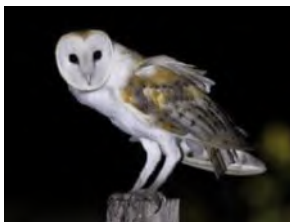
Brightly-colored ground-dwelling thrush. Bright orange head, breast, and belly are unmistakable. Hops about foraging in the leaf litter in forested areas, often in wet gullies and ravines. Beautiful song is composed of well-spaced strophes of warbling and buzzy notes.

18) Purple-rumped Sunbird (*Eptocoma zeylonica*)

A colorful sunbird; the male has a green metallic crown and shoulder patch, a dark brown body with purple rump, a purple throat, lemon-yellow underparts, and whitish flanks. Often seen hopping and hovering around flowers, picking up insects, and probing flowers for nectar.

19) Magpie Robin (*Copsychus saularis*)

They have a good repertoire of melodious calls and are known to imitate other bird calls. The most commonly heard call is a whistle given at dawn. Most often seen singing from a high exposed perch. These birds are often seen in cultivated areas, open woodlands, and gardens.

20) Barn Owl (*Tyto alba*)

Far from being some evil banshee, the Barn Owl is harmless to us humans, flying low and slow over the ground listening intently for its prey of voles, mice, rats and shrews which they hunt over rough grassland, meadows and road verges.

4.2.13 Wildlife Mammals of Khulna Region

There are no protected areas or critical habitats in the project area, which is characterized as a highly modified habitat.

4.3 Socio-Economic Conditions**4.3.1 Urban and Rural Livelihoods**

Urbanization sustains mainly by acquisition and conversion of agricultural land and water bodies in the peri-urban areas. Consequently, this process adversely affects the peri-urban areas leading to stresses on the life and livelihood of the community. The rural communities of Khulna are embodied with diverse livelihood opportunities based on agriculture and aquaculture. These livelihood options are often exhausted by unplanned urbanization. Peri-urban or rural area is closely linked with an urban setting and livelihood of these people is largely affected by urban activities. Climatic disasters adversely affect people's livelihood in Khulna and these disasters have increased the vulnerability of the local communities living in the area.

Urban & rural livelihood activities in the KCC may be clustered into some broad categories: natural resource-based activities, such as agriculture and human resource-based activities, such as industry & services. These two categories broadly correspond to farm and non-farm activities. Both categories of activities may be based on self-employment and wage employment. According, to BBS 2011, the livelihood patterns in KCC, for both urban & rural area are shown in **Table 4.16**. In the study area, services comprise the largest livelihood group in terms of number for both, urban & rural region.

Table 4.16 Urban & Rural Livelihood Pattern in the Study Area (Ref. BBS, 2011)

KCC	Urban Area			Rural Area			Total		
	Agriculture	Industry	Service	Agriculture	Industry	Services	Agriculture	Industry	Services
Daulatpur	1987	7368	20806	1120	516	1991	3107	7884	22727
Khalishpur	1183	14062	38050	0	0	0	1183	14062	38050
Khan Jahan Ali	22	1309	2924	2083	9127	11934	2105	10436	14858
Sadar	2655	9825	61711	0	0	0	2655	9825	61711
Sonadanga	1341	4437	48044	0	0	0	1341	4437	48044
Total	7188	37001	171535	3203	9643	13925	10391	46644	185390

4.3.2 Land Use (including seasonal land use) & Land Tenure

In KCC, seasonal land uses are classified as net cropped (permanent & seasonal) area, current fallow, and area not available for cultivation. Regarding the seasonal cropping or cultivation, the best example is flood plains of the Mayur River used for cultivation during the dry season and which went underwater in the wet season. According to the Agriculture Census 2008, the yearly crop productivity of the seasonal cropped area is 75 metric tons. For paddy, wheat & potato cultivation, the cultivated lands are 2969, 35 & 197 acres respectively whereas the field used for these crops under irrigation facilities are 435, 13 & 20 acres respectively.

The Agriculture Census 2008 also describes that, under the jurisdiction of KCC, in total 9631 residents are depending on agricultural practices for their livelihoods. Among them, approximately 3500 residences are cultivating on their owned lands, whereas nearly 2000 holdings are owner cum tenant. More than 4000 holdings are tenants and are cultivating on the leasehold lands for their existence.

4.3.2.1 Agriculture/livestock farming

Massive displacement of people to megacities perpetuates environmental degradation and climate change resulting in the shrinkage of areas available for agriculture and causing the loss of livelihoods based on agricultural and livestock farming. In terms of sectoral percentage, agriculture declined from 37.4 percent to 33.7 (KDA Detailed, Area plan- 2003, Volume-II). The extension area proposed by the KCC to the Ministry is dominated by rural entities. Few of these areas were found to be urbanized or Gross Built-up Areas. It can be observed that large amounts of land in the proposed extension area were occupied by agriculture and rural settlements.

According to Agriculture Census 2008, within the KCC approximately 811 acres of land is occupied by the permanent cropped area whereas the temporary cropped area (single, double & triple cropped) occupied nearly 4229 acres of land, mainly occupied in the flood plains of the Mayur. Although, lentil, pepper, turmeric, tomato, radish, bean, parable, cabbage, brinjal, lady's finger, arum, cauliflower, cucumber, papaya, guava, lime, lemon, jackfruit, banana, mango, litchi, and blackberry are cultivating on both permanent & temporary cropped areas.

According to District Statistics 2011, under the KCC, approximately 5000 of holdings reporting selected livestock species. Among them, 2021 number of holdings involved with Cows & buffaloes, whereas 2899 holdings are engaged with the goats, and 46 holdings are with sheep. In the case of poultry farming, nearly 300 holdings are generating their incomes from this sector.

4.3.3 Demographics

The latest official census of the population in Khulna is the Population & Housing Census from 2011 by the Bangladesh Bureau of Statistics (BBS). According to the 2011 census the population in KCC's 31 wards was 663,342. The next census is expected in 2021. The figure below presents the population in Khulna (KCC area) from 1974 to 2011 based on the BBS data (refer to **Figure 4.19**). The following figure shown that, population decreased in the KCC area between 2001 and 2011 while the growth rate counted -1.48%.

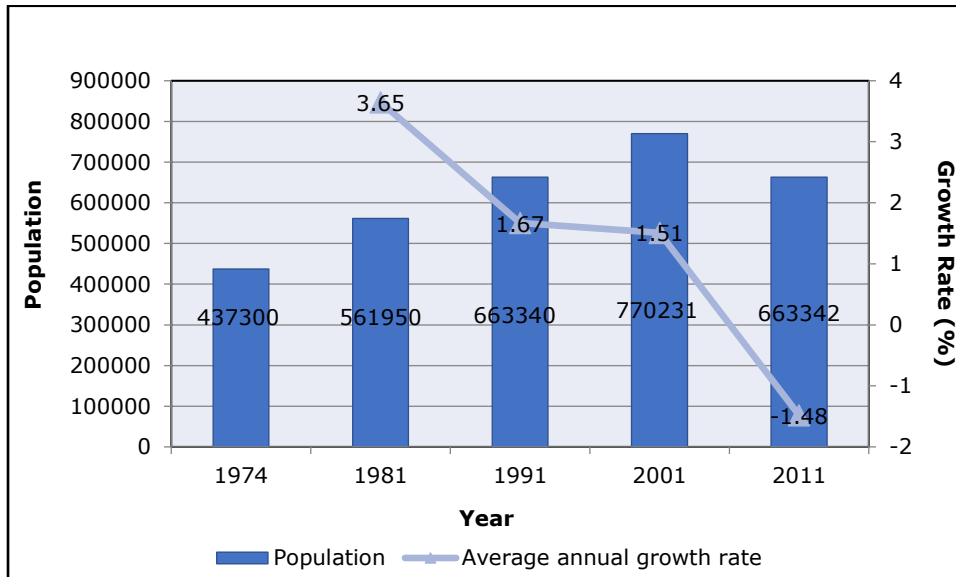


Figure 4.19 Population in Khulna (KCC area) from 1974 to 2011

The planned area of KCC has recently been extended to cover further areas to the north, west, and south-west of the city and closing the gap towards the Western By-Pass Road. The decrease in the population may at least partially be explained by a spatial expansion of Khulna into the extended area.

The project area includes the KCC area of Khulna, which comprises 31 Wards and a planned expansion to cover an additional extended area. The extension area had a population of 128,072 in 2011. Thus, the combined population in the base year 2011 is 791,414. The following **Figure 4.20** has shown the baseline population data.

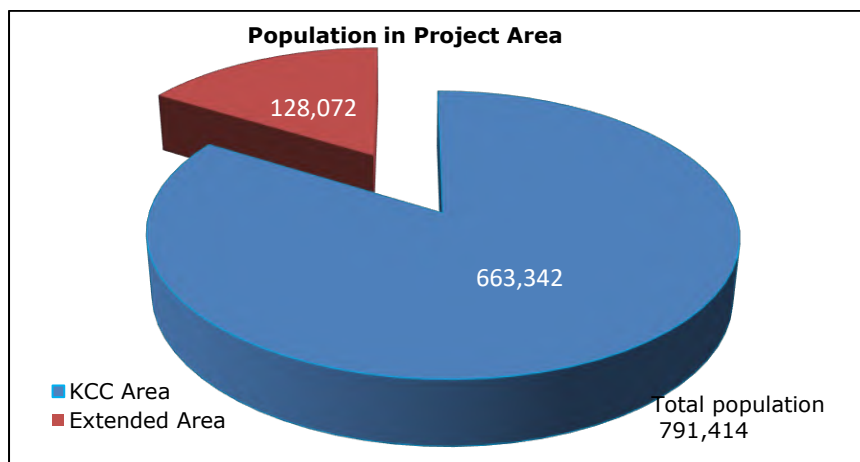


Figure 4.20 Population in the KCC area and extended area (Population census 2011)

Average density of population is about 19,000 per km². illustrated that, Ward 19 & Ward 27 are densely populated among the 31 administrative wards of KCC where the existing population density ranges from 35001 to 45000. Although, the extended area of KCC such as Atra Gilatala, Jogipole, AranGhata, Gutudia & Jalma covered by lower density of populations, and which are ranges from 1614 to 7000.

Most of the people in Khulna are the Bengali people, as is the case in most of Bangladeshi. The city population is also composed of people from the neighbouring districts and from the greater Barisal and Faridpur regions of Bangladesh. Many people from greater Noakhali region also reside in the city. Khulna also has a significant number of Bihari populations. Most residents of Khulna speak Bengali, the national language. Many distinctive Bengali dialects and regional languages are also spoken. Islam is the major religion in Khulna, approximately 80.12% people are Muslim, and the proportions of other religions are: Hindu 19.11%, Christian 0.67%, Buddhist 0.04%, and Others 0.06% (See **Figure 4.21**).



Figure 4.21 Population Density Map of Project Area (Khulna), 2011

4.3.4 Employment of KCC Area

Khulna's GDP per capita is around €1,500, and the gross domestic product is estimated to be close to €200 million. The industrial sector of KCC represented by more than 800 mills and factories. It is estimated that 20% of employment from the industry and manufacturing has been lost because of the collapse of the industries and led to dependency on the service sector (KDA, 2002). The city is dependent on its service sector (76%), but industry and manufacturing sector (19% of jobs) is the second important sector (ADB, 2016). Alarmingly, currently 26.5% male are unemployed in the city whereas female unemployment rate is 24.6%. Average monthly earnings of the working population are between €420 and €660 (Rahman, 2017). It is estimated that approximately 40% of the population is under the poverty line, and among them 20% lives in slums (ADB, 2011).

Trend analysis between 1991 and 2011 statistics shows that service and business sector has constantly contributed 80% to 82% jobs in the city. In 1991 jobs in the manufacturing sector contributed 7% of jobs but now the contribution increased to 19% because of the new shrimp-based industries. The major shift in the employment sector between 1991 and 2011 lies has been the agriculture sector. Because of the decrease in urban agriculture land, employment in this sector decreased by 8% over the last 30 years.

Alarmingly, the city still has many dependent populations (under 15 and over 60) who are outside regular employment. In 1991, 63% of people were dependent, and currently, that lies dropped down to 40%. Thus, the active age group people are the main workforce in the city. Being a female, many among them are involved with outside work and mainly contribute to their own house or others' house as a domestic worker. New employment in the shrimp processing industries is remarkable and positively changed the livelihood of some locals. Overall, the livelihood of the citizens in Khulna is gradually shifting from skilled jobs in the manufacturing sector to low skilled jobs in the informal service sector.

4.3.5 Socio-cultural Institutions and Cultural Norms

The socio-cultural institutions of the area are different social facilities e.g., educational institutes, health facilities, parks & markets. These are used frequently by the local residents to fulfil their basic needs and for the purposes of social & cultural gathering. There are 203 educational institutes, 218 health facilities, 28 parks and 12 markets in the project area. More than 50% of the health facilities are located in Ward 17, 18, 20, 23 & 24. Also, approximately 50% of the educational institutes including two universities are situated in Ward 12, 14, 16, 17, 18, 23 & 24 whereas each Ward has more than 10 institutes. **Figure 4.22** shown socio-economic infrastructure identified within the project area.

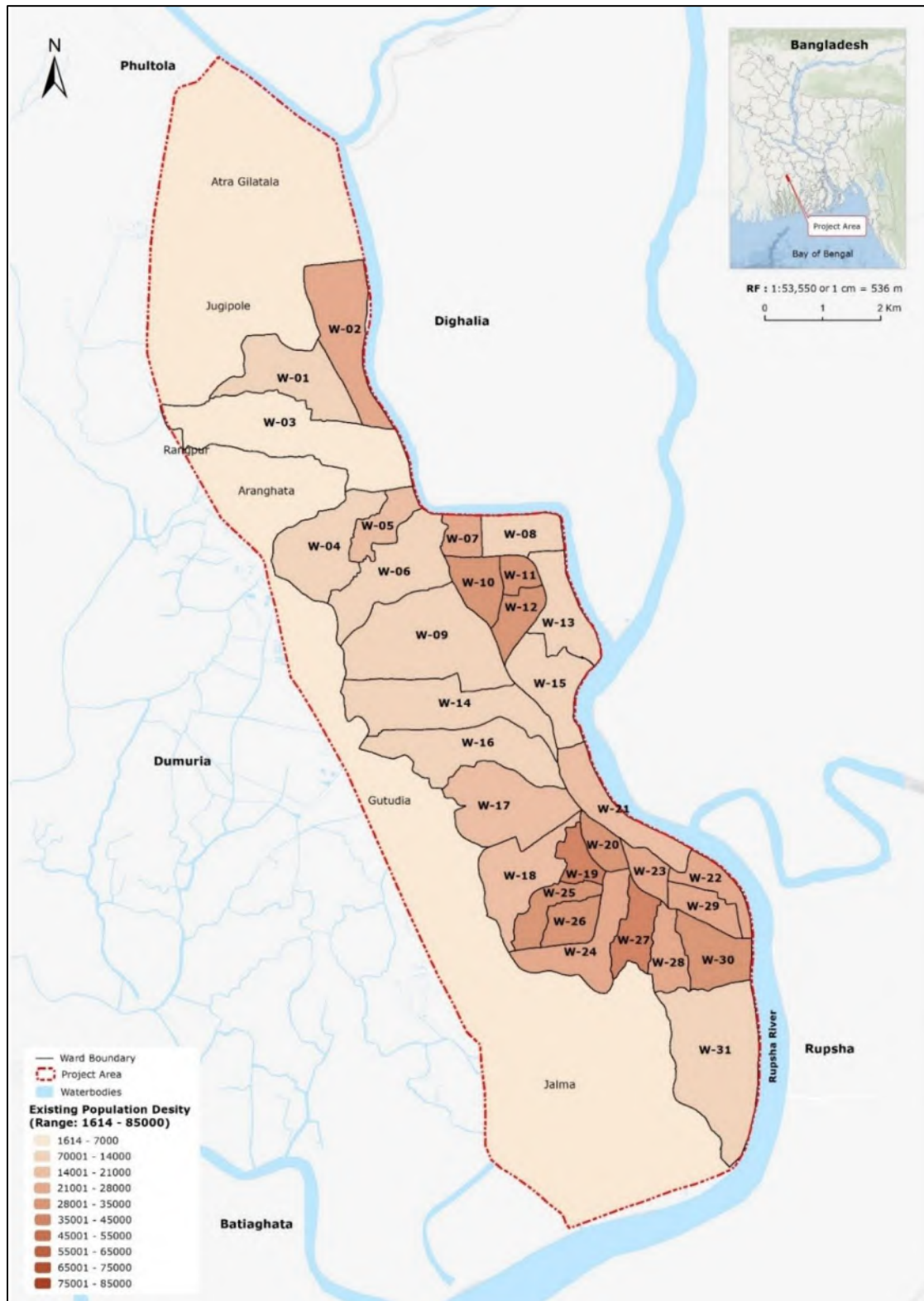


Figure 4.22 Socio-Economic Infrastructure Map of Project Area (Khulna)

4.3.6 Community Health and Safety

Health care service in Khulna city followed a pluralistic approach (See **Figure 4.23**) and mostly provided by three different authorities namely, City Corporation, government and private sectors. Government health care services include specialized hospitals, charitable dispensaries and some general hospitals are provided and maintained by MoHFW (KDA, 2002). From the data of Urban Community Health Services, 1996 (KDA, 2002) acclaims that, within KCC area government operates 9 general hospitals, 9 health care centers and nine FP & EPI clinics, KCC operates six general hospitals and 97 FP & EPI clinics, NGO operates 10 general hospitals, 17 health centers and 21 FP & EPI clinics and private organizations operate 35 general hospitals, 10 health centers and one FP & EPI clinic.

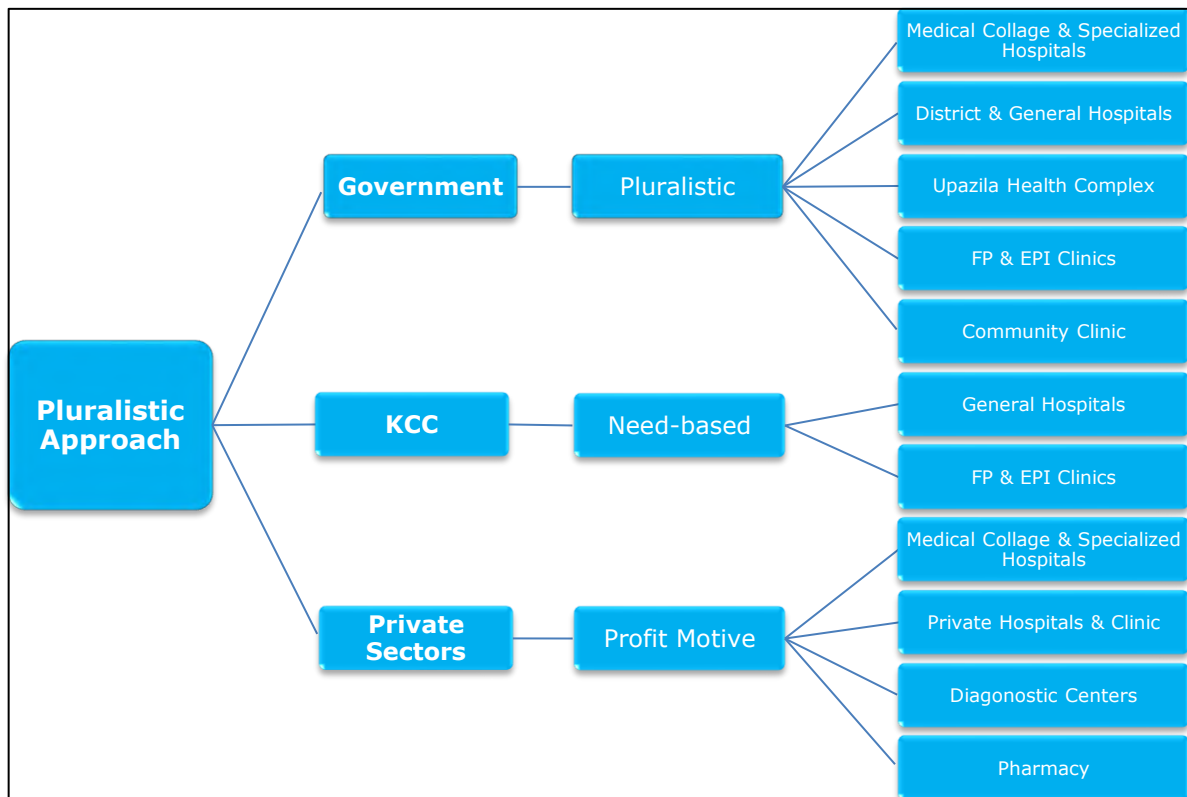


Figure 4.23 Approach of Health Service Delivery in KCC

Moreover, healthcare infrastructures are spatially distributed in an uneven manner throughout the Khulna city without consideration of the density of population or the number of population or number of households. The existing health infrastructure in Khulna city developed in the inner city following an aggregated pattern, where most of the health care centers are located within close proximity of inner neighborhoods. However, in the city periphery and in the outer suburbs there are only a few health care facilities. For instance, ward 31 being a densely populated area there is only one health care center and ward 01, 03 & 04 located at the city periphery does not have any health care center. Again ward 23, a small neighborhood with low household density, lays the huge number of health care centers (BBS, 2012).

The limited number of government health infrastructures to deliver health care service provision pressurizes the health care delivery system and makes the citizen dependent on private services. Low and lower-middle-income groups prefer public health care facility because of its lower cost but because of the lack of health centers and hospitals poor people find this extremely difficult to get access to available services.

4.3.7 Educational Institutions in KCC Area

In the KCC area, central education service is delivered through pluralistic approach and mainly provided by the government, the private sector and NGOs, however, the primary education is mostly publicly financed and operated by the Ministry of Primary Education (MoPME) (World Bank, 2008). However, public and private sectors follow different approaches regarding education service provision. Public education is delivered either by central government (MoE or MoPME) or KCC. For education delivery in Khulna city, public service delivery is followed by a need-based pluralistic approach. Whereas private sectors including different private institutions are completely focused on profit motive and NGOs are solely engaged in education provision in urban slums of Khulna city (see **Figure 4.24**).

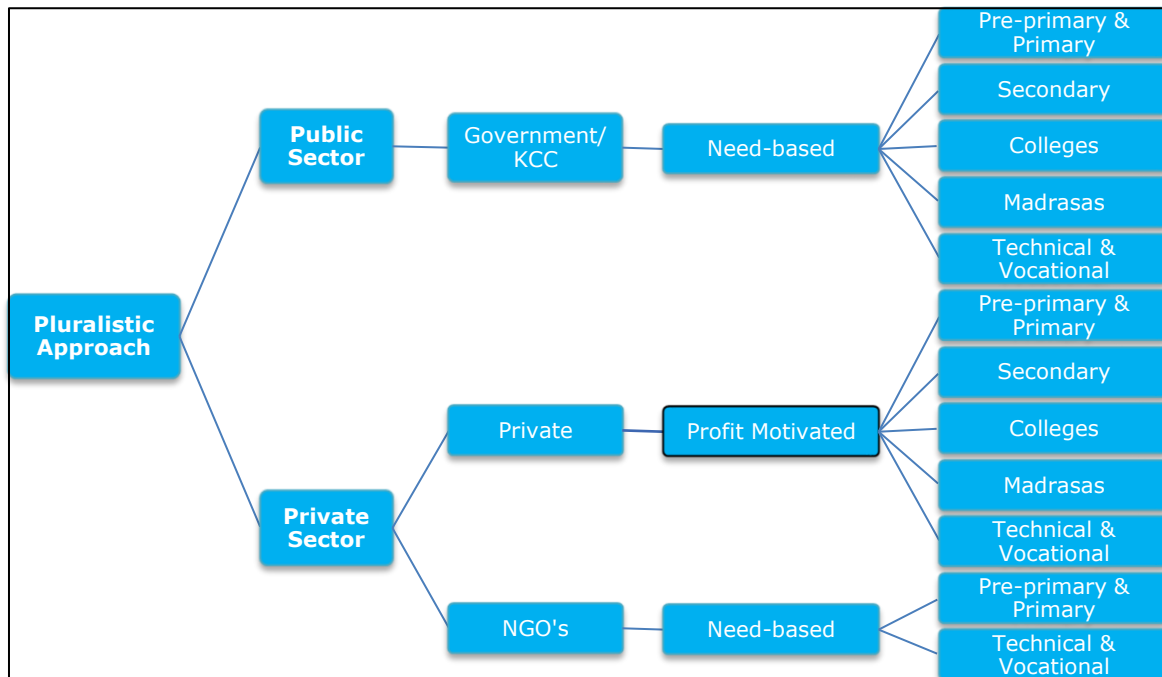


Figure 4.24 Approach of Educational Provision in KCC

In 2011 in Khulna city, there are numbers of government primary schools including 30 registered primary schools, 23 private non-registered primary schools and 53 NGO schools (BBS, 2013). According to KDA (2002), 450-acre area of KCC is used for education and related infrastructure. KCC is obliged to ensure free primary education provision and provision of general and primary education within its juridical area as per KCC ordinance and KCC developed four schools within its juridical area (KCC, 2018). However, for urban slums education of Khulna city, NGOs and private sectors provide support through their programs. There are 203 educational institutes in KCC including 106 primary schools, 11 madrasa, 9 school & collage, 53 collage, 22 institutes and 2 universities (see **Figure 4.25**).

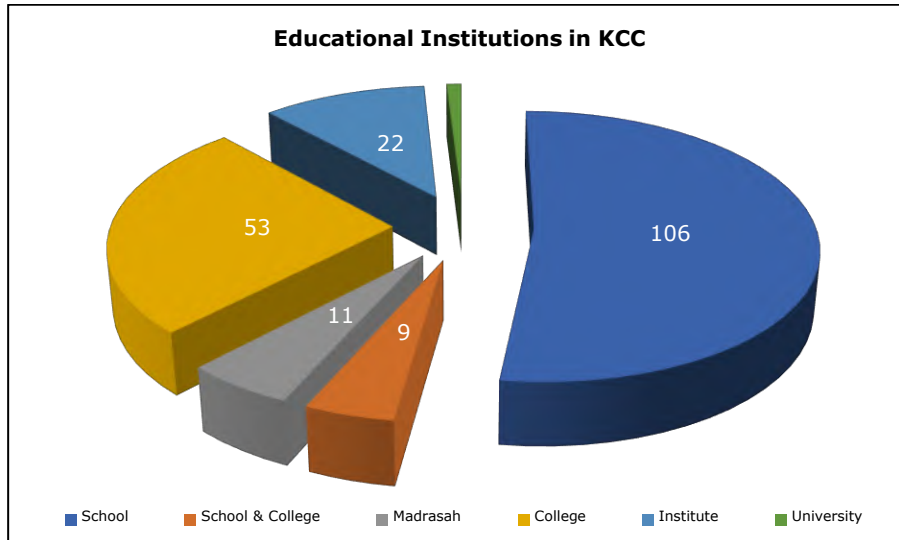


Figure 4.25 Educational Institutions in KCC

Unequal spatial distribution of education institutions is responsible for reducing access to education facilities. Primary schools and high schools are also distributed disproportionately within Khulna city. For instance, in some neighbourhoods (ward no 01, ward no 03, ward no 04, ward no 11 & ward no 14), there are no primary schools. Even with the highest household density in ward no 31; there is only one primary school (**Figure 4.25**). For which students of these neighbourhoods are forced to travel to other neighbourhoods in search of education opportunities. Moreover, in the neighbourhoods of the inner city, the number of education institutions is comparatively greater than the outer neighbourhoods of periphery (KDA, 2012). However, the major issue regarding education provision in Khulna city is the insufficient number of education infrastructures.

4.3.8 Critical Infrastructure

The locations of critical infrastructure such as existing water supply pumping stations, future sewage pumping stations and treatment plants, and power supply sub-stations, are shown in **Figure 4.26**.

4.3.8.1 Water Supply

Khulna's water supply system relies on 75% surface water and 25% groundwater. A new water supplies system for Khulna was completed in June 2019, comprising a new surface water intake at Madhumati which is situated 60 km from Khulna. The intake and the water treatment plant are located outside of the KCC area. The plant distributes treated water to 7 reservoirs and 10 overhead tanks within the KCC area. The foundations of the pumping stations associated with the reservoirs are 1.0 m above ground level to prevent flooding. The distribution network comprises 700 km of distribution pipelines. Despite the recently established water supply facilities/system, another 31 water reservoirs and 38 overhead tanks are identified within the KCC area. Among them, 8 overhead tanks are located in ward 15, and 12 numbers of water reservoirs are in ward 21.

4.3.8.2 Wastewater

Centralized wastewater collection and treatment has not yet been implemented, but a system is currently being designed with funding from ADB. Implementation is planned to commence in March 2021 and will be completed by June 2025. Under the mentioned wastewater collection and treatment project, total 8 numbers of sewerage pumping stations (SPS) will be constructed in eight different administrative wards of KCC, and

1 sewerage treatment plant (STP) will be established in Jalma Union. Currently most buildings in Khulna rely on septic tanks for wastewater, with the tank overflows discharging to the drainage system. However, in many cases wastewater is directly discharged to the storm water drains.

4.3.8.3 Electricity in KCC Area

A 225 MW power station is located along the banks of the Bhairab River and supplies power to the KCC area as well as Dhaka. Despite this, 1 PDB supply station, 2 power grids and 4 power sub-stations are found within the KCC area.

4.3.8.4 Transportation Infrastructure in Khulna

Existing transportation infrastructure in Khulna is presented in **Figure 4.27**. At subproject sites there will during construction be increased traffic and blocking of lanes requiring traffic management (refer 5.3.7).

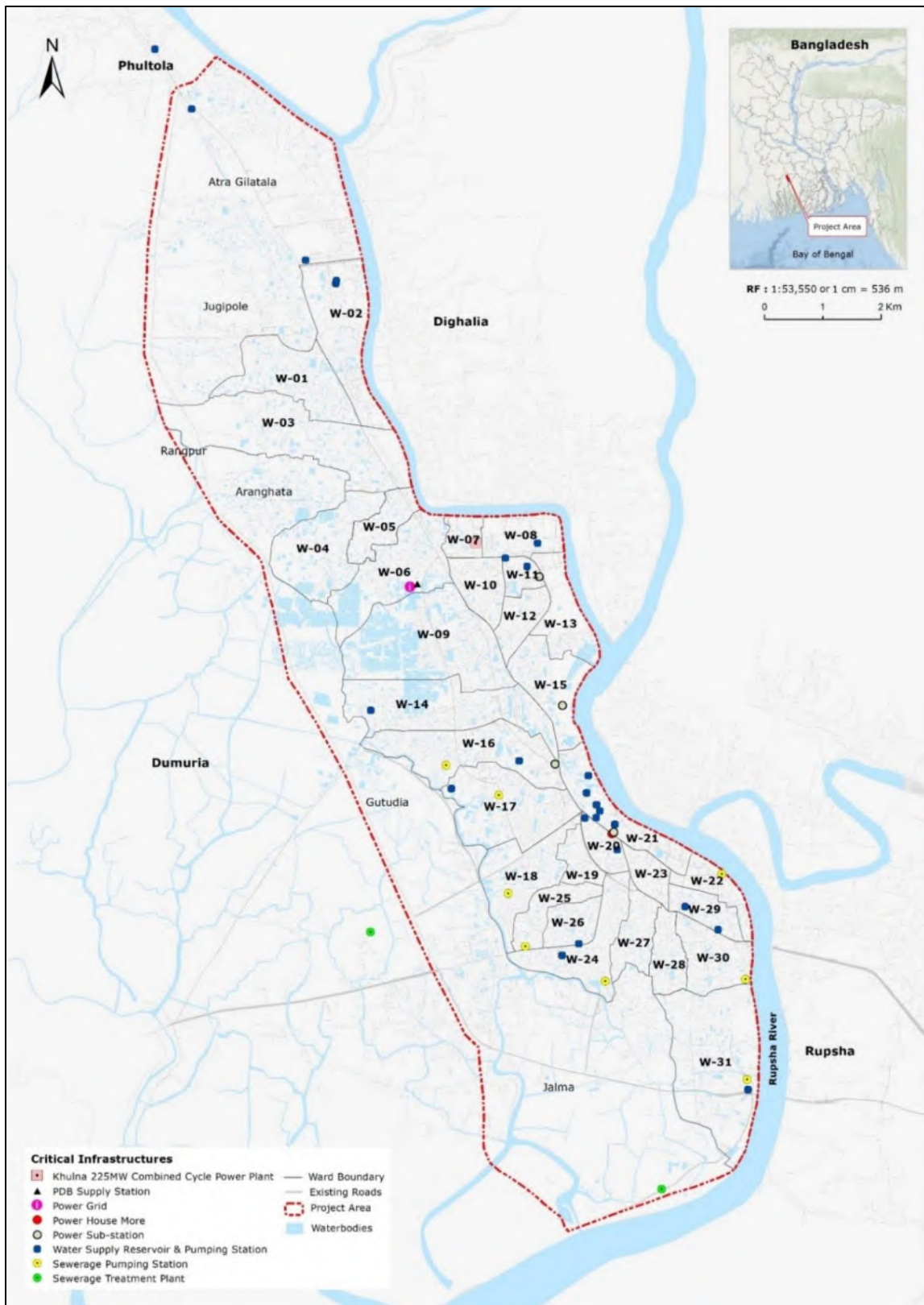


Figure 4.26 Critical Infrastructure Map

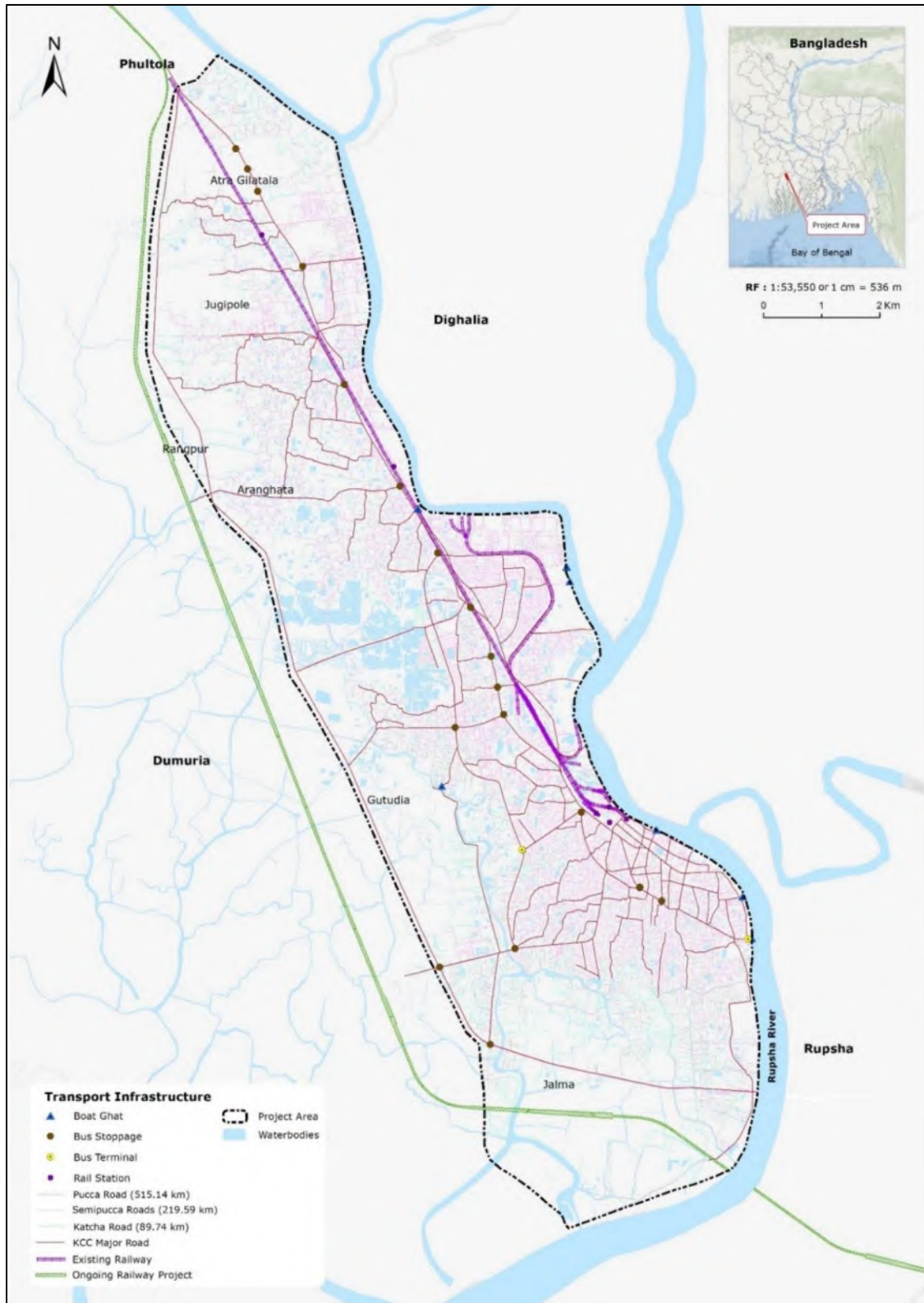


Figure 4.27 Transportation Infrastructure Map of Project Area (Khulna)

4.3.8.5 Waste Management of Khulna City Corporation

Khulna City Corporation's population is currently at 791,414. It is estimated that the average quantity of waste generated per capita in KCC is 0.3 kg/person/day. KCC has estimated that the daily generation of waste in the city of Khulna is 1,200 tonnes (excluding waste from construction works). KCC collects a daily quantity of 800 tonnes of waste. The remaining 400 tonnes or unclaimed garbage often end up at roadsides and eventually carried down the drains and canals. This scenario presents a serious threat to people's health and pollution of the surrounding environment.

Also, within the KCC area, there are more than 200 hospitals, private clinics, and pathological laboratories in the city. It is estimated that the generation rate for medical waste is 0.25 kg/bed/day and the total generated amount is about 500 kilograms per day. It is estimated that only around 1% of the total solid waste generation in KCC is from medical facilities like hospitals. Only 10%-25% of the hospital waste is infectious or hazardous.

Two slaughterhouses that currently operate in KCC generate about 2 to 3 tons of waste per day. Another added burden to the solid waste problem in KCC is generation of slaughterhouse wastes. At present, about 150 animals are slaughtered daily at two slaughterhouses in KCC. The generated waste is transported by trucks on an irregular basis and disposed of in the existing dumpsites. Currently KCC utilizes two types of solid waste collection systems.

- Conventional System: The households carry their waste to the nearest roadside bins or similar facilities provided by KCC. KCC then collects the deposited wastes and transfers them to the final disposal site at regular intervals.
- Community Based Door-to-Door Collection System: Waste collector collects waste from houses every day by utilizing a rickshaw van, and then takes the collected wastes to a nearby transfer point. The collector gets a monthly fee from every household. The wastes are then transported from the transfer point to the final disposal site by KCC trucks.

Door-to-door collections are carried out by local NGOs and CBOs and transport the collected waste to the nearest secondary transfer station (STS). About 65 tricycle rickshaw vans are operated by 16 local NGOs and CBOs for this purpose. However, approximately 136 numbers of workforce involved to collect waste from 21,132 households and this scheme covers only approximately 10% of the total domestic waste sources in the city.

KCC operates around 50 secondary transfer stations (STS), including 7 standard STS and 40-45 smaller STS which are poor quality. Seven standard STS have been built under the ADB-funded Urban Public and Environmental Health Sector Development Project and are currently being used. And these STS are located at Rail Station, Boyra - 250 Bed Hospital, in front of Khalishpur newsprint mill, in front of Khalishpur new market, Ward 8 – Bastuhara, Daulatpur – Beside Haruner hotel and Track Terminal. However, these secondary transfer stations are underutilized due to lack of coordinated and efficient solid waste collection and hauling in the city. **Table 4.17** shows the inventory of existing fleet of equipment being used by KCC.

Table 4.17 Equipment Used for Waste Collection and Transport by KCC

SL. No.	Vehicle Types	No. of Vehicles	Pay-load (tons)
1	Dump truck (L)	9	7
2	Dump truck (M)	8	5
3	Covered truck	3	5
4	Container carrier (L)	5	5

SL. No.	Vehicle Types	No. of Vehicles	Pay-load (tons)
5	Container carrier (M)	8	3
6	Container carrier (L, Double container)	5	5
7	Open truck	16	3
8	Front end loader	4	
9	Excavator	1	
10	Skips	65	
11	Tri-cycle rickshaw vans	144	
12	Hand carts	76	

About 8% of the total generated waste in the city is recycled by the informal sector. It is estimated that 40 tons of solid waste is recycled and recovered by the primary level of stakeholders such as households and scavengers. The livelihood of 10,000-15,000 people depends on this recycling value chain. A separate study found that there are 450 dealers of recyclables in KCC, and that these dealers all together handle about 41.23 tons of recyclable materials daily. These dealers process mainly paper, plastic, iron, animal bone, tire or rubber, glass, and aluminium.

Khulna City Corporation has three existing dumpsites of which only one is in operation at Rajband (refer **Table 4.18**). The bigger dumpsite is located at Rajbandh, which is around 7 km from the city centre and along the Khulna-Satkhira road. Solid waste infrastructure is presented in **Figure 4.28**. Location of landfill sites, slaughterhouses, and secondary transfer stations in **Figure 4.28**.

Table 4.18 Existing and Proposed Landfills in Khulna

Name	Location and size	Comments
Rajband1 landfill/dumpsite	Located by the Khulna-Satkhira Road at Rajband and about 20 acres in size.	It has been used as a dumping site for the last 30 years. The existing incineration plant is not in operation. It is planned to be converted into a controlled Landfill site.
Rajband 2 landfill /dumpsite	Located adjacent to Rajband1. It is about 5 acres.	It is mainly used for medical waste dumping. The, water body beside the dumping site is being contaminated due to having no boundary or separation. It has also a fecal sludge management (FSM) site, which is in operation. The FSM facility produces briquets as a pilot basis. These briquets are supplied to shops for cooking as fuel. They are pathogen-free.
Sholua Landfill	The total planned area is 17 acres.	Currently the Landfill site at Sholua is not in operation. It will come under operation when the construction of the sanitary landfill is completed.
Mathahanage Landfill site	The proposed Landfill is located in Upazila of Batia Ghata and under the Union of Mathabhangha. It is planned to be a controlled landfill covering 25 acres.	Detailed design was prepared in 2013-2014 under an ADB funded project. Implementation has not yet commenced.
RUSTIC composting plant, Rajbandh	Rajbandh	RUSTIC Compost Plant is recycling organic waste to produce compost for use in gardens. In 20118, the plant recycled 2,800 tons of organic waste to produce 480 tons of compost fertilizer per year (www.rusticbd.org).
KCC composting facilities at Rajbandh	Rajbandh	KCC has expanded compost processing capacity in Khulna to include two composting plants at Rajbandh Landfill with 20 tons capacity per day and another one is 475 tons capacity per day.

4.3.8.6 Cultural Heritage of Khulna

KCC hosted only one archaeological site or protected historical heritage site named 'Kuthibari' of Mr. Charlie near the railway station. The city along with its extended area has numerous religious institutions such as 146 mosques, 27 temples and 12 churches. However, none of these structures are listed as critical historical or religious sites protected by the Bangladesh Department of Archaeology. Also, the project area comprised 2 museums, 2 Shahid Miners & 2 stadiums.

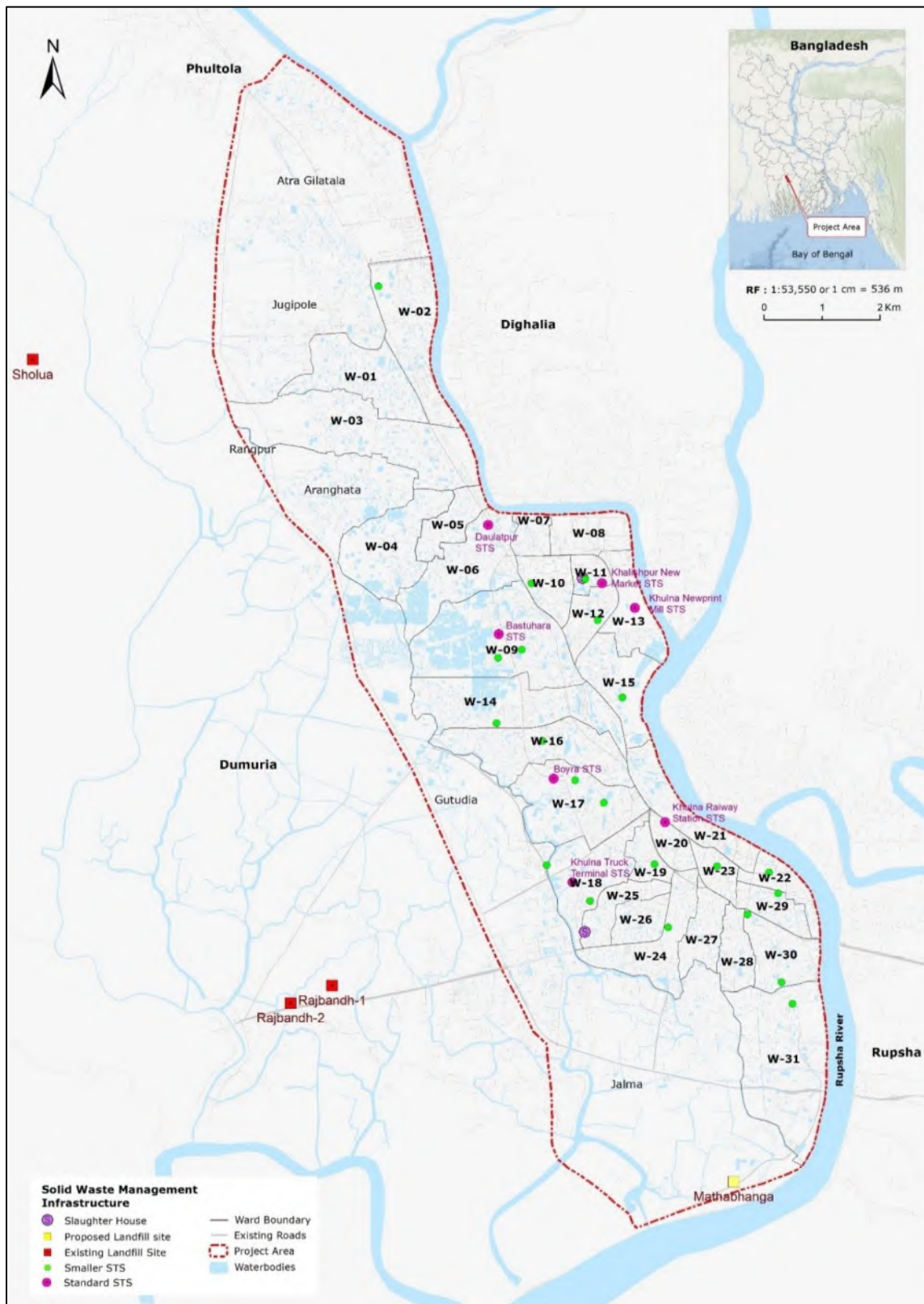


Figure 4.28 Location of Landfill Sites, Slaughterhouses, and Secondary Transfer Stations

5. ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

This chapter identifies and assesses the likely significant environmental and social risks and potential impacts of the project and nine subprojects, including identification of potentially affected local communities and sensitive resources and receptors. A detailing of likely and planned subproject activities has been prepared by the engineering team of the Feasibility Study assignment. On that basis subproject activities have been listed in an interaction matrix with the resources and receptors identified as relevant at the scoping stage on the other axis of the matrix. The activities have been analysed with respect to their potential to impact and interact with the resources and receptors in the interaction matrix. Following prediction of impacts a multicriteria analysis to evaluate the impact significance was carried out.

5.1 Impact Evaluation Methodology and Approach

5.1.1 Impact Assessment Process

The impact assessment process builds on the results of the scoping phase where the potential impacts of subprojects with respect to a longlist of resources and receptors were analysed. On that basis, the relevant resources and receptors were identified, and a preliminary impact identification and assessment was carried out. In the impact assessment stage, the activities of the subprojects have been further detailed in close cooperation with the feasibility study team. A similar process of impact prediction and evaluation has been completed at the level of the subprojects.

The process of the impact assessment carried out is summarized below:

- **Scoping** of impacts of subprojects with respect to a longlist of resources and receptors to identify relevant resources, receptors, and conduct preliminary impact identification and assessment.
- **Detailing of subproject activities** in cooperation with technical feasibility study team.
- **Impact prediction** to determine what could potentially happen to resources/receptors as a consequence of the subproject and identified detailed list of activities.
- **Impact magnitude evaluation** through multicriteria analysis to evaluate the magnitude of the predicted impacts by considering the scale, spatial extent, and duration of impacts.
- **Impact significance assessment** by further multicriteria analysis of magnitude of impact together with the sensitivity, value, and importance of the affected resource/receptor.
- **Mitigation and enhancement** to identify appropriate avoidance, minimisation, mitigation, management, compensation measures for negative impacts or enhancement measures for positive impacts.
- **Residual impact evaluation** to evaluate the significance of impacts assuming application of identified mitigation and enhancement measures.

The environmental and social resources and receptors identified as relevant in the scoping phase are carried forward to the assessment stage. Preliminary impact identification and assessment was carried out during the scoping phase. The resources, receptors, and impact identification will be confirmed and elaborated at the assessment stage. The identification of subproject activities which may significantly affect the environment has been carried out in conjunction with the design team, where the level of detail regarding likely project activity increases as the design progresses.

The impact assessment will be informed by the feasibility study which will have progressed the design of the subprojects to a level where project activities associated with impacts or risks to the environment are elaborated and listed.