Initial Environmental Examination

Document Stage: Updated
Loan Number: 49329-007
May 2021

Bangladesh: Khulna Sewerage System Development Project

Prepared by Khulna Water Supply and Sewerage Authority, Ministry of Local Government and Rural Development and Cooperatives, Government of Bangladesh for the Asian Development Bank.

CURRENCY EQUIVALENTS

(as of 31 May 2021)

Currency unit	–	Bangladesh Taka (Tk.)
Tk1.00	=	$0.01179
$1.00	=	Tk. 84.80

ABBREVIATIONS

ADB	–	Asian Development Bank
AAQ	–	ambient air quality
BDT	–	Bangladesh Taka
BNBC	–	Bangladesh National Building Code
BOD	–	biochemical oxygen demand
BOQ	–	bill of quantities
CEO	–	Chief Executive Officer
COD	–	chemical oxygen demand
DO	–	dissolved oxygen
DOE	–	Department of Environment
DPHE	–	Department of Public Health Engineering
EA	–	executing agency
EIA	–	environmental impact assessment
ECA	–	Environmental Conservation Act
ECR	–	Environmental Conservation Rules
ECC	–	environmental clearance certificate
EMP	–	environmental management plan
FSTP	–	fecal sludge treatment plant
GOB	–	Government of Bangladesh
GRC	–	grievance redress committee
GRM	–	grievance redress mechanism
IADC	–	institutional development, awareness creation and design consultants
IEE	–	initial environmental examination
KWASA	–	Khulna Water Supply and Sewerage Authority
LGED	–	Local Government Engineering Department
NGO	–	nongovernment organization
NOC	–	no objection certificate
O&M	–	operation and maintenance
PMU	–	project management unit
PMSC	–	project management and supervision consultant
REA	–	rapid environmental assessment
ROW	–	right of way
SCADA	–	supervisory control of administrative data acquisition
SPS	–	safeguard policy statement
STP	–	sewage treatment plant
WHO	–	World Health Organization

WEIGHTS AND MEASURES

ha	–	hectare
km	–	kilometer
m	–	meter
mg/l	–	milligram per liter
MLD	–	million liters per day
mm	–	millimeter
km/h	–	kilometer per hour

NOTE

In this report, "$" refers to United States dollars.

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EXECUTIVE SUMMARY

Khulna City is located on the southern part of Bangladesh, which has more than 1.190 million people in 45.65 in km^2 area. Existing sanitary condition in Khulna revealed that majority of households use toilets with septic tanks, mostly connected to the storm water drains, causing contaminated water to spread over access roads, land and yards, and public places.[1] With growing concern over the environmental problem caused by this situation, the Khulna Sewerage System Development Project (KSSDP or project) has been proposed by Khulna Water Supply and Sewerage Authority (KWASA) to implement an organized sewerage system in Khulna city.

Scope of the Project. Khulna City has been divided into 10 sewerage districts (SDs) based on the nature of existing topography and land use pattern of Khulna City Corporation (KCC) (footnote 1). For the project, seven SDs will be covered, and these are SD1, SD2, SD3, part of SD4, part of SD5, SD6 and part of SD7. The project will have three subprojects, namely: (i) construction of 269 km of primary transmission/pipe collection, secondary and tertiary network, including 13.2 km rising main; (ii) establishment of eight sewage lifting and pumping station, including allied appurtenances, and (iii) construction of two sewage treatment plants (STPs) with aggregate capacity of 80,000 m^3/day, including one fecal sludge treatment plant with capacity of 160 m^3/day that will be constructed in one of the sites of the STPs.

Categorization. In accordance with ADB Safeguard Policy Statement (SPS) 2009, an initial screening using ADB rapid environmental assessment (REA) checklist was conducted for all three packages envisaged under the proposed KSSDP (Appendix 1). Result of this assessment reveals that the project is unlikely to cause significant adverse impacts. The assessment also reveals that there could be likely negative impacts that are related to both construction phase and operations phase of the project. However, these impacts are manageable and can be mitigated through proper design and engineering measures. Therefore, per ADB SPS, the project has been classified as Category B for environment. Consequently, an initial environmental examination (IEE) has been undertaken in accordance with ADB SPS requirements for Category B projects. The assessment was also carried out within the policy, legal, and administrative frameworks of the government relevant to sewerage and sanitation projects in the country. Per Government of Bangladesh Environment Conservation Act, 1995 (ECA, 1995) and Environment Conservation Rules (ECR, 1997), the project is categorized as Red, which would require a Site Certificate and Environmental Clearance Certificate (ECC) from the Department of Environment (DOE).

This IEE report aims to (i) provide facts, findings, and recommended actions from environmental assessment; (ii) present the national and local legal and institutional framework within which the environmental assessment has been carried out; (iii) provide information on existing geographic, ecological, social and temporal context including associated facilities within the project's area of influence; (iv) assess the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic, and physical cultural resources in the project's area of influence; (v) identify mitigation measures and any residual negative impacts that cannot be mitigated; (vi) describe the process undertaken during project design to engage stakeholders and the planned information disclosure measures and the process for carrying out consultation with affected people and facilitating their participation during project implementation; (vii) describe the project's grievance redress mechanism for resolving complaints about environmental performance; (viii) present the set of mitigation measures to be undertaken to avoid, reduce, mitigate, or compensate for adverse environmental impacts; (ix) describe the monitoring

[1] Feasibility Study and Formulation of Waste Water Management Master Plan for Khulna City, Bangladesh. ADB TA – 7820 BAN. Final Master Plan. April 2016.

measures and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures; and (x) identify who is responsible for carrying out the mitigation and monitoring measures.

Description of the Environment. Subproject components are located in the jurisdiction of KCC, and the area is in urban to semi-urban setting which has continuously developed through the years. There are no land-based natural habitat within and immediate vicinities of the subproject sites. Further, the subproject sites are located in existing rights of way and/or government-owned lands. There are no protected areas, wetlands, mangroves, or estuaries in or near the subproject location. There are no forest areas within or near Khulna city. A vital river system, known as the Bhairab-Rupsha river system, borders Khulna city in the northeast and eastern sides**.**

Assessment of Environmental Impacts. Potential environmental impacts were identified on the basis of review and analysis of the primary and secondary data or information and stakeholder consultations, and field visits to the sites. Impacts were identified in relation to the different phases of project implementation — pre-construction, construction, and operation of the built infrastructure. Evaluation of the likely degree of impacts has been done on each of identified potential impacts. Based on this evaluation, mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists and experts responsible for the engineering and environmental aspects.

The public consultation program has been undertaken both formally and informally throughout the study to ensure that the knowledge, experience, and views of stakeholders and the general public are taken into account during the IEE work. The findings from the public consultations were utilized in the development of environmental management plans (EMPs), especially in identifying the significant impacts of the proposed project and developing the corresponding mitigation measures.

In order to ensure that the assessment of impact is robust, a biodiversity assessment has been undertaken relative to the subproject locations. The Integrated Biodiversity Assessment Tool was initially used to screen and assess potential risks on the protected areas or critical habitat that may exist around the project sites (default area of analysis of 50 km radius). Initial screening results show there are no key biodiversity areas around the immediate vicinities of the project sites, but likely a critical habitat due to the presence of protected areas and species within this default area of analysis. A more detailed critical habitat assessment was undertaken following International Finance Corporation Performance Standard 6 Criteria. Results show that the project is at considerable distance from the identified protected areas and that the impact of project activities to these areas is not expected. However, results also show that the South Asia River Dolphin, an International Union for Conservation of Nature Red List species, qualifies the Bhairab and Rupsha river system bordering Khulna City as critical habitat. As part of the assessment, the IEE evaluated all aspects of project components and implementation methodologies to understand if any of these aspects will negatively impact such critical habitat, in particular the Bhairab and Rupsha river system. The assessment reveals that none of the components and/or procedures and methodologies considered at all phases of project implementation (pre-construction, construction, and operation) will negatively impact the river system. Further, assessment revealed that the project itself is regarded as an initiative that will otherwise have a direct beneficial impact (i.e. as a protection) to the critical habitat due to the reduction of pollution load to the river system once the project is put in place in the future. A major positive impact from the project is the improvement in surface water quality in the region, as a result of the proper

collection, containment, and treatment of sewage prior to discharge. Cleaning up the waterways in the catchment area will result in a habitat improvement for aquatic species.

Environmental Management. The EMP will guide the environmentally sound construction of the project and ensure efficient lines of communication among (i) KWASA; (ii) project management unit (PMU); (iii) project management and supervision consultant (PMSC); (iv) institutional development, awareness creation and design consultants (IADC); and the contractors. The EMP will (i) ensure that the activities are undertaken in a responsible non-detrimental manner; (ii) provide a pro-active, feasible, and practical working tool to enable the measurement and monitoring of environmental performance on site; (iii) guide and control the implementation of findings and recommendations of the environmental assessment conducted for the project; (iv) detail specific actions deemed necessary to assist in mitigating the environmental impact of the project; and (v) ensure that safety recommendations are complied with. A copy of the EMP shall be kept on-site during the construction and operation phase at all times. The contractor/s appointed will be responsible for the organization, direction, and execution of environmental management related activities during construction of the proposed subprojects. The contractor will undertake all activities in accordance with the relevant environmental requirements, including consent documentation and other regulatory and/or statutory and contractual requirements.

The project is unlikely to cause significant adverse impacts because: (i) most of the individual components involve straightforward construction and operation, so impacts will be mainly localized; (ii) in most cases, the predicted impacts are likely to be associated with the construction process at isolated locations and are produced because of excavation, obstruction at specific construction locations, and earth movements; and (iii) being located mainly along roads and built-up area will not cause direct impact on terrestrial biodiversity values. The potential adverse impacts that are associated with design, construction, and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures. As well, all aspects of the project components and implementation procedures and methodologies will not have any negative impact to the river systems surrounding Khulna city. Rather, the project itself will help reduce pollution load to receiving bodies of water in the area once it operates in the future.

Implementation Arrangement. KWASA will be responsible for the overall planning, guidance, management, and implementation of the project. An inter-ministerial project steering committee (PSC) will be established for the project. The PSC will be chaired by the Secretary of Local Government Division under the Ministry of Local Government, Rural Development and Cooperatives. The PSC will provide overall policy guidance and oversee the overall implementation of the Project. Apart from the PSC, project implementation committee will be established to review the progress and resolve the issues as regard to project implementation.

A PMU will be established within KWASA to oversee the day to day activities of the project. The PMU will be supported by various consultant teams hired for each specific subproject. Consultant teams[2] are responsible for: (i) contract documents preparation and safeguards facilitation; (ii) project management and administration support; (iii) assistance in supervising construction; (iv) strengthening of local governance, conducting studies and/or surveys on flood inundation and climate change impacts, facilitating disaster risk management capacity building and community level adaptation through locally managed climate resilience funds; and (v) community-based

[2] Consultant teams are composed of project management and supervision consultants (PMSC), and institutional development, awareness creation and design consultants (IADC).

climate adaptation and disaster preparedness, awareness raising on behavioral change in water, sanitation, and hygiene activities, and facilitating resettlement procedures; among others.

Consultation, Disclosure and Grievance Redress. The stakeholders were involved in developing the IEE through on-site discussions and public consultation. Their views were incorporated into the IEE and in the planning and development of the subprojects. The IEE will be made available at public locations in the city and will be disclosed to a wider audience via the ADB and KWASA websites. The consultation process will be continued and expanded during project implementation, including design period, to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation. A grievance redress mechanism is described within the IEE to ensure that any public grievance is addressed quickly.

The project's grievance redress mechanism (GRM) will provide the citizens with a platform for redress of their grievances and describes the informal and formal channels, time frame and mechanisms for resolving complaints about environmental performance. The GRM will be proportionate to the potential risks and impacts of the project and will be accessible and inclusive, and handling of grievances will be done in a culturally appropriate manner and be discreet, objective, sensitive and responsive to the needs and concerns of the project-affected parties.

Monitoring and Reporting. The PMU, with support from PMSC and/or IADC, will be responsible for monitoring. The contractors will submit monthly report to PMSC and/or IADC. PMSC and/or IADC will consolidate these monthly reports and submit quarterly report to PMU. PMU will submit semi-annual environmental monitoring reports (SEMRs) to ADB. PMU and ADB will post the cleared SEMRs on project website and ADB website, respectively. ADB will monitor the project on an ongoing basis until a project completion report is issued.

Conclusions and Recommendations. The people of Khulna city will be the major beneficiaries of this project. The benefits of improved sanitation translate into improved health, an increase in productivity, fewer days of absence from school for children, and improved quality of life. Centralized systems of sewage management will improve community health and hygiene, particularly in socially deprived groups, and reduce financial burden of the city. People would spend less on healthcare and lose fewer working days due to illness, resulting to better economic status and overall health.

This IEE has been prepared based on technical specifications of the final detailed design of the sewer network packages and preliminary design of the STP and FSTP package. Based on assessment, the proposed project is unlikely to cause significant adverse impacts and net environmental and health benefits to people of Khulna city will be positive. The potential negative environmental impacts that are associated with design, construction and operation of the project can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures following internationally recognized best practices and standards as discussed in the EMPs.

Therefore, this IEE report has been prepared in accordance with ADB SPS's requirements for projects classified as Category B for environment. With the above premises considered, no further special study or detailed environmental assessment needs to be undertaken to comply with ADB SPS. However, per ECA, 1995 and ECR, 1997 of Bangladesh, the project is categorized as "Red" category. Hence, preparation of an environmental impact assessment (EIA) based on DOE approved terms of reference is mandatory. Upon approval of the submitted EIA, ECC must be obtained from the DOE prior to award of civil works contracts.

This IEE has also been updated to reflect the results of supplemental baseline data gathering and meaningful consultations conducted in subproject sites, which were deferred or delayed due to limitations brought about by the COVID-19 pandemic in 2020.

In particular for the STPs and FSTP, this IEE is based on the preliminary designs of these subproject components. Therefore, this IEE report, including the EMP, shall be updated based on the final detailed designs of the STPs and FSTP. No contract for any of these STP subprojects, including the FSTP, shall be awarded unless this IEE report is updated based on the following:

STP:

(i) Follow up consultations with, and acceptability of the final detailed design of the STP subprojects by all receptors surrounding the STP sites;

(ii) Final detailed design, including, but not limited to, the following:
   a. characterization of influent and description of desired treated effluent;
   b. sizing of final components, final volumetric flow rates, and final technology selection;
   c. engineering calculations for the treatment process; and
   d. final layout of STP components relative to the location or area of the two STP sites;

(iii) Final description of sludge treatment and management, including expected volume of generated sludge;

(iv) Final disposal area of treated sludge. If final disposal site is in existing landfill site/s, environmental and social compliance audit per ADB SPS shall be undertaken by external experts to the existing landfill site, including on-site assessment, to identify past or present concerns related to impacts on the environment, involuntary resettlement, and indigenous peoples. The objective of the compliance audit is to determine whether actions were in accordance with ADB's safeguard principles and requirements, and to identify and plan appropriate measures to address outstanding compliance issues. Where noncompliance is identified, a corrective action plan agreed on by ADB and KWASA, on behalf of the government, will be prepared.;

(v) Confirmation that relevant government agency approval (e.g. from Ministry of Agriculture, and/or Department of Environment, and/or other mandated agencies) on the use of sludge as compost or fertilizer will be obtained if such option is selected as an alternative for sludge disposal; and

(vi) Description of operation and maintenance (O&M) procedures in ensuring compliance with environmental standards on noise, air emission and effluents, and with the measures to avoid or mitigate all forms of nuisance such as odor to the surrounding communities.

FSTP:

(i) Follow up consultations with, and acceptability of the final detailed design of the FSTP by all receptors surrounding the STP-1 site (location of FSTP);

(ii) Actual fecal sludge quantification and characterization necessary for the final design considerations;

(iii) Treatment design criteria;

(iv) Engineering design in terms of final components, final system configuration and hydraulic profile, and final technology selection;

(v) Engineering calculations for the treatment process;

(vi) Final description of sludge treatment and management, including expected volume of generated sludge and final disposal site. If final disposal site is in existing landfill site/s, environmental and social compliance audit per ADB SPS shall be undertaken by external experts to the existing landfill site, including on-site assessment, to identify past or present concerns related to impacts on the environment, involuntary resettlement, and indigenous peoples. The objective of the compliance audit is to determine whether actions were in accordance with ADB's safeguard principles and requirements for KWASA on behalf of the government as borrower, and to identify and plan appropriate measures to address outstanding compliance issues. Where noncompliance is identified, a corrective action plan agreed on by ADB and KWASA on behalf of the government will be prepared; and

(i) Description of O&M procedures in ensuring compliance with environmental standards on noise, air emission, and effluents; and with all measures to avoid or mitigate all forms of nuisance such as odor to the surrounding communities.

I. INTRODUCTION

A. Background

1. The Khulna Sewerage System Development Project (KSSDP or project) is one of the projects responding to Asia's rapid urbanization, Strategy 2030 of the Asian Development Bank (ADB) that emphasizes on the commitment to inclusive and sustainable urban development, among others, through collaboration with other development institutions and the private sector. The intervention of KSSDP will provide Khulna city region with modern sewerage and wastewater management facilities in order to safeguard the public health and the environment.

2. KSSDP is included in the latest Country Operations Business Plan (2020-2022) of Bangladesh with an indicative loan amount of $160 million, of which $50 million from ADB's ordinary capital resources (OCR) in regular terms, and of $110 million in concessional terms. The project aims at improving urban infrastructure and services in Khulna city through developing centralized sewerage management system including:

(i) Construction of 269 km of primary transmission/pipe collection, secondary and tertiary network, including 13.2 km rising main, household sewer connections and other appurtenances;
(ii) Establishment of eight sewerage pumping and lifting stations, and other appurtenances; and
(iii) Construction of two sewerage treatment plants (STPs) (52 MLD and 28 MLD) and fecal sludge treatment plant (FSTP) (160 m^3/day) in one of the sites of these STPs.

B. Outcome and Outputs of the Project

3. **Outcome**. The project is aligned with the following impact: basic needs of the people ensured in a sustainable manner without damaging the environment.[3] The project will have the following outcome: management and sustainability of sewerage services in Khulna city improved.[4]

4. **Output 1: Climate resilient centralized and organized sewerage system for Khulna city established.** The project will establish a sustainable and inclusive sewerage system in Khulna city, covering commercial and densely populated residential areas with around 850,000 population by 2028. The project will focus on creating a centralized sewerage system through establishing 269 km of sewer network,[5] eight pumping stations, two STPs (52,000 m^3 per day and 28,000 m^3 per day),[6] and approximately 27,000 property level sewer connections.[7] A fecal sludge treatment plant (160 m^3 per day) will be also part of project to provide sanitation solutions for residents in LICs where a piped sewer network is not feasible.[8] Two years of O&M for sewer network and pumping stations and three years of O&M for STPs will ensure professional

[3] Government of Bangladesh, Ministry of Planning. 2012. ***Perspective Plan of Bangladesh 2010–2021: Making Vision 2021 a Reality.*** Dhaka.
[4] The design and monitoring framework is in Appendix 1.
[5] There will be no interference between the existing drains and the proposed sewer network. The depth of sewer network will be between 2.5 to 5 m underground while that of drains is between 1 to 1.5 m underground. And, the crossing of drains will be conducted through trenchless method.
[6] Septic tanks in the project area will be permanently decommissioned. Guidelines on decommissioning of septic tanks will be prepared by KWASA with the support of loan consultant teams before providing service connection.
[7] Most households in project area are currently using septic tanks located in ground or underground floor of each property. There are existing internal connections (master traps) in each property to connect from households to septic tanks. Sewer network under the project will be connected to the existing internal connections.
[8] KCC will collect and transport fecal sludge from household septic tanks to the treatment plant inside the areas of STPs for co-treatment of fecal sludge.

operations in the initial years, and to transfer O&M skills to KWASA. The project will have an immediate positive impact on the city's environment, enhance its climate and disaster resilience by increasing sewage treatment capacity, and open the door to the possibility of forging future partnership with private sector.[9]

5. **Output 2: Institutional capacity of KWASA in delivering sustainable sewerage services strengthened.** The physical investments will be complemented by targeted institutional reforms, capacity building, and sustainability, which will build on ongoing reforms for KWASA to adopt.[10] Activities include: (i) developing institutional capacity enhancement plan for KWASA;[11] (ii) implementing training and skills development programs on sewerage system including standard O&M manual; (iii) formulating sewerage tariff policy; (iv) operationalizing the supervisory control and data acquisition (SCADA) system for sewerage system; (v) identifying appropriate public-private partnership (PPP) modality for water supply and sewerage services of Khulna;[12] (vi) increasing the knowledge of KWASA staff on O&M of sewerage system; and (vii) enhancing project readiness for future investments.[13] The project will also support the Khulna city in enhancing hygienic level by: (i) developing a sustainable and inclusive sanitation plan and (ii) conducting public awareness campaigns on the benefits of sewerage service. The project will also support for enhancing women's decision-making capacity and reducing gender inequality by ensuring women's effective participation in decision making on sewerage connection and facilities, planning, implementation, monitoring, and awareness raising program through the implementation of the gender action (GAP).[14]

6. KCC is currently providing on-site sanitation services with FSM and decentralized sewerage systems to residents in Khulna.[15] To provide city-wide sanitation services, the project will support FSM activities of KCC by providing fecal sludge treatment infrastructure inside STP sites through co-treatment, to cover the central and southern part of the city. A sustainable and inclusive sanitation plan and public awareness on sanitation will be developed and conducted jointly by KCC and KWASA under the project.[16] ADB will closely monitor and support the cooperation between KCC an KWASA to contribute to enhancing overall hygiene level in Khulna.

C. Purpose of the Initial Environmental Examination

7. The overall objective of the IEE is to provide guidance to KWASA, its contractors and other operators on how to plan, build and operate the project in an environmentally responsible manner, ensuring that all negative effects are prevented or mitigated, and positive impacts are enhanced. In the IEE, KWASA has identified the necessary tools to fit for purpose. A set of actions that will

[9] Inadequate tariff levels for cost recovery together with large up-front investment costs have not attracted private investment to sewerage sector in Bangladesh.

[10] The national development programs launched by the Government of Bangladesh include: (i) National Hygiene Promotion Strategy for Water Supply and Sanitation Sector in Bangladesh (2012); (ii) National Hygiene Promotion Strategy for Water Supply and Sanitation Sector in Bangladesh (2014), and (iii) Seventh Five-Year Plan (2015).

[11] Strengthening institutional and financial capacity of KWASA will be financed by TA 9781-REG: Developing South Asian Livable Cities Facility.

[12] Government of Bangladesh, Local Government Division. 2011. ***Sector Development Plan***. Dhaka. The government encourages utilities to consider PPP to gain experience for subsequent wider application.

[13] KWASA will engage consultants to prepare future projects, mainly involving the expansion of water supply and sewerage systems in Khulna city.

[14] Through inclusion of 30% women in public consultations on construction work and benefit of safe sanitation services, sewerage connection fees and user charges to ensure their voices are heard and integrated into project decisions

[15] The Bill & Melinda Gates Foundation is currently providing technical support to KCC for on-site sanitation.

[16] KCC expressed its concern on untreated sewage clogging the drainage system and low public awareness on sanitation. A sustainable and inclusive sanitation plan under the project will focus on these issues.

need to be implemented in order to eliminate or at least reduce the environmental impacts to a level acceptable to GOB and ADB are identified and planned during the assessment.

D. Methodology

8. This IEE report has been prepared on the basis of field investigations and stakeholder consultations to meet the requirements for environmental assessment process and documentation per ADB SPS, 2009. Supplementary information was taken from Bangladesh Bureau of Statistics, Bangladesh Meteorological Department, and review of various documents. Environmental assessment was conducted through primary data collection during site visits and secondary data from various sources, socio-economic, hydrological, topographic, and engineering surveys at project sites, meaningful consultation with the stakeholders, including concerned government officials, project personnel and the general public. Baseline environmental monitoring was initiated by KWASA and the monitoring focused on air quality, noise level, surface water quality and groundwater quality. The resulting data provided information on existing conditions against which predictions of changes and field measurements during the construction period will be compared in order to assess change and its significance. The Integrated Biodiversity Assessment Tool (IBAT) was initially used to screen and assess potential risks on the protected areas or critical habitat that may exist around the project sites.

9. Initial scoping and field reconnaissance visits were conducted at project sites by KWASA, to establish the potential impacts and categorization of project activities. Informal public consultation activities were conducted with the community, affected landowners, affected laborer, non-titleholders, and kept notes on the impacts of the proposed project. The methodology of the IEE study was then conveyed and elaborated to these stakeholders in order to address all impacts and for those impacts requiring mitigation measures were proposed to reduce impacts within acceptable limits.

E. Structure of the Report

10. The report has been structured in compliance with ADB SPS, 2009.

(i) **Executive Summary.** This section describes concisely the critical facts, significant findings, and recommended actions.

(ii) **Introduction.** Presents a brief overview of the assignment along with its background, objectives, scope of work and methodology etc.

(iii) **Policy, Legal, and Administrative Framework.** This section discusses the national and local legal and institutional framework within which the environmental assessment is carried out. It also identifies project-relevant international environmental agreements to which the country is a party.

(iv) **Description of the Project.** This section describes the proposed project; its major components; and its geographic, ecological, social, and temporal context, including any associated facility required by and for the project.

(v) **Description of the Environment.** This section describes relevant physical, biological, and socioeconomic conditions within the study area. It also looks at current and proposed development activities within the project's area of influence, including those not directly connected to the project. It indicates the accuracy, reliability, and sources of the data.

(vi) **Anticipated Environmental Impacts and Mitigation Measures.** This section predicts and assesses the project's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic (including occupational health and safety, community health and safety, vulnerable groups and gender issues, and

impacts on livelihoods through environmental media, and physical cultural resources in the project's area of influence, in quantitative terms to the extent possible; identifies mitigation measures and any residual negative impacts that cannot be mitigated; explores opportunities for enhancement; identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics that do not require further attention; and examines global, transboundary, and cumulative impacts as appropriate.

(vii) **Analysis of Alternative.** Analyzes the environmental situation “With and Without project”.

(viii) **Information Disclosure, Consultation, and Participation.** This section (i) describes the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders; (ii) summarizes comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and Indigenous Peoples; and (iii) describes the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

(ix) **Grievance Redress Mechanism.** This section describes the grievance redress framework (both informal and formal channels), setting out the time frame and mechanisms for resolving complaints about environmental performance.

(x) **Environmental Management Plan.** This section deals with the set of mitigation and management measures to be taken during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts (in that order of priority). It may include multiple management plans and actions (mitigation, monitoring and performance indicators).

(xi) **Monitoring and Reporting.** Outlines the environmental monitoring program and reporting system including the cost of implementing the EMP.

(xii) **Conclusion and Recommendations.** Presents the conclusion and recommendations of the IEE study.

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

11. Alongside ADB Safeguard Policy Statement (SPS, 2009), each component of the project must comply with the relevant legal and policy framework of Government of Bangladesh, such as the Environment Conservation Act 1995 (ECA, 1995) with amendments in 2000, 2002 and 2010, and the Environment Conservation Rules 1997 (ECR, 1997), which are the primary environmental law and rules of the country.

A. ADB Safeguard Policy Statement 2009

12. The Safeguards Policy Statement (SPS, 2009) of ADB provides guidance on the environment category of projects based on the degree of anticipated environmental impacts. ADB environmental safeguards objectives are: (i) to ensure the environmental soundness and sustainability of projects and (ii) to support the integration of environmental considerations into the project decision-making process. ADB environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. The initial process of categorization involves filling out a sectoral rapid environmental assessment (REA) checklist. A project is

classified as one of the four environmental categories (A, B, C, or FI) based on the most environmentally sensitive component. Categories are as follows:

(i) **Category A:** Project that is likely to have significant adverse environmental impacts which are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA), including an environmental management plan (EMP), is required.
(ii) **Category B:** Project with potential adverse environmental impacts that are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required.
(iii) **Category C:** Project that is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.
(iv) **Category FI:** Project is classified as category FI if it involves the investment of ADB funds to, or through, a financial intermediary.

13. Initial screening using ADB REA checklist for sewage treatment plants (Appendix 1) was conducted, and results of the rapid assessment show that the project is unlikely to cause any significant adverse impacts, and therefore classified under Category B per ADB SPS. Thus, this IEE report has been prepared in accordance with ADB SPS requirements for project with Category B classification.

14. **Environmental Management Plan.** An EMP, which addresses the potential impacts and risks identified by the environmental assessment, shall be prepared. The level of detail and complexity of the EMP and the priority of the identified measures and actions will be commensurate with the project's impact and risks.

15. **Public Disclosure.** Upon review and confirmation that a safeguard document complies with the requirements of ADB SPS, ADB will post such safeguard document on its website as well as disclose relevant information in accessible manner in local communities:

(i) for environmental category A projects, draft EIA report at least 120 days before Board consideration;
(ii) final or updated EIA and/or IEE upon receipt; and
(iii) environmental monitoring reports submitted by the PMU during project implementation upon receipt.

16. **Consultation and Participation.** The PMU, with support from project management and supervision consultant (PMSC) and/or institutional development, awareness creation and design consultants (IADC), shall carry out meaningful consultation[17] with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. The

[17] Per ADB SPS, 2009, meaningful consultation means a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;1 (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

consultation process and its results are to be documented and reflected in the environmental assessment report.

17. **Grievance Redress Mechanism.** KWASA, through PMU, shall establish a mechanism to receive and facilitate resolution of affected peoples' concerns, complaints, and grievances about the project's environmental performance. The grievance mechanism shall be scaled to the risks and adverse impacts of the project. As of the ADB loan processing for the project, a grievance redress mechanism (GRM) has been established and discussed in detail in Section VIII below.

18. **Monitoring and Reporting.** PMU, with support from PMSC and/or IADC, shall monitor, measure and document the progress of implementation of the EMP. If necessary, PMU will identify the necessary corrective actions, and reflect them in a corrective action plan. PMU will prepare and submit to ADB semi-annual environmental monitoring reports that describe progress with implementation of the EMP, and compliance issues and corrective actions, if any. For the STP and FSTP subprojects that are likely to have environmental impacts during operation, reporting will continue until ADB issues a project completion report.

19. **Unanticipated Environmental Impacts.** Where unanticipated environmental impacts become apparent during implementation, PMU shall update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.

20. **Pollution Prevention and Control Technologies.** During the design, construction, and operation of the project, the PMU will apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environment, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When Government of Bangladesh regulations differ from these levels and measures, the PMU will achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, the PMU will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

21. **Occupational Health and Safety.** PMU[18] shall ensure that workers[19] are provided with a safe and healthy working environment, considering risks inherent to the sector and specific classes of hazards in the subproject work areas, including physical, chemical, biological, and radiological hazards. PMU shall ensure to take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v)

[18] In case where responsibility is delegated to subproject contractors during construction phase, PMU shall ensure that the responsibilities on occupational health and safety as described herein are included in the contract documents.

[19] Including nonemployee workers engaged by KWASA through contractors or other intermediaries to work on project sites or perform work directly related to the project's core functions.

documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

22. **Community Health and Safety.** The PMU shall ensure to identify and assess the risks to, and potential impacts on, the safety of affected communities during the design, construction, operation, and decommissioning of the subproject, and will establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts.

23. PMU shall ensure to apply preventive and protective measures for both occupational and community health and safety consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines**.**[20] PMU shall also adhere to necessary protocols in response to emerging infectious diseases such as the corona virus disease (COVID-19) consistent with the guidelines of relevant government healthcare agencies and the World Health Organization.

24. **Physical Cultural Resources**. PMU is responsible for siting and designing the subprojects to avoid significant damage to physical cultural resources. Such resources likely to be affected by the subproject will be identified, and qualified and experienced experts will assess the subproject's potential impacts on these resources using field-based surveys as an integral part of the environmental assessment process. The chance finds procedure or protocol included in this IEE shall be used as mandatory guide for contractors.

25. **Environmental Audit.** When a subproject involves existing activities or facilities, PMU is responsible to ensure that relevant external experts will perform environmental audits to determine the existence of any areas where such subproject may cause or is causing environmental risks or impacts. If the subproject does not foresee any new major expansion, the audit constitutes the environmental assessment for the subproject.

26. **Bidding and Contract Documents.** This IEE report, which contains the EMP, shall be included in bidding and contract documents and verified by PMU. The PMU shall also ensure that bidding and contract documents include specific provisions requiring contractors to (i) comply with all other conditions required by ADB,[21] and (ii) to submit to PMU, for review and approval, a site-specific environmental management plan (SEMP), including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; (iii) monitoring program as per EMP; and (iv) budget for SEMP implementation, among others as may be required. No works can commence prior to approval of SEMP. A copy of the EMP and/or approved SEMP will be kept on site during the construction period at all times. Non-compliance with, or any deviation from, the conditions set out in the EMP and/or SEMP constitutes a failure in compliance and shall require corrective actions.

27. **Conditions for Award of Contract and Commencement of Work.** PMU shall not award any works contract under the subproject until (i) relevant provisions from the EMP are incorporated into the works contract; (ii) this IEE report is updated to reflect subproject's final detailed design and PMU has obtained ADB's clearance of such updated IEE report; and (iii)

[20] World Bank Group, 2007. ***Environmental, Health, and Safety General Guidelines.*** Washington, DC.

[21] Contractors to comply with (i) all applicable labor laws and core labor standards on (a) prohibition of child labor as defined in national legislation for construction and maintenance activities; (b) equal pay for equal work of equal value regardless of gender, ethnicity, or caste; and (c) elimination of forced labor; and with (ii) the requirement to disseminate information on sexually transmitted diseases, including HIV/AIDS, to employees and local communities surrounding the project sites.

DOE-approved EIA (i.e. EIA in compliance with ECR, 1997) and other necessary permits from relevant government agencies have been obtained. For “design, build, and operate” type contracts, PMU shall ensure no works for a subproject which involves environmental impacts shall commence until (i) relevant provisions from the EMP are incorporated into the works contract; and (ii) this IEE report is updated to reflect subproject’s detailed design and PMU has obtained ADB’s clearance for such updated IEE.

B. Environmental Legislation Framework

1. Overview of the Project Approval Process

28. Key legislation governing the environmental approvals process for the proposed project is the Bangladesh Environmental Conservation Act, 1995 (ECA, 1995) and the Environmental Conservation Rules (ECR, 1997).

29. According to Rule 7 of the ECR, proposed developments within Bangladesh are classified as one of four categories, as follows:

(i) Green;
(ii) Orange A;
(iii) Orange B; and
(iv) Red.

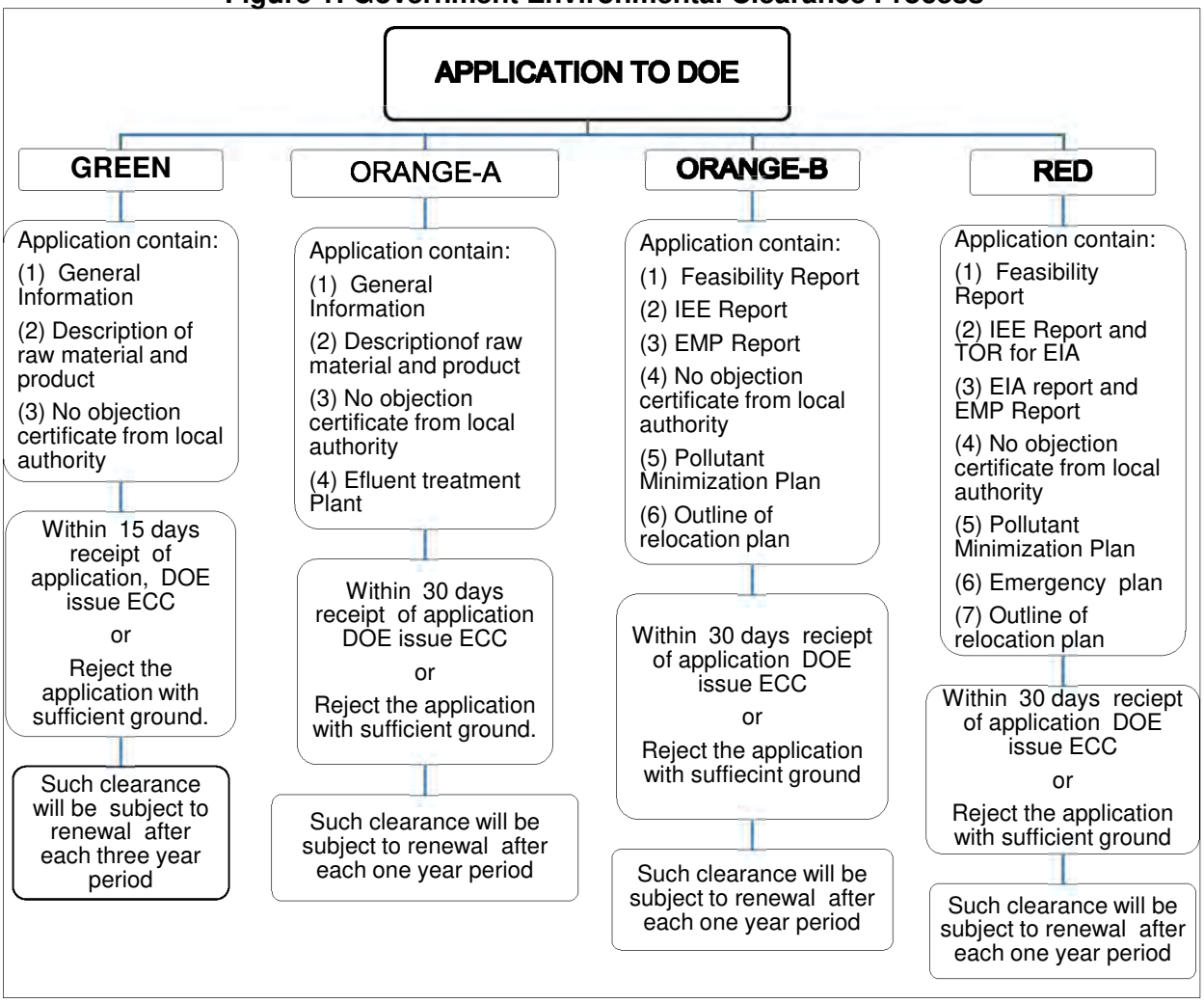
30. These categories define proposed developments according to their potential environmental impact. Section 12 of the ECA states that no industrial unit or project shall be established or undertaken without obtaining an environmental clearance certificate (ECC) from the Director General, in the manner prescribed by the Rules.

2. Environmental Approval Framework

31. Key milestones in the approvals process are outlined in Figure 1. These comprise:

(i) **Project Authorization Letter:** Formal authorization of the project by the KWASA is required in order for the environmental approvals process to formally commence.
(ii) **No Objection Certificate (NOC):** A NOC must be received from the Deputy Commissioner in the project area before the site clearance certificate (SCC) application can be made.
(iii) **Site Clearance Certificate:** An SCC will be issued by DOE upon approval of the IEE study (note that the IEE submission is to include the Project Authorization Letter, NOC and SCC application form). The SCC will include a TOR for the IEE/EIA study, and typically provides authorization for site establishment works to commence.
(iv) **Environmental Clearance Certificate:** The ECC will be issued by DOE upon approval of the IEE/EIA study (including associated EMP). The ECC allows project construction to commence and contains specific approvals requirements for matters such as pollution control and environmental monitoring.

Figure 1: Government Environmental Clearance Process



DOE = Department of Environment, EIA = environmental impact assessment, ECC = Environmental Compliance Certificate, EMP = environmental management plan, IEE = initial environmental examination, TOR = term of reference.

32. Table 1 provides an overview of key Bangladesh legislative approvals requirements which are relevant to the project, and the permissions required under this legislation in order to undertake the project works.

Table 1: Required Permissions for Project under Bangladesh Legislation

Legislation	Permission Required	Purpose	Permission Given By
Environment Conservation Act (1995) Environment Conservation Rules (1997)	SCC and ECC	DOE will issue an SCC to allow for a detailed EIA as per Section 12 (ECA), Rule- 7 and Form -3 of the ECR.	Director General of the Bangladesh DOE
Acquisition and Requisition of	Application required	To acquire and compensate for any Project land	Ministry of Land and Deputy Commissioner

Legislation	Permission Required	Purpose	Permission Given By
Immovable Property Act (1982)			

33. Rule 7 of ECR indicates the procedure and requirements for the issuance of an ECC. The corresponding requirements per category are described below:

(i) Green Category Projects:
- (a) completed application for ECC, and the appropriate fee (shown in Schedule 13);
- (b) general information about the project;
- (c) exact description of the raw materials to be used, and the product to be manufactured (where relevant); and
- (d) No-objection certificate from the local authority.

(ii) Orange-A Category Projects: Same requirements as green category projects, plus the following:
- (a) process flow diagram;
- (b) layout plan (showing location of effluent treatment plant or ETP);
- (c) effluent discharge arrangement; and
- (d) outlines of the plan for relocation and rehabilitation (if applicable).

(iii) Orange-B Category Projects:
- (a) completed Application for ECC, and the appropriate fee;
- (b) report on the feasibility of the project;
- (c) report on the IEE for the project, plus process flow diagram, and in the case of an industrial project, layout plan (showing ETP) and ETP design;
- (d) report on the environmental management plan (EMP);
- (e) no objection certificate from the local authority;
- (f) emergency plan relating to adverse environmental impact and plan for mitigation of the effect of pollution; and
- (g) outline of the relocation and rehabilitation plan (where applicable).

(iv) Red Category Projects: Same requirements as Orange Category B, except that Item 3 (IEE) is amended to read as follows:
- (a) report on the IEE for the project, and terms of reference for the EIA; or EIA report prepared based on TOR previously approved by DOE;
- (b) in the case of an industrial project, layout plan showing location of ETP, process flow diagram, design, and time schedule of the ETP.

3. Government Environmental Categorization

34. Environmental Conservation Rules, 1997 clearly defines the classification of all industrial and project schemes into four broad categories. The categorization considers all the physical interventions in implementation of those project or industries and operational procedures and risk associated therein. Susceptibility of the location where the projects would be implemented also determines the categories; sometimes stringent management issues are levied on the project implementation and operation.

35. Large projects are likely to have different segments and types of interventions under a single project umbrella, where each part of larger interventions are taken into consideration and categorization are made individually for each segments and highest category among those are set for the overall project in order to keep the environment safer and reduce the risk of adverse consequences. However, the categorization for the subproject has been identified to be Red Category in overall scale. Under this subproject or component, two major types of interventions are planned, and categorization is made accordingly:

Table 2: Categorization of the Project

Subproject/ Component	Interventions	ECR Category
Construction of sewerage network including pumping stations, Package-1	Laying trunk or sewage pipeline along the existing road network	Red
Construction of sewerage network including pumping stations, Package-2	Engineering works associated with Sewage Pumping Station or Lifting Station with building structure	Red
Construction of sewage treatment plants and fecal sludge treatment plant	Construction of Sewage Treatment Plants	Red
	Construction of ancillary facilities (Building structures), and Fecal Sludge Treatment Plant	Red

C. National Environmental Act and Laws

1. The Constitution of the People's Republic of Bangladesh

36. The constitution of the country was adopted in 1972, but the 15th amendment to this constitution made in 2011 included the concept of the protection and improvement of environment and biodiversity under fundamental principles of state policy (part II). To this end, Article 18A clearly states that the state shall endeavor to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild life for the present and future citizens. Inclusion of this clause into the constitution underscores the requirement for the protection and improvement of environment and biodiversity, and also has influenced to develop and promulgate further environmental laws, rules and directives in Bangladesh. The constitution also proclaims that the state shall adopt effective measures to remove social and economic inequality between man woman and to ensure the equitable distribution of wealth among citizens endeavor to ensure equality of opportunity and participation of women in all spheres of national life. The same also emphasizes to adopt measures for the protection against disfigurement, damage or removal of all monuments, objects or places of special artistic or historic importance or interest.

37. **Relevance to the project.** The aforementioned clauses stated into the constitution clearly put directives to protection and improvement of natural environment and biodiversity, social justice and conservation of monuments, objects or places having special artistic or historical importance, during the planning, construction and O&M phases of the project.

2. Environmental Conservation Act (ECA), 1995 (and subsequent amendments)

38. Provides for the conservation of environment, improvement of environmental standards and control and mitigation of environmental pollution. In line with these provisions of the Act, the Environmental Conservation Rules, 1997 have been framed. This Act provides for (i) remedial measures for injury to ecosystem; (ii) provides for any affected person due to environmental pollution to apply to Department of Environment (DOE) for remediation of the damage; (iii) discharge of excessive environmental pollutants; (iv) inspection of any activity for testing any equipment or plant for compliance to the environment act, including power to take samples for compliance; (v) power to make rules and standards with reference to environment; and (vi) penalty for non-conformance to environment act under the various sections.

39. The main strategies of the Act can be summarized as:

(i) Declaration of ecologically critical areas, and restriction on the operation and process, which can be carried, out or cannot be initiated in the ecologically critical areas.
(ii) Regulation in respect of vehicles emitting smoke harmful for the environment.
(iii) Environmental clearance.
(iv) Regulation of the industries and other development activities – discharge permit.
(v) Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes
(vi) Promulgation of standard limit for discharging and emitting waste.
(vii) Formulation and declaration of environmental guidelines.

40. Amendment 2000 of the Bangladesh Environmental Conservation Act focuses on: (i) ascertaining responsibility for Compensation in cases of damage to ecosystems, (ii) increased provision of punitive measures both for fines and imprisonment, and (iii) fixing authority on cognizance of offences. The next amendment in 2002 emphasizes on: (i) restriction on polluting automobiles, (ii) restriction on the sale and production of environmentally harmful items like polythene bags, (iii) assistance from law enforcement agencies for environmental actions, (iv) break up of punitive measures, and (v) authority to try environmental cases. The latest amendment in 2010 declares demarcation of wetlands and water bodies, and imposes restrictions on hazardous waste import, transportation, storage etc.; and activities on cutting of hills and/or mountains along with Ecologically Critical Areas. Failure to comply with any part of the Environment Conservation Act 1995 may result in punishment to a maximum of 5 years' imprisonment or a maximum fine of Tk. 100,000, or both.

41. **Relevance to the project.** According to this law, no industrial unit or project shall be established or undertaken without obtaining, in the manner prescribed by rules, an Environmental Clearance Certificate from the Director General.

3. Environment Conservation Rules, 1997 (including amendments of 2002, 2003, and 2005)

42. The Environment Conservation Rules, 1997 (ECR, 1997) provide a first set of rules under the Environment Conservation Act, 1995. These rules are further amended in 2002, 2003, 2005, 2010 and 2017. These provide, amongst other items, standards and guidelines for:

(i) Categorization of industries and development projects;
(ii) Procedure for obtaining environmental clearance; and
(iii) Environmental quality standards in relation to water pollution, air pollution and noise, as well as permitted discharge/emission levels of water and air pollutants and noise by projects.

43. ECR, 1997 classifies industrial units and development projects into four categories for the purpose of issuance of Environmental Clearance Certificate (ECC). These categories are: Green; Orange-A; Orange-B; and Red. Per ECR 1997, all existing and new industries and projects in Orange B and Red category require an Environmental Management Plan (EMP) to be prepared (after conducting an IEE or EIA) and submitted along with other necessary papers while applying for environmental clearance.

44. **Relevance to the project.** In accordance with the ECR, 1997, the project is classified under Red Category, requiring an EIA for the issuance of ECC from DOE. This ECC has to be obtained prior to commencement of the project.

4. Environmental Courts Act, 2000

45. The Environment Court Act, 2000 has been enacted in order to establish environmental courts in each administrative division of Bangladesh. This Act sets out policy for effective pursuance and completion of legal proceedings related to environmental crimes. Under this Act the Director General of the DOE has the power to impose heavy penalties to industrial polluters who are dumping untreated wastewater into the environment or not operating their legally mandated effluent treatment plants.

46. **Relevance to the project.** This Act covers the project because one of the subprojects employ sewage and fecal sludge treatment facilities that have the potential to pollute the environment if not operated properly. According to this Act, government can take legal actions if any environmental problem occurs due to project activities.

5. Bangladesh Climate Change Strategy and Action Plan 2009

47. The Government of Bangladesh prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 and revised in 2009. This is a comprehensive strategy to address climate change challenges in Bangladesh. It is built around the following six themes:

(i) Food security, social protection and health to ensure that the poorest and most vulnerable in society, including women and children, are protected from climate change. All programs focus on the needs of this group for food security, safe housing, employment and access to basic services, including health.

(ii) Comprehensive disaster management to further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities.

(iii) Infrastructure to ensure that existing assets (e.g., coastal and river embankments) are well maintained and fit for purpose and that urgently needed infrastructures (cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change.

(iv) Research and Knowledge management to predict that the likely scale and timing of climate change impacts on different sectors of economy and socioeconomic groups; to underpin future investment strategies; and to ensure that Bangladesh is networked into the latest global thinking on climate change.

(v) Mitigation and low carbon development to evolve low carbon development options and implement these as the country's economy grows over the coming decades.

(vi) Capacity building and Institutional strengthening to enhance the capacity government ministries, civil society and private sector to meet the challenge of climate change.

48. **Relevance to the project.** This strategy and action plan is relevant to the project. The project is required to consider in its design mitigation measures that will ensure the infrastructures can withstand the impact of climate change in the future. This, in turn, will contribute to the realization of the objectives of the strategy and action plan.

6. National Water Policy 1999

49. The National Water Policy was promulgated in 1999 with the intention of guiding both public and private actions to ensure optimal development and management of water in order to benefit both individuals and the society at large. The policy aims to ensure progress towards fulfilling national goals of economic development, poverty alleviation, food security, public health and safety, a decent standard of living for the people and protection of the natural environment. According to the policy, all agencies and departments entrusted with water resource management responsibilities (regulation, planning, construction, operation, and maintenance) will have to enhance environmental amenities and ensure that environmental resources are protected and restored while executing their activities. Environmental needs and objectives will be treated equally with the resources management needs. The policy has several clauses related to the protection and conservation of the natural environment to ensure sustainable development.

50. **Relevance to the project.** Clause 4.6b of this policy states that natural depressions and water bodies in major urban areas must be preserved in order to recharge underground aquifers and rainwater management. Moreover, measures must be taken to minimize disruption to the natural aquatic environment in streams and water channels (Clause 4.9b). In addition, this policy requires each water resources development project or rehabilitation program to give full consideration to environmental protection, restoration and enhancement measures consistent with National Environmental Management Action Plan and the National Water Management Plan and adhere to a formal environment impact assessment process, if required by the Government (Clause 4.12a and clause 4.12b). The policy covers the project due to the STP components that could potentially pollute surface water bodies and groundwater. Therefore, the project is bound to comply with or consider the requirements under this policy in its design.

7. National Safe Drinking Water Supply and Sanitation Policy 1998

51. The National Safe Drinking Water Supply and Sanitation Policy was adopted in 1998 and sets out the basic framework for the improvement of public health quality and to ensure an improved environment, together with a set of broad sectoral action guidelines. The policy has the following objectives:

(i) To manage water supply and sanitation related basic needs for all;
(ii) To bring about a positive change of peoples' attitude towards water and sanitation;
(iii) To reduce the outbreak of water-borne diseases;
(iv) To increase the efficiency of the Local Government and associated communities for handling the problems related to water supply and sanitation;
(v) To improve sustainable water supply and sanitation system;
(vi) To promote proper conservation, management and use of surface water and to control water pollution in light of the scarcity of groundwater; and
(vii) To take necessary steps to capture and use rain water.

52. **Relevance to the project.** This policy covers the project as far as the protection of surface waters and groundwater are concerned. The project will have to ensure that its operations from all phases of implementation will not cause negative impacts to these water supply resources.

8. National Land Use Policy, 2001

53. The National Land Use Policy was adopted by Bangladesh government in 2001, setting out guidelines for improved land-use and zoning regulations. The main objectives of this policy is to ensure criteria based uses of land and to provide guidelines for usage of land for the purpose of agriculture, housing, afforestation, commercial and industrial establishments, rail and highway and for tea and rubber gardens. Overall, this policy promotes a sustainable and planned utilization of land. The main contents of this policy are:

(i) Stopping the high conversion rate of agricultural land to nonagricultural purposes;
(ii) Utilizing agro-ecological zones to determine maximum land use efficiency;
(iii) Adopting measures to discourage the conversion of agricultural land for urban or development purposes;
(iv) Improving the environmental sustainability of land-use practices.

54. **Relevance to the project.** The policy covers the project as its several components will be established in various areas with different land use classifications. The proposed project must adhere to the conditions of this policy, particularly in selecting the appropriate location of project components.

9. Bangladesh National Building Code (BNBC)

55. In order to ensure optimum return of substantial portion of national resource invested in building construction, in both public and private sectors and to achieve satisfactory performance of any building, construction needs to be controlled and regulated. The purpose of Bangladesh National Building Code is to establish minimum standards for design, construction, quality of materials, use and occupancy, location and maintenance of buildings within Bangladesh in order to safeguard, within achievable limits, life, limb, health, property and public welfare.

56. **Relevance to the project.** This building code is very relevant to the project. The design of the project must follow the specifications of the building code to ensure structural integrity of all infrastructures to be built.

10. National Agricultural Policy, 1999

57. 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 a dependable food security system for all. One of the specific objectives of National Agricultural Policy is to take necessary steps to ensure environmental protection as well as ‘environment-friendly sustainable agriculture’ through increased use of organic manure and strengthening of the integrated pest management program. The policy also suggests creating awareness so that the chemical fertilizers and pesticides used for increased crop production do not turn out to be responsible for environmental pollution. Water logging and salinity are identified as one of the serious problems in some parts of the country including the coastal areas for agricultural activities and environmental damage. The policy recommends for crop rotation and salt tolerant crop varieties.

58. **Relevance to the project.** According to the policy, locations and alignments of subprojects must be selected carefully so that acquisition of fertile agricultural land is minimal. Moreover, adequate measures should be taken to reduce water-logging and not hamper irrigation system due to construction of the project.

11. National Fisheries Policy, 1996

59. The National Fisheries Policy, 1996 recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy suggests following actions:

(i) Shrimp and fish culture will not he expanded to the areas which damage mangrove forest in the coastal region;
(ii) Biodiversity will be maintained in natural water bodies and in marine environment;
(iii) Chemicals harmful to the environment will not be used fish shrimp farms;
(iv) Environment friendly fish shrimp culture technology will be used;
(v) Control measures will be taken against activities that have a negative impact on fisheries resources and vice-versa;
(vi) Laws will be formulated to ban the disposal of any untreated industrial effluents into the water bodies.

60. **Relevance to the project.** This policy covers the project due to the potential impact of project construction and operations to river systems considered as habitat of aquatic species. The project is required to take proper action and measures to avoid or minimize impact to aquatic biodiversity in the area.

12. The Forest Act (1927) and the Forest (Amendment) Act (2000)

61. The Forest Act (1927) was enacted to control trespass, illegal resources extraction from forests and to provide a framework for the forestry revenue collection system. It is the main legislative context for forestry protection and management in Bangladesh. The Act allows for the notification of forest reserves in which the government, through the Forest Department, regulates the felling, extraction and transport of forestry produce in Bangladesh. The Act grants the government several basic powers, largely for conservation and protection of government forests, and limited powers for private forests.

62. **Relevance to the project.** Although there are no forests around the project areas and Khulna city, the relevance of this Act is only on the potential cutting of trees in some project locations. The project will be required to obtain permits on cutting of any trees prior to start of civil works.

13. Bangladesh Wildlife (Conservation and Security) Act, 2012

63. This Act aims to protect and conserve wildlife in Bangladesh. Wildlife preservation, conservation and management fall within the jurisdiction of the Forestry Department. The previous Wildlife (Preservation) Order, 1973 & Wildlife (Preservation) (Amendment) Act, 1974 have been revamped to Wildlife (Conservation & Security) Act of 2012.

64. The Act has adopted new types of protected areas for conservation and protection of wildlife resources, created avenue for community conserved areas and also community-based management of protected areas. This Act protects 1,307 species of plants and animals under four schedules that 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. Protection of wildlife is provided with lists of species within four schedules of the Order:

(i) First Schedule - The Schedule -1 (823) represents Protected Animal (Amphibians-14, reptiles-96, birds-578, mammals-110, fishes-25) of Bangladesh which are

open to shooting and may be hunted on a special hunting permit (though since 1988 no hunting permits have been issued by the Government).

(ii) Second Schedule – Schedule-2 (424) also represents Protected Animal (Amphibians-18, reptiles-58, birds-44, mammals-3, fishes-27, phylum cnidaria – class anthozoa (coral)-32, molluscs – shells and snails-137, arthropods – crustacea (crabs and lobster)-22, insect (butterflies and moths)-59, Insect – beetles-24 those species that are not to be hunted, killed or captured and CITES Specification;

(iii) Third Schedule – Schedule -3 (6) represents Vermin-6 Protected animals; and

(iv) Fourth Schedule - Schedule -4 (54) represents Protected Plants-41 and Orchid-13.

65. **Relevance to the project.** This Act is relevant to the project as the interventions or subproject activities may affect wildlife habitat and obstruct movement. The project needs to assess project activities that may have impact to biodiversity.

14. Water Supply and Sewerage Authority Act, 1996

66. Under article 3 of WASA Act 1996, Government of Bangladesh established Khulna Water Supply and Sewerage Authority (KWASA) on March 2, 2008 with a view to expand and improve the services of water supply for the Khulna city. However, the WASA Act 1996 does not specifically mention about responsibility of the authority with regard to on-site sanitation system or any activity related to emptying of pits and septic tanks, collection, transportation, treatment and disposal and/ or reuse of fecal sludge from on-site facilities.

15. Bangladesh Standards and Guidelines for Sludge Management, 2015

67. Bangladesh Standards and Guidelines for Sludge Management was promulgated in 2015 with the intention to ensure the human health and the environmental protection from any negative impacts of sludge management. As described in the standards and guidelines document, the responsibility for sludge management lies with the producer of the sludge. The holder of the sludge must also comply with the requirements mentioned in this document.

68. The producer of the sludge is required to submit a sludge management plan to the Department of Environment (DOE) as part of the environmental clearance application. The producer of sludge can only proceed to use or dispose of the sludge with written permission of the DOE. According to this document, depending upon the origin of the wastewater, sludge is being classified as:

(i) Category A: Municipal sludge including comparable sludge from domestic wastewater treatment

(ii) Category B: Sludge from industry including sludge from CETP

(iii) Category C: Sludge from industry including sludge from CETP belonging to the Category of hazardous waste.

69. In cases where wastewater producing a type of sludge that is classified as Category C is mixed with other types of wastewater and treated together (for example in a CETP), the resulting sludge is to be classified as Category C. In cases where wastewater producing a type of sludge classified as Category B is mixed with wastewater producing sludge classified as Category A and both are treated together, the resulting sludge is to be classified as Category B. If different classes

of sludge are mixed during collection, transport, treatment, or during other stages of sludge management, then the method of classification described above is to be applied.

70. Depending on the category of the sludge, specific sludge management options may be chosen, provided that they are in compliance with the requirements given in this document. The options include: anaerobic digestion, land application, thermal incineration, controlled landfill, and recycling in formation of construction materials.

71. Sludge from municipal wastewater or comparable industry may be composted and used in agriculture provided that it complies with the standard for reuse stipulated in this document. Sludge from hazardous industries/CETP must either be treated using thermal incineration or landfilled to protect human health and the environment. Any alternative disposal options may be employed only with prior consent of the Department of Environment.

72. **Relevance to the project.** The proposed project must follow the guidelines to ensure safe disposal of sludge produced in the STPs and the wetland.

16. Bangladesh Public Procurement Rule (PPR), 2008

73. This rule applies to the Procurement of Goods, Works or Services by any government, semi-government or any statutory body established under any law. The rule includes the adequate measure regarding the "Safety, Security and Protection of the Environment' in the construction works. This clause includes mainly; the contractor shall take all reasonable steps to (i) safeguard the health and safety of all workers working on the site and other persons entitled to be on it, and to keep the site in an orderly state and (ii) protect the environment on and off the site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of the Contractors methods of operation.

D. Legislation Relating to Occupational Health and Safety

74. Relevance of occupational health and safety are presented in the below Table.

Table 3: Relevance of Occupational Health and Safety Legislation

Title of Laws and Rules	Relevance
Social Security under the Act, 1923 and an amendment in 1980	According to the Act social impact assessment includes the processes of analyzing, monitoring and managing the intended and unintended social consequences, both positive and negative of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions.
Bangladesh Labor Law of 2006	- Compliance to the provisions on employment standards, occupational safety and health, welfare and social protection, labor relations and social dialogue, and enforcement - Prohibition of employment of children and adolescent
The Employer's Liability Act, 1938	The Act declares that the doctrine of common employment and of assumed risk shall not be raised as a defense in suits for damages in respect of employment injuries. Under the Maternity Benefit Act, 1939, the Maternity Benefit Act, 1950, the Mines Maternity Benefit Act, 1941, and finally the rules framed thereunder, female employees are entitled to various benefits for maternity, but in practice they enjoy leave of 6 weeks before and 6 weeks after delivery.

Title of Laws and Rules	Relevance
Public Health (Emergency Provisions) Ordinance, 1994	The ordinance calls for special provisions with regard to public health. Whereas an emergency has arisen, it is necessary to make special provision for preventing the spread of human disease, safeguarding public health and providing them adequate medical service and other services essential to the health of respective community and workers in particular during the construction related work.
The Employees State Insurance Act, 1948	It has to be noted that health, injury and sickness benefit should be paid to people, particularly respective workers at work place under the Act.
Bangladesh Factory Act, 1979	The Act requires every workplace including small or large scale construction where women are employed to have an arrangement of childcare services. Based on this Act and Labor Laws - medical facilities, first aid and accident and emergency arrangements are to be provided by the authority to the workers at workplaces.
Water Supply and Sewerage Authority Act, 1996	The Act specify WASA's responsibility to develop and manage water supply and sewerage systems for the public health and environmental conservation.

E. Relevant International Conventions, Treaties

75. Relevant International Conventions, Treaties and Protocols (ICTPs) are given in the following Table.

Table 4: International Environmental Conventions Relevant to the Project Activities

Sl. No.	International Treaties	Ratified/ Accessed (AC)/ Accepted (AT)/ Adaptation (AD)	Relevance
1	International Plant Protection Convention (Rome, 1951) & Plant Protection Agreement for SE Asia and Pacific (1999 Revision)	01.09.1978 04.12.1974 (AC)	Ensures that component work or construction materials do not introduce plant pests
2	Convention on Wetlands of International Importance, 1971 (Ramsar Convention)	20.04.1992 (ratified)	Protection of significant wetland and prevention of draining or filling during construction
3	Convention Concerning the Protection of World Cultural and Natural Heritage (Paris, 1972)	03.11.1983 (ratified)	Prevention of damage or destruction of culturally and/or historically significant sites, monuments, etc.
4	Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal 1987)	02.08.90 31.10.90 (AC) (entry into force)	Use of equipment or facilities (e.g, refrigeration and air-conditioning units) that utilize ozone friendly chemicals or substances.
5	Convention on Biological Diversity, 1992 (Rio de Janeiro)	03.05.1994	Protection of biodiversity during construction and operation.
6	Cartagena protocol on Biosafety to the Convention on Biological Diversity	In the process of Ratification	Protection of biodiversity during construction and operation.
7	Convention on Persistent Organic Pollutants, 2001	In process	Restriction of use of pesticides and herbicides.

Sl. No.	International Treaties	Ratified/ Accessed (AC)/ Accepted (AT)/ Adaptation (AD)	Relevance
8	United Nations Framework Convention on Climate Change, 1997	22.10.2001 13.11.2003 (amended)	Reduce greenhouse gas concentrations in the atmosphere to a level that would prevent dangerous anthropogenic interference with the climate system.

F. Gaps in Legal and Guiding Instruments

76. Construction and operation of sewage treatment plant is new technology in Bangladesh. The country is still lacks comprehensive and realistic legal or guiding documents on sustainable construction and operation of sewage treatment plants.

77. Comparative analysis of Environmental Safeguard principles is shown in the following Table.

Table 5: Comparative Analysis of Environmental Safeguard Policy

Sl. No.	ADB SPS, 2009		GOB Principles	Gaps (if any)
	Principles	Delivery Process		
1	Use of screening process to determine the appropriate environmental assessment	Uses sector-specific rapid environmental assessment checklist for screening and assigns categories based on potential impacts: A- EIA required (irreversible, diverse or unprecedented adverse environmental impacts); B- IEE required; C- No environmental assessment required but a review of environmental implications; FI - ESMS required.	ECA 1995 and ECR 1997 set screening criteria to classify industries/ projects based on potential environmental impacts as follows: Green (pollution-free), Orange-A, Orange-B and Red (cause significant environmental impacts). The screening criteria is based on the project or industry type and do not consider the scale and location. The category determines the level of environmental assessment.	No major gaps
2	Conduct an environmental assessment	EIA and IEE - Identify potential impacts on physical, biological and socioeconomic aspects in the context of project's area of influence (i.e., primary project site and associated facilities) ESMS for FIs	Industry/project category Green- no environmental assessment required Orange A - no IEE or EIA required but must provide process flow, lay-out showing effluent treatment plant, etc. Orange B - IEE required; Red - both IEE and EIA are required.	No major gaps

Sl. No.	ADB SPS, 2009		GOB Principles	Gaps (if any)
	Principles	Delivery Process		
3	Examine alternatives	Analyze alternatives to the project's location, design, and technology Document rationale for selecting the particular project location, design, and technology Consider "no project" alternative	Regulations (i.e., ECA 1995 and ECR 1997) do not require specifically the identification and analysis of alternatives	Not required by law but the ToR for EIA to be approved by the DOE now includes a discussion on analysis of alternatives.
4	Prepare an environmental management plan (EMP)	EMP to include monitoring, budget and implementation arrangements.	EMP and procedures for monitoring included in the IEE and EIA (i.e., Orange-A, Orange-B, and Red category projects)	No major gaps
5	Carry out meaningful Consultation	Starts early and continue during implementation; Undertaken in an atmosphere of free intimidation Gender inclusive and responsive tailored to the needs of vulnerable groups Allows for the incorporation of all relevant views of stakeholders Establish a grievance redress mechanism	Public consultation and participation is not mandatory based on ECA 1995 and ECR 1997 Grievance redress mechanism is not mentioned in ECA 1995 and ECR 1997; EIA format required by DOE includes stakeholders' consultation.	Approval of the ToR of EIA by DOE now includes consultation with stakeholders, though not mandatory
6	Timely disclosure of draft environmental assessment (including the EMP)	Draft EIA report posted on ADB website at least 120 days prior to Board consideration; Draft EA/EARF prior to appraisal Final or updated EIA/IEE upon receipt Environmental monitoring report submitted by borrowers upon receipt.	No requirement for public disclosure of environmental reports but DOE posts the minutes of the meeting on the application for environmental clearance certificate to its website, http://www.doebd.org/minutes.php	Still no requirement for public disclosure of environmental assessment
7	Implement EMP and monitor effectiveness	Prepare monitoring reports on the progress of EMP Retain qualified and experienced external experts or NGOs to verify monitoring information for Category A projects Prepare and implement corrective action plan if noncompliance is identified	ECC is subject to annual renewal based on compliance of the conditions set by DOE	No major gaps

Sl. No.	ADB SPS, 2009		GOB Principles	Gaps (if any)
	Principles	Delivery Process		
		Requires submission of quarterly, semi-annual, and annual reports to ADB for review		
8	Avoid areas of critical habitats (use of precautionary approach to the use, development and management of renewable natural resources)	Provides guidance on critical habitats.	ECA 1995 and ECR 1997 identifies ecologically-critical areas and the rules to protect them.	No major gaps
9	Use pollution prevention and control technologies and practices consistent with international good practices	Refers to World Bank's Environmental Health and Safety (EHS) General Guidelines 2007 (or any update) If national regulations differ, more stringent will be followed. If less stringent levels are appropriate in view of specific project circumstances, provide full and detailed justification	Effluent standards, ambient and emission standards included in ECA 1995 and ECR 1997. Ambient noise levels included in Noise Pollution Control Rules 2006.	No major gaps
10	Provide workers with safe and healthy working conditions	Refers to WB EHS General Guidelines 2007 (or any update).	Occupational health and safety standards included in the Factories Act 1965, the Bangladesh Labour Law 2006, and the Bangladesh Labor Act 2013.	No major gaps
11	Conserve physical cultural resources (PCR) and avoid destroying or damaging them	Use of field-based surveys and experts in the assessment. Consult affected communities on PCR findings Use chance find procedures for Guidance.	Preservation and protection of cultural resources are within the Antiquities Act 1968.	No major gaps

G. Permits and Clearance

78. Per ECA, 1995 (amended 2010) and ECR, 1997, it is mandatory for each and every type of industry and project to obtain ECC from the DOE. For the issuance of ECC, any proponent should follow the steps described above in part B of this section.

79. The application and requirement for issuance of ECC are described in the ECR, 1997 and

summarized in Part B above. This involves the completion and submission of an application using a form available from the DOE website,[22] which is revised from time to time. The accomplished application form is submitted to DOE together with requirements as enumerated in Part B above. The proponent is also required to pay equivalent application fee prescribed in Schedule 13 of ECR, 1997.

80. The ECC is issued within 30 days from receipt of the application by DOE. Such ECC is required to be renewed every year from the date of its effectivity. For the project, KWASA, through PMU, is responsible for application for ECC. This ECC will cover all subprojects identified under the project. Application for said ECC is ongoing.[23]

H. Applicable Environmental Standards

81. ECR, 1997 also provides the environmental standards applicable to the project. Schedule 2 of the ECR presents the national standards as presented in Appendix 3. Following requirements of ADB SPS, the project shall apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in EHS Guidelines. When the government regulations differ from these levels and measures, the project shall achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, KWASA through PMU will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS. The tables below show the comparison of the national standards and internationally recognized standards, including the applicable standards to be followed under the project per ADB SPS requirements.

Table 6: Applicable Ambient Air Quality Standards for Bangladesh Projects

Parameter	Bangladesh Ambient Air Quality Standard ($\mu g/m^3$)[a]	WHO Air Quality Guidelines ($\mu g/m^3$)		Applicable to ADB-funded Projects Per ADB Safeguard Policy Statement[d] ($\mu g/m^3$)
		Global Update[b] 2005	Second Edition[c] 2000	
TSP	200 (8-h)	-	-	200 (8-h)
PM_{10}	50 (1-year) 150 (24-h)	50 (24-h) 500 (10-min)	-	50 (24-h)
$PM_{2.5}$	15 (1-year) 65 (24-h)	10 (1-year) 25 (24-h)	-	25 (24-h)
SO_2	80 (1-year) 365 (24-h)	20 (24-h) 500 (10-min)	-	20 (24-h)
NO_2	100 (1-year)	40 (1-year) 200 (1-h)	-	40 (1-year) 200 (1-h)

[22] Government of Bangladesh. Department of Environment.
[23] Per information from KWASA, initial coordination and liaising works with DOE is ongoing.

Parameter	Bangladesh Ambient Air Quality Standard (µg/m³)[a]	WHO Air Quality Guidelines (µg/m³)		Applicable to ADB-funded Projects Per ADB Safeguard Policy Statement[d] (µg/m³)
		Global Update[b] 2005	Second Edition[c] 2000	
CO	10,000 (8-h) 40,000 (1-h)	-	10,000 (8-h) 100,000 (15-min)	10,000 (8-h)
Lead	0.5 (1-year)			0.5 (1-year)
Ozone (O_3)	235 (1-h) 157 (8-h)	100 (8-h)		100 (8-h)

ADB = Asian Development Bank, CO = carbon oxide, h = hour, µg/m³ = microgram per cubic meter, min = minute, NO_2 = nitrogen dioxide, $PM_{2.5}$ = particulate matter 2.5, PM_{10} = particulate matter 10, SO_2 = sulfur dioxide, TSP = total suspended particle, WHO = World Health Organization.

[a] Based on SRO 220-Law 2005 (Amendment of Schedule 2 of ECR, 1997). Air Quality Management Project of Bangladesh http://www.doe-bd.org/aqmp/standard.html

[b] IFC World Bank Group. 2007. ***Environmental, Health and Safety General Guidelines***. Washington, D.C.

[c] WHO Regional Office for Europe. 2000. ***Air Quality Guidelines for Europe, Second Edition***. Copenhagen.

[d] If less stringent levels or measures are appropriate in view of specific project circumstances, executing agency will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

Table 7: Applicable Noise Levels for Bangladesh Projects

Receptor/ Source	National Noise Standard Guidelines, 1997[a] (dB)		WHO Guidelines Value For Noise Levels Measured Out of Doors[b] (One Hour LA_q in dBA)		Applicable to ADB-funded Projects Per ADB Safeguard Policy Statement[c] (dBA)	
	Day (06:00-21:00)	Night (21:00-6:00)	07:00 – 22:00	22:00 – 07:00	Day time	Night time
Industrial area	75	70	70	70	70	70
Commercial area	70	60	70	70	70	60
Mixed Area	60	50	55	45	55	45
Residential Area	50	40	55	45	50	40
Silent Zone[d]	45	35	55	45	45	35

[a] Schedule 4 of ECR, 1997.

[b] WHO. 1999. Guidelines for Community Noise**;** World Bank Group. 2007. Environmental, Health and Safety General Guidelines. Washington, D.C.

[c] If less stringent levels or measures are appropriate in view of specific project circumstances, executing agency will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS.

[d] Area up to a radius of 100 meters around hospitals or educational institutions or special institutions/establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited.

Table 8: Applicable Effluent Discharge Standards (Schedule 10 Standards for Waste From Industrial Units or Projects Waste [See Rule 13]) for Bangladesh Projects

Sl. No.	Parameters	Unit	Discharge To		
			Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
1	Ammoniacal nitrogen (as elementary N)	mg/L	50	75	75
2	Ammonia (as free ammonia)	mg/L	5	5	15
3	Arsenic (as As)	mg/L	0.2	0.05	0.2
4	BOD_5 at 20°C	mg/L	50	250	100
5	Boron	mg/L	2	2	2
6	Cadmium (as Cd)	mg/L	0.5	0.05	0.05
7	Chloride	mg/L	600	600	600
8	Chromium (as total Cr)	mg/L	0.5	1.0	1.0
9	COD	mg/L	200	400	400
10	Chromium (as hexavalent Cr)	mg/L	0.1	1.0	1.0
11	Copper (as Cu)	mg/L	0.5	3.0	3.0
12	Dissolved oxygen (DO)	mg/L	4.5-8	4.5-8	4.5-8
13	Electro-conductivity (EC)	micromho/cm	1200	1200	1200
14	Total dissolved solids	mg/L	2100	2100	2100
15	Fluoride (as F)	mg/L	2	15	10
16	Sulfide (as S)	mg/L	1	2	2
17	Iron (as Fe)	mg/L	2	2	2
18	Total kjeldahl nitrogen (as N)	mg/L	100	100	100
19	Lead (as Pb)	mg/L	0.1	1	0.1
20	Manganese (as Mn)	mg/L	5	5	5
21	Mercury (as Hg)	mg/L	0.01	0.01	0.01
22	Nickel (as Ni)	mg/L	1.0	2.0	1.0
23	Nitrate (as elementary N)	mg/L	10.0	Not yet set	10
24	Oil and grease	mg/L	10	20	10
25	Phenolic compounds (as C_6H_5OH)	mg/L	1.0	5	1.0
26	Dissolved phosphorus (as P)	mg/L	8	8	15
27	Radioactive substance	(to be specified by Bangladesh Atomic Energy Commission)			
28	pH	----	6-9	6-9	6-9
29	Selenium (as Se)	mg/L	0.05	0.05	0.05
30	Zinc (as Zn)	mg/L	5	10	10
31	Temperature	°C (summer) °C (winter)	40 45	40 45	40 45
32	Suspended solids (SS)	mg/L	150	500	200
33	Cyanide (as Cn)	mg/L	0.1	2.0	0.2

Notes:

(1) These standards shall be applicable to all industries or projects other than those specified under the heading “Standards for sector wise industrial effluent or emission.”

(2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production, and in other cases, from the moment a project starts operation.

(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.

(4) Inland Surface Water means drains/ponds/tanks/water bodies/ ditches, canals, rivers, springs and estuaries.

(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.

(6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.

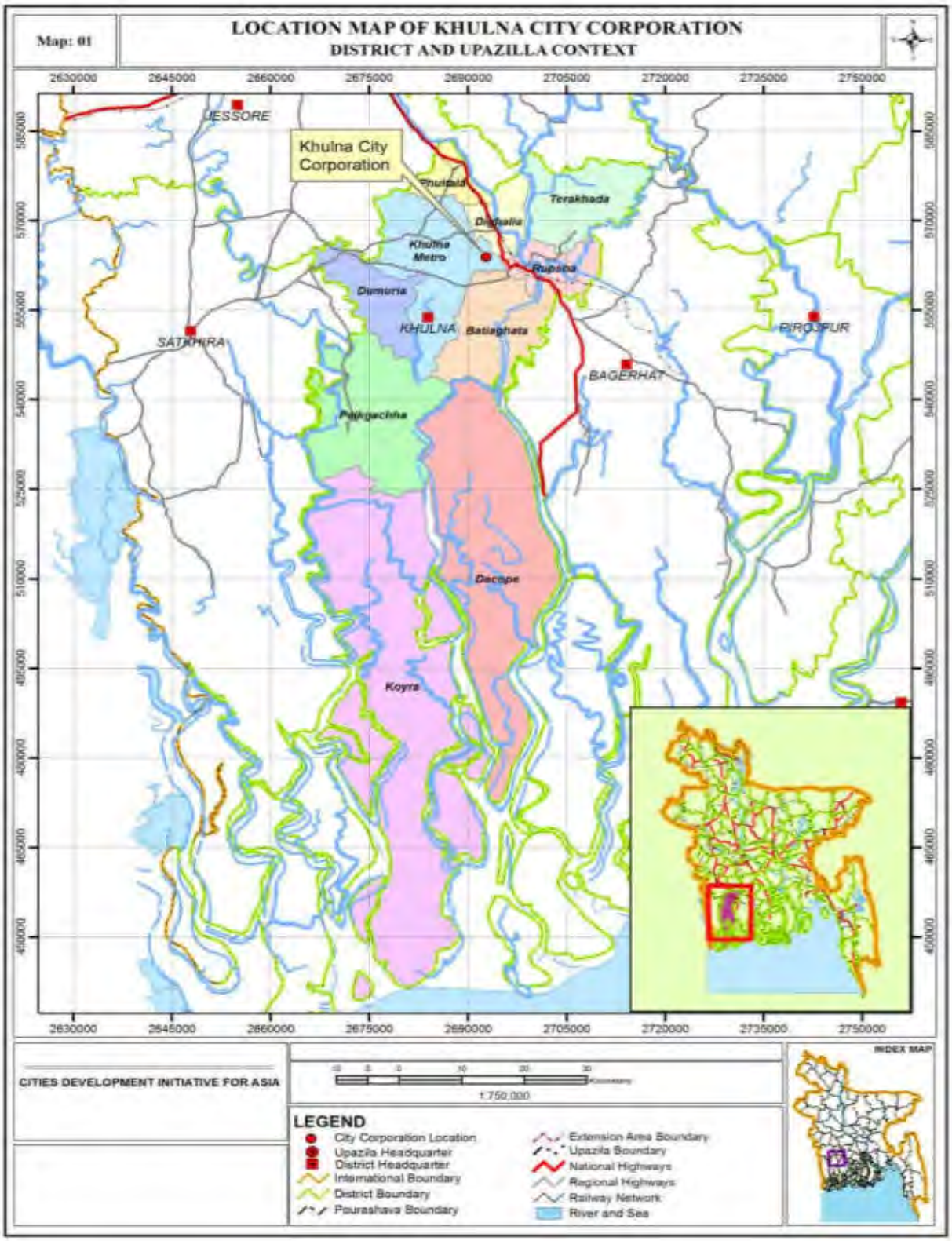
(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

III. DESCRIPTION OF THE PROJECT

A. Project Location and Area

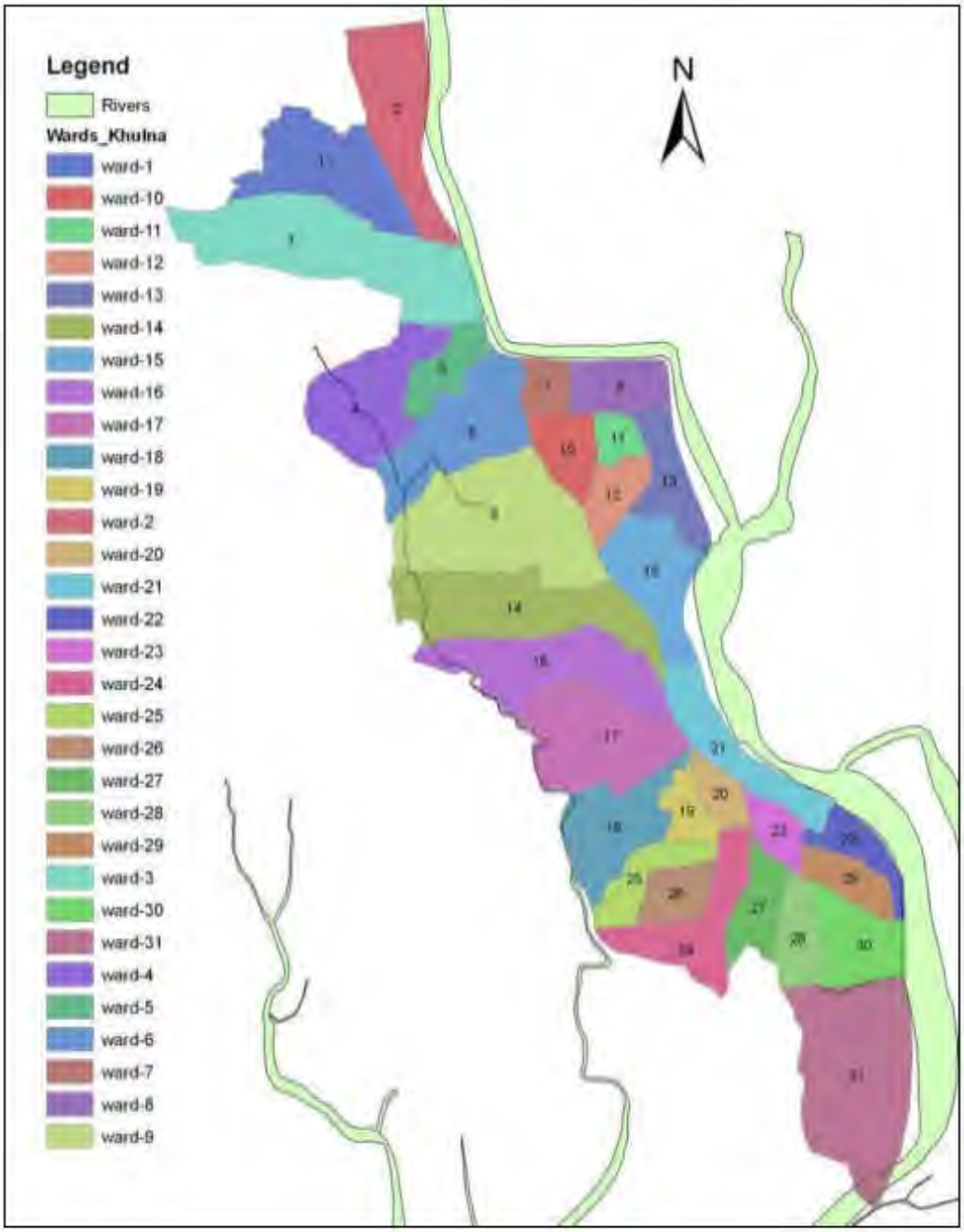
82. The location for the components of the project is within the jurisdictional area of Khulna city (the third largest city in Bangladesh), which is nearly 333 km by road south-southwest from Dhaka, at 22°49′0″N 89°33′0″E, on the banks of the Rupsha and Bhairab river. The city is connected by roads to Jessore in north, Gopalganj in East, Bagerhat in south and Satkhira in west. The location of Khulna city is shown in Figure 2.

Figure 2: Location of Khulna City



83. Khulna is the second port entry in Bangladesh covering a total area of 59.57 km² and composition of 31 wards as shown in Figure 3.

Figure 3: Wards of Khulna City



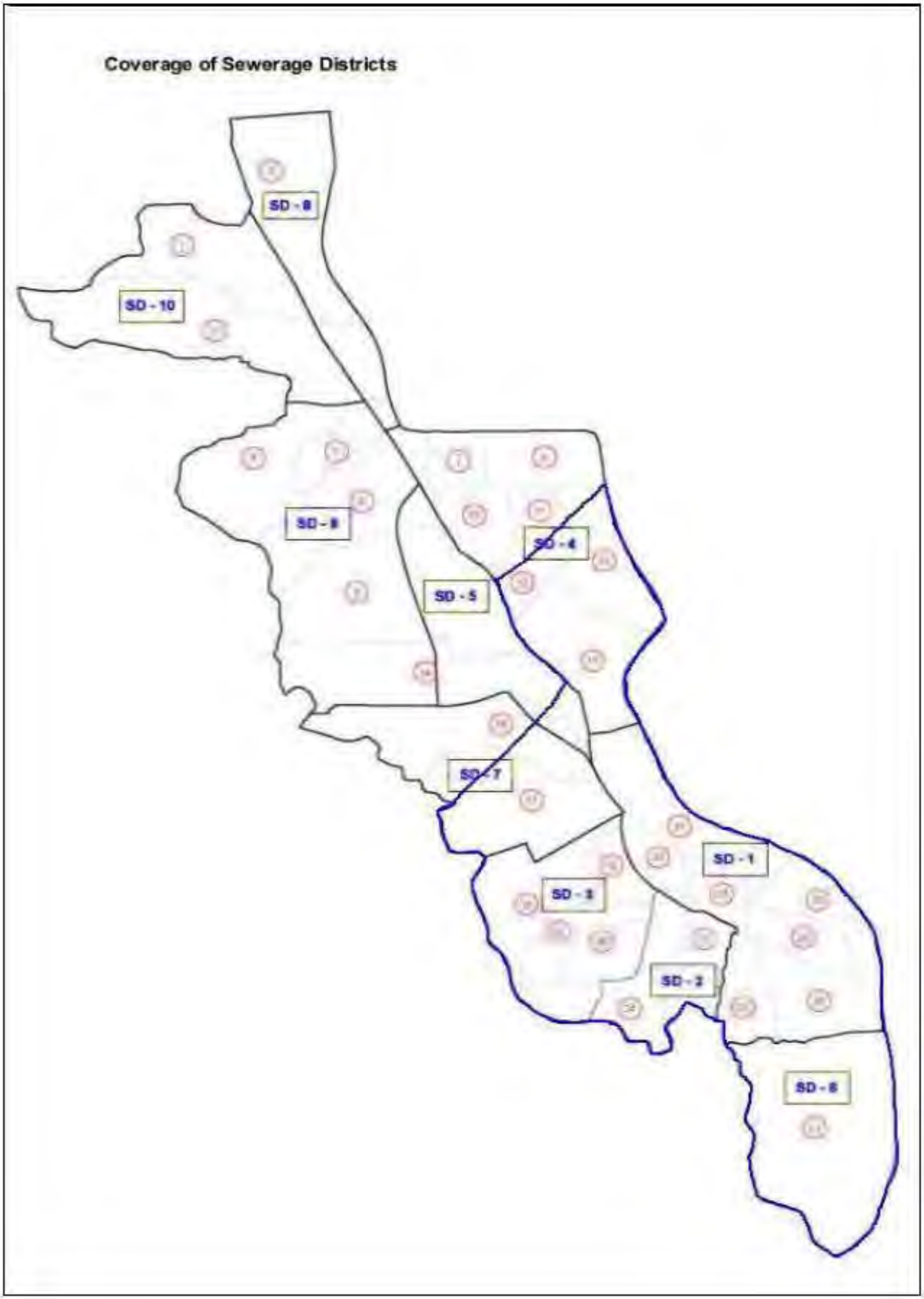
84. The city was once a very important industrial hub in the country having direct access to the foreign shipment through Mongla Sea port and the remnants of those days are still present in some areas. However, the city is gaining its importance incrementally in the last couple of years as destination for new industries and led to planned improvement of physical infrastructure and communication services. With the growing trend of development, people from different places have been relocated in the city, adding up on the existing population demography of the area. This increases the demand for necessary urban facilities and services, including a well-developed sewerage and sanitation facilities equipped with an efficient management system. In view of this

necessity and urgency, the KSSDP was proposed. All project components will fall primarily within the urban landscapes, with the balance located in peri-urban or semi-rural environments.

85. Through a previous study[24] conducted, the city has been divided into 10 sewage districts (SDs) based on the nature of the existing topography and land use pattern of the Khulna city Corporation (KCC). The proposed sewage collection network packages under the project will be designed to intercept and carry three types wastewater usually disposed form an ordinary household in the city- wash water from washrooms, spent water from kitchens, and wastewater from toilets. All these three types of wastewater will be referred to as “sewage” or “wastewater” in combination. Only storm water run-off will be isolated to be carried by existing road side drains. Figure 4 shows the sewer districts as described above.

[24] ADB TA-7820-BAN: Supporting the Khulna Water Supply Project

Figure 4: Sewerage District Coverage in Khulna city



B. Project Rationale

86. Khulna city is one of the seven Divisional Cities of Bangladesh and is located in the northern part of the district and primarily is an expansion of trade centers near to the rivers, Rupsha and Bhairab. The city lies along river Bhairab over a length of about 15 km and current KCC covers an area of 45.65 km^2. Large patches of low-lying swamps and marshes are located in the northwest and western portion of the city. All rivers flowing through Khulna are tidal rivers and they experience tidal effect twice daily from the Bay of Bengal. Around 1.5 million people living in and around Khulna city mostly depend on individual options for sanitation in absence of any conventional and organized sewerage system. Majority of households are using pit latrines and, in some cases, septic tanks are connected to such latrines. Almost every road in KCC area, regardless of its width, is provided with road-side rectangular storm water (surface) drains, either lined or unlined. Septic tanks are connected with surface drains disposing either untreated or inadequately treated wastewater (septage) into these road -side drains.

87. KCC, in its very limited capacity, is now disposing sludge from septic tanks to an open field using sludge collection vehicles. Wastewater from kitchen generally finds its way to surface drains which gravitates to low lying areas and ultimately joins the nearby rivers, canals, Nalla, low land, and at times flows get stagnated over some roads. In absence of any organized sewerage and sanitation facility, inadequately managed sanitation system causes significant threat to public health and environment. The situation becomes worse during rainy season when storm water run-off overflows from surface drains causing contaminated water to spread over access roads, land and yards, and other public places.

88. Population of Khulna is expected to be nearing 2 million by the year 2035 which would result in further increase in wastewater load causing a much greater threat to public health if existing sanitary conditions are not improved immediately. The Khulna Water Supply and Sewerage Authority (KWASA), being the nodal agency for managing wastewater generated inside current administrative city corporation boundary of Khulna is mandated to implement and maintain existing and future wastewater management scheme. Empowered by such a mandate and in view of ongoing water supply infrastructure development in Khulna, KWASA is now required to establish a sustainable sewerage and sanitation system for the city to improve its public health and hygiene and upgrade prevailing environment conditions. KWASA prepared its masterplan (footnote 1) and is now set to implement the suggestions provided therein in phased manner.

C. Project Alternatives

89. Khulna city does not have either organized or centralized sanitation facility. Therefore, a phased approach in developing sanitation facility infrastructure will be required. Realizing the need for this development, the entire city is divided into a number of sewerage districts as per relevant engineering and other considerations, including the natural topography and gradient of project area. After having conducted a reconnaissance of city area, and assessing feasibility of construction of sewers under existing roads of various widths, it was observed that the generic urban setting of Khulna can be classified into the following categories: (i) Congested city center areas bustling with commercial activities, referred to as “central business district”. This is probably one of the oldest parts of Khulna, which is already quite developed, with scattered industrial, commercial, institutional establishments, etc., (ii) Relatively organized areas of the city which are mostly residential, with clearly demarcated plots, utility corridors, etc., as delineated and developed by KDA from time to time, (iii) Unorganized residential areas with unplanned growth, poor road network having inconsistent widths and drainage planning, (iv) Areas inhabited by economically poorer sector of society, with very narrow roads and streets, sparse houses, limited

accessibility, close to natural drainage courses, etc., and (iv) Peripheral areas of the city with open areas, water bodies, and swamps, which are yet to be developed. Moreover, the city is spread along the course of Bhairab-Rupsha river system with very flat terrain and mild slopes both longitudinally and transversely, in a very congested urban setting. This poses further constraints in framing a gravity sewage collection system.

90. Congested and already developed (or in advanced stage of development) residential areas, adjacent to city, have been given preference over distant areas for providing sewerage system. Congested areas are prioritized in order to have a larger base of beneficiaries to economically and financially support the implementation of the scheme.

91. Primary sewers are major sewers and would be constructed at first (along with corresponding pumping stations and other downstream facilities) which will be then gradually supplemented by secondary or medium size sewers. Areas in the city having either too narrow streets or are too low lying to be connected to a centralized sewerage system would be continued to be served with different arrangements, however, the centralized system would be extended to cover more city areas progressively in tune with their development in next phases. Operating points like pumping stations and treatment facilities would be kept as minimum as possible to facilitate future maintenance of civil works and equipment deployed.

92. In view of Khulna's diverse land use pattern, mature urban setting, geographical orientation, varying topography, number of physical constraints, prevailing soil conditions and terrain, etc., it would not be technically feasible to attempt to collect all wastewater generated from the city to a single location. Attempts are therefore made to reduce proposed locations of treatment facilities for better and efficient management of treatment system and the study (footnote 1) has concluded that it would be optimum to provide three separate treatment facilities, all outside or at the fringe of city corporation area but well connected to the city by existing road network. Depending on their locations, these three treatment facilities have been referred to as Labanchora Treatment Plant as STP-1 (located on the southernmost fringe of Khulna along the Labanchora Road), Tikraband Treatment Plant as STP-2 beside the Khulna-Satkhira road (near existing solid waste dump site being used by KCC), and Aranghata Treatment Plant as STP 3 (near crossing of Khulna City Bypass and Old Satkhira Road). However, first two STPs will be implemented under the proposed project, on priority basis.

93. In the way of choosing an appropriate option for treatment process, a techno-economic assessment was conducted in light of receiving sewage quality and quantity and keeping balance between highly mechanized, supervision-intensive system and merely hydraulically connected process with little or no maintenance seems to be more practical and operation friendly. A modular approach with equal sizes of plant, structures, chambers, and equipment is preferable for better operation and maintenance, repairs, renewals, exchangeability, and system compatibility. In relation to these selection criteria, extended aeration process has been adjudged as a suitable treatment option and this will comprise, in general, a terminal sewage pumping station for conveyance of incoming sewage to the inlet chamber of the plant. Other downstream units will comprise grit chamber, aeration basin, secondary clarifier, supported by other ancillary facilities like sludge or residual management, chemical dosing, laboratory for testing, administrative, and residential quarters for O&M staff.

D. Project Development Plan and Project Components

94. Being one of the large metropolitan and port cities of Bangladesh, which attracts substantial investment in development, Khulna is supposed to have a very good, well structured,

economically viable, planned and inclusive sanitation system. Unfortunately, this expectation is completely nonexistent in the city. Regardless of this downside, the city is still growing very rapidly with other urban facilities and population, so the demand for viable sewerage system with tenable sanitation facilities intensifies through time. In the feasibility study conducted (footnote 1) by KWASA, recommendation for a centralized wastewater management system for Khulna in an organized and phased manner with a 20-year project horizon (from year 2016 to 2035) is highlighted. Projected population in KCC area used in the study and master plan was 1.314 million by the year 2025 and 1.588 million by the year 2035, with per capita sewage load of 87 lpcd. The proposed components of the project would meet the target, delineated into the first phase of the master plan. This considers the availability and readiness of resources and benefits covering 67% of population. The remaining part will be covered under next phase.

95. Under the first phase of the study and master plan development initiative (footnote 1), approximately 250 km of sewer network will be developed, 8 sewage lifting and pumping stations, and two sewage treatment plants will be constructed under the proposed project. Necessary changes or modifications have been planned and incorporated into the project design and estimation.

96. Project components under the first phase of development are divided into three separate subprojects or packages for the preparation of bidding documents. This would help select the best options among choices, gain momentum in taking the most pragmatic decisions as to the inclusion or preclusion of areas in this first phase of development plan, and keep overall control on the total workflow.

(i) **Subproject-1:** Construction of 118.53 km Sewage Collection Network, Gravity Mains and Sewage Pumping Stations (3 locations) at Khulna city (SD1 and SD6).

(ii) **Subproject-2:** Construction of 137.94 km Sewage Collection Network, Gravity Mains and Sewerage Pumping Stations (5 locations) at Khulna city (SD2, SD3, part of SD4 and part of SD7).

(iii) **Subproject-3:** Construction of Sewage Treatment Plants (STP-1 and STP-2). The capacity of the sewage treatment plant STP-1 is 28 MLD will be constructed on Labanchora in the southern fringe of Khulna and STP-2 will have the capacity of 60 MLD and situated beside the Khulna - Satkhira Road in Tikraband. Wet land having capacity 160 m3/day will be constructed to facilitate the co-treatment of fecal sludge (non-sewer) through STP-1.

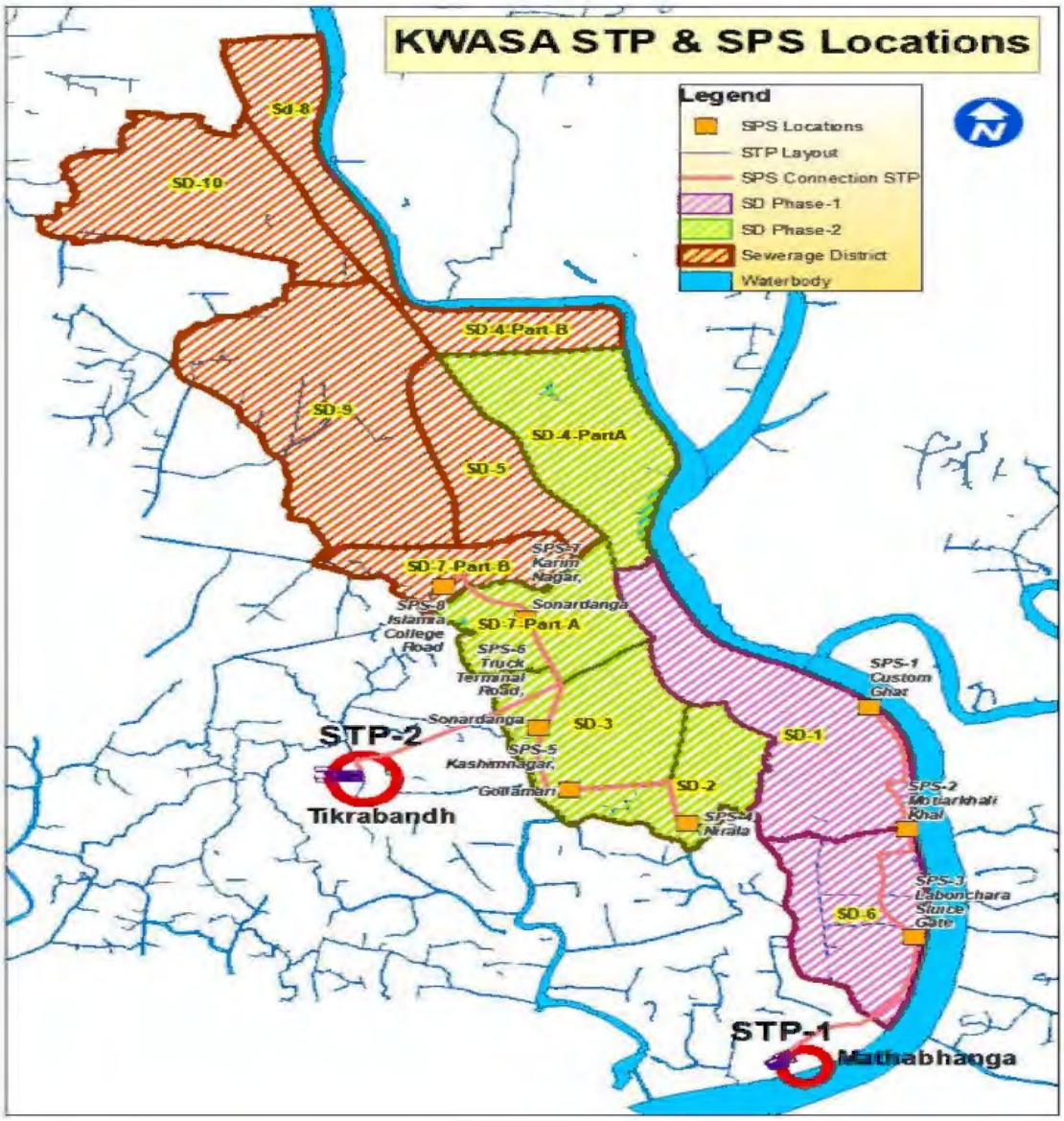
Table 9: Coordinates of Project Components

Sl No	Component Name and Location	Longitude	Latitude
1	STP-1, Labanchora	89.566675	22.762951
2	STP-2, Tikrabandh	89.517679	22.803748
3	sewage pumping station-1 Custom Ghat	89.576911	22.812129
4	sewage pumping station-2 Motiarkhali Khal	89.580758	22.794798
5	sewage pumping station-3 Labanchora Sluice Gate	89.581163	22.779604
6	sewage pumping station-4 Nirala	89.556655	22.796017
7	sewage pumping station-5 Kashimnagar, Gollamari	89.543759	22.801074
8	sewage pumping station-6 Truck Terminal Road, Sonadanga	89.540498	22.809813
9	sewage pumping station-7 Karim Nagar, Sonadanga	89.539418	22.825175
10	sewage pumping station-8 Islamia College Road	89.530483	22.829955

1. Sewerage District and Sewer Network

97. The basis of selection of project components is primarily on the ten separate Sewerage Zones or Districts (SDs), which were delineated in the feasibility study/master plan (footnote 1), considering the topography, gradient and other relevant factors. Every SD would have its exclusive sewage collection network, from collection from individual households or reception points up to conveyance by gravity to a terminal pumping or lifting station. Any SD served with two pumping stations would be divided into two sub-zones, one on the upstream side where one pumping station would work as a lifting station, pumping wastewater to a strategically located manhole in the next sub-zone, an then flows to the downstream pumping station by gravity. During the implementation period of the first phase of the planned development, sewers will be laid across the areas of southern districts, comprising sewerage districts 1 and 6. For ensuring an effective and smooth transmission of sewage, three pumping stations (1 sewage pumping station at Customghat, 1 sewage pumping station at Matiakhali, and 1 sewage pumping station in Labonchora) will be constructed to covey the waste water to a proposed Sewage Treatment Plant (STP) to be built in Labonchora. Another sewerage network system will cover the northern districts, comprising sewerage districts 2, 3, 4 (partly) and 7 (partly). The wastewater or sewage from these SDs will be conveyed to another proposed Sewage Treatment Plant (STP) to be constructed near the Khulna-Satkhira Road. These four northern SDs will have five sewage pumping stations. Connection of sewage pumping stations and STPs covering the 6 SDs are shown in the following Figure 5.

Figure 5: Sewage Pumping Stations Connected to STP



1.1. Description of Sewerage Districts

98. **Sewerage District 1.** This remains to be the most congested and properly developed area of Khulna and is commonly referred to as the Central Business District or CBD area. This is referred to as SD-1 or Sewerage District 1. SD-1 will mostly cover wards 20, 21, 22, 23, 28, 29, 30, and a small part of ward 24. Current land use is a mixture of commercial places, government establishments (both offices and residents), residential houses and complexes, some poor settlements, water bodies such as canals, gardens, parks, playgrounds, other utilities, markets, etc. Apart from this, most of the important government facilities (courts, jails, residential quarters, etc.) are located in this area. This area has been given top priority for sewer network because of the urban congestion, and its commercial and administrative importance. There is a few low lying pockets (mostly draining towards the drainage course on the south-side) in this zone which would be difficult to connect to centralized sewerage system being conceived. Old Jessore Road serves as ridge line and divides this area into two parts with its northern part (adjacent to river Rupsha)

naturally sloping to the river and southern part (inside city area) towards the south. Planning of sewage collection network has been framed per this topography to reduce sewer inverts. Some culverts need to be crossed in sewer pipe alignment.

99. **Sewerage District 2.** The second sewerage district (SD-2) comprises ward 27 and partly ward 24 and is the smallest SD. It is bound on the northern side by Khan Jahan Ali Road (a major arterial road in Khulna CBD), river Mayuri on the southern side, and Khulna -Satkhira Road on north-western side. Natural gradient of this area is towards Mayuri river on its southern end and accordingly terminal pumping station has been located on the south-eastern fringe by the side of Nirala.

100. **Sewerage District 3.** The third sewerage district (SD-3) covers the area of Sonadanga Main Road and Sonadanga Bypass in the north, KDA Avenue and Khulna-Satkhira Road in the east and south, respectively, and Mayur river in the west. The area consists of wards 18, 19, 25, 26 and part of 24, and includes Sonadanga Residential Area (earlier developed by KDA), Arambag area, and Khorshed Nagar. Natural slope of this area is towards south and west directions.

101. **Sewerage District 4.** The fourth sewerage district (SD-4) consists of Khalishpur area, located on eastern part of Old Jessore Road. The upstream sub-zone (SD-4A) will be discharging it wastewater through a pumping station (acting as a lifting station) to a strategic point in the second sub –zone (SD-4B) on the southern side.

102. **Sewerage District 6.** The sixth sewerage district (SD-6) consists of ward 31. Some low lying areas are also included in this zone. This district has a mild slope from north to south towards an existing drainage course along Al-Amin Sarak and a tributary of Mayur river on the western side. This drainage course has divided the district into two parts. A major sewer line has been proposed along the Shipyard Road from north to south which would be receiving and conveying flow pumped from district 1. This sewer would also capture incoming flows from western part of the district but would be executed in the immediate phase to complement sewage conveyance from SD 1 to treatment facility near Labanchora. Per design, depth of excavation over some stretches suggested that trenchless construction may be required to avoid disruption of urban traffic along these busy roads.

103. **Sewerage District 7.** The seventh sewerage district (SD-7) consists of Khulna-Dhaka-Jessore Highway (on the east), Jalil Sarani (on the north), Majid Sarani and Sondanga Bypass (on the south), and Mayur river (on west) SD-7. This is primarily a residential area with natural slopes in western and southern directions. This district will be provided with two sewage pumping stations, each having a demarcated sub-zone.

104. SD-wise sewer lines are in the following table.

Table 10: Sewerage District wise Population and Sewer Line

Sewerage District	Ward Coverage	Area in km	Population (2035)	Pipeline in m
SD-1	20	0.488	46,055	
	21	1.37	50,819	
	22	0.681	44,467	
	23	0.508	38,114	
	24	0.061	3,468	

Sewerage District	Ward Coverage	Area in km	Population (2035)	Pipeline in m
	28	0.736	46,055	
	29	0.662	42,879	
	30	1.217	73,052	
Sub-Total		5.723	344,909	68,000
SD-2	24	1.093	62,164	
	27	0.835	65,112	
Sub-Total		1.928	127,276	23,000
SD-3	18	1.638	34,938	
	19	0.499	53,995	
	24	0.41	23,301	
	25	0.746	55,583	
	26	0.664	36,526	
Sub-Total		3.957	204,343	40,000
SD-4 (Partly)	10 (30%)	0.250	11,625	
	11 (40%)	0.153	15,881	
	12 (45%)	0.311	48,596	
	13 (60%)	0.710	24,774	
	15	1.438	52,407	
Sub-Total		2.862	153,282	37,000
SD-6	31	4.022	67,335	
Sub-Total		4.022	67,335	40,000
SD-7 (Partly)	16 (60%)	1.290	41,287	
	17	2.371	62,253	
Sub-Total		3.661	103,540	42,000
Total		22.153	1,000,685	250,000

1.2. Design Parameter for Sewerage Network

105. **Pipe Material.** Considering the soil condition, durability, expected overburden, dynamic, and static loading on pipe, cost, availability, and several other issues, HDPE, DI and RCC pipe have been selected to be laid.

(i) **Gravity Network**
   (a) HDPE pipe 250 - 630 mm dia: 245.95km
   (b) RCC pipe 600 - 1100 mm dia: 10.52 km

(ii) **Rising Main**
   (a) HDPE 560 – 800 mm dia: 9.67km
   (b) DI Pipe 150 – 700 mm dia: 3.53km

106. **Flow Velocity.** The flow velocity in the sewers shall be such that the suspended materials in sewage do not get silted up and maximum velocity should be limited to avoid abrasion. In line with the CPHEEO manual, maximum velocity (non-scouring) is considered as 3.0 m/sec and minimum (cleansing velocity) is of 0.6 m/sec.

107. **Excavation Method.** Considering the minimization of public nuisance and damage of existing structure, trenchless method for pipeline laying including micro-tunneling, has been given preference. However, in some cases an open excavation method has been selected to employ for pipe laying particular for the lower depth. These methods are briefly described below.

108. Open Excavation: Open cut trench excavation is the traditional and most popular method for lateral sewer construction, repair, or replacement. Open cut trench excavation consists of excavating a trench for the manual installation of each piece of pipe. The open cut trench method involves excavating down to and exposing the existing pipeline so that it can be repaired or replaced and then backfilled. Open excavation is usually carried out when there is enough open space to carry out the construction.

109. Horizontal Directional Drilling: The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at variable angle, while delivering a pressurized fluid mixture to guidable drill (bore) head. The machine shall have capacity to adequately complete the drilling and piping installation. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system should be self-contained and with sufficient pressure and volume to power drilling operations. The hydraulic system shall be free of leak.

110. Micro-Tunneling: Micro-tunneling is a digging process that uses a remotely controlled micro-tunnel boring machine combined with the pipe jack-and-bore method to install pipes underground in a single pass directly. This process avoids the need to have a long stretch of an open trench for pipe-laying. Excavated material, at the tunnel face, is mixed with bentonite and other lubrication fluids to create slurry. The pressure at the cutting face is balanced with earth removal, groundwater head, and propulsion of the tunnel support without manned entry. Excavated material which is captured in the slurry is pumped to the surface and separated. Micro tunneling will be carried out in heavily constructed areas where there is no open space is available.

Table 11: Details of Gravity Sewer Network in Subproject-1

Method of Laying	Pipe Material	Dia. of Pipe (mm)	Length (km)
Open cut	HDPE	250 - 500	49.21
HDD	HDPE	250-630	65.22
Micro- Tunneling	M50 grade RCC pipe	600-1100	4.1
		Total	**118.53**

Table 12: Details of Gravity Sewer Network in Subproject-2

Method of Laying	Pipe Material	Dia. of Pipe (mm)	Length (km)
Open cut	HDPE	250 - 500	62.49
HDD	HDPE	250-630	69.03
Micro- Tunneling	M50 grade RCC pipe	600-1100	6.42
		Total	**137.94**

111. **Rising Mains**. Khulna city is essentially very flat with limited ground slope. SD1 is the most congested and properly developed area. This area has been given top priority for sewer network because of its commercial and administrative importance and urban congestion, which urgently needs a centralized sewerage system. Some culverts need to be crossed in sewer pipe alignment. SD-6 has low lying and mild slope from north to south towards an existing drainage course. As per design, depth of excavation over some stretches suggested that trenchless construction may be required to avoid disruption of urban traffic along these busy roads. The

system has adopted the approach of gravity sewer. But the terrain in the city does not provide adequate slope to ensure wastewater flow by gravity alone. Moreover, in some cases, some terrains would require sewers to be laid in reverse slope direction. This resulted in required additional depth of inverts. The prevailing soil condition also puts restrictions on depth of excavation for laying sewers. In order to reduce depth of excavation, three pumping stations (2 in SD-6 and 1 in SD-1) have been proposed to elevate the head of wastewater flow.

Table 13: Details of Rising Main in Subproject-1

Pipe Material	Dia. of Pipe (mm)	Length (km)
HDPE	560-800	5.30
DI	150 -700	0.34
	Total	**5.64**

Table 14: Details of Rising Main in Subproject-2

Pipe Material	Dia. of Pipe (mm)	Length (km)
HDPE	200 - 1000	4.37
DI	150 -900	3.19
	Total	**7.56**

112. **Manholes.** The project will involve a total of 11,173 precast RCC manhole considering the quality control and to minimize the public suffering in roads as it takes less time during construction. The manholes have been proposed at each road junction / crossing. Along straight road lengths the manholes have been considered at a spacing of 30m.

113. **Inspection Pits.** Total of 9000 and 12200 nos. of inspection pits will be constructed in Subproject 1 and Subproject 2 accordingly, near the property line on the road edge and therefore will be accessible from the public area (road or otherwise). These inspection chambers will enable maintenance in case of blockages. One inspection chamber will mostly serve two or more adjacent properties based on its proximity to the households.

114. **House Service Connections.** Provision of 27,000 house service connections have been proposed to ensure adequate flows in the sewer network and optimum utilization of the STP capacity. The works related to service connection involves, construction of roadside inspection chambers including laying of sewer lines from the property lines up to the inspection chambers including cutting and reinstatement of roads. Roadside inspection chambers shall be constructed every 15m on either side of the Road.

2. Sewage Lifting/Pumping Station

2.1. Location of the Sewage Lifting/Pumping Stations

115. Wastewater from sewerage districts 1 and 6 will be conveyed to STP-1 proposed at the Labanchora. Collected sewage from other sewerage districts 2, 3, 4 (Part), 7 (Part) proposed to be conveyed to Tikraband area (beside Khulna - Shatkhira road). Both the STPs are located outside the Khulna city area and wastewater will be conveyed under gravity force, while the pumping stations will be utilized for the lifting purposes.

116. The picture of the 8 sewage pumping stations are shown in the figure below:

Figure 6: Location of Sewage Lifting/Pumping Station



sewage pumping station-1, Customghat



sewage pumping station-2 Motiarkhali khal



sewage pumping station-3, Lobanchora sluice gate



sewage pumping station-4, Nirala



sewage pumping station-5, kasimnagar, Sonadanga



sewage pumping station-6, Truck terminal road, Sonadanga



sewage pumping station-7, Karimnagar



sewage pumping station-8, Islamia college road

117. The eight Sewage Pumping Stations or Lifting Stations will have the same land surface area within the boundary of about 1000 m^2. Of these land areas, nearly 343 m^2 will have direct footprint for usage; the building area including the pump house and ancillary facilities would occupy nearly 255 m^2 and rest area will be paved for internal road. Around 14 m^2 green area will enjoy the lushes of beautification and enhancement works. Land required for the sewage pumping stations are given in table below:

Table 15: Land Required for Sewage Lifting/Pumping Stations

Sl No	Name of sewage pumping station	Location	Area in Decimal
1	sewage pumping station-1, under SD-1	Custom Ghat	24.71
2	sewage pumping station-2, under SD-1	Motiarkhali khal par	24.71
3	sewage pumping station-3, under SD-6	Labonchora Sluice ghate	24.71
4	sewage pumping station-4	Nirala	24.71
5	sewage pumping station-5	Kashimnagar, Gollamari	29.65
6	sewage pumping station-6	Truck Terminal Road, Sonadanga	24.71
7	sewage pumping station-7	Karim Nagar, Sonadanga	24.71
8	sewage pumping station-8	Islamia College Road	24.71

3. Design Consideration of Sewage Lifting/Pumping Station

118. Lean, average, and peak flows are taken into consideration for optimum selection of pumping system. The relationship of pump characteristics of different pumps with various sizes of compatible force mains and corresponding power consumption, power efficiency zone, has been analyzed to arrive at the most economical alternatives of pumping system and rising main under the perspective of designated pump operating points.

119. Construction of sewage pumping station includes the following components:

(i) sump cum pump house,

(ii) transformer room, control panel,
(iii) operator's room, security cabin,
(iv) boundary wall,
(v) gate including provision of by-pass arrangement in case of exigencies.
(vi) submersible sewage pump sets. The pumping arrangement shall be that some of these pump sets will be working, while the others will serve as standby for peak flow. Provision of sluice gates for isolation / control, mechanical and manual bar screens for operation of the sewage pumping station. Pump start and stop shall be based on the level of sewage inflow into the wet well.
(vii) SEB room, Control Panel, internal and external illumination.

120. Maximum velocity of the rising main will be 3 m/s, and minimum velocity will be 0.8 m/s. Hydraulic design parameter and capacities are indicated in the tables below.

121. **Control Room.** Provision of Control panel room (of approximately 39.09 Sq. m) shall be provided for housing of the Electric meters, Distribution control unit, Voltage Regulator, DG Set control unit etc. Provision of voltage regulator is contemplated so as to ensure steady voltage and reliable power supply.

122. **Generator Sets.** In the absence of dedicated feeder line diesel, operated generating sets are imperative alternative to ensure continuous running of pumping machineries. The generator sets shall be included at each pumping station as backup arrangement.

123. **Pumps and Pumping Machinery.** In sewage pumping stations, pumps will lift accumulated sewage from sumps to the desired high level at selected locations on the sewer network or the sewage treatment plant. Submersible non-clog sewage pump is recommended for intermediate and main sewage pumping stations.

Table 16: Hydraulic Design of Sewage Lifting/Pumping Station

Indicative Description	Unit	Sewage Pumping Station-1	Sewage Pumping Station-2	Sewage Pumping Station-3
Gr. Level at Pumping	m	2.90	2.26	3.00
Finished Floor Level	m	3.5	3.5	3.5
Invert Level of Sewer Pipe	m	-2.90	-3.70	-2.80
Design Peak flow	lps	405	637	721
Peak Factor		2.25	2.25	2.25
Hydraulic retention time	min	3.75	3.75	3.75
Depth of liquid	m	2.1	2.1	2.1
Depth of submergence	m	0.8	0.8	0.8

124. Based on the sewage flows for the design year of 2035, the pump capacities have been determined. Submersible sewage pumps have been proposed, considering the economy, both in terms of capital cost, and operation and maintenance costs. Summary details of pumping stations are presented below:

Table 17: Capacity of Sewerage Pumping Station in Subproject-1

Sewage Pumping Station Nos.	Capacity (m^3/ hour)
Sewage Pumping Station-1, Customghat	1,260
Sewage Pumping Station-2, Motiakhli	2,295
Sewage Pumping Station-3, Labanchora	2,595
Manhole-PS1	120
Manhole-PS2	120

Table 18: Capacity of Sewerage Pumping Station in Subproject-2

Sewage Pumping Station Nos.	Capacity (m^3/ hour)
Sewage Pumping Station-4, Nirala	1,140
Sewage Pumping Station-5, Gollamari Kashim Nagar	5,040
Sewage Pumping Station-6, Beside truck terminal, Sonaganga	2,310
Sewage Pumping Station-7, Karim Nagar, Sonadanga	1,650
Sewage Pumping Station-8, Beside Islamia College Road	810
Manhole-PS1	120
Manhole-PS2	240
Manhole-PS3	120

4. Preliminary Design of Sewage Treatment Plant (STP)

125. Two extended aeration type sewage treatment plants (STPs) will be constructed, one at Labanchora with a capacity of 28 MLD (STP-1) with discharging treated wastewater to Rupsha River, and other at Tikraband area with a capacity of 52 MLD (STP-2) discharging treated wastewater to Hoghldanga Khal.

126. A fecal sludge treatment plant (FSTP), with capacity of 160 m^3/day, will be set up in the STP-1 site, which will serve as dedicated treatment plant for septage from septic tanks that will be collected from households.

127. Sewage treatment facilities emit odors that can persist at some distance from the source and a buffer zone is the physical distance between (or setback from) the nearest liquid surface within a sewage treatment facility to the corner of the nearest occupied building within a development. This buffer zone helps to foster a living and work environment that is generally free of sewage odors and minimizes health concerns. The buffer zone requirement for sewerage infrastructure is generally influenced by a number of factors including the nature and size of the plant, the topography, microclimate and the sensitivity of neighboring land uses. The surrounding areas of the proposed STP-1 and STP-2 sites are nearly uninhabited. But expectedly, the surrounding areas of both of the sites may be inhabited in next couple years given the present development trend. Therefore, a minimum distance of 30 m from the fence of the treatment plant to the nearest habitable building property line should be kept for buffer zone. The buffer zone can be used for any purpose except permanent habitable buildings, for example, as a drainage reserve, road or highway reserve, transmission reserve, utility reserve or public park. In the case where buffer area is to be regularly used by the residents such as car park and playgrounds, proper precautions during design stage must be taken to minimize nuisance such as odor, noise and unpleasant sight to the surrounding environment.

128. Peak hour flows have been established based on the values determined during the feasibility stage, and the values have been calculated as 1,094 m^3/h and 2,475m^3/h for STP-1 and STP-2 respectively.

129. STP-1 will have the surface area of about 45,800 m^2, in which the screen chamber, grit chamber, aeration tank, distribution chamber, clarifiers, chlorination contact basin, administrative building and other ancillary facilities will be accommodated. On the other hand, STP-2 site will have a surface area of about 89,000 m^2 and the same process unit will also be occupying here, but with bigger capacity, thus occupying the bigger land areas. Reinforced cement concrete internal road within both STP sites having a width of minimum of 5.5m with side drain on both sides, will be constructed.

a. Design Parameters of the STPs

130. Preliminary design parameters for the STPs are shown in the following table.

Table 19: Preliminary Design Parameters

Parameters	**Unit**	**STP-1**	**STP-2**
Temperature	°C	26.6	26.6
Population	Persons	288,571	664,150
BOD_5	mg/l	300	300
WW	l/c/d	87	87
Flow	m^3/d	26,277	59,514
BOD_5 (based on 300 mg/l)	Kg/d	7,985	17,854
Aeration Basin			
Volume (estimated range)	m^3	16,000- 24,000	40,000- 56,000
Depth	m	4	4
$HRT_{AVGFLOW}$ (estimated range)	Hours	15-22	15-22
Number of Aeration Tanks	Nos.	4	6
Total Area (estimated range)	m^2	4000- 6000	10,000-14,000
L x W (estimated range)	m x m	66 x 16 - 97 x16	88 x 20 - 120x20
TSS Concentration in Tank	Kg/ m^3	2.5-3.0	2.5-3.0
Extracted Sludge Volume @0.7%	m^3/d	1,122	2,597
Sludge Retention Time Aerated Volume		3.61 – 4.03	3.74 -4.16
Sludge Retention Time on Total Volume (estimated range)	D	7.4 -6.4	6.23 -6.93
Retention Time $_{AVGFLOW}$	H	15-22	16-22
Secondary Clarifier			
Number of Cells	Nos.	4	6
Diameter	m	28	36
Clarifier Area	m^2	2,463	6,107
SWD (Side Water Depth)	m	3.65	3.65
Upflow Velocity			
Average	m/h	0.44	0.41
Dry weather peak flow	m/h	0.98	0.91
Total Secondary Sludge Production	Kg/d	7,448	17,312
SRT on Total Biological Volume	D	6.4-7.4	6.9-7.8

Parameters	Unit	STP-1	STP-2
AOR (Actual Oxygen Requirements)	Kg/d	867	2,122
Excess sludge to be extracted	Kg/d	7,064	16,413
Extracted Volume	m^3/d	1,122	2,597

131. Preliminary dimensions of the major components of the STPs are presented in the following table.

Table 20: Dimension of Major Components of STPs

No	Parameters	Units	STP-1		STP-2	
			Pump Number (Duty/ Standby)	Dimension of Structure	Pump Number (Duty/ Standby)	Dimension of Structure
1	Inlet pump station/influent pump station	m x m	6/1	17.0 x 5.3	4/1	10x5.3
2	Screening Chamber	m x m	1/1	32.4 x 14.9	2/0	32.4 x 11.47
3	Aerated grit chamber	m x m	1/1	18.0 x 10.1	1/1	20.0 x 10.1
4	Aeration tank	m x m	4	66.0 x 16	6	88 x 20
5	Secondary Clarifier (diameter)	m	4	28.0	6	36.0
6	Splitter box (hexagonal shape with arm length)	m	1	5.6/2 2.195	1	5.6/2 3.12
7	Sludge thickening and dewatering	m x m	1	42.24 x 13.6	1	50 x 13.6
8	Chlorine contact chamber	m x m	1	26.3 x18.35	1	40 x 28
9	Chlorine storage house	m x m	1	12.4 x 9.4	1	16.4 x 9.4
10	Sludge storage tank	m x m	1	62.0 x 8.0	1	62.0x 8.0
11	Admin building	m x m	1	18.2 x 7.2	1	18.2 x7.2
12	Generator and Substation building	m x m	1	25.8 x 5.5	1	35.0 x 5.5

132. The sewage enters the STP through the inlet pumping station. The inlet pumps are driven by variable frequency drive (VFD) and SCADA controls. The VFD will maintain a constant water flow. Ultrasonic level transmitter measures the water level and sends the information to SCADA

as the pumped influent wastewater flows through coarse screen and fine screen. SCADA measures the differential levels and control the screens to remove large solids. The water then gravitates through the Grit and Grease removal chambers to the Aeration tank. In grit and grease removal Chamber, grit and grease will be removed. The Ultrasonic level transmitter measures the water level and flow meters' measure flow and sends the information to SCADA.

133. In the aeration tanks, blower is operated by VFD and controlled by SCADA to maintain the dissolved oxygen levels. In addition, PH levels and temperature information are passed to SCADA from here. The water then gravitates to the secondary clarifiers. RAS as well as WAS pumps are operated by VFD and controlled by SCADA depending on level and flow.

134. The belt press feed pumps are controlled by each VFD. The amount of sludge fed into each individual combine gravity table/belt filer press will be measured by means of magnetic inductive flow metering. The signal from the flow meter is transferred to the PLC system. This signal will provide control for the polymer dosing pumps assigned to each their designated press. The dosage of polymer is adjusted proportional to the flow of sludge. Polymer dosing, for sludge conditioning, is facilitated. The level transmitters send level information to SCADA that controls the pumps through VFD. The water finally goes to the chlorination section where chlorine dosing is carried out depending on flow of water. Electromechanical components of STPs are shown in Table below.

Table 21: Electro-Mechanical Component of STPs

Components	Unit	STP-1		STP-2	
		Quantity	Capacity	Quantity	Capacity
Transformer (on load tap-changer)	KVA	2	750	2	1000
Generator in KVA	KVA	1	1000	1	1500
On-grid solar system	KW		500		800
11 KV feeder line	KM	10	-	2.5	-
Vacuum Circuit breaker	Amp	3	630	3	630
Main MCC	A	4	800, 630, 500, 160	4	1000, 1000, 630, 160
PFI plant	KVAR	2	450	2	600

b. Maps and Layout Plans of the STPs

135. Layout plans of two STPs by plotting on goggle maps are shown in the following figures.

Figure 7: Layout Plan of STP-1



Figure 8: Layout Plan of STP-2



c. Sewage Treatment Process Description

136. **Inlet Pump Station and Wet Well.** First structure of the sewage treatment plant, which is a closed tank of size 10.0m x 5.3m to take sewage from the main sewer and supply to the screening chamber by pumping. The bottom of the structure is about six to seven-meter-deep from the finished ground level which is below the ground water level also the highest flood level.

Equipped with four pumps on duty and one standby, each are chosen for a flow of 636 m^3/h, with a 12 m head for a peak flow of 2,463 m^3/h equivalent to 0.68 m^3/s.

137. **Screen Chamber.** Screen chamber of size 32.4m x 11.47m to mainly separate coarse and fine particle from the sewage will be installed at 3.60 m above the finished ground level due to process requirement. A blower room containing four blowers for aeration tanks and one for aerated grit chamber will be kept under the screening chamber which reduces the structural cost. A bypass channel with a manual screen will be also provided to screen coarse particles during peak and stormy seasons when there are chances of overflow.

138. **Aerated Grit and Grease Chamber.** The grit chambers are designed to remove grit, consisting of sand, gravel or other heavy solids materials that have subsiding velocities or specific gravities substantially greater than the organic solids in the wastewater. Grit chambers are provided to protect moving mechanical equipment from aeration and accompanying abnormal wear; to reduce the formation of heavy deposits in the pipeline, channels and conduits. It also reduces the cleaning process that may be required as a result of excessive accumulation of grit in treatment units.

139. Grease is collected in the grease collection section of the grit and grease removal chamber. A grease scraper, which is an integrated part of the moving bridge, scrapes the floating grease and pushes it towards the end of the grease chamber. The grease is skimmed by means of Overflow Adjustable Mechanical Weirs and evacuated to a Scum Box Collector from where it is removed by tanker truck or by other means.

140. **Aeration Tanks.** The wastewater is mixed with activated sludge at the inlet of the tank. The mixture of wastewater and activated sludge enters the aeration tanks over 5m wide adjustable weirs, installed at the inlet of each tank. The biological treatment is facilitated in an aeration tank. The aeration tank is designed to facilitate effective removal of organic matter (BOD and COD). The aeration causes a mixing of the sludge and wastewater. In order to ensure a complete mix of the tanks each aeration tank is also equipped with two flow-makers.

141. **RAS/WAS Pumps.** The Waste Sludge pumps transfer the sludge from the RAS/WAS pump station to the Waste Sludge Tank. The capacity shall fulfil the requirements of sludge wasting at differing sludge consistencies. The Activated Sludge is extracted from the bottom well located at the center of the bottom of each of the Secondary Clarifiers. From here, it is gravitated to the inlet of the Return Activated Sludge Pumps which returns the Activated Sludge to the inlet box located at the inlet to the Inlet Launder feeding the four aeration tanks. Here it is mixed with the incoming degreased and degrited wastewater. RAS pumps shall be able to perform at 25 to 100% of design flow. The pumps shall be capable to perform in accordance with the expected volumes that will be wasted or re-circulated at different sludge consistencies and allow for a trouble-free operation.

142. **Flow Distribution Chamber (Splitter Box).** A mixture of aerated wastewater and activated sludge enters the Distribution Box by means of gravity. The flow is evenly divided into four streams by overflow through 6 identical 5m adjustable weirs, each of which supply to its designated Secondary Clarifier. The flow leaves each of the Distribution Chamber through a DN600 mm pipe which leads to the center well of each of the Secondary Clarifiers. The Distribution Chamber ensures and even split of the combination of aerated wastewater and activated sludge into the six parallel operating Secondary Clarifiers.

143. **Secondary Clarifying Tank.** After leaving the Distribution Box, the mixture of aerated wastewater and activated sludge is diverted to the distribution well located at the center of each Secondary Clarifier. The distribution/flocculation well provides a quiescent regime, which allows an even sedimentation of solids discharged from the Aeration Tanks to the Secondary Clarifiers. The settled solids are scraped by a scraper, which sweeps the bottom and conveys the sludge to a center pit for removal by Waste Sludge Pumps. The moving scraper bridge is furthermore facilitated with a skimming device, which sweeps the skimmings at the surface of each of the Secondary Clarifiers. The scum is collected in a pump sump fixed on the scraper bridge and pumped by a submersible pump to the center of the clarifier from where it is conveyed to the internal sewer system of the plant.

144. **Sludge Thickening and Dewatering.** Sludge Thickening and Dewatering building is a closed structure consisting of different parts for different facilities for sludge management, such as electrical control panel, waste activated and return activated sludge pump station, and workshop spaces.

145. **Chlorine Station:** Chlorine gas is drawn through the chlorinator under vacuum, the vacuum is created by an injector. The injector requires a motive water supply at a given pressure and quantity, depending on the back pressure at the point of injection of chlorine solution and the length of chlorine solution delivery pipe work. Water Booster pumps, located in the Process Water Pumping Station, provide the motive water.

146. **Chlorine Tank:** The secondary clarified wastewater will enter the inlet of the Chlorination Contact Tank where it will be injected with chlorine solution. The chlorinated secondary treated wastewater will be subjected to a serpentine pattern motion through the Chlorination Contact Tank. After being retained in the Chlorination Tank, the Chlorinated and treated wastewater is discharged from the Chlorination Tank over a 5m adjustable weir. From here, it will gravitate to the wetlands or directly to the River.

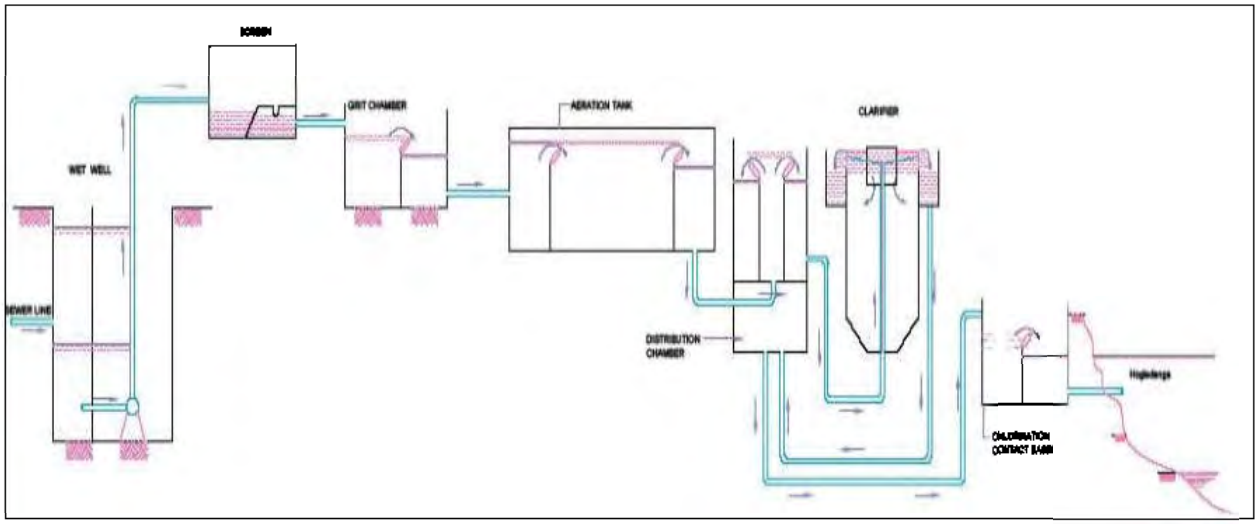
147. **Sludge Storage.** The dewatered sludge, at 22% dryness, is dropped onto a sludge screw conveying system. Dewatered sludge is discharged to an inclined enclosed conveying screw, which transports the dewatered sludge and discharges into a transportable sludge holding container. The transportable sludge holding containers are located outside the Sludge Dewatering Building. From here the sludge will be trucked away for final disposal. The disposal of treated sludge will be either disposed in landfills or for use as composet or fertilizer to the satisfactory level with the legislation requirement of Bangladesh guidelines on sludge management for agricultural use needs.

148. All components, design figures, scenario analysis, and collection system, including sludge management and disposal options, will be addressed and finalized in the final detailed design of the STP, and will be included in the updating or finalization of this IEE.

d. Flow Diagram

149. The flow diagram of the sewerage treatment process has been shown in following Figure.

Figure 9: Process Flow Diagram



5. Fecal Sludge Management

150. A fecal sludge treatment plant (FSTP) will be constructed at the STP-1 site. The objective is to have a co-treatment system that will treat at least a portion of Khulna's fecal sludge. The volume of fecal sludge liquids is minimal under this co-treatment scheme when compared with the volume of municipal wastewater. However, because the septage liquids is much stronger in terms of BOD than municipal wastewater, there is a much higher oxygen demand.

151. When determining the suitability of co-treatment at the STP-1 site, the key determinants are (i) the combined organic loading which has a bearing on the amount of oxygen required by the combined flow, and (ii) the hydraulic loading and overflow rates from the aeration basin.

152. In the case of the septage volume that will be delivered to the proposed FSTP, it is very small compared to the sewage volume. Calculations show that it is less than 1%, which will not have impact on the overflow rates from the aeration basin. However, the oxygen demand from the combined flows turns out to be a significant factor. Modeling of co-treatment indicates that co-treatment for the full anticipated load of up to 160 cubic meters per day of septage delivered to the FSTP will be viable as long as the STP-1 plant utilization does not exceed 80%.

153. Once utilization does exceed 80%, co-treatment is still possible, but either: i) at a lower volume of septage liquids, or ii) with the addition of more oxygenation equipment in the aeration basin.

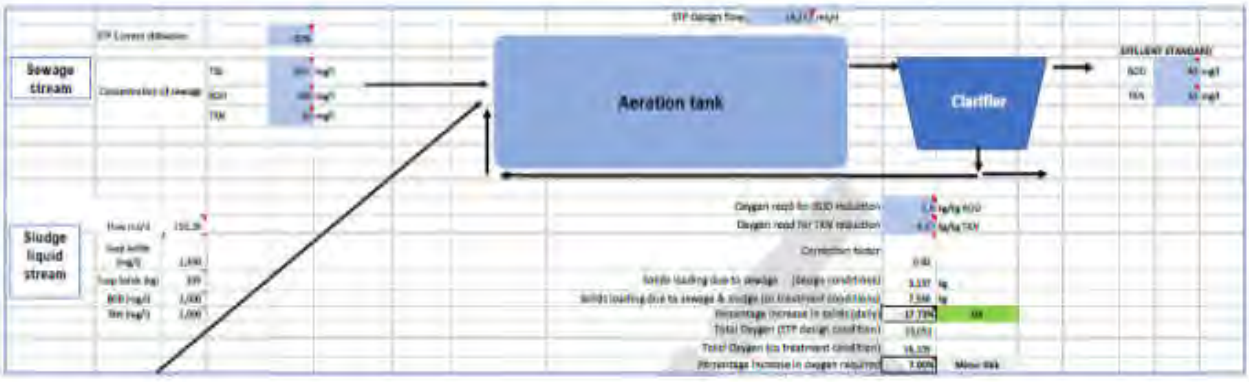
154. Based on the preliminary STP design, the volume of acceptable liquids rapidly decreases from 160 cubic meters per day at 80% utilization down to 0 cubic meters (no co-treatment possible) at 100% utilization. Once 80% utilization is reached, additional oxygen supply can be provided in the aeration basin, or another form of treatment will be required for the septage liquids.

Figure 10: Excerpt from Co-Treatment Workbook Used to Check Adequacy of STP-1 For Septage Flow up to 160 m³/d



155. To check the adequacy of the STP-1 to accept the septage liquids, the Co-Treatment Workbook was utilized. The parameters were input into the model (Figure 10 and 11) and the outputs checked. Figure 11 illustrates the outputs at 80% wastewater treatment plant utilization. There is a 7% oxygen deficit in this scenario, but that poses only a minor risk that the effluent standards would be exceeded.

Figure 11: Output at 80% Utilization



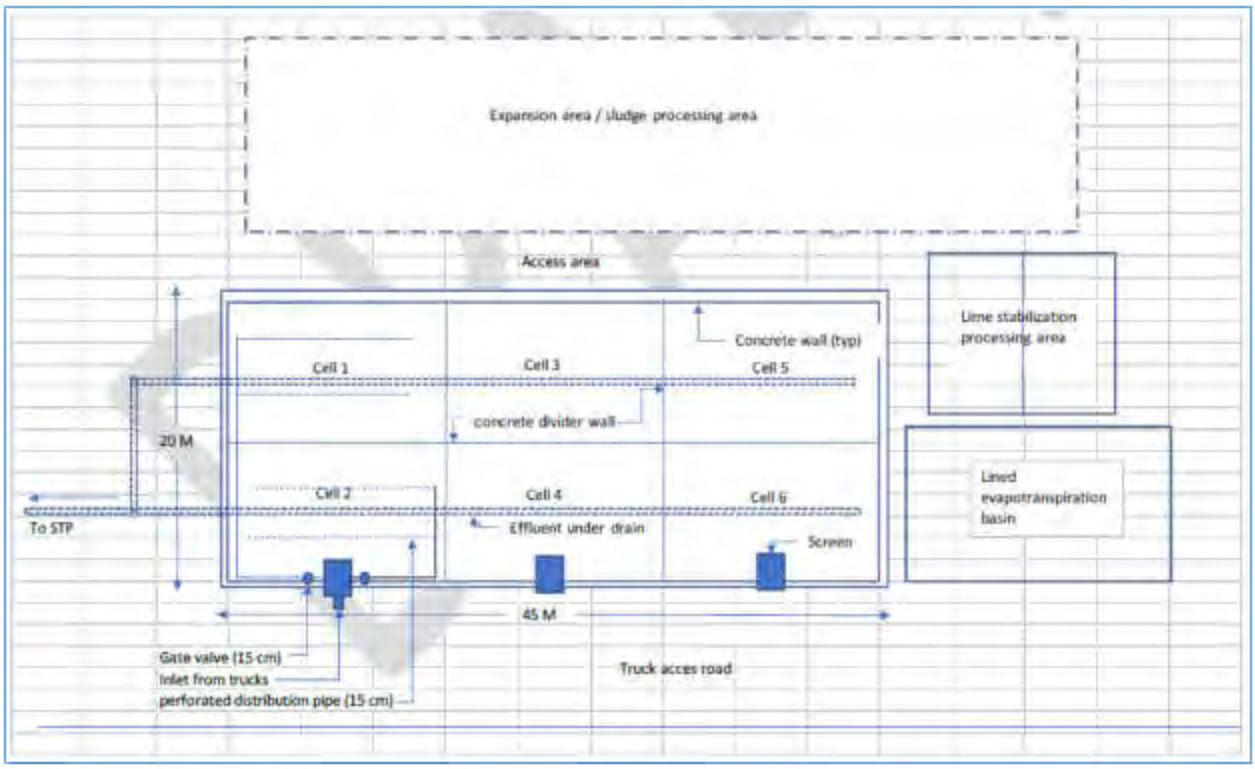
156. The co-treatment assumption is based on: (i) flows of up to 160 cubic meters of septage will be added each day, and (ii) BOD concentration will be 4,000 mg/L, and total suspended solids (TSS) will be at 4,350 mg/L with removal efficiencies through the wetlands at 50% and 70% respectively. It is important to note that even if TSS values turn out to be much higher, it will not

impact the oxygen requirements, which are dependent upon the oxygen demand requirements of the BOD. TSS removal through the wetlands will be 70% and BOD removal will be 50% which are assumed. Once septage begins to flow through the system, it will be possible to collect samples and determine actual loading.

157. The most likely scenario is that BOD of septage liquids exiting the wetlands will be less than 2,000 mg/L and that plant utilization will be under the 80% threshold for many years to come. Also, it is likely that due to infiltration and the addition of greywater, the incoming sewage strength will be less than assumed. Therefore, co-treatment appears to be the preferred method of addressing septage liquids at the STP-1 and will continue to be for many years to come.

a. Configuration of Fecal Sludge Treatment Plant (FSTP) at STP-1 Site

Figure 12: FSTP Layout at STP-1 Site



158. Six (6) vertical flow wetlands cells will form the heart of the system. There are three septage receiving ports that are attached to 3 screens used for coarse screening of the incoming septage. Each screen is connected to two outlet pipes each fitted with a gate valve. The gate valves send the untreated septage to distribution pipes in one of two cells. For example, if the truck connects to the screen located in cell 2, the left gate valve when open sends the septage to cell 1 for distribution to the cell. The right gate valve when open sends the waste to the distribution pipes to cell 2.

159. The piping system from the screens including the gate valves should be 15 cm plastic pipe with UV protection. The distribution pipes are perforated with 5 cm openings (2 every linear meter of pipe) to allow the septage to be evenly distributed throughout the cell surface.

160. There is an underdrain (perforated 15 cm pipe) at the bottom of each cell protected from siltation by hollow concrete block. The underdrain collects the separated septage liquids which flow by gravity to the STP-1 headwork.

161. Expansion area / sludge processing area. There is open space adjacent to the 6 wetland cells that can be used for: i) expansion area in the event that additional fecal sludge processing is required, and ii) sludge processing prior to the installation of any expanded treatment system. Workers may find it convenient to have this open space for dried sludge processing once it is removed from the wetland cells. The space should be used for expansion; all sludge processing will be accomplished off site.

162. Dedicated lime stabilization pit that can accommodate contaminated batches of septage. There should be two pits each 3 m x 4 m by 1 meter deep. These are also formed using concrete divider and exterior walls. A sludge pump is used to transfer the lime treated septage to the evapotranspiration basin.

163. An evapotranspiration basin will also be provided for processing of any lime stabilized waste. There should not be much contaminated sludge to process, perhaps one or two loads per month. Once contaminated septage is lime stabilized, it is pumped to the Evapotranspiration (ET) basin. Here the liquids are removed to the atmosphere through the processes of evaporation and plant transpiration and the remaining solids, dried by the sun. The contaminated dried biosolids are removed to the landfill.

b. Fecal Sludge Collection Equipment

164. A fleet of 22 six cubic meter capacity vacuum trucks will be required to perform the desludging services in 2030. Based on preliminary design, it assumes the following:

(i) 30% of all plots will require desludging services
(ii) Desludging cycle will be 2 years for plots not connected to a sewer
(iii) Tank abandonment will occur from 2025 – 2030 with assumption that an equal number of tanks will be abandoned each year
(iv) Tank volume average is 5.6
(v) Vacuum truck capacities bill be 6 cubic meters
(vi) Crews will work 300 days per year
(vii) Trucking operation efficiency is 80%

165. All tanks will be desludgeable and able to be accessed by vacuum truck with 300 meters of hose. A duel pumping system may be required for runs between 150 and 300 meters.

166. All components, design figures, scenario analysis, and collection system, including treated sludge management and disposal, will be finalized in the final detailed design of the FSTP, and will be included in the updating or finalization of this IEE.

E. Project Phases and Schedule

167. The duration of the proposed project stretches from January 2020 to June 2025. All the three components will run simultaneously during the project period. The various activities that may produce environmental impacts related to environmental issues can be listed as given below:

(i) Planning Stage
    (a) Recruitment of Project Management and Supervision Consultant (PMSC) and Contractors,

(b) Survey investigation for STP sites, pumping station sites, and pipe laying alignments,
(c) Preparation of draft IEE and obtaining Environmental Clearance,
(d) Preparation of Land Acquisition and Involuntary Resettlement Action Plan (RAP).

(ii) Design Stage
(a) Review and design finalization for STPs, pumping stations, pipe laying, temporary storage and construction material management,
(b) Incorporation of IEE recommendations to design and specifications,
(c) Survey investigation including soil investigation,
(d) Implementation of land acquisition and RAP.

(iii) Construction Stage
(a) Site preparation and transportation for pipe laying (both for conventional open-cut and trenchless construction techniques),
(b) Excavation and disposal of soil and debris (especially for pipe laying)
(c) Relocation of utilities and allocation of utilities for construction,
(d) Transportation and storage of construction material at site,
(e) Dewatering of certain areas and pipeline trenches,
(f) Construction of temporary storages,
(g) Construction of wastewater treatment plants,
(h) Construction of pumping station and transmission pipes,
(i) Reinstatement of roads along pipeline alignment,
(j) Construction of manhole, receiving chamber, drop manholes, and other diversion structures,
(k) Construction of other related infrastructure,
(l) Supplies of utilities,
(m) Implementation of IEE recommended mitigation measures,
(n) Observing health and safety in every stage of construction, traffic management in areas,
(o) Environmental monitoring.

(iv) Testing and Commissioning of Facilities

(v) Operational Stage
(a) Maintenance of sewers, de-silting, cleaning, and repairs from time to time,
(b) Operation of pumping stations and transmission pipeline,
(c) Operation of treatment plant including treated wastewater reuse/ disposal and sludge management.

F. Resource Utilization

168. A significant amount of gravel, sand and aggregate, will be required for civil construction part of this project, most of which are available in Bangladesh, which may, however, need to be transported over long distances. Stones are also imported from across the national boundary. Brick aggregates will be used in the sub-base and lower part of the base of the inside road of the STP sites. Cement is produced in the country, even in Khulna. However, indigenous cement satisfies about 75% of total need of the country; the shortfall is being met by importation. Reinforcing steel (both mild and high grade) is produced in the country. However, a guarantee of

quality, quantity and delivery schedule is important. All of these materials, and other construction materials will be sourced from legitimate entities authorized by the government.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Baseline Information

169. The primary objective in this chapter is to provide an environmental baseline of the proposed STP site. Baseline data includes an inventory of physical, ecological and socio-economic parameters. Covering these aspects, data has been compiled for:

(i) Land Environment;
(ii) Water Environment;
(iii) Air Environment;
(iv) Noise Environment;
(v) Ecological Environment; and
(vi) Socio-economic Environment

170. Baseline environmental data gathering was initiated by KWASA and the monitoring focused on air quality, noise level, surface water quality and groundwater quality. The Integrated Biodiversity Assessment Tool (IBAT) was initially used to screen and assess potential risks on the protected areas or critical habitat that may exist around the project sites. Some secondary information and data were also used in gathering baseline information.

B. Project Influence Area

171. Project influence area (PIA) (impact zone) varies per the interventions and the environmental and socio-economic settings of the area where the project is to be implemented. For the construction of sewerage network along the existing road alignment, the PIA would cover up to 5 m on each side of the network line, which spaces are used for necessary preparation and construction of the said sewerage line and directly be impacted.

172. Construction of Sewage Treatment Plants (STPs) would have a wide influence area depending on its location and nature of surrounding environment. Since this component has sufficient land areas on its own, the primary impact will be confined mostly within the boundary. For carrying of materials by vehicles to the sites, setting up of labor camps and disposal of wastewater to the nearby rivers/canals would extend the PIA area substantially large. The influence area for this assessment covers 0.5km /500 m radial distance centering each STP site in order to include sufficient coverage of the receiving environment of the impacts of the Project.

173. However, the construction of Sewage pumping or lifting stations is anticipated to dissipate the associated impacts to the least distance considering its volume of work and ownership of land. As the construction work mostly would be confined within its own land area, a maximum of 50 m of radial distance is counted for the PIA of this component.

C. Land Environment

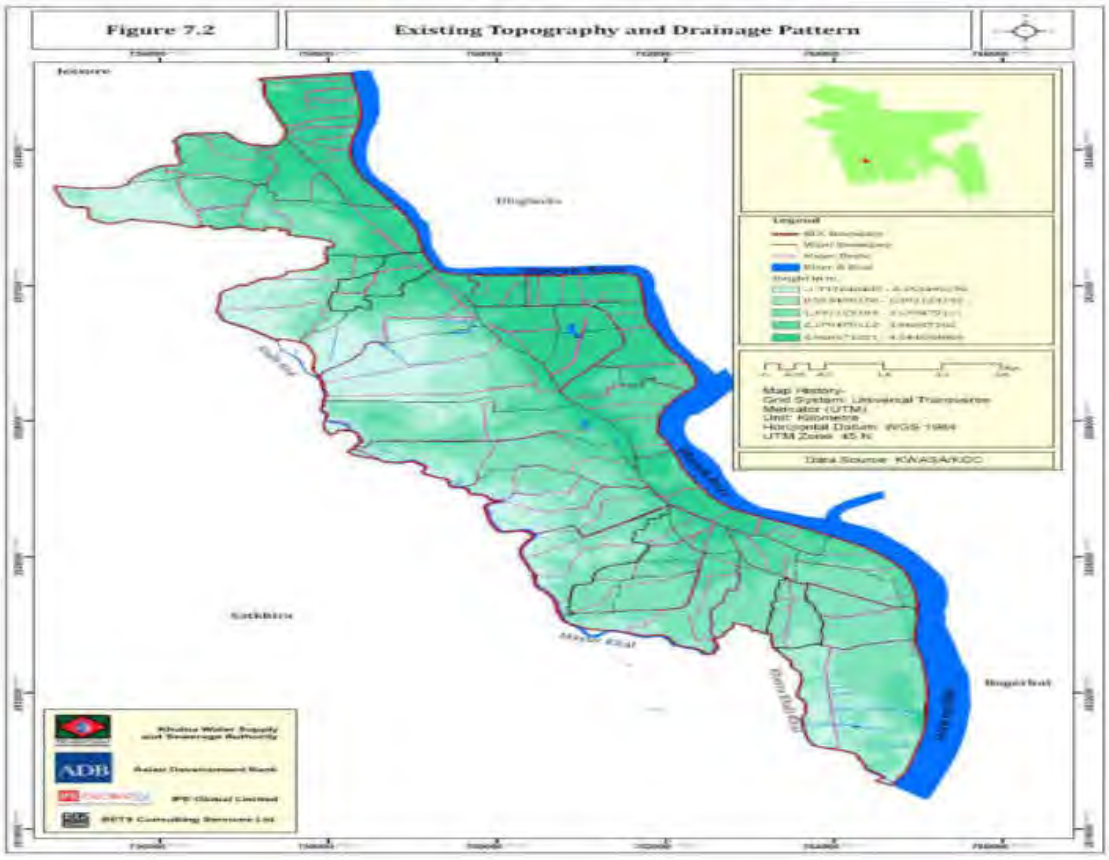
1. Topography

174. Maximum and minimum existing ground elevations in Khulna vary from about + 4.2 m to – 1.7 m approximately. Overall, Khulna-Jessore road serves as the ridge line from north to south divides the city area into two parts, the eastern part drains towards river Rupsha/ Bhairabi and

western part slopes towards river Mayuri in the west. These rivers are tidal rivers and as per available records maximum tidal level can be up to 2.4 m in Khulna. In transverse direction (from north to south), the city has a mild slope towards south. Apart from these two main rivers, several natural and man-made channels drain the city which primarily culminates into these two rivers.

175. It was indicated that there are patches of land which are either low lying or adjacent to natural drainage course or connected to drainage course in some way and are prone to flooding. To avoid future flooding, certain areas were recommended to be developed or raised above 2.4 m (SoB) formation level. It was also mentioned that any area in Khulna existing below this ground level would be prone to flooding. Topography and drainage pattern map of Khulna city has been given in Figure below.

Figure 13: Topography of Khulna City



2. Geology

176. Bangladesh is filled with sediments of Tertiary to Quaternary age and recent flood plain and piedmont alluvium, which occupies roughly seventy percent of the total land area of Bangladesh. Moreover, the sediments of Bangladesh are divided into two major tectonic units, the Precambrian platform in the northeast and the Bengal Fore deep in the southeast separated by Kolkata-Mymensingh Hinge Line. The thickness of the sedimentary cover on the basement is increasing towards southeast and the area affects by the settlement due to consolidation of the sediments. Soft soil Khulna is mainly available in alluvial flood plain deposits, depression deposits and tidal plain deposits. The soft soil is comprised of unconsolidated to normally consolidated clays and silt containing organic materials. The alluvial flood plain deposit consists of silts and silty clays with silt predominating. Fine sand with mica abounds at greater depth. The depression

deposits contain organic clay deposits overlying clay at depth and estuarine and tidal floodplain deposits is silt and silty clays; organic soils close to the surface in some places. The average elevation is +2.75 m with respect to the mean sea level (Khulna Master Plan, 2001) and the land gradient is approximately 1 m per 20 km. The ground water lies either at the surface or at about 1.0 m below the existing ground level during rainy season and dry season, respectively.

3. Soil

177. According to Roy et al. (2005), Khulna City Corporation (KCC) lies on the formation of late Holocene to Recent Alluvium of the Ganges deltaic plain in north and tidal plain in south and the area is composed of sand, silt and clay in various proportions with small amount of coarse sand, which is classified into seven litho-stratigraphic units from base to top. Complexes of channels of fluvial/tidal origin, natural levees, bars, swamps and plains like floodplain, deltaic plains, estuarine plains or coastal plain constitute the geomorphological units of KCC area. Of these the area occupied by the natural levee, flood plain and bars are ranked high for future urban development. The elevation of the city area varies from 3.90 m in north to 2.70 m towards southwest direction.

178. Underground soil environment and its core characteristics with relevance to this project have been investigated through geo technical investigation on both STP sites. The Labonchora site, due to its close proximity to the river Rupsha and containment under the river tidal system for a long time in the past should exhibit a tidal soil characteristic. However, the site is now well confined and free from regular tidal inundation and becomes inundated even for months only in the event of a strong rainfall. The topsoil layer up to 6 m is found to be consisting of clayey silt with trace sand followed by a 3 m layer of very loose to loose silty fine sand. This type of soil is very much susceptible to settlement. A general soil profile for the Labonchora site is given hereunder.

Table 22: Soil Profile of STP-1, Labonchara

Layer no.	Depth (ft.)		N-Value		Predominant Soil Type	Consistency and plasticity /compactness
	From	To	Min.	Max.		
I	0	30	0	5	Clayey Silt	Very soft to soft with low plasticity
II	30	45	1	28	Silty Sand	Very loose to medium dense
III	45	165	5	30	Clayey Silt	Firm to very stiff with medium plasticity
IV	165	200	64	70	Silty Sand	Very dense

179. The major portion of Khulna-Satkhira STP site is a marshy paddy field combined with several ponds protected with narrow banks. The site is also vegetated with several species of trees and bushes and vegetables are grown seasonally. The topsoil layer up to 6m consists of clayey silt with trace sand followed by a 3m layer of very loose to loose silty fine sand. A general soil profile for the Khulna-Satkhira STP site is given hereunder.

Table 23: Soil Profile of STP-2, Khulna-Satkhira

Layer no.	Depth (ft.)		N-Value		Predominant Soil Type	Consistency and plasticity /compactness
	From	To	Min.	Max.		
I	0	15	1	6	Clayey Silt	Very Soft to Firm

Layer no.	Depth (ft.)		N-Value		Predominant Soil Type	Consistency and plasticity /compactness
	From	To	Min.	Max.		
II	15	45	1	21	Silty Sand	Very loose to Medium Dense
III	45	100	7	31	Fine Sand	Loose to Medium Dense
IV	100	130	6	33	Clayey Silty	Firm to Hard
V	130	200	24	68	Fine Sand	Medium Dense to Very Dense

180. The results of the executed boreholes during the investigation in both places have found the subsoil stratification to be slightly differed from each other, but that difference can be neglected from the engineering point of view. Drainage characteristics of soil in Khulna city area is primarily classified into Imperfectly Drained (26%), Poorly Drained (52%) and Very Poorly Drained (22%).

4. Seismicity

181. Seismicity of a particular region denotes the proneness of that region to earthquake occurrence. Higher seismicity of a region is more likely to experience more frequent and large earthquakes than a region of lower seismicity. This seismicity can be shown in seismic zoning map, that considers the soil type, foundation conditions, ground structure and its dynamic characteristics, intensity distribution during past earthquakes, ground motion attenuation characteristics, location of seismically active zone, etc. Likewise, Bangladesh is divided into three generalized seismic zones- Zone I (High Risk), Zone II (Moderate Risk) and Zone III (Low Risk).

182. The project site in Khulna district, lies within the Zone-III comprising the southwestern part of Bangladesh, is seismically quiet, with an estimated basic seismic co-efficient of 0.04. The project area is the least vulnerable in terms of seismicity compared to the other parts of Bangladesh like northern and eastern regions of Bangladesh with the presence of several faults and thrust counting the basic seismic co-efficient of 0.08 or the central part of Bangladesh representing the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur Tracts, and the western extension of the folded belt. However, all building structures will be designed following the Bangladesh National Building Code 2006, in order to avert the least impact caused by any potential tremor.

Figure 14: Earthquake Zone of Bangladesh



5. Natural Disaster

183. Khulna district is situated in the natural disaster prone area. Local people opined that waterlogging, salinity intrusion, cyclone, storm surge, river erosion are the main natural disasters in the district area. These occur almost every year in this area. However, the city area, including the STP sites, is mostly free from these sorts of disasters, except some cyclonic events lambasting periodically.

6. STP Sites and the Surroundings

184. Khulna city is located in the northern part of Khulna district and bounded by Bhairab and Rupsha river on the eastern side and Khulir khal, Mayur Khal and Khetrakhali Khal on the western side. The Labonchora STP site occupies an area of 12 acre of land area, at the conjecture of Mathabhanga and Putimari area, under Batiaghata Upazila of Khulna district. The aerial distance of the site from the Khulna city center is around 6.8 km. The site runs nearly 320 m along the Labonchora Road, from the north-east to south-west direction, and the other side of the site is confined by the river Rupsha. However, bank protection measures are already in place along the river, so instability in relation to river bank erosion or flooding is very much unlikely now. It should

be noted that Department of Environment has already issued a Site Clearance for the construction of proposed project.

185. During a survey took place on 16 May 2019, the designated site was found fully inundated by water, while with remnants of a paddy field swaying beneath the shallow water level. Consultation with nearby people revealed that the site is completely vacant and seasonally used for rice cultivation or pisciculture. The site has already been identified and acquisition process is running. A brickfield was found in operation at the South-Western side of the site, whose contribution to the air may result in a bit high concentration of CO2 and CO in local atmosphere.

Figure 15: Proposed Site for STP-1 and Its Surroundings



186. The Tikraband STP site occupies an area of 22 acre of land area, situated in more southern areas of the city, by the Khulna-Satkhira Highway, under Batiaghata Upazila area. The site lies between Khulna City Bypass and the Khulna-Mongla Rail line (construction underway). The aerial distance of the site from the Khulna city center is around 5.2 km. Khulna Palli Biddut Head Office (Head office for Rural Electrification Board of Khulna) is situated very nearby from the site and the site electrification will be arranged and provided by this office.

187. During a survey took place on 16 May 2019, the designated site was found undeveloped, filled with patches of cultivated land where vegetables were grown, number of shallow water bodies/ponds were therein, several fruit and bushy trees and a good number of coconut trees along the boundary line of the site were found standing. Consultation with nearby people revealed that the site is completely vacant and seasonally used for gardening and cultivation. The site has

already been identified and acquisition process is running. The site access road comes from the Khulna-Satkhira Highway and passing through the adjacent of site.

188. Surroundings of the site area are largely vacant and uninhabited. Surprisingly, a Church-cum-School structure is sited at the left corner of the access to the site (more north to the site). The outfall of this STP site will be stretched further north through pipeline and pumped out into a canal, nearly 390 m distant from the Site.

Figure 16: Proposed Site for STP-2 and Its Surroundings



7. Access Route to the STP Sites

189. Labonchora STP-1 site is easily accessible without facing much setback by traffic or pedestrians. With recent development trend being perceived in and across the city and surrounding areas and huge investment in energy and infrastructure sector by the government itself, new urban centers are about to bloom across the places immediately outside of the existing city or in the fringe areas.

190. The Labonchora STP-1 is located by the side of Labonchora road at a distance of nearly 2.5 km from the Khan Jahan Ali Bridge end and the Labonchora road is almost a free road, where usual daily traffic is still very negligible due to primarily the undeveloped nature of the area. The STP can be accessed from the city either through Rupsha to Khan Jahan Ali Bridge road via the Shipyard road, running through the opposite direction of the Labonchora road and below the

bridge approach road, though the Shipyard road is relatively narrower with unscrupulous movement of traffic.

Table 24: Length of Access Road to the STP-1

Access Route	Length (Km)
Rupsha to Khan Jahan Ali Bridge	3.25
Khan Jahan Ali Bridge to STP site	2.50
Total Length	5.75

Figure 17: Access Route to the STP-1



191. The Tikraband STP-2 site is easily accessible following a direct connectivity to the city with Khulna-Satkhira Highway, which is relatively a busy roadway with significant numbers of traffic plying over. With recent development trend being perceived in and across the city and surrounding areas and huge investment in energy and infrastructure sector by the government itself, new urban centers are about to bloom across the places immediately outside of the existing city or in the fringe areas. These places will flourish keeping the 'Zero point' at the center of development, which is a roundabout having direct access to every direction to the city and the targeted future development areas, along with adjoining districts. Two major road ways crosses at 'Zero Point' roundabout, one is the Khulna City Bypass that goes straight through Khan Jahan Ali Bridge to the North-Eastern districts up to Dhaka, and the other one is the Khulna-Satkhira

Highway, directly coming from the city center of Khulna metropolitan area heading towards the South-western (relative to Khulna) district of Satkhira.

192. As quoted above, the Tikraband STP-2 is accessible through an access road directly connected to the Khulna-Satkhira Highway at a distance of nearly 1.3 km from the zero point and the length of the access road is around 0.7 km. Being the part of a national highway, the section from Zero point to Khulna-Satkhira Highway is relatively a busy traffic area, but free from any traffic congestion. However, an access road has to be constructed along the toe-line of Khulna-Mongla Rail track. In order to establish that direct and free access to the STP site, consultation with the Department of Railway is necessary and formal consent has to be sought. The proposed access road will be paved with bituminous carpeting before the project starts any material/ equipment shipment as part of the construction works.

Table 25: Length of Access Road to the STP-2

Access Route	Length (Km)
Zero Point to access road to the site	1.3
Access road to the site	0.7
Total Length	2.0

Figure 18: Access Route to the STP-2



D. Water Environment

1. River Drainage System

193. Rupsha and Bhairab, is the lifeline of Khulna city and municipal areas, and constitute the key receiving points for surface drainage. These two are actually the same rive course, assuming different names at different lengths; Bhairab enters from the northwest of the district following a south-easterly course in the northern part of the Khulna district and from the point of 'Charer hat' it assumes a new name Rupsha, which flows further South until meeting Pasur river. Rupsha-Bhairab river system is a part of Ganges river system and depositional trail through Khulna to the lower region of the country up to the Bay of Bengal exhibits the characteristic deltaic floodplain traits. Atharobanki River, flowing through the easterly direction from the city boundary, conveys the surplus water of Madhumati river into the Rupsha, near to the Custom Ghat point. This Rupsha-Bhairab river system experiences the tidal effect predominantly, which also protrudes into adjoining number of canals crossing through the city, and the system as a whole is providing different ecosystem services (incl. provisioning, regulating, cultural and supporting) for the city dwellers and environment, to a significant extent beyond the capacity reflecting in the quality of water to a seriously deteriorating level.

2. Surface Water Resources

194. Rainfall and trans-boundary rivers' flows are the main sources of surface water in Bangladesh. There are 700 rivers including tributaries and distributaries criss-crossing the landscape and creating about 98,000 ha of inland water bodies along with more than 24,000 km streams of water channels. Additionally, there are about 1.3 million ponds, covering about 1, 47,000 ha area, and nearly 10,000 haors, baors and beels (different types of topographical depressions) in Bangladesh, most of which are waterless during the winter.

195. The huge resources of surface water flows through Bangladesh do not contribute in development significantly for a number of reasons. Most importantly, there are very few opportunities for either gravity diversions or surface storage. Even in critical time for surface water irrigation, predominantly in dry season, the net diversions from the entire system is not more than five percent of the total inflow. Besides, these loads of surface water are being treated as the ultimate receptor of a huge amount of pollution discharged by the industries or municipalities, without considering the potential capacity of attenuation. Further, recent industrial development is making an unscrupulous use of surface water sources, using huge quantities of water for different processes, washing and cooling, but discharging the same with physico-chemical properties being modified adversely. Similar condition is prevailing across the Khulna city area, where in absence of adequately functional sanitation and sewerage system, septage along with sewage loads finds way to get discharged into either the existing sewer network or nearby surface water bodies.

196. The surface water quality assessment in the project influence area has been carried out for Nitrate, Ammonia, Phosphate, Chromium, Cadmium, Lead, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Salinity and Faecal Coliform (FC) in the month of June and October 2020. Sampling was conducted from four locations of Rupsha River and Hoghldanga Khal: upstream and downstream of each STP and the samples were collected at least 10 m from riverbank/shore and 1.5 m below the waterways. Test result of surface water sampling analysis of project-influenced area is given in the following Table and sampling locations are showing in the Figure 20.

Table 26: Surface Water Quality

Sl. No.	Project Component	Waterbody	Sampling Location	GPS	Water Quality Parameter										
					DO (mg/l)	BOD (mg/l)	COD (mg/l)	Salinity (ppt)	Nitrate (mg/l)	Ammonia (mg/l)	Phosphate (mg/l)	Chromium (mg/l)	Cadmium (mg/l)	Lead (mg/l)	Fecal Coliform
1	Sewerage Treatment Plant (STP-1)	Rupsa River (Upstream)	Rab-06 Ghat, 31 no ward, Labonchara,	22°46'18.8"N 89°34'50.3"E	2.77	6	8	0.16	0.2	0.11	11.2	0.001	0.00015	0.006	148
2		Rupsa River (Downstream)	Habibia Graveyeard, Putimari, Labonchara	22°45'36.4"N 89°33'40.5"E	2.4	5	8	0.48	0.1	0.1	2.9	0.001	0.00015	0.003	120
3	Sewerage Treatment Plant (STP-2)	Hoghldanga Khal (Upstream)	Near Jela karagar, chalkahsan khali,	22°48'46.5"N 89°31'18.1"E	2.31	10	49.9	0.46	0.2	0.14	1.68	0.006	0.00015	0.001	75
4		Hoghldanga Khal (Downstream)	Near Hoghladanga mondir,, Batighata	22°47'37.8"N 89°30'12.2"E	2.36	7	41	0.20	0.4	0.19	1.16	0.005	0.00015	0.004	180
Bangladesh Standards for inland surface water: water usable for irrigation, SCHEDULE – 3, A (ECR)'97					5 or more	10 or less	-	-	-	-	-	-	-	-	1000 or less
Standards for Waste Water from Industrial Units or Projects for Inland Surface Water, SCHEDULE – 10 (ECR)'97					4.5 – 8	50	200	-	10	5	8	0.5	0.5	0.1	-

197. **Dissolved Oxygen (DO):** The dissolved oxygen is necessary for organisms living in water including fish, invertebrate, bacteria and plant. Decrease in DO values below the critical level of 3 mg/l causes death of most fishes and other aerobic aquatic organisms. The dissolved oxygen values ranged from 2.31 to 2.77 mg/l in four locations. Numerous scientific studies suggest that 4-5 parts per million (ppm) of DO is the minimum amount that will support a large, diverse fish population. The DO level in good fishing waters generally averages about 9 parts per million (ppm).

198. **Biochemical Oxygen Demand (BOD5):** Biochemical Oxygen Demand is the amount of oxygen required by micro-organisms to decompose aerobically the organic substances contained in water. A high BOD is an indication of abundant organic content in water originating from untreated sewage by industrial and municipal units. Typically, the BOD due to industrial sewage is many times that of domestic sewage. When sewage enters a surface water body, micro-organisms begin to decompose the organic materials by consuming the DO of river water. This can quickly deplete the available oxygen and subsequently affect aquatic life. The test results show that BOD value was detected within the national standard. The highest BOD value of the surface water was found as 10 mg/l at the upstream of STP-2 in Hoghldanga Khal and the lowest value observed was 5 mg/l at the downstream in the Rupsha river along the STP-1.

199. **Chemical Oxygen Demand (COD):** The COD value indicates the amount of oxygen which is needed for the oxidation of all organic substances in water in mg/l. Chemical Oxygen Demand is an important water quality parameter because, similar to BOD, it provides an index to assess the effect discharged wastewater will have on the receiving environment. The COD test is often used as an alternate to BOD due to shorter length of testing time. The COD values ranged from 8 to 49.9 mg/l in four locations where the highest concentration was found at the upstream of STP-2 in Hoghldanga Khal and the lowest value monitored was 8 mg/l in Rupsha river next to the STP-1.

200. **Salinity:** The salinity of water indicates the presence of ionic substances that may come from the reaction of metals and acids containing in water. The highest salinity value of the surface water was found as 4.9 ppt at the downstream of STP-1 in the Rupsha River and the lowest value observed was 1.92 ppt in both locations along the STP-2.

201. **Nitrate:** The highest Nitrate concentration was found at the downstream of STP-2 in Hoghldanga Khal 0.4mg/l. The lowest value was found at the downstream of STP-1 in Rupsha River, 0.1 mg/l.

202. **Ammonia:** Ammonia is extremely toxic and even relatively low levels pose a threat to fish health. Ammonia is produced by fish and all other animals, including ourselves, as part of normal metabolism. Excess ammonia increases the load on the nitrifying bacteria in water. Ammonia follows almost the same trend as it was for Nitrate. The highest ammonia concentration was found at the downstream of STP-2 in Hoghldanga Khal 0.19 mg/l. The lowest value was found 0.10 mg/l at the downstream of STP-1 in Rupsha River.

203. **Phosphate:** Phosphate stimulates the growth of plankton and aquatic plants which provide food for large organisms in the aquatic food chain. Initially, this increased productivity can cause an increase in the fish population and overall biological diversity of the system. But as the phosphate loading continues, the aging process of the surface water ecosystem can be accelerated. The overproduction of the phosphate in waterbody can lead to an imbalance in the nutrient amd material cycling process. This overproduction of phosphate due to nutrient can lead to a variety of problems ranging from anoxic waters (through decomposition) to toxic algal blooms (eutrophication) that eventually decrease aquatic diversity and cause habitat destruction. The

concentration of phosphates ranges from 11.2 mg/l to 1.16 mg/l in the water body located along the STPs. The water sample collected from the upstream of STP-1 in the Rupsha River recorded the highest value of phosphate which exceeded the GOB standard for waste water from industrial units or projects for inland surface water.

204. **Heavy Metals (Cr, Cd and Pb):** Concentration of three heavy metals chromium (Cr), cadmium (Cd) and lead (Pb) and were analysed at four locations along the STPs in order to further assess the toxicity of the surface water. These elements are also believed to be cancer-causing agents. The concentration for all the carcinogenic metals were much below the permissible limit of DOE for aquatic life. In this respect, it can be concluded that the surface water body is not polluted in terms of heavy metals and the present level of the concentrations caused no matter of concern.

205. **Fecal Coliform (FC):** Fecal coliforms originated in human and animal waste. Untreated organic matter that contains fecal coliform can be harmful to the health. The value of FC was varied within the range 75 CFU/100ml to 180 CFU/100ml. Laboratory test report attached in the Appendix 5.

3. Groundwater Quality of Khulna City

206. Groundwater in Bangladesh occurs at a very shallow depth where the recent alluvial sediments form the primary aquifers in the floodplains. Recharge to these aquifers is mainly from percolation of rainwater and floodwater. Rivers and other standing water bodies contribute in recharging to the nearby aquifers. The main component of discharge is the withdrawal of groundwater by different types of tube-wells for different purposes, whereas a minor discharge component flows towards lower gradient, sometimes as base flow. Recharge rate during the monsoon is too high that causes the groundwater level to be very close to the surface, while during the months of April and May the level goes to the maximum depth.

207. Irrigation constitutes the largest share of groundwater use across the country. Groundwater use for domestic purposes including drinking is also prevailing in rural and urban areas. Thus, the presence of high concentration of some natural elements like Arsenic, Iron, Manganese or Fluoride in groundwater poses a high risk on public health. Additionally, high salinity in coastal areas and presence of fecal coliform (in shallow groundwater) aggravate the public health scenario in respective areas. Recently industrial use of groundwater abstracted though deep tube-wells is increasing alarmingly, which often causes drainage of polluted water into the surface streams.

208. A study conducted by the Department of Environment, the nodal agency of Bangladesh Government responsible for environmental protection and management, on the quality of surface and groundwater of different rivers and areas, in 2016 revealed that the quality of groundwater in Khulna city is quite good, except for the presence of chloride that is found higher than the acceptable level. Total of 26 sampling points across the city was selected for the study (footnote 1). Below are results of two sampling points relevant to the proposed STP sites. Rupsha Bus Stand is closer to the Labonchora STP site, whereas Khulna University located relatively closer to the Khulna-Satkhira STP site.

Table 27: Groundwater Quality at Different Location

Sampling Location	pH		Elec. Conductivity (EC) (µmohos/cm)		Chloride (mg/l)		Iron (mg/l)		Salinity (ppt)	
	Highest Value	Lowest Value	Highest Value	Lowest Value	Highest Value	Lowest Value	Highest Value	Lowest Value	Highest Value	Lowest Value
Rupsha Bus Stand	7.69	7.38	2185	1674	530	340	0.55	0.31	0.2	0.0
Khulna University	7.68	7.38	1846	1532	484	362	0.56	0.32	0.1	0.0
Overall Assessment	pH of Khulna District GW was within the EQS (6.5-8.5), varied from 7.18 to 7.84		EC of GW was mostly above the EQS (1200 µmohos/cm), varied from 735 to 2444 µmohos/cm.		EQS of Chloride for drinking water is 150-600 mg/l, while the concentration in GW varied from 312 mg/l to 1674 mg/l.		Iron in GW was within the EQS (0.3-1.0 mg/l), varied from 0.22 to 0.58 mg/l. GW quality was found good.		Salinity of GW was within EQS (400 ppt), varied from 0.0 to 0.4 ppt.[a]	
Standards for drinking water SCHEDULE – 3, B (ECR)'97	6.5-8.5		-		150-600 mg/l		0.3-1.0 mg/l		-	
Standards for Waste Water from Industrial Units or Projects for Inland Surface Water, SCHEDULE – 10 (ECR)'97			1200 µmohos/cm						-	

[a] Source: Surface and Ground Water Quality Report 2016, DOE (December 2017)

209. Most recent groundwater samples were also collected during the month of June and October 2020 from the tube wells near the project components (Figure 19 and 20). The result of the groundwater quality is presented in the table below and copies of laboratory test results are in Appendix 5.

Figure 19: Water Sampling in Project Site





SPS-6: TRUCK TERMINAL ROAD, SONADANGA



SPS-1: CUSTOMGHAT

Figure 20: Location Map of Water Sampling



Table 28: Groundwater Quality at Different Location

Sl. No.	Project Component	Sampling Location	GPS	Water Quality Parameter							
				pH	Salinity (ppt)	Nitrate (mg/l)	Fecal Coliform	TDS (mg/l)	Hardness (mg/l)	Ammonia (mg/l)	Phosphate (mg/l)
1	Sewerage Treatment Plant (STP-1)	Putimari bazar jame masjid, Labonchara	22°45'40.8"N 89°33'40.1"E	8.05	0.44	1.00	0	511	200	0.06	0.67
2	Sewerage Treatment Plant (STP-2)	Sarna Jame Masjid, Thikrabond	22°48'03.8"N 89°30'56.7"E	7.90	0.61	0.30	0	703	330	0.07	0.71
3	Sewerage Pumping Station-1 (SPS-1)	Sarnali trading, 1 no Custom ghat , 22 no Ward	22°48'41.9"N 89°34'40.1"E	7.50	0.69	0.3	0	770	430	0.061	2.45
4	Sewerage Pumping Station-2 (SPS-2)	Motiyarkhali jame masjid, 31 no Ward	22°47'41.1"N 89°34'49.5"E	7.95	0.55	1.3	0	630	205	0.04	0.36
5	Sewerage Pumping Station-3 (SPS-3),	Near Labonchara sluice gate, DPHE, 31 no Ward,	22°46'51.6"N 89°34'47.6"E	8.05	0.38	0.3	0	454	100	0.03	0.91
6	Sewerage Pumping Station-4 (SPS-4)	Near Nirala Digi, ward no24, DPHE, Nirala R/A,	22°47'47.4"N 89°33'19.7"E	8.25	0.34	0.2	0	398	90	0.05	1.55
7	Sewerage Pumping Station-5 (SPS-5)	Gallamari Kasai khana KCC tube well, ward no 25, Kashim nagar	22°48'04.5"N 89°32'28.3"E	7.55	3.85	0.5	0	4301	855	0.03	0.91
8	Sewerage Pumping Station-6 (SPS-6)	Sonadanga Truck Terminal Alir club para, KCC Tube well,	22°48'30.7"N 89°32'19.7"E	8.25	0.6	1.5	0	770	430	0.01	1.47
9	Sewerage Pumping Station-7 (SPS-7)	Behind the Dr. Rawshan ara clinic, ward no 17, karimnagar	22°49'31.7"N 89°32'23.8"E	7.35	0.65	1.9	0	640	260	0.04	0.93
10	Sewerage Pumping Station-8 (SPS-8)	Sirajul Islam Jame Masjid Tube well, 16 no ward, Islamia college road	22°47'44.7"N 89°29'57.9"E	8.30	0.38	0.2	0	1105	630	0.03	1.72
Bangladesh Standard for Drinking Water SCHEDULE – 3, B (ECR)'97				6.5-8.5	-	10	0	1000	200-500	0.5	6

210. **pH:** pH is a measure of the hydrogen ion concentration in water and indicates whether the water is acidic or alkaline. The measurement of alkalinity and acidity of pH is required to determine the corrosiveness of the water. From the pH value of the groundwater samples it is observed that

all tested drinking water samples are within the Bangladesh Standard for Drinking Water Quality whereas the lowest value (7.35) is found in samples collected from SPS-7 and the highest concentration detected as 8.30 in SPS-8.

211. **Nitrate:** If water containing nitrate levels greater than standard level (10 mg/l), it can cause methemoglobinemia in infant, is a condition in which red blood cells are prevented from transporting oxygen throughout the infant body. The common sources of excessive nitrate can be sewage and agricultural runoff. However, the highest nitrate concentration was found at SPS-7, 0.4mg/l and the lowest value was found at both SPS-4 and SPS-8, 0.2 mg/l which are within the limit of Bangladesh Standard for Drinking Water Quality.

212. **Salinity:** The salinity of water indicates the presence of ionic substances that may come from the reaction of metals and acids containing in water. The highest salinity value of the groundwater was found as 0.6 ppt at SPS-2 and SPS-3 and the lowest value observed was 0.2 ppt at SPS-4, SPS-5 and SPS-8.

213. **Fecal Coliform (FC):** Coliform bacteria are a commonly used bacterial indicator of sanitary quality of foods and water. While coliforms are themselves not normally causes of serious illness, they are easy to culture and their presence is used to indicate that other pathogenic organisms of fecal origin may be present. Fecal pathogens include bacteria, viruses, or protozoa and many multicellular parasites. No presence of FC was detected in any of the tested drinking water samples.

214. **Total Dissolve Solids (TDS):** TDS values indicate the general nature of water quality and are usually related to conductivity. However, the values of TDS of all the samples collected throughout the project influence area are within the standard limit ranges except SPS-5 and SPS-8 which were found as 4301mg/l and 1105 mg/l.

215. **Hardness:** Hardness is an important criterion for determining the suitability of groundwater for domestic, agricultural and industrial uses. As per Bangladesh standard for drinking water quality, permissible limit for hardness is lies between 200 to 500 mg/l. Hardness varied in the range of 90 to 855mg/l. It is observed that the groundwater sample collected near SPS-5 contains very hard water (very hard- >180 mg/l) which can cause scale in utensils and hot water system in boilers etc.

216. **Ammonia:** Ammonia is a colorless, pungent gaseous compound of hydrogen and nitrogen that is highly soluble in water. Ammonia is not typically found in freshwater drinking sources. However, drinking water sources close to agricultural or animal confinement areas are especially prone to ammonia contamination, as the soluble ammonia from fertilizers or animal waste will seep into the groundwater via infiltration. The concentration for all the samplings are ranges from 0.01 to 0.07 mg/l which is much below the permissible limit of DOE for drinking (0.5 mg/l).

217. **Phosphate:** Phosphate may occur in groundwater as a result of domestic sewage, detergents, agricultural with fertilizers and industrial waste water. The values of phosphate of all the samples collected throughout the project influence area ranges between 0.67 mg/l to 2.45 mg/l are much below the permissible limit of DOE (6 mg/l).

E. Air Environment

1. Climate of the Project area

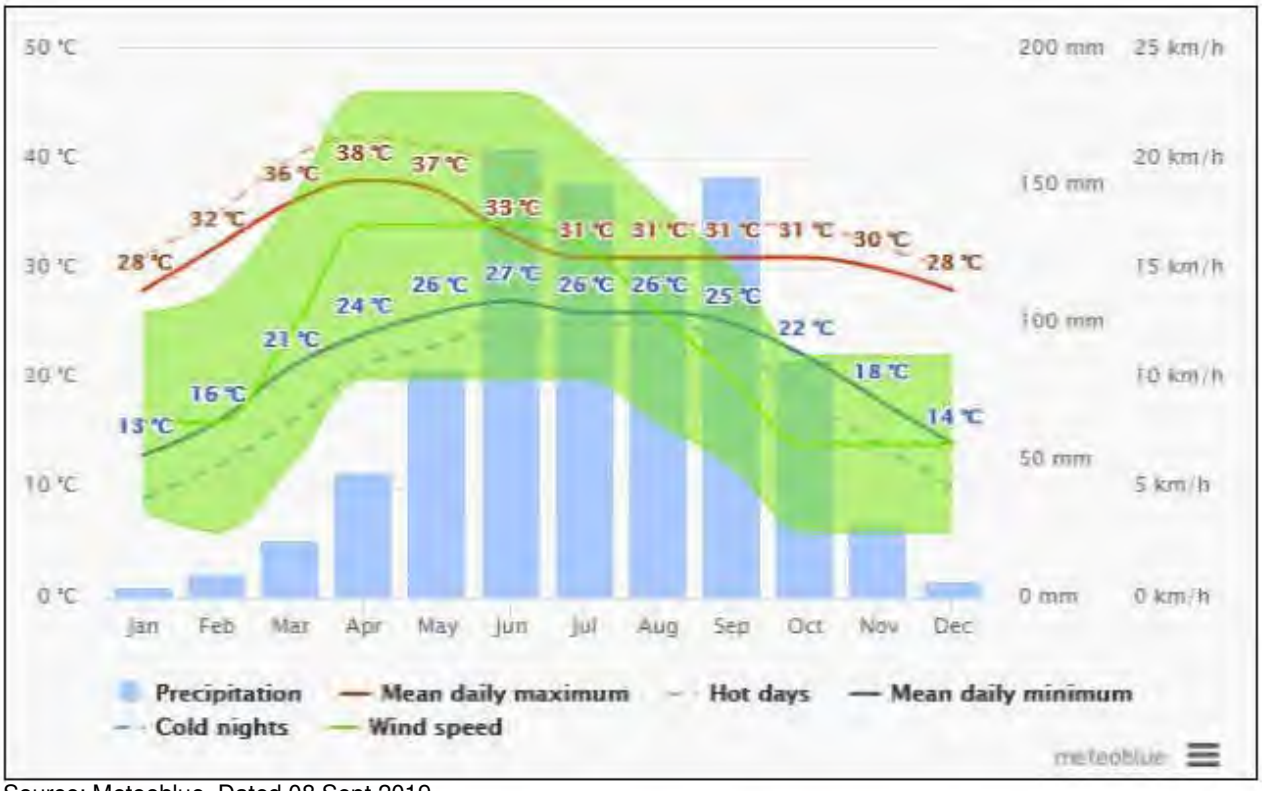
218. Climate is the average condition of the atmosphere near the earth's surface over a long period of time. Geographical location and physical settings of any country directly govern the

climatic factors like temperature, precipitation, humidity, cloud, barometric pressure etc. Similarly lying in the tropical monsoon region and surrounded by the Assam hills in the east, the Meghalaya Plateau in the north and lofty Himalayas lying farther to the north, Bay of Bengal on the south and West Bengal along with the vast area of Gangetic plain on the west also determines its characteristic high temperate, heavy rainfall and often excessive humid seasonal variations.

219. Three distinct seasons can be recognized in Bangladesh:
(i) Cool dry season- November through February
(ii) Pre-monsoon hot season- March through May
(iii) Rainy monsoon- June through October

220. Khulna city, being placed on the northern part of Khulna district, lying on the South-West climatic region of Bangladesh, receives around 1900 mm of rainfall a year. More than 80% of the total rainfall pours down during the monsoon, June being the wettest month taking into account last 30-years average rainfall data. April is the warmest month while January gives the coolest feeling in a year. The difference between the mean daily maximum and minimum temperature is around 25 °C. The following figure also shows the hot days' and cold nights' (dashed red and blue lines) average hottest and coldest temperature of each month of the last 30 years.

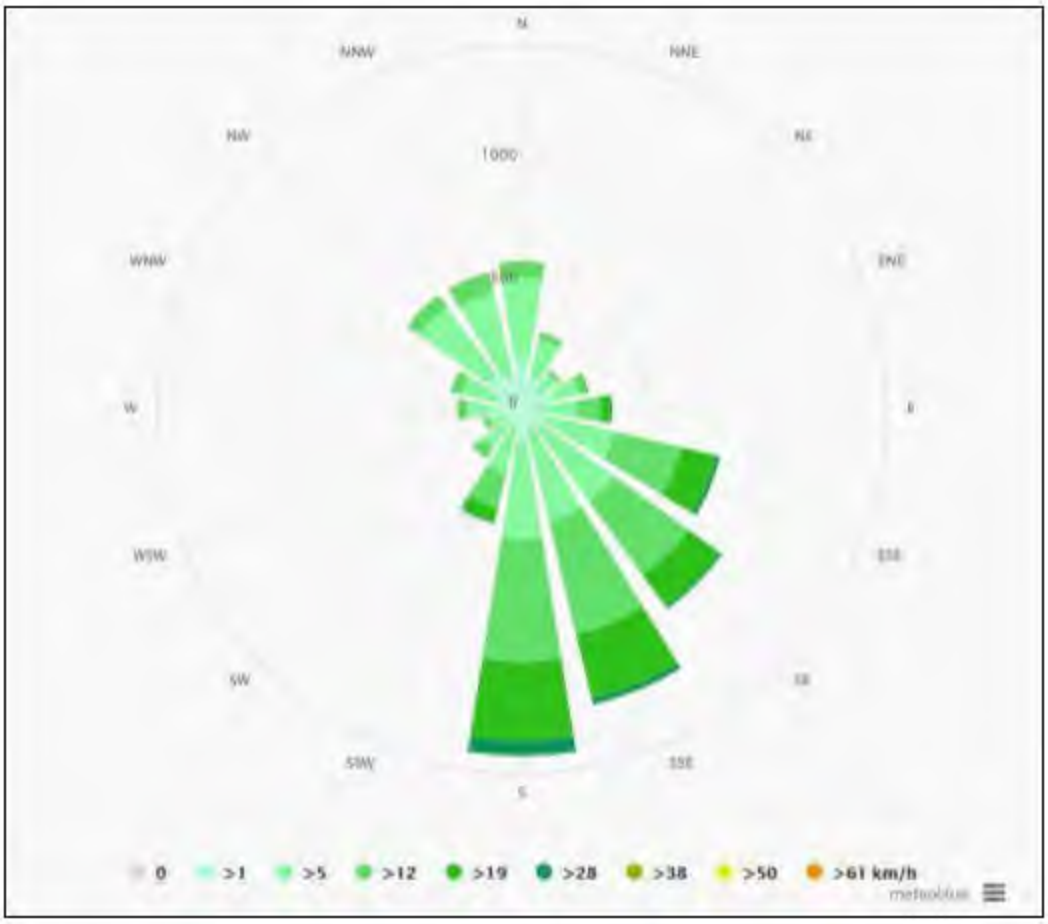
Figure 21: Climate Profile of Khulna City



Source: Meteoblue, Dated 08 Sept 2019.

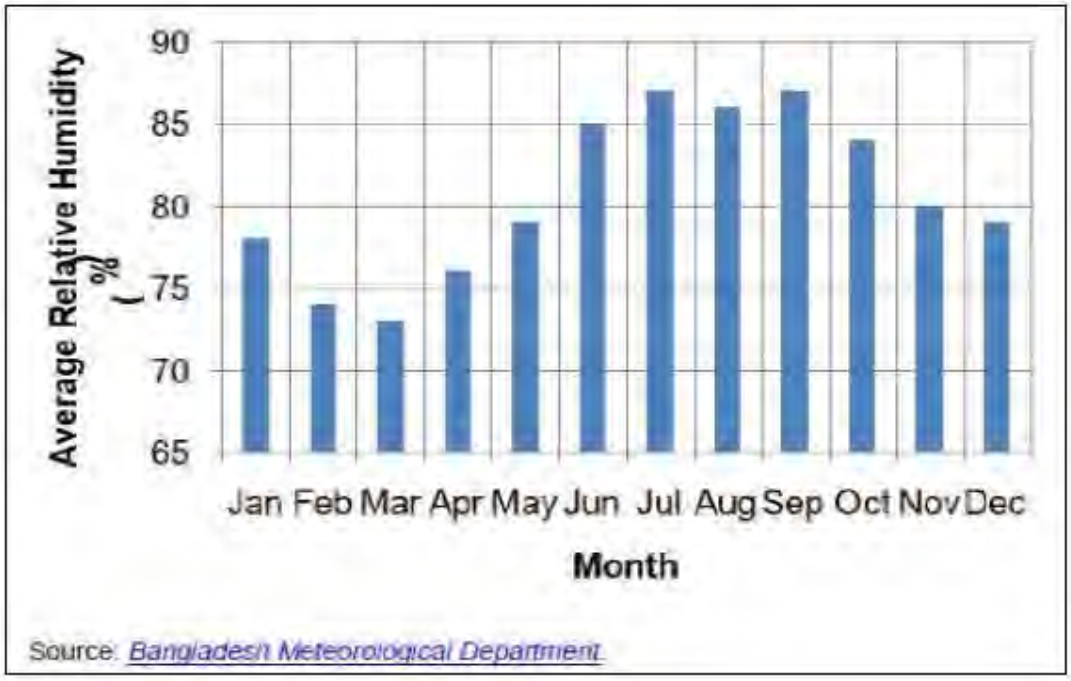
221. Wind speed and direction are also two most important weather parameters. Wind rose diagram can provide the information about the prevailing wind speed and direction over a particular area. The following wind rows for Khulna shows the number of hours per year the wind blows from the indicated direction and the predominant direction is confined within a zone stretching from South and East-South-East direction. Average wind speed ranges from 5 to 19 km/h during the maximum period of the year.

Figure 22: Wind Rows Diagram for Khulna City



222. Being situated in the Southern coastal region of Bangladesh, another strong parameter of daily weather of Khulna is average relative humidity, which is relatively high all the year round. 85% is the average relative humidity from June through October (monsoon period) month.

Figure 23: Average Relative Humidity (%)

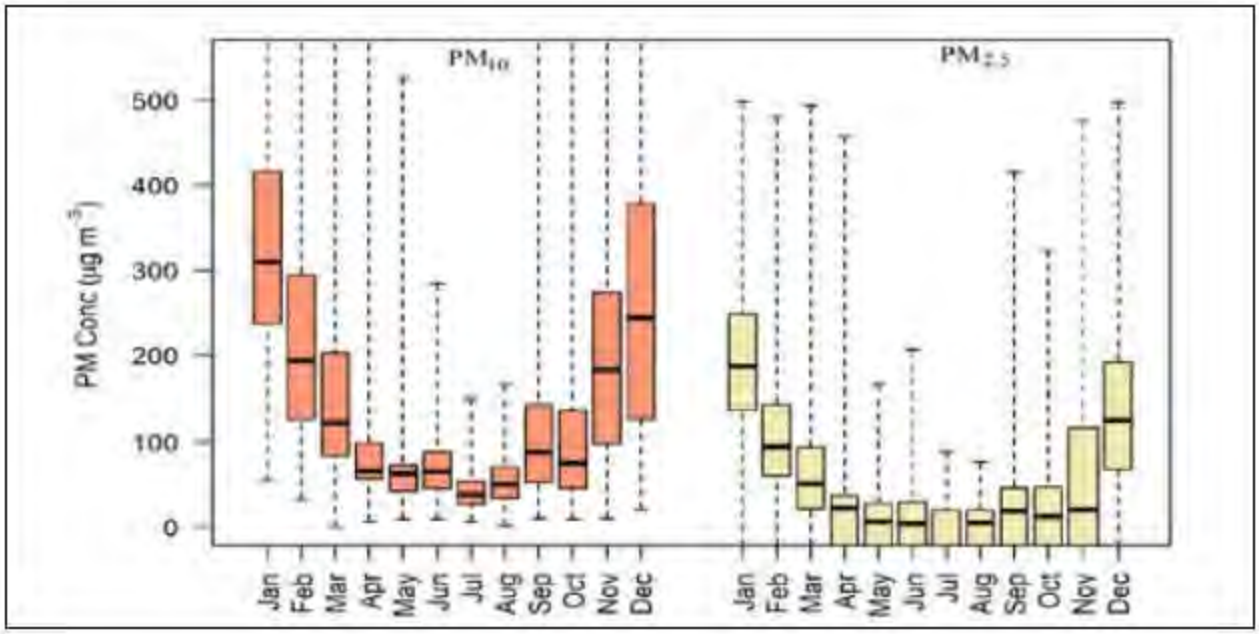


2. Air Quality

223. Six pollutants (i.e. particulate matter, sulfur dioxide, nitrogen oxides, ozone, carbon monoxide and lead) are termed as the criteria air pollutants (CAP) for their abundances as pollutants in the atmosphere and ability to harm human health, plants, and properties. The Government of Bangladesh has set standards for each of the CAP for controlling their presence in air. The CASE project under the DOE monitors all of the CAPs, except lead, in air of the major cities of the country. Lead concentrations in ambient air are significantly reduced after the phase-out of lead additives in gasoline in mid-1999.

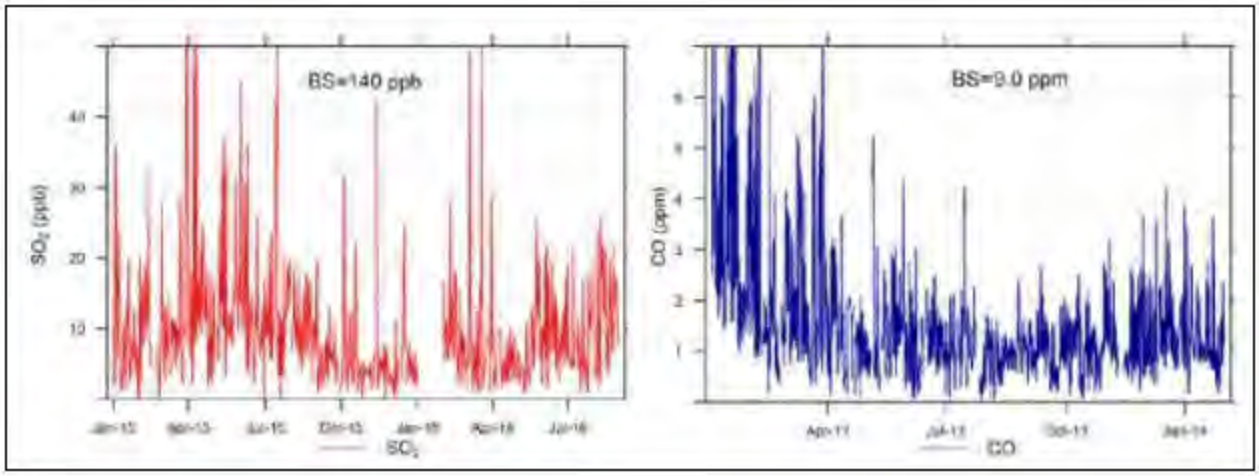
224. Like other big cities of Bangladesh, the growing demand of transportation in Khulna results in a high number of road kilometers with high diesel traffic and their emissions. Significant numbers of brick kilns are also operational to meet the ever increasing construction demand. Some heavy and medium industries like hardboard mills, jute mils, match factory, shipyard, cement industry etc. are also responsible for emissions to the air. Eleven Continuous Air Monitoring Stations (CAMS) have so far been established in 8 major cities, including Khulna (CAMS-8 in Baira, Khulna), under the Clean Air and Sustainable Environment (CASE) project of the Department of Environment. Five criteria air pollutants (PM, SO2, NOx, O3, and CO) and meteorology parameters are being monitored every minute in those CAMS. Instead of detailed presentation of air quality status in Khulna, a snapshot is demonstrated in the following for the poor data capture at Khulna station. Only those data and the period having adequate validity are presented here. The trends in PM concentration are as usually influenced by the seasonal impacts – very high PM concentration in dry season and low concentration in wet season. Like other urban areas, December to January is the polluted period in Khulna followed by February, March and November. Figure 23 shows Box-whisker plots of PM concentrations in different months of the year.

Figure 24: Box-whisker Plots of PM Concentrations in Different Months in Khulna (CASE Project, 2012-18)



225. The status of gaseous pollutants, like SO2 and CO in the air irrespective of the seasons in Khulna is found very accommodating.

Figure 25: Trends in Daily Average SO2 Conc. (left) and 8-h Average CO Conc. (right) in Khulna



226. Data on Total Suspended Particulates (TSP) from the Department of Environment reveal varying ambient air quality levels in the different parts of Khulna city. Most of the areas studied show TSP levels within the national standard, except for one study area where the level is extremely above the national standard. Site analysis explains that the sampling location for this high TSP value is near a bus station in the busy center of the city. Table below shows these data.

Table 29: Total Suspended Particulates Levels in Khulna City

Date	Sampling Location	TSP (µg/ m^3)
27 February 2020	Jaman Foundry and Engineering works, Bscic, Khulna	185
24 February 2020	M/S Kazi Sobhan Auto Rice Mill, Labonchara, Rupsa, Khulna	194
23 February 2020	Sonadansa Bus standn Khulna Sadar, Khulna'	851
09 January 2020	Golori Jute Ltd. Jabusha, Rupsha, Khulna	157
09January 2020	/S Kazi Sobhan Auto Rice Mill, Rupsha, Khulna	194
National Standard		**200**

227. Air quality measurements carried out in November 2020 at ten locations. The laboratory test results are given in Appendix 5 and the monitoring results are given in Table 30 and compared with Bangladesh national standards for ambient air quality. The key air quality parameters suspended particulate matter (SPM), particulate matter-PM10 and PM2.5, oxides of sulphur-SOx, oxides of nitrogen–NOx and carbon monoxide-CO were analysed from samples collected over an hour period at each sampling sites. Figure 26 shows air quality monitoring in the project influence area.

Figure 26: Air Quality Monitoring in Project Site





Table 30: Ambient Air Quality in Project Area

Sl. No.	Project Component	Sampling Location	GPS	Air Quality Parameter					
				SPM (µg/m^3)	PM10 (µg/m^3)	PM2.5 (µg/m^3)	NOx (µg/m^3)	SOx (µg/m^3)	CO (mg/m^3)
1	Sewerage Treatment Plant (STP-1)	Mathabhanga	22.762951N 89.566675E	84	77	40	40	10	0.80
2	Sewerage Treatment Plant (STP-2)	Thikrabond	22.803748N 89.517679E	73	67	55	93	12	0.75
3	Sewerage Pumping Station-1 (SPS-1)	Custom Ghat	22.812129N 89.576111E	106	99	70	112	32	0.70
4	Sewerage Pumping Station-2 (SPS-2)	Motiyarkhali Khal	22.794798N 89.580758E	166	137	99	96	28	0.76

Sl. No.	Project Component	Sampling Location	GPS	Air Quality Parameter					
				SPM ($\mu g/m^3$)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	NOx ($\mu g/m^3$)	SOx ($\mu g/m^3$)	CO (mg/m^3)
5	Sewerage Pumping Station-3 (SPS-3),	Labonchara Sluice Gate	22.779604N 89.581163E	89	74	35	73	15	0.54
6	Sewerage Pumping Station-4 (SPS-4)	Nirala	22.796017N 89.556655E	53	47	37	103	37	0.45
7	Sewerage Pumping Station-5 (SPS-5)	Kashimnagar, Gallamari	22.801074N 89.543759E	103	91	33	85	10	0.39
8	Sewerage Pumping Station-6 (SPS-6)	Truck Terminal, Sonadanga	22.825175N 89.540498E	117	102	40	103	21	0.28
9	Sewerage Pumping Station-7 (SPS-7)	Karimnagar, Sonadanga	22.825175N 89.539418E	82	72	39	45	14	0.33
10	Sewerage Pumping Station-8 (SPS-8)	Islamia College Road	22.832049N 89.531470E	118	105	46	8	5	0.16
*Bangladesh Standard for Ambient Air Quality				200 (24-hr)	150 (24-hr)	65 (24-hr)	100 (Annual)	365 (24-hr)	10 (8-hr)

*Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19 July 2005 vide S.R.O. No. 220-Law/2005.

228. **Suspended Particulate Matter (SPM):** SPM concentrations in ambient air at the project area are recorded ranges from 53 µg/m3 to 161.57µg/m3. The concentration level of all locations are reported below the National Ambient Air Quality Standards (NAAQS) of Bangladesh. However, the highest concentration was recorded at SPS-2 located in Motiyarkhali Khal area due to heavy traffic movement.

229. **PM10:** Particle pollution, also called particulate matter or PM, is a mixture of solids and liquid droplets floating in the air. Some particles are released directly from a specific source, while others form in complicated chemical reactions in the atmosphere. PM10 are 2.5 to 10 micrometers in diameter. However, PM10 concentration for all the samples were reported below the National Ambient Air Quality Standards where the highest value is recorded in Motiyarkhali Khal (SPS-2) due to dust stirred up by vehicles on roads.

230. **PM2.5:** PM2.5 are 2.5 micrometers in diameter or smaller, and can only be seen with an electron microscope. Fine particles are produced from all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes. The highest PM2.5 value was found as 99µg/m3 at SPS-2 in Motiyarkhali Khal area and the lowest value observed was 33 µg/m3 at SPS-5 in Kashimnagar. The test results show that the values PM2.5 are within the national standards.

231. **Sulfur oxides (SOx):** Sulfur oxides are compounds of sulfur and oxygen molecules. Sulfur dioxide (SO2) is the pre-dominant form found in the lower atmosphere. It is a colorless gas that can be detected by taste and smell in the range of 1,000 to 3,000 micrograms per cubic meter (µg/m3). Concentration of SO2 for all the samples are within national standard for air quality. The

highest SO2 concentration was found at SPS-8, 5µg/m3. The lowest value was found SPS-4 in Nirala, 37µg/m3.

232. **Nitrogen Oxides (NOx):** In atmospheric chemistry, NOx is a generic term for the nitrogen oxides that are most relevant for air pollution, namely nitric oxide (NO) and nitrogen dioxide (NO2). These gases contribute to the formation of smog and acid rain, as well as tropospheric ozone. The concentration was exceeded national standard for air quality at SPS-1 (112µg/m3) in Custom ghat area where heavy traffic movement is reported. However, the lowest value was found at SPS-8 in Islamia College road area, 8µg/m3.

233. **Carbon Monoxide (CO):** Carbon monoxide is a gas and is found in air. High levels of carbon monoxide are poisonous to humans and, unfortunately, it cannot be detected by humans as it has no taste or smell and cannot be seen. The main sources of additional carbon monoxide are motor vehicle exhaust and some industrial activities. Cigarette smoking and cooking is major indoor sources of carbon monoxide. CO concentrations are within the national standard for all the sampling locations.

F. Noise Environment

234. Excessive noise is a potential issue for both human and biological receivers and can cause a range of negative issues, from mild annoyance and moderately elevated levels of aggression to significant disturbance of behavioral patterns and in severe cases temporary or permanent hearing loss. Surprisingly, there was tranquility prevailing on the site, as there was neither traffic burden, nor residential or commercial establishment in the area. However, the site will definitely generate noise and cacophony during the construction and operational period.

235. The following aspects are particularly relevant to the noise generation:

Construction Period:
(i) Noise and vibration associated with construction activities at the STP site;
(ii) Noise associated with the revetment construction;
(iii) Noise and vibration associated with construction activities at the interceptor sewer locations; and
(iv) Noise associated with construction traffic.

Operational Period:
(i) New sources of noise associated with the operation of the STP; and
(ii) Noise associated with operational traffic.

236. Vehicles and equipment will generate noise during the construction period according to the following ranges, which need to minimize adopting better engineering and management practices.

Table 31: Noise Ranges at 50ft from Common Construction Equipment

Equipment	Noise Level Range (dBA)	Equipment	Noise Level Range (dBA)
Heavy trucks (avg.)	82 – 96	Backhoe (avg.)	72 – 90
Grader (avg.)	79 – 93	Paver (+grind) (avg.)	85 – 89
Excavator (avg.)	81 – 97	Front loader (avg.)	72 – 90
Crane (avg.)	74 – 89	Generator (avg.)	71 – 82

Equipment	Noise Level Range (dBA)	Equipment	Noise Level Range (dBA)
Pile driver (peak)	81 – 115	Jackhammer/rock drills (avg.)	75 – 99
Concrete mixer (avg.)	75 – 88	Roller (vg.)	72 – 75
Compressor (avg.)	73 – 88	Pumps (avg.)	68 – 80

237. According to World Health Organization's Guidelines for Community Noise (1999), daily sound pressure levels of 50 decibels (dB) or above can create discomfort amongst humans, while ongoing exposure to sound pressure levels over 85 dB is usually considered the critical level for temporary hearing damage. According to the noise quality standards as per schedule 4 of ECR'1997, permissible noise limit in an industrial area is 75 dB unit during the daytime (6 am to 9 pm) and 70 dB unit during the night (9 pm to 6 am), whereas the values stands at 60 dB in a mixed area during the day time and 50 dB during the night. Labonchora STP area will have more likely chance to be an industrial area in future, whereas the Tikraband (beside Khulna-Satkhira road) STP area will be a mixed area in near future.

238. Data from Bangladesh Department of Environment on noise level in Khulna city reveal slightly higher than the noise level standard for day time in commercial areas. Logically, these noise levels are attributed to busy commercial activities, transportation, construction activities and other human activities in the city center. Table below summarizes these noise level measurements.

Table 32: Noise Level Measurements in Various Locations in Khulna City

Date	Sample Location	Results(dBA)
25/3/20	Power House More, Khulna	68.5
25/3/20	In front of Gazi Medical College, Khulna	69.5
3/3/20	Dakbangla More, Khulna	82.4
3/3/20	Feryghat More, Khulna	81.3
3/3/20	Royal More, Khulna	80.6
3/3/20	Picture Palace More, Khulna	76.5
3/3/20	Rupsa Traffic More, Khulna	78.7
3/3/20	Sonadanga Bus Terminal, Khulna	84.6
3/3/20	Daulatpur Busstand, Khulna	80.3
3/3/20	Gollamari Busstand, Khulna	79.4
Bangladesh Standards- Commercial Area (Day)		**70**

239. A-weighted sound pressure level was measured at ten locations in the project area during the month of November 2020 by using calibrated noise level meter. Noise level was measured at regular intervals of 15 minutes and was measured during the day and night times using a calibrated CEM DT-8820 set to A-weighting and statistical analysis settings. The values of noise levels at project sites are presented in Table 33. The details result is given in Appendix 5 of this report. Figure 27 shows noise level measurement in the project influence area.

Figure 27: Noise Level Monitoring in Project Site





Table 33: Noise Level Measurement in Project Area

Sl. No.	Project Component	Sampling Location	GPS	Noise Level (dBA) (LAeq)		Bangladesh Standard*		Land Use Category
				Day	Night	Day	Night	
1	Sewerage Treatment Plant (STP-1)	Mathabhanga	22.762951N 89.566675E	51	44	60	50	Mixed Area
2	Sewerage Treatment Plant (STP-2)	Thikrabond	22.803748N 89.517679E	42	41	60	50	Mixed Area
3	Sewerage Pumping Station-1 (SPS-1)	Custom Ghat	22.812129N 89.576111E	47	37	60	50	Mixed Area
4	Sewerage Pumping Station-2 (SPS-2)	Motiyarkhali Khal	22.794798N 89.580758E	49	45	60	50	Mixed Area
5	Sewerage Pumping Station-3 (SPS-3),	Labonchara Sluice Gate	22.779604N 89.581163E	57	46	60	50	Mixed Area
6	Sewerage Pumping Station-4 (SPS-4)	Nirala	22.796017N 89.556655E	48	44	60	50	Mixed Area
7	Sewerage Pumping Station-5 (SPS-5)	Kashimnagar, Gallamari	22.801074N 89.543759E	58	51	60	50	Mixed Area
8	Sewerage Pumping Station-6 (SPS-6)	Truck Terminal, Sonadanga	22.825175N 89.540498E	46	40	60	50	Mixed Area
9	Sewerage Pumping Station-7 (SPS-7)	Karimnagar, Sonadanga	22.825175N 89.539418E	47	42	60	50	Mixed Area
10	Sewerage Pumping	Islamia College Road	22.832049N 89.531470E	45	38	60	50	Mixed Area

Sl. No.	Project Component	Sampling Location	GPS	Noise Level (dBA) (LAeq)		Bangladesh Standard*		Land Use Category
				Day	Night	Day	Night	
	Station-8 (SPS-8)							

*Notes: Land use category is based on the classification provided in the Noise Pollution Control Rules (2006), The sound level standards for mixed area are 60 at day time and 50 at night time.

240. The Noise Pollution (Control) Rules 2006 were adopted under Section 20 of the Bangladesh Environment Conservation Act 1995 with a view to laying down the specific guidelines regarding noise pollution and the degree of allowable noise in different areas.

241. The Rules lay down the permitted noise levels for both day and night-time in five types of areas silent areas, residential areas, mixed areas, commercial areas and industrial areas. Silent areas include hospitals, educational institutions, offices and similar establishments, and their surrounding 100-meter area. Silent areas are areas where the noise level is to be kept at the lowest (50 decibels at day and 40 decibels at night); permitted noise level for residential areas is 55 decibels at day and 45 decibels at night. In industrial areas, where the highest noise levels are permitted, the limit is 75 decibels at day and 70 decibels at night. As per the Rules, the hours between 6 am and 9 pm are to be considered as daytime, and the remaining hours are considered as night-time. A separate range is prescribed for vehicular noise under Schedule-Z to the Rules, and the use of horns is completely prohibited in areas identified as silent areas.

242. All the locations are generally within the limits prescribed by the ambient noise level standards by DOE. Noise levels vary from 42 dB(A) at STP-2 to 58 dB(A) at SPS-5 during day time. In case of night time measurement, the noise level at SPS-5, 51 dB(A) exceeded the standard. The noise level at night was found a little bit higher than the day time in STP-2, however, both of the values are within standard set for mixed areas (50 dB). The vehicle movements are the major source of noise along the project area; the air horns used by the trucks are contributing for the higher levels of the noise.

G. Ecological Environment

243. **Flora:** The Labonchora STP site was found devoid of any vegetation, filled only with stagnant water. The peripheral areas had some standing trees, which include Betel nut palm (***Areca catechu***), coconut (***Cocos nucifera***), Khejur (***Phoenix sylvestris)***, etc.

244. The vegetation within the Tikraband site 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***), etc. Homestead vegetation provides good shelter and habitat for local animals like birds, reptiles and amphibians.

245. **Fauna:** Consultation with local people revealed that the Labonchora STP site was seasonally used for fish cultivation and culture fishes at the site included Rui (***Labeo Rohita), Catla (Catla catla), Mrigel (Cirrhinu scirrhosus, Silver Carp (Hypophthalmichthyes molitrix), Grass Carp (Ctenopharyn godonidela), Shol (Chan nastriatus), Bagda Chingri (Penaeus monodon, etc.***

246. The Tikraband site was found to have several shallow ponds, being used for seasonal fish cultivation and the culture fishes included Rui (***Labeo Rohita), Catla (Catla catla), Mrigel (Cirrhinu***

scirrhosus, Silver Carp (Hypophthalmichthyes molitrix), Grass Carp (Ctenopharyn godonidela), Shol (Chan nastriatus), etc***.***

Table 34: Terrestrial and Aquatic Flora and Fauna Resources in Khulna City

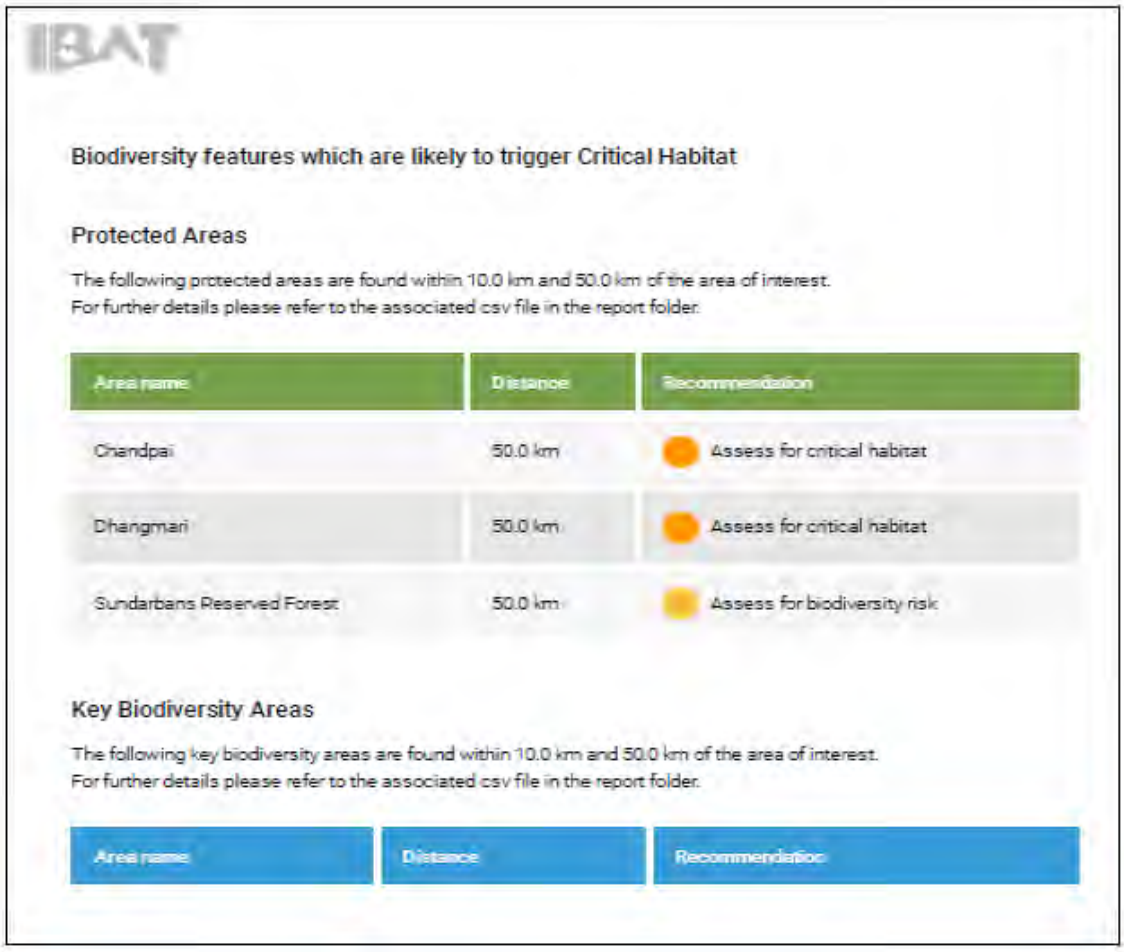
SL No.	Local Name	Scientific Name	Status
Terrestrial Flora			
1.	Betel nut	***Areca catechu***	Fairly Common
2.	Mashkalai (type of pulse)	***Phaseolus mungo roxb***	Fairly Common
3.	Potato	***Solanum tuberosum***	Fairly Common
4.	Ground Nut	***Arachis hypogea***	Fairly Common
5.	Ginger	***Zingiber officinale***	Fairly Common
6.	Wheat	***Triticum aestivum***	Fairly Common
7.	Til	***Sesamum indicum***	Fairly Common
8.	Kumra	***Cucurbita maxima***	Fairly Common
Terrestrial Fauna (Reptiles)			
1.	Anjila	***Mabuya carinata***	Common
2.	Dhura Shap	***Amphiesma stolata***	Common
3.	Matia Shap	***Atretium schistosum***	Common
4.	Tiktiki	***Hemidactylus brooke***	Common
5.	Daraish Shap	***Ptyas mucosus***	Fairly Common
6.	Gui Shap	***Varanus nubulosus***	Fairly Common
Terrestrial Fauna (Mammals)			
1.	Babur	***Pteropus giganteus***	Common
2.	Idur	***Mus musculus***	Common
3.	Shial	***Vulpes bengalensis***	Common
4.	Chika	***Pipistrellus. Sp***	Common
5.	Beji	***Herpestes***	Fairly Common
Avifauna (Birds)			
1.	Choroi	***Passer domesticus***	Common
2	Doyel	***Opsychus sularis***	Common
3.	Kak	***Carvus splendens***	Common
4.	Ghugho	***Streptapelia Orientalis***	Common
5.	Shalik	***Stuma contra***	Common
6.	Tuntuni	***Orthotomus sutorius***	Common
7.	Machranga	***Helcyon smyrrensis***	Fairly Common
8.	Haludpakhi	***Oriolus xanthornus***	Fairly Common
Insects			
1.	Dragon fly nymph	***Odonata***	Fairly Common
2	Damsel fly nymph	***Odonata***	Fairly Common
3.	Water strider	***Hemiptera***	Fairly Common
4.	Midge	***Diptera***	Fairly Common
5.	Flies	***Diptera***	Fairly Common
6.	Ant	***Hymenoptera***	Common
7.	Caddisfly	***Trichoptera***	Fairly Common
Fish			
1.	Pabda	***Ompoc pabda***	Fairly common
2	Golsha	***Mystus cavasius***	Fairly common
3.	Bele	***Glossogobius giuris***	Fairly common
4.	Tengra	***Mystus vittatus***	Common
5.	Puti	***Puntius conchonius***	Common
6.	Fali	***Notopterus notopterus***	Fairly common
7.	Kachki	***Corica suborna***	Fairly common
8	Mola	***Amblypharyngodon mola***	Common

SL No.	Local Name	Scientific Name	Status
9	Kakila	***Xenentodon cancila***	Fairly common
10	Chapila	***Gudusia chapra***	Fairly common
11	Kholisha	***Colisha fasciatus***	Common
12	Chingri	***Macrobrachium eqidense***	Common
13	Shol	***Channa striates***	Common
14	Taki	***Channa punctatus***	Common
15	Shing	***Heteropneustes fossilis***	Fairly common
16	Koi	***Anabas testudineus***	Fairly common
17	Gozar	***Channa marulius***	Fairly common
18	Chela	***Chela cachius***	Fairly common
19	Rui	***Labeo rohita***	Common
20	Katla	***Catla catla***	Common
21	Kalibaush	***Labeo calbasu***	Common
22	Boal	***Wallago attu***	Common
23	Ayre	***Sperata aor***	Fairly Common
24	Bain	***Mastacembelus armatus***	Common
25	Chital	***Chitala chitala***	Fairly Common
26	Fasha	***Setipinna phasa***	Fairly Common
27	Bata	***Liza Persia***	Fairly Common
28	Dari	***Scistura scaturigina***	Fairly Common

Source: Second City Region Development Project, 2019

247. **Critical Habitats**. In order to ensure that the assessment of impact is robust, a biodiversity assessment has been undertaken relative to the subproject locations. The Integrated Biodiversity Assessment Tool (IBAT) was initially used to screen and assess potential risks on the protected areas or critical habitat that may exist around the project sites (default area of analysis of 50 km radius). Initial screening results show there are no key biodiversity areas around the immediate vicinities of the project sites, but likely a critical habitat due to the presence protected areas and species within this default area of analysis. A more detailed critical habitat assessment was undertaken following IFC Performance Standard 6 Criteria. Results show that the project is at considerable distance from the identified protected areas and that the impact of project activities to these areas is not expected. However, results also show that the South Asia River Dolphin, an IUCN Red List species, qualifies the Bhairab and Rupsha river system bordering Khulna city as critical habitat. The complete critical habitat assessment report is in Appendix 4. Figures 25-26 below show the screen shots of the IBAT Proximity Test Results.

Figure 28: IBAT Results for the Mathabanga STP-1 Site



IBAT

Biodiversity features which are likely to trigger Critical Habitat

Protected Areas

The following protected areas are found within 10.0 km and 50.0 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

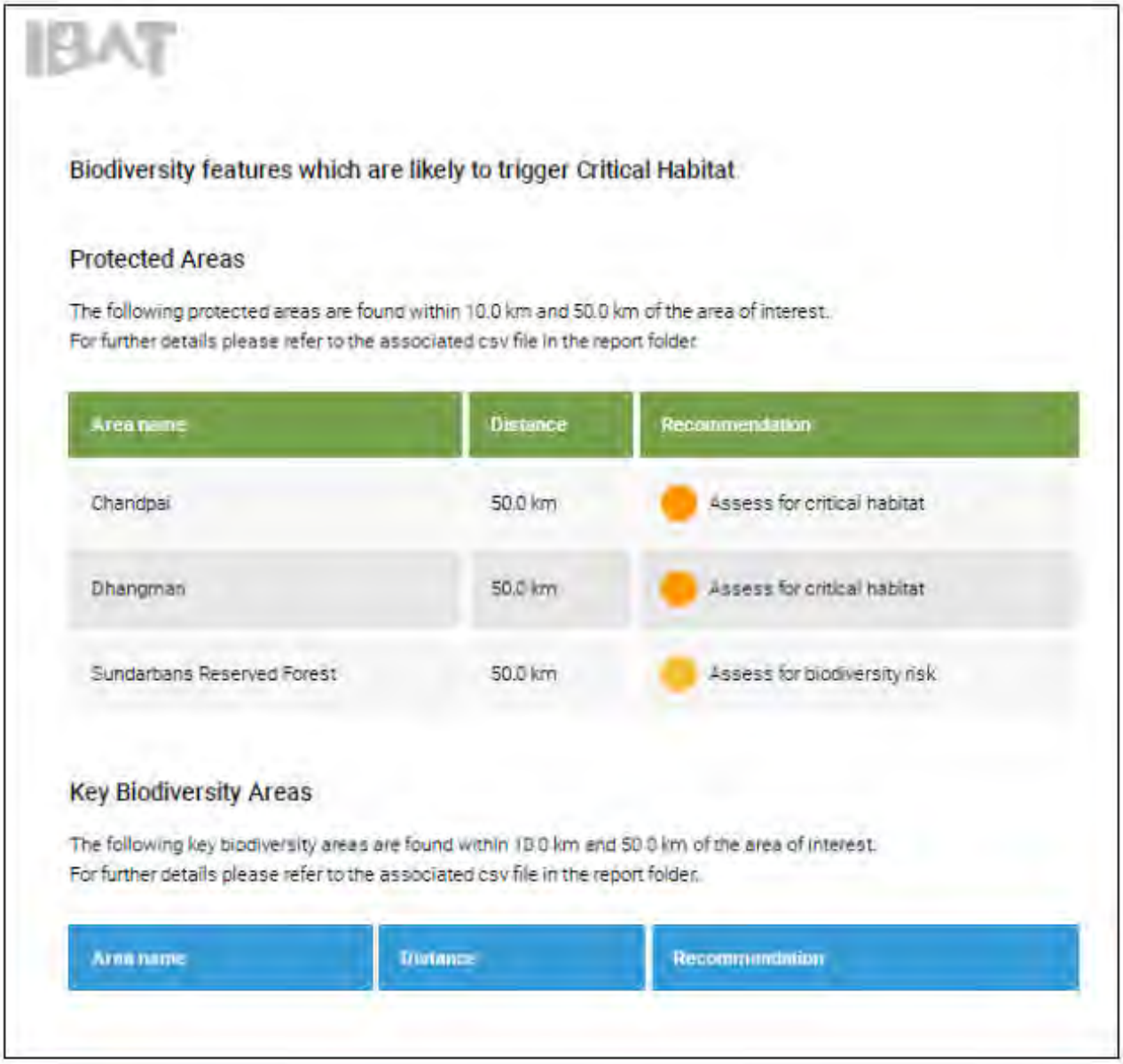
Area name	Distance	Recommendation
Chandpai	50.0 km	Assess for critical habitat
Dhangmari	50.0 km	Assess for critical habitat
Sundarbans Reserved Forest	50.0 km	Assess for biodiversity risk

Key Biodiversity Areas

The following key biodiversity areas are found within 10.0 km and 50.0 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	Recommendation

Figure 29: IBAT Results for the Thikrabanda STP-2 Site



IBAT

Biodiversity features which are likely to trigger Critical Habitat

Protected Areas

The following protected areas are found within 10.0 km and 50.0 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	Recommendation
Chandpai	50.0 km	Assess for critical habitat
Dhangmari	50.0 km	Assess for critical habitat
Sundarbans Reserved Forest	50.0 km	Assess for biodiversity risk

Key Biodiversity Areas

The following key biodiversity areas are found within 10.0 km and 50.0 km of the area of interest.
For further details please refer to the associated csv file in the report folder.

Area name	Distance	Recommendation

248. As precautionary measure, the IEE provides measures to ensure no critical habitats, or features for which they are qualified as critical habitats, will be impacted.

H. Socio-economic Environment

249. Primary data were collected using tools and techniques such as Rapid Rural Appraisal, Key Informant Interview (KII), observations and informal consultations. Secondary data were collected from Bangladesh Bureau of Statistics (BBS) 2012 and other available government publications.

1. Population

250. Khulna city corporation area is subdivided into 31 smaller administrative units (‘ward’ in local language). The population consists of 51% and 49% females. The male-female ratio is 105

which is higher than the national average of 100.3 (BBS, 2012). The average household size is about 6.

2. Age Structure

251. Prime working age group (25-59 years old) dominates the population (43%) followed by children, 30% (with age group 0-14 years old). About 26% of the population belongs to the age group 30-49 years old and the lowest, about 3% belongs to the age group of 60-64 years old. This classification is important as the size of young population (under age 15) would need more investment in education and health while size of older populations (ages 65 and over) would need more investments in the health sector.

3. Housing Condition

252. On average, 14.1% of the households are in pucca, 51.2% are kutcha, 30.6% are in semi pucca while the rest of the households are in Jhupri house (4.1%).

4. Literacy Rate and Employment

253. Literacy rate is 60% compared to the national rate of 52%. Male population accounts for 62% and female accounts for 57%. About 41% is employed in different sectors of which 34% are male and 7% are female. About 34.4% of people are engaged in household work while 24.2% are not working. Main occupation is service (47.8%) in which 38.2% is male and 9.6% is female. This is followed by people engaged in agriculture (27.1%) and about 25.1% are engaged in industrial work.

5. Labor Availability and Wage Rate

254. Daily wage rate varies between 500Tk to 700Tk. A few migrant laborers stay in the study area all the year round and return to their homes at the end of the year with all their income. Women's participation in the agricultural sector is negligible.

6. Land Use Pattern

255. The aerial distance of both STP sites from the Khulna city center is around 6 km. The STP-1 site connected with almost a free road where usual daily traffic is still very negligible due to primarily the undeveloped nature of the area. The STP-2 site is easily accessible following a direct connectivity to the city with Khulna-Satkhira Highway, which is relatively a busy roadway with significant numbers of traffic plying over.

256. The designated sites for STPs were found undeveloped, filled with patches of cultivated land where vegetables were grown, number of shallow water bodies/ponds were therein, several fruit and bushy trees were found standing.

257. However, with recent development trend being perceived in and across the city and surrounding areas and huge investment in energy and infrastructure sector by the government itself, new urban centers are about to bloom across the places immediately outside of the existing city or in the fringe areas.

Figure 30: Land Use Map of the Project Area



7. Land Acquisition

258. For the implementation of the proposed Khulna Sewage System Development project, KWASA has planned to acquire about 3,603 decimals of lands that have already been identified in 10 different places. Based on the draft resettlement plan (RP), it is evident that among the total proposed land, 98.7% (3,553.58 decimals) of the land is found under the private ownership and the remaining 1.3% (49.42 decimals) land is owned by the government. Land acquisition of these private lands are ongoing following government guidelines and ADB SPS requirements. Accordingly, the draft RP will be finalized based on the developments under the project.

8. Business and Industry

259. Khulna is the third largest economic center in Bangladesh. It is situated north of the Port of Mongla and has various heavy and light industries. However, industrial pattern has been changed in recent years in Khulna. The major sectors are jute, chemicals, fish and seafood packaging, food processing, sugar mills, power generation and shipbuilding. Currently, cement manufacturing and LNG gas terminal is also flourishing. The region has an Export Processing Zone which has attracted substantial foreign investment. The city is home to the corporate branch offices of numerous national companies, including among others, M. M. Ispahani Limited, Beximco, James Finlay Bangladesh, Summit Power and the Abul Khair Group. Some of the largest companies based in the city include Khulna Shipyards, Bangladesh Oxygen, Platinum Jubilee Mills, Star Jute Mills and the Khulna Oxygen Company.

9. Drinking Water and Sanitation

260. At present 70% of the population has access to piped water supply, remaining has the point source. 84% population has the toilet with septic tank and 16% has pit latrine. However, most of the cases, septic tanks are connected with the surface drain.

261. According to the feasibility study,[25] a portion of ward 12 being served by an existing centralized sewerage system, partially built before independence covering 100 households and augmented after 1971 covering another 500 households. A sewage pumping station with two HP pumps operating 8-10 hours a day convey wastewater to river Rupsha without any treatment. In order to verify and assess the system, it is reported that there were no documents available at present. In other areas, toilets with septic tanks are predominant in households which on an average almost 66% and the rest of 34% have access to pit latrine to manage their wastewater. Majority of the septic tanks are not provided with any soak pits. As the groundwater table of Khulna is high in Khulna, adequate dispersal of wastewater becomes a serious issue in addition to the overflowing of soak well at times.

10. Health Facility

262. Local people in the study area reported that the most prevalent diseases in the area are diarrhea, typhoid, pneumonia, jaundice, skin diseases, etc. Children are mostly affected by water-borne diseases. Emergency health facilities are inadequate in nearby areas, except within the city corporation area. Hypertension/high blood pressure is also increasing among the people. Disability is also found in the area. Total disability is about 1.5%.

263. Khulna City Corporation area is now housing three major government health facilities-150-bed Khulna Sadar Hospital, 250-bed Shaheed Sheikh Abu Naser Specialized Hospital and 250-bed Khulna Medical College Hospital. Patients from different districts receive better medical treatment from all these medical facilities. Apart from these, over 25 private clinics and hospitals are serving the city dwellers alongside the people of nearby districts.

264. About 48% of patients go to trained physician as people have easy access to the trained physician in Khulna city. About 25% people in the city area go to paramedic doctor and about 22% patients go to quack doctors. Local people are now-a-days much more aware about their

[25] Feasibility Study and Formulation of Waste Water Management Master Plan for Khulna City, Bangladesh. ADB TA – 7820 BAN. Final Master Plan. April 2016.

health. They have eagerness to receive health treatment from trained physicians but all of them are not able to do that due to inadequate financial capability and availability of health facility.

11. Electricity

265. BBS (2012) data shows that about 71.9% of the households are consuming grid electricity to meet their daily demand, the rest on solar energy or household lantern.

12. Transportation

266. Modes of transport available are roadway, railway and waterway. The main roadway is Jessore-Khulna highway road, Khulna-Bagerhat–Pirojpur road which is connected to the southern part of Bangladesh. One of the major roads is Khulna to Dhaka via Gopalganj and Mawaghat. There is railway connection in Khulna and an airport in Jessore district. Further rail connection through Mongla sea port is now underway. Water transport is mainly through Bhairab, Rupsha and Passur River. However, there are sufficient infrastructures to support the project activities. The existing roads are adequate to take the load of increased traffic during the construction and operation of the project.

13. Social Safety Net

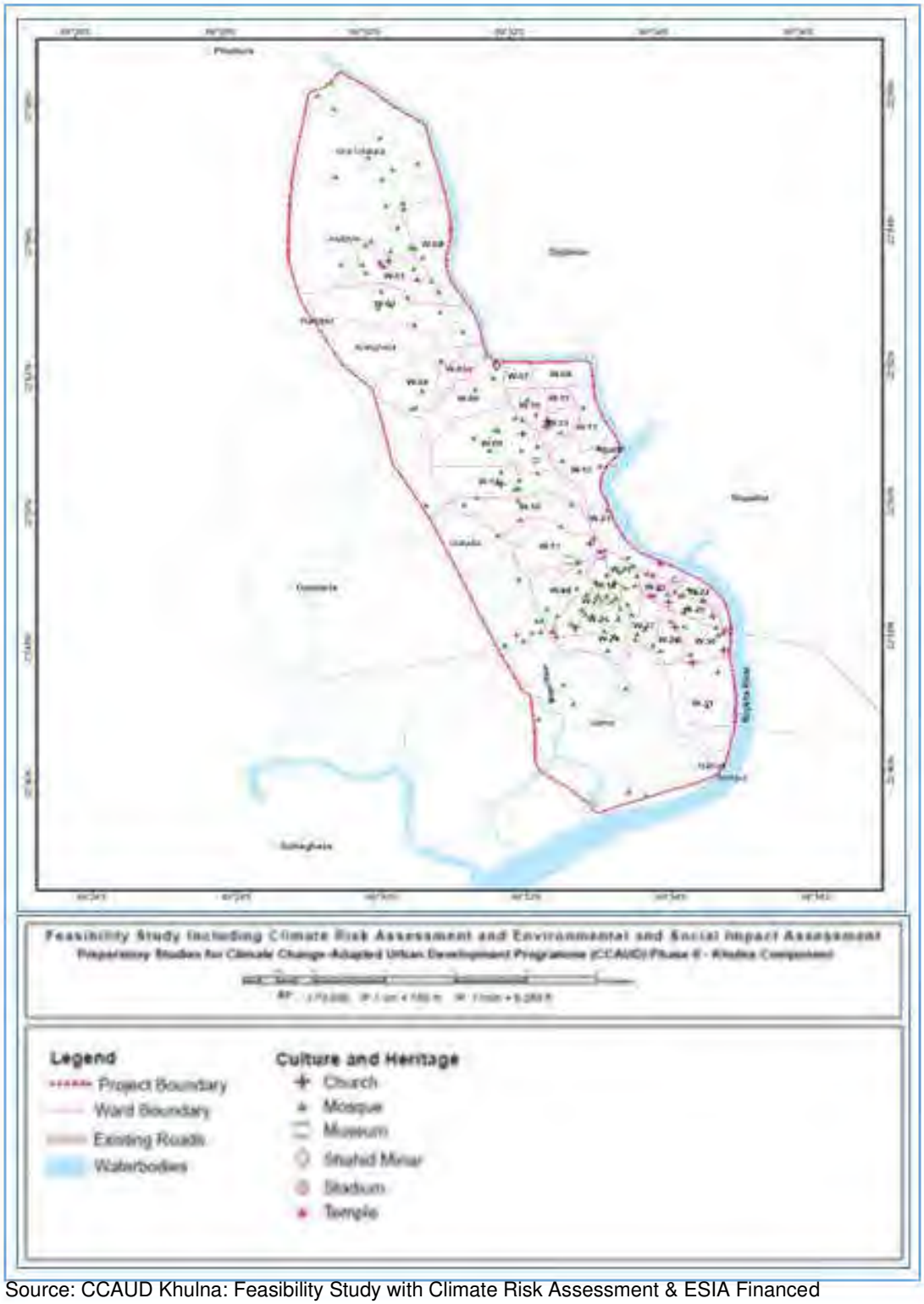
267. Major social safety nets and poverty reduction programs in the area include the Vulnerable Group Development (VGD), Food/Taka for Work (F/TFW), Food for Education/Cash for Education, Rural Maintenance Program (RMP), Old Age Allowance, Freedom Fighter Allowance and Integrated Poverty Reduction Program. According to local people, these programs have created food security as well as social security among the targeted poor households and vulnerable communities. A number of local, national and international NGOs are working in the study area. The main activities of these NGOs are operating microcredit programs among the rural poor and landless women/men.

1. Physical and Cultural Resources

268. Khulna City Corporation has developed several parks and amusement areas in Khulna city in last couple of years, among those, amusement park and walk-away along the Moyuri river is notable. Several parks have been rejuvenated with necessary implementing actions.

269. Shahid Hadis Park and a mass killing spot at Gollamari is historically notable place in Khulna. Besides, Khulna has several old Churches which are also notable for scenic beauty. Figure below shows a mapping of the physical cultural resources in Khulna city.

Figure 31: Mapping of Physical Cultural Resources in Khulna City



Source: CCAUD Khulna: Feasibility Study with Climate Risk Assessment & ESIA Financed by KFW.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

270. Environmental impact assessment is the systematic identification and evaluation of the potential impacts (effects) of proposed projects, plans, programs, or legislative actions relative to the physical, chemical, biological, cultural, and socioeconomic components of the total environment. The primary purpose of this assessment process is to encourage the consideration of the environmental issues in planning and decision making and to ultimately arrive at actions that are more environmentally compatible (Canter, 1986).

271. Impact assessment must take account of the nature, scale and duration of effects on the environment, whether such effects are positive (beneficial) or negative (detrimental). It is also imperative that each issue/impact is assessed according to the project stages from planning, through construction and operation to the decommissioning phase. Where necessary, the proposal for mitigation or optimization of an impact is noted. The environmental impact assessment is focused on the following phases of the project namely: (i) pre-construction; (ii) construction phase; and (ii) operation phase. As the project entails development of sewerage and sanitation infrastructures, which will be permanent, decommissioning is not applicable to this specific project.

272. The project area will require extensive site preparation and granting authorization from the appropriate authority to start the construction works, primarily due to the extensive pipe laying works in part of the central business district and some other peripheral areas of the city, and earthworks in both STP sites. The proposed major activities will involve earth filling, construction of labor camps, site preparation, transportation of machinery and ancillaries, storage of equipment and materials for construction, erection of all equipment and machineries, construction of sewer pipelines, etc. The project-related activities will have diversified impacts on the environment and socio-economic conditions of the local people. Among the impacts from the proposed activities, some are temporary in nature and limited to pre-construction and construction period, and others are continuous until the operation phase.

273. All the possible impacts are largely construction related and can be addressed through adoption of good engineering practices, good house-keeping, better construction materials management at site, observing health and safety for workers and pedestrians during project implementation. A number of activities with possible impacts on existing environmental settings were identified and their individual mitigation measures to be addressed during construction were indicated. Some of the impacts will be minimized within permissible limits by following site-specific mitigation measures as required. Causing disturbances, dust generation and other nuisance during the busy working hours of the day in core business areas of the city, clearing of vegetations during site preparation and labor camp induced sanitation and social stress are the most significant impacts of the construction works.

B. Impact Assessment

1. Methodology

274. Potential environmental and social impacts were identified on the basis of the review and analysis of the primary and secondary data or information and stakeholder consultations, and several field visits to the sites. In order to sketch out the potential impacts posed by the project interventions, it was necessary to single out every activity under the project; thereafter a detail

understanding of the existing environmental and socio-economic settings of the project area was made. The significance of potential impacts was assessed using the criteria and methodology given below.

275. **Impact Magnitude.** All the interventions associated with this project can be grouped into two major types- (i) construction of sewer network across the sewerage districts, which mainly involves earth excavation along the existing roads, laying pipelines inside, and backfill the earth on top of the pipelines; earthworks of similar types will also be practiced in sewage lifting and pumping stations (SLPS) and STP sites, and (ii) civil and electromechanical works for the construction of SLPS and STPs. Electromechanical works may pause some risks of accident and disruptions, but not so naively cause any detrimental impacts on immediate surrounding environment. The potential impacts of the project have been categorized as major, moderate, minor or nominal based on consideration of the parameters such as: (i) duration of the impact; (ii) spatial extent of the impact; (iii) reversibility; (iv) likelihood; and (v) legal standards and established professional criteria. These magnitude categories are defined in the below Table.

Table 35: Parameters for Determining Magnitude

Parameter	Major	Medium/Moderate	Minor	Negligible
Duration of potential impact	Long term (more than 35 years)	Medium Term Lifespan of the project (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate Project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Baseline requires a year or so with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains constant
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

276. **Sensitivity of Receptor.** The sensitivity of a receptor has been determined based on review of the population (including proximity/numbers/vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to

the topic. Criteria for determining receptor sensitivity of the project's potential impacts are outlined in the following Table.

Table 36: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very Severe	Vulnerable receptor with little or no capacity to absorb proposed changes
Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Mild	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation
Low	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

277. **Assigning Significance.** Following the determination of impact magnitude and sensitivity of the receiving environment or potential receptors, the significance of each potential impact has been established using the impact significance matrix shown below in the table.

Table 37: Significance of Impact Criteria

Magnitude of Potential Impact	Sensitivity of Receptors			
	Very Severe	Severe	Mild	Low
Major	Critical	High	Moderate	Negligible
Medium	High	High	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

2. Summary of Impacts

278. The project's potential impacts on the key environmental parameters have been assessed and their significance determined using the methodology described above. A summary of the potential impacts of the project on the key environmental parameters and significance of these impacts are presented in the following Table.

Table 38: Summary of the Potential Impacts of the Project

Potential Impacts	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Design/Pre-Construction Phase								
Land Acquisition and Resettlement	Long term	Local	No	Certain	Major	Severe	High	Low
Disruption of Utilities/services	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Tree Removal	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Consents, Permits, NOCs, Clearances etc.	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Natural Calamities such as flood, earthquake etc.	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Fecal Sludge Collection System	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Road Excavation	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Traffic Management Plan	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Community Awareness Program	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
EMP Implementation Training	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Construction Phase								
Sources of Materials	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Construction Camps, Stockpile Areas and Storage Sites	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Landscape and Visual	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Road Excavation Works	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Trenchless Pipe Installation	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Road excavations	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Laying of Pipeline near Canal and Stream	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Surface Water Quality	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible

Potential Impacts	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Groundwater Quality	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Soil Erosion and Sediment Mobilization	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Drainage Congestion	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Air and dust pollution	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Noise Pollution	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Protection of Flora Resources	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Protection of Fauna	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Socio-economic status-loss of livelihoods	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Socio-economic status-employment	Short term	Local	Yes	Certain	Minor	Mild	Positive	Positive
Traffic Control and Safety	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Physical and Cultural Heritage	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Community health and safety	Short term	Local	Yes	Certain	Major	Severe	High	Negligible
Worker health and safety	Short term	Local	Yes	Certain	Major	Severe	High	Negligible
Site Reinstatement	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Operation and Maintenance Phase								
Occupational Health and Safety	Long term	Local	Yes	Certain	Major	Severe	High	Negligible
Community Health and Safety	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Leakage and Overflows	Long Term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Inefficient Working of STP	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Odor Generation and Air Emission	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Acoustic Environment	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Water Pollution	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible

Potential Impacts	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Sludge Management	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Handling of Hazardous Wastes (fuels, chemical etc.)	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Pathogens and Vectors	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Socio-economic aspect-Employment	Short term	Local	Yes	Certain	Minor	Mild	Positive	Positive
Survival rate of trees	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Traffic Management	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible

C. Anticipated Impacts and Mitigation Measures during Pre-Construction Phase

279. Detailed Design of the project has afforded the opportunity to minimize many potential adverse environmental impacts through the appropriate routing and sizing of water and sewer pipelines.

1. Land Acquisition and Resettlement

280. **Impacts.** For the implementation of the proposed project, about 3,603 decimals of lands to be acquired and among the total proposed land, 98.7% (3,553.58 decimals) of the land is found under the private ownership and the remaining 1.3% (49.42 decimals) land is owned by the government where 24 HHs will be relocated from the proposed location. For conversion purposes, 1 decimal = 0.00404686 hectare.

Table 39: Status of Land Acquisition for the Project

SL No.	Name of Land	Quantity (Decimal)*	No. of Owner	Displaced Families	Significant Loss	Temporary Loss
1	Labanchora (STP-1)	1,200	7			
2	Tikrabandh (STP-2)	2,200	193	15 (6 owner and 9 non-owner)		
3	Custom Ghat (Sewage Pumping Station-1)	24.71	Govt. land			22 non-titled traders
4	Motiarkhali khal par (Sewage Pumping Station-2)	24.71	Govt. land			
5	Labonchora Sluice gate (Sewage Pumping Station-3)	24.71	1	7 (No-owner)		
6	Nirala (Sewage Pumping Station-4)	24.71	1			
7	Kashimnagar Gollamari (Sewage Pumping Station-5)	29.65	1			
8	Truck Terminal Road, Sonadanga (Sewage Pumping Station-6)	24.71	1			
9	Karim Nagar, Sonadanga (Sewage Pumping Station-7)	24.71	5	1 (Non-owner)	2 (Non-0wner	
10	Islamia College Road (Sewage Pumping Station-8)	24.71	1	1 (No-owner)		
Total		3603	210	24 (6 owner, 18 non-owner)	***2***	22

* 1 decimal = 0.00404686 hectare
Source: Draft Resettlement Plan, 2020

281. Land acquisition will cause removal of structures, resettlement of affected people, removal of vegetation and inconvenience to the local people and animal living in and around the land area to be acquired. The resettlement is anticipated to cause mainly three types of social impacts such as psychological stress, split of communities, and loss of livelihoods or business opportunities.

282. **Mitigation.** Land acquisition and resettlement plan has to be prepared by the social and resettlement specialists following the national legal frameworks and ADB SPS in order to deliver proper compensation and resettlement of the affected people. All efforts to be made in STP/Sewage Pumping Station design to reduce resettlement. Proper and adequate compensation package must be developed for affected persons and prior to site works, compensate the affected people based on the Resettlement Plan.

2. Disruption to Public Utilities

283. **Impacts.** During the installation of new subsurface infrastructure, it is very easy to damage existing service cables and pipelines or temporarily interrupt supplies to consumers. The levels of potential impacts arising from disruption damage to public utilities are summarized in following Table**.**

Table 40: Potential Impacts of Disruption to Public Utilities

Utility	Nature of Impact	Severity
High Voltage Electricity Cables	Interruption of Supply	Severe production loss and public inconvenience
	Personal Injury	Likely death of operator
	Cost of Repair/Delay to Works	Very severe
Medium Voltage Electricity Cables	Interruption of Supply	Severe production loss and public inconvenience
	Personal Injury	Probable death or serious injury of operator
	Cost of Repair/Delay to Works	Severe
Low Voltage Electricity Cables	Interruption of Supply	Localized but severe public inconvenience
	Personal Injury	Possible serious injury to operator
	Cost of Repair/Delay to Works	Minor production loss. Short public inconvenience.
Trunk Distribution Pipelines	Interruption of Supply	Significant production loss and public inconvenience
	Personal Injury	Possible injury to operator
	Cost of Repair/Delay to Works	Severe
Local Water Networks	Interruption of Supply	Localized but significant public inconvenience
	Personal Injury	Unlikely
	Cost of Repair/Delay to Works	Minor
Telephone Cables	Interruption of Supply	Severe disruption to national and international telecommunications
	Personal Injury	Possible injury to operator
	Cost of Repair/Delay to Works	Limited
Telecom Cables	Interruption of Supply	Extreme disruption to national and international telecommunications
	Personal Injury	Unlikely
	Cost of Repair/Delay to Works	Very Severe

284. Investigations during design phase suggest there are few services that might be disrupted within the vicinity of the project area. All power and telephone cables are above ground in Khulna city, but underground are water supply pipelines which are assets of the project proponent. A

small number of electric or telephone poles may need to be shifted but disruption of services should otherwise be minimal.

285. **Mitigation Measures.** Record drawings of utility services are not always accurate, and the contractor shall accurately locate all services, by trial pits, if necessary, before work commences in any given area. Nevertheless, accidents will occur where small diameter water pipelines and low voltage power cables are unrecorded or where an excavator operator carelessly swings an extended boom into overhead cables. All such incidents shall be reported to the engineer, and the contractor shall be responsible for the expeditious repair of accidental damage.

286. Damage to any utility at a defined site shall be made good to the satisfaction of the responsible agency at the contractor's cost. Damage to utilities not defined prior to construction, despite the contractor having undertaken all reasonable liaisons with the responsible agencies, shall not be the responsibility of the contractor. It shall be the responsibility of KWASA to ensure the utilities agencies respond in time to the contractor's requests for information.

287. Contractors shall liaise with each of the agencies responsible for the maintenance of utilities that are to be crossed, temporarily diverted or otherwise affected by the works as to the timing and nature of any disruption of service. Where required, the responsible agency shall be requested by KWASA to carry out the necessary works at the time required and at KWASA's cost. The tender documents shall contain sufficient information on utilities crossings to permit the contractor to include the cost of the works for which he is responsible in his bid.

3. Removal of Trees

288. **Impacts.** Construction of the project may require clearing of vegetation, including trees. Tree assessment survey has been done in the proposed location during socio-economic survey. Based on the assessment, 1,980 trees within project area will be felled. Of these trees, 727 are large, 797 are medium and 456 are small trees. Subproject-wise tree felling is shown in table below. Removal of trees will affect the local ecosystem, habitat of local birds, animals and wildlife. Particularly, the wildlife that is living on the affected trees will permanently lose the ecological services from those trees. Therefore, removal of mature trees will be a significant loss to the environment, humans and other living organisms benefiting from them.

Table 41: Details of Affected Trees

Subproject	Component	Location	No of Trees			
			Large	Middle	Small	Total
Subproject-1	Sewerage Pumping Station-1	Custom ghat	5	-	-	5
	Sewerage Pumping Station-2	Motiarkhali khal	-	-	3	3
	Sewerage Pumping Station-3	Labonchora sluice gate	1	2	2	5
Sub-total			6	2	5	13
Subproject-2	Sewerage Pumping Station-4	Nirala	43	5	-	48
	Sewerage Pumping Station-5	Kashim nagar, Gollamari	-	-	-	-
	Sewerage Pumping Station-6	Sonadanga Truck Terminal	3	-	-	3

Subproject	Component	Location	No of Trees			
			Large	Middle	Small	Total
	Sewerage Pumping Station-7	Karimnagar	-	1		1
	Sewerage Pumping Station-8	Islamia College road	35	1	-	36
Sub-total			81	7	-	88
Subproject-3	Sewerage Treatment Plant (STP-1)	Matahabhanga	-	-	-	-
	Sewerage Treatment Plant (STP-2)	Tikrabandh	640	788	451	1879
Sub-total			640	788	451	1,879
Total			**727**	**797**	**456**	**1,980**

Source: Socio-economic Survey, 2020

289. **Mitigation.** The following actions are proposed to mitigate the impact of tree removal:

(i) After the finalization of the designs and layout of the project components, the trees within proposed construction areas will be marked;
(ii) Trees within area required for construction will be felled after prior approval;
(iii) Compensation will be provided for the affected trees based on the unit prices of trees determined by the agriculture/horticulture experts. For trees in public-owned lands such as ROWs where no claimant for compensation is confirmed, replacement of the tree shall be undertaken by KWASA at the replacement ratio of two trees for every tree that is cut (i.e. 2:1 ratio);
(iv) Only trees that will require removal within the proposed construction areas of the sites will be cut; and
(v) For trees not proposed to be cut, taking all precautions to protect them from any damage from construction activities.

4. Consents, Permits, NOCs, Clearances

290. **Impacts.** Without permission, the project cannot be implemented. Failure to obtain necessary consents, permits, and other appropriate regulatory clearances can result to design revisions and work stoppage.

291. **Mitigation.** All of the necessary consents, permits, and clearances shall be obtained before the start of civil works and acknowledge in writing and provide report on compliance all obtained permits, clearance, NOCs, etc. Permissions and clearances are required from the following government agencies and departments:

(i) Department of Environment;
(ii) Department of Forests;
(iii) Khulna City Corporation;
(iv) Roads and Highway Department;
(v) Khulna District Authority.

5. Natural Calamities

292. **Impacts.** If a natural hazard were to occur, this would affect the STP, sewage lifting and pumping stations, and collection system indirectly creating a hazard to human health in the

instance of spillage of wastewater or breakdown of the STP resulting in raw sewage discharged into the river.

293. **Mitigation.** The natural hazard mitigation is integrated in the design of the project. The STP and sewage lifting and pumping stations are designed within the "Zone 3" BNBC Building Code based on expected seismic activity. These structures are also designed for a basic wind speed considering BNBC Codes which, according to historical storm tracks, is not expected. The collection system is also designed with a similar approach. Flooding of the STP site will be mitigated by considering this impact in the detailed design phase of the STP subproject. Historical maximum river levels of the Rupsha River were obtained from BWDB data. STP and Sewage Pumping Station are designed which is above the highest flood level (HFL) information of last 25 years and sewer network will be laid at 3- to 5-meter depth below the ground level. The STP will be designed such that treatment process continues even throughout the high-water levels of a flood.

6. Fecal Sludge Collection System

294. **Impacts.** Spillage may occur during fecal sludge collection, which could affect public health and environmental problems. Collection may be impeded in the inaccessible area and sometime when there is difficulty of pumping out thick, dried sludge from the bottom of the pits. Moreover, traffic congestion and accident may happen due to frequent movement and random parking of the trucks.

295. **Mitigation.** Provision of the following measure shall be included in the design:

(i) Use of long hose pipe will be considered to reach the pits located in inaccessible areas;
(ii) Chemical disinfectant will be used for the spillage, if this happens during sludge collection;
(iii) A long spade or jetted with a water hose will be used for compacted layers of the sludge;
(iv) Vacuum trucks will be checked on a daily basis before operation;
(v) The speed limit of the trucks will be restricted to 20 km/hr;
(vi) A well-defined schedule and route will be followed by the sludge carrying trucks; and
(vii) A proper traffic management plan should be implemented to mitigate adverse impacts.

7. Road Excavation

296. **Impacts.** Construction of 256 km primary transmission/pipe collection, secondary and tertiary network, 65-70% trenchless and 30-35% open cut method will be followed for pipe laying. Trenches will inevitably restrict traffic flows to an extent and roads may have to be closed on occasion. Although works on roads will be conducted at night, except in residential areas, impact to traffic can still be significant, given the congestion problem that exists in core business center of the city. The pipeline in the major roads are given in the following Table.

Table 42: Major Road to be Excavated for Sewer Network

Sl. No.	Name of the Road	Width of Road	Dia. of Pipe (mm)	Trench Width (mm)	Ownership of Road	Permission Required
1	Lower Jessore Road	15.5m-9.5m	250-1000	850-600	KCC	Yes
2	West Market Road	2.9m-3.3m	250	850-600	KCC	Yes

Sl. No.	Name of the Road	Width of Road	Dia. of Pipe (mm)	Trench Width (mm)	Ownership of Road	Permission Required
3	Baro Bazar Road	2.9m-3m	250-315	850-915	KCC	Yes
4	Seikh para main Road	4.4m-7.4m	225-403	825- 1003	KCC	Yes
5	Seikh para Road	4.4m-4.5m	225-283	825- 883	KCC	Yes
6	Sher -E- Bangla Road	8.5m-10.1m	225-403	825- 1003	RHD	Yes
7	B.K. Roy Road	6.0m - 6.3m	225-358	825-958	KCC	Yes
8	Deben Babu Road	3.8m-4.m	225-283	825-883	KCC	Yes
9	Khan Jahan ali Road	8.9m-9.9m	225-283	825-883	RHD	Yes
10	Cementry Road	5.9m-7.6m	225	825-600	KCC	Yes
11	Tarer pukur Road	5m-5.6m	225-283	825-883	KCC	Yes
12	Sir Iqbal Road	5.6m-6.3m	225-358	825-958	KCC	Yes
13	Ahsan Ahamed Road	7.6m-8m	225-283	825-883	KCC	Yes
14	Shamsur Rahman Road	4.8m-8.2m	319-458	919-1058	KCC	Yes
15	Babu Khan Road	5.8m-4.5m	225-500	825-1100	KCC	Yes
16	Haji Mohasin Road	6.1m-7.4m	225-358	825-958	KCC	Yes
17	S Central Road	7m-9.2m	225-403	825-1003	KCC	Yes
18	Gagan babu Road	8.6m-9m	225-600	825-1200	KCC	Yes
19	Rupsha Strand Road	9.2m-12.4m	225-500	825-1100	KCC	Yes
20	Rupsha ghat Road	5.3m-5.6m	225-358	825-958	KCC	Yes
21	Railway Hospital Road	3.7m-8.5m	225-403	825-1003	KCC	Yes
22	Station Road	7m-9.4m	225-283	825-883	KCC	Yes
23	Clay Road	7.2m-10.2m	225-319	825-919	KCC	Yes
24	K.D. Ghos Road	8.2m-10.2m	225-283	825-883	KCC	Yes
25	Advocate Manjrul Imam Road	5.2m-8.3m	225	825-600	KCC	Yes
26	Hospital Road	7.5m -8.5m	225	825-600	KCC	Yes
27	Tutpara central road	5m-6.7m	250	850	KCC	Yes
28	Tutpara main road	5.5m-6.3m	225-600	825-1200	KCC	Yes
29	Korpara road	5.4m-5.8m	319-403	919-1003	KCC	Yes
30	Purba Baniakhamar Road	3.9m-4.9m	225-403	825-1003	KCC	Yes
31	Azizur rahman road	4.3m-4.6m	225-283	825-883	KCC	Yes
32	S.Circular road	3.8m-4.8m	225	825	KCC	Yes
33	Shipyard road	6.5m-9.8m	1000	1600	KCC	Yes
34	Ali Hafege road	3.3m-3.7m	225-403	825-1003	KCC	Yes
35	Jinnah para road	3.6m-5.6m	225-403	825-1003	KCC	Yes
36	Ibrahimia Madrasah Road	2.8m-3.6m	225-358	825-958	KCC	Yes
37	Al-amin- sarak	2.9m-3.9m	225-283	825-883	KCC	Yes
38	Mukta sarak	2m-3.1m	225	825	KCC	Yes
39	Rupsha bridge approach road	9m-8.6m	225	825	KCC	Yes
40	BIDC Road	5.5m -12.0m	225-358	825-958	KCC	Yes
41	KDA Bypass Road	14.0m - 21.0m	600-1200	1200-1800	KCC	Yes
42	Kishob Lal Road	3.1m - 3.6m	358-500	958-1100	KCC	Yes
43	Jalil Sarani	12m - 14m	225-500	825-1100	KCC	Yes
44	Sher-e-Bangla Road	18m - 22m	358-500	958-1100	KCC	Yes
45	Bagmara main road	5.4m - 7.6m	319-600	919-1200	KCC	Yes

Sl. No.	Name of the Road	Width of Road	Dia. of Pipe (mm)	Trench Width (mm)	Ownership of Road	Permission Required
46	Islampura Road	5.8m - 7.5m	225-319	825-919	KCC	Yes
47	Tetultala road	2.5m - 3.7m	225-358	825-958	KCC	Yes
48	Nirala Road	15.2m - 15.5m	500-600	1100-1200	KCC	Yes
49	Majid Sarani	16.3m - 26.0m	225-500	825-1100	KCC	Yes
50	Navy Colony Road	14.5m - 17.5m	358-500	958-1100	KCC	Yes
51	Goalkhali Main	5.2m - 7.5m	358-500	958-1100	RHD	Yes
52	Boyra Goalkhali Main Road	6.2m - 7.5m	225-358	825-958	KCC	Yes
53	Palpara Road	3.3m - 4.5m	225-358	825-958	KCC	Yes
54	Boyra Main Road	6.3m - 8.4m	225-358	825-958	KCC	Yes
55	KDA Approach Road	7.5m - 9.6m	225-358	825-958	KCC	Yes
56	Sonadanga Main Road	6.3m - 8.4m	225-358	825-958	KCC	Yes
57	Haji IsmailLink Road	5.4m - 7.6m	319-500	919-1100	KCC	Yes
58	Puraton Gollamari Road	8.1m -9.3m	225-358	825-958	KCC	Yes
59	Paschim Banihakhamar main road	6.3m -8.4m	225-358	825-958	KCC	Yes
60	Mistripara Bazar Road	6.3m - 8.4m	225-319	825-919	KCC	Yes

297. Road cutting for pipe installation within the city will also result in considerable delays to traffic flows. The impacts of this activity are increased journey time and increased costs associated with delays. Method for pipe laying and effective traffic management will be key in determining the severity of impacts.

298. Delays will be most noticeable during morning and evening peak 'rush-hours'. Although at present, these are relatively modest across the city, the intensity is becoming more severe in central business areas of the city. Delays will be most serious when they impact ambulances, fire engines, blood bank vans and other emergency vehicles. However, no significant impacts to non-vehicular traffic is expected.

299. **Mitigation.**

(i) No temporary or permanent works must proceed before the design and drawings are approved by the Project Director and road cutting permission obtained from relevant authorities (KCC, RHD) by PMU;

(ii) Road cutting plan necessary for the application for road cutting permission from the authorities must be prepared by the contractor;

(iii) KWASA should apply for the road cutting permission prior to starting the works and the contractor shall give full effort and cost for collection of road cutting permission for required days;

(iv) The contractor shall prepare a traffic management plan (road closure program or diversions) and incorporate detail of traffic diversions and pedestrian routes, all traffic signs (for the regulation and for information) and road markings shall be ensured prior to start of road cutting; and

(v) Road cutting will be done on a section-wise basis (e.g. not exceeding 50-meter linear distance of excavation works at a given time) depending on the length and width of roads under consideration so as to avoid or minimize disruption to traffic and pedestrian flow.

8. Traffic Management Plan

300. **Impacts.** Ease of access to and from the site will be a fundamental requirement. All points of contact between construction and existing traffic will potentially give rise to accident black spots due to the number of turning movements by construction traffic, its relatively low speed, increased damage to the road surface and the deposition of mud, chippings, oil and other foreign matter.

301. **Mitigation.** Contractor shall conduct traffic impact assessments to plan traffic management to minimize disturbance of vehicular traffic and pedestrians. Access arrangements for vehicles accessing the project area will be formulated such that this will avoid community disturbance and severance, and the plan will include consideration of the following:

(i) Lane availability and minimizing interference with traffic flows past the work site;
(ii) Establishment of acceptable working hours and constraints;
(iii) Establishment of appropriate linear distance for excavation works at a given time (e.g. not exceeding 50 meters) depending on the length and width of roads under consideration;
(iv) Agreement on time scale and establishment of traffic flow/delay requirements;
(v) Programming issues, including the time of year and available resources;
(vi) Discussion of the PMSC's inspection/monitoring role;
(vii) Establishment of complaints management system for the duration of the work.

9. Update IEE and Preparation of SEMP

302. PMU with support of PMSC will update IEE based on final detailed designs, and submitted to ADB for review, clearance, and disclosure prior to commencement of work. Contractor shall be responsible for preparing the Site-Specific Environmental Management Plan (SEMP). The SEMP shall be based on the corresponding EMP in this IEE report, with details on staff, implementation schedules, monitoring procedures, and resources, including costs for implementing measures against the 2019 corona virus disease (COVID-19) or any other emerging infectious diseases that may arise during project implementation. The SEMP shall also include detailed health and safety plan with monitoring and reporting procedures consistent with national guidelines and internationally recognized standards or guidelines such as the WHO guidelines. Contractor will submit its SEMP to PMU, and PMU will review and approve accordingly. The approved SEMP will be the basis for monitoring by PMU and PMSC. The SEMP will allow PMU, construction supervision engineer to focus on what are specific items expected from the contractor regarding environmental safeguards on a day-to-day basis. With the SEMP, PMU can easily verify the associated environmental requirements each time the contractor will request approval for work schedules.

10. Community Awareness Program

303. Before the start of project implementation, the local population should be well aware of the upcoming project. There should be regular interaction with the local population and make them understand the project activities. Important information needed to be disseminated to the people are, among others, the following:

(i) Overview and objectives of the proposed project;
(ii) Preliminary and/or final detailed design of proposed project components;
(iii) Potential environmental and social impacts (positive and negative) of the project, and the proposed mitigation measures for the perceived negative impacts; and
(iv) Grievance redress mechanism and contact details of the project.

11. EMP Implementation Training

304. Often lack of proper training to implement the EMP stipulated in the bid document leads to mismanaged environmental safeguards. Therefore, EMP training for the contractors, workers and implementing agency is necessary before construction goes on-board. A training needs to be arranged before construction starts with all involved parties: contractor, workers and representatives from KWASA through the PMU to undergo EMP implementation including spoils management, standard operating procedures (SOP) for construction works; community and occupational health and safety, core labor standards and laws, applicable environmental laws, etc.

D. Anticipated Impacts and Mitigation Measures during Construction Phase

305. The impacts during construction shall include generic construction related impacts associated with construction activities which can be mitigated to acceptable levels with the following mitigation measures.

1. Sources of Materials

306. **Impacts.** Extraction of construction materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.

307. **Mitigation.** PMU, with support from PMSC and/or IADC, will prepare a draft materials management plan (MMP) that will guide the project in minimizing the use of non-renewable resources and rock-based materials. The MMP will also be used to plan for asphalt and aggregates management so that an overall balance for asphalt and materials could be made, and minimize impacts on other local resources. The contractor will be responsible for:

(i) Updating draft MMP from the detailed design phase;
(ii) Prioritize sites which already permitted by the authority;
(iii) If other sites are necessary, it is contractor's responsibility to verify the suitability of all material sources and to obtain the approval of PMU and consultants;
(iv) If additional quarries will require after construction is started, construction contractor to obtain a written approval from PMU.
(v) Maintain a construction material register at the site.

2. Landscape and Visual

308. **Impacts.** Activities such as site clearing using heavy machinery have potential to change the natural landscape and may therefore degrade areas of scenic beauty. Areas will need to be cleared for the installation of STP, pumping houses as well as trenching where the pipeline will subsequently be laid. These activities have the potential to destabilize the existing natural ecosystems within the respective project areas. However, installation of structures and compacting using heavy machinery has the potential to change the natural landscape and may therefore have an impact on local aesthetics. This impact is, however, expected to be minimal.

309. **Mitigation.** The contractor is required to implement the following measures in relation to landscape and visual during construction:

(i) The nature of the construction activities in the townscape environment is such that there will always be disruption. Mitigation during construction relates to phasing of construction activity to different working areas sequentially to minimize the duration of significant effects arising from construction activities at any one location, and/or

effective pedestrian and traffic management to minimize inconvenience and ensure access is maintained as appropriate.

(ii) Reinstated vegetation is undertaken by a suitably qualified landscape contractor, and their contract will include two-year aftercare.

3. Construction Camps, Stockpile Areas and Storage Sites

310. **Impacts.** All major construction projects require a large area for site offices, the storage of construction materials and depending on the contractor's preference, facilities for the concrete and tarmac manufacture, concrete pre-casting and worker's accommodation. Preferred location for the site offices and contractor's facilities are not yet decided, and there needs to include refabricated offices and parking areas for the administration and technical staff of the Contractor, specialist sub-contractors, the Supervising Engineer and representative/supervision engineer from KWASA. These will also include areas for materials testing and storage, and equipment cleaning and maintenance. The contractors will be asked to maximize the employment of people from the project affected area and the need for residential accommodation is likely to be minimal.

311. The storage of materials will primarily comprise pipes, fittings and other civil construction materials. Pipe bedding material, aggregate, marl for treatment plant and other quarried materials are readily available within the city and are expected to be procured on-demand with only limited volumes held in the Contractor's storage areas. There should be no requirement for rock crushing and grading within the Contractor's camp. Similarly, any pre-cast concrete items, such as inspection chambers are expected to be manufactured at a different site set for such activities. It is understood that there are no asphalt plants in Khulna, but since the need to tarmac in road reinstatement is limited it is expected this will also be brought in as and when required rather than produced by the Contractor locally.

312. **Mitigation.** For the safe and sustainable disposal of wastewater the Contractor shall supply a self-contained collection and disposal system in construction camp area, for which he shall obtain the approval of the Engineer prior to installation. Contractor shall request KWASA to consult with the DOE on the precautionary measures required for the storage and handling of a list of potentially polluting substances he intend to keep on site. It is expected these will include, at a minimum, specific operational requirement such as:

(i) Definition of any materials to be isolated from each other;
(ii) Use of proper protective clothing and equipment by employees;
(iii) Definition of proper handling techniques;
(iv) Other safety requirements, ventilation, fire- fighting equipment; and,
(v) Any measures needed to contain and isolate spills and leakages to specific areas through the use of hard standings, internal drainage and the construction of holding tanks.

313. The contractor shall set aside a building or covered secure enclosure for the storage of lubricating and hydraulic oils, greases, solvents and other hazardous materials required for his operations. For the storage of petroleum for vehicles and fuel oil for generators and other machinery he shall utilize tanks composed of a material approved for the purpose securely fenced with access to authorized personnel only. The area beneath each tank shall be enclosed by a bund adequate to retain 110% of the volume of the tank. An area not less than 20 m beyond each compound shall be designated 'No Smoking or Naked Lights'. The contractor's site records shall include details of chemical and fuel deliveries and their subsequent dispersal to site, to include date, quantities and responsible persons. Used batteries are both toxic and corrosive and the contractor will be required to deliver those to an appropriate collector upon consultation with the

engineer. In the event of a serious spill or contamination, the contractor shall immediately notify the engineer. Remedial works required shall be undertaken as a matter of urgency by the contractor or an appropriate specialist at the Contractor's expense. Failure to notify of such incidents will be considered a breach of contract.

314. For the disposal of waste other than surplus soil and rock, it is normal practice for a construction camp to be included in the existing municipal solid waste collection and disposal process. From their review of the materials to be stored on site, KWASA should notify contractors of any solid waste expected to be generated that may require special handling and treatment, and hence separation from other waste for collection and disposal. Mitigation of the impacts from construction traffic at the camp should primarily take three forms; access control, road cleaning and the definition of approved routes. Access control will require the restriction of turning movements to approved access points to and from existing highways, the erection of appropriate signage and, at night, adequate lighting. Road cleaning will be required to ensure major roads are kept in a safe condition, with oil, mud and other materials removed regularly. Wide or abnormal loads shall be transported between 2300 and 0500 hours with routes to be agreed with the relevant authorities (mostly KCC).

315. Ensure with grass/vegetation coverage to be made of the use of top soil that there is no dust generation from the loose/exposed sandy surface. Pave the internal roads of at least haring-bond bricks to suppress dusts and to work against possible muddy surface during monsoon. Both sides of roads are to be provided with shallow drains to drain off storm water to a silt retention pond which shall be sized to provide a minimum of 20 minutes' retention of storm water flow from the whole site. Channel all discharge from the silt retention pond to natural drainage via a grassed swale at least 20 meters in length with suitable longitudinal gradient.

4. Road Excavation Works

316. **Impacts.** Another physical impact that is commonly associated with large scale excavation is the effect on local drainage patterns if surface and groundwater collects in voids as they are being dug. In overall terms, although a large volume of material will be removed during trench construction, a large volume of sand will be brought to the working sites which may create dust pollution, and a relatively large area will be affected.

317. **Mitigation.** The contractor will be responsible for:

(i) All excavations shall be done to the minimum dimension as required for safety and working facility.

(ii) The excavation shall be executed in such manner, that the contractor does not damage or interfere with existing services or structures. If damage or interference is so caused the contractor shall make arrangements with the supply and/or building owner to execute the repairs at the contractor's own cost.

(iii) All trenches and pit excavations and other work shall be carried out during night time at busy road section.

(iv) Road drains and channels shall be kept free from obstructions at all times.

(v) In case of excavation in large roads, the trenches and pits maybe need to be covered by steel plates to allow traffic to pass during non-working periods. The contractor must liaise with the KWASA and the responsible police to familiarize themselves and adhere to such rules.

(vi) Trench excavation along roads be located in footpaths or adjacent to the road. Trench excavation shall wherever practicable be carried out in such a way that

every part of the excavation is at least 0.5m clear of existing edges of the carriage way.

(vii) The contractor shall have particular regard to the safety of pedestrian, livestock, and shall ensure that all open excavation, access routes and steep or loose slopes arising from the contractor's operations are adequately fenced and protected.

5. Trenchless Pipe Installation

318. **Impacts.** Trenchless pipe laying involves the use of horizontal direction drilling (HDD) which involves a hydraulic machinery to drill a horizontal tunnel for a new pipe, so no trenches are dug, and excavation is limited to the entry and exit points. Noise generated due to HDD may affect the neighboring communities and other sensitive receptors (such as students at schools and other educational institutes, patients at hospitals etc.).

319. During drilling bentonite slurry may be used to cooling the drill bit, lubricating the drill bit and drill rods, increasing the stability of the borehole, etc. A part of the original bentonite slurry may be recycled and reused, while the remaining slurry may spill out to the watercourses. If the bentonite slurry is not properly collected and treated, it will contaminate the adjacent watercourse.

320. **Mitigation.** The contractors' mitigation measures will include but not necessarily be limited to the following measures:

(i) Pipes shall be installed by the horizontal directional drilling (HDD) methods where required. If the method is not feasible for any road, the contractor shall inform the Project Manager and gain prior approval for an alternative method or for open trench method.

(ii) Excavation material shall be removed from the conduit as the work progresses. No accumulation of excavated material within the conduit will be permitted.

(iii) The contractor shall provide sediment and erosion control measures in accordance with local environmental legislation.

(iv) The contractor shall supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Spent drilling fluids and cuttings shall be confined to the entrance and exit pits.

(v) The contractor shall take all necessary precautions to minimize the damage to the adjacent properties. Drilling fluid/ bentonite slurry that enters the pipe shall be removed by flushing or other suitable methods. Sediment tanks of sufficient capacity constructed from pre-formed individual cells of approximately 6-8m^3 capacities shall be used for settling wastewaters prior to disposal.

(vi) The contractor shall be responsible for cleanup and restoration of the site.

(vii) Pits excavated to permit connection of bored pipe shall be backfilled, and disturbed areas shall be restored to their original state or better. Sections of sidewalks, curbs, and gutters or other permanent improvements damaged during HDD operations shall be repaired or replaced at the contractor's expense.

6. Pipe Laying Works near Waterbody

321. **Impacts.** During the installation of pipeline adjoining waterbodies, if without proper care, excavated soil would be washed out and run to the river because of rainfall. Particular concern is the potential for spillages to pollute watercourses. Construction works can also obstruct the water flow.

322. **Mitigation.** The contractors' mitigation measures will include but not necessarily be limited to the following measures:

(i) Trenching and backfilling operations at the canal crossings/stream crossings will be carried out in the lean seasons, when the flow will be minimum, and disruption will also be minimum.
(ii) In case of crossings at existing minor bridges and culverts, the Contractor will ensure that there is no impact/disturbance to the bridges/culverts due to crossing of the water pipelines.
(iii) Silt fencing to be provided at all water bodies near canal and streams.
(iv) Do not disturb the water body except the actual work area; no equipment, machinery shall be operated outside the work area;
(v) Avoid use of fuels, chemicals and lubricants; ensure no spillage;
(vi) Clean up the area after the completion and prior to the onset of monsoon flow.

7. Surface Water Quality

323. **Impacts.** Some temporary dislocation of existing drainage systems is likely rehabilitation and pipeline construction. Adverse environmental impacts may include ponding, a threat to public health and safety, and damage to adjacent property. In the vicinity of existing watercourses and drainage ditches short-term increased rates of erosion and sedimentation may result from: Installation of temporary discharge points, particularly in areas of friable soils; and, Loose and unconsolidated aggregate, fill and spoil heaps stored pending re-use.

324. Transportation and stockpiling of construction materials, disposal of construction wastes, pipe laying on the canal and worker camps, etc. would cause unavoidable impacts to the surrounding water bodies. If the construction materials such as fuel, oil and chemicals are not well preserved, they may be washed away into canals causing water pollution.

325. Bentonite slurry used in trenchless pipe installation is not properly collected and treated, it will contaminate the adjacent watercourse. Although bentonite is not toxic in term of chemical properties, it is harmful in term of physical properties. With its fineness, bentonite may paralyze the entire respiratory system of creatures in the river/sea bed under its coverage. In addition, to increase the viscosity and some other features for improving efficiency of boring work, some toxic chemical additives are usually mixed with bentonite. Therefore, it needs to carefully handle bentonite slurry to prevent them spilling to the adjacent watercourse.

326. Oil leakage from the operation of machinery may also cause water pollution. In addition, domestic wastewater generated from construction camps may also cause water pollution unless it is properly controlled and treated at the site.

327. Domestic wastewater generated from construction camps may include fecal sewage and would be a potential source of water pollution. Main pollutants in domestic wastewater are COD and BOD. This wastewater would pollute the surrounding water bodies if it is discharged directly into these water bodies without treatment.

328. Wastes usually used in construction works such as lubricant oil, heavy oil, organic solvent, acid and alkali, oil paint, etc. are listed in the national list of hazardous wastes. If these hazardous wastes are not properly managed, stored, transported and disposed of, it will cause serious impacts to the surrounding water bodies.

329. **Mitigation.** The Contractor shall undertake at all times to prevent water pollution as a result of his activities, and shall implement the measures to control water pollution that shall include, but not be limited to the followings:

(i) Provision of temporary sedimentation canal and/or silt traps along construction areas, particularly alignments that are adjacent to receiving bodies of water or canals.
(ii) The measures to address soil erosion at the proposed facilities will consist of measures as per design, or as directed by the PMSC to control soil erosion, sedimentation, and water pollution. All temporary sedimentation, pollution control works, and maintenance thereof will be deemed incidental to the earthwork or other items of work.
(iii) All temporary discharge points shall be located, designed and constructed in a manner that will minimize erosion in the receiving channels.
(iv) Ensure proper compaction of refilled soil and there shall not be any loose soil particles on the top; the material shall be refilled in layers and compacted properly layer by layer.
(v) Use surplus soil for beneficial purposes such as in any other construction activities, or to raise the level of low lying areas.
(vi) Avoid scheduling of excavation work during the monsoon season. Earthworks during dry season.
(vii) Confine construction area including the material storage (sand and aggregate) so that runoff from upland areas will not enter the site.
(viii) Ensure that drains are not blocked with excavated soil
(ix) Stockyards at least 50 meters (m) away from watercourses.
(x) Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%.
(xi) No obstruction in flowing water.
(xii) For effluents from work place, camps, and offices, provide treatment arrangements such as retention ponds and septic tanks which should be incorporated in the facility designs. A sewage management plan has to be prepared by the contractor and agreed with the PMSC.
(xiii) Monitor water quality according to the environmental monitoring plan.

8. Groundwater Quality

330. **Impacts.** Increased demand for groundwater is anticipated during the construction phase for construction activities and personal consumption by workers. Even a small project can require 100 m3/day of water. Uncontrolled extraction of water may affect availability of water to locals. It is expected that most fill material will generally be compacted dry. The pressure testing of pipelines will be carried out with compressed air. The testing of water retaining structures such as pumping stations, water will be used but limited to a single filling of the structure.

331. In addition, construction waste, if left unattended, will result in percolation of leachate through the soil strata reaching the groundwater table contaminating it.

332. **Mitigation.** It is necessary that arrangement for safe drinking water is made prior to start of work. Water will be supplied for consumption only after adequate analysis and requisite treatment. The workers may also be trained on the need for judicious use of freshwater resources. The contractors will use water in consideration to its value as a resource. Mitigation measures will include:

(i) Prevent pollutants from contaminating the soil and the groundwater;

(ii) All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned;
(iii) Storage of lubricants and fuel at least 50 m from water bodies;
(iv) Storage of fuel and lubricants in double hulled tanks. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%;
(v) Daily control of machinery and vehicles for leakages;
(vi) Collection of waste during construction activities;
(vii) Provide uncontaminated water for dust suppression;
(viii) Enclose the construction area to prevent unauthorized access.

9. Soil Erosion and Sediment Mobilization

333. **Impacts.** Rainfall is often considered to be one of the triggering elements for soil erosion at gravity which include water erosion, collapse and landslide. As the project is located in an area with adequate rainfall which often concentrates in a certain period, proper measures such as well construction and improvement of drainage system might considerably reduce the soil erosion that would occur due to land disturbance by construction work.

334. Erosion can be happened at the pipe laying sites adjacent to the bridges and culverts. The silt from erosion if run into the nearby surface water streams, the aquatic life living in the water body and the water body itself will be affected. The accumulation of suspended particulate matters will increase the turbidity of the water and will decrease the depth for navigation. In the highly turbid aquatic ecosystem normal photosynthesis is disrupted. Moreover, if eroded materials run into the agricultural land then crop production will be hampered.

335. **Mitigation.** During construction phase, the Contractor shall implement the measures at all time to control soil erosion that shall include, but not be limited to the followings:
(i) The Contractor shall plan his works to minimize surface excavation works during the rainy season where practicable.
(ii) Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and actions to be taken during or after rainstorms shall be developed by the Contractor.
(iii) The earthwork sites where exposed land surface is vulnerable to runoff shall be consolidated and/or covered.
(iv) Channels, earth bunds, netting, tarpaulin and or sandbag barriers shall be used on site to manage surface water runoff and minimize erosion.
(v) The overall slope of the works areas and construction yards shall be kept to a minimum to reduce the erosive potential of surface water flows.
(vi) Monitor groundwater quality that could exist close to the working areas to ensure compliance.

10. Drainage Congestion

336. **Impacts.** Construction material getting into surface run off or uncontrolled disposal may cause temporary drainage congestion, especially near the locations of the construction camps and sites. The impact of these on hydrology is expected to be more pronounced during post monsoon period with rapid movement of rain water through existing drainage structures, which if blocked by construction waste and debris may cause flooding in neighboring areas. Impacts due to surface runoff include increased soil erosion in cleared land areas and local flooding or water logging.

337. **Mitigation.** The contractor shall adopt a site clearance procedure that separates topsoil and stores it under appropriate conditions for reuse as instructed by the Engineer. Where short-term construction work in a water-course or drainage channel is unavoidable, turbidity levels may be allowed to increase beyond those normally acceptable on agreement with the Engineer. In such cases, the Contractor shall submit to the engineer a program of work detailing any proposed mitigation and the time frame of the required work, for prior approval.

338. Wastes and construction debris will not be disposed in a manner that these would end up in drainage canals. All temporary discharge points shall be located, designed and constructed in a manner that will minimize erosion in the receiving channels. Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning.

339. The on-site storage of excessive quantities of unwanted spoil and aggregate materials should be avoided. Where storage is necessary, the Contractor shall ensure heaps and stockpiles are located at sites that they do not permit direct runoff into watercourses and are on land sloping at less than 1.5%. All heaps shall be of a size and stability that will ensure the risk of mass movement during period of heavy rainfall is minimized.

11. Air and Dust Pollution

340. **Impacts.** There will be two main sources of air emissions i.e. mobile sources and fixed sources during construction phase. Mobile sources are mostly associated with vehicles involved in construction activities. On the other hand, air pollution from fixed sources is mainly from generator sets, construction equipment (e.g. compressors) and excavation/ grading activities.

341. Dust and gaseous emissions will be generated by the construction machinery. Pollutants of primary concern include particulate matter (PM10). However, suspended dust particles are coarse and settle within a short distance of the construction area. Therefore, the impact will be direct but temporary, and will be restricted to areas in close vicinity of the construction activities only.

342. Construction work also involves breaking up, digging, transporting, and dumping large quantities of dry material. The particulate matter from these and emissions from crushers and quarry sites can also cause health impacts, i.e. respiratory problems, irritation in eyes and reduction in visibility.

343. **Mitigation.** The Contractor shall comply with all applicable regulations concerning the prevention of air pollution, especially those relating to stack emissions. In the conduct of construction activities and the operation of equipment, contractors shall utilize all practical methods to control, prevent and otherwise minimize atmospheric emissions, specifically:

(i) Take every precaution to reduce the levels of dust at construction sites, and not exceeding the pre-project ambient air quality standards.
(ii) Fit all heavy equipment and machinery with air pollution control devices that are operating correctly.
(iii) Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust.
(iv) Reduce dust by spraying stockpiled soil, excavated materials, and spoils.
(v) Cover with tarpaulin vehicles transporting soil and sand.
(vi) Cover stockpiled construction materials with tarpaulin or plastic sheets.
(vii) Trenching and transport vehicles shall move only in designated areas and roads.

(viii) Water spraying to access roads, camp sites and work sites to reduce dust emissions.
(ix) Machines and vehicles must be regularly examined and maintained to comply with requirements of technical specifications.
(x) All vehicles, equipment, and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of DOE. Copies of conformance will be submitted regularly to the PMSC.
(xi) Repair and maintain access roads, as necessary.
(xii) Monitor air quality according to the environmental monitoring plan.

12. Noise Pollution

344. **Construction activities related to noise generation.** The construction/installation of the different components of the project (STP, Sewage Pumping Station, Sewer Network) will include the activities listed below:

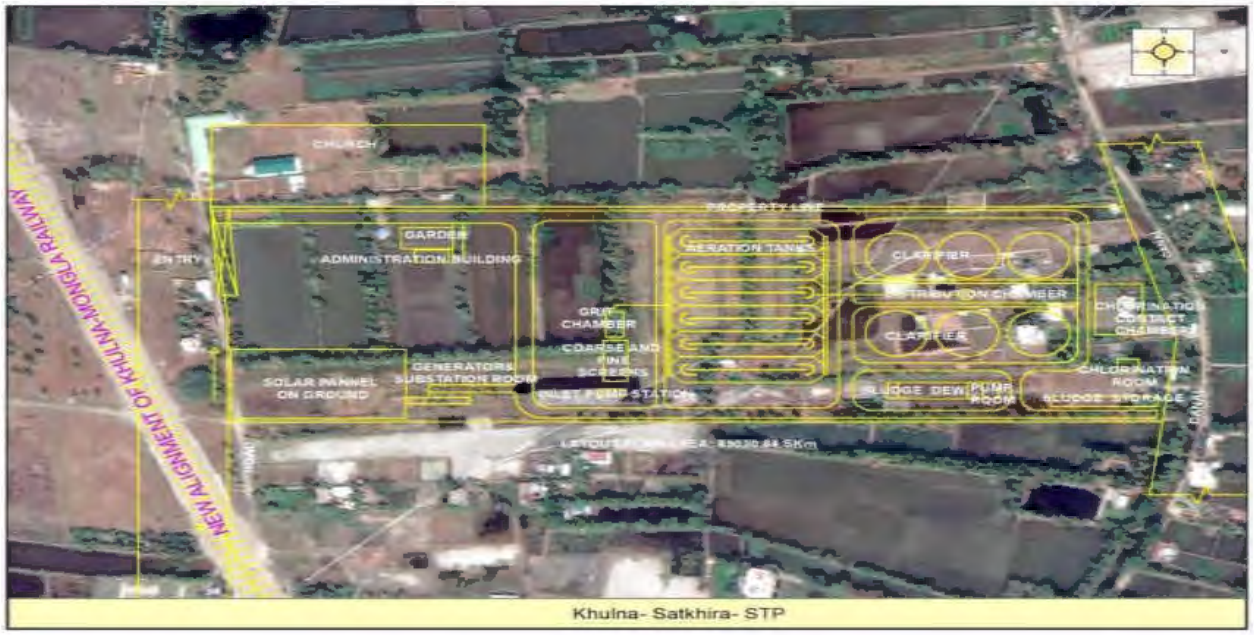
(i) Preparation and leveling of the land;
(ii) Construction of STPs and SPSs;
(iii) Drilling for trenchless pipe installation;
(iv) Excavation works to the required depth for the trenches needed to install the pipeline and trench preparation following excavation including leveling, constructing the pipe foundation, and connecting the pipes etc.;
(v) Construction of Reinforced concrete elements and other civil works.

345. **The vulnerable groups** who are susceptible to the construction noise are the following:

(i) Onsite Workers who are the most exposed to the highest noise levels generated from different construction activities due to their proximity to the noise sources.
(ii) Neighboring communities and other sensitive receptors (such as worshipers at church/mosque, students at schools and other educational institutes, patients at hospitals etc.).

346. There is a sensitive receptor which was identified during the site visits close to the locations of the STP-2 site in Tikrabandh. The nearest receptors to STP include: A Church located about 20m away (Figure 29).

Figure 32: Location of the Church along the STP-2 Site



347. **Impacts.** Typical noise emissions for the plant and equipment likely to be deployed in the construction work are listed in the following Table together with typical international standards which to be used to ascertain the significance of noise impact on the sensitive receptor.

348. It was clear from the site visits and the Figure 29 that the church is located around 20m away from the proposed site for STP-2. According to Table 43, the level of noise generated during the different construction equipment which will reach the boundary of the Church will exceed 75dB. The potential generated noise will therefore affect the worshipers as well as workers on site. The impact should be therefore considered of moderate significance, and it should be controlled by applying proper mitigation measures.

Table 43: Typical Noise Emission from Plant and Equipment

Type of Equipment	Distance between equipment and observer			Standard for the Project (Commercial Area)[a]	
	5m	20m	50m	Day	Night
Loader	90	78	70	70	60
Grader	90	78	70	70	60
Vibration Roller	86	74	66	70	60
Bulldozer	86	74	66	70	60
Generator	98	86	78	70	60
Impact Drill	87	75	67	70	60
Concrete Mixer	91	79	71	70	60
Concrete Pump	85	70	62	70	60
Pneumatic Hammer	84	86	78	70	60

Figures in dB(A).
[a] Refer to Table 7 for other standards depending on area.

349. **Mitigation.** Mitigation measures to reduce the noise impacts off-site at the nearest sensitive receptors include the following:

(i) Communicate the construction schedule with the neighboring church and operations shall be restricted to the hours of worship as per discussion;

(ii) Noise barriers or 2.4m hoarding shall be installed between the source and receptor;
(iii) Generators will be located away from sensitive receivers and will be enclosed;
(iv) Plant and vehicles shall be started sequentially rather than all together;
(v) Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable;
(vi) Use modern vehicles and machinery with standard adaptations to reduce noise and exhaust emissions, and ensure they are maintained to manufacturers' specifications;
(vii) Noise-generating equipment must be fitted with silencers.
(viii) Optimize the use of noisy construction equipment and turn off any equipment if not in use;
(ix) Regular maintenance of all equipment and vehicles;
(x) Stop all construction activities during at night;
(xi) Implement a complaints handling system;

350. On-site construction noise shall be mitigated to ensure a safe work environment by implementing an on-site occupational health and safety plan, which considers national and international requirements. The plan shall include the following measures:

(i) Ear muffs/protective hearing equipment shall be made available to all workers in noise critical areas
(ii) Training on how and when to use protective hearing equipment shall be conducted as part of the workers' induction sessions.
(iii) Place visually clear instructions in areas where noise emissions are significant.
(iv) Measure noise level according to the environmental monitoring plan.

13. Waste Management

351. **Impacts.** The majority of waste generated will include construction wastes (solid wastes: piece of rods, woods, bricks, stones, containers, electric wire, pipes etc. liquid waste: paint, bitumen, oil etc.) and general wastes (solid wastes: papers, plastic containers, residues of food, fruits etc. and liquid waste: from kitchen and bathroom etc.). These wastes will be generated due to construction camps, construction activities and materials used for construction. If inadequate arrangements exist for the disposal of above mentioned wastes, there will be negative impact on the soil, aesthetic beauty of area and workers' health and safety.

352. **Mitigation.** The contractor is required to implement the following in relation to resource and waste management during construction:

(i) The contractor is required to prepare, implement and maintain a Waste Management Plan throughout construction that addresses the following as a minimum:
   a. Description of the proposed development;
   b. Wastes arising including procedures for minimization/reuse/recycling;
   c. Estimated cost of waste management;
   d. Roles including training and responsibilities for construction and demolition waste;
   e. Procedures for education of workforce and plan dissemination program;
   f. Record keeping procedures;
   g. Waste collectors, recycling and disposal sites including copies of relevant permits or licenses; and
   h. Waste auditing protocols.

(ii) The Contractor will minimize waste disposal so far as is reasonably practicable;
(iii) Source segregation. Where possible metal, timber, glass and other recyclable material will be segregated during construction works and removed off site to a designated facility for recycling. Waste stream color coding, and photographs of wastes to be placed in each container as required, will be used to facilitate segregation. Where waste generation cannot be avoided this will maximize the quantity and quality of waste delivered for recycling and facilitate its movement up the waste hierarchy away from landfill disposal and reduce its environmental impact;
(iv) Supply chain partners. The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse;
(v) Waste auditing. The contractor will record the quantity in tons and types of waste and materials leaving site during the construction phase;
(vi) Waste fuels/oils may be generated from equipment used on-site during construction and may be classified as hazardous waste. Such wastes will be stored in a secure, bunded area on-site prior to collection by relevant parties;
(vii) Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavation material may not be re-used within the proposed works the contractor will endeavor to send material for recovery or recycling so far as is reasonably practicable;

14. Disposal of Surplus Materials

353. **Impacts.** Wherever the material excavated from pipeline trenches is suitable, it will be reused, as general backfill, for example, around inspection chambers. It is not expected that surplus material will need to be sent to a municipal landfill. Under the project, 60-70% sewer pipe will be laid adopting trenchless method which will minimize the disposal of surplus materials. However, any potential excess spoils will impact surrounding areas particularly the streets and drainages if no proper measures is put in place.

354. **Mitigation.** Excavated soil during sewer network excavation and pipelaying activities will be managed and stored in an appropriate manner on site with all the proper safety measures to contain them, prevent possible siltation of nearby drainages, and prevent disturbance to community people including pedestrians. Most, if not all, the excavated soil will be re-used as backfill materials once pipelaying is done. The disposal of excess spoil, if any, including construction materials and debris, shall be carried out in accordance with the construction waste management plan to be prepared by the contractor and approved by the KWASA through the PMU prior to the commencement of work. The normal manner of disposal shall include all necessary precautions for minimizing water and air pollution, drainage impedance, the risk of fire, and damage to ecosystems.

15. Hazardous Materials and Hazardous Waste Disposal

355. **Impacts.** Use of hazardous substances such as paints, oils and lubricants can cause significant impacts if not properly controlled, or if waste is not disposed of correctly. Mitigation measures will seek to control access to and use of hazardous substances and control waste disposal. The PMU, with support from PMSC and/or IADC, will be responsible for monitoring the contractor’s progress in updating the Waste Management Plan to include implementation of mitigation measures and to minimize impacts from hazardous substances.

356. **Mitigation.** The contractors' mitigation measures will include but not necessarily be limited to the following measures:

(i) Ensure that safe storage of paint, fuel, other hazardous substances, and bulk materials are agreed on by PMU/Consultant, and have necessary approval/ permit from DOE and local authorities;
(ii) Hydrocarbon, toxic materials, and explosives will be stored in adequately protected sites consistent with national and local regulations to prevent soil and water contamination;
(iii) Equipment/ vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuels. Such areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency;
(iv) The contractor will identify personnel in the WMP/EMP in charge of these sites, and ensure they are properly trained to control access to these areas; entry will be allowed only under authorization;
(v) Fuel and other hazardous substances will be stored in areas provided with roof, impervious flooring, and containment wall to protect these from the elements and to readily contain spilled fuel/lubricant;
(vi) Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport, and disposal shall not cause pollution and will be undertaken consistent with national and local regulations;
(vii) Ensure all storage containers are in good condition with proper labelling;
(viii) Regularly check containers for leakage and undertake necessary repair or replacement;
(ix) Store hazardous materials above possible flood level;
(x) Discharge of oil-contaminated water will be prohibited;
(xi) Used oil and other toxic and hazardous materials will be disposed of in an authorized facility offsite;
(xii) Adequate precautions will be taken to prevent oil, lubricant, or hydrocarbon contamination of drainage channel beds;
(xiii) Ensure availability of spill, clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored;
(xiv) Spillage, if any, will be immediately cleared with utmost caution to leave no traces;
(xv) Spillage waste will be disposed of at disposal sites approved by local authorities and by the Consultant; and
(xvi) All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities to combat emergency situations complying with all the applicable statutory stipulations.

16. Asbestos Cement Pipes

357. **Impacts**. During excavation activities, workers may encounter asbestos cement (AC) pipes that could either be abandoned or in use by the current water supply network in Khulna city. Accidental breakage of these AC pipes during excavation works could pose health hazard to workers that has latent effect in the long term, such as asbestosis or lung cancer. Exposure to AC pipes should be seriously dealt with and handled by the contractor through proper mitigation measures.

358. **Mitigation**. The contractors and workers should be able to understand the nature of AC materials and their effects to human health. The following measures should be adopted by the contractor prior to conducting excavation works or when actual encounter of AC pipes occur during excavation activities:

(i) Development and application of a detailed procedure to protect workers and the people surrounding the excavation sites. This should comply with national and/or international standards for handling asbestos, and should include: (a) removal of all persons to a safe distance; (b) usage of appropriate breathing apparatus and protective equipment by persons assigned to handle the AC material; and (c) procedures for the safe removal and long-term disposal of all asbestos- containing material encountered;

(ii) Training of all personnel and site workers to enable them to understand the dangers of AC pipes and to be able for them to recognize AC pipes;

(iii) If AC pipes encountered are not broken, leave them in-situ as much as possible, and ensure proper protection and precautions are observed in order to avoid breaking the AC pipes during excavation or reinstatement activities; and

(iv) Reporting procedures to inform management immediately if AC pipes are encountered.

17. Protection of Flora Resources

359. **Impacts.** During the construction work of the Project, a total of 3,960 tree seedlings can be planted which will provide positive impact on the natural environment. Inappropriate selection of tree species and plantation location may not ensure the inherent objective of the tree plantation. Moreover, lack of proper care (e.g. watering, securing with fence) by the respective authority will also hinder the process of proper growth of the planted trees.

360. **Mitigation.** Afforestation will be done at the ratio of 1 (cut): 2(new planting). A total of 3,960 sapling trees will be planted as per tree plantation plan developed by KWASA. No trees, shrubs or groundcover will be removed, or vegetation stripped without the prior permission of PMU and Consultants. Indigenous trees most suited to the tract will be planted and early replanting and regular watering of the disturbed areas with local native vegetation should be undertaken to ensure speedy recovery of the cleared vegetation. Moreover, an awareness campaign targeted on the neighborhood affected persons will be carried to popularize tree planting and saplings should be provided to interested parties.

18. Protection of Fauna

361. **Impacts.** There are no game reserves or wildlife sanctuaries is located along the project area, only disturbance from the visual impacts, vehicles and construction equipment may cause disruption of wildlife activity such as breeding and/or feeding. The project will pose minor negative impact on the fauna present in the project area. However, the critical habitat assessment for the project identified that the Bhairab and Rupsha river system is a critical habitat for the South Asia River Dolphin species. As part of the assessment, the all aspects of project components and implementation methodologies has been evaluated to understand if any of these aspects will negatively impact such critical habitat, in particular the Bhairab and Rupsha river system. The assessment reveal that none of the components and/or procedures and methodologies considered at all phases of project implementation (pre-construction, construction and operation) will negatively impact the river system. Further assessment reveal that the project itself is regarded as an initiative that will have a direct beneficial impact (i.e. as a protection) to the critical

habitat due to the reduction of pollution load to the river system once the project is put in place in the future.

362. **Mitigation.** The following mitigation measures, however, will be implemented:

(i) Setting up and implementation code of conducts to workers, including no catching or hunting fish and wildlife, and no consumption of wildlife products.
(ii) While clearing vegetation it must be ensured that no wildlife injure and/or die.
(iii) Minimize the release of oil, oil wastes or any other substances harmful to aquatic species to any waters, particularly to the Bhairab and Rupsha rivers.
(iv) New and good condition machinery with minimum noise will be used in construction;
(v) Construction work that may generate high noise levels will not be carried out during night time so that there would be no disturbance to local birds and animals;
(vi) Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.

19. Impacts on Socio-Economic Resources

363. **Impacts.** Construction works may result in temporary loss of livelihoods and interruption of social and economic activities. If sewerage network installation is conducted in areas where there are shops or other commercial activities, these could lose some business while the works conducted if access is difficult for customers.

364. **Mitigation.** The contractor will ensure:

(i) Establish a Grievance Redress Mechanism, and respond to grievances;
(ii) Trenchless method shall be used in areas where there are shops or other commercial activities;
(iii) The construction works do not interfere with the convenience of the public or access to, use, and occupation of public or private roads, or any other access to properties, whether public or private.
(iv) Temporary access to properties adjacent to the construction site will be provided through the construction of ramps with concrete slabs for use of pedestrians and light vehicles;
(v) In critical areas such as institutions, operating hours are factored into work schedules and workforce is increased for speedy completion;
(vi) Advance information on works to be undertaken including appropriate signage is provided;
(vii) The diversion is done in coordination with the traffic police division for necessary rerouting of traffic and traffic management.

20. Income/Job Opportunities

365. Primarily a positive impact, the project will create significant temporary employment for construction workers, equipment maintenance and support staff. While a small number of senior project managers may come from overseas and other specialists from elsewhere in Bangladesh, the majority of project staffs are expected to be recruited locally from within the native/local workforce. The number of temporary jobs created during the construction period is likely to be 1000 - 1200.

21. Disruption of Public Access

366. Impacts. In addition to the general disruption of communications, pipe laying will result in the temporary loss of access as work progresses past individual property entrances. This will be most serious when crossing roads and in front of public building and emergency service centers.

367. **Mitigation.** Disruptions to public access shall be identified in the contractor's traffic management plan, under which suitable notice of intending delays and closures are given to all concerned parties and approved prior to commencing work. Notwithstanding this, all road closures shall be separately notified and agreed with the KCC and KWASA as appropriate, and through notices posted throughout the affected area at least 48 hours in advance of the proposed closure. Partial closures and traffic delays managed with temporary traffic lights or flagmen need not be separately notified.

(i) Prepare alternative transportation routes. The diversion shall be done in coordination with the traffic police division for necessary rerouting of traffic and traffic management;
(ii) Consult with business and institutions for work schedules. In critical areas such as schools or hospitals, operating hours are factored into work schedules and workforce is increased for speedy completion;
(iii) Period between trench opening and temporary reinstatement should not exceed 48 hours. It is recognized that extraordinary circumstances will occasionally arise, and this period may be extended to 4 days with the approval of the Engineer. Excavations for inspection chambers in roads shall not remain open for longer than 10 days.
(iv) Access to or from an individual property is closed for a period of 2 hours or more, the owner shall be informed at least 24 hours in advance;
(v) Inform through display board about nature, duration of construction and contact for complaints;
(vi) Schedule material deliveries on low traffic hours;
(vii) Restore damaged properties and utilities;
(viii) Erect and maintain barricades if required;
(ix) Pedestrian access to schools, public libraries, courts, doctor's surgeries, pharmacists, and other premises frequently by the public will be maintained with the use of walking boards. Wheelchair and disabled access shall be maintained.
(x) All surfaced roads shall be subject to road cleaning and unsurfaced roads to dust suppression, the methodology and frequency of which shall be included in the traffic management plan.

22. Traffic Control and Safety

368. **Impacts.** The excavation of trenches and pipe installation along main roads within the city will result in considerable and unavoidable delays to traffic flows. The impact upon vehicular movement will generally be confined to increased journey time and the costs associated with delays, which in the majority of cases will only be of minor inconvenience. Delays will be most noticeable during morning and evening peak 'rush-hours' even though these are relatively modest across the city, though the intensity is becoming severe in central business areas of the city in present days.

369. **Mitigation.** This impact is temporary but highly significant and will cause adverse impacts on all road users. Therefore, the Contractor shall:

(i) Detailed Traffic Management Plans will be prepared before taking up any construction work and submitted to the Engineer for approval, 5 days prior to commencement of work on any section of road.

(ii) Contractor should inform the traffic police authority before starting road cutting/excavation. In view of this, dedicated liaison personnel may appoint to communicate with traffic police.
(iii) Provide, erect and maintain barricades, signs, markings, flags, lights and flagmen as may be required for the information and protection of traffic. The flagmen shall be equipped with red and green flags and lanterns/lights.
(iv) Plan and conduct work in such a way that can be completed in 6-8 hours with as little as possible of traffic interruption, so all of this work (and probably most of the daytime work in minor roads) will be conducted by small teams of men, working on short lengths of the network (around 100 - 150 m) at a time.
(v) Construction would seriously hamper the traffic movement specially at the intersection points, thus trenching should be done at night in busy road sections.
(vi) Construction equipment and materials shall be removed from the busy roads at the end of night shift.
(vii) Where ramps, temporary carriageways and walkways are required, they shall be provided and maintained to a standard suitable in all respects for the class or classes or traffic or pedestrians. These must be kept usable by women, children, patients and disables.
(viii) Emergency response plan must be prepared for any traffic accident during construction.

23. Physical and Cultural Heritage

370. **Impacts.** There are no physical cultural resources (PCRs) listed in UNESCO World Heritage list of archaeological sites along the entire project alignment. This is confirmed in a mapping of PCRs done for Khulna city as shown in Figure 31. But based on this mapping, there are various socio-cultural and religious establishments such as churches, mosques, and educational institutes like schools and colleges in the area. During construction activities, these socio-cultural establishments may be impacted by noise and dust pollution. Accessibility to these institutions also may be hampered during construction phase.

371. The project sites are not potential archaeological areas and therefore no impact is envisaged. However, as a precautionary approach, measures or protocols for chance finds will be followed by the project.

372. **Mitigation.** This impact is temporary and minor in nature. Mitigation measures will include:
(i) Facilitating access using alternative routes, or by using planks with handrails, during excavation and construction, including timely completion of construction works;
(ii) Establishment of construction site camp and labor camp maintaining proper distances from the cultural sites;
(iii) Affecting dust and noise control measures provided in the EMP; and
(iv) In the event of a chance finds, the following measures shall be strictly adopted by the contractor:
    a. strictly follow the protocol by coordinating immediately with PMU and Bangladesh Department of Archaeology for any suspicion of chance finds during excavation works;
    b. stop work immediately to allow further investigation if any finds are suspected; and

c. request authorized person from the Bangladesh Department of Archaeology to observe when excavation resumes for the identification of the potential chance find, and comply with further instructions.

24. Occupational Health and Safety

373. **Impacts.** Health risks and safety problems for workers are concerns in all construction projects. Safety risks and health issues arise from storage, handling and transport of hazardous construction material. Construction workers are also at risk of accidents due to moving vehicles, and other construction related activities. Workers are also exposed to high level of pollution from dust, exhaust of vehicles and machinery and noise. Further, if workers do not keep to regulated working hours, the risk of accident events will be higher due to fatigue.

374. **Mitigation.** The Contractor shall present a Health and Safety policy for approval by the Engineer prior to commencement of work. This will contain normal internationally accepted procedures in relation to the risks imposed by the nature of the work to be undertaken. The contractor shall ensure all authorized persons present on all sites, be they his own staff, representatives of the implementing agency or the construction Manager, or other visitors, are aware of any site-specific safety requirements and are supplied with hard hats and other protective clothing appropriate for the work being undertaken.

375. The following mitigation measures will be implemented:

(i) All relevant provisions of the Bangladesh Labor Act, 2006 and relevant WHO guidelines will be adhered to, concerning the provision of adequate measures to avoid contracting and/or spreading diseases during construction phase.

(ii) Follow international best practices on occupational health and safety such as those in Section 4.2 of World Bank EHS Guidelines on Construction and Decommissioning Activities.[26]

(iii) Follow established occupational health and safety protocol on emerging infectious diseases such as the corona virus disease (COVID19). See Appendix 7 for a sample guidance note in responding to COVID19.

(iv) A proper occupational health and safety plan has to be prepared and will have to be followed to avoid health hazard of the workers.

(v) At every workplace, a readily available first aid unit, including an adequate supply of sterilized dressing material and appliances, will be provided as per the factory rules. Suitable transport will be provided to facilitate the transfer of injured or ill persons to the nearest hospital.

(vi) At every workplace and construction camp, equipment and nursing staff will be provided.

(vii) The contractor will, at his own expense, conform to all disease prevention instructions given to him by the PMSC.

(viii) Provide regular health check-ups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce.

(ix) The contractor shall provide at cost all labor and materials and construct/install and maintain site safety, hard barricading, flexible green net, signboards, temporary day/light traffic diversions throughout the construction activities according to the

[26] IFC World Bank Group. 2007. ***Environmental, Health, and Safety (EHS) Guidelines – General EHS Guidelines: Construction and Decommissioning***.

specifications and provide personal protective equipment (PPE) to all the laborers working at the construction site.

(x) Launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards.

(xi) Make available first aid kits, ambulance facilities, and fire extinguishers in camp sites.

(xii) Compensation for the loss of life (a zero tolerance to loss of life policy should be developed and implemented) or for any type of injuries.

(xiii) Provide insurance to the workers. Health and safety training for all site personnel is very important and must be mandatory.

25. Community Health and Safety

376. **Impacts.** Given the limited scale of construction for Sewer network, and specialized controlled work for STP and sewage pumping station components, the risk to public safety in both physical extent and the types of risk posed, will be restricted. The most serious threats will be in the vicinity of pipeline trench and inspection chamber excavations along public roads where they will be easily accessed. Other areas of public danger will include:

(i) Where heavy plant and equipment moves in and out of the contractor's yard; and

(ii) Construction materials and fuel storage areas.

377. There may be an increased risk of traffic accidents where delays and diversions are imposed or altered without adequate warnings and precautions. There may also be risk of accidental fall of pedestrians in excavated areas. Proper diversion system and appropriate temporary access for pedestrians will minimize the risk of accidents.

378. **Mitigation.** Along pipeline routes, warning signs, warning tapes and notices will deter access to trenches. The excavation of trenches ahead of pipe laying and backfilling shall be limited such that the period from the time of opening a trench to temporary reinstatement shall not normally exceed 48 hours unless exceptional circumstances agreed with the Engineer prevail. Work crews on roads shall include flagmen to provide for the safe passage of traffic and all work sites shall be adequately watched and lit during the hours of darkness. Planks with handrails shall be provided in excavated areas, particularly in location where access to residential, commercial and institutional establishments is affected.

379. The following mitigation measures will be implemented:

(i) Code of conduct for workers includes restricting workers in designated areas, no open defecation, no littering, no firewood collection, no fire except designated places, no trespassing, no residence at construction sites, and no obligation to potentially dangerous work;

(ii) Follow International best practices on community health and safety such as those in Section 4.3 of World Bank Environmental Health and Safety (EHS) Guidelines on Construction and Decommissioning Activities;[27]

(iii) Follow established community health and safety protocol on emerging infectious diseases such as COVID19. See Appendix 7 for a sample guidance note in responding to COVID19;

[27] IFC World Bank Group. 2007. ***Environmental, Health, and Safety (EHS) Guidelines – General EHS Guidelines: Construction and Decommissioning***.

(iv) Maintain a complaint logbook in worker's camp and take action promptly of complaints;
(v) Plan transportation routes in consultation with KCC, RHD and Police;
(vi) Schedule transportation activities by avoiding peak traffic periods;
(vii) Clean wheels and undercarriage of haul trucks prior to leaving construction site;
(viii) Educate drivers: limit speed between 20-25 km/h in settlements and avoid use of horn;
(ix) Earmark parking place for construction equipment and vehicles when idling; no parking shall be allowed on the roads, that may disturb the traffic movement;
(x) Provide prior information to local people about work;
(xi) No night time construction activities including material/waste haulage near or within residential areas. Construction activities in these areas must be prohibited from 9pm to 7am;
(xii) Noise barriers must be installed in housing areas to reduce the noise level;
(xiii) Temporary access such as planks with handrails will be provided at excavation areas, particularly in locations where access to residential, commercial and institutional establishments is affected.

26. Reinstatement of Working Areas on Completion

380. The contractor will reinstate all working areas and access routes as work proceeds during construction. All plant, equipment, materials, temporary infrastructure and vehicles will be removed at the earliest opportunity and the surface of the ground restored as near as practicable to its original condition.

E. Anticipated Impacts and Mitigation Measures during Operation Phase

381. The component of the project relating to the construction of two STPs in two vacant, undeveloped, desolate sites pose very negligible impacts in terms of the presence of appropriate receptors, sensitive environmental components and residual effects. Most of the impacts identified are associated with construction works of the site facilities including buildings for administration, storage, security, substation and vehicular resting. Construction of process facilities involves electro-mechanical interventions, which also are part of construction related impacts. During the operational phase of the treatment plant, involvement of certain chemicals/reagents may cause further impacts, if doses/quantities are not optimized carefully. Occupational health safety issues are more prevalent and draw more attention than many other issues. Below are discussions on the impacts and associated mitigation measures during the operation phase of the STPs and FSTP.

1. Occupational Health and Safety

382. There will be risk of health of workers during operation and maintenance if repair and maintenance crews do not abide by the proper health and safety procedures and therefore they may suffer infectious diseases. The following measures will be implemented:

(i) Ensure routine vaccinations for workers for influenza, tetanus, and Hepatitis "B" (in consultation with appropriate physicians);
(ii) Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available;

(iii) Use PFDs when working near waterways;
(iv) Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance;
(v) Use fall protection equipment when working at heights;
(vi) Maintain work areas to minimize slipping and tripping;
(vii) Implement fire and explosion prevention measures in accordance with internationally accepted standards;
(viii) Workers must be trained to recognize potential hazards, use proper work practices and procedures, recognize adverse health effects, understand the physical signs and reactions related to exposures, and are familiar with appropriate emergency evacuation procedures. They must also be trained to select and use the appropriate PPE;
(ix) Provide all the personal protective equipment like gum boots, nose mask, gloves etc. for the protection of workers;
(x) The workplace will be equipped with fire detectors, alarm systems and fire-fighting equipment. The equipment will be periodically inspected and maintained in good working condition;
(xi) Providing adequate personnel facilities, including washing areas and areas to change clothes before and after work;
(xii) Medical check-up will be conducted on regular basis and the health conditions will be monitored;
(xiii) First aid facilities required to attend immediately for meeting emergency situations will be made available at the facility;
(xiv) Maintain good housekeeping in waste processing and storage areas;
(xv) Conduct detailed identification and marking of all electrical connections prior to any maintenance work;
(xvi) Use specially trained personnel to demount electrical parts;
(xvii) Provide safe means of access and egress from confined places, such as stairs and ladders, and safety ropes;
(xviii) Avoid operating combustion equipment for prolonged periods unless the area is actively ventilated; and
(xix) Avoid exposure to excessive noise levels beyond permissible limits set out by local and international regulations.

383. When installing or repairing mains adjacent to roadways, implement procedures and traffic controls, such as:

(i) Establishment of work zones so as to separate workers from traffic and from equipment as much as possible;
(ii) Reduction of allowed vehicle speeds in work zones;
(iii) Use of high-visibility safety apparel or reflectorized vests for workers in the vicinity of traffic;
(iv) For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists; and
(v) Locate all underground utilities before digging.

2. Community Health and Safety

384. Neighboring community is likely to be temporarily disrupted due to mismanagement of overflows, hazardous waste and materials and odor and noise nuisance. However, public safety in respect of operational impacts is best secured through the prevention of unauthorized access.

Operational staff will be trained in and comply with all the provisions of the KWASA Health and Safety requirements, delineated by the contractor before handing over the plant.

(i) Develop and implement appropriate protocols to reduce risks to safety, public health, and environment that include well-written instructions;
(ii) Response to overflows by preventing, containing, minimizing, the overflow where it is feasible and safe to do so;
(iii) Develop a contingency plan (site-specific);
(iv) Protect components of sewage pumping stations from flood damage where it is feasible to do so (for instance, protecting components from rising flood water to enable reinstating more rapidly);
(v) Train operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training;
(vi) Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment;
(vii) Prepare written Standard Operating Procedures (SOPs) for filling containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response;
(viii) Transport and dispose waste residues from screens in legal and approved disposal sites;
(ix) Make available spill response equipment sufficient to handle at least initial stages of a spill;
(x) Train and educate operational personnel on response activities in the event of spill, release, or chemical emergency; and
(xi) Provide quality monitoring tests for groundwater and surface water resources adjacent to project locations.

3. Leakage and Overflows

385. Once the sewer network is laid, tested and commissioned, there should be no impact except for rare accidental breaks and leaks. Sewage pipelines laid at a suitable depth with appropriate bedding material and adequate depth of cover should also be largely trouble free. Occasional breakages may occur, but more frequent, there may be blockages due to the disposal of inappropriate materials such as food waste, plastics and other household refuse where individuals are unaware of the limitations on sewer capacity.

386. The prompt repair of pipe breakages will largely mitigate actual and potential sewage overflows. Effective operation to avoid and/or immediate clearance of such leaks, blockages. Implementation of regular O&M schedules could avoid leakage and overflow problems in sewers.

4. Odor Generation and Air Emission

387. **Sewage Treatment Plant.** The generation and dispersion of odorous emissions and its control or management is another key environmental issue. The main sources of odor at STP are generally associated with either sludge or septic wastewater and hence, the priority for odor treatment is the inlet works, sumps and sludge tanks. Mechanical ventilation is considered appropriate where from potentially fewer odors will be vent out, mostly for secondary treatment facilities.

388. From the baseline climatic data of Khulna, it is very obvious that wind flow regime is mostly dominant through East-Southeast to Southern direction with an average wind speed ranges from 5 to 19 km/h during maximum period in a year. In the following map, a wind rose diagram is shown along with a possible wind flow path (dominant) on a google map. For STP-1, nuisance from odor produced in the plant will have very negligible effect on nearby population throughout most of the year, since the whole block of the dominant wind blowing region is barely populated, found both in physical survey in the area and also from the aerial map.

Figure 33: Dominant Wind Flow Direction in Wind Rose Diagram and Corresponding Areal Map in Google



389. In case of mechanical management of odor, emission points (e.g., aeration basins, clarifiers, sludge thickeners, tanks, and channels) needs to be covered and vented to control systems (e.g., compost beds, bio-filters, chemical scrubbers, etc.) as needed to reduce the pungency.

Table 44: DOE Standards for Odor (Schedule- 8 in ECR 1997)

Parameters	Unit	Standard Limit
Acetaldehyde	ppm	0.5-5
Ammonia	ppm	1-5
Hydrogen Sulfide	ppm	0.02-0.2
Methyl Disulfide	ppm	0.009-0.1
Methyl Sulfide	ppm	0.01-0.2
Styrene	ppm	0.4-2.0
Trim ethylamine	ppm	0.005-0.07

Notes: (1) Following regulatory limit shall be generally applicable to emission/exhaust outlet pipe of above 5-meter height: Q = 0.108 x He2Cm (Where Q = Gas Emission rate Nm3 /hour) He = Height of exhaust outlet pipe (m) Cm = Above mentioned limit (ppm); (2) In cases where a special parameter has been mentioned, the lower limit shall be applicable for warning purposes, and the higher limit shall be applicable for prosecution purpose or punitive measure.

390. **Sewerage Network.** Odor emitting from sewer pipelines is indicative of septicity taken place within the line rather than under controlled conditions at the treatment plant. Given the proposed sewer network will be designed with appropriate pipe diameters and gradients to maintain self-cleansing velocities, there will be little potential for odor.

391. As with air pollution and noise, the most effective means of combating the propensity of raw sewage to create odor is to maintain pipelines and ensure efficient operation.

5. Acoustic Environment

392. High noise levels can be present in the vicinity of operating machinery and flowing water at water and sanitation facilities which may result in heath stress to workers, local community and wildlife. The impact is negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.

393. Plant and maintain a green belt around the site. Implement a complaints system to investigate any noise complaints from neighboring communities. Monitor noise levels within STP and sewage pumping station boundary, to ensure limits are not exceeded. Create retrofitting noise controls where practical, like fencing and enclosures;

6. Soil and Water Pollution

394. The effluent for any reason may become not compliant with the standards, hence containing harmful amounts of compounds. This could have then a direct impact on the soil and surface water and could leach to the groundwater. The risk would depend on the degree of unconformity of the treated effluent.

395. **Mitigation.**

(i) Implement preventive maintenance program to all structures and electromechanical equipment in sewage pumping stations, STPs and FSTP;
(ii) The supplier of each equipment should provide a preventive maintenance schedule for supplied equipment. Implementing this schedule should be part of the STP/FSTP and sewage pumping station operational manual;
(iii) Take all precautions to prevent entering of run-off into streams, watercourses or irrigation system.
(iv) Avoid discharging untreated wastewater to any receiving body of water;
(v) Quality of final effluent from STP and soil quality shall be regularly monitored to ensure that water quality complies with the DOE standards; and
(vi) Quality of soil within and around the STP sites shall be regularly monitored to ensure that it complies with the government standards.

7. Handling of Hazardous Wastes

396. Accidental spillages of chemicals or hazardous substances may happen at the STP sites, or wherever there are maintenance and repair activities. Workers may also be exposed to hydrogen sulfide, methane, carbon monoxide, chloroform, and other chemicals generated during wastewater treatment. Oxygen may be displaced or consumed by microorganisms, thus resulting in an oxygen deficient environment in areas where wastewater or wastewater residues are processed.

397. **Mitigation.** The following procedures are recommended to prevent, minimize, and control chemical exposure at water and sanitation facilities::

(i) A waste management plan complying with international best practice and relevant national regulations and covering all types of potentially hazardous wastes shall be developed and implemented by the project's operator;

(ii) The waste management plan should also refer to health and safety plan and emergency procedures for containing and managing accidental spillages;
(iii) Availability of Material Safety Data Sheets (MSDS) which list the characteristic of the substance and cleansing methods in the event of a spill;
(iv) Implement a training program for operators who work with chlorine and ammonia regarding safe handling practices and emergency response procedures;
(v) Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use and maintenance;
(vi) Prepare escape plans from areas where there might be a chlorine or ammonia emission;
(vii) Install safety showers and eye wash stations near the chlorine and ammonia equipment and other areas where hazardous chemicals are stored or used;
(viii) If source water contains radioactive substances, locate water treatment units and water treatment sludge areas as far as possible from common areas (e.g., offices);
(ix) Conduct radiation surveys at least annually, especially in areas where radionuclides are removed;
(x) Limit wastes entering the sewer system to those that can be effectively treated in the wastewater treatment facility and reduce the amount of air-strippable hazardous compounds entering the system by controlling industrial discharges (e.g., by permit or similar system). Analyze incoming raw wastewater to identify hazardous constituents;
(xi) Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance;
(xii) Use personal gas detection equipment while working in a wastewater facility;
(xiii) Continuously monitor air quality in work areas for hazardous conditions (e.g. explosive atmosphere, oxygen deficiency);
(xiv) Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping;
(xv) Prohibit eating, smoking, and drinking except in designated areas; and
(xvi) Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.

8. Pathogens and Vectors

398. **Impact.** Workers and staff at wastewater and sludge treatment facilities and fields where treated wastewater or sludge is applied, as well as operators of sludge collection vehicles, can be exposed to the many pathogens contained in sewage. Processing of sewage can generate bio-aerosols which are suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods of time, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be carried by airborne dust particles. Vectors for sewage pathogens include insects (e.g. flies), rodents (e.g. rats) and birds (e.g. gulls).

399. **Mitigation.** Recommended measures to prevent, minimize, and control exposure to pathogens and vectors include wastewater and sludge treatment, and land application. Specific mitigation measures that will be employed include:

(i) Safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors;
(ii) Use of vacuum trucks or tugs for removal of fecal sludge instead of manual methods;
(iii) Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;
(iv) Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps minimize chemical and radionuclide exposure;
(v) Encourage workers at wastewater facilities to wash hands frequently;
(vi) Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations;
(vii) Reduce aerosol formation and distribution, for example by planting trees around the aeration basin to shield the area from wind and to capture the droplets and particles
(viii) Reducing aeration rate, if possible, but not to the detriment of wastewater treatment efficiency;
(ix) Avoid handling screenings by hand to prevent needle stick injuries;
(x) Maintain good housekeeping in sewage processing and storage areas; and
(xi) Advise individuals with asthma, diabetes, or suppressed immune systems not to work at wastewater treatment facilities, because of their greater risk of infection.

9. Maintenance

400. **Impacts.** Solving any problems with sewage mains is likely to involve temporary road excavation to undertake repair, resulting in traffic delay or diversion. Significant but short-term noise and dust will be generated, and surplus spoil may remain to be disposed of. Service to consumers and customers is likely to be temporarily disrupted.

401. **Mitigation.** As with many other issues, the mitigation of impacts arising from the general maintenance of the water and sewerage networks will be programmed preventive maintenance and the rapid and effective response to emergencies. The 'As Built' drawings of the sewer network, sewage pumping stations, STP and FSTP shall be retained by KWASA and operators of the facilities to ensure access to these drawing 24/7 and avoid delays of repair and maintenance when these are needed as reference.

10. Employment

402. KWASA will need to employ additional repair and maintenance crews to manage the new sewer pipelines and keep drainage ditches clear of accumulated debris. The numbers to be employed are not known but will be derived from the local community.

11. Traffic Management

403. Trucks carrying wastes that ply the city roads with high speed may cause road accident. Random parking of vehicles and unplanned loading / unloading areas can lead to traffic congestion. The following measures shall be implemented to improve traffic management:
(i) A proper traffic management plan will be implemented to mitigate adverse impacts;
(ii) A well-defined schedule and route will be followed by the septage carrying trucks;

(iii) Proper signage will put up near the proposed facility giving route directions;
(iv) Vehicles will be parked inside the facility premises in the designated slots;
(v) Entry and exit routes from the premises will be clearly marked;
(vi) Adequate lighting and reflective boards will be put up for night time safety;
(vii) All routes will be planned to cause minimal disturbance to local community;
(viii) The vehicles will be allowed to move in the site only through dedicated entry and exit points within the site;
(ix) Dedicated parking area will be provided in the facility for parking of vehicles; and
(x) The speed limit of vehicles will be restricted to 20-25 km/hr.

F. Mitigation Measures for Malfunctions and Accidents at STP during Operation

404. Accidents and malfunctions are untoward events that can occur, which could potentially lead to impacts to the biophysical and social environment around and within the project area. These events may happen as results of either human errors, operational glitches in the treatment system, and/or natural phenomena. The probable accidents and malfunctions, and corresponding mitigation measures cam be grouped according to the following themes:

(i) Spills;
(ii) Process disruptions;
(iii) Natural disasters
(iv) Power failures;
(v) Fires; and
(vi) Injury/death/accidents.

1. Spills

405. **Impacts.** The potential of a spill occurring is likely in all stages of the project. But during the operations phase of the project, spill of the following substances may be hazardous or non-hazardous:

(i) Untreated wastewater (hazardous);
(ii) Sodium hypochlorite (hazardous);
(iii) Polymer (non-hazardous);
(iv) Dewatered sludge (non-hazardous);
(v) Fuels (hazardous);

a. Untreated Wastewater

406. The impact of a spillage will vary based on the characteristic of the material and the environment in which it was discharged into. Wastewater spills may occur at the STP and lift station sites or through a sewer main. If a wastewater spill were to occur at the STP, the magnitude of the impact will be negligible on-site since it would be easier to contain. However, if the wastewater spill at the STP flows down to the river the impact would be moderate and may occur on a wider scale affecting all communities downstream of the river. The effects if this were to occur are (i) decreased river water quality, (ii) foul odor, and (iii) potential human health effects.

407. Where a wastewater spill occurs at the sewage pumping stations, the impact magnitude will vary based on location. If the spills occur near to residential area, the effect may be the generation of a rotten foul scent will be generated in conjunction with potential indirect human health impacts, e.g., presence of vermin attracted to the wastewater which may also transmit diseases. The unmitigated impact is considered minor on a local scale. If a wastewater spill occurs in any of the lift stations nearby river the impact will be of the same scale typically minor with

possibly a regional scale. A wastewater leak within the Collection System is not expected to occur because the pipes would be of a good quality and installed according to best engineering practices. Nevertheless, if a pipe is fractured and wastewater leaks, the impact magnitude and scale would vary from negligible to minor on a local or regional scale because of the sewer main routes which are mainly located on roadways.

b. Sodium Hypochlorite

408. Sodium hypochlorite would only be stored and utilized at the STP. If a spill were to occur at the site, the impact would be a minor impact on a local scale. The effects of a spill would possibly only be felt by employees that would have been working close to the chemical.

c. Polymers

409. A polymer spillage can only potentially occur at the STP since during the operation phase of the project this substance will be stored and transported there. The polymer used for the process is dry polymer therefore any real impact would occur when this has been mixed and converted to a liquid form. Workers around the site of leakage may be slightly affected but the impact is expected to be negligible on a local scale

d. Dewatered Sludge

410. A potential mishap can occur if the dewatered sludge falls out of the transport trucks during transit to the landfill. The magnitude of this impact would be determined based on the area in which the sludge would have escaped however, the trucks are not expected to pass through any environmentally sensitive locations, and therefore the magnitude of impact may range from negligible to minor on a local scale.

e. Fuels

411. The fuels that are used for operating the construction equipment will be filled on-site via a fuel truck. There is potential for a fuel spill to occur while the equipment is being re-fueled. The impact of this would be minor on a local scale affecting only the workers present at the re-fueling site and the soil where the spill occurred. During a rainfall event, runoff at the site may cause the fuel to spread to nearby drains and streams. The impact of fuel runoff would then be minor in magnitude but on a regional scale.

412. **Mitigation**. The main measures to be implemented to prevent and reduce the effects of these potential impacts include:

(i) Provisions in the design for spill containment of chemicals in the storage areas.
(ii) Design includes level meters with alarms in the wet wells, shutoff valves and backflow prevention valves to prevent overflows.
(iii) An enforced health and safety plan that details prevention for spills including, spill kits, personal protective equipment, site maintenance and tidiness.
(iv) Availability of Material Safety Data Sheets (MSDS) which list the characteristic of the substance and cleansing methods in the event of a spill.

413. In the event of wastewater and septage spillage the health and safety plan will contain emergency response procedures in case the leak does occur. The emptying and loading of trucked septage, fuel, and sludge will be done in accordance to best safety practices and will be limited to specific paved areas on the site, thus minimizing the area in which a spillage might

occur and the extent of damage that may be caused as a result. Spills will be immediately cleaned using the appropriate procedure based on the substance. The flow of these chemicals into the nearby drainage will not likely occur, and will be contained through proper construction of chemical containment areas. When these mitigation measures are established and practiced the magnitude of a chemical spillage would decrease to negligible on a local scale.

2. Process Disruption

414. **Impacts.** A process disruption will be considered the malfunction of any equipment in the SPTs and SPSs apart from power failure. The impact of a process disruption is specific to the actual process breakdown and the equipment. The magnitude of the impact is indirectly affected by the piece of equipment which would have failed and the extent of damage in order for repair to occur. The impact is expected to be between a negligible and moderate impact on a local or regional scale.

415. **Mitigation.** The mitigation measures that will be employed in the event of a process disruption are incorporated in the STPs and SPSs design. The design has included for redundancy in all process equipment, including extra pumps, screens, blowers, vortex grit removal chambers and additional features including dual wet wells and storage tanks. Spare parts will be stored on site. Process malfunctions will be treated with extreme attention and mitigation will be employed promptly. Scheduled maintenance of the equipment will occur to prevent breakdown of any process equipment.

416. **Residual Impact.** Post-mitigation, the impact is expected to be negligible to the STP process, and will occur for short term durations.

3. Natural Hazards

417. **Impact.** If a natural hazard were to occur, this would affect the STP, lift stations and collection system indirectly creating a hazard to human health in the instance of spillage to wastewater or breakdown of the STP resulting in raw sewage discharged into the river.

418. **Mitigation.** The natural hazard mitigation is instilled in the design of the Wastewater Project. The STP and lift stations have been designed within the “Zone 3” BNBC Building Code based on expected seismic activity. These structures are also designed for a basic wind speed considering BNBC Codes which, according to historical storm tracks is not expected. The collection system is also designed with a similar approach. Flooding of the STP site was also mitigated in the design phase of the project. Historical maximum river levels of the Rupsha River were obtained from BWDB data. The STP is constructed to continue treatment throughout the high water levels of a flood.

419. **Residual Impact.** Post-mitigation, the impact is expected to be negligible in the event of hurricane and minor the event of earthquake, or flood.

4. Power Failure

420. **Impacts.** The potential for a power failure to occur is fairly probable and will be determined by the supplier. A power failure event would result in the breakdown of the STPs and SPSs (lift stations) resulting in raw wastewater back up throughout the collection system with possible overflow to the Rupsha and Moyur River. This could impact human health and social environment since toilets and drains could back up into homes. The impact could be major on a regional scale therefore affecting the entire project area.

421. **Mitigation.** The chief mitigation measure for a power failure event is the installation of emergency standby generators which would power the total facility. There would be generators on-site at STPs and SPSs which would automatically start when the power outage occurs. These generators will be diesel driven and cooled with water and they are equipped to function for a 48-hour period. Backup power will supply 100% of the STP and Sewage Pumping Station site.

5. Fire

422. **Impacts.** The possibility of a fire is likely within the project area. The fire may be as a result of a process malfunction or from the spread of a nearby bush fire. The impact of a fire on the STP and lift stations will be based on the extent of damage. If the fire is on a small scale and only effects part of the STP or lift station structure, then the impact will be minor. Conversely, if the entire structure is engulfed in the fire, then the impact could be of a moderate or major magnitude on a local scale affecting the treatment process and associated works. The impact of a fire on the sewer pipes is negligible since these structures would be underground. During construction if there is a bush fire nearby then work will have to be postponed. The impact of this would also be negligible.

423. **Mitigation.** The impact of a fire on the STP and lift stations can be mitigated by notifying employees of the contact information for the relevant fire services. An emergency response plan will also be completed where an evacuation procedure will be established for all on-duty employees. Fire drills will be carried out to ensure that the emergency response is well-known among staff.

424. The design of the STP also includes fire suppression devices in the administration and utility building. There will be a piped fire water system installed in each building where a hose will be mounted on the wall for complete coverage of the area. Portable chemical fire extinguishers will also be placed at strategic locations including:

(i) Points of egress
(ii) Laboratory areas
(iii) Kitchens
(iv) Shop areas
(v) Mechanical rooms
(vi) Electrical rooms
(vii) Storage areas

425. Post-mitigation the impact of fire is expected to have a minor impact on a rare occurrence.

6. Injury/Death

426. **Impacts.** The impact of an injury will depend on the type of injury and the number of workers affected by the cause of the bodily damage. If the injury is irreversible then the magnitude may be moderate to major for one employee and major if several workers are injured permanently.

427. In the event of death, the impact will be major if one or more employee dies. The impact of injury or death of by-passers or ordinary persons not involved in the project must also be considered. The expectancy of an event to occur which will endanger the lives of residents not involved in the project is minimal with the implementation of the health and safety measures and other mitigation measures presented. However, any injury or death of a non-employee will be considered a major impact.

428. **Mitigation.** The residual impact of injury and death of both members of staff and persons who are not employed will be reduced to negligible when the following mitigation measures are instated:

(i) World Bank EHS guidelines for water and wastewater
(ii) General EHS guidelines.

429. Compliance with the World Bank EHS guidelines for water and wastewater and General EHS guidelines will reduce the impact. To ensure these health and safety guidelines are followed the Contractor will be responsible for employing appropriate personnel trained in regulations to make sure the health and safety of workers are the first priority. Specific operation stage Occupational Health and Safety measures are furnished in the subsequent section.

430. Occupational Health and Safety during operation Occupational health and safety impacts during the construction and decommissioning of Water and Sanitation facilities are common to other large industrial projects and are addressed in the General EHS Guidelines. Occupational health and safety impacts associated with the operational phase of water and sanitation projects primarily include the following:

(i) Accidents and Injuries;
(ii) Chemical Exposure;
(iii) Hazardous Atmosphere;
(iv) Exposure to Pathogens and Vectors; and
(v) Noise.

7. Accidents and Injuries

431. **Source of Impact.** Work at water and sanitation facilities is often physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energized circuits, and heavy equipment. Work at water and sanitation facilities may also involve entry into confined spaces, including manholes, sewers, pipelines, storage tanks, wet wells, digesters, and pump stations. Methane generated from anaerobic biodegradation of sewage can lead to fires and explosions.

432. **Mitigation Measures.** Mitigation measures for accidents and injuries are addressed in the General EHS Guidelines. In addition, the following procedures are recommended to prevent, minimize, and control accidents and injuries at water and sanitation facilities:

(i) Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available;
(ii) Use PFDs when working near waterways;
(iii) Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance;
(iv) Use fall protection equipment when working at heights;
(v) Maintain work areas to minimize slipping and tripping
(vi) Use proper techniques for trenching and shoring;
(vii) Implement fire and explosion prevention measures in accordance with internationally accepted standards;
(viii) When installing or repairing mains adjacent to roadways, implement procedures and traffic controls, such as:

a. Establishment of work zones so as to separate workers from traffic and from equipment as much as possible
b. Reduction of allowed vehicle speeds in work zones;
c. Use of high-visibility safety apparel for workers in the vicinity of traffic
d. For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists

(ix) Locate all underground utilities before digging.

8. Chemical Exposure and Hazardous Atmospheres

433. Water and wastewater treatment involve use of potentially hazardous chemicals, including strong acids and bases, chlorine, sodium and calcium hypochlorite, and ammonia. Water may contain radioactive substances and heavy metals, which typically accumulate in the water treatment sludge. Potential sources of exposure to radio-nuclides include: pumps and piping where mineral scales accumulate; lagoons, and flocculation and sedimentation tanks where residual sludge accumulate; filters, pumping stations, and storage tanks where scales and sludge accumulate; facilities where filter backwash, brines, or other contaminated water accumulates; facilities that are enclosed (radon); residuals processing or handling areas; and land disposal or application areas where residuals are shoveled, transported, or disposed.

434. **Source of Impact.** Wastewater may contain potentially hazardous chemicals depending on the source water quality, drinking water treatment processes, and industries discharging to the sewer, including include chlorinated organic solvents and pesticides, PCBs, polycyclic aromatics, petroleum hydrocarbons, flame retardants, nitrosamines, heavy metals, asbestos, dioxins, and radioactive materials. In addition, workers may be exposed to hydrogen sulfide, methane, carbon monoxide, chloroform, and other chemicals generated during wastewater treatment. Oxygen may be displaced or consumed by microorganisms, thus resulting in an oxygen deficient environment in areas where wastewater or wastewater residues are processed.

435. **Mitigation Measures.** Prudent handling and storage of hazardous chemicals, as described in General EHS Guidelines, will help to minimize potential risks to workers. In addition, the following procedures are recommended to prevent, minimize, and control chemical exposure at water and sanitation facilities include:

(i) Implement a training program for operators who work with chlorine and ammonia regarding safe handling practices and emergency response procedures;
(ii) Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use and maintenance.
(iii) Prepare escape plans from areas where there might be a chlorine or ammonia emission;
(iv) Install safety showers and eye wash stations near the chlorine and ammonia equipment and other areas where hazardous chemicals are stored or used;
(v) If source water contains radioactive substances, locate water treatment units and water treatment sludge areas as far as possible from common areas (e.g., offices);
(vi) Conduct radiation surveys at least annually, especially in areas where radionuclides are removed;
(vii) Limit wastes entering the sewer system to those that can be effectively treated in the wastewater treatment facility and reduce the amount of air-strippable hazardous compounds entering the system by controlling industrial discharges (e.g., by permit or similar system). Analyze incoming raw wastewater to identify hazardous constituents;

(viii) Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance.
(ix) Use personal gas detection equipment while working in a wastewater facility;
(x) Continuously monitor air quality in work areas for hazardous conditions (e.g. explosive atmosphere, oxygen deficiency);
(xi) Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping;
(xii) Prohibit eating, smoking, and drinking except in designated areas;
(xiii) Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.

9. Pathogens and Vectors

436. **Source of Impact.** Workers and staff at wastewater and sludge treatment facilities and fields where treated wastewater or sludge is applied, as well as operators of sludge collection vehicles, can be exposed to the many pathogens contained in sewage. Processing of sewage can generate bio-aerosols which are suspensions of particles in the air consisting partially or wholly of microorganisms, such as bacteria, viruses, molds, and fungi. These microorganisms can remain suspended in the air for long periods of time, retaining viability or infectivity. Workers may also be exposed to endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be carried by airborne dust particles. Vectors for sewage pathogens include insects (e.g. flies), rodents (e.g. rats) and birds (e.g. gulls).

437. **Mitigation.** Recommended measures to prevent, minimize, and control exposure to pathogens and vectors include: Wastewater and sludge treatment and also land application. Wastewater and Sludge Treatment mitigation measures includes:
(i) Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors;
(ii) Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods;
(iii) Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves, aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes;
(iv) Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure;
(v) Encourage workers at wastewater facilities to wash hands frequently;
(vi) Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations;
(vii) Reduce aerosol formation and distribution, for example by planting trees around the aeration basin to shield the area from wind and to capture the droplets and particles
(viii) Reducing aeration rate, if possible
(ix) Avoid handling screenings by hand to prevent needle stick injuries;
(x) Maintain good housekeeping in sewage processing and storage areas;

(xi) Advise individuals with asthma, diabetes, or suppressed immune systems not to work at wastewater treatment facilities, especially composting facilities, facility because of their greater risk of infection

438. Land Application mitigation measures includes:

(i) Consider use of drip irrigation of treated wastewater, which minimizes worker exposure and the amount of water needed. Avoid use of spray irrigation of treated wastewater, if possible;
(ii) Provide field workers with personal protective equipment, such as rubber gloves and waterproof shoes;
(iii) Provide access to safe drinking water and sanitation (including hand washing) facilities;
(iv) Provide worker health monitoring, including regular physical examinations;
(v) Control vectors and intermediate hosts.

439. If the above mitigation measures undertaken, then the residual impact will be minimum.

10. Noise

440. **Source of Impact.** High noise levels can be present in the vicinity of operating machinery and flowing water at water and sanitation facilities.

441. **Mitigation.** Impacts and mitigation measures are similar to those at other industrial facilities, and are addressed in the General EHS Guidelines. If General EHS Guidelines, measures are undertaken then residual impacts will be minimum.

G. Cumulative Impacts and Mitigation

442. STP and Sewer network components of the projects that may generate cumulative impacts. The valued components identified in this IEE are air quality, water (surface and groundwater) quality, noise, traffic management, socio-economic, cultural resources, and human health.

443. Air quality will be affected during construction. Emissions of common air contaminants and fugitive dust may increase near the construction sites but will be short term and localized. Greenhouse gas emissions may increase due to vehicle and equipment operation, disposal of excavated material, concrete production, etc. But their contribution during construction will not be very significant with the implementation of mitigation measures discussed in this IEE report.

444. Noise levels near the construction sites will increase but the duration will be short. Ground vibrations due to concrete mixers, rollers, and excavators may be annoying, and damages may occur especially to older buildings. But mitigation measures, if implemented as proposed in this IEE report, will minimize these problems.

445. Traffic management during construction will be very important. A traffic management plan will be developed in consultation with relevant local traffic management agencies to ensure that the plan will be effective. After the project construction phase is over, the traffic condition will return to normal, and the operation of the project itself will have a long-term cumulative benefit to the people.

446. Although there will be temporary increase in the noise levels, fugitive dust, and common air emissions near the construction areas, no adverse residual effects to human health will occur because the impacts are short-term, localized, and will not be significant with the implementation of mitigation measures discussed in this IEE report.

H. Environmental Benefits and Enhancement Measures

447. The environmental impacts can be listed out to be positive and negative impacts for any developmental projects. It has been associated with some negative impacts, which can be fixed with suggested mitigation measures with timely implementation.

1. Public Health

448. The provision of safe and sustainable water and sanitation for a community will have a major positive impact on public health. Households with sanitary sewage services will see a significant reduction in waterborne, pathogen and fungal diseases, particularly among children. This improvement should significantly reduce health care costs per family. The burden of maintaining a sanitary home, which falls on the women, will be lowered, due to the sanitary toilet and washing facilities.

2. Improved Water Quality

449. The benefit of the projects will be very significant and extensive. There will be a major reduction of pollution from the sewage effluent as it will be fully treated by the treatment plant and the sewage will be piped away in a sanitary manner. This will mean water with much of the nutrient load, pathogens and bacteria removed, and a far cleaner effluent discharged into the water bodies. In addition, there will be a reduced risk of drinking water, and well contamination downstream and the reduced risk of the spread of communicable disease.

3. Employment

450. Primarily a positive impact, the project will create significant temporary employment for construction workers, equipment maintenance and support staff. While a small number of senior project managers may come from overseas and other specialists from elsewhere in Bangladesh, the majority of project staffs are expected to be recruited locally from within the native/local workforce. The number of temporary jobs created during the construction period is likely to be 1000 - 1200. Moreover, KWASA will need to employ additional repair and maintenance crews to manage the new sewer pipelines and keep drainage ditches clear of accumulated debris during operation and maintenance. The numbers to be employed are not known but will be derived from the local community.

4. Induced Development

451. With the installation of improved and organized sewage system, the city will gain healthy environment. Modern infrastructure induces development, stimulates investment and employment and helps to improve marginal investment opportunities. The extent to that development having positive or negative impact will be determined by the effectiveness of the planning framework.

5. Solar Power

452. Solar panels will generate power to run the system, reducing the carbon emission significantly and lowering the need to draw energy from the grid. This will reduce the carbon footprint of the plants.

6. Tree Plantation

453. Under this project, tree plantation is proposed that will reduce the carbon footprint by absorbing carbon-dioxide. Vegetation improves the air quality by providing a cooling effect through transpiration water loss from their leaves and by filtering atmospheric pollutants through their leaves. By decreasing both the temperature and the amount of pollutants in the atmosphere, trees can have a positive effect on air quality.

7. Buffer Zone

454. Constructing a buffer zone of sufficient distance is one of the prime environmental management issues. A buffer zone is the physical distance between (or setback from) the nearest liquid surface within a sewage treatment facility to the corner of the nearest occupied building within a development. This buffer zone helps to foster a living and work environment that is generally free of sewage odors and minimizes health concerns. The buffer zone requirement for sewerage infrastructure is generally influenced by a number of factors including the nature and size of the plant, the topography, micro climate and the sensitivity of neighboring land uses. However, the surrounding areas of the two proposed sites for Sewage Treatment Plant (STP) in Khulna city are nearly uninhabited, except a Church located in close proximity of the Khulna-Satkhira STP (at Tikerband). As such, the surrounding areas of both of the sites would be inhabited in next couple of years, keeping abreast with the present development trend. Therefore, a minimum distance of 30 m from the nearest liquid surface of the treatment plant to the nearest habitable building property line should be kept for buffer zone. The buffer zone can be used for any purpose except permanent habitable buildings, for example, as a drainage reserve, road or highway reserve, transmission reserve, utility reserve or public park. In the case where buffer area is to be regularly used by the residents such as car park and playgrounds, proper precautions during design stage must be taken to minimize nuisance such as odor, noise and unpleasant sight to the surrounding environment. In addition to keep a 30 m buffer zone, both of the sites should be afforested with different species of timber and medicinal trees (mangrove trees along the river side of the Labonchora STP) along the boundary areas and around the whole site which not only reduce the unpleasant visual access to the site but reduce the pungent odor to a greater extent also.

I. Summary of Impacts and Mitigation

455. A major positive impact from the wastewater project is the improvement in surface water quality in the region, as a result of the untreated wastewater being properly collected and treated at the new STPs. Cleaning up the waterways in the catchment area will result in a habitat improvement for aquatic species, improved public health and decrease in waterborne diseases for humans, and overall improvement in the quality of life.

456. The most significant negative impact is disruption of traffic flow during construction. Traffic disruption has potential to affect over the people of the area throughout the construction process. A significant portion of the construction will be within road rights-of-way. Mitigation of traffic impacts will be accomplished by utilizing trenchless technology in high traffic roadways, and a comprehensive traffic management plan that includes provisions for proper detours and signage, provision of access to all businesses and properties, restrictions on construction hours, and limits

on the amount of construction that can occur at any one location. Once these mitigation measures are utilized in the construction, the unmitigated major negative impact becomes a mitigated minor to moderate negative impact.

VI. ANALYSIS OF ALTERNATIVES

A. General

457. Environmental and social issues will be mainstreamed into the Project design through a detailed analysis of alternatives of the project locations or alignment, design, technology, and construction approaches. The primary objective of the "analysis of alternatives" is to identify the location/design/technology for a particular project that is viable in terms of cost, acceptability would generate the least adverse impact and maximize the positive impacts.

458. The criteria to be considered in evaluating various alternatives will be based on the following sub-criteria:

(i) Technical Aspects: Robustness, constructability, geology, maintenance requirements, history of performance, etc.;
(ii) Financial Aspects: Construction cost and maintenance cost;
(iii) Environmental Aspects: project footprints, material requirements; and
(iv) Social Aspects: Land acquisition, Resettlement, nuisance, Impacts on people, socioeconomic impacts, etc.

459. This section examines alternatives to the proposed project sites, technology, design, and operation and the basis for selecting alternative options for all the components. Feasible alternatives to treatment plant locations, routes of sewer pipeline, pumping station sites, and wastewater treatment process were studied – including the zero or no alternatives – in terms of potential environmental impacts and feasibility of mitigating these impacts.

B. Alternatives Relating to Site/Location

1. Construction Site for STPs

460. Typical Sewerage Treatment Plant needs relatively a bigger land area and the area should avoid some of the social and environmental issues relating to the locational sensitivity. For example, a STP site might produce odors and may not be scenic in visibility, and in both cases, the site should be in peripheral areas of a city. Another important consideration is that, a treatment plant needs to drain out the treated wastewater and dispose the sludge off in an acceptable manner. Therefore, connecting a river/canal or flowing water body is necessary as a receiver of the treated water having the assimilative capacity to attenuate any further pollution. Moreover, the best location for the new STP would be at the lowest elevation in the catchment so wastewater can be conveyed to the plant site by gravity and minimize the need for expensive pumping.

461. In all the above respect, selection of two sites in Labonchora and Tikraband has been a perfect choice from the end of implementing agency. Both the areas are located at the peripheral areas of the city, having enough land area to accommodate the plants and can directly be connected to either a river and or a canal, so that disposal process can easily be handled and city dwellers will not be disturbed with the vicinity of the functional areas of the treatment plants. A quick but considerate attention was given to the general wind speed and direction of the city and surrounding areas, which shows that wind flow regime is mostly dominant through East-Southeast to Southern direction with an average wind speed ranges from 5 to 19 km/h during maximum

period in a year. For Labonchora STP, nuisance from odor produced in the plant will have very negligible effect on nearby population throughout most of the year, since the whole block of the dominant wind blowing region is barely populated, found both in physical survey in the area and also from the aerial map. People residing at the patches of areas with prevailing wind blowing zone after the treatment plant at Tikraband might face some obnoxious problem with odors, which has to be mitigated through regular mechanical odor management options in built with the plant operational system. Further, as per guidance for sludge management options in Bangladesh set by the Department of Environment, using it in agricultural land as a potential manure is suggested, and agricultural practice in the peripheral areas of Khulna city is well prevalent, where sludge can be used after conducting the test of sludge quality and motivating people in using those at later stages. Further, locating the STPs anywhere near the Rupsha, and Mayuri River would meet the criterion for siting at or near the lowest elevation of the catchment area.

2. Construction Site for Sewage Pumping Station/SLS

462. Gravity conveyance of sewage is generally given priority over pumping of sewage to reduce length of sewage pressure mains. Only at places, where it could not be avoided, transfer of sewage by pumping is recommended. Pumping stations are therefore constructed in such that places where gravity conveyance reaches to the dipping point and sewage needs to pump up to a certain higher gradient area, where gravitational conveyance will not work effectively. Gravity Sewer system, thus, would translate into reduction in significant energy charges during operational phase of the scheme.

463. The Sewerage districts in Khulna are segregated into two level, southern districts and northern districts. Southern districts comprise SD 1 and 6 which will be connected to sewage treatment plant STP-1 (Labanchora). Northern districts will consist of all the other districts and out of these, SD 2, 3, 4 (part), and 7(part) will be connected to STP-2 (Tikraband). Gravity transfer of sewage has been given preference over pumping, however, some sewage pumping stations would actually act as lifting stations to transfer sewage received at a certain depth and discharge this into a high level downstream sewer, e.g. like 1st pumping station in SD 1, for onward gravity transmission to subsequent pumping station. So, construction sites for Sewage Pumping Stations or Lifting Stations are selected considering the slope gradient and potential of pumps to transfer sewage further. All the pumps proposed under the scheme are situated at the best suited places where from the sewage flow needs further expedition to the next receiving points of a pumping station.

3. Sewer Pipe Laying Site

464. Khulna is devoid of any centralized sewer network; an integrated all-inclusive sewer networks would be best option to materialize. However, due to the constraint of funding and immediate readiness for the implementation of the component, alternative option is to be sorted out, and pipe laying works under this project, therefore, should consider most output from every meter of pipes to be laid down the trenches during this first phase of works. The areas which are already developed, densely inhabited, having importance on residential or commercial background, should be targeted first, so that investment in that area would benefit a larger cohort of inhabitants within a smaller area or single point of sources.

465. Considering above the facts, Sewerage District 1 includes the Central Business District area of Khulna city, and old Jessore Road under this district, by and large serves as ridge line and divides this area into two parts with its northern part (adjacent to river Rupsha) naturally sloping to the river and southern part (inside city area) towards the south. Planning of sewage

collection network has been framed as per this topography to reduce sewer inverts and maximize the benefit of serving the most populated and economically vibrant part of the city. Counting another choice among Sewerage districts, natural gradient of the area covering district 2 is towards Mayuri river on its southern end and accordingly terminal pumping station will be located on the south-eastern fringe by the side of Nirala. This location is at a low ground elevation to accommodate the sewage pumping station for this sewerage district. Similar considerations have been made in selecting other sewerage districts and parts of those, in this first phase of sewerage network development component.

C. Alternatives Relating to Design and Technology

1. Design and Technology of STPs

466. Diverse land use pattern, mature urban setting, geographical orientation, varying topography, number of physical constraints, prevailing soil conditions and terrain, etc., of Khulna city suggest that it would not be technically feasible to attempt to collect all wastewater generated from the city to a single location. Attempts are therefore made to reduce proposed locations of treatment facilities for better and efficient management of treatment system, and three different places have been selected for setting up of STPs. Of those, two treatment plants will be constructed during this first phase of intervention.

467. While selecting the appropriate treatment technology to be adopted into those sites, several different treatment technology options that were described in the FS/Waste Water Management Master Plan. These have been reviewed during this study. Since the concept/practice of design and operation of any wastewater treatment facility would be first of its kind in Khulna and needs to strike a balance between a highly mechanized, supervision-intensive system and merely hydraulically connected process with little or no maintenance. While the former type of process becomes too complex for available personnel and staff, in converse, the latter type of process can infuse lack of attention on the part of O&M staff. Keeping this idea in mind, the technical team of this study has suggested for extended aeration process to be counted in design and implementation. However, this process is relatively less complicated and easier to manage and operate and widely used in many parts of the world. Nonetheless the exact technology among the options is to be selected comparing several other factors.

468. Extended aeration is a complete mix flow process with an efficiency of BOD5 removal rate of 75-95% using mechanical aerators with diffused air. It is the most widely used option for treatment of domestic wastewater for medium to large towns where land is available. It is a well proven process and the most common process used worldwide. The process is similar to and an extension of conventional activated sludge process except that it operates in the endogenous respiration phase. It requires long aeration time and low organic loading rate. Therefore, the aeration equipment design is controlled by mixing needs not oxygen demand. Secondary clarifiers are designed at lower hydraulic loading rates than conventional activated sludge clarifiers to better handle large flow variations.

2. Design for Sewage Pumping Station/SLS- No. of Pumps, Active/Standby Pumps, Working hour

469. Gravity Sewer network is the prime option for sewage water conveyance for the proposed project. If the Sewer network requires being effectively operational across the Sewerage districts of Khulna city, extensive site leveling, deeper trenches and shoring, and specialized piping and fittings are required, which are way too expensive and even may not be effective as a whole in

the end. To optimize the situation, especially the varying land use pattern and topography, various alternatives for sewage conveyance have been explored with the primary objective of reducing pumping cost as much as possible and use of existing slopes and gradients to the extent feasible for making the complete sewerage system operate as an integrated facility. Construction of pumping or lifting stations at different critical points has been found the best alternative, though it would require additional expenditure to be incurred in the initial phase for construction of pumping house with associated facilities, along with laying gravity sewers and some other components, but would eventually benefit the planning and future development.

470. Pump stations having nearly 1000 square meter of land area, will receive collected sewerage and provide temporary storage facility before onward transmission to the downstream pumping facility or treatment plant. During the proposed phase of implementation, eight pumping or lifting stations will be constructed; of those three will be connected to the STP at Labonchora and the rest five will be connected to the Tikraband STP. Each pumping station will be equipped with an active pump to be running for 15 hours a day. A standby pump and a generator will be deployed in the pump stations for meeting the emergencies.

3. Pipe Materials and Laying Method

471. There are various pipe materials available for application in wastewater collection and each of these materials has a set of unique characteristics under different field conditions. Several materials for gravity sewers are available, e.g. glass/ fiber reinforced plastic (GRP/ FRP), unplasticized polyvinyl chloride (uPVC), high density polyethylene (HDPE), double wall corrugated (DWC), stone ware (SW), vitrified clay (VC), polymer concrete (PC), ductile iron (DI), etc., apart from the most conventional reinforced cement concrete (RCC) pipe. Cost, durability, corrosiveness, maintenance, impact resistance, handling and maneuvering, renewal potential, availability, ease of laying, available craftsmanship, etc. are usually assessed in selecting any particular type or a combination of sewer pipe materials. Pipe material selection considerations further include trench conditions (soil conditions), corrosion potential of ground, temperature variations, safety requirements, and cost. Key pipe characteristics are corrosion resistance (both interior and exterior), scouring factor, leak tightness and jointing method, buoyancy effect, hydraulic characteristics.

472. A summary of various factors is considered for determining the type of pipe material for this project is given below (not necessarily in order of priority)

(i) Expected overburden, dynamic, and static loading on pipe,
(ii) Lengths of pipe available, joining materials and installation equipment required,
(iii) Time taken and ease of laying,
(iv) Soil properties and chemistry, location of water table, stability, floatation,
(v) Chemical and physical properties of wastewater and its corrosion potential.
(vi) Joint tightness and level of craftsmanship required,
(vii) Size range requirements, availability,
(viii) Pipe renewal and rehabilitation potential,
(ix) Manholes, pits, sumps, and other required structures to be connected.

473. Based on analysis, HDPE pipe has been selected in general, for Sewer line considering its smooth surface reducing friction losses, long pipe section reducing infiltration potential, durability easy to handle. However, for higher diameter pipe (more than 500 mm), DI pipes will be used.

474. Primary sewers are major sewers and would be constructed at first (along with corresponding pumping stations and other downstream facilities) along major and minor roads.

475. Depth of excavation for laying sewers has been restricted to 4 m in most cases, in view of existing soil conditions. However, at a few locations some lower inverts of sewers are expected, mostly for large diameter sewers and along major roads. But there are some areas or stretches of road which are extremely congested to allow for open cut construction. It would potentially be inordinately time consuming and incur very high social and environmental costs. Use of trenchless technology (pipe installation by micro-tunneling) at such locations has been thought of at a higher cost but a significant saving in indirect (i.e. social and environmental) cost. In either case, some portion of the roads would have to be isolated and cordoned off. Then, vehicular traffic has to be diverted and managed suitably.

D. Environmental Implications of Alternatives

476. Location or sitting of a STP site near the river or canal is vital for social and environmental point of view. Waste water after the treatment may still carry some unwanted polluting agents detrimental for soil environment or biological environment, which after disposing to the river will be diluted and would potentially be neutralized. Moreover, a STP site staying outside the vicinity of people's sight would be a better alternative as part of a preventive measure. Odors emitting from the STP sites also may create nuisance for nearby people and animals. Keeping major residential areas and activities bit far from the sites would deter the effect substantially.

477. All types of construction works would generate a grandiose amount of soil and spillage from the drains. Failure in managing those spoils in an efficient and appreciable manner may cause dust emission, obstruction to vehicles and passersby, even accidents to the people and workers. Quick removal and transport of spoils to STP sites (which needs a huge infilling of soil) my put an effective remedy to these problems.

E. Implication of No-Project Alternative

478. A 'No Action' alternative to the components of the proposed project entails that none of the components will be implemented under the KSSDP. It has been found that the city is devoid of any type of sewer network, neither the city has any sewage treatment plants. Stepping back from the proposed implementation would keep the sanitation problem as deteriorated as it's been since long before. Rather the scenario would be more aggravated with the growing numbers of population and industrial set up in city and surrounding areas. It's anticipated that 'no action' measures would translate into the curbing of any potential pollution, hazards and impacts caused by the construction works.

479. Without the proposed project, urbanization and population growth will result in increasing volumes of untreated domestic and small quantities of industrial wastewater being discharged into the rivers and drains and a consequent deterioration in surface water quality. The pollution of surface water would continue to affect and threaten drinking water safety and thus the health of urban and rural residents. Regular discharge of polluted water to the rivers, canals or nearby water bodies will significantly reduce the assimilative capacity of the receiving water bodies, may cause 'algal bloom' and subsequently critically deteriorate the water quality.

480. 'No action' alternative will not keep the standard of living of urban population in the same state; rather downgrade it with the passage of time. Conversely, implementation of the proposed project will contribute in improving sanitation facilities of city dwellers, improving health conditions,

reducing pollution load into the nearby water bodies and help improving the ecosystem services of the river and surrounding water bodies.

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. General

481. This chapter deals with the information disclosure to the public and consultation sessions held with the different stakeholders that are likely to be affected adversely and/or beneficially due to the implementation of the proposed Khulna Sewerage System Development Project (KSSDP). The purpose of public consultation was to gather opinions and suggestions on any environmental issues considered relevant by the people living in the area of the project impact zone. The public consultation is an essential part of the environmental assessment process and has been undertaken both formally and informally throughout the tasks to ensure that the knowledge, experience, and views of stakeholders and the general public are taken into account for IEE. The information shared and recorded has been applied where relevant to justify design, alignment, construction methodology, and timing changes, in order to reduce predicted negative environmental impacts. The consultation process was carried out as per the environmental guidelines of DOE and ADB. It is noted that public consultation has been conducted considering the restriction for COVID 19 using safety measures and adopting telecommunication in some cases.

B. Objectives

482. Based on the following objectives the consultation task has been carried out:

(i) Share information with stakeholders on proposed improvement works and expected impacts on the physical, biological and socio-economic environment of the KSSDP project areas;
(ii) Understand stakeholders' concerns regarding various aspects of the project, including the existing land use pattern, adverse and benefits of the project, and the likely impact of construction and operation related activities;
(iii) Provide an opportunity to the public to influence project design in a positive manner;
(iv) Obtain local and traditional knowledge regarding decision and construction;
(v) Increase public confidence in the proponent, reviewers, and decision-makers;
(vi) Reduce conflict through the early identification of controversial issues, and work through them to find acceptable solutions;
(vii) Create a sense of ownership of the proposal in the mind of the stakeholders; and
(viii) Develop the sustainable proposal;
(ix) Disseminate information about the KSSDP to the stakeholders;
(x) Provide a better understanding of existing environmental conditions;
(xi) To inform primary and secondary stakeholders about the project, its environmental implications within the project area, potential environmental impacts and mitigation measures, project benefits, and the "cut-off date" for persons directly affected by the project;
(xii) Encourage stakeholders to contribute meaningfully toward improvements in the delivery of the project and inform them about the mechanism for handling potential grievance related to the project;
(xiii) Familiarize the stakeholder with KWASA and its operations of KSSDP as well; and

(xiv) Motivation toward minimizing the disruption of the local communities affected, through dialogue and interaction.

483. The information shared and recorded where relevant will be applied to justify design, alignment, construction methodology, and timing changes, in order to reduce predicted negative effects. This approach satisfies statutory consultation requirements of ADB and DOE.

C. The rationale of Selection of Public Consultation Locations

484. During the field visit on December 26-28, 2012, ten locations were selected, based on the significance of those areas in relation to proposed land for the project components. The final selection was made after discussion with local dwellers nearby SPSs and STPs. These locations for both consultation cycles were:

(i) STP-1: Sewerage Treatment Plant, Mathabhanga
(ii) STP-2:SewerageTreatmentPlant,Thikrabandh
SPS-1: Sewerage Pumping Station, Custom ghat
(iii) SPS-2: Sewerage Pumping Station, Motiyarkhal
(iv) SPS-3: Sewerage Pumping Station, Labonchara Sluice Gate
(v) SPS-4: Sewerage Pumping Station, Nirala
(vi) SPS-5: Sewerage Pumping Station, Kashim nagar, Gollamari
(vii) SPS-6: Sewerage Pumping Station, Sonadanga Truck Terminal
(viii) SPS-7: Sewerage Pumping Station, Karim nagar
(ix) SPS-8: Sewerage Pumping Station, Islamia College road

D. Approach and Methodology

485. During the field survey, significant efforts were made to identify the possible categories of stakeholders and their stakes. During the field survey, different stakeholders identified were the villagers/local residents, government officials, farmers, fishermen, businessmen, shop keepers, public representatives, DOE, and NGO's. All those stakeholders had different types of stakes according to their professions and livelihood characteristics.

486. Stakeholders were classified into primary and secondary stakeholders. These stakeholders are characterized as the following:

E. Stakeholder

487. Based on the linkage with the project, the stakeholders were divided into two categories; (1) Primary stakeholder and (2) Secondary stakeholder

F. Identification of Stakeholder:

488. During the field survey, significant efforts were made to identify the possible categories of stakeholders and their stakes. During the field survey, different stakeholders identified were the villagers/local residents, government officials, farmers, fishermen, businessmen, shop keepers,public representatives, DOE, and NGO's. All those stakeholders had different types of stakes according to their professions and livelihood characteristics.

(1) Primary stakeholders

489. These are persons who reside in or around the proposed KSSDP sites, or who are temporarily or permanently engaged with any type of livings in the areas that may be directly affected during the construction and operation phase. Primary stakeholders included landowners, teachers, students, caretakers, and different local occupational groups.

(2) Secondary stakeholders:

490. These are persons or organizations that will not be directly affected but may have interests that can contribute to the project or may affect decision-making in some areas. Secondary stakeholders may include relevant government agencies like local government institutions, DoE, community-based organizations, NGOs, KUET, and other interested individuals or groups. Stakeholders were first informed about the ins-and-outs of the project, its components, implementation arrangement, social and environmental issues, and mitigation measures. Then the consultation and discussion part were initiated. Checklists were used to guide the consultations to ensure that the discussions are focused and relevant. A summary includes information about the project, proposed implementation schedule, and potential project impacts. Views and concerns of the participants were recorded and their questions were properly responded to by the consultants.

G. Preliminary Consultation.

491. Public consultations were conducted from 10 January 2021 to 18 February 2021 which was attended by various stakeholders. During the consultation, safety measures were taken to address COVID 19 pandemic. The summary of the consultation meeting (Appendix-A) is attached in the appendix. The following are some of the views discussed:

(i) Local people would support the KSSDP project activities for the sake of city sewerage system development and its management;
(ii) The main issue arising from the consultation was that whether the area becomes more stinky and unlivable for the nearby residents. It was revealed that some of the respondents living nearby areas will directly be benefited by having a more likely chance to be employed during the construction period;
(iii) During the construction period, some participants apprehended that the community activities would be affected. However, it was explained that the project will ensure measures shall be put in place to avoid any negative impact to the community;
(iv) It was confirmed with the local stakeholders that there is no protected areas in and around the project areas**;**
(v) The project will have no impact on biodiversity, natural water body and not contaminate the soil resources. It was explained that the project will implement adopting appropriate mitigation measures to ensure the natural water bodies in the area will not be negatively impacted; and
(vi) The participants assured that they welcome the project, and will support/cooperate in all stages of the project works.

H. Consultation Delivery

492. A range of stakeholder consultation and engagement methods have been used depending on the stakeholder type and the level of interest or concern. The key methods used during these consultation sessions were:

(i) Group discussions - stakeholders were provided with a project briefing, followed by a question and answer period;
(ii) Face-to-face individual interview with specific KWASA staffs; and
(iii) Phone Calls.

I. Information Recording and Responsibility:

493. KWASA assigned a dedicated environment focal person along with other staff, for each consultation, whose responsibility was to record participant comments and submit a report. The KWASA representative provided answers responding to the queries and concerns arose by the participants and specifies actions to be taken. Each consultation had minutes recorded and attendance taken with signatures (Appendix- A). A brochure was also prepared both in English and Bangla to share with the participants.

J. Information Disclosure:

494. Information shall be disclosed through a public consultation and more formally by making documents and other materials available in a form and at a location in which they can be easily accessed by stakeholders. This normally involves making draft reports available for the public in the subproject locations and providing a mechanism for the receipt of comments and making documents available more widely by lodging them on ADB and KWASA websites. KWASA will submit to ADB the following documents for disclosure on ADB's website:

(i) The final IEE report
(ii) Updated IEE reports and corrective action plan prepared during project implementation, if any; and
(iii) Semi-annual environmental monitoring reports.

495. PMU will provide relevant environmental information, including information from the relevant documents in a timely manner, in an accessible place, and a form and language(s) understandable to affected people and other stakeholders. For illiterate people, other suitable communication methods will be used. For the benefit of the community, the summary of the IEE will be translated in Bangla and made available at (i) the office of PMU; and (ii) offices of the contractors. Hard copies of the IEE report will also be available at the PMU and accessible to citizens as a means of disclosing the document and at the same time creating wider public awareness. On-demand, the person seeking information can obtain a hard copy of the complete IEE document at the cost of the photocopy from the office of the Project Director, on a written request and payment for the same. The electronic version of the IEE will be placed on the official website of KWASA after clearance from ADB. PMU will issue notification on the disclosure mechanism in local newspapers, ahead of the initiation of implementation of the project, providing information on the project, as well as the start dates, etc. This will create awareness of the project implementation among the public. Posters designed to mass campaign the basic tenets of the IEE will be distributed to libraries in different localities that will be generating mass awareness.

496. The discussions were primarily focused on receiving maximum inputs from the participants regarding their acceptability and environmental concerns arising out of the project. The purpose of this stakeholder consultation was to identify the views of major institutional and project affected persons and stakeholders in the project area, and to identify issues of relevance to the environmental impact, as well as any impacts which the project may have on the project, and to assess any mitigation measures which may be undertaken to minimize any adverse impacts of the proposed project. Subsequently, stakeholder consultation was considered as one of the

important parts of the IEE to address the environmental aspects as well as socio-economic issues from stakeholders' points of view. Issues KSSDP were discussed in-depth with the government officials and NGOs, while in the case of the people, those issues were touched upon which are relevant to them. Discussion started with giving a brief outline of the project's objectives, type, and components of the project in a simplified manner and their native language. A set of pre-determined common questions were provided to the stakeholders to seek their perception of the project. The discussion with the stakeholders was focused mainly on the following points:

(i) Whether they have heard about the KSSDP project or not and their understanding regarding the activities and requirements of the project;
(ii) Any concerns about significant negative impacts of the project on different components of the environment (e.g. surface water, groundwater, soil, air, and biodiversity issues as a whole) and the possible mitigation measures of the impacts;
(iii) About environmentally sensitive issues; and
(iv) The overall expectation of the stakeholders regarding the KSSDP.

K. Compliance with Relevant Regulatory Requirements

497. The public consultation was undertaken as per the DOE and ADB's requirements. All the five principles of public consultation given by ADB such as information dissemination, information solicitation, integration, coordination, and engagement into dialogue were incorporated during the task. A framework to address different environmental impacts likely from the KSSDP project was strengthened and modified based on opinions of all those consultations, especially at the micro-level by setting up dialogues with the local people from whom information on-site and prevailing conditions were collected. The requirement of public consultation during the implementation of the project is proposed as part of the mitigation plan.

L. Major Comments Received

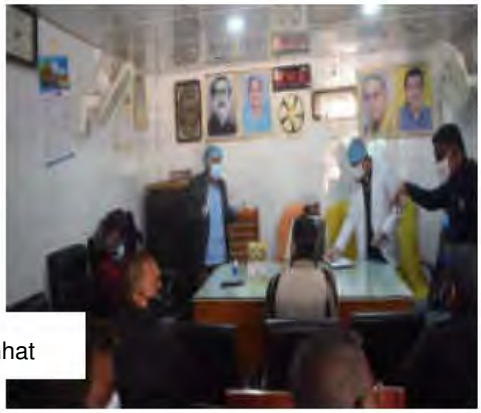
498. While a wide range of people from different administrative, social, and economic backgrounds were consulted, their concerns and outcome of the consultation along with suggestions made by them are described in the following sections.

M. Focus Group Discussion:

499. Each group consisted of more than five people that were gathered and discussions were held for a minimum of half an hour to share information. This helped to gather their opinion and concerns. Altogether 10 FGDs were held starting from 10 January 2021 to 18 February 2021. Proper precautions were made before the public consultation. The schedules, venues, and the participant's number are given in Table (Detail list of participants are presented in Table); photos of FGD conduction are given in the following Figure.

Picture of public consultation





SPS-1: Custom Ghat





SPS-1: Custom Ghat













STP-1: Mathabhanga





STP-1: Mathabhanga





STP-1: Mathabhanga



SPS-5: Kashimnagar Gollamari



SPS-5:Kashimnagar, Gollamari



SPS-7: Karim nagar











500. During the consultation, the participants expressed their opinions and suggestions about the implementation of the KSSDP.The summary of the FGD's findings is presented in the Table below. Meeting minutes and attendance sheet given in Appendix-13 and Appendix-14

Table: Summary of the Focus Group Discussion Findings at KSSDP sites.

Questions to the Focus Groups	Participants opinion, comments, and suggestions	KWASA response
1. Have you ever heard about KSSDP project?	Mostly have heard	KWASA representative briefed about KSSDP activities to the participants particularly those who have known little about KSSDP
2. How will this sewerage development project contribute to the local people?	The project will contribute by improving the sanitation system, creating job opportunity, and reducing the smell across the road sites	KWASA representative explained the need and output of the project
3. What are your general comments and observations regarding the project locations?	In general, participants have no different opinions regarding the selected STP and SPS sites.	KWASA representative explained the function of each component and the appropriateness of locations.
4. What are your general comments and observations regarding the	They expressed that delay of construction work may increase the public suffering.	It was appraised that effective co-ordination with all the stakeholders will be ensured to

Questions to the Focus Groups	Participants opinion, comments, and suggestions	KWASA response
project construction work? Agree / disagree / comment.		avoid any delays in construction work.
5. Will the project activity cause any local problems?	They expressed some concerns such as traffic increase, air, and noise pollution, during construction.	It was informed that adequate measures including modern equipment will be used to have the less impact.
6. What are your comments on the disruption of public access due to road excavation for pipe laying works?	They viewed that public access may be disrupted during sewer line construction.	They were informed that to reduce public suffering, trenchless technology will be used for pipe laying in most cases, and temporary diversion roads will be constructed to ensure public access.
7. Do you have any specific observation on the environmental changes and impacts (odor, dust, noise, water and drainage issue etc.) that will take place?	They opined for proper treatment of sewerage before disposal of effluent to water bodies.	It was confirmed that the standard of effluent quality will be strictly maintained.
8. Do you have any suggestions to reduce such environmental impacts?	They requested for keeping the attention of KWASA to ensure the proper treatment of sewerage.	It was appraised that regular monitoring of the effluent quality will be ensured in place.
9. Are there any specially protected buildings within 50m of the project components (historical/cultural/ religious, military, police or special protected building, pump house, substations, etc.)?	They informed that no such protected building in project locations	No such protected building in project locations

N. The outcome of the Public Consultation

501. Addressing the challenge of COVID 19, the public consultation meetings were organized in different project sites taking all the measures in this regard. A total of 70 person participants attended the public consultation.

502. Overall, participants were supportive of the Project and recognized the need for the Project. They feel the Project has national and interest of ADB, that will bring social and economic development to the area of the city through a healthy and modern sanitation system. The summary of the consultation outcome is provided below;

(i) Most people will be benefited from the project;
(ii) Employment opportunities will be created;
(iii) Healthy sanitation will reduce disease;
(iv) Hazard during septic tank de-sludging will be eliminated;
(v) Bad smell over the road site will be reduced;
(vi) No historical/cultural/ religious, military, police, or special protected building exists in project locations;
(vii) Air pollution, sound pollution during construction;
(viii) Heavy vehicle may cause road damage during construction;

(ix) Road traffic may increase during the laying of sewer network; and
(x) The project will take appropriate measure to mitigate the adverse effects.

O. Future Consultations during Detailed Design Stage

503. The stakeholder consultations during detailed design stage will be continued to discuss about the project, including the implementation of the EMP and SEMP developed for the project. PMU and PMSC will ensure that consultations will be conducted as meaningful per definition of ADB SPS 2009.

P. Information Disclosure

504. Information shall be disclosed through public consultation and more formally by making documents and other materials available in a form and at a location in which they can be easily accessed by stakeholders. This normally involves making draft reports available for the public in the project locations and providing a mechanism for the receipt of comments, and making documents available more widely by lodging them on ADB and KWASA websites. KWASA through will submit to ADB the following documents for disclosure on ADB's website:

(i) Final IEE report;
(ii) New or updated IEE reports and corrective action plan prepared during project implementation, if any; and
(iii) Semiannual environmental monitoring reports.

505. PMU will provide relevant environmental information, including information from the relevant documents in a timely manner, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders. For illiterate people, other suitable communication methods will be used. For the benefit of the community, the summary of the IEE will be translated in Bangla and made available at: (i) office of PMU; and (ii) offices of the contractors. Hard copies of the IEE report will also be available at the PMU and accessible to citizens as a means of disclosing the document and at the same time creating wider public awareness. On demand, the person seeking information can obtain a hard copy of the complete IEE document at the cost of photocopy from the office of the Project Director, on a written request and payment for the same. Electronic version of the IEE will be placed in the official website of KWASA after approval of the documents by Government and clearance from ADB. PMU will issue notification on the disclosure mechanism in local newspapers, ahead of the initiation of implementation of the project, providing information on the project, as well as the start dates, etc. This will create awareness of the project implementation among the public. Posters designed to mass campaign the basic tenets of the IEE will be distributed to libraries in different localities that will be generating mass awareness.

VIII. GRIEVENCE REDRESS MACHANISM

506. The Site selection, design options, procurement and construction activities may raise grievances among the nearby communities of the STP sites. Activities related to construction works, intensive scheduling of construction activities and inappropriate timing of construction vehicle flow may arise concerns to the local people. The land acquisition law allows land owners to raise their objections and complaints at the beginning of the legal process of land acquisition and later at the time of notification for collection of compensation. It is evident that complaints and grievances may range from dispute over ownership and inheritance of the acquired lands, the affected persons and lost assets missed by PAP census, valuation of the affected assets, compensation payment, environmental pollution, procurement, and construction quality.

Moreover, during the construction period, contracted or third party employing/engaging workers may have grievances to get resolved, and cultural conflicts between migrant workers and local communities may evolve complex problem in site areas. Besides, any stakeholder may intend to produce a suggestion or enquiries on any plausible issues that also may trigger social or environmental conflicts or concerns. Therefore, a project-specific grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of AP or communities' concerns, complaints, and grievances about the social and environmental performance at the level of the project.

A. Objective

507. The Objectives of grievance response are to create an enabling environment for any aggrieved persons and entities including project affected persons to lodge complaints, claims, grievances, etc. and their grievances are redressed as quickly as possible through a process of conciliation and negotiation. Thus, the GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental performance of the project.

508. The grievance mechanism will be proportionate to the potential risks and impacts of the project and will be accessible and inclusive, and handling of grievances will be done in a culturally appropriate manner and be discreet, objective, sensitive and responsive to the needs and concerns of the project-affected parties. Where feasible and suitable for the project, the grievance mechanism will utilize existing formal or informal grievance mechanisms, supplemented as needed with project-specific arrangements. It is expected to address concerns promptly and effectively, in a transparent manner that is culturally appropriate and readily accessible to all project-affected parties, at no cost and without retribution. The mechanism will also allow for anonymous complaints to be raised and addressed. The project must make publicly available a record documenting the responses to all grievances received.

509. A best practice grievance mechanism may include the following: (a) Different ways in which users can submit their grievances, which may include submissions in person, by phone, text message, mail, email or via a web site; (b) A log where grievances are registered in writing and maintained as a database; (c) Publicly advertised procedures, setting out the length of time users can expect to wait for acknowledgement, response and resolution of their grievances; (d) Transparency about the grievance procedure, governing structure and decision makers; and (e) An appeals process (including the national judiciary) to which unsatisfied grievances may be referred when resolution of grievance has not been achieved.

510. Contracted workers will have access to a grievance mechanism. In cases where the third party employing or engaging the workers is not able to provide a grievance mechanism to such workers, the KWASA will make available the grievance mechanism to the contracted workers. A grievance mechanism will be provided for all direct workers and contracted workers (and, where relevant, their organizations) to raise workplace concerns. Such workers will be informed of the grievance mechanism at the time of recruitment and the measures put in place to protect them against any reprisal for its use. Measures will be put in place to make the grievance mechanism easily accessible to all such project workers.

B. Statutory Requirement

511. None of the safeguard documents from Bangladesh Government end include any clauses or requirement for redressing grievances of affected population of any kind. ADB in its Safeguard Policy Statement (June 2009) articulates the requirement for establishing and maintaining a

grievance redress mechanism by every borrower/client in order to receive and facilitate resolution of affected peoples' concerns and grievances. A prompt, easily understandable and transparent process is to be established which must be gender responsive, culturally appropriate and readily accessible to all segments of the affected people.

C. Common Grievance Redress Mechanism (GRM)

512. A common grievance redress mechanism (GRM) will be put in place to receive, evaluate, and facilitate the resolution of social, environmental or any other project related grievances. The GRM will aim to provide a time-bound and transparent mechanism to voice and resolve social and environmental concerns linked to the project. The GRM described below has been developed in consultation with stakeholders. Public awareness campaign will be conducted to ensure that awareness on the project and its grievance redress procedures is generated and shared with affected persons and other stakeholders. The campaign will ensure that the poor, vulnerable and others are made aware of.

513. The GRM provides an accessible, inclusive, gender-sensitive and culturally appropriate platform for receiving and facilitating resolution of affected persons' grievances related to the project. The multi-tier GRM for the project is outlined below, each tier having time-bound schedules and with responsible persons identified to address grievances and seek appropriate persons' advice at each stage, as required. Public awareness campaigns will ensure that awareness on grievance redress procedures is generated through the campaign. The Environmental and Social Safeguard Officer of PMU will have the overall responsibility for timely grievance redress on environmental and social safeguards issues.

514. **Who can complain:** A complaint may be registered by stakeholders who may be, "directly, indirectly, materially, and adversely" affected by the project. Any other representative can register a complaint on behalf of the affected person/s or any stakeholder by, provided that he or she identifies the affected person/sand includes evidence of the authority to act on their behalf.

515. **What the Grievance/Complain should contain:** Any concerns pertaining to safeguard compliance - environment, involuntary resettlement, and indigenous people, design related issues, compensation, service delivery or any other issues or concerns related to the project. The complaint must contain name, date, address/contact details of the complainant, location of the problem area, along with the problem. Sample grievance registration form is included in the initial environmental examination report and resettlement plan of the project.

516. **Where and How to file a Complaint:** The contractor's site office will be the primary point for receiving and lodging any complaint. Apart from that, Grievances/ suggestions from affected persons can be dropped into suggestion boxes or conveyed through phone or e-mails. Affected Persons or any complainant will also be able to register grievances on social, environmental or other related issues, personally to the Grievance Redress Committee (GRC). The Social Safeguard Officer (SSO) and designated official will be able to correctly interpret/record verbal grievances of non-literate persons and those received over telephone. The concerned Executive Engineers/ contractor's site engineer, Environment Health and Safety (EHS) Officer or any designated person from the Contractor's side will monitor these grievance register books and if possible take necessary actions to redress minor complaints with intimation to the complainant as well as to the SSO at PMU. The time period to resolve any grievances at different level of GRC has been discussed below.

517. **Documentation:** Documentation of the complaints is important and must contain name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and how the problem was resolved. SSO at PMU with the support of Social Safeguard Specialist, PMSC will have the overall responsibility for timely grievance redress, and for registration of grievances, related disclosure, and communication with the aggrieved party. All the documents made available to the public at the community level (at ward offices) and will include information on the contact number, address and contact person for registering grievances, and will be disseminated throughout the project area by the PMU

518. **Grievance/Problem Redress through Participatory Process:** Efforts must be made by the PMU with the support of safeguard officers to resolve problems and conflicts amicably through participatory process with the community and relevant local government. In case of grievances that are immediate and urgent in the perception of the complainant, the Contractor and supervision personnel from the PMSC will provide the most easily accessible or first level of contact for the quick resolution of grievances. Contact phone numbers and names of the concerned staff and contractors will be posted at all construction sites at visible locations.

519. **Grievance Redressal Committee:** In pursuance of Asian Development Bank (ADB) Guideline, an independent Grievance Redressal Committee (GRC) has to be established under KWASA to address the grievance of persons affected due to implementation of sub- projects under ADB assisted projects. The composition of the GRC is provided in table below:

Table 45: Composition of Grievance Redressal cell

Level 1:Site level GRC	Level 2: Central GRC	Level 3: Apex GRC
• Social Safeguard Officer, EHS Officer of Contractor • Contractor's site engineer • Site Engineer, KWASA	• Deputy Managing Director, Khulna WASA – Convener • Project Director, Khulna WASA – Member • Executive Engineer, Khulna WASA –Member • Assistant Engineer, Khulna WASA –Member	• Project Director, Khulna WASA – Convener • Respective Ward Councilor, Khulna City Corporation – Member • Representative from Affected Persons –Member • Respective Union Paraisad Chairman/ Councilor-Member • Assistant Engineer, Khulna WASA

520. **Grievance Redress Process and Timeframe:**

(i) **1st level grievance**: In case of grievances that are immediate and urgent in the perception of the complainant, he/she can first register their complaint with the Contractor's Site Engineer. Complaints and grievances will be heard by the SSO, EHS Officer of Contractor and focus group discussions at the village level. The grievance will need to be resolved within 14 days from the date of receipt of the complaint. If the grievance cannot be addressed at level 1 then it should be escalated to second level. The affected person can approach the GRC.

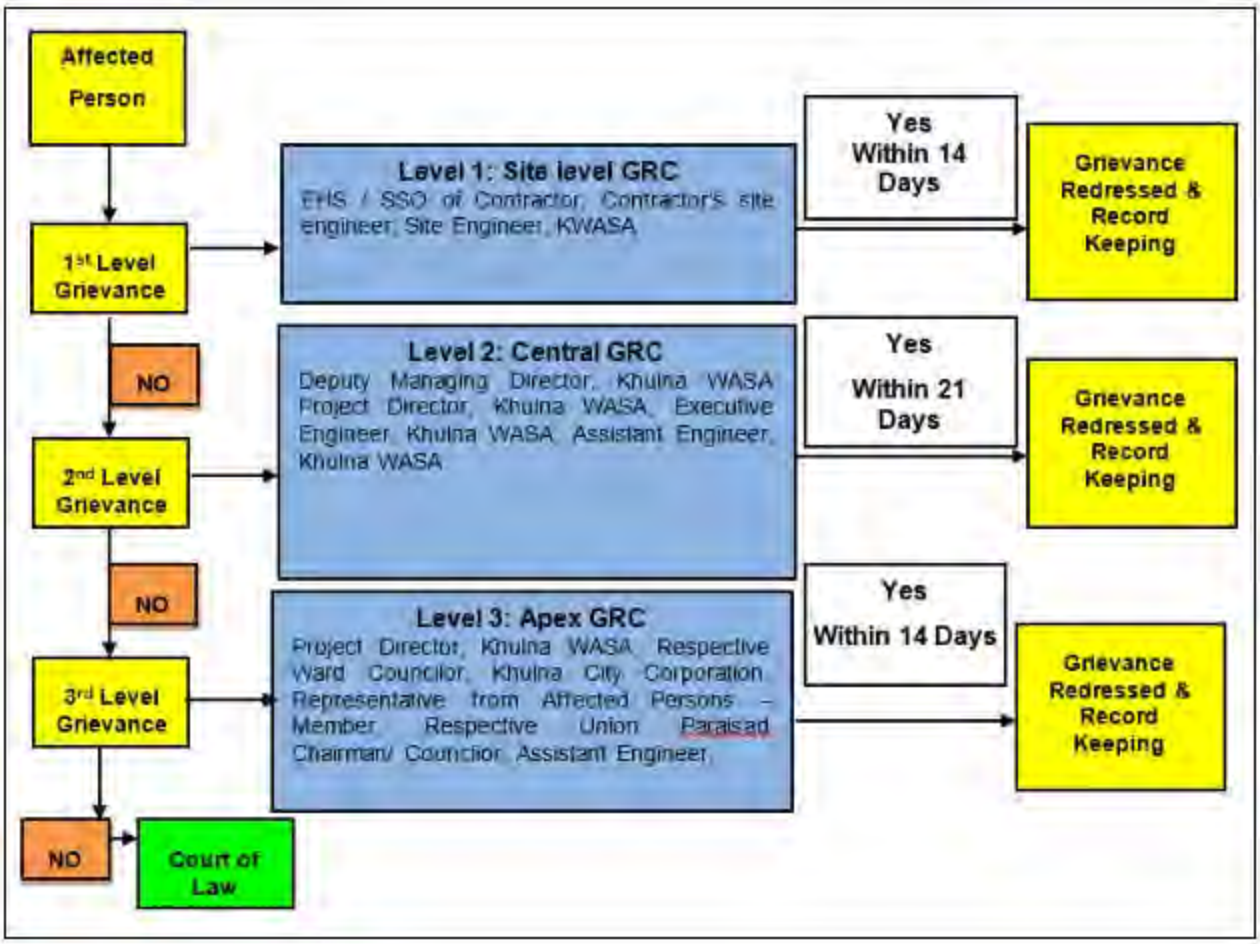
(ii) **2nd level grievance**: All grievances that cannot be redressed at first level within 14 days will be brought to the notice of Deputy Managing Director, Khulna WASA who

is also the convener of the 2nd level GRC by the SSO. The 2nd level GRC comprising of Project Director, Executive Engineer, KWASA will try to resolve the complaints/ grievances raised by the complainant, facilitated by the SSO within a time period of 21 days from the date of receipt of the complaint at the 2nd level. If the grievance cannot be addressed at 2nd level then it should be escalated to third level. affected person or the complainant can approach the 2nd tier directly also.

(iii) **3rd level grievance:** All the grievances that cannot be not addressed at 2ndlevel within in 21 days of receipt will be brought to the notice of the Apex Grievance Redressal Committee (GRC). The Apex GRC will meet twice a month (based on grievances launched with the Apex GRC) and determine the merit of each grievances brought to the committee. The GRC will resolve the grievance within 14 days of receiving the complaint at the 3rd level. The Social Safeguard Officer will communicate all decisions taken by the GRC to the complainant.

521. The process of the grievance redressal mechanism (GRM) is given in Figure 31.

Figure 34: :Grievance Redressal Mechanism



522. In case of any inter-departmental or inter-jurisdictional coordination required for resolution of specific grievances, the PMU will refer the matter directly to the Deputy Managing Director, Khulna WASA for inter-departmental coordination and resolution. The project GRM notwithstanding, an aggrieved person shall have access to the country's legal system at any stage, and accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

523. Periodic community meetings with affected communities to understand their concerns and help them through the process of grievance redress (including translation from local dialect/language, recording and registering grievances of non-literate affected persons and explaining the process of grievance redress) will be conducted if required. The above Grievance Redress Process will be discussed with the different stakeholders during stakeholder consultation meetings. These meetings will be held with affected persons and community members (beneficiaries) and the concerned Municipal Ward Councilors where civil works are proposed. The process and timelines for grievance redress and contact details of the persons responsible for grievance redress will be shared in the stakeholder meetings. Action taken in respect of all complaints will be communicated to the complainant by letter, over phone or e-mail or WhatsApp as the case may be.

524. **Consultation Arrangements for GRM** - This will include group meetings and discussions with affected persons, to be announced in advance and conducted at the time of day agreed on with affected persons and conducted to address general/common grievances; and if required with the SSO of PMU and Social Safeguard Specialist of PMSC for one-to-one consultations. Non-literate affected persons/ vulnerable affected persons will be assisted to understand the grievance redress process. At the site office the of contractor, EHS or Safeguard personnel will assist the non-literate affected persons to register complaints and with follow-up actions at different stages in the process.

525. **Documentation and Record keeping.** All GRC documents will be maintained by Contractor and PMU. Record of all complaints received, and action taken will be maintained at both at the field level and the PMU. This information will be available for review and verification by supervision consultants and ADB or any third party. KWASA field offices will act as secretariat to the GRCs. All the grievance records will be updated regularly and easily accessible on-site.

526. **Information dissemination methods of the GRM:** GRC procedures and operational rules will be publicized widely through community meeting and pamphlets in Bengali so that the affected persons are aware of their rights and obligation, and procedures of grievance redress.

527. Grievances received, and responses provided will be documented and reported back to the affected persons. The number of grievances recorded and resolved and the outcomes will be displayed/disclosed in the Central Complaint Cell at KWASA and web. The phone number where grievances are to be recorded will be prominently displayed at the construction sites.

528. Leaflet containing information of the project along with grievance redress, the address and contact numbers where the affected persons can go and register their complaints have been distributed to the affected persons.

529. **Costs:** All costs involved in resolving the complaints (meetings, consultations, communication and reporting/information dissemination) will be borne by the PMU.

530. **ADB Accountability Mechanism**: If the established GRM is not in a position to resolve the issue, the affected person also can use the ADB Accountability Mechanism through directly contacting (in writing) the Complaint Receiving Officer (CRO) at ADB headquarters. Before submitting a complaint to the Accountability Mechanism, it is recommended that affected people make a good faith effort to resolve their problems by working with the concerned ADB operations department (in this case, the Bangladesh Resident Mission). Only after doing that, and if they are still dissatisfied, they could approach the Accountability Mechanism. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities, as part of the project GRM.

IX. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

1. Purposes

531. The purpose of this EMP is to provide a framework that outlines how KWASA and any contractor appointed will manage and where practicable, minimize negative environmental effects during the design, construction and operation of the proposed development. Construction is considered to include all site preparation, enabling works, demolition, materials delivery, materials and waste removal, construction activities and associated engineering works.

532. This EMP identifies the minimum requirements with regard to the appropriate mitigation, monitoring, inspection and reporting mechanisms that need to be implemented throughout design, construction and operation periods of the project. Compliance with this EMP does not absolve the contractors or their subcontractors (during construction phase) and/or the STP/FSTP operators (during operation phase) from compliance with all legislation and bylaws relating to construction phase and operation phase activities, respectively.

2. Approach

533. This EMP provides a framework to:

(i) Describe the project for environmental management during design, construction and operation phases;
(ii) Implement those monitoring and mitigation measures identified in this IEE;
(iii) Outline the principles and minimum standards required of the contractors during the development of their respective SEMPs;
(iv) Identify the relevant roles and responsibilities for developing, implementing, maintaining and monitoring environmental management; and

(v) Outline the procedures for communicating and reporting on environmental aspects of the proposed development throughout all phases of project implementation.

B. Institutional Arrangement

1. General

534. KWASA is mandated to provide an effective water supply and sewerage system and services that cater to the citizens and dwellers of Khulna city. KWASA is responsible for the development, management and regular operation of the system and allied services. In line with this responsibility, the development of an integrated sewerage system requires technical capability, resource potential, and institutional modernization, including the development of municipal infrastructure and O&M capacities.

535. Water supply system managed and operated by different WASAs and other local government bodies across Bangladesh are well integrated, largely inclusive and guided by appropriate legal and institutional policies, frameworks and regulatory measures. While the concept of wastewater treatment and management in the country has been largely associated with industrial effluents being discharged to nearby surface water bodies, the Department of Environment has formulated strict guiding principles and standards for effluent corresponding to the types of industries or interventions. Other forms of wastewater, especially municipal wastewater or sewage, did not get much attention in terms of policy formulation, strategy fixation or setting up of regulatory standards, which is a necessity to achieve an efficient and organized sanitation services. To date, only the Dhaka WASA wastewater treatment plant in Pagla has been built, and the project, once built, will be the second. No other WASA in the country has taken similar initiative so far.

2. Safeguard System Assessment of KWASA

536. **Institutional Framework.** Successful implementation of wastewater management system requires an institutional framework based on the specifics of local situation, urban setting, work culture, public participation, etc. So far, the WASA Act is currently the only guiding instrument for operational activities of KWASA.

537. **Regulatory Framework.** In its organizational structure, KWASA's Wastewater Management Division has the responsibility of complying any regulatory requirements on environment. Regulatory framework concerning wastewater management system or services encompasses related laws, rules and regulations, which the Department of Environment is mandated to implement and oversee. However, to date, there is still the lack of detailed guidelines issued specific for municipal wastewater management or sanitation services. In order to overcome this regulatory gap, the previously formulated wastewater management master plan for Khulna city suggested the formation of an independent monitoring body to ensure that public utilities like water supply and sewerage systems are operating within acceptable standards, and the creation of a separate regulatory commission like those in other utility organizations.

538. **Existing Working Area and Personnel Structure.** KWASA is the agency mandated to provide water supply system in Khulna city area. The KWASA board of director is headed by Chairman and eleven members, including a Managing Director (MD) who has the executive power to run the KWASA. Apart from the MD, two Deputy Managing Directors, one Chief Engineer, one Secretary, and two Superintending Engineers, comprise the senior management. Currently KWASA has four O&M sections, each being headed by its respective Executive Engineers. Revenue and Accounts sections are controlled by a Commercial Manager, while the

Administration section is headed by a Secretary. There organization has a total of 233 personnel under the prevailing management structure (as approved in November 2014).

539. **Resource Gap.** In its organizational structure, KWASA is short of resources necessary to deliver an efficient sewage management system or sanitation services. The major areas of concern where a resource gap was identified are the following: (i) stringent monitoring practices by a surveillance entity, (ii) structuring and streamlining KWASA's staffing pattern for an effective and efficient performance for sewerage system.

540. As such, this gap will require a separate group within the organization (e.g. a Sewerage Management Division) that will accommodate management functions for the project facilities, such as the sewer network, conveyance system, pumping stations, and treatment plants. This group will carry out the tasks for a sewerage system management as mandated by the WASA Act.

3. Overall Institutional Arrangement

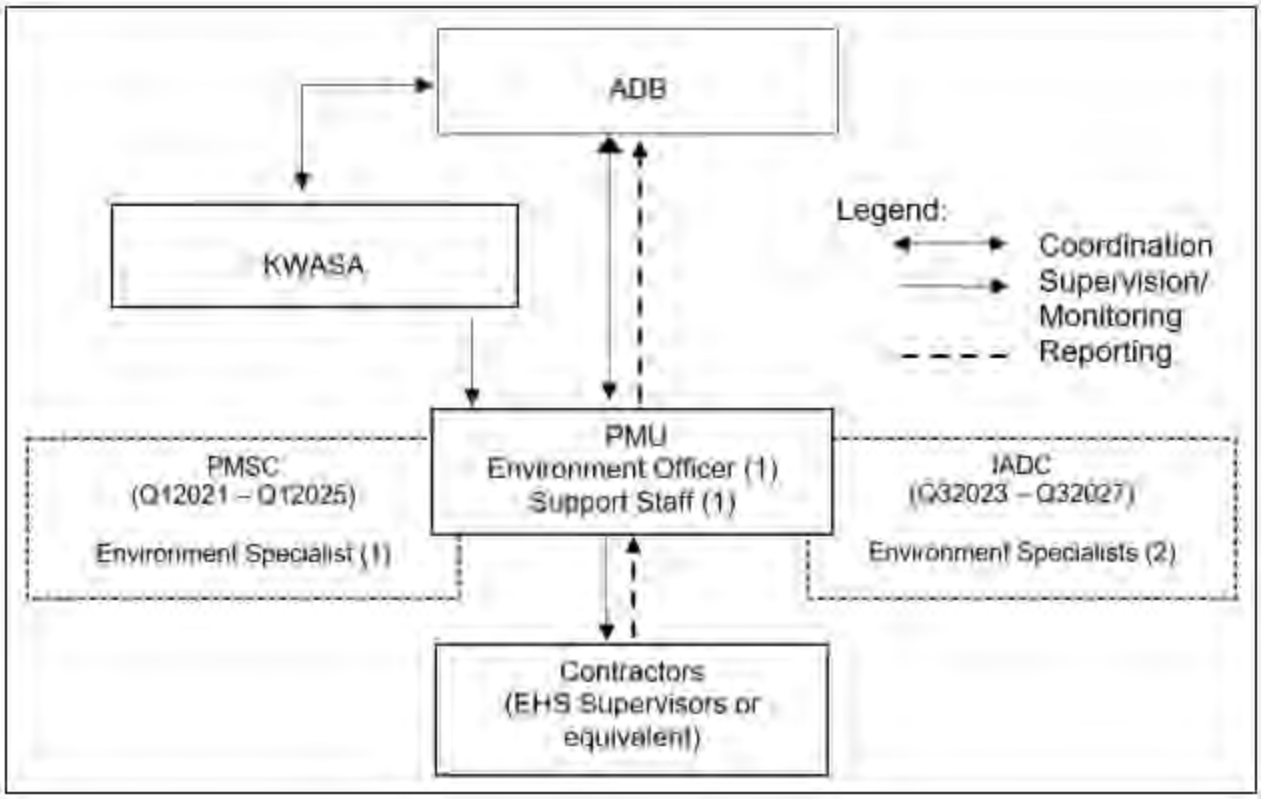
541. Khulna WASA will be the executing agency and implementing agency. Khulna WASA will be responsible for the overall planning, guidance, management and implementation of the project.

542. An inter-ministerial Project Steering Committee (PSC) will be established for the Project. The PSC will be chaired by the Secretary of Local Government Division (LGD) under the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC). The PSC will provide overall policy guidance and oversee the overall implementation of the Project. Apart from the PSC, Project Implementation Committee (PIC) will be established to review the progress and resolve the issues as regard to project implementation.

543. Khulna WASA will recruit consulting firms using quality- and cost-based selection method with a quality cost ratio of 90:10 in accordance with the guidelines on the Use of Consultants by Asian Development Bank and Its Borrowers. Procurement of works and goods will be carried out in accordance with ADB's Procurement Guidelines. Disbursements under the project will be made in accordance with ADB's Loan Disbursement Handbook (2015, as amended from time to time).

544. **Environmental Safeguards Implementation Arrangements**. Figure below depicts the implementation arrangement for environmental safeguards.

Figure 35: Environmental Safeguards Implementation Arrangement



ADB = Asian Development Bank, EHS = environmental, health and safety, IADC = institutional development, awareness creation and design consultants, KWASA = Khulna Water Supply and Sewerage Authority, PMSC = project management and supervision consultant, PMU = project management unit.

545. **Project Management Unit.** An environmental safeguards officer will be assigned in PMU to ensure efficient overall implementation of environmental safeguards. The environmental safeguards officer will be supported by an environment specialist consultant through the PMSC and IADC, and capacity development and training. The responsibilities of the environmental safeguards officer are:

(i) review and confirm draft IEE including EMPs are finalized based on detailed designs of STPs;
(ii) update the final IEE including EMPs if changes in detailed design of any package occur during implementation phase;
(iii) ensure that EMPs are included in bidding documents and civil works contracts;
(iv) provide oversight on environmental management aspects of subprojects and ensure EMPs are implemented by contractors;
(v) establish a system to monitor environmental safeguards of the project including monitoring the indicators set out in the monitoring plan of the EMP;
(vi) facilitate and confirm overall compliance with all government rules and regulations regarding site and environmental clearances as well as any other environmental requirements as relevant;
(vii) review, monitor and evaluate effectiveness with which the EMPs are implemented, and recommend necessary corrective actions to be taken;
(viii) consolidate monthly environmental monitoring reports from contractors and submit semi-annual environmental monitoring reports to ADB;

(ix) ensure timely disclosure of final IEEs/EMPs in project website and in a form accessible to the public;
(x) address any grievances brought about through the grievance redress mechanism (GRM) in a timely manner as per the IEEs (GRM is in **Appendix 7**);
(xi) undertake regular review of safeguards-related loan covenants, and the compliance during program implementation; and
(xii) organize periodic capacity building and training programs on safeguards for project stakeholders, PMU, and contractors.

546. **Project Management and Supervision Consultant (PMSC) and Institutional Development, Awareness Creation and Design Consultants (IADC)**. The PMSC team (Q12021 – Q12025) and IADC team (Q32023 – Q32027) will have their respective Environment Specialist Consultants who will assist PMU in the review and updating of all necessary environmental safeguard documentation as required by ADB SPS and national laws, regulations, policies and guidelines applicable to the project. Specific tasks of the PMSC/IADC Environment Specialist Consultants are to assist PMU in:

(i) finalizing the IEE including EMPs based on final detailed design of the STP package and in accordance with ADB SPS and national laws, regulations, policies and guidelines;
(ii) updating the final IEE including EMPs if changes in detailed design of any package occur during implementation phase;
(iii) conduct of due diligence of associated facilities and/or audit of existing facilities, if any, during the detailed design phase, as defined in ADB SPS;
(iv) conduct of meaningful consultations and ensure issues/concerns/suggestions raised are incorporated in the design and updated/final IEE report;
(v) ensuring relevant provisions from the updated/final IEE report and EMPs are incorporated in the bid and contract documents;
(vi) establishing GRM and ensure members of the grievance committee have the necessary capacity to resolve project-related issues/concerns;
(vii) conduct of safeguards capacity building, together with the social safeguard experts, to ensure PMU has the capacity to implement, monitor, and report on implementation of EMPs, resettlement plans and indigenous peoples plans (if any);
(viii) day to day monitoring of implementation of EMPs at all works sites, including all potential safeguard issues identified in the safeguard documentation mentioned above; and
(ix) monitoring any unanticipated environmental risks or impacts that may arise during construction, implementation or operation of the project that were not considered in the IEE report and EMPs. Prepare corrective action plans and ensure that these are implemented by the contractor and reported accordingly in environmental monitoring reports to ADB.

547. **Civil Works Contracts and Contractors.** The IEE with EMPs is to be included in bidding and contract documents and verified by PMU. The contractor will be required to designate an environment, health and safety supervisor to ensure implementation of EMP during civil works. Contractors are to carry out all environmental mitigation and monitoring measures outlined in their contract. The contractor will be required to submit to PMU, for review and approval, a site-specific environmental management plan (SEMP) including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; (iii) monitoring

program as per EMP; and (iv) budget for SEMP implementation. No works can commence prior to approval of SEMP.

548. A copy of the EMP/approved SEMP will be kept on-site during the construction period at all times. Non-compliance with, or any deviation from, the conditions set out in the EMP/SEMP constitutes a failure in compliance and will require corrective actions.

549. PMU will ensure that bidding and contract documents include specific provisions requiring contractors to comply with: (i) all applicable labor laws and core labor standards on (a) prohibition of child labor as defined in national legislation for construction and maintenance activities; (b) equal pay for equal work of equal value regardless of gender, ethnicity, or caste; and (c) elimination of forced labor; and with (ii) the requirement to disseminate information on sexually transmitted diseases, including HIV/AIDS, to employees and local communities surrounding the project sites.

C. Environmental Management Plan Matrices

550. Consistent with Section V, the following tables summarize the impacts and mitigation measures relative to the three packages/subprojects.

Table 46: Environmental Impacts and Mitigation Measures for Subproject-1 (114.53 km of Sewer Network including 3 Sewage Pumping Stations)

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
1. Design and Pre-Construction Phase				
1.1 Land Acquisition and Resettlement	Total of 74.1 decimals of land including 49.42 government land will be required due to construction of Subproject-1 where 7 HHs will be relocated from the proposed locations. The impact is permanent and significant.	• All efforts have been made in Sewage Pumping Station design to reduce land acquisition; • Developing proper and adequate compensation package for affected persons; • Prior to site works, payment of compensation to affected people based on the Resettlement Plan; • Impacts on land and assets due to sewer network will be avoided through routing of alignments within the available ROW. Temporary impacts, if any, within the ROW will be addressed in accordance with the RP.	DC/PMU/PMSC	PMU
1.2 Disruption of Utilities/services	Utility lines along the sewer network will have to be moved disrupting services.	• Provision in the design and budget for the relocation of the existing utility infrastructures, wherever required; • Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; • Identify and include locations of water/gas pipes, power/telephone lines and any other infrastructure on the way of pipe line and redesign pipe layout to avoid any damage on such infrastructure; • Require construction contractors to prepare a contingency plan to include actions to be taken in case of unintentional interruption of services; • Utilities will only be removed and relocated with proper agency approvals and permission; • Informing all hospitals, schools, places of worship, and affected communities well in advance; • If utilities are damaged during construction, it will be reported to the Consultants and utility authority and repairs will be arranged immediately at the contractor's expense; and • Reconnection of utilities will be completed at the shortest practicable time before construction commences.	Contractor, PMSC	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
1.3 Tree Removal	Around 13 trees will be cut for the construction of Sewage Pumping Station under Subproject-1.	• After the finalization of the designs and layout of the project components, the trees within proposed construction areas will be marked; • Trees within the corridor of impact (area required for construction) will be felled after prior approval; • Compensation to be provided for the affected trees based on the unit prices of trees determined by the agriculture/horticulture experts; • Only trees that will require removal within the proposed construction areas of the sites will be cut; and • For trees not proposed to be cut, taking all precautions to protect them from any damage from construction activities.	Contractor/PMSC/PMU	PMU, PMSC
1.4 Consents, Permits, NOCs, Clearances, etc.	Failure to obtain necessary consents, permits, and other appropriate regulatory clearances can result to design revisions and work stoppage.	• Obtain all of the necessary consents, permits, and clearances before the start of civil works. • Acknowledge in writing and provide report on compliance all obtained permits, clearance, NOCs, etc. • Include in detailed design drawings and documents all conditions and provisions if necessary.	Contractor, PMSC	PMU
1.5 Natural Calamities such as flood, cyclone, earthquake etc.	Natural calamities can affect the pumping stations and collection system indirectly creating a hazard to human health.	• Consider potential impacts from extreme climate change scenario in designing the Sewage Pumping Station and sewer main. • Torrential rainfall during the monsoon is also considered for the Sewage Pumping Station. • Sewage Pumping Station are designed by considering the highest flood level (HFL) information of last 25 years and sewer network will be laid at 3 to 5m depth below the ground level.	Design Consultant	PMU
1.6 Road Excavation	Traffic congestion, road accident and dropping of pedestrian in open trenches etc.	• No temporary or permanent works proceed before the design and drawings are approved by the Project Director and road cutting permission obtained from relevant authorities (KCC, RHD) by PMU. • Road cutting plan necessary for the application for road cutting permission from the authorities must be prepared by the contractor. • KWASA should apply for the road cutting permission prior to starting the works and the contractor shall give full effort and cost for collection of road cutting permission for required days. • Contractor has to take all necessary safeguards to avoid accidents at site, prevent loss/damage to all existing utilities like pipelines, telephone/electric cables, poles etc. and any government or private property during the contract period. • The contractor shall prepare a traffic management plan (road closure program or diversions) and incorporate detail of traffic diversions and pedestrian routes, all traffic signs (for the regulation and for information) and road markings shall be ensured prior to start of road cutting.	Contractor, PMSC	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
1.7 Traffic Management Plan	Minimize traffic disruption and congestion.	Contractor shall conduct traffic impact assessments to plan traffic management to minimize disturbance of vehicular traffic and pedestrians. Access arrangements for vehicles accessing the project area will be formulated such that this will avoid community disturbance and severance, and the plan will include consideration of the following: • Lane availability and minimizing interference with traffic flows past the work site; • Establishment of acceptable working hours and constraints; • Agreement on time scale and establishment of traffic flow/delay requirements; • Programming issues, including the time of year and available resources; • Discussion of the PMSC's inspection/monitoring role; • Establishment of complaints management system for the duration of the work.	Contractor, PMSC	PMU
1.8 Updating of IEE and SEMP	Expecting minor impacts, during construction period only and mitigation measures are addressed.	• Update IEE based on detailed designs, and submitted to ADB for review, approval, and disclosure prior to commencement of work. • Formulate SEMP during implementation and get approval from the PD. • Relevant information shall be disclosed.	Contractor, PMSC	PMSC, PMU
1.9 Community Awareness Program	Without proper interaction with local communities and or with stakeholders may lead to confusion and agitation and non-cooperation of local people.	Before the start of the project, the local population should be well aware of the upcoming project. There should be regular interaction with the local population and make them understand the project activities.	Contractor	PMSC, PMU
1.10 EMP Implementation Training	Irreversible impact to the environment, workers, and community.	Project manager and all key workers of contractors will be required to undergo EMP implementation training including spoils management, Standard operating procedures (SOP) for construction works; health and safety (H&S), core labor laws, applicable environmental laws etc.	Contractor, PMSC	PMU
2. During Construction Phase				
2.1 Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	• A materials management plan (MMP) will be produced to minimize the use of non-renewable resources and rock-based materials. The MMP will be approved by the engineer and revised as required by the Engineer. • Prioritize sites which already permitted by the authority. • If other sites are necessary, it is contractor's responsibility to verify the suitability of all material sources and to obtain the approval of PMU and consultants. • If additional quarries will require after construction is started, construction contractor to obtain a written approval from PMU. • Maintain a construction material register at the site.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
2.2 Construction Camps, Stockpile Areas and Storage Sites	Conflicts with local community; disruption to traffic flow and sensitive receptors.	• Submit to the PMU for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps; • Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view; • Shall not be located in productive agricultural lands, water bodies, natural drainage channels, flood plains and groundwater recharge areas, forests, vegetative lands, etc.; • For private lands, obtain land owner's written consent; indicate the requirement for reinstatement to original; • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters; • Locate at sites that will not promote instability, flooding and result in destruction of natural drainage, vegetation, irrigation, & drinking water supply; • Locate the garbage pit/waste disposal site min 500 m away from the residence so that peoples are not disturbed with the odor likely to be produced from anaerobic decomposition of wastes at the waste dumping places. Encompass the waste dumping place by fencing and tree plantation to prevent children to enter and play with. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. • Provide appropriate security personnel (police / home guard or private security guards) and enclosures to prevent unauthorized entry in to the camp area. Maintain register to keep a track on a head count of persons present in the camp at any given time. • Provide medical facility and appropriate type of fire-fighting equipment suitable for the construction camps; • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.	Contractor	PMSC, IADC, PMU
2.3 Landscape and Visual	The presence of heavy duty vehicles and equipment, temporary structures at construction camps,	• Properly fence off storage areas. • Collect all domestic solid waste and dump at designated disposal site. • Contractor to exercise strict care in disposing construction waste.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	stockpiles, may result in impacts on aesthetics and landscape character; and Visual changes to topography.	• Reinstated vegetation shall be undertaken by a suitably qualified landscape contractor, and their contract will include two-year aftercare. • Construction activity shall be conducted sequentially at different working areas in the city; • Ensure effective pedestrian and traffic management to minimize inconvenience and ensure access is maintained as appropriate.		
2.4 Road Excavation Works	Potential erosion, dust generation, traffic congestion, road accident, dropping pedestrians in open trench etc. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• All excavations shall be done to the minimum dimension as required for safety and working facility. • The excavation shall be executed in such manner, that the contractor does not damage or interfere with existing services or structures. If damage or interference is so caused the contractor shall make arrangements with the supply and/or building owner to execute the repairs at the contractor's own cost. • All trench and pit excavations and other work shall be carried out during night time at busy road section. • Road drains and channels shall be kept free from obstructions at all times. • In case of excavation in large roads, the trenches and pits maybe need to be covered by steel plates to allow traffic to pass during non-working periods. • The contractor must liaise with KWASA and the responsible police to familiarize themselves and adhere to such rules. • Trench excavation along roads be located in footpaths or adjacent to the road. Trench excavation shall wherever practicable be carried out in such a way that every part of the excavation is at least 0.5m clear of existing edges of the carriage way. • The contractor shall have particular regard to the safety of pedestrian, livestock, and shall ensure that all open excavation, access routes and steep or loose slopes arising from the contractor's operations are adequately fenced and protected.	Contractor	PMSC, IADC, PMU
	Damage to underground archaeological artifacts	• In the event of chance finds, the following measures shall be strictly adopted: o strictly follow the protocol by coordinating immediately with PMU and Bangladesh Department of Archaeology for any suspicion of chance finds during excavation works; o stop work immediately to allow further investigation if any finds are suspected; and o request authorized person from the Bangladesh Department of Archaeology to observe when excavation resumes for the	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		identification of the potential chance find, and comply with further instructions.		
2.5 Trenchless Pipe Installation	Noise generated due to HDD may affect the neighboring communities and other sensitive receptors (such as students at schools and other educational institutes, patients at hospitals etc.). Bentonite slurry spilled out to the watercourses may contaminate the adjacent surface water.	• Pipes shall be installed by the horizontal directional drilling (HDD) methods where required. If the method is not feasible for any road, the contractor shall inform the Project Manager and gain prior approval for an alternative method or for open trench method. • Excavation material shall be removed from the conduit as the work progresses. No accumulation of excavated material within the conduit will be permitted. • The contractor shall provide sediment and erosion control measures in accordance with local environmental legislation. • The contractor shall supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Spent drilling fluids and cuttings shall be confined to the entrance and exit pits. • The contractor shall take all necessary precautions to minimize the damage to the adjacent properties. The contractor shall take all necessary precautions to minimize the damage to the adjacent properties. • Drilling fluid/ bentonite slurry that enters the pipe shall be removed by flushing or other suitable methods. Sediment tanks of sufficient capacity, constructed from pre-formed individual cells of approximately 6-8m3 capacities shall be used for settling waste-waters prior to disposal. • The contractor shall be responsible for cleanup and restoration of the site. • Pits excavated to permit connection of bored pipe shall be backfilled, and disturbed areas shall be restored to their original state or better. Sections of sidewalks, curbs, and gutters or other permanent improvements damaged during HDD operations shall be repaired or replaced at the contractor's expense.	Contractor	PMSC, IADC, PMU
2.6 Laying of Pipeline near Waterbodies	Sewer pipeline will cross several water bodies which may cause siltation and reduction in the quality of adjacent bodies of water. Degradation of water flow.	• Trenching and backfilling operations at the canal crossings/stream crossings will be carried out in the lean seasons, when the flow will be minimum, and disruption will also be minimum. • In case of crossings at existing minor bridges and culverts, the Contractor will ensure that there is no impact/disturbance to the bridges/culverts due to crossing of the water pipelines. • Silt fencing to be provided at all water bodies near canal and streams. • Do not disturb the water body except the actual work area; no equipment, machinery shall be operated outside the work area; • Avoid use of fuels, chemicals and lubricants; ensure no spillage;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Clean up the area after the completion and prior to the onset of monsoon flow.		
2.7 Surface Water Quality	Soil erosion from trenching and excavation, run-off from stockpiled materials Chemicals such as fuels and lubricants may pollute runoff during rainfall, which may cause pollution of adjacent bodies of water. Bentonite slurry used in trenchless pipe installation may contaminate the adjacent watercourse. Effluent from labor camp sites and constructions sites may pollute surface waters.	• Provision of temporary sedimentation canal and/or silt traps along construction areas, particularly alignments that are adjacent to receiving bodies of water or canals. • The measures to address soil erosion at the proposed facilities will consist of measures as per design, or as directed by the PMSC to control soil erosion, sedimentation, and water pollution. All temporary sedimentation, pollution control works, and maintenance thereof will be deemed incidental to the earthwork or other items of work. • All temporary discharge points shall be located, designed and constructed in a manner that will minimize erosion in the receiving channels. • Ensure proper compaction of refilled soil and there shall not be any loose soil particles on the top; the material shall be refilled in layers and compacted properly layer by layer. • Use surplus soil for beneficial purposes such as in any other construction activities, or to raise the level of low lying areas. • Avoid scheduling of excavation work during the monsoon season. Earthworks during dry season. • Confine construction area including the material storage (sand and aggregate) so that runoff from upland areas will not enter the site. • Ensure that drains are not blocked with excavated soil • Stockyards at least 50 meters (m) away from watercourses. • Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%. • No obstruction in flowing water. • For effluents from work place, camps, and offices, provide treatment arrangements such as retention ponds and septic tanks which should be incorporated in the facility designs. A sewage management plan has to be prepared by the contractor and agreed with the PMSC. • Monitor water quality according to the environmental monitoring plan.	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU
2.8 Groundwater Quality	Uncontrolled extraction of water may affect availability of water to locals. Contamination of groundwater from construction related	• Prevent pollutants from contaminating the soil and the ground water. • All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned; • Storage of lubricants and fuel at least 50 m from water bodies • Storage of fuel and lubricants in double hulled tanks. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%. • Daily control of machinery and vehicles for leakages	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	sources such a fuel and liquid wastes.	• Collection of waste during construction activities • Provide uncontaminated water for dust suppression • Monitor groundwater quality according to the environmental monitoring plan.		
2.9 Soil Erosion and Sediment Mobilization	The construction activities may cause serious soil degradation problems in the areas of Sewage Pumping Station and alignment of pipeline etc.	• The Contractor shall plan his works to minimize surface excavation works during the rainy season where practicable. • Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and actions to be taken during or after rainstorms shall be developed by the Contractor. • The earthwork sites where exposed land surface is vulnerable to runoff shall be consolidated and/or covered. • Channels, earth bunds, netting, tarpaulin and or sand bag barriers shall be used on site to manage surface water runoff and minimize erosion. • The overall slope of the works areas and construction yards shall be kept to a minimum to reduce the erosive potential of surface water flows. • Monitor groundwater quality that could exist close to the working areas to ensure compliance.	Contractor	PMSC, IADC, PMU
2.10 Drainage Congestion	Construction material getting into surface run off or uncontrolled disposal may cause temporary drainage congestion.	• Prepare a program for prevent/avoid standing waters, which PMSC will verify in advance and confirm during implementation; • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line; • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem. Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there; • Wastes and construction debris will not be disposed in a manner that these would end up in drainage canals. • Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning;	Contractor	PMSC, IADC, PMU
2.11 Air and Dust Pollution	Dust from construction related traffic and machinery. Dust from works, carrying machinery equipment to the site, and roads due to vehicle movements	• Take every precaution to reduce the levels of dust at construction sites, and not exceeding the pre-project ambient air quality standards. • Fit all heavy equipment and machinery with air pollution control devices that are operating correctly. • Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust. • Reduce dust by spraying stockpiled soil, excavated materials, and spoils. • Cover with tarpaulin vehicles transporting soil and sand. • Cover stockpiled construction materials with tarpaulin or plastic sheets.	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Air pollution generated from exhaust/emissions of engines. The impacts are negative but short-term, impacts within a relatively small area and reversible by mitigation measures.	• Trenching and transport vehicles shall move only in designated areas and roads. • Water spraying to access roads, camp sites and work sites to reduce dust emissions. • Machines and vehicles must be regularly examined and maintained to comply with requirements of technical specifications. • All vehicles, equipment, and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of DOE. Copies of conformance will be submitted regularly to the PMSC. • Repair and maintain access roads, as necessary. • Monitor air quality according to the environmental monitoring plan.		
2.12 Noise Pollution	Onsite Workers who are the most exposed to the highest noise levels generated from different construction activities due to their proximity to the noise sources. The impact is short-term and reversible by mitigation measures.	To reduce the noise impacts off-site at the nearest sensitive receptors, include the following: • Communicate the construction schedule with the neighboring sensitive receptors before starting works; • Generators will be located away from sensitive receivers and will be enclosed; • Plant and vehicles shall be started sequentially rather than all together; • Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable; • Use modern vehicles and machinery with standard adaptations to reduce noise and exhaust emissions, and ensure they are maintained to manufacturers' specifications; • Noise-generating equipment must be fitted with silencers. • Optimize the use of noisy construction equipment and turn off any equipment if not in use; • Regular maintenance of all equipment and vehicles; • Stop all construction activities during at night; • Implement a complaints handling system; • Measure noise level according to the environmental monitoring plan. On-site construction noise shall be mitigated to ensure a safe work environment by implementing an on-site occupational health and safety plan, which considers national and international requirements. The plan shall include the following measures: • Ear muffs/protective hearing equipment shall be made available to all workers in noise critical areas • Training on how and when to use protective hearing equipment shall be conducted as part of the workers' induction sessions.	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Place visually clear instructions in areas where noise emissions are significant.		
2.13 Waste Management	Waste generates due to construction activities at construction sites and contractor's camp site which could result in unhygienic conditions, health risk to work force and general public. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• The contractor is required to prepare, implement and maintain a Waste Management Plan approved by PMU throughout construction period; • Ensure proper collection and disposal of solid wastes within the construction camps; • Insist waste separation by source; organic wastes in one pot and inorganic wastes in another pot at household level • The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse; • The contractor will record the quantity in tons and types of waste and materials leaving site during the construction phase; • Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed; • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector; • Dispose organic wastes in a designated safe place on daily basis. At the end of the day cover the organic wastes with a thin layer of sand so that flies, mosquitoes, dogs, cats, rats, are not attracted. • The construction wastewater and kitchen wastewater will be sent out to two settling pits and once settled the water will be used for watering surrounding plantations. • The waste water pit and garbage dumpsite should be totally barricaded; • The project will not develop a project-specific garbage dumpsite. Rather, solid wastes shall be regularly collected and disposed of in disposal sites approved by local authorities.	Contractor	PMSC, IADC, PMU
	Disposal of Surplus Materials	• Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavation material may not be re-used within the proposed works the contractor will endeavor to send material for recovery or recycling so far as is reasonably practicable.	Contractor	PMSC, IADC, PMU
	Use of hazardous substances such as paints, oils and lubricants can cause significant impacts.	• Ensure that safe storage of paint, fuel, other hazardous substances, and bulk materials are agreed on by PMU/Consultant, and have necessary approval/ permit from DOE and local authorities; • Hydrocarbon, toxic materials, and explosives will be stored in adequately protected sites consistent with national and local regulations to prevent soil and water contamination;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Equipment/ vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuels. Such areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency; • The contractor will identify personnel in the WMP/EMP in charge of these sites, and ensure they are properly trained to control access to these areas; entry will be allowed only under authorization; • Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport, and disposal shall not cause pollution and will be undertaken consistent with national and local regulations; • Ensure availability of spill, clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored; • Ensure all storage containers are in good condition with proper labelling and regularly check containers for leakage and undertake necessary repair or replacement; • Discharge of oil-contaminated water will be prohibited; • Used oil and other toxic and hazardous materials will be disposed of in an authorized facility offsite; • Adequate precautions will be taken to prevent oil, lubricant, or hydrocarbon contamination of drainage channel beds; • Spillage, if any, will be immediately cleared with utmost caution to leave no traces; • Spillage waste will be disposed of at disposal sites approved by local authorities and by the Consultant; and • All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities to combat emergency situations complying with all the applicable statutory stipulations.		
2.14 Protection of Flora Resources	A total of 26 tree seedlings will be planted during construction. Inappropriate selection of tree species and plantation location may not ensure the inherent objective of the tree plantation.	• No trees, shrubs or groundcover will be removed, or vegetation stripped without the prior permission of PMU and Consultants; • Afforestation will be done at the ratio of 1 (cut):2 (new planting). A total of 26 sapling trees will be planted as per tree plantation plan developed by KWASA; • Indigenous trees most suited to the tract will be planted; • Early replanting and regular watering of the disturbed areas with local native vegetation should be undertaken to ensure speedy recovery of the cleared vegetation. • The contractor should undertake awareness training for the workers regarding the importance of biodiversity.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Lack of proper care (e.g. watering, securing with fence) by the respective authority will hinder the process of proper growth of the planted trees.	• An awareness campaign targeted on the neighborhood affected persons will be carried to popularize tree planting and saplings should be provided to interested parties.		
2.15 Protection of Fauna	There are no game reserves or wildlife sanctuaries is located along the project area, only disturbance from the visual impacts, vehicles and construction equipment may cause disruption of wildlife activity such as breeding and/or feeding. The project will pose minor negative impact on the fauna present in the project area.	• Setting up and implementation code of conducts to workers, including no catching or hunting fish and wildlife, and no consumption of wildlife products. • While clearing vegetation it must be ensured that no wildlife injure and/or die. • Minimize the release of oil, oil wastes or any other substances harmful to aquatic species to any waters. • New and good condition machinery with minimum noise will be used in construction; • Construction work that may generate high noise levels will not be carried out during night time so that there would be no disturbance to local birds and animals; • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.	Contractor	PMSC, IADC, PMU
2.16 Socio-economic Status	Temporary loss of livelihoods and interruption of social and economic activities.	The contractor will ensure that: • Establish a Grievance Redress Mechanism, and respond to grievances; • Trenchless method shall be used in areas where there are shops or other commercial activities; • The construction works do not interfere with the convenience of the public or access to, use, and occupation of public or private roads, or any other access to properties, whether public or private. • Temporary access to properties adjacent to the construction site will be provided through the construction of ramps with concrete slabs for use of pedestrians and light vehicles; • In critical areas such as institutions, operating hours are factored into work schedules and workforce is increased for speedy completion; • Advance information on works to be undertaken including appropriate signage is provided; • The diversion is done in coordination with the traffic police division for necessary rerouting of traffic and traffic management.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Manpower will be employed from local community during construction and operation stage. Thus, potential impact is positive and long-term.	• Employ at least 50% of labor force from communities in the vicinity of the site. This will have the added benefit of avoiding social problems that sometimes occur when workers are imported, and avoiding environmental and social problems from workers housed in poorly serviced camp accommodation. • Secure construction materials from local market.	Contractor	PMSC, IADC, PMU
	Potential road closures due to construction activities. Hauling of construction materials and operation of equipment on-site can cause traffic problems.	• Formulate and implement the approved Traffic Management Plan. • Prepare alternative transportation routes. The diversion shall be done in coordination with the traffic police division for necessary rerouting of traffic and traffic management; • Consult with business and institutions for work schedules. In critical areas such as schools or hospitals, operating hours are factored into work schedules and workforce is increased for speedy completion; • Period between trench opening and temporary reinstatement should not exceed 48 hours. It is recognized that extraordinary circumstances will occasionally arise, and this period may be extended to 4 days with the approval of the Engineer. Excavations for inspection chambers in roads shall not remain open for longer than 10 days. • Access to or from an individual property is closed for a period of 2 hours or more, the owner shall be informed at least 24 hours in advance; • Inform through display board about nature, duration of construction and contact for complaints; • Schedule material deliveries on low traffic hours; • Restore damaged properties and utilities; • Erect and maintain barricades if required; • Pedestrian access to schools, public libraries, courts, doctor's surgeries, pharmacists, and other premises frequently by the public will be maintained with the use of walking boards. Wheelchair and disabled access shall be maintained. • All surfaced roads shall be subject to road cleaning and unsurfaced roads to dust suppression, the methodology and frequency of which shall be included in the traffic management plan.	Contractor	PMSC, IADC, PMU
2.17 Traffic Control and Safety	Traffic will be disrupted by work in day or night on the busy road.	• Detailed Traffic Management Plans will be prepared before taking up any construction work and submitted to the Engineer for approval, 5 days prior to commencement of work on any section of road. • Contractor should inform the traffic police authority before starting road cutting/excavation. In view of this, dedicated liaison personnel may appoint to communicate with traffic police. • Provide, erect and maintain barricades, signs, markings, flags, lights and flagmen as may be required for the information and protection of traffic.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		The flagmen shall be equipped with red and green flags and lanterns/lights. • Plan and conduct work in such a way that can be completed in 6-8 hours with as little as possible of traffic interruption, so all of this work (and probably most of the daytime work in minor roads) will be conducted by small teams of men, working on short lengths of the network (around 100 - 150 m) at a time. • Construction would seriously hamper the traffic movement specially at the intersection points, thus trenching should be done at night in busy road sections. • Construction equipment and materials shall be removed from the busy roads at the end of night shift. • Where ramps, temporary carriageways and walkways are required, they shall be provided and maintained to a standard suitable in all respects for the class or classes or traffic or pedestrians. These must be kept usable by women, children, patients and disables. • Emergency response plan must be prepared for any traffic accident during construction.		
2.18 Physical and Cultural Heritage	Disturbance/nuisance/noise due to construction activities to the nearby socio-cultural structures such as church, mosques, schools; Accessibility to the socio-cultural sites may be hampered.	• Facilitating access using alternative routes during construction and timely completion of construction work; • Establishment of construction site camp and labor camp maintaining proper distances from the cultural sites; • Affecting dust and noise control measures provided in the EMP.	Contractor	PMSC, IADC, PMU
	Damage to underground archaeological artifacts	• In the event of chance finds, the following measures shall be strictly adopted: o strictly follow the protocol by coordinating immediately with PMU and Bangladesh Department of Archaeology for any suspicion of chance finds during excavation works; o stop work immediately to allow further investigation if any finds are suspected; and o request authorized person from the Bangladesh Department of Archaeology to observe when excavation resumes for the identification of the potential chance find, and comply with further instructions.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
2.19 Occupational Health and Safety	Impact on health of workers, including risk of diseases (malaria, dengue fever, HIV Aids) and physical injury from any form of force majeure.	• All relevant provisions of the Bangladesh Labor Act, 2006 and relevant WHO guidelines will be adhered to, concerning the provision of adequate measures to avoid contracting and/or spreading diseases during construction phase. • Follow international best practices on occupational health and safety such as those in Section 4.2 of World Bank EHS Guidelines on Construction and Decommissioning Activities. • A proper occupational health and safety plan has to be prepared and will have to be followed to avoid health hazard of the workers. • At every workplace, a readily available first aid unit, including an adequate supply of sterilized dressing material and appliances, will be provided as per the factory rules. Suitable transport will be provided to facilitate the transfer of injured or ill persons to the nearest hospital. • At every workplace and construction camp, equipment and nursing staff will be provided. • The contractor will, at his own expense, conform to all disease prevention instructions given to him by the PMSC. • Provide regular health check-ups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce. • The contractor shall provide at cost all labor and materials and construct/install and maintain site safety, hard barricading, flexible green net, signboards, temporary day/light traffic diversions throughout the construction activities according to the specifications and provide Personal Protective Equipment (PPE) to all the laborers working at the construction site. • Launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards. • Make available first aid kits, ambulance facilities, and fire extinguishers in camp sites. • Compensation for the loss of life (a zero tolerance to loss of life policy should be developed and implemented) or for any type of injuries. • Provide insurance to the workers. Health and safety training for all site personnel is very important and must be mandatory.	Contractor	PMSC, IADC, PMU
	Risk of contractors or subcontractors hiring child labor in the construction activities.	National laws on child labor will be strictly followed. No child labor will be allowed by the contractors or subcontractors in any of the project activities.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Insufficient hygiene in the construction camps and sites.	• Any construction of labor camp should be constructed following the standards outlined in the IFC/EBRD Accommodation Guidance Note, including hygienic facilities with proper ablution facilities and waste management. • Provide safe drinking water in sufficient quantity for the workforce at the construction site as well as at the construction camps. • Provide adequate toilets, separate for women and men, at the construction sites, with septic tanks. Sewage management plan for the work camp has to be prepared by the contractor and agreed with the construction supervision. • Provide garbage bins in the camps, empty regularly and the garbage disposed of in a hygienic manner. A waste management plan for the work camp has to be prepared by the contractor and agreed with the PMSC. • Make arrangement for disposal of excreta in accordance with local or national guidelines.	Contractor	PMSC, IADC, PMU
	Health risk of construction workers due to COVID-19.	• Prepare the health and safety guidance for COVID-19 at work sites and get approval of PD; • Strictly follow and implement the H&S guidance for COVID-19 at worksite; • Everyone entering the worksite must wear a mask, gloves and hard shoes. • At the entrance of the worksite/camp site every personnel must wash their hands for 20 second with maintaining a distance of at least 1m (3 ft) from each other; • A designated EHS/Medical person should stay all time during work and ensure physical distances (minimum 1m) among workers, disinfecting surfaces that are commonly used and investigate worker/site personnel health and safety. • Discourage site personnel to gather and gossip at any time, rather encourage physical distance while chatting/discussing. • Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwelling (both camp site and home). • Encourage frequent hand washing and social distancing at campsite. • Ensure personal distance at least 1 meter (3 feet), preferably 2m (6ft) during lunch, dinner and prayer. • Train workers on how to properly put on, use/wear, and take off protective clothing and equipment. Make these trainings mandatory at worksites and provide 10-15 minutes of a workday for such 'training and encouragement' activities.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Health hazard due to encounter of asbestos cement pipes during excavation activities.	• Development and application of a detailed procedure to protect workers and the people surrounding the excavation sites. This should comply with national and/or international standards for handling asbestos, and should include: (a) removal of all persons to a safe distance; (b) usage of appropriate breathing apparatus and protective equipment by persons assigned to handle the AC material; and (c) procedures for the safe removal and long-term disposal of all asbestos- containing material encountered; • Training of all personnel and site workers to enable them to understand the dangers of AC pipes and to be able for them to recognize AC pipes; • If AC pipes encountered are not broken, leave them in-situ as much as possible, and ensure proper protection and precautions are observed in order to avoid breaking the AC pipes during excavation or reinstatement activities; and • Reporting procedures to inform management immediately if AC pipes are encountered.	Contractor	PMSC, IADC, PMU
2.20 Community Health and Safety	Disturbance/ nuisance/ noise due to construction activities, including hauling of construction materials or solid wastes.	• Code of conduct for workers includes restricting workers in designated areas, no open defecation, no littering, no firewood collection, no fire except designated places, no trespassing, no residence at construction sites, and no obligation to potentially dangerous work. • Follow International best practices on community health and safety such as those in Section 4.3 of World Bank Environmental Health and Safety (EHS) Guidelines on Construction and Decommissioning Activities. • Maintain a complaint logbook in worker's camp and take action promptly of complaints. • Plan transportation routes in consultation with KCC, RHD and Police. • Schedule transportation activities by avoiding peak traffic periods. • Clean wheels and undercarriage of haul trucks prior to leaving construction site. • Educate drivers: limit speed between 20-25 km/h in settlements and avoid use of horn. • Earmark parking place for construction equipment and vehicles when idling; no parking shall be allowed on the roads, that may disturb the traffic movement. • Provide prior information to local people about work; • No night time construction activities including material/waste haulage near or within residential areas. Construction activities in these areas must be prohibited from 9pm to 7am. • Noise barriers must be installed in housing areas to reduce the noise level.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Damages to utilities, private properties, and services during construction.	• Immediately inform service providers to any damages to utilities during construction. • Replace (or compensate for) public and private physical structures damaged due to construction or vibration. Compensation and assistance will be provided in accordance with the provisions of the RP. • Provide prior public information about the likely disruption of services.	Contractor	PMSC, IADC, PMU
	Public health and safety issues due to excavation. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Plan activities in consultation with local communities so that activities with greatest potential to generate dust and noise are planned during the days with least disturbance; • Use dust suppression techniques by applying water to minimize dust from vehicle movements; • Coordinate with utility service providers (power lines, water lines, gas etc.) and have a designated point of contact person for coordination requirements and have a representative available on site when utilities interruption is required; • Post warning signs and warning lights near the residential areas. In addition, use safety fences near residential areas, schools and roads; • Avoid excavated soil or debris as well as building materials and sewer pipes on the narrow roads in high densely populated areas.	Contractor	PMSC, IADC, PMU
	Public safety issues due to unauthorized access to working sites.	• Restrict access to the working site, through combination of institutional and administrative controls, like fencing, signage, and communication of risks to the local community, • Remove hazardous conditions on construction sites that cannot be controlled by restricting access, such as covering opening to small confined spaces, and ensuring means of escape, like in case of locked storage of hazardous materials.	Contractor	PMSC, IADC, PMU
2.21 Submission of Environmental Monitoring Report	Unsatisfactory compliance to SEMP.	• Appointment of contractor's supervisor to ensure SEMP implementation. • Timely submission of monitoring reports including photo-log.	Contractor	PMSC, IADC, PMU
2.22 Site Reinstatement	Damage due to debris, spoils, excess construction materials. Potential impacts are negative and long-term but reversible by mitigation measures.	• Remove all spoils wreckage, rubbish, or temporary structures; • All affected structures rehabilitated/compensated; • The area that previously housed the construction worker shed is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up.	Contractor	PMSC, IADC, PMU
3. Operation and Maintenance (O&M) Phase				
3.1 Occupational Health and Safety	Risk of health of workers during operation and	• Ensure routine vaccinations for workers for influenza, tetanus, and Hepatitis "B" (according to Consultations with the institute's physicians). • Workers must be trained to recognize potential hazards, use proper work practices and procedures, recognize adverse health effects, understand	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	maintenance; workers may suffer infectious diseases.	the physical signs and reactions related to exposures, and are familiar with appropriate emergency evacuation procedures. They must also be trained to select and use the appropriate PPE. • Provide all the personal protective equipment like gum boots, nose mask, gloves etc. for the protection of workers. • The workplace will be equipped with fire detectors, alarm systems and fire-fighting equipment. The equipment will be periodically inspected and maintained in good working condition. • Providing adequate personnel facilities, including washing areas and areas to change clothes before and after work. • Medical check-up will be conducted on regular basis and the health conditions will be monitored; • First aid facilities required to attend immediately for meeting emergency situations will be made available at the facility. • Maintaining good housekeeping in waste processing and storage areas. • Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available; • Use PFDs when working near waterways; • Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance; • Use fall protection equipment when working at heights; • Maintain work areas to minimize slipping and tripping • Use proper techniques for trenching and shoring; • Implement fire and explosion prevention measures in accordance with internationally accepted standards;		
	Health issues related to working with electrical equipment and control panels	• Conduct detailed identification and marking of all electrical connections prior to any maintenance work, • Lock out (de-charge and leave open with a controlled locking device) and tag-out (by a warning sign placed on the lock) devices during dismantling and maintenance, • Ensure circuit breaking before starting work on electrical parts, • Use electricity-specific PPE, including insulating clothing, suits, and gloves, • Use specially trained personnel to demount electrical parts.	Contractor	KWASA
	Health issues related to working in confined places.	• Provide safe means of access and egress from confined places, such as stairs and ladders, and safety ropes,	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Avoid operating combustion equipment for prolonged periods unless the area is actively ventilated, • Use special PPE including respirators, protective suits, gloves, and eye protection. • Minimize exposure period to the extent possible.		
	Installing or repairing mains adjacent to roadways, implement procedures and traffic controls.	• Establishment of work zones so as to separate workers from traffic and from equipment as much as possible • Reduction of allowed vehicle speeds in work zones; • Use of high-visibility safety apparel for workers in the vicinity of traffic; • For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists; • Locate all underground utilities before digging.	Contractor	KWASA
	Health and stress issues due to noise in work environment	• Effectively isolating control room against noise; • Avoid exposure to excessive levels beyond permissible limits set out by local and international regulations; • Monitor noise levels frequently (within a SOP), • Use noise hearing protection gear and vibration resistant boots, gloves, and clothing, • Keep records of breaching incidents, and report to the higher management.	Contractor	KWASA
3.2 Community Health and Safety	Community health issues and contamination of environment due to mismanagement of overflows.	• Develop and implement appropriate protocols to reduce risks to safety, public health, and environment that include well-written instructions; • Develop a contingency plan (site-specific); • Response to overflows by preventing, containing, minimizing, the overflow where it is feasible and safe to do so; • Protect Sewage Pumping Station's components from flood damage where it is feasible to do so (by for instance, protecting components from rising flood water to enable reinstating more rapidly.	Contractor	KWASA
	Odor and noise nuisance to adjacent sensitive receptors.	• Apply preventive and corrective maintenance on odor control units, in a frequency applicable to the manufacturer's instructions; • Establish a Standard Operating Procedure (SOP) to include requirements for maintenance, monitoring, and personnel training; • Monitor outdoor odor and noise levels within Sewage Pumping Station boundary, to ensure limits are not exceeded; • Create retrofitting noise controls where practical, like fencing and enclosures; • Keep records of the maintenance logs, local complaints, and analyze trends.	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Public health issues and contamination of environment due to mismanagement of hazardous waste and materials.	• Train operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training, • Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment, • Prepare written Standard Operating Procedures (SOPs) for filling containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response, • Transport and dump waste residues from screens in legal and approved dumpsites, • Make available spill response equipment sufficient to handle at least initial stages of a spill; • Train and educate operational personnel on response activities in the event of spill, release, or chemical emergency; • Provide quality monitoring tests for surface and ground water resources adjacent to project locations.	Contractor	KWASA
3.3 Leakage and Overflows	It may affect the sewer system, contaminate land, water and create public health issues	• Effective operation to avoid and/or immediate clearance of such leaks, blockages; • Implementation of regular O&M schedules.	Contractor	KWASA
3.4 Odor Generation and Air Emission	Odor generation and air emission from Sewage Pumping Station may cause health risk to the worker and community. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Establish close communication with the neighboring areas, establish a complaints handling system and assign a staff member at the Sewage Pumping Station to receive odor complaints. This could be done through posters and the distribution of brochures that illustrate the right to complain, and the contacts information of the responsible staff assigned to supervise the plant. • Apply preventive and corrective maintenance on odor control units, in a frequency applicable to the manufacturer's instructions; • Monitor outdoor odor levels within Sewage Pumping Station boundary, to ensure limits are not exceeded; • Supplied standby generators to Sewage Pumping Station should be checked with suppliers for their emission standards.	Contractor	KWASA
3.5 Acoustic Environment	Noise may generate due to operation of Sewage Pumping Station which will result in heath stress to worker and the	• Plant and maintain a green belt around the site. • Implement a complaints system to investigate any noise complaints from neighboring communities.	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	community. The impact is negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Monitor noise levels within Sewage Pumping Station boundary, to ensure limits are not exceeded; • Create retrofitting noise controls where practical, like fencing and enclosures; • Keep records of the maintenance logs, local complaints, and analyze trends.		
3.6 Handling of Hazardous Wastes (fuels, chemical etc.)	Workers may expose to hydrogen sulfide, methane, carbon monoxide, chloroform, and other chemicals generated during wastewater treatment.	• A waste management plan complying with international best practice and relevant national regulations and covering all types of potentially hazardous wastes shall be developed and implemented by the project's operator. • The waste management plan should also refer to health and safety plan and emergency procedures for containing and managing accidental spillages. • Availability of Material Safety Data Sheets (MSDS) which list the characteristic of the substance and cleansing methods in the event of a spill. • Implement a training program for operators who work with chlorine and ammonia regarding safe handling practices and emergency response procedures; • Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use and maintenance. • Prepare escape plans from areas where there might be a chlorine or ammonia emission; • Install safety showers and eye wash stations near the chlorine and ammonia equipment and other areas where hazardous chemicals are stored or used; • If source water contains radioactive substances, locate water treatment units and water treatment sludge areas as far as possible from common areas (e.g., offices); • Conduct radiation surveys at least annually, especially in areas where radionuclides are removed; • Limit wastes entering the sewer system to those that can be effectively treated in the wastewater treatment facility and reduce the amount of air-strippable hazardous compounds entering the system by controlling industrial discharges (e.g., by permit or similar system). Analyze incoming raw wastewater to identify hazardous constituents; • Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance.	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Use personal gas detection equipment while working in a wastewater facility; • Continuously monitor air quality in work areas for hazardous conditions (e.g. explosive atmosphere, oxygen deficiency); • Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping; • Prohibit eating, smoking, and drinking except in designated areas; • Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.		
3.7 Socio-economic Aspect	Employment generation	KWASA will need to employ additional repair and maintenance crews to manage the new sewer pipelines and keep drainage ditches clear of accumulated debris. The numbers to be employed are not known but will be derived from the local community.	Contractor	KWASA
3.8 Survival Rate of Trees	Survival of trees, maintenance of landscaping, and the greenery.	Proper care will be taken to increase survival rate of saplings, like regular watering, pruning, provision of tree guards, provision of manure for better nourishment, etc., including timely replacement of perished saplings.	Contractor	KWASA

Table 47: Environmental Impacts and Mitigation Measures for Subproject-2 (137.94km of Sewer Network including 5 Sewage Pumping Station)

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
1. Design and Pre-Construction Phase				
1.1 Land Acquisition and Resettlement	Total of 128.49 decimals of land will be required due to construction of Subproject-2 where 2 HHs will be relocated from the selected project sites. The impact is permanent and significant.	• All efforts have been made in Sewage Pumping Station design to reduce land acquisition; • Developing proper and adequate compensation package for affected persons; • Prior to site works, payment of compensation to affected people based on the Resettlement Plan; • Impacts on land and assets due to sewer network will be avoided through routing of alignments within the available ROW. Temporary impacts, if any, within the ROW will be addressed in accordance with the RP.	DC/PMU/PMSC	PMU
1.2 Disruption of Utilities/services	Utility lines along the sewer network will have to be moved disrupting services.	• Provision in the design and budget for the relocation of the existing utility infrastructures, wherever required; • Identify and include locations and operators of these utilities in the detailed design documents to prevent unnecessary disruption of services during construction phase; • Identify and include locations of water/gas pipes, power/telephone lines and any other infrastructure on the way of pipe line and redesign pipe layout to avoid any damage on such infrastructure; • Require construction contractors to prepare a contingency plan to include actions to be taken in case of unintentional interruption of services; • Utilities will only be removed and relocated with proper agency approvals and permission; • Informing all hospitals, schools, places of worship, and affected communities well in advance; • If utilities are damaged during construction, it will be reported to the Consultants and utility authority and repairs will be arranged immediately at the contractor's expense; and • Reconnection of utilities will be completed at the shortest practicable time before construction commences.	Contractor, PMSC	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
1.3 Tree Removal	Around 88 trees will be cut for the construction of Sewage Pumping Station and sewer network under Subproject-2.	• After the finalization of the designs and layout of the project components, the trees within proposed construction areas will be marked; • Trees within the corridor of impact (area required for construction) will be felled after prior approval; • Compensation to be provided for the affected trees based on the unit prices of trees determined by the agriculture/horticulture experts; • Only trees that will require removal within the proposed construction areas of the sites will be cut; and • For trees not proposed to be cut, taking all precautions to protect them from any damage from construction activities.	Contractor/PMSC/PMU	PMU, PMSC
1.4 Consents, Permits, NOCs, Clearances, etc.	Failure to obtain necessary consents, permits, and other appropriate regulatory clearances can result to design revisions and work stoppage.	• Obtain all of the necessary consents, permits, and clearances before the start of civil works. • Acknowledge in writing and provide report on compliance all obtained permits, clearance, NOCs, etc. • Include in detailed design drawings and documents all conditions and provisions if necessary.	Contractor, PMSC	PMU
1.5 Natural Calamities such as flood, cyclone, earthquake etc.	Natural calamities can affect the pumping stations and collection system indirectly creating a hazard to human health.	• Consider potential impacts from extreme climate change scenario in designing the Sewage Pumping Station and sewer main. • Torrential rainfall during the monsoon is also considered for the Sewage Pumping Station. • Sewage Pumping Station are designed by considering the highest flood level (HFL) information of last 25 years and sewer network will be laid at 3 to 5m depth below the ground level.	Design Consultant	PMU
1.6 Road Excavation	Traffic congestion, road accident and dropping of pedestrian in open trenches etc.	• No temporary or permanent works proceed before the design and drawings are approved by the Project Director and road cutting permission obtained from relevant authorities (KCC, RHD) by PMU. • Road cutting plan necessary for the application for road cutting permission from the authorities must be prepared by the contractor. • KWASA should apply for the road cutting permission prior to starting the works and the contractor shall give full effort and cost for collection of road cutting permission for required days. • Contractor has to take all necessary safeguards to avoid accidents at site, prevent loss/damage to all existing utilities like pipelines, telephone/electric cables, poles etc. and any government or private property during the contract period. • The contractor shall prepare a traffic management plan (road closure program or diversions) and incorporate detail of traffic diversions and pedestrian routes, all traffic signs (for the regulation and for information) and road markings shall be ensured prior to start of road cutting.	Contractor, PMSC	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
1.7 Traffic Management Plan	Minimize traffic disruption and congestion.	Contractor shall conduct traffic impact assessments to plan traffic management to minimize disturbance of vehicular traffic and pedestrians. Access arrangements for vehicles accessing the project area will be formulated such that this will avoid community disturbance and severance, and the plan will include consideration of the following: • Lane availability and minimizing interference with traffic flows past the work site; • Establishment of acceptable working hours and constraints; • Agreement on time scale and establishment of traffic flow/delay requirements; • Programming issues, including the time of year and available resources; • Discussion of the PMSC's inspection/monitoring role; • Establishment of complaints management system for the duration of the work.	Contractor, PMSC	PMU
1.8 Updating of IEE and SEMP	Expecting minor impacts, during construction period only and mitigation measures are addressed.	• Update IEE based on detailed designs, and submitted to ADB for review, approval, and disclosure prior to commencement of work. • Formulate SEMP during implementation and get approval from the PD. • Relevant information shall be disclosed.	Contractor, PMSC	PMSC, PMU
1.9 Community Awareness Program	Without proper interaction with local communities and or with stakeholders may lead to confusion and agitation and non-cooperation of local people.	Before the start of the project, the local population should be well aware of the upcoming project. There should be regular interaction with the local population and make them understand the project activities.	Contractor	PMSC, PMU
1.10 EMP Implementation Training	Irreversible impact to the environment, workers, and community.	Project manager and all key workers of contractors will be required to undergo EMP implementation training including spoils management, Standard operating procedures (SOP) for construction works; health and safety (H&S), core labor laws, applicable environmental laws etc.	Contractor, PMSC	PMU
2. During Construction Phase				
2.1 Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding	• A materials management plan (MMP) will be produced to minimize the use of non-renewable resources and rock-based materials. The MMP will be approved by the engineer and revised as required by the Engineer. • Prioritize sites which already permitted by the authority. • If other sites are necessary, it is contractor's responsibility to verify the suitability of all material sources and to obtain the approval of PMU and consultants.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	and water logging, and water pollution.	• If additional quarries will require after construction is started, construction contractor to obtain a written approval from PMU. • Maintain a construction material register at the site.		
2.2 Construction Camps, Stockpile Areas and Storage Sites	Conflicts with local community; disruption to traffic flow and sensitive receptors.	• Submit to the PMU for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps; • Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view; • Shall not be located in productive agricultural lands, water bodies, natural drainage channels, flood plains and groundwater recharge areas, forests, vegetative lands, etc.; • For private lands, obtain land owner's written consent; indicate the requirement for reinstatement to original; • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters; • Locate at sites that will not promote instability, flooding and result in destruction of natural drainage, vegetation, irrigation, & drinking water supply; • Locate the garbage pit/waste disposal site min 500 m away from the residence so that peoples are not disturbed with the odor likely to be produced from anaerobic decomposition of wastes at the waste dumping places. Encompass the waste dumping place by fencing and tree plantation to prevent children to enter and play with. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. • Provide appropriate security personnel (police / home guard or private security guards) and enclosures to prevent unauthorized entry in to the camp area. Maintain register to keep a track on a head count of persons present in the camp at any given time. • Provide medical facility and appropriate type of fire-fighting equipment suitable for the construction camps; • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
2.3 Landscape and Visual	The presence of heavy duty vehicles and equipment, temporary structures at construction camps, stockpiles, may result in impacts on aesthetics and landscape character; and Visual changes to topography.	• Properly fence off storage areas. • Collect all domestic solid waste and dump at designated disposal site. • Contractor to exercise strict care in disposing construction waste. • Reinstated vegetation shall be undertaken by a suitably qualified landscape contractor, and their contract will include two-year aftercare. • Construction activity shall be conducted sequentially at different working areas in the city; • Ensure effective pedestrian and traffic management to minimize inconvenience and ensure access is maintained as appropriate.	Contractor	PMSC, IADC, PMU
2.4 Road Excavation Works	Potential erosion, dust generation, traffic congestion, road accident, dropping pedestrians in open trench etc. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• All excavations shall be done to the minimum dimension as required for safety and working facility. • The excavation shall be executed in such manner, that the contractor does not damage or interfere with existing services or structures. If damage or interference is so caused the contractor shall make arrangements with the supply and/or building owner to execute the repairs at the contractor's own cost. • All trench and pit excavations and other work shall be carried out during night time at busy road section. • Road drains and channels shall be kept free from obstructions at all times. • In case of excavation in large roads, the trenches and pits maybe need to be covered by steel plates to allow traffic to pass during non-working periods. • The contractor must liaise with KWASA and the responsible police to familiarize themselves and adhere to such rules. • Trench excavation along roads be located in footpaths or adjacent to the road. Trench excavation shall wherever practicable be carried out in such a way that every part of the excavation is at least 0.5m clear of existing edges of the carriage way. • The contractor shall have particular regard to the safety of pedestrian, livestock, and shall ensure that all open excavation, access routes and steep or loose slopes arising from the contractor's operations are adequately fenced and protected.	Contractor	PMSC, IADC, PMU
	Damage to underground archaeological artifacts	• In the event of a chance find, the following measures shall be strictly adopted: o strictly follow the protocol by coordinating immediately with PMU and Bangladesh Department of Archaeology for any suspicion of chance finds during excavation works;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		○ stop work immediately to allow further investigation if any finds are suspected; and • request authorized person from the Bangladesh Department of Archaeology to observe when excavation resumes for the identification of the potential chance find, and comply with further instructions.		
2.5 Trenchless Pipe Installation	Noise generated due to HDD may affect the neighboring communities and other sensitive receptors (such as students at schools and other educational institutes, patients at hospitals etc.). Bentonite slurry spilled out to the watercourses may contaminate the adjacent surface water.	• Pipes shall be installed by the horizontal directional drilling (HDD) methods where required. If the method is not feasible for any road, the contractor shall inform the Project Manager and gain prior approval for an alternative method or for open trench method. • Excavation material shall be removed from the conduit as the work progresses. No accumulation of excavated material within the conduit will be permitted. • The contractor shall provide sediment and erosion control measures in accordance with local environmental legislation. • The contractor shall supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Spent drilling fluids and cuttings shall be confined to the entrance and exit pits. • The contractor shall take all necessary precautions to minimize the damage to the adjacent properties. The contractor shall take all necessary precautions to minimize the damage to the adjacent properties. • Drilling fluid/ bentonite slurry that enters the pipe shall be removed by flushing or other suitable methods. Sediment tanks of sufficient capacity, constructed from pre-formed individual cells of approximately 6-8m3 capacities shall be used for settling waste-waters prior to disposal. • The contractor shall be responsible for cleanup and restoration of the site. • Pits excavated to permit connection of bored pipe shall be backfilled, and disturbed areas shall be restored to their original state or better. Sections of sidewalks, curbs, and gutters or other permanent improvements damaged during HDD operations shall be repaired or replaced at the contractor's expense.	Contractor	PMSC, IADC, PMU
2.6 Laying of Pipeline near Waterbodies	Sewer pipeline will cross several water bodies which may cause siltation and reduction in the quality of adjacent bodies of water. Degradation of water flow.	• Trenching and backfilling operations at the canal crossings/stream crossings will be carried out in the lean seasons, when the flow will be minimum, and disruption will also be minimum. • In case of crossings at existing minor bridges and culverts, the Contractor will ensure that there is no impact/disturbance to the bridges/culverts due to crossing of the water pipelines. • Silt fencing to be provided at all water bodies near canal and streams.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Do not disturb the water body except the actual work area; no equipment, machinery shall be operated outside the work area; • Avoid use of fuels, chemicals & lubricants; ensure no spillage; • Clean up the area after the completion & prior to the onset of monsoon flow.		
2.7 Surface Water Quality	Soil erosion from trenching and excavation, run-off from stockpiled materials Chemicals such as fuels and lubricants may pollute runoff during rainfall, which may cause pollution of adjacent bodies of water. Bentonite slurry used in trenchless pipe installation may contaminate the adjacent watercourse. Effluent from labor camp sites and constructions sites may pollute surface waters.	• Provision of temporary sedimentation canal and/or silt traps along construction areas, particularly alignments that are adjacent to receiving bodies of water or canals. • The measures to address soil erosion at the proposed facilities will consist of measures as per design, or as directed by the PMSC to control soil erosion, sedimentation, and water pollution. All temporary sedimentation, pollution control works, and maintenance thereof will be deemed incidental to the earthwork or other items of work. • All temporary discharge points shall be located, designed and constructed in a manner that will minimize erosion in the receiving channels. • Ensure proper compaction of refilled soil and there shall not be any loose soil particles on the top; the material shall be refilled in layers and compacted properly layer by layer. • Use surplus soil for beneficial purposes such as in any other construction activities, or to raise the level of low lying areas. • Avoid scheduling of excavation work during the monsoon season. Earthworks during dry season. • Confine construction area including the material storage (sand and aggregate) so that runoff from upland areas will not enter the site. • Ensure that drains are not blocked with excavated soil • Stockyards at least 50 meters (m) away from watercourses. • Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%. • No obstruction in flowing water. • For effluents from work place, camps, and offices, provide treatment arrangements such as retention ponds and septic tanks which should be incorporated in the facility designs. A sewage management plan has to be prepared by the contractor and agreed with the PMSC. • Monitor water quality according to the environmental management plan.	Contractor through a nationally recognized laboratory	PMSC, IADC, PMU
2.8 Groundwater Quality	Uncontrolled extraction of water may affect availability of water to locals.	• Prevent pollutants from contaminating the soil and the ground water. • All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned; • Storage of lubricants and fuel at least 50 m from water bodies	Contractor through a nationally recognized laboratory	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Contamination of ground water from construction related sources such a fuel and liquid wastes.	• Storage of fuel and lubricants in double hulled tanks. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%. • Daily control of machinery and vehicles for leakages • Collection of waste during construction activities • Provide uncontaminated water for dust suppression • Enclose the construction area to prevent unauthorized access.		
2.9 Soil Erosion and Sediment Mobilization	The construction activities may cause serious soil degradation problems in the areas of Sewage Pumping Station and alignment of pipeline etc.	• The Contractor shall plan his works to minimize surface excavation works during the rainy season where practicable. • Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and actions to be taken during or after rainstorms shall be developed by the Contractor. • The earthwork sites where exposed land surface is vulnerable to runoff shall be consolidated and/or covered. • Channels, earth bunds, netting, tarpaulin and or sand bag barriers shall be used on site to manage surface water runoff and minimize erosion. • The overall slope of the works areas and construction yards shall be kept to a minimum to reduce the erosive potential of surface water flows. • Monitor groundwater quality that could exist close to the working areas to ensure compliance.	Contractor	PMSC, IADC, PMU
2.10 Drainage Congestion	Construction material getting into surface run off or uncontrolled disposal may cause temporary drainage congestion.	• Prepare a program for prevent/avoid standing waters, which PMSC will verify in advance and confirm during implementation; • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line; • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem. Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there; • Wastes and construction debris will not be disposed in a manner that these would end up in drainage canals. • Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning;	Contractor	PMSC, IADC, PMU
2.11 Air and Dust Pollution	Dust from construction related traffic and machinery. Dust from works, carrying machinery equipment to the	• Take every precaution to reduce the levels of dust at construction sites, and not exceeding the pre-project ambient air quality standards. • Fit all heavy equipment and machinery with air pollution control devices that are operating correctly. • Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust. • Reduce dust by spraying stockpiled soil, excavated materials, and spoils.	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	site, and roads due to vehicle movements Air pollution generated from exhaust/emissions of engines. The impacts are negative but short-term, impacts within a relatively small area and reversible by mitigation measures.	• Cover with tarpaulin vehicles transporting soil and sand. • Cover stockpiled construction materials with tarpaulin or plastic sheets. • Trenching and transport vehicles shall move only in designated areas and roads. • Water spraying to access roads, camp sites and work sites to reduce dust emissions. • Machines and vehicles must be regularly examined and maintained to comply with requirements of technical specifications. • All vehicles, equipment, and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of DOE. Copies of conformance will be submitted regularly to the PMSC. • Repair and maintain access roads, as necessary. • Monitor air quality according to the environmental monitoring plan.		
2.12 Noise Pollution	Onsite Workers who are the most exposed to the highest noise levels generated from different construction activities due to their proximity to the noise sources. The impact is short-term and reversible by mitigation measures.	To reduce the noise impacts off-site at the nearest sensitive receptors, include the following: • Communicate the construction schedule with the neighboring sensitive receptors before starting works; • Generators will be located away from sensitive receivers and will be enclosed; • Plant and vehicles shall be started sequentially rather than all together; • Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable; • Use modern vehicles and machinery with standard adaptations to reduce noise and exhaust emissions, and ensure they are maintained to manufacturers' specifications; • Noise-generating equipment must be fitted with silencers. • Optimize the use of noisy construction equipment and turn off any equipment if not in use; • Regular maintenance of all equipment and vehicles; • Stop all construction activities during at night; • Implement a complaints handling system; • Measure noise level according to the environmental monitoring plan. On-site construction noise shall be mitigated to ensure a safe work environment by implementing an on-site occupational health and safety plan, which considers national and international requirements. The plan shall include the following measures: • Ear muffs/protective hearing equipment shall be made available to all workers in noise critical areas	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Training on how and when to use protective hearing equipment shall be conducted as part of the workers' induction sessions. • Place visually clear instructions in areas where noise emissions are significant.		
2.13 Waste Management	Waste generates due to construction activities at construction sites and contractor's camp site which could result in unhygienic conditions, health risk to work force and general public. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• The contractor is required to prepare, implement and maintain a Waste Management Plan approved by PMU throughout construction period; • Ensure proper collection and disposal of solid wastes within the construction camps; • Insist waste separation by source; organic wastes in one pot and inorganic wastes in another pot at household level • The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse; • The contractor will record the quantity in tons and types of waste and materials leaving site during the construction phase; • Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed; • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector; • Dispose organic wastes in a designated safe place on daily basis. At the end of the day cover the organic wastes with a thin layer of sand so that flies, mosquitoes, dogs, cats, rats, are not attracted. • The construction wastewater and kitchen wastewater will be sent out to two settling pits and once settled the water will be used for watering surrounding plantations. • The waste water pit and garbage dumpsite should be totally barricaded; • The project will not develop a project-specific garbage dumpsite. Rather, solid wastes shall be regularly collected and disposed of in disposal sites approved by local authorities.	Contractor	PMSC, IADC, PMU
	Disposal of Surplus Materials	• Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavation material may not be re-used within the proposed works the contractor will endeavor to send material for recovery or recycling so far as is reasonably practicable.	Contractor	PMSC, IADC, PMU
	Use of hazardous substances such as paints, oils and lubricants can cause significant impacts.	• Ensure that safe storage of paint, fuel, other hazardous substances, and bulk materials are agreed on by PMU/Consultant, and have necessary approval/ permit from DOE and local authorities;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Hydrocarbon, toxic materials, and explosives will be stored in adequately protected sites consistent with national and local regulations to prevent soil and water contamination; • Equipment/ vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuels. Such areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency; • The contractor will identify personnel in the WMP/EMP in charge of these sites, and ensure they are properly trained to control access to these areas; entry will be allowed only under authorization; • Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport, and disposal shall not cause pollution and will be undertaken consistent with national and local regulations; • Ensure availability of spill, clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored; • Ensure all storage containers are in good condition with proper labelling and regularly check containers for leakage and undertake necessary repair or replacement; • Discharge of oil-contaminated water will be prohibited; • Used oil and other toxic and hazardous materials will be disposed of in an authorized facility offsite; • Adequate precautions will be taken to prevent oil, lubricant, or hydrocarbon contamination of drainage channel beds; • Spillage, if any, will be immediately cleared with utmost caution to leave no traces; • Spillage waste will be disposed of at disposal sites approved by local authorities and by the Consultant; and • All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities to combat emergency situations complying with all the applicable statutory stipulations.		
2.14 Protection of Flora Resources	A total of 176 tree seedlings will be planted during construction. Inappropriate selection of tree species and plantation location may not ensure the	• No trees, shrubs or groundcover will be removed, or vegetation stripped without the prior permission of PMU and Consultants; • Afforestation will be done at the ratio of 1 (cut):2(new planting). A total of 176 sapling trees will be planted as per tree plantation plan developed by KWASA; • Indigenous trees most suited to the tract will be planted;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	inherent objective of the tree plantation. Lack of proper care (e.g. watering, securing with fence) by the respective authority will hinder the process of proper growth of the planted trees.	• Early replanting and regular watering of the disturbed areas with local native vegetation should be undertaken to ensure speedy recovery of the cleared vegetation. • The contractor should undertake awareness training for the workers regarding the importance of biodiversity. • An awareness campaign targeted on the neighborhood affected persons will be carried to popularize tree planting and saplings should be provided to interested parties.		
2.15 Protection of Fauna	There are no game reserves or wildlife sanctuaries is located along the project area, only disturbance from the visual impacts, vehicles and construction equipment may cause disruption of wildlife activity such as breeding and/or feeding. The project will pose minor negative impact on the fauna present in the project area.	• Setting up and implementation code of conducts to workers, including no catching or hunting fish and wildlife, and no consumption of wildlife products. • While clearing vegetation it must be ensured that no wildlife injure and/or die. • Minimize the release of oil, oil wastes or any other substances harmful to aquatic species to any waters. • New and good condition machinery with minimum noise will be used in construction; • Construction work that may generate high noise levels will not be carried out during night time so that there would be no disturbance to local birds and animals; • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.	Contractor	PMSC, IADC, PMU
2.16 Socio-economic Status	Temporary loss of livelihoods and interruption of social and economic activities.	The contractor will ensure that: • Establish a Grievance Redress Mechanism, and respond to grievances; • Trenchless method shall be used in areas where there are shops or other commercial activities; • The construction works do not interfere with the convenience of the public or access to, use, and occupation of public or private roads, or any other access to properties, whether public or private. • Temporary access to properties adjacent to the construction site will be provided through the construction of ramps with concrete slabs for use of pedestrians and light vehicles; • In critical areas such as institutions, operating hours are factored into work schedules and workforce is increased for speedy completion; • Advance information on works to be undertaken including appropriate signage is provided;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• The diversion is done in coordination with the traffic police division for necessary rerouting of traffic and traffic management.		
	Manpower will be employed from local community during construction and operation stage. Thus, potential impact is positive and long-term.	• Employ at least 50% of labor force from communities in the vicinity of the site. This will have the added benefit of avoiding social problems that sometimes occur when workers are imported, and avoiding environmental and social problems from workers housed in poorly serviced camp accommodation. • Secure construction materials from local market.	Contractor	PMSC, IADC, PMU
	Potential road closures due to construction activities. Hauling of construction materials and operation of equipment on-site can cause traffic problems.	• Formulate and implement the approved Traffic Management Plan. • Prepare alternative transportation routes. The diversion shall be done in coordination with the traffic police division for necessary rerouting of traffic and traffic management; • Consult with business and institutions for work schedules. In critical areas such as schools or hospitals, operating hours are factored into work schedules and workforce is increased for speedy completion; • Period between trench opening and temporary reinstatement should not exceed 48 hours. It is recognized that extraordinary circumstances will occasionally arise, and this period may be extended to 4 days with the approval of the Engineer. Excavations for inspection chambers in roads shall not remain open for longer than 10 days. • Access to or from an individual property is closed for a period of 2 hours or more, the owner shall be informed at least 24 hours in advance; • Inform through display board about nature, duration of construction and contact for complaints; • Schedule material deliveries on low traffic hours; • Restore damaged properties and utilities; • Erect and maintain barricades if required; • Pedestrian access to schools, public libraries, courts, doctor's surgeries, pharmacists, and other premises frequently by the public will be maintained with the use of walking boards. Wheelchair and disabled access shall be maintained. • All surfaced roads shall be subject to road cleaning and unsurfaced roads to dust suppression, the methodology and frequency of which shall be included in the traffic management plan.	Contractor	PMSC, IADC, PMU
2.17 Traffic Control and Safety	Traffic will be disrupted by work in day or night on the busy road.	• Detailed Traffic Management Plans will be prepared before taking up any construction work and submitted to the Engineer for approval, 5 days prior to commencement of work on any section of road. • Contractor should inform the traffic police authority before starting road cutting/excavation. In view of this, dedicated liaison personnel may appoint to communicate with traffic police.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Provide, erect and maintain barricades, signs, markings, flags, lights and flagmen as may be required for the information and protection of traffic. The flagmen shall be equipped with red and green flags and lanterns/lights. • Plan and conduct work in such a way that can be completed in 6-8 hours with as little as possible of traffic interruption, so all of this work (and probably most of the daytime work in minor roads) will be conducted by small teams of men, working on short lengths of the network (around 100 - 150 m) at a time. • Construction would seriously hamper the traffic movement specially at the intersection points, thus trenching should be done at night in busy road sections. • Construction equipment and materials shall be removed from the busy roads at the end of night shift. • Where ramps, temporary carriageways and walkways are required, they shall be provided and maintained to a standard suitable in all respects for the class or classes or traffic or pedestrians. These must be kept usable by women, children, patients and disables. • Emergency response plan must be prepared for any traffic accident during construction.		
2.18 Physical and Cultural Heritage	Disturbance/nuisance/noise due to construction activities to the nearby socio-cultural structures such as church, mosques, schools; Accessibility to the socio-cultural sites may be hampered.	• Facilitating access using alternative routes during construction and timely completion of construction work; • Establishment of construction site camp and labor camp maintaining proper distances from the cultural sites; • Affecting dust and noise control measures provided in the EMP.	Contractor	PMSC, IADC, PMU
	Damage to underground archaeological artifacts	• In the event of chance finds, the following measures shall be strictly adopted: o strictly follow the protocol by coordinating immediately with PMU and Bangladesh Department of Archaeology for any suspicion of chance finds during excavation works; o stop work immediately to allow further investigation if any finds are suspected; and o request authorized person from the Bangladesh Department of Archaeology to observe when excavation resumes for the	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		identification of the potential chance find, and comply with further instructions.		
2.19 Occupational Health and Safety	Impact on health of workers, including risk of diseases (malaria, dengue fever, HIV Aids) and physical injury from any form of force majeure.	• All relevant provisions of the Bangladesh Labor Act, 2006 and relevant WHO guidelines will be adhered to, concerning the provision of adequate measures to avoid contracting and/or spreading diseases during construction phase. • Follow international best practices on occupational health and safety such as those in Section 4.2 of World Bank EHS Guidelines on Construction and Decommissioning Activities. • A proper occupational health and safety plan has to be prepared and will have to be followed to avoid health hazard of the workers. • At every workplace, a readily available first aid unit, including an adequate supply of sterilized dressing material and appliances, will be provided as per the factory rules. Suitable transport will be provided to facilitate the transfer of injured or ill persons to the nearest hospital. • At every workplace and construction camp, equipment and nursing staff will be provided. • The contractor will, at his own expense, conform to all disease prevention instructions given to him by the PMSC. • Provide regular health check-ups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce. • The contractor shall provide at cost all labor and materials and construct/install and maintain site safety, hard barricading, flexible green net, signboards, temporary day/light traffic diversions throughout the construction activities according to the specifications and provide Personal Protective Equipment (PPE) to all the laborers working at the construction site. • Launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards. • Make available first aid kits, ambulance facilities, and fire extinguishers in camp sites. • Compensation for the loss of life (a zero tolerance to loss of life policy should be developed and implemented) or for any type of injuries. • Provide insurance to the workers. Health and safety training for all site personnel is very important and must be mandatory.	Contractor	PMSC, IADC, PMU
	Risk of contractors or subcontractors hiring child	National laws on child labor will be strictly followed. No child labor will be allowed by the contractors or subcontractors in any of the project activities.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	labor in the construction activities.			
	Insufficient hygiene in the construction camps and sites.	• Any construction of labor camp should be constructed following the standards outlined in the IFC/EBRD Accommodation Guidance Note, including hygienic facilities with proper ablution facilities and waste management. • Provide safe drinking water in sufficient quantity for the workforce at the construction site as well as at the construction camps. • Provide adequate toilets, separate for women and men, at the construction sites, with septic tanks. Sewage management plan for the work camp has to be prepared by the contractor and agreed with the construction supervision. • Provide garbage bins in the camps, empty regularly and the garbage disposed of in a hygienic manner. A waste management plan for the work camp has to be prepared by the contractor and agreed with the PMSC. • Make arrangement for disposal of excreta in accordance with local or national guidelines.	Contractor	PMSC, IADC, PMU
	Health risk of construction workers due to COVID-19.	• Prepare the health and safety guidance for COVID-19 at work sites and get approval of PD; • Strictly follow and implement the H&S guidance for COVID-19 at worksite; • Everyone entering the worksite must wear a mask, gloves and hard shoes. • At the entrance of the worksite/camp site every personnel must wash their hands for 20 second with maintaining a distance of at least 1m (3 ft) from each other; • A designated EHS/Medical person should stay all time during work and ensure physical distances (minimum 1m) among workers, disinfecting surfaces that are commonly used and investigate worker/site personnel health and safety. • Discourage site personnel to gather and gossip at any time, rather encourage physical distance while chatting/discussing. • Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwelling (both camp site and home). • Encourage frequent hand washing and social distancing at campsite. • Ensure personal distance at least 1 meter (3 feet), preferably 2m (6ft) during lunch, dinner and prayer. • Train workers on how to properly put on, use/wear, and take off protective clothing and equipment. Make these trainings mandatory at worksites	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		and provide 10-15 minutes of a workday for such 'training and encouragement' activities.		
	Health hazard due to encounter of asbestos cement pipes during excavation activities.	• Development and application of a detailed procedure to protect workers and the people surrounding the excavation sites. This should comply with national and/or international standards for handling asbestos, and should include: (a) removal of all persons to a safe distance; (b) usage of appropriate breathing apparatus and protective equipment by persons assigned to handle the AC material; and (c) procedures for the safe removal and long-term disposal of all asbestos- containing material encountered; • Training of all personnel and site workers to enable them to understand the dangers of AC pipes and to be able for them to recognize AC pipes; • If AC pipes encountered are not broken, leave them in-situ as much as possible, and ensure proper protection and precautions are observed in order to avoid breaking the AC pipes during excavation or reinstatement activities; and • Reporting procedures to inform management immediately if AC pipes are encountered.	Contractor	PMSC, IADC, PMU
2.20 Community Health and Safety	Disturbance/ nuisance/ noise due to construction activities, including hauling of construction materials or solid wastes.	• Code of conduct for workers includes restricting workers in designated areas, no open defecation, no littering, no firewood collection, no fire except designated places, no trespassing, no residence at construction sites, and no obligation to potentially dangerous work. • Follow International best practices on community health and safety such as those in Section 4.3 of World Bank Environmental Health and Safety (EHS) Guidelines on Construction and Decommissioning Activities. • Maintain a complaint logbook in worker's camp and take action promptly of complaints. • Plan transportation routes in consultation with KCC, RHD and Police. • Schedule transportation activities by avoiding peak traffic periods. • Clean wheels and undercarriage of haul trucks prior to leaving construction site. • Educate drivers: limit speed between 20-25 km/h in settlements and avoid use of horn. • Earmark parking place for construction equipment and vehicles when idling; no parking shall be allowed on the roads, that may disturb the traffic movement. • Provide prior information to local people about work; • No night time construction activities including material/waste haulage near or within residential areas. Construction activities in these areas must be prohibited from 9pm to 7am.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Noise barriers must be installed in housing areas to reduce the noise level.		
	Damages to utilities, private properties, and services during construction.	• Immediately inform service providers to any damages to utilities during construction. • Replace (or compensate for) public and private physical structures damaged due to construction or vibration. Compensation and assistance will be provided in accordance with the provisions of the RP. • Provide prior public information about the likely disruption of services.	Contractor	PMSC, IADC, PMU
	Public health and safety issues due to excavation. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Plan activities in consultation with local communities so that activities with greatest potential to generate dust and noise are planned during the days with least disturbance; • Use dust suppression techniques by applying water to minimize dust from vehicle movements; • Coordinate with utility service providers (power lines, water lines, gas etc.) and have a designated point of contact person for coordination requirements and have a representative available on site when utilities interruption is required; • Post warning signs and warning lights near the residential areas. In addition, use safety fences near residential areas, schools and roads; • Avoid excavated soil or debris as well as building materials and sewer pipes on the narrow roads in high densely populated areas.	Contractor	PMSC, IADC, PMU
	Public safety issues due to unauthorized access to working sites.	• Restrict access to the working site, through combination of institutional and administrative controls, like fencing, signage, and communication of risks to the local community, • Remove hazardous conditions on construction sites that cannot be controlled by restricting access, such as covering opening to small confined spaces, and ensuring means of escape, like in case of locked storage of hazardous materials.	Contractor	PMSC, IADC, PMU
2.21 Submission of Environmental Monitoring Report	Unsatisfactory compliance to SEMP.	• Appointment of contractor's supervisor to ensure SEMP implementation. • Timely submission of monitoring reports including photo-log.	Contractor	PMSC, IADC, PMU
2.22 Site Reinstatement	Damage due to debris, spoils, excess construction materials. Potential impacts are negative and long-term but reversible by mitigation measures.	• Remove all spoils wreckage, rubbish, or temporary structures; • All affected structures rehabilitated/compensated; • The area that previously housed the construction worker shed is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up.	Contractor	PMSC, IADC, PMU
3. Operation and Maintenance (O&M) Phase				

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
3.1 Occupational Health and Safety	Risk of health of workers during operation and maintenance; workers may suffer infectious diseases.	• Ensure routine vaccinations for workers for influenza, tetanus, and Hepatitis "B" (according to Consultations with the institute's physicians). • Workers must be trained to recognize potential hazards, use proper work practices and procedures, recognize adverse health effects, understand the physical signs and reactions related to exposures, and are familiar with appropriate emergency evacuation procedures. They must also be trained to select and use the appropriate PPE. • Provide all the personal protective equipment like gum boots, nose mask, gloves etc. for the protection of workers. • The workplace will be equipped with fire detectors, alarm systems and fire-fighting equipment. The equipment will be periodically inspected and maintained in good working condition. • Providing adequate personnel facilities, including washing areas and areas to change clothes before and after work. • Medical check-up will be conducted on regular basis and the health conditions will be monitored; • First aid facilities required to attend immediately for meeting emergency situations will be made available at the facility. • Maintaining good housekeeping in waste processing and storage areas. • Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available; • Use PFDs when working near waterways; • Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance; • Use fall protection equipment when working at heights; • Maintain work areas to minimize slipping and tripping • Use proper techniques for trenching and shoring; • Implement fire and explosion prevention measures in accordance with internationally accepted standards;	Contractor	KWASA
	Health issues related to working with electrical equipment and control panels	• Conduct detailed identification and marking of all electrical connections prior to any maintenance work, • Lock out (de-charge and leave open with a controlled locking device) and tag-out (by a warning sign placed on the lock) devices during dismantling and maintenance, • Ensure circuit breaking before starting work on electrical parts, • Use electricity-specific PPE, including insulating clothing, suits, and gloves,	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Use specially trained personnel to demount electrical parts.		
	Health issues related to working in confined places.	• Provide safe means of access and egress from confined places, such as stairs and ladders, and safety ropes, • Avoid operating combustion equipment for prolonged periods unless the area is actively ventilated, • Use special PPE including respirators, protective suits, gloves, and eye protection. • Minimize exposure period to the extent possible.	Contractor	KWASA
	Installing or repairing mains adjacent to roadways, implement procedures and traffic controls.	• Establishment of work zones so as to separate workers from traffic and from equipment as much as possible • Reduction of allowed vehicle speeds in work zones; • Use of high-visibility safety apparel for workers in the vicinity of traffic; • For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists; • Locate all underground utilities before digging.	Contractor	KWASA
	Health and stress issues due to noise in work environment	• Effectively isolating control room against noise; • Avoid exposure to excessive levels beyond permissible limits set out by local and international regulations; • Monitor noise levels frequently (within a SOP), • Use noise hearing protection gear and vibration resistant boots, gloves, and clothing, • Keep records of breaching incidents, and report to the higher management.	Contractor	KWASA
3.2 Community Health and Safety	Community health issues and contamination of environment due to mismanagement of overflows.	• Develop and implement appropriate protocols to reduce risks to safety, public health, and environment that include well-written instructions; • Develop a contingency plan (site-specific); • Response to overflows by preventing, containing, minimizing, the overflow where it is feasible and safe to do so; • Protect Sewage Pumping Station's components from flood damage where it is feasible to do so (by for instance, protecting components from rising flood water to enable reinstating more rapidly.	Contractor	KWASA
	Odor and noise nuisance to adjacent sensitive receptors.	• Apply preventive and corrective maintenance on odor control units, in a frequency applicable to the manufacturer's instructions; • Establish a Standard Operating Procedure (SOP) to include requirements for maintenance, monitoring, and personnel training; • Monitor outdoor odor and noise levels within Sewage Pumping Station boundary, to ensure limits are not exceeded; • Create retrofitting noise controls where practical, like fencing and enclosures;	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Keep records of the maintenance logs, local complaints, and analyze trends.		
	Public health issues and contamination of environment due to mismanagement of hazardous waste and materials.	• Train operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training, • Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment, • Prepare written Standard Operating Procedures (SOPs) for filling containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response, • Transport and dump waste residues from screens in legal and approved dumpsites, • Make available spill response equipment sufficient to handle at least initial stages of a spill; • Train and educate operational personnel on response activities in the event of spill, release, or chemical emergency; • Provide quality monitoring tests for surface and ground water resources adjacent to project locations.	Contractor	KWASA
3.3 Leakage and Overflows	It may affect the sewer system, contaminate land, water and create public health issues	• Effective operation to avoid and/or immediate clearance of such leaks, blockages; • Implementation of regular O&M schedules.	Contractor	KWASA
3.4 Odor Generation and Air Emission	Odor generation and air emission from Sewage Pumping Station may cause health risk to the worker and community. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Establish close communication with the neighboring areas, establish a complaints handling system and assign a staff member at the Sewage Pumping Station to receive odor complaints. This could be done through posters and the distribution of brochures that illustrate the right to complain, and the contacts information of the responsible staff assigned to supervise the plant. • Apply preventive and corrective maintenance on odor control units, in a frequency applicable to the manufacturer's instructions; • Monitor outdoor odor levels within Sewage Pumping Station boundary, to ensure limits are not exceeded; • Supplied standby generators to Sewage Pumping Station should be checked with suppliers for their emission standards.	Contractor	KWASA
3.5 Acoustic Environment	Noise may generate due to operation of Sewage Pumping	• Plant and maintain a green belt around the site.	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Station which will result in heath stress to worker and the community. The impact is negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Implement a complaints system to investigate any noise complaints from neighboring communities. • Monitor noise levels within Sewage Pumping Station boundary, to ensure limits are not exceeded; • Create retrofitting noise controls where practical, like fencing and enclosures; • Keep records of the maintenance logs, local complaints, and analyze trends.		
3.6 Handling of Hazardous Wastes (fuels, chemical etc.)	Workers may expose to hydrogen sulfide, methane, carbon monoxide, chloroform, and other chemicals generated during wastewater treatment.	• A waste management plan complying with international best practice and relevant national regulations and covering all types of potentially hazardous wastes shall be developed and implemented by the project's operator. • The waste management plan should also refer to health and safety plan and emergency procedures for containing and managing accidental spillages. • Availability of Material Safety Data Sheets (MSDS) which list the characteristic of the substance and cleansing methods in the event of a spill. • Implement a training program for operators who work with chlorine and ammonia regarding safe handling practices and emergency response procedures; • Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use and maintenance. • Prepare escape plans from areas where there might be a chlorine or ammonia emission; • Install safety showers and eye wash stations near the chlorine and ammonia equipment and other areas where hazardous chemicals are stored or used; • If source water contains radioactive substances, locate water treatment units and water treatment sludge areas as far as possible from common areas (e.g., offices); • Conduct radiation surveys at least annually, especially in areas where radionuclides are removed; • Limit wastes entering the sewer system to those that can be effectively treated in the wastewater treatment facility and reduce the amount of air-strippable hazardous compounds entering the system by controlling industrial discharges (e.g., by permit or similar system). Analyze incoming raw wastewater to identify hazardous constituents;	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance. • Use personal gas detection equipment while working in a wastewater facility; • Continuously monitor air quality in work areas for hazardous conditions (e.g. explosive atmosphere, oxygen deficiency); • Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping; • Prohibit eating, smoking, and drinking except in designated areas; • Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.		
3.7 Socio-economic Aspect	Employment generation	KWASA will need to employ additional repair and maintenance crews to manage the new sewer pipelines and keep drainage ditches clear of accumulated debris. The numbers to be employed are not known but will be derived from the local community.	Contractor	KWASA
3.8 Survival Rate of Trees	Survival of trees, maintenance of landscaping, and the greenery.	Proper care will be taken to increase survival rate of saplings, like regular watering, pruning, provision of tree guards, provision of manure for better nourishment, etc., including timely replacement of perished saplings.	Contractor	KWASA

Table 48: Environmental Impacts and Mitigation Measures for Subproject-3 (Two STPs including FSTP)

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
1. Design and Pre-Construction Phase				
1.1 Land Acquisition and Resettlement	Total of 3400 decimals of land will be required due to construction of two STPs where 15 HHs will be relocated from the proposed locations. The impact is permanent and significant.	• All efforts have been made in STP design to reduce land acquisition; • Developing proper and adequate compensation package for affected persons; • Prior to site works, payment of compensation to affected people based on the Resettlement Plan.	DC/PMU/PMSC	PMU
1.2 Tree Removal	Around 1879 trees will be cut for the construction of STPs under subproject-3..	• After the finalization of the designs and layout of the project components, the trees within proposed construction areas will be marked. • Trees within the corridor of impact (area required for construction) will be felled after prior approval. • Compensation to be provided for the affected trees based on the unit prices of trees determined by the agriculture/horticulture experts. • Only trees that will require removal within the proposed construction areas of the sites will be cut. • For trees not proposed to be cut, taking all precautions to protect them from any damage from construction activities.	Contractor/PMU/ PMSC	PMU, PMSC
1.3 Consents, Permits, NOCs, Clearances, etc.	Failure to obtain necessary consents, permits, and other appropriate regulatory clearances can result to design revisions and work stoppage.	• Obtain all of the necessary consents, permits, and clearances before the start of civil works. • Acknowledge in writing and provide report on compliance all obtained permits, clearance, NOCs, etc. • Include in detailed design drawings and documents all conditions and provisions if necessary.	Contractor, PMSC	PMU
1.4 Natural Calamities such as flood, cyclone, earthquake etc.	Natural calamities can affect the STP indirectly creating a hazard to human health.	• Consider potential impacts from extreme climate change scenario in designing the STP. • Torrential rainfall during the monsoon is also considered for STP. • STPs are designed which is above the highest flood level (HFL) information of last 25 years.	Design Consultant	PMU
1.5 Fecal Sludge Collection System	Spillage may occur during sludge collection could affect public health and environmental problems. Collection may impede in the inaccessible area.	• Disinfectant will be used for the spillage if happen during sludge collection. • Provision of long hose pipe has been considered to cover the tanks located in the inaccessible area. • A long spade or jetted with a water hose should be used for compacted layers of the sludge. • Vacuum trucks should be checked daily basis before operation.	Design Consultant	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	Cannot pump thick, dried sludge at the bottom of the tanks. Traffic accident may increase due to frequent movement of vacuum trucks. Traffic congestion may happen due to random parking of the trucks.	• The speed limit of the trucks will be restricted to 20-25km/hr; • A well-defined schedule and route will be followed by the sludge carrying trucks; • A proper traffic management plan should be implemented to mitigate adverse impacts;		
1.6 Updating of IEE and SEMP	Expecting minor impacts, during construction period only and mitigation measures are addressed.	• Update IEE based on detailed designs, and submitted to ADB for review, approval, and disclosure prior to commencement of work. • Formulate SEMP during implementation and get approval from the PD. • Relevant information shall be disclosed.	Contractor, PMSC	PMSC, PMU
1.7 Community Awareness Program	Without proper interaction with local communities and or with stakeholders may lead to confusion and agitation and non-cooperation of local people.	Before the start of the subproject, the local population should be well aware of the upcoming subproject. There should be regular interaction with the local population and make them understand the subproject activities.	Contractor	PMSC, PMU
1.8 EMP Implementation Training	Irreversible impact to the environment, workers, and community.	Project manager and all key workers of contractors will be required to undergo EMP implementation training including spoils management, Standard operating procedures (SOP) for construction works; health and safety (H&S), core labor laws, applicable environmental laws etc.	Contractor, PMSC	PMU
2. During Construction Phase				
2.1 Sources of Materials	Extraction of materials can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	• A materials management plan (MMP) will be produced to minimize the use of non-renewable resources and rock-based materials. The MMP will be approved by the engineer and revised as required by the Engineer. • Prioritize sites which already permitted by the authority. • If other sites are necessary, it is contractor's responsibility to verify the suitability of all material sources and to obtain the approval of PMU and consultants. • If additional quarries will require after construction is started, construction contractor to obtain a written approval from PMU. • Maintain a construction material register at the site.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
2.2 Construction Camps, Stockpile Areas and Storage Sites	Conflicts with local community; disruption to traffic flow and sensitive receptors.	• Submit to the PMU for approval a detailed layout plan for the development of the construction camp showing the relative locations of all temporary buildings and facilities that are to be constructed together with the location of site roads, fuel storage areas (for use in power supply generators), solid waste management and dumping locations, and drainage facilities, prior to the development of the construction camps; • Locate the construction camps at areas which are acceptable from environmental, cultural or social point of view; • Shall not be located in productive agricultural lands, water bodies, natural drainage channels, flood plains and groundwater recharge areas, forests, vegetative lands, etc.; • For private lands, obtain land owner's written consent; indicate the requirement for reinstatement to original; • Local authorities responsible for health, religious and security shall be duly informed on the set up of camp facilities so as to maintain effective surveillance over public health, social and security matters; • Locate at sites that will not promote instability, flooding and result in destruction of natural drainage, vegetation, irrigation, & drinking water supply; • Locate the garbage pit/waste disposal site min 500 m away from the residence so that peoples are not disturbed with the odor likely to be produced from anaerobic decomposition of wastes at the waste dumping places. Encompass the waste dumping place by fencing and tree plantation to prevent children to enter and play with. • Provide adequate drainage facilities throughout the camps to ensure that disease vectors such as stagnant water bodies and puddles do not form. • Provide appropriate security personnel (police / home guard or private security guards) and enclosures to prevent unauthorized entry in to the camp area. Maintain register to keep a track on a head count of persons present in the camp at any given time. • Provide medical facility and appropriate type of fire-fighting equipment suitable for the construction camps; • Dismantle camps in phases and as the work gets decreased and not wait for the entire work to be completed. Restore the site to its condition prior to commencement of the works or to an agreed condition with the landowner.	Contractor	PMSC, IADC, PMU
2.3 Landscape and Visual	The presence of heavy duty vehicles and equipment, temporary structures at construction camps, stockpiles, may result in	• Properly fence off storage areas. • Collect all domestic solid waste and dump at designated disposal site. • Contractor to exercise strict care in disposing construction waste.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	impacts on aesthetics and landscape character; and Visual changes to topography.	• Reinstated vegetation shall be undertaken by a suitably qualified landscape contractor, and their contract will include two-year aftercare.		
2.4 Surface Water Quality	Chemicals such as fuels and lubricants may pollute runoff during rainfall, which may cause pollution of adjacent bodies of water. Bentonite slurry used in trenchless pipe installation may contaminate the adjacent watercourse. Effluent from labor camp sites and constructions sites may pollute surface waters.	• Provision of temporary sedimentation canal and/or silt traps along construction areas that are adjacent to receiving bodies of water or canals. • The measures to address soil erosion at the proposed facilities will consist of measures as per design, or as directed by the PMSC to control soil erosion, sedimentation, and water pollution. All temporary sedimentation, pollution control works, and maintenance thereof will be deemed incidental to the earthwork or other items of work. • All temporary discharge points shall be located, designed and constructed in a manner that will minimize erosion in the receiving channels. • Ensure proper compaction of refilled soil and there shall not be any loose soil particles on the top; the material shall be refilled in layers and compacted properly layer by layer. • Use surplus soil for beneficial purposes such as in any other construction activities, or to raise the level of low lying areas. • Avoid scheduling of excavation work during the monsoon season. Earthworks during dry season. • Confine construction area including the material storage (sand and aggregate) so that runoff from upland areas will not enter the site. • Ensure that drains are not blocked with excavated soil. • Stockyards at least 50 meters (m) away from watercourses. • Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%. • No obstruction in flowing water. • For effluents from work place, camps, and offices, provide treatment arrangements such as retention ponds and septic tanks which should be incorporated in the facility designs. A sewage management plan has to be prepared by the contractor and agreed with the PMSC. • Monitor water quality according to the environmental monitoring plan.	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU
2.5 Groundwater Quality	Uncontrolled extraction of water may affect availability of water to locals. Contamination of ground water from construction	• Prevent pollutants from contaminating the soil and the groundwater. • All tube wells, test holes, monitoring wells that are no longer in use or needed shall be properly decommissioned; • Storage of lubricants and fuel at least 50 m from water bodies	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	related sources such a fuel and liquid wastes.	• Storage of fuel and lubricants in double hulled tanks. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110%. • Daily control of machinery and vehicles for leakages. • Collection of waste during construction activities. • Provide uncontaminated water for dust suppression. • Monitor groundwater quality according to the environmental monitoring plan.		
2.6 Soil Erosion and Sediment Mobilization	The construction activities may cause serious soil degradation problems in the areas of STPs.	• The Contractor shall plan his works to minimize surface excavation works during the rainy season where practicable. • Precautions to be taken at any time of year when rainstorms are likely, actions to be taken when a rainstorm is imminent or forecast, and actions to be taken during or after rainstorms shall be developed by the Contractor. • The earthwork sites where exposed land surface is vulnerable to runoff shall be consolidated and/or covered. • Channels, earth bunds, netting, tarpaulin and or sand bag barriers shall be used on site to manage surface water runoff and minimize erosion. • The overall slope of the works areas and construction yards shall be kept to a minimum to reduce the erosive potential of surface water flows. • Monitor groundwater quality that could exist close to the working areas to ensure compliance.	Contractor	PMSC, IADC, PMU
2.7 Drainage Congestion	Construction material getting into surface run off or uncontrolled disposal may cause temporary drainage congestion.	• Prepare a program for prevent/avoid standing waters, which PMSC will verify in advance and confirm during implementation; • Provide alternative drainage for rainwater if the construction works/earth-fillings cut the established drainage line; • Regularly inspect and maintain all drainage channels to assess and alleviate any drainage congestion problem. Establish local drainage line with appropriate silt collector and silt screen for rainwater or wastewater connecting to the existing established drainage lines already there; • Wastes and construction debris will not be disposed in a manner that these would end up in drainage canals. • Construct wide drains instead of deep drains to avoid sand deposition in the drains that require frequent cleaning;	Contractor	PMSC, IADC, PMU
2.8 Air and Dust Pollution	Dust from construction related traffic and machinery. Dust from works, carrying machinery equipment to the	• Take every precaution to reduce the levels of dust at construction sites, and not exceeding the pre-project ambient air quality standards. • Fit all heavy equipment and machinery with air pollution control devices that are operating correctly. • Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust.	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	site, and roads due to vehicle movements Air pollution generated from exhaust/emissions of engines. The impacts are negative but short-term, impacts within a relatively small area and reversible by mitigation measures.	• Reduce dust by spraying stockpiled soil, excavated materials, and spoils. • Cover with tarpaulin vehicles transporting soil and sand. • Cover stockpiled construction materials with tarpaulin or plastic sheets. • Trenching and transport vehicles shall move only in designated areas and roads. • Water spraying to access roads, camp sites and work sites to reduce dust emissions. • Machines and vehicles must be regularly examined and maintained to comply with requirements of technical specifications. • All vehicles, equipment, and machinery used for construction will be regularly maintained to ensure that pollution emission levels comply with the relevant requirements of DOE. Copies of conformance will be submitted regularly to the PMSC. • Repair and maintain access roads, as necessary. • Monitor air quality according to the environmental monitoring plan.		
2.9 Noise Pollution	Sensitive receptor was identified about 20m away from the locations of STP-2 in Tikrabandh where noise level will exceed the standard limit during construction. Onsite Workers who are the most exposed to the highest noise levels generated from different construction activities due to their proximity to the noise sources.	To reduce the noise impacts off-site at the nearest sensitive receptors, include the following: • Communicate the construction schedule with the neighboring church and operations shall be restricted to the hours of worship as per discussion; • Noise barriers or A C. 2.4m hoarding shall be installed between the source and receptor; • Generators will be located away from sensitive receivers and will be enclosed; • Plant and vehicles shall be started sequentially rather than all together; • Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable; • Use modern vehicles and machinery with standard adaptations to reduce noise and exhaust emissions, and ensure they are maintained to manufacturers' specifications; • Noise-generating equipment must be fitted with silencers. • Optimize the use of noisy construction equipment and turn off any equipment if not in use; • Regular maintenance of all equipment and vehicles; • Stop all construction activities during at night; • Implement a complaints handling system; • Measure noise level according to the environmental monitoring plan. On-site construction noise shall be mitigated to ensure a safe work environment by implementing an on-site occupational health and safety plan, which considers national and international requirements. The plan shall include the following measures:	**Contractor through a nationally recognized laboratory**	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Ear muffs/protective hearing equipment shall be made available to all workers in noise critical areas • Training on how and when to use protective hearing equipment shall be conducted as part of the workers' induction sessions. • Place visually clear instructions in areas where noise emissions are significant.		
2.10 Waste Management	Waste generates due to construction activities at construction sites and contractor's camp site which could result in unhygienic conditions, health risk to work force and general public. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• The contractor is required to prepare, implement and maintain a Waste Management Plan approved by PMU throughout construction period; • Ensure proper collection and disposal of solid wastes within the construction camps; • Insist waste separation by source; organic wastes in one pot and inorganic wastes in another pot at household level • The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse; • The contractor will record the quantity in tons and types of waste and materials leaving site during the construction phase; • Establish waste collection, transportation and disposal systems with the manpower and equipment/vehicles needed; • Store inorganic wastes in a safe place within the household and clear organic wastes on daily basis to waste collector; • Dispose organic wastes in a designated safe place on daily basis. At the end of the day cover the organic wastes with a thin layer of sand so that flies, mosquitoes, dogs, cats, rats, are not attracted. • The construction wastewater and kitchen wastewater will be sent out to two settling pits and once settled the water will be used for watering surrounding plantations. • The waste water pit and garbage dumpsite should be totally barricaded; • The project will not develop a project-specific garbage dumpsite. Rather, solid wastes shall be regularly collected and disposed of in disposal sites approved by local authorities.	Contractor	PMSC, IADC, PMU
	Disposal of Surplus Materials	Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavation material may not be re-used within the proposed works the contractor will endeavor to send material for recovery or recycling so far as is reasonably practicable.	Contractor	PMSC, IADC, PMU
	Use of hazardous substances such as paints, oils and	• Ensure that safe storage of paint, fuel, other hazardous substances, and bulk materials are agreed on by PMU/Consultant, and have necessary approval/ permit from DOE and local authorities;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	lubricants can cause significant impacts.	• Hydrocarbon, toxic materials, and explosives will be stored in adequately protected sites consistent with national and local regulations to prevent soil and water contamination; • Equipment/ vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuels. Such areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed of oil and maintained to ensure efficiency; • The contractor will identify personnel in the WMP/EMP in charge of these sites, and ensure they are properly trained to control access to these areas; entry will be allowed only under authorization; • Segregate hazardous wastes (oily wastes, used batteries, fuel drums) and ensure that storage, transport, and disposal shall not cause pollution and will be undertaken consistent with national and local regulations; • Ensure availability of spill, clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored; • Ensure all storage containers are in good condition with proper labelling and regularly check containers for leakage and undertake necessary repair or replacement; • Discharge of oil-contaminated water will be prohibited; • Used oil and other toxic and hazardous materials will be disposed of in an authorized facility offsite; • Adequate precautions will be taken to prevent oil, lubricant, or hydrocarbon contamination of drainage channel beds; • Spillage, if any, will be immediately cleared with utmost caution to leave no traces; • Spillage waste will be disposed of at disposal sites approved by local authorities and by the Consultant; and • All areas intended for storage of hazardous materials will be quarantined and provided with adequate facilities to combat emergency situations complying with all the applicable statutory stipulations.		
2.11 Protection of Flora Resources	A total of 3,758 tree seedlings will be planted during construction. Inappropriate selection of tree species and plantation location may not ensure the	• No trees, shrubs or groundcover will be removed, or vegetation stripped without the prior permission of PMU and Consultants; • Afforestation will be done at the ratio of 1 (cut):2(new planting). A total of 3,758 sapling trees will be planted as per tree plantation plan developed by KWASA; • Indigenous trees most suited to the tract will be planted;	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	inherent objective of the tree plantation. Lack of proper care (e.g. watering, securing with fence) by the respective authority will hinder the process of proper growth of the planted trees.	• Early replanting and regular watering of the disturbed areas with local native vegetation should be undertaken to ensure speedy recovery of the cleared vegetation. • The contractor should undertake awareness training for the workers regarding the importance of biodiversity. • An awareness campaign targeted on the neighborhood affected persons will be carried to popularize tree planting and saplings should be provided to interested parties.		
2.12 Protection of Fauna	There are no game reserves or wildlife sanctuaries is located along the project area, only disturbance from the visual impacts, vehicles and construction equipment may cause disruption of wildlife activity such as breeding and/or feeding. The project will pose minor negative impact on the fauna present in the project area.	• Setting up and implementation code of conducts to workers, including no catching or hunting fish and wildlife, and no consumption of wildlife products. • While clearing vegetation it must be ensured that no wildlife injure and/or die. • Minimize the release of oil, oil wastes or any other substances harmful to aquatic species to any waters. • New and good condition machinery with minimum noise will be used in construction; • Construction work that may generate high noise levels will not be carried out during night time so that there would be no disturbance to local birds and animals; • Provide adequate knowledge to the workers regarding protection of flora and fauna, and relevant government regulations and punishments for illegal poaching.	Contractor	PMSC, IADC, PMU
2.13 Socio-economic Status	Temporary loss of livelihoods and interruption of social and economic activities.	The contractor will ensure that: • Establish a Grievance Redress Mechanism, and respond to grievances; • The construction works do not interfere with the convenience of the public or access to, use, and occupation of public or private roads, or any other access to properties, whether public or private. • Temporary access to properties adjacent to the construction site will be provided through the construction of ramps with concrete slabs for use of pedestrians and light vehicles; • In critical areas such as institutions, operating hours are factored into work schedules and workforce is increased for speedy completion; • Advance information on works to be undertaken including appropriate signage is provided; • The diversion is done in coordination with the traffic police division for necessary rerouting of traffic and traffic management.	Contractor	PMSC, IADC, PMU
	Manpower will be employed from local community during construction and operation	• Employ at least 50% of labor force from communities in the vicinity of the site. This will have the added benefit of avoiding social problems that sometimes occur when workers are imported, and avoiding	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	stage. Thus, potential impact is positive and long-term.	environmental and social problems from workers housed in poorly serviced camp accommodation. • Secure construction materials from local market.		
2.14 Traffic Safety	Increased volume of construction vehicles on the roads may lead to increased wear and tear of roads in the vicinity of the subproject site. Road safety concerns due to slow moving construction vehicles. Hauling of construction materials and operation of equipment on-site can cause traffic problems. The road closure will impact on a public transport operations and routing for a short period. Pedestrian movements will be affected by the partial road closure.	• Formulate and implement the approved Traffic Management Plan. • Prepare alternative transportation routes. The diversion shall be done in coordination with the traffic police division for necessary rerouting of traffic and traffic management; • Inform through display board about nature, duration of construction and contact for complaints; • Provide, erect and maintain barricades, signs, markings, flags, lights and flagmen as may be required for the information and protection of traffic. The flagmen shall be equipped with red and green flags and lanterns/lights. • Schedule material deliveries on low traffic hours; • Restore damaged properties and utilities; • Erect and maintain barricades if required; • All surfaced roads shall be subject to road cleaning and unsurfaced roads to dust suppression, the methodology and frequency of which shall be included in the traffic management plan. • Emergency response plan must be prepared for any traffic accident during construction.	Contractor	PMSC, IADC, PMU
2.15 Physical and Cultural Heritage	Disturbance/nuisance/noise due to construction activities to the nearby socio-cultural structures such as church, mosques, schools; Accessibility to the socio-cultural sites may be hampered.	• Facilitating access using alternative routes during construction and timely completion of construction work; • Establishment of construction site camp and labor camp maintaining proper distances from the cultural sites; • Affecting dust and noise control measures provided in the EMP.	Contractor	PMSC, IADC, PMU
	Damage to underground archaeological artifacts	• In the event of chance finds, the following measures shall be strictly adopted:	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		○ strictly follow the protocol by coordinating immediately with PMU and Bangladesh Department of Archaeology for any suspicion of chance finds during excavation works; ○ stop work immediately to allow further investigation if any finds are suspected; and ○ request authorized person from the Bangladesh Department of Archaeology to observe when excavation resumes for the identification of the potential chance find, and comply with further instructions.		
2.16 Occupational Health and Safety	Impact on health of workers, including risk of diseases (malaria, dengue fever, HIV Aids) and physical injury from any form of force majeure.	• All relevant provisions of the Bangladesh Labor Act, 2006 and relevant WHO guidelines will be adhered to, concerning the provision of adequate measures to avoid contracting and/or spreading diseases during construction phase. • Follow international best practices on occupational health and safety such as those in Section 4.2 of World Bank EHS Guidelines on Construction and Decommissioning Activities. • A proper occupational health and safety plan has to be prepared and will have to be followed to avoid health hazard of the workers. • At every workplace, a readily available first aid unit, including an adequate supply of sterilized dressing material and appliances, will be provided as per the factory rules. Suitable transport will be provided to facilitate the transfer of injured or ill persons to the nearest hospital. • At every workplace and construction camp, equipment and nursing staff will be provided. • The contractor will, at his own expense, conform to all disease prevention instructions given to him by the PMSC. • Provide regular health check-ups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce. • The contractor shall provide at cost all labor and materials and construct/install and maintain site safety, hard barricading, flexible green net, signboards, temporary day/light traffic diversions throughout the construction activities according to the specifications and provide Personal Protective Equipment (PPE) to all the laborers working at the construction site. • Launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards. • Make available first aid kits, ambulance facilities, and fire extinguishers in camp sites. • Compensation for the loss of life (a zero tolerance to loss of life policy should be developed and implemented) or for any type of injuries.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Provide insurance to the workers. Health and safety training for all site personnel is very important and must be mandatory.		
	Risk of contractors or subcontractors hiring child labor in the construction activities.	National laws on child labor will be strictly followed. No child labor will be allowed by the contractors or subcontractors in any of the project activities.	Contractor	PMSC, IADC, PMU
	Insufficient hygiene in the construction camps and sites.	• Any construction of labor camp should be constructed following the standards outlined in the IFC/EBRD Accommodation Guidance Note, including hygienic facilities with proper ablution facilities and waste management. • Provide safe drinking water in sufficient quantity for the workforce at the construction site as well as at the construction camps. • Provide adequate toilets, separate for women and men, at the construction sites, with septic tanks. Sewage management plan for the work camp has to be prepared by the contractor and agreed with the construction supervision. • Provide garbage bins in the camps, empty regularly and the garbage disposed of in a hygienic manner. A waste management plan for the work camp has to be prepared by the contractor and agreed with the PMSC. • Make arrangement for disposal of excreta in accordance with local or national guidelines.	Contractor	PMSC, IADC, PMU
	Health risk of construction workers due to COVID-19.	• Prepare the health and safety guidance for COVID-19 at work sites and get approval of PD; • Strictly follow and implement the H&S guidance for COVID-19 at worksite; • Everyone entering the worksite must wear a mask, gloves and hard shoes. • At the entrance of the worksite/camp site every personnel must wash their hands for 20 second with maintaining a distance of at least 1m (3 ft) from each other; • A designated EHS/Medical person should stay all time during work and ensure physical distances (minimum 1m) among workers, disinfecting surfaces that are commonly used and investigate worker/site personnel health and safety. • Discourage site personnel to gather and gossip at any time, rather encourage physical distance while chatting/discussing. • Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwelling (both camp site and home). • Encourage frequent hand washing and social distancing at campsite.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Ensure personal distance at least 1 meter (3 feet), preferably 2m (6ft) during lunch, dinner and prayer. • Train workers on how to properly put on, use/wear, and take off protective clothing and equipment. Make these trainings mandatory at worksites and provide 10-15 minutes of a workday for such 'training and encouragement' activities.		
	Health hazard due to encounter of asbestos cement pipes during excavation activities.	• Development and application of a detailed procedure to protect workers and the people surrounding the excavation sites. This should comply with national and/or international standards for handling asbestos, and should include: (a) removal of all persons to a safe distance; (b) usage of appropriate breathing apparatus and protective equipment by persons assigned to handle the AC material; and (c) procedures for the safe removal and long-term disposal of all asbestos- containing material encountered; • Training of all personnel and site workers to enable them to understand the dangers of AC pipes and to be able for them to recognize AC pipes; • If AC pipes encountered are not broken, leave them in-situ as much as possible, and ensure proper protection and precautions are observed in order to avoid breaking the AC pipes during excavation or reinstatement activities; and • Reporting procedures to inform management immediately if AC pipes are encountered.	Contractor	PMSC, IADC, PMU
2.17 Community Health and Safety	Disturbance/ nuisance/ noise due to construction activities, including hauling of construction materials or solid wastes.	• Code of conduct for workers includes restricting workers in designated areas, no open defecation, no littering, no firewood collection, no fire except designated places, no trespassing, no residence at construction sites, and no obligation to potentially dangerous work. • Follow International best practices on community health and safety such as those in Section 4.3 of World Bank Environmental Health and Safety (EHS) Guidelines on Construction and Decommissioning Activities. • Maintain a complaint logbook in worker's camp and take action promptly of complaints. • Plan transportation routes in consultation with KCC, RHD and Police. • Schedule transportation activities by avoiding peak traffic periods. • Clean wheels and undercarriage of haul trucks prior to leaving construction site. • Educate drivers: limit speed between 20-25 km/h in settlements and avoid use of horn. • Earmark parking place for construction equipment and vehicles when idling; no parking shall be allowed on the roads, that may disturb the traffic movement.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Provide prior information to local people about work; • No night time construction activities including material/waste haulage near or within residential areas. Construction activities in these areas must be prohibited from 9pm to 7am. • Noise barriers must be installed in housing areas to reduce the noise level.		
	Damages to utilities, private properties, and services during construction.	• Immediately inform service providers to any damages to utilities during construction. • Replace (or compensate for) public and private physical structures damaged due to construction or vibration. Compensation and assistance will be provided in accordance with the provisions of the RP. • Provide prior public information about the likely disruption of services.	Contractor	PMSC, IADC, PMU
	Community health and safety issues due to excavation. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Plan activities in consultation with local communities so that activities with greatest potential to generate dust and noise are planned during the days with least disturbance; • Use dust suppression techniques by applying water to minimize dust from vehicle movements; • Coordinate with utility service providers (power lines, water lines, gas etc.) and have a designated point of contact person for coordination requirements and have a representative available on site when utilities interruption is required; • Post warning signs and warning lights near the residential areas. In addition, use safety fences near residential areas, schools and roads; • Avoid excavated soil or debris as well as building materials and sewer pipes on the narrow roads in high densely populated areas.	Contractor	PMSC, IADC, PMU
	Public safety issues due to unauthorized access to working sites.	• Restrict access to the working site, through combination of institutional and administrative controls, like fencing, signage, and communication of risks to the local community, • Remove hazardous conditions on construction sites that cannot be controlled by restricting access, such as covering opening to small confined spaces, and ensuring means of escape, like in case of locked storage of hazardous materials.	Contractor	PMSC, IADC, PMU
2.18 Submission of Environmental Monitoring Report	Unsatisfactory compliance to EMP	• Appointment of contractor's supervisor to ensure SEMP implementation. • Timely submission of monitoring reports including photo-log.	Contractor	PMSC, IADC, PMU
2.19 Site Reinstatement	Damage due to debris, spoils, excess construction materials. Potential impacts are negative	• Remove all spoils wreckage, rubbish, or temporary structures; • All affected structures rehabilitated/compensated; • The area that previously housed the construction worker shed is to be checked for spills of substances such as oil, paint, etc. and these shall be cleaned up.	Contractor	PMSC, IADC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	and long-term but reversible by mitigation measures.			
3. Operation and Maintenance (O&M) Phase				
3.1 Occupational Health and Safety	Risk of health of workers during operation and maintenance; workers may suffer infectious diseases.	• Ensure routine vaccinations for workers for influenza, tetanus, and Hepatitis "B" (according to Consultations with the institute's physicians). • Workers must be trained to recognize potential hazards, use proper work practices and procedures, recognize adverse health effects, understand the physical signs and reactions related to exposures, and are familiar with appropriate emergency evacuation procedures. They must also be trained to select and use the appropriate PPE. • Provide all the personal protective equipment like gum boots, nose mask, gloves etc. for the protection of workers. • The workplace will be equipped with fire detectors, alarm systems and fire-fighting equipment. The equipment will be periodically inspected and maintained in good working condition. • Providing adequate personnel facilities, including washing areas and areas to change clothes before and after work. • Medical check-up will be conducted on regular basis and the health conditions will be monitored; • First aid facilities required to attend immediately for meeting emergency situations will be made available at the facility. • Maintaining good housekeeping in waste processing and storage areas. • Install railing around all process tanks and pits. Require use of a life line and personal flotation device (PFD) when workers are inside the railing, and ensure rescue buoys and throw bags are readily available; • Use PFDs when working near waterways; • Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance; • Use fall protection equipment when working at heights; • Maintain work areas to minimize slipping and tripping • Use proper techniques for trenching and shoring; • Implement fire and explosion prevention measures in accordance with internationally accepted standards;	Contractor	KWASA
	Health risk of workers due to COVID-19.	• Prepare and implement a health and safety plan that is based on the developments about COVID-19 at the local and global fronts. All protocols contained in the health and safety plan should comply with all national health and safety regulations related to COVID-19 and with	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		internationally recognized guidelines for dealing with COVID-19, such as the WHO guidelines.		
	Health issues related to working with electrical equipment and control panels	• Conduct detailed identification and marking of all electrical connections prior to any maintenance work, • Lock out (de-charge and leave open with a controlled locking device) and tag-out (by a warning sign placed on the lock) devices during dismantling and maintenance, • Ensure circuit breaking before starting work on electrical parts, • Use electricity-specific PPE, including insulating clothing, suits, and gloves, • Use specially trained personnel to demount electrical parts.	Contractor	KWASA
	Health issues related to working in confined places.	• Provide safe means of access and egress from confined places, such as stairs and ladders, and safety ropes, • Avoid operating combustion equipment for prolonged periods unless the area is actively ventilated, • Use special PPE including respirators, protective suits, gloves, and eye protection. • Minimize exposure period to the extent possible.	Contractor	KWASA
	Installing or repairing mains adjacent to roadways, implement procedures and traffic controls.	• Establishment of work zones so as to separate workers from traffic and from equipment as much as possible • Reduction of allowed vehicle speeds in work zones; • Use of high-visibility safety apparel for workers in the vicinity of traffic; • For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists; • Locate all underground utilities before digging.	Contractor	KWASA
	Health and stress issues due to noise in work environment	• Effectively isolating control room against noise; • Avoid exposure to excessive levels beyond permissible limits set out by local and international regulations; • Monitor noise levels frequently (within a SOP), • Use noise hearing protection gear and vibration resistant boots, gloves, and clothing, • Keep records of breaching incidents, and report to the higher management.	Contractor	KWASA
3.2 Community Health and Safety	Community health issues and contamination of environment due to mismanagement of overflows	• Develop and implement appropriate protocols to reduce risks to safety, public health, and environment that include well-written instructions; • Develop a contingency plan (site-specific); • Response to overflows by preventing, containing, minimizing, the overflow where it is feasible and safe to do so;	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Protect STP's components from flood damage where it is feasible to do so (by for instance, protecting components from rising flood water to enable reinstating more rapidly.		
	Odor and noise nuisance to adjacent sensitive receptors	• Apply preventive and corrective maintenance on odor control units, in a frequency applicable to the manufacturer's instructions; • Establish a Standard Operating Procedure (SOP) to include requirements for maintenance, monitoring, and personnel training; • Monitor outdoor odor and noise levels within STP boundary, to ensure limits are not exceeded; • Create retrofitting noise controls where practical, like fencing and enclosures; • Keep records of the maintenance logs, local complaints, and analyze trends.	Contractor	KWASA
	Public health issues and contamination of environment due to mismanagement of hazardous waste and materials.	• Train operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training, • Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment, • Prepare written Standard Operating Procedures (SOPs) for filling containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response, • Transport and dump waste residues from screens in legal and approved dumpsites, • Make available spill response equipment sufficient to handle at least initial stages of a spill. • Train and educate operational personnel on response activities in the event of spill, release, or chemical emergency. • Provide quality monitoring tests for groundwater resources adjacent to project locations	Contractor	KWASA
3.3 Inefficient Functioning of STP	Inefficient working of STP may cause poor quality of treatment and resulting under treatment of waste water and sludge and may cause environment, health and safety risk to workers and environment.	• Procedure for each step of operation shall be documented and all workers/operators shall be trained on the proper operation of each component of the STP, including the proper desludging procedure for septic tanks. • Although impact is likely to be minimal due to new and well-designed efficient system, it must be ensured that the facility is operating properly at all times.	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Periodic monitoring of effluent and dried sludge to check suitability as a manure is suggested.		
3.4 Odor Generation and Air Emission	Odor generation and air emission from the STP may cause health risk to the worker and community. The impacts are negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Establish close communication with the neighboring areas, establish a complaints handling system and assign a staff member in the STP to receive odor complaints. This could be done through posters and the distribution of brochures that illustrate the right to complain, and the contacts information of the responsible staff assigned to supervise the plant. • Apply preventive and corrective maintenance on odor control units, in a frequency applicable to the manufacturer's instructions; • Monitor outdoor odor levels within STP boundary, to ensure limits are not exceeded; • Supplied standby generators to STPs should be checked with suppliers for their emission standards.	Contractor	KWASA
3.5 Acoustic Environment	Noise may generate due to operation of STPs which will result in heath stress to worker and the community. The impact is negative but short-term, site-specific within a relatively small area and reversible by mitigation measures.	• Plant and maintain a green belt around the site. • Implement a complaints system to investigate any noise complaints from neighboring communities. • Monitor noise levels within STP boundary, to ensure limits are not exceeded; • Create retrofitting noise controls where practical, like fencing and enclosures; • Keep records of the maintenance logs, local complaints, and analyze trends.	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
3.6 Water Pollution	Run-off from STP which may cause reduction in the quality of adjacent water body and groundwater.	• Implement preventive maintenance program to all structures and electromechanical equipment in SPSs • The supplier of each equipment should provide a preventive maintenance schedule for supplied equipment. Implementing this schedule should be part of the STP operational manual. • Take all precautions to prevent entering of run-off into streams, watercourses or irrigation system. • In case the influent is totally or partially bypassed to the river, KWASA should be immediately notified with the reasons, durations and applied control measures for such event. • Quality of final effluent discharged from STP shall be regularly monitored to ensure that water quality complies with the DOE standards.	Contractor	KWASA
3.7 Disposal of Sludge	Environmental hazard and health risk to workers and other people.	• Sludge shall be used as soil conditioner to enhance soil fertility in nearby farms. If reuse is not feasible safe disposal should be ensured. • Monitor sludge quality as per environmental monitoring plan. • Prior to transporting sludge to an approved disposal facility, a copy of the laboratory analysis shall be provided to KWASA for review and approval. • Vehicles should be carefully selected for their local routes to minimize inconvenience to the public.	Contractor	KWASA
3.8 Handling of Hazardous Wastes (fuels, chemical etc.)	Workers may expose to hydrogen sulfide, methane, carbon monoxide, chloroform, and other chemicals generated during wastewater treatment.	• A waste management plan complying with international best practice and relevant national regulations and covering all types of potentially hazardous wastes shall be developed and implemented by the project's operator. • The waste management plan should also refer to health and safety plan and emergency procedures for containing and managing accidental spillages. • Availability of Material Safety Data Sheets (MSDS) which list the characteristic of the substance and cleansing methods in the event of a spill. • Implement a training program for operators who work with chlorine and ammonia regarding safe handling practices and emergency response procedures;	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• Provide appropriate personal protective equipment (including, for example, self-contained breathing apparatus) and training on its proper use and maintenance. • Prepare escape plans from areas where there might be a chlorine or ammonia emission; • Install safety showers and eye wash stations near the chlorine and ammonia equipment and other areas where hazardous chemicals are stored or used; • If source water contains radioactive substances, locate water treatment units and water treatment sludge areas as far as possible from common areas (e.g., offices); • Conduct radiation surveys at least annually, especially in areas where radionuclides are removed; • Limit wastes entering the sewer system to those that can be effectively treated in the wastewater treatment facility and reduce the amount of air-strippable hazardous compounds entering the system by controlling industrial discharges (e.g., by permit or similar system). Analyze incoming raw wastewater to identify hazardous constituents; • Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance. • Use personal gas detection equipment while working in a wastewater facility; • Continuously monitor air quality in work areas for hazardous conditions (e.g. explosive atmosphere, oxygen deficiency); • Periodically sample air quality in work areas for hazardous chemicals. If needed to meet applicable occupational health national requirements or internationally accepted standards, install engineering controls to limit worker exposure, for example collection and treatment of off-gases from air stripping; • Prohibit eating, smoking, and drinking except in designated areas; • Rotate personnel among the various treatment plant operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.		
3.9 Pathogens and Vectors	Workers may expose to the endotoxins, which are produced within a microorganism and released upon destruction of the cell and which can be carried by airborne dust particles. Vectors for sewage pathogens	• Include in safety training program for workers, safe handling and personal hygiene practices to minimize exposure to pathogens and vectors; • Use vacuum trucks or tugs for removal of fecal sludge instead of manual methods; • Provide and require use of suitable personal protective clothing and equipment to prevent contact with wastewater (e.g., rubber gloves,	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
	include insects (e.g. flies), rodents (e.g. rats) and birds (e.g. gulls).	aprons, boots, etc.). Especially provide prompt medical attention and cover any skin trauma such as cuts and abrasions to prevent infection and use protective clothing and goggles to prevent contact with spray and splashes; • Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. This practice also helps to minimize chemical and radionuclide exposure; • Encourage workers at wastewater facilities to wash hands frequently; • Provide worker immunization (e.g. for Hepatitis B and tetanus) and health monitoring, including regular physical examinations; • Reduce aerosol formation and distribution, for example by planting trees around the aeration basin to shield the area from wind and to capture the droplets and particles • Reducing aeration rate, if possible • Avoid handling screenings by hand to prevent needle stick injuries; • Maintain good housekeeping in sewage processing and storage areas; • Advise individuals with asthma, diabetes, or suppressed immune systems not to work at wastewater treatment facilities, especially composting facilities, facility because of their greater risk of infection		
3.10 Socio-economic Aspect	Employment generation	KWASA will need to employ additional repair and maintenance crews to manage the STPs. The numbers to be employed are not known but will be derived from the local community.	Contractor	KWASA
3.12 Survival Rate of Trees	Survival of trees, maintenance of landscaping, and the greenery.	Proper care will be taken to increase survival rate of saplings, like regular watering, pruning, provision of tree guards, provision of manure for better nourishment, etc., including timely replacement of perished saplings.	Contractor	KWASA
3.13 Traffic Management	Waste carrying trucks will be plying to the facility from the city and random parking of vehicles and unplanned loading / unloading areas can lead to traffic congestion.	• A proper traffic management plan will be implemented to mitigate adverse impacts; • A well-defined schedule and route will be followed by the septage carrying trucks; • Proper signage will put up near the proposed facility giving route directions; • Vehicles will be parked inside the facility premises in the designated slots; • Entry and exit routes from the premises will be clearly marked; • Adequate lighting and reflective boards will be put up for night time safety; • All routes will be planned to cause minimal disturbance to local community;	Contractor	KWASA

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Supervision
		• The vehicles will be allowed to move in the site only through dedicated entry and exit points within the site; • Dedicated parking area will be provided in the facility for parking of vehicles; • The speed limit of vehicles will be restricted to 20-25 km/hr;		

D. Site-Specific Environmental Management Plan

551. KWASA through the PMU is responsible to implement the overall EMP. During construction stage, the contractors are responsible to mitigate all environmental impacts related with the construction activities. In this context, the EMP has been included into the Bidding Documents (BD) of all the construction packages so that it serves as a condition of contract and to ensure contractors are aware of their responsibilities in managing the impacts of the project to the environment and people likely to be affected by it at all phases of implementation. .

552. KWASA through the PMU intends to procure the works from the qualified contractor through international advertisement for the major works, such as STPs and sewer network including sewerage pumping station. The contractor would be required to comply with all of the performance requirements set out in the tender documentation including the statutory consent approvals which may be granted by the Department of Environment. The contractor is therefore required to prepare a site-specific EMP (SEMP) for each specific package of works as required, which will be based on the EMP in this IEE report developed for the entire project.

553. The contractor is required to develop its SEMP that:

(i) is in accordance with the mitigation measures specified in the IEE and EMP;
(ii) is in accordance with any conditions that may be prescribed as part of the consent(s) for the proposed development; and
(iii) where practicable the contractor should seek to identify opportunities for further reducing significant negative environmental effects and to implement best practice in as far as reasonably practicable, i.e. take every reasonable effort to reduce and prevent negative effects, while enhancing benefits.

554. Further, the contractor is required to develop the following plans, and any others considered relevant, and incorporate accordingly into the SEMP:

(i) Construction Compound Management Plan;
(ii) Construction Traffic Management Plan;
(iii) Construction Health and Safety Plan;
(iv) Materials Management Plan;
(v) Noise and Vibration Management Plan
(vi) Water Quality Management Plan;
(vii) Dust Management Plan;
(viii) Waste Management Plan; and
(ix) Emergency Incident Response Plan.

555. The SEMP is considered a living document that will be reviewed and revised regularly as construction progresses. The process for update, review, and approval of the SEMP must be documented in the SEMP to ensure that all revisions can be easily understood, applied and updated by PMU and the contractor throughout construction.

556. It is expected that amendments to the SEMP may be necessary to reflect, *inter alia*, changes in the project scope, contract scheduling, contractor appointments, environmental management policies, practices or regulations, and developments on the site. These reviews and updates are necessary to ensure that environmental performance is subject to continual improvement and that best practice is implemented throughout construction.

E. Roles and Responsibilities of the Contractors

557. **Employer**. KWASA will be the employer responsible for ensuring that competent parties are appointed to undertake construction and those sufficient resources are made available to facilitate the appropriate management of risks to the environment.

1. Contractor

558. The contractor(s) appointed will be responsible for the organization, direction and execution of environmental related activities during the detailed design and construction of the proposed development. The contractor is required to undertake all activities in accordance with the relevant environmental requirements including the consent documentation and other regulatory and contractual requirements.

2. Site Manager

559. A Site Manager will be appointed by the contractor to oversee the day-to-day management of working areas within the site and ensure that effective, safe, planned construction activities are delivered on an ongoing basis to the highest standards. The Site Manager will be a suitably qualified, competent and experienced professional that will oversee site logistics, communicate regularly with construction staff, accommodate project-specific inductions for staff on site and ensure that all work is compliant with the relevant design standards and health and safety legislation.

3. Environmental Health and Safety Officer

560. An Environmental Health and Safety (EHS) Officer will be appointed by the contractor to ensure that the EMP and SEMP are effectively implemented. The EHS Officer will be a suitably qualified, competent and experienced professional that would perform the necessary tasks, review environmental procedures and consult with the members of the construction team and stakeholders as requited.

561. The EHS Officer would be responsible for:

(i) Preparing, maintaining and implementing the EMP;
(ii) Establishing, implementing, and maintaining the EMP;
(iii) Conducting regular environmental inspections and audits as specified in the contract and checking adherence to the EMP;
(iv) Ensuring that construction occurs in accordance with the relevant environmental requirements and that such compliance is adequately recorded and documented;
(v) Completing a site inspection and compiling an environmental compliance report on a monthly basis;
(vi) Attending site and stakeholder meetings as required;
(vii) Keeping up-to-date with relevant environmental best practice and legislative changes;
(viii) Liaising with the relevant staff to prepare Method Statements and relevant plans for all activities where there is a risk of environmental damage;
(ix) Having a detailed level of knowledge on all aspects of environmental information associated with the proposed development;
(x) Ensuring all personnel have undertaken adequate environmental inductions, awareness briefings and training (including subcontractors);

(xi) Dealing with environmental complaints; and
(xii) Managing and responding to environmental incidents and ensuring that all incidents are recorded and reported in an appropriate manner.

4. Communication Procedures

562. **Community and Stakeholder Engagement**. The contractor will take all reasonable steps to engage with stakeholders in the local community, focusing on those who may be affected by the construction works including residents, businesses, community resources and specific vulnerable groups. Communication with all relevant stakeholders shall be undertaken at an appropriate level and frequency throughout construction. KWASA will establish a Communications Management Plan that will specify obligations in relation to community and stakeholder engagement that the contractor must adhere to. Where communications are related to environmental issues the EHS Officer will be informed and engaged with, as appropriate.

5. Advance Notice of Works

563. The contractor will ensure that local residents, businesses, occupiers, general users of the area and stakeholders are informed in advance of construction activities that may affect them. Relevant obligations and procedures in relation to advance notice of works will be identified in the SEMPs and in the Communications Management Plan. All notifications will detail the nature, estimated duration and working hours. All notifications will include a project-specific contact number to which any enquires can be directed. The contractor will be responsible for preparing and issuing the notifications subject to the relevant approval and consents. KWASA and statutory stakeholders will decide whether to arrange any further targeted consultation with the public or relevant stakeholders in advance of specific construction activities on a local basis.

6. Contacts

564. An emergency contact list will be established and made available to all construction staff employed. The contact list shall be displayed prominently on site as well as at suitable locations where construction activity is being carried out around working areas. The contact list will include key environmental representatives that may need to be contacted in the event of an incident.

7. Inquiries and Complaints

565. The contractor would establish a process for handling all enquires including complaints consistent with the grievance redress mechanism of the project as discussed in Section VIII. All inquires will be recorded and a log would be maintained to include details of the response and action taken. This will be available upon request for inspection to any stakeholders, including ADB. All inquiries, whether a query or a complaint, will be dealt with in a timely manner. The EHS Officer will be immediately informed of any environmental related issues that have been raised. Where appropriate, the EHS Officer would be responsible for informing KWASA, relevant stakeholders and statutory bodies.

8. Environmental Management Procedures

566. **Training, Awareness and Competence**. The contractor (and their subcontractors) would be selected with due consideration of relevant qualifications and experience. The contractor will be required to employ construction staff with appropriate skills, qualifications and experience appropriate to the needs of the works to be carried out during construction. A site induction will be provided to all construction staff before they commence work on site. Where appropriate, the

contractor will identify specific training needs for the construction workforce and will ensure that appropriate training requirements are fulfilled. The contractor must establish an Environmental Training and Awareness Program and ensure that all personnel receive adequate training prior to the commencement of construction activities. A baseline level of environmental awareness will be established through the site induction program. Key environmental considerations and objectives will be incorporated into this induction. Specifically, site inductions will cover the following as a minimum:

(i) Introduction to the EHS Officer;
(ii) Description of the EMP(s) and consequences of non-compliance;
(iii) The requirements of due diligence and duty of care;
(iv) Overview of conditions of consents, permits and licenses;
(v) Requirements associated with community engagement and stakeholder consultation;
(vi) Identification of environmental constraints and notable features within the site; and
(vii) Procedures associated with incident notification and reporting including procedures for dealing with damage to the environment.

567. No one will work on site without first receiving environmental induction. Signed records of environmental training will be established, maintained and made available to the PMU. Site briefings and talks would be carried out on a regular basis to ensure that construction staff have an adequate level of knowledge on environmental topics and community relations, and can effectively follow environmental control procedures throughout construction.

9. Meetings

568. PMU will arrange regular meetings (every three months) to discuss environmental matters and ensure effective coordination to be attended by:

(i) The PMU;
(ii) Contractor;
(iii) EHS Officer; and
(iv) Environmental Specialists – engaged by either KWASA and/or the contractor.

569. The EHS Officer will be responsible for arranging and holding monthly meetings and site walk overs with the PMU. The EHS Officer would develop and distribute minutes of the monthly meetings and distribute them accordingly.

10. Monitoring, Inspections and Audits

570. For the duration of the contract/s, the environmental performance of the contractor will be monitored through site inspections and audits. The program for monitoring, inspections and audits shall be specified in the contract and it is likely to be a combination of internal inspections and independent external audits that may be either random or routine. Records of all inspections carried out should be recorded on standard forms and all actions should be closed out in a reasonable time. The SEMP/s would include further details of inspection procedures.

571. **Monitoring.** Mitigation and monitoring will be carried out in accordance with the requirements set out in this IEE report so that construction activities are undertaken in a manner that does not give rise to significant negative effects. Suitable monitoring program will need to be developed, implemented, documented, and assessed (with potential follow up) in accordance with the specification outlined in the SEMPs. The results of all environmental monitoring activities would be reviewed by the EHS Officer on an ongoing basis to enable trends or exceeding the

criteria to be identified and corrective actions to be implemented as necessary. The contractor will be required to inform the PMU of any continuous violation of criteria.

572. **Inspections.** Routine inspections of construction activities will be carried out by the EHS Officer on a daily basis to ensure all necessary environmental measures relevant to the construction activities are being effectively implemented by construction staff, ensuring legal and contractual conformity. More detailed inspections would be undertaken by the EHS Officer on a weekly basis.

573. The weekly inspections would be appropriately documented by the EHS Officer and copies of these records and any action required to be undertaken should be made available to the PMU. Each month one of the weekly inspections will include a review of environmental documentation and records. The monthly inspection will be recorded on a standard form and reported to the PMU within five days of the inspection taking place. This standard form will address the following as a minimum:

(i) Summary of compliance/non-compliance with the EMP/s;
(ii) Results and interpretation of the monitoring program;
(iii) Key issues noted in inspections and/or audits;
(iv) Summary record of non-conformities, incidents and corrective actions;
(v) Summary of environmental complaints and queries received in relation to environmental matters; and
(vi) Summary record of environmental training undertaken by staff.

574. **Audits.** KWASA will arrange for independent environmental audits to be carried out by a third party during construction. External audits provide the opportunity for an independent auditor to advise on compliance with applicable environmental regulatory requirements, the efficacy of the environmental management approaches used, and recommendations for reducing identified environmental risks (if considered appropriate). Further, regulatory and statutory bodies may undertake site visits to monitor compliance with legislative and regulatory requirements. These site visits may occur randomly throughout the construction period. The contractor will facilitate these visits and the EHS Officer will be available to provide information as required and deal with any issues that may arise during, or as a result of, these visits.

575. Planned and documented audits aimed at evaluating the conformance of the EMS would also be carried out by the EHS Officer. As part of the SEMPs, the EHS Officer will establish a schedule for internal audits and this inspection calendar will be made available to the PMU. These environmental audits will be scheduled at least once every three months. The contractor will be required to prepare standard forms for reporting and audit items shall include but not be limited to the following activities:

(i) Review of environmental documentation to establish if relevant requirements are being achieved and if continual improvement is occurring;
(ii) Site inspection and interviews with onsite personnel; and
(iii) Reporting with recommendations.

576. For any environmental nonconformities found, the auditor will prepare a corrective actions report to describe and record the findings of the nonconformance. The verification of previous corrective actions reports should be also recorded. Upon completion of an audit, the auditor will review all corrective actions reports and prepares an audit report to summarize:

(i) Corrective action requests raised;
(ii) Previous corrective action requests closed; and
(iii) Observations made during the audit.

577. The EHS Officer will be entitled to participate in all audits. Notwithstanding this, the PMU shall produce and provide the contractor with a copy of each audit report within five working days of the audit. Each audit report will detail the findings from the auditor, specify non-conformances identified and outline the proposed corrective action.

11. Incidental Response

11.1. Corrective Actions

578. **Overview.** Corrective actions are measures to be implemented to rectify any non-conformances (i.e. exceedance of criteria or targets) identified during monitoring, inspections and/or audits. In the first instance, an investigation should be undertaken by the EHS Officer to identify the cause of any non-conformances. Appropriate remedial measures shall be identified and implemented as soon as practicable to prevent further non-conformances. If necessary, the appropriate statutory authority and stakeholders will be notified. Where new or amended measures are proposed, the relevant EMP/s will be updated accordingly by the EHS Officer and the PMU should be informed at the earliest opportunity.

579. **Corrective Action Reports** A corrective actions report is prepared on foot of any non-conformances identified during environmental monitoring, inspections and/or audits on site. The corrective actions report will describe in detail the cause and effect of a non-conformance on site and describe the recommended corrective action that is required to remedy it. An appropriate timeline for closing out the corrective actions will be identified by the contractor in their SEMP/s as well as arrangements for the EHS Officer verifying the corrective actions report and informing appropriate authorities and stakeholders in a timely manner.

12. Emergency Incidents

580. **Overview.** Emergency incidents are those occurrences that give rise to significant negative environmental effects including but not limited to the following:

(i) Any malfunction of any mitigation measure and/or environmental protection system;
(ii) Any emission that does not comply with the requirements of the contract and relevant licenses;
(iii) Any circumstance with the potential for environmental pollution; or
(iv) Any emergency that may give rise to environmental effects (e.g. significant spillages or fire outbreak).

581. **Spill Control Measures**. Every effort will be made to prevent pollution incidents associated with spills during the construction of the proposed development. The risk of oil/fuel spillages will exist on the site and any such incidents will require an emergency response procedure. The following steps provide the procedure to be followed in the event of an oil/fuel spill occurring on site:

(i) Identify and stop the source of the spill and alert people working in the vicinity;
(ii) Notify the EHS Officer immediately giving information on the location, type and extent of the spill so that they can take appropriate action;
(iii) If applicable, eliminate any sources of ignition in the immediate vicinity of the incident;

(iv) Contain the spill using the spill control materials, track mats or other material as required. Do not spread or flush away the spill;
(v) If possible, cover or bund off any vulnerable areas where appropriate such as drains, watercourses and/or sensitive habitats;
(vi) If possible, clean up as much as possible using the spill control materials;
(vii) Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited;
(viii) The EHS Officer shall inspect the site as soon as practicable and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring; and
(ix) The EHS Officer will notify the appropriate stakeholders such as KWASA, DOE, or KCC.

582. Environmental incidents are not limited to just fuel spillages. Therefore, any environmental incident must be reported, recorded and investigated.

583. **Emergency Incident Response Plan.** A set of standardized emergency response procedures will govern the management of emergency incidents. The contractor will be required to detail emergency incident response procedures in the SEMP/s and to develop an Emergency Incident Response Plan. The Emergency Incident Response Plan will contain emergency phone numbers and the method of notifying local authorities, statutory authorities and stakeholders. Contact numbers for key personnel will also be included therein. Contractors will be required to adhere to and implement these procedures and ensure that all staff and personnel on site are familiar with the emergency arrangements. In the case of work required in an emergency, or which if not completed would be unsafe or harmful to workers, the public or local environment, KWASA will be informed as soon as reasonably practicable of the reasons and likely duration. Examples may include where the ground needs stabilizing if unexpected ground conditions are encountered, concrete pouring taking longer than anticipated due to delayed deliveries or equipment failure.

584. In the event of an emergency incident occurring, the contractor will be required to investigate and provide a report including the following, as a minimum. A description of the incident, including location, the type and quantity of contaminant and the likely receptor(s);
(i) Contributory causes;
(ii) Negative effects;
(iii) Measures implemented to mitigate adverse effects; and
(iv) Any recommendations to reduce the risk of similar incidents occurring.

585. The contractor will consult with the relevant statutory authorities, stakeholders and relevant parties such as Bangladesh Police, Department of Fire Service and Civil Defense, the Ambulance Service, the DOE, utilities companies and KCC when preparing and developing response measures. Further, if any sensitive receptor is impacted, the appropriate environmental specialists will be informed and consulted with accordingly. Any response measures will be incorporated into an updated Emergency Incident Response Plan that should be disseminated accordingly to construction staff, and KWASA representative.

586. **Emergency Access**. The contractor will be required to maintain emergency access routes throughout construction and identify site access points for each working area. This should be developed in partnership with the emergency services and documented as part of the SEMPs and Emergency Incident Response Plan.

587. **Extreme Weather Events.** The contractor will consider the impacts of extreme weather events and related conditions during construction. The contractor will use a short to medium range weather forecasting service from meteorological department or other approved meteorological data and weather forecast provider to inform short to medium term program management, environmental control and mitigation measures. The SEMP/s should consider all measures deemed necessary and appropriate to manage extreme weather events and should specifically cover training of personnel and prevention and monitoring arrangements for staff. As appropriate, method statements should also consider extreme weather events where risks have been identified, e.g. construction works adjacent to river Rupsha.

588. **Unexpected Discoveries (chance find procedure).** Consistent with the chance finds protocol discussed in this IEE, the contractor is obliged to put in place appropriate procedures to be employed in the event of encountering unexpected archaeological or cultural heritage assets or subsurface contamination during intrusive ground works. The contractor will be required to develop appropriate procedures as part of their SEMP/s and the EHS Officer will ensure that specialists (e.g. archaeologist) are facilitated to ensure management in accordance with industry best practice and effective compliance with the relevant legislation. All unexpected discoveries will be reported to the appropriate authorities and documented in an appropriate manner.

F. Environmental Performance

1. Sanitation

589. **Effluent Guidelines:** The choice of sanitation technology and design of wastewater treatment begin with a determination of the required level and type of treatment. Project-specific effluent guidelines for sanitation projects should be established based on a clear definition of health objectives and a comprehensive evaluation of alternatives, considering appropriate treatment technologies; quality and quantity of raw wastewater and its variability; available land area for the treatment facility; resources for capital expenditures, training, operation, maintenance, and repair; and availability of skilled operators, maintenance personnel, treatment chemicals, and replacement parts. The selected approach should achieve effluent water quality consistent with applicable national requirements or internationally accepted standards35 and with effluent water quality goals based on the assimilative capacity and the most sensitive end use of the receiving water.

590. Treatment standards usually are either technology standards, which specify the treatment technologies or processes that must be used to meet water quality objectives, or effluent standards, which specify the physical, biological, and chemical quality of the effluent to be produced by the treatment. Effluent standards often set limits on allowable concentrations of biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), nitrogen, phosphorous, etc. Treated Wastewater Re-use and Sludge Management: Treated wastewater and sludge quality for land application should be consistent with WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater and applicable national requirements. Potential impact on soil, groundwater, and surface water, in the context of protection, conservation and long term sustainability of water and land resources should be assessed when land is used as part of any wastewater treatment system. Sludge from a waste treatment plant needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a nonhazardous waste and managed accordingly as described in the Waste Management section of this document.

2. Environmental Monitoring

591. Environmental monitoring programs for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored using internationally recognized standards and procedures. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Additional guidance on applicable sampling and analytical methods for emissions and effluents is provided in the General EHS Guidelines.

3. Occupational Health and Safety Monitoring

592. The working environment should be monitored for occupational hazards relevant to the specific project. Monitoring should be designed and implemented by credentialed professionals experienced in water and sanitation as part of an occupational health and safety monitoring program. Facilities should also maintain a record of occupational accidents and diseases and dangerous occurrences and accidents. Additional guidance on occupational health and safety monitoring programs is provided in the General EHS Guidelines.

X. MONITORING AND REPORTING

593. PMU, with support from PMSC and/or IADC, will monitor the progress of EMP implementation in the different subprojects. The table below illustrates the monitoring plan under the project. The PMU will undertake site inspections and document review to verify compliance with the EMP and progress toward the final outcome. The contractor will conduct day to day implementation of the SEMP. A sample inspection checklist is in Appendix 10.

594. The contractor will submit monthly reports to the PMU. The monthly reports will include compilation of copies of monitoring sheets accomplished and duly signed by the contractor's EHS supervisor (or equivalent) on a daily basis. A sample daily monitoring sheet which can be used by the contractors is in Appendix 11. This monitoring sheet is indicative which can be further enhanced depending on the actual situations at subproject construction sites.

595. PMU, with support from PMSC and/or IADC, shall accomplish semi-annual environmental monitoring report (SEMRs), which shall be submitted to ADB for review and disclosure on ADB website. Submission of SEMR will continue until ADB issues a project completion report. The template for the SEMR is attached as Appendix 12.

596. ADB will carry out the following monitoring actions to supervise the project implementation:

(i) On a need basis, conduct site visits for subproject with potential adverse environmental or social impact;
(ii) Conduct supervision missions with detailed review by ADB's environment/social safeguard specialists and/or officers and/or consultants for subprojects with adverse environmental and social impacts;
(iii) Review the SEMRs submitted by PMU to ensure that adverse impacts and risks are mitigated as planned in the EMP;
(iv) Work with KWASA to rectify to the extent possible any failures to comply with its environmental safeguard commitments, as covenanted in the loan agreement and

elaborated in all environmental safeguard documents; and formulate and implement a corrective action plan to re-establish compliance as appropriate; and

(v) Prepare a project completion report that assesses whether the objective and desired outcomes of the safeguard plans have been achieved, taking into account the baseline conditions and the results of monitoring.

597. ADB's monitoring and supervision activities are carried out on an on-going basis until a project completion report is issued. ADB issues a PCR within 1-2 years after the project is physically completed and in operation.

Table 49: Environmental Monitoring Plan

Sl. No.	Monitoring Attributes	Parameters to be Monitored[a]	Location	Frequency	Standards	Responsibility	
						Implementation	Implementation
1. Pre-Construction Phase							
1.1	Land Acquisition and Resettlement	Ensure that PAPs get compensation as per RP; and Resettlement of PAPs as per the procedure of RP.	For all the subproject areas (STPs, Sewage Pumping Station and Sewer Network)	During pre-construction period	As per RP	KWASA/DC/ PMSC	PMU, PMSC
1.2	Disruption of Utilities/services	Ensure that the respective authority of utility service providers and consumers are informed in time; and Inspect that utilities are being relocated at the designated site maintaining proper safety measures	Subproject 1 and Subproject 2 (Sewage Pumping Station and Sewer Network)	Monthly - prior to start of construction	Utility relocation plan	KWASA for water supply pipelines; PDB/REB for electricity; and BTCL	PMU, PMSC
1.3	Tree Removal	Monitoring activities; Check whether proper compensation as mentioned in RP is received by PAPs.	For all the subproject areas (STPs, Sewage Pumping Station and Sewer Network)	During tree felling and site clearing operations	Tree plantation program and RP	Contractor	PMU, PMSC
1.4	Consents, Permits, NOCs, Clearances, etc.	Checked all copies of permit, clearance and NOCs.	For all the subproject areas (STPs, Sewage Pumping Station and Sewer Network)	Once in a year; prior to start of construction	Locational Clearance ECC Road cutting permit	Contractor	PMU, PMSC
1.5	Community Awareness Program	Confirms that Contractor arrange awareness program	At the community area and project site office	Every six months	Record of attendees list Photolog	Contractor	PMU, PMSC
1.6	EMP Implementation Training	Minutes of workshop, attendance list and presentation review	At the project site office	During pre-construction period	Record of attendees list Photolog	Contractor, PMSC	PMU, PMSC
2. Construction Phase							
2.1	Landscape and Visual	Consultation with adjacent households and KWASA authority to get opinion on work being completed.	For all the subproject areas (STPs, Sewage Pumping Station and Sewer Network)	Construction stage/ Monthly inspection	Monitoring	Contractor	PMU, PMSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored[a]	Location	Frequency	Standards	Responsibility	
						Implementation	Implementation
2.2	Drainage Congestion	Construct drainage structures as per the design; and Control erosion and siltation.	Construction camp, work sites and internal roads	Weekly during monsoon	EMP; Complaints from Community	Contractor	PMU, PMSC
2.3	Construction Camps, Storage Areas	Undertake good housekeeping practices inspection weekly and report results and record what actions taken to mitigate	Construction camps, Stockpile areas and storage sites	Inspection	Approved location plan; Construction method; No complaints received; No dumped wastes and litter at work sites at all time.	Contractor	PMU, PMSC
2.4	Public Disturbance	Program of Performance Inventory of utilities, signs and barriers, Access to paths, steps, bridges, crossings or drives for all entrances to property; Complaints from stakeholders and affected people Records of public consultation	Throughout the project area specially at road excavation sites.	Prior to start of civil works (per pipe section) During pipe laying. As work progress.	EMP; Zero accident record; No complaints.	Contractor	PMU, PMSC
2.5	Soil Erosion and Siltation	Extent and degree of erosion	Site for excavation, disposal, cut and fill, and land clearing activities for site levelling and internal roads.	Whenever necessary during the monsoon	EMP No complaints.	Contractor	PMU, PMSC
2.6	Soil Quality	Heavy metals (Cr, Pb, Cd), Oil and Grease	Two random places at Material storage sites, 2 random places at each STP sites and 2 random sections at sewer network	Before, in the middle of and after the Construction period	USEPA	Contractor through a nationally recognized laboratory	PMU, PMSC
2.7	Air Quality	SPM, PM2.5, PM10, SO2, NOx, CO	Construction camps/ site locations of all subproject areas	Quarterly/year for 3 years at 4 locations	Bangladesh Standards for Ambient Air Quality Schedule-2; Rule 12,	Contractor through a nationally	PMU, PMSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored[a]	Location	Frequency	Standards	Responsibility	
						Implementation	Implementation
					Environment Conservation Rules of 1997	recognized laboratory	
2.8	Noise Level	Equivalent day and nighttime	Construction camps/ stack yard/ site locations of all subproject areas	Quarterly/year for 3 years at 4 locations during day and night	Bangladesh Standards for Noise, Schedule 4; Rule 12, Environment Conservation Rules, 1997	Contractor through a nationally recognized laboratory	PMU, PMSC
2.9	Groundwater quality (for construction and drinking purposes)	GW level, pH, TDS, TSS, hardness, Ammonia, Nitrate, Phosphate, and Coliforms.	Groundwater source at STP, Sewage Pumping Station sites	Quarterly/year for 3 years at 4 locations	National Standard for Drinking water	Contractor through a nationally recognized laboratory	PMU, PMSC
2.10	Water Quality (surface water)	Water temp., DO, BOD5, COD, Nitrate, phosphate, salinity, faecal coliform and heavy metals (Cr, Cd, Pb).	Rupsha river (Labonchora)/ Canal (Khulna- Satkhira STP) and Sewage Pumping Station location; Sampling point to be determined by the Environmental Safeguard Consultant	Quarterly/year for 3 years at 4 locations	National Standard for Inland Surface water	Contractor through a nationally recognized laboratory	PMU, PMSC
2.11	Fish Diversity	Confirm not to turbid the surface water; and Yield and impacts on fish species	Rupsha river (Labonchora)/ Canal (Khulna- Satkhira STP)	Once in a year during construction period	Interviews and consultations, including with fisheries department	PMU with support from Environmental Safeguard Consultant of PMSC	PMU, PMSC
2.12	Tree Plantation	Ensure that tree plantation plan is followed properly during planting seedlings of 3,960 trees.	For all the subproject areas (STPs, Sewage Pumping Station and Sewer Network)	Periodic at the end of the construction of each components.	Tree Plantation Plan	Contractor	PMU, PMSC
2.13	Waste Management	Check storage, transportation, disposal, handling of hazardous waste; Waste and effluents to be collected and disposed safely from all camps;	Construction sites, labor camps and work sites	Weekly	Contract provisions; EMP; No complaints	Contractor	PMU, PMSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored[a]	Location	Frequency	Standards	Responsibility	
						Implementation	Implementation
		Waste and garbage from bridge construction site to be disposed safely.					
2.14	Socioeconomic benefit	Local labor employment, income level status	At the construction areas during construction period.	Once in a month during construction period.	Primary survey and consultations	PMU, PMSC (by the Social Safeguard Officer)	PMU
2.15	Community Health and Safety	Access to paths, steps, bridges, crossings or drives for all entrances to property; Complaints from stakeholders and affected people; Records of disclosure and public consultations; Control movement of project traffics especially at dense populated areas such as school, bazars etc. to avoid any accident.	Throughout the project area specially at road excavation sites.	Prior to start of civil works (per pipe section); During pipe laying; As work progress	Contract provisions; EMP; Zero accident record; No complaints.	Contractor	PMU, PMSC
2.16	Occupational Health and Safety	Check quality of food and accommodation at construction camp. Check safe water supply, hygienic toilet at camps and construction of drain at camp sites. Check toilets are close to construction site and separate toilet for female workers; First-Aid kit with required tools and medicine; The heavy construction material to handled and stored safely putting due care on public safety; Heavy construction materials at bridge construction site to be	Construction sites, labor camps and work sites	Regularly	Contract provisions; EMP; Zero accident record; No complaints.	Contractor	PMU, PMSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored[a]	Location	Frequency	Standards	Responsibility	
						Implementation	Implementation
		stored and handled safely; and Check of personal protective equipment (PPE) for worker at the sites.					
3. Operation and Maintenance Phase							
3.1	Community Health and Safety	Incidents records, Records of complaining system;	Localities along the project sites	Regularly	Zero incidents of Project related infections/ diseases.	Contractor	KWASA
3.2	Occupational Health and Safety	Incidents records, Records at medical care centers.	STPs and Sewage Pumping Station	Regularly	Zero medical complaint/ assistance, Zero incident reports	Contractor	KWASA
3.3	Odour	Record odour complaints received from neighboring areas.	STPs and Sewage Pumping Station	Regularly	No complaints.	Contractor	KWASA
3.4	Surface and Groundwater Quality	SW: Water temp., DO, BOD5, COD, Nitrate, phosphate, salinity, faecal coliform and heavy metals (Cr, Cd, Pb). GW: GW level, pH, TDS, TSS, hardness, Ammonia, Nitrate, Phosphate, and Coliforms.	River water Rupsha River/Labonchora/ Canal; Groundwater (STPs and Sewage Pumping Station)	River water- Twice a year (pre monsoon and post monsoon) during O&M period. GW- Quarterly/year for 1st year and half yearly for rest of the period.	National Standard for Inland Surface water Drinking water.	Contractor through a nationally recognized laboratory	KWASA
3.5	Influent Water Quality (source related)	pH, TDS, TSS, hardness, BOD, fecal coliform, total nitrogen, total phosphorus, heavy metals, temperature, DO, hydrocarbons, mineral oils, phenols, cyanide	At the intake point	Daily, during the operation of facilities	Bangladesh Standards for Industrial Unit and Project Effluent, Schedule 9 & 10; Rule 13, Environment Conservation Rules, 1997 (In-house standard need to be set up by KWASA)	Contractor	KWASA
3.6	Water Quality (for disinfectant optimization)	pH, Biochemical Oxygen Demand (BOD), temperature, Chlorine Demand, Mixed Liquor Suspended Solids (MLSS),	Chlorination tank	Daily, during the operation of the facilities	Bangladesh Standards for Industrial Unit and Project Effluent, Schedule 9 & 10; Rule 13, Environment	Contractor	KWASA

Sl. No.	Monitoring Attributes	Parameters to be Monitored[a]	Location	Frequency	Standards	Responsibility	
						Implementation	Implementation
		Mixed Liquor Volatile Suspended Solids (MLVSS)			Conservation Rules, 1997 (In-house standard need to be set up by KWASA)		
3.7	Effluent Water Quality	pH, BOD, temperature, Residual Chlorine, Mixed Liquor Suspended Solids (MLSS),	At the discharge point and one kilometer away (downstream) from the discharge point	Daily, during the operation of the facilities	Bangladesh Standards for Industrial Unit and Project Effluent, Schedule 9 & 10; Rule 13, Environment Conservation Rules, 1997 (In-house standard need to be set up by KWASA)	Contractor	KWASA
3.8	Sludge Monitoring	Sludge volume Index (SVI), sludge quality (incl. presence of Heavy metals), pH, BOD, fecal coliform, helmiths,	At the location of the sludge drying bed at the treatment plant	Quarterly/year for 1st year and Twice/year over last 2 years	Bangladesh Standards and Guidelines for Sludge Management.	Contractor	KWASA
3.9	Air Quality	SPM, PM2.5, PM10, SO2, NOx, CO	One sampling location from each Treatment Plant and 2 random samples from Sewage Pumping Station sites.	Quarterly/year for 1st year and half yearly for rest of the period at 4 locations.	Bangladesh Standards for Ambient Air Quality Schedule-2; Rule 12, Environment Conservation Rules of 1997	Contractor through a nationally recognized laboratory	KWASA
3.10	Noise Level	Equivalent day and nighttime	One sampling location from each Treatment Plant and 2 random samples from Sewage Pumping Station sites.	Quarterly/year for 1st year and half yearly for rest of the period at 4 locations during day and night	Bangladesh Standards for Noise, Schedule 4; Rule 12, Environment Conservation Rules, 1997	Contractor through a nationally recognized laboratory	KWASA
3.11	Survival rate of tree plantation	Survival rate	In the areas where plantation is designed and materialized.	Half yearly for 2 years	Inspection to ensure proper plantation with proper species.	KWASA/NGOs/ Contractor	KWASA
3.12	Fish diversity	Yield and impacts on fish species	Rupsha river (Labonchora)/ Canal (Khulna- Satkhira STP); sampling point or consultation to be determined by the Environmental Safeguard Consultant	Half yearly for 3 consecutive years during operational period	Interviews and consultations, including with fisheries department	PMU with support from Environmental Safeguard Consultant (SC)	KWASA

Sl. No.	Monitoring Attributes	Parameters to be Monitored[a]	Location	Frequency	Standards	Responsibility	
						Implementation	Implementation
3.13	Socioeconomic benefit	Local labor employment, income level status.	Admin. Offices during operational period.	Once in a year during operation of the project.	Primary survey and consultations	KWASA (by the Social Safeguard Officer)	KWASA

[a] Applicable standards to be followed for environmental data parameters are in Table 6, Table 7 and Table 8 in Section II above.

G. Capacity Building

598. The present capacity of KWASA on safeguards planning and implementation is not adequate to handle safeguard issues. To ensure effective implementation of environmental aspects as outlined in this IEE report, an environmental safeguard officer/responsible person will be recruited to oversee the EMP implementation.

599. PMSC Environmental Specialists will train and assist the KWASA according to the training program outlined below, to ensure smooth implementation and monitoring of the EMP.

600. The proposed capacity building program will include:

(i) sensitization of KWASA staff and stakeholders on environmental management, including on the ADB, and Government of Bangladesh requirements on environment;
(ii) capacity building programs on environmental issues including quality monitoring; and
(iii) capacity building programs to improve the capability of environment staff at all levels in carrying out/monitoring and implementing environmental management measures for the Project.

601. PMSC Environmental Specialist will provide the basic training required for environmental awareness followed by specific aspects of infrastructure improvement projects along with environmental implications for projects. Specific modules customized for the available skill set will be devised after assessing the capabilities of the members of the Training Program and the requirements of the Project. The entire training would cover basic principles of environmental assessment and management mitigation plans and programs, implementation techniques, monitoring methods and tools. The proposed training program along with the frequency of sessions is presented in the following Table.

Table 50: Training Modules for Environmental Management

Module	Frequency of Sessions	Target participants	Conducting Agency
1. Introduction and Sensitization to Environmental Issues (One-day workshop): • ADB Safeguards Policy Statement; • Government of Bangladesh applicable safeguard laws, regulations and policies including but not limited to core labor standards, OHS, etc.; • Sensitization on environmental concerns, environmental impacts of urban infrastructure improvement projects.	Once during Pre-construction	KWASA engineers / management team, officials responsible for implementing the Project, and other KWASA Officials.	PMSC Environmental Specialist
2. Project training on hazards, health, safety and environmental issues pertaining to the Project (Two days' workshop and site visits):	Once before and during construction	KWASA engineers and management professionals, to be involved in on-site execution and	PMSC Environmental Specialist

Module	Frequency of Sessions	Target participants	Conducting Agency
• EMP mitigation and monitoring measures; • Roles and responsibilities; • Public relations, • Consultations; • Grievance redress; • Monitoring and corrective action planning; • Reporting and disclosure; • Construction site standard operating procedures (SOP); • Chance find (archeological) protocol; • Health and safety plan; • Traffic management plan; • Waste management plan; • Site clean-up and restoration.		operation of the proposed facilities.	
3. EMP implementation (Two-day session and site visit): • Implementation of EMP Identification of environment impacts Monitoring and reporting for EMP public interactions and consultations Coordination for consents with various departments Monitoring formats filling and review of impacts.	Once during construction stage	KWASA Engineers, Officials responsible for implementing the Project, and other KWASA / PMSC staff	PMSC Environmental Specialist

H. Monitoring Cost

602. Monitoring cost has been estimated as far reasonably as possible in the following table. Costs associated with activities that are borne by the PMU, PMSC and/or IADC, such as fish diversity and socioeconomic condition survey, are not included in the estimates. Moreover, costs integral to the contractors' costs (during construction phase), and operational cost of running the pumping stations and STPs (during the operation phase) are not included as well. Examples of these are the inherent daily operating expenses and manpower costs, including the cost for hiring or appointing EHS officer/s.

Table 51: Tentative Cost Estimate for Environmental and Other Measures

SL.	Particulars	Parameter	Component	Unit	Quantity	Rate (BDT)	Amount (BDT)
A. Mitigation Measures during Construction Phase							
1.	Environmental mitigation/ enhancement measures integrated into the designs and costs included as part of civil works	Covered under BOQ of Construction Document					
2.	Tree Plantation Program	Number and Condition	STP and Sewage Pumping Station sites	No of Tree	4,000	300.0	1,200,000.00
3.	Pollution Control Measure	Air, dust, noise and water pollution control measure	STP, Sewage Pumping Station and Sewer Components	Per Site	3	100,000.0	300,000.00
4.	Occupational Health and Safety	PPE such as vest, helmet, gumboot, musk and first aid box	STP, Sewage Pumping Station and Sewer Components	Per Site	3	300,000.0	900,000.00
					Sub Total (A. Mitigation Measures)		**2,400,000.00**
B. Monitoring Measures during Construction							
1.	Air Quality	SPM, PM2.5, PM10, SO2, NOx and CO (Quarterly/year for 3 years at 4 locations)	STP and Sewage Pumping Station and Sewer Components	No.	Subproject-1: 4X1X3=12 Subproject-2: 4X1X3=12 Subproject-3: 4X2X3=24 Total= 48	25,000.0	1,200,000.00
2.	Noise Level	Leq (dB) (Quarterly/year for 3 years at 4 locations during day and night)	STP and Sewage Pumping Station and Sewer Components	No.	Subproject-1: (4X1X3) X2=24 Subproject-2: (4X1X3) X2=24 Subproject-3: (4X2X3) X2=48 Total= 96	3,000.0	288,000.00
3.	Surface Water Quality	Water temp., DO, BOD5, COD, Nitrate, phosphate, salinity, fecal coliform and heavy metals (Cr, Cd, Pb) (Quarterly/year for 3 years at 4 locations)	STP and Sewage Pumping Station sites	No.	Subproject-1: 4X1X3=12 Subproject-2: 4X1X3=12 Subproject-3: 4X2X3=24 Total= 48	15,000.0	720,000.00
4.	Groundwater Quality (drinking purpose)	GW level, pH, TDS, TSS, hardness,	STP and Sewage Pumping	No.	Subproject-1: 4X1X3=12	10,000.0	480,000.00

SL.	Particulars	Parameter	Component	Unit	Quantity	Rate (BDT)	Amount (BDT)
		Ammonia, Nitrate, Phosphate, and Coliforms (Quarterly/year for 3 years at 4 locations)	Station and Sewer Components		Subproject-2: 4X1X3=12 Subproject-3: 4X2X3=24 Total= 48		
5.	Soil quality	Cr, Cd, Pb and Oil and Grease (Before, in the middle of and after the Construction period from 8 locations)	STP and Sewage Pumping Station and Sewer Components	No.	Subproject-1: 2X3=6 Subproject-2: 2X3=6 Subproject-3: 4X3=12 Total=24	15,000.0	360,000.00
					Sub Total (B. Monitoring Measures during Construction)		**3,048,000.00**
C. Monitoring Measures during Operation							
1.	Air Quality	SPM, PM2.5, PM10, SO2, NOx and CO (Quarterly/year for 1st year and half yearly for rest of the period at 4 locations)	STP and Sewage Pumping Station Sites	No.	Subproject-1: 4X1X1+2X1X1=6 Subproject-2: 4X1X1+2X1X1=6 Subproject-3: 4X2X1+2X2X2=16 Total= 28	25,000.0	700,000.00
2.	Noise level	Leq (dB) (Quarterly/year for 1st year and half yearly for rest of the period at 4 locations during day and night)	STP and Sewage Pumping Station Sites	No.	Subproject-1: (4X1X1+2X1X1)X2=12 Subproject-2: (4X1X1+2X1X1)X2=12 Subproject-3: (4X2X1+2X2X2)X2=32 Total= 56	3,000.0	168,000.00
3.	Surface Water Quality	Water temp., DO, BOD5, COD, Nitrate, phosphate, salinity, fecal coliform and heavy metals (Cr, Cd, Pb) (Twice a year (pre monsoon and post monsoon) for 3 years at 2 locations)	STP sites	No.	Subproject-3: 2X2X3=12	15,000.0	180,000.00
4.	Groundwater Quality (drinking purpose)	GW level, pH, TDS, TSS, hardness, Ammonia, Nitrate, Phosphate, and Coliforms (Quarterly/year for 1st year and half yearly for	STP and Sewage Pumping Station sites	No.	Subproject-1: 4X1X1+2X1X1=6 Subproject-2: 4X1X1+2X1X1=6 Subproject-3: 4X2X1+2X2X2=16 Total= 28	10,000.0	280,000.00

SL.	Particulars	Parameter	Component	Unit	Quantity	Rate (BDT)	Amount (BDT)
		rest of the period at 4 locations)					
5.	Survival Rate of Plantation	Number and Condition (10% of total saplings)	STP and Sewage Pumping Station sites	No of Tree	400	300.00	120,000.00
Sub Total (C. Monitoring Measures during Operation)							**1,448,000.0**
D. Capacity Building							
1.	Introduction and sensitization to environmental issue	Pre-construction	-	LS	-	-	50,000.00
2.	Project training on hazards, health, safety, and environmental issues	Pre-construction and Construction	-	LS	-	-	100,000.00
3.	EMP Implementation	Construction	-	LS	-	-	100,000.00
Sub Total (D. Capacity Building)							**250,000.00**
Grand Total (A+B+C+D)							**7,146,000.00**
Total (in $) @ 84.71 Taka per $							**$84,357.90**

I. Other Reporting Obligations

1. Incident Investigation Reports

603. The contractor will inform the PMU of all emergency incidents immediately and prepare an initial report within 24 hours setting out the details of the incident and cause(s) if known. The contractor will be required to complete the Environmental Incident Report and any further documentation requested by the PMU in relation to the incident within 7 days of the incident occurring. The Contractor will respond to all comments made by the ER on any incident. The Environmental Incident Report will contain details of the incident including the location, known and suspected causes and weather conditions. It will define the scale and effects (short, medium, long term, temporary/permanent) as well as required corrective actions and mitigation/ remediation/compensation measures (as appropriate).

2. Environmental Records

604. The contractor shall maintain records of all environmental documentation including monitoring, test results, method statements and plans. All records will be kept up to date and be made available for audits, inspections and periodical reporting. The contractor will maintain the following environmental records (as a minimum) that will be made available for inspection to the PMU and the relevant authorities, if required:

(i) Management Plans;
(ii) Records of environmental incidents;
(iii) Monthly environmental reports;
(iv) Records of environmental training;
(v) Register of environmental complaints;
(vi) Corrective action reports;
(vii) Environmental inspection and audit reports;
(viii) All monitoring data;
(ix) Waste and chemical inventories; and
(x) Health and safety records.

XI. CONCLUSION AND RECOMMENDATION

605. This IEE report of the project has been prepared based on preliminary information, including review of technical specifications of the subprojects as included in available final detailed engineering designs of sewage network packages and preliminary design of the STP package. This IEE report has also been prepared based on available draft bidding documents, and primary and secondary information of the subproject sites and their surroundings.

606. The findings of this IEE study have determined the likely nature and extent of environmental impacts and identified environmental control measures for incorporation into the design and implementation of the proposed project and effluent reuse or disposal option to ensure compliance with environmental legislation and standards during construction and operation phase.

607. The key environmental outcomes accrued from the environmental considerations and analysis during the IEE process and the implementation of environmental control measures of the project have been adequately explained in this report. The extent of adverse impacts is expected to be local, confined within the project's main areas of influence, waste disposal sites, and the

routes to and from these sites. With mitigation measures in place and ensuring that the bulk of earthworks are completed before the onset of the rainy season, the potential adverse impacts during construction would be site-specific. This study has predicted that with implementation of the recommended mitigation measures, the project would be environmentally acceptable to the surrounding population and environmental sensitive receivers. Planning principles and design considerations have been reviewed and incorporated into the site planning process whenever possible; thus, environmental impacts as being due to the project design or location were not significant.

608. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. Mitigation will be assured by a program of environmental monitoring to ensure that all measures are implemented, and will determine whether the environment is protected as intended. It will include observations on- and off-site, document checks, and interviews with workers and beneficiaries. Any requirements for corrective action will be reported to the ADB.

609. The stakeholders were involved in developing the IEE through discussions on-site and public consultation, after which views expressed were incorporated into the IEE and in the planning and development of the project. The IEE will be made available at public locations in the city and will be disclosed to a wider audience via the ADB and KWASA websites. The consultation process will be continued and expanded during project implementation to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation. A grievance redress mechanism is described within the IEE to ensure any public grievances are addressed quickly. The PMU will be responsible for monitoring. The PMSC will submit monthly monitoring reports to PMU, and the PMU will send semi-annual monitoring reports to ADB. ADB will post the environmental monitoring reports on its website.

610. The EMP will assist the PMU and contractors in mitigating the environmental impacts, and guide them in the environmentally sound execution of the proposed project. The EMP will also ensure efficient lines of communication between the implementing agency, project management unit, and contractors. A copy of the EMP shall be kept on-site during the construction period at all times. The EMP shall be made binding on all contractors operating on the site, and will be included in the contractual clauses. Non-compliance with, or any deviation from, the conditions set out in this document shall constitute a failure in compliance.

611. The people of Khulna City Corporation (KCC) will be the major beneficiaries of this project. The benefits of improved sanitation translate into improved health, an increase in productivity, fewer days absent from school for children, and improved quality of life. In addition to improved environmental conditions, the project will reduce exposure to climate extremes. Centralized systems of waste water management will improve community health and hygiene, particularly in socially deprived groups, and reduce financial burden of KCC. People would spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health. Therefore, the proposed project is unlikely to cause significant adverse impacts and net environmental and health benefits to citizens of KCC will be positive. The potential impacts that are associated with design, construction and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures.

612. Therefore, the proposed project is unlikely to cause significant adverse impacts and net environmental benefits to citizens of KCC will be positive. The potential impacts that are associated with design, construction and operation can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended

mitigation measures and procedures. Based on the findings of the IEE, there are no significant impacts and the classification of the project as Category "B" is confirmed. No further special study or detailed environmental assessment needs to be undertaken to comply with ADB SPS. However, per Environment Conservation Act, 1995 (ECA, 1995) and Environment Conservation Rules (ECR, 1997) of Bangladesh, the project is categorized as "Red" category. Hence, preparation of an environmental impact assessment (EIA) based on DOE approved terms of reference is mandatory. Upon approval of the submitted EIA, ECC must be obtained from the DOE prior to award of civil works contracts.

613. This IEE has also been updated to reflect the results of supplemental baseline data gathering and meaningful consultations conducted in subproject sites, which were deferred or delayed due to limitations brought about by the COVID-19 pandemic in 2020.

614. In particular for the STPs and FSTP, this IEE is based on the preliminary designs of these subproject components. Therefore, this IEE report including the EMP shall be updated based on the final detailed design of the STPs and FSTP. No contract for any of these STP subprojects, including the FSTP, shall be awarded unless this IEE report is updated based on the following:

STP:

(i) Follow up consultations with, and acceptability of the final detailed design of the STP subprojects by all receptors surrounding the STP sites;
(ii) Final detailed design, including, but not limited to, the following:
  a. characterization of influent and description of desired treated effluent;
  b. sizing of final components, final volumetric flow rates, and final technology selection;
  c. engineering calculations for the treatment process; and
  d. final layout of STP components relative to the location or area of the two STP sites;
(iii) Final description of sludge treatment and management, including expected volume of generated sludge;
(iv) Final disposal area of treated sludge. If final disposal site is in existing landfill site/s, environmental and social compliance audit per ADB SPS shall be undertaken by external experts to the existing landfill site, including on-site assessment, to identify past or present concerns related to impacts on the environment, involuntary resettlement, and Indigenous Peoples. The objective of the compliance audit is to determine whether actions were in accordance with ADB's safeguard principles and requirements, and to identify and plan appropriate measures to address outstanding compliance issues. Where noncompliance is identified, a corrective action plan agreed on by ADB and KWASA on behalf of the government will be prepared.;
(v) Confirmation that relevant government agency approval (e.g. Ministry of Agriculture, and/or Department of Environment, and/or other mandated agencies) on the use of sludge as compost or fertilizer will be obtained if such option is selected as an alternative for sludge disposal; and
(vi) Description of operation and maintenance (O&M) procedures in ensuring compliance with environmental standards on noise, air emission and effluents, and with the measures to avoid or mitigate all forms of nuisance such as odor to the surrounding communities.

FSTP:

(i) Follow up consultations with, and acceptability of the final detailed design of the FSTP by all receptors surrounding the STP-1 site (location of FSTP);
(ii) Actual fecal sludge quantification and characterization necessary for the final design considerations;
(iii) Treatment design criteria;
(iv) Engineering design in terms of final components, final system configuration and hydraulic profile, and final technology selection;
(v) Engineering calculations for the treatment process;
(vi) Final description of sludge treatment and management, including expected volume of generated sludge and final disposal site. If final disposal site is in existing landfill site/s, environmental and social compliance audit per ADB SPS shall be undertaken by external experts to the existing landfill site, including on-site assessment, to identify past or present concerns related to impacts on the environment, involuntary resettlement, and Indigenous Peoples. The objective of the compliance audit is to determine whether actions were in accordance with ADB's safeguard principles and requirements for KWASA on behalf of the government as borrower, and to identify and plan appropriate measures to address outstanding compliance issues. Where noncompliance is identified, a corrective action plan agreed on by ADB and KWASA on behalf of the government will be prepared; and
(vii) Description of O&M procedures in ensuring compliance with environmental standards on noise, air emission, and effluents; and with all measures to avoid or mitigate all forms of nuisance such as odor to the surrounding communities.

APPENDIX-1: Rapid Environmental Assessment (REA) checklist (Sewerage Treatment Plant)

Instructions:

(i) The project team completes this checklist to support the environmental classification of a project. It is to be attached to the environmental categorization form and submitted to the Environment and Safeguards Division (SDES) for endorsement by the Director, SDES and for approval by the Chief Compliance Officer.

(ii) This checklist focuses on environmental issues and concerns. To ensure that social dimensions are adequately considered, refer also to ADB's (a) checklists on involuntary resettlement and Indigenous Peoples; (b) poverty reduction handbook; (c) staff guide to consultation and participation; and (d) gender checklists.

(iii) Answer the questions assuming the "without mitigation" case. The purpose is to identify potential impacts. Use the "remarks" section to discuss any anticipated mitigation measures.

Country/Project Title: Bangladesh/ Khulna Sewerage System Development Project

Sector Division: Urban Development

Components:

1.	Construction of Sewage Network, Gravity Mains and Sewage Pumping Stations (3 locations) at Khulna City (SD1 and SD6).
2.	Construction of Sewage Network, Gravity Mains and Sewerage Pumping Stations (5 locations) at Khulna City (SD2, SD3, SD4, and SD7).
3.	Construction of Sewage Treatment Plant (STP-1 and STP-2).

Screening Checklist for Component 3:

Screening Questions	Yes	No	Remarks
B. Project Siting Is the project area…			
Densely populated?	√		Package1 and 3 will be taking place in densely populated areas, but areas under Package 2 are in the city outskirt having no such inhabitation and surrounding areas are very scarcely inhabited.
Heavy with development activities?	√		Khulna is the 3rd largest city of Bangladesh, with lots of developmental activities, including housing and infrastructure construction taking place in recent years.
Adjacent to or within any environmentally sensitive areas?			
Cultural heritage site		√	STPs will be constructed into KWASA acquired land areas which are neither adjacent nor within any environmentally sensitive areas of listed types. Further,
Protected Area		√	

Screening Questions	Yes	No	Remarks
Wetland		√	the sewer network will be laid within the ROW of existing road network, which will not pass by any environmentally sensitive areas, including the type of sites listed here. In fact, neither the Khulna city nor its surroundings possess any of the listed sites/areas in its territory. This has been ascertained by several field visits made in and around the proposed sites.
Mangrove		√	
Estuarine		√	
Buffer zone of protected area		√	
Special area for protecting biodiversity		√	
Bay		√	
Potential Environmental Impacts Will the Project cause…			
impairment of historical/cultural monuments/areas and loss/damage to these sites?		√	Field visits to the proposed sites revealed that a school cum Church is sitting just next to the Khulna-Satkhira STP site under the component 2 of this project. However, appropriate protection measures will be taken during the construction and operational period of the project, and will be included into the respective IEE.
interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?	√		Interference with other utilities and blocking of access to buildings is more likely during construction phase due to sewer network pipe-laying. Potential to making nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc. is also high during operation of pumping stations and STPs. Mitigation measures are included in the Environmental Management Plan (EMP).
dislocation or involuntary resettlement of people?	√		The dislocation/ involuntary resettlement is limited to 24 HHs. However, it will be finalized during Resettlement Plan.

Screening Questions	Yes	No	Remarks
disproportionate impacts on the poor, women and children, Indigenous Peoples or other vulnerable groups?		√	Not anticipated. None of the components of the project will encounter those vulnerable groups, except the sewer network works may temporarily affect the general access to the school building, hospitals, or other sensitive places. But appropriate alternative access to the facilities will be ensured during the implementation period and sites will be restored fully after the construction period. Moreover, contractor will take every measure to engage local poor and women labors wherever possible.
impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?		√	Not anticipated, Project will improve existing sewage collection system and introduce treatment facilities. During the operation phase, discharge will be tested on a regular basis to ensure that effluent quality is within national / international standards.
overflows and flooding of neighboring properties with raw sewage?		√	Not anticipated. Project will develop O & M manual which includes routine maintenance procedures and schedules.
environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?		√	Not anticipated. Project will develop O&M manual which includes sludge management (collection, handling and disposal). Reuse of dewatered and dried sludge will follow internationally-accepted best practices. Industrial waste will not be connected to the sewer line.
noise and vibration due to blasting and other civil works?		√	Project will not involve blasting. Road and site excavation may increase local noise levels during construction phase, however not expected to be significant as project sites of component 1 & 3 are within urban and developed areas and the sites of component 2 falls within two very scarcely inhabited areas. Mitigation measures are included in the EMP.

Screening Questions	Yes	No	Remarks
risks and vulnerabilities related to occupational health and safety due to physical, chemical, and biological hazards during project construction and operation?		√	Not anticipated. Occupational health and safety measures are included in the EMP. Chemicals will not be used during construction and operation activities for component 1 & 3. Chemicals to be used under component 2 in operational activities will follow strict doses and procedures as per national/international standard.
discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to workers?		√	Not anticipated. Chemicals will not be used during construction and operation activities.
inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisances, and protect facilities?		√	Design of pumping stations and STP includes buffer zones. Trees and vegetation will be provided in and around the pumping stations and STPs. Sufficient area will be available for tree plantation.
road blocking and temporary flooding due to land excavation during the rainy season?		√	Contractor is required to develop and implement a traffic management plan. Also, construction activities will be avoided during the monsoon.
noise and dust from construction activities?	√		Anticipated during construction activities. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Good construction practices will mitigate noise and dust, and will be specified in the EMP
traffic disturbances due to construction material transport and wastes?	√		Anticipated during construction activities. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Contractors will be required to develop and implement a traffic management plan.
temporary silt runoff due to construction?		√	Due to excavation and run-off from stockpiled materials. The impacts are negative but short-term and site-specific within a relatively small area and reversible through mitigation measures. Good construction practices will mitigate soil erosion and silt runoff and will be specified in the EMP.

Screening Questions	Yes	No	Remarks
hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		√	Not anticipated. STPs are designed which is above the highest flood level (HFL) information of last 25 years and sewer network will be laid at 3 to 5-meter depth below the ground level. The network system will be fully covered with provisions of manholes at certain distances. So, overflow flooding or any chances of groundwater pollution due to failure in sewerage system are very unlikely. Not anticipated.
deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?		√	Not anticipated. Collected septage and sewage sludge will be treated in the proposed STPs (component 2). The design of the STP ensures sludge and effluent will comply with Bangladesh standards and effluent will be discharged after meeting the set quality to avoid any pollution or hazards to downstream. Reuse of dewatered and dried sludge will follow internationally-accepted best practices that are feasible in-country context.
contamination of surface and ground waters due to sludge disposal on land?		√	Not anticipated. Reuse of dewatered and dried sludge will follow internationally-accepted best practices. Treated sludge maintained complying stringent standard to avoid any contamination to ground or surface water, and will temporarily be stored in dewatering and sludge thickening tank in STPs, and later be used as agricultural manure in the field (which is currently the acceptable way of using sewage sludge).
health and safety hazards to workers from toxic gases and hazardous materials which maybe contained in confined areas, sewage flow and exposure to pathogens in untreated sewage and un-stabilized sludge?		√	Not anticipated. Guidance on workers' health and safety, specifically the use of personal protective equipment and trainings, will be included in the EMP and be followed in field during the implementation period.
large population increase during project construction and operation that causes increased burden on social infrastructure (such as sanitation system)?		√	Not anticipated. The contractor/s will be encouraged to hire local workers from the local labor force. Improved management systems through capacity building and institutional development will ensure reduced burden on services and infrastructure.

Screening Questions	Yes	No	Remarks
social conflicts between construction workers from other areas and community workers?		√	Not anticipated. The contractor/s will be encouraged to hire local workers from the local labor force.
risks to community health and safety due to the transport, storage, and use and/or disposal of materials such as explosives, fuel and other chemicals during construction and operation?		√	Not applicable. Construction will not involve use of explosives and chemicals. Trenching will be done manually.
community safety risks due to both accidental and natural hazards, especially where the structural elements or components of the project are accessible to members of the affected community or where their failure could result in injury to the community throughout project construction, operation and decommissioning?		√	Operational areas will be clearly demarcated and access will be controlled. Only workers and project-concerned members will be allowed to visit the sites.

Subproject Classification as per ADB SPS 2009:

The impacts are minor, local and mostly construction related. No significant irreversible impacts are envisaged on human populations or environmentally sensitive areas including wetlands, forests, grasslands, and other natural habitats. All impacts can be mitigated under the scope of IEE.

Classification: Category B

A Checklist for Preliminary Climate Risk Screening

Country/Project Title: Bangladesh /Khulna Sewerage System Development Project
Sector:
Subsector:
Division/Department:

Screening Questions		Score	Remarks[28]
Location and Design of project	Is siting and/or routing of the project (or its components) likely to be affected by climate conditions including extreme weather related events such as floods, droughts, storms, landslides?	0	
	Would the project design (e.g. the clearance for bridges) need to consider any hydro-meteorological parameters (e.g., sea-level, peak river flow, reliable water level, peak wind speed etc.)?	1	Package 1 and 3 is climate neutral; Package 2 already considered the highest flood level and flood frequency in the site areas.
Materials and Maintenance	Would weather, current and likely future climate conditions (e.g. prevailing humidity level, temperature contrast between hot summer days and cold winter days, exposure to wind and humidity hydro-meteorological parameters likely affect the selection of project inputs over the life of project outputs (e.g. construction material)?	0	
	Would weather, current and likely future climate conditions, and related extreme events likely affect the maintenance (scheduling and cost) of project output(s)?	1	Package-2 considered the torrential rainfall during the monsoon.
Performance of project outputs	Would weather/climate conditions and related extreme events likely affect the performance (e.g. annual power production) of project output(s) (e.g. hydro-power generation facilities) throughout their design life time?	0	

Options for answers and corresponding score are provided below:

Response	Score
Not Likely	0
Likely	1
Very Likely	2

Responses when added that provide a score of 0 will be considered low risk project. If adding all responses will result to a score of 1-4 and that no score of 2 was given to any single response, the project will be assigned a medium risk category. A total score of 5 or more (which include providing a score of 1 in all responses) or a 2 in any single response, will be categorized as high-risk project.

[28] If possible, provide details on the sensitivity of project components to climate conditions, such as how climate parameters are considered in design standards for infrastructure components, how changes in key climate parameters and sea level might affect the siting/routing of project, the selection of construction material and/or scheduling, performances and/or the maintenance cost/scheduling of project outputs.

Result of Initial Screening (Low, Medium, High): Medium
Other Comments: Being a coastal district Khulna is at the forefront of receiving some grim effects of climate change, like increased coastal surges, salinity intrusion, etc. However, the proposed sites for all three components in Khulna city are free from any adverse climatic effects, which have been observed through the information regarding significant hydro-meteorological events, took place in last two decades.

APPENDIX-2: No Mitigation Scenario Checklist

Subproject 1: Construction of Sewage Network, Gravity Mains and Sewage Pumping Stations (3 locations) at Khulna City (SD1 and SD6).

Checklist 1: Scoping Checklist Part 1 - Questions on Project Characteristics

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1. Will construction, operation or decommissioning of the Project involve actions which will cause physical changes in the locality (topography, land use, changes in water bodies, etc)?				
1.1	Permanent or temporary change in land use, land cover or topography including increases in intensity of land use?	**Yes**	Partial changes in land use are anticipated; Sewage Pumping Stations will be constructed on selected open land areas, but the construction of Sewage Collection Network and Gravity Mains will follow the existing road alignment and the sites will be turned to the previous state once the pipe laying works are done.	**No**- The impact will be negligible. The pumping stations will be constructed on open land spaces acquired by the KWASA, and only 24.71 decimal land spaces is required for each Sewage Pumping Station. Though the land spaces earmarked for three pumping stations are now being partially occupied for storing construction materials by some traders, they will move out at any time on notice. Laying pipelines along the existing roads require an MOU with the Khulna City Corporation (KCC) and that will be made before the works are initiated. Land areas or patches to be used for both purposes are already in use for different urban necessities and there are no environmentally sensitive areas or natural habitat in or near the project locations. If tree felling or demolition work is required at any point, proper procedure will be followed as per existing government rule.
1.2	Clearance of existing land, vegetation and buildings?	**Yes**	Insignificant changes in land use in Sewage Pumping Station sites may take place. Temporary structures in Sewage Pumping Station sites may need to demolish or can be used for storage. Vegetation clearance will not be required at Sewage Pumping Station sites. Construction of Sewage Network and Gravity Mains may involve vegetation clearance at some point, but with proper consents or authorization.	**No**- All works related to Sewage Pumping Station will be confined in KWASA's acquired land areas. Construction works of Sewage Network and Gravity Mains must require necessary permission from KCC and relevant govt. departments, wherever applicable. Consent from private property owners may require on case-by-case basis, if the implementation works require temporary use of private land at any places.
1.3	Creation of new land uses?	**Yes**	Partly; Construction of each Sewage Pumping Station will turn an open land area into an organized small building structure facilitating urban utility services.	**No**- Not significant at all. Pipelines will be laid along the exist KCC road in open cut method, and trenchless technology is suggested at critical

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
			The patches along the existing roads for laying pipelines will be turned into the same state once the work is done.	sections in order to minimize the construction effects.
1.4	Pre-construction investigations e.g. boreholes, soil testing?	**Yes**	Soil investigation will be carried out by the contractor before starting the works.	**No**- Necessary pre-construction investigations will be carried out as per standard specifications. Soil investigation will be carry out by the contractor to assess the soil type, soil strata, GW level, soil salinity and other required indicators before starting the works.
1.5	Construction works?	**Yes**	Disruption to traffic flows and sensitive receptors along with nuisance from noise and dust is clearly envisaged during the construction period. Social conflicts between construction workers from other areas and local workers/host communities may arise.	**No** – Temporary work. No significant impact will be envisaged in Sewage Pumping Station sites, as those are KWASA's acquired and confined properties. Still good EHS practices at worksite will be followed all along. The pipelines will be buried below in a trench along the road within the existing right of way (RoW). There are no impacts of pipe laying on permanent/semi-permanent structures is envisaged. Temporary impacts on movable structures within RoW are envisaged as temporary livelihood issues resulting mainly from laying of pipelines in busy commercial areas. Local labour force will be suggested to be used as far as possible to avoid such conflict, if any and proper training on occupational health, safety and sanitation must be provided before engaging into work. These are the general impacts of construction in urban and habitable areas, and there are well developed methods of mitigation that will be suggested in the EMP
1.6	Demolition works?	**No**	It is envisaged primarily that demolition works are not required in any of the sites.	**No –** Temporary structures in Sewage Pumping Station sites can be used as store house or so, if not demolished. Restoration of roads is a part of the project. Prior permission from concerned departments such as City Corporation and RHD shall

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				be obtained for road cutting for pipe laying. If demolition is planned at any stage during the implementation period, proper debris management plan will be followed.
1.7	Temporary sites used for construction works or housing of construction workers?	**Yes**	Air and noise pollution from the operation of different machineries and equipment; water and soil pollution from storage and use of fuels, oils, solvents, and lubricants. Unsanitary and poor living conditions for workers in the work Camps.	**No -** Temporary sites will be used for Construction Yards, Labour Camps, and Construction Camps; all the sites will be restored after the construction work. Good Sanitary and living conditions will be ensured in workers' camp.
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations?	**Yes**	The civil work for the subproject includes earth work excavation for sewer trenches, sewer laying, and construction of manholes, shifting of public utilities and providing house service connections. In the built-up areas of the city where there are a variety of human activities, will result in impacts to the environment and sensitive receptors such as schools, religious places, courts, hospitals and the community in general.	**No. -** These anticipated impacts are temporary and for short duration. Also, construction of these project components involves appropriate techniques of civil work**.**
1.9	Underground works including mining or tunnelling?	**Yes**	Laying sewers in open cut method may pose risk to surrounding buildings, utilities and cables**. E**xcavation in narrow streets will pose risk to children and elders in the locality.	**No -** The trenches will be done mechanically with the protection bracings to avoid collapses, and also to avoid any risk to surrounding buildings. Construction sequencing of work, to minimize the amount of exposed sites, will be followed and trenches will be covered or backfilled as soon as possible. Trenchless technique will be applied where it requires to avoid consequences.
1.10	Reclamation works?	NA		
1.11	Dredging?	NA		
1.12	Coastal structures e.g., seawalls, piers?	NA		
1.13	Offshore structures?	NA		
1.14	Production and manufacturing processes?	NA		
1.15	Facilities for storage of goods or materials?	**Yes**	Improper storage of materials may deteriorate or corrode if exposed to the weather.	**No**. - Construction raw materials like stone/sand, aggregate, reinforced bar etc. will be stored in open spaces but covered with polythene, and chemicals would be stored in covered location with adopting all necessary safety measures.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1.16	Facilities for treatment or disposal of solid wastes or liquid effluents?	**Yes**	Failure in proper disposal of solid wastes or liquid effluents produced in construction sites or worker's camp will cause nuisance to the surroundings and degradation of aesthetics.	**No**. Good practice in working environment and living condition will minimize the cause in the first place. Moreover, contractor must follow all the procedure for management of solid and liquid effluent during the construction period.
1.17	Facilities for long term housing of operational workers?	**NA**		
1.18	New road, rail or sea traffic during construction or operation?	**No**	Only construction vehicles and machineries will create additional traffic during construction.	**No -** Excavation and laying pipelines along public roads will interfere with the traffic. Construction material transport will increase traffic within the city. Traffic diversions will be made with prior permission from Traffic Police during construction phase.
1.19	New road, rail, air, waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?	**NA**		
1.20	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	**Yes**	During construction, diversion along existing roads wherever the project components crosses.	**No –** Work along the existing road will progress in sections or sequences, so impacts will be insignificant and temporary. Excavation and laying pipelines along public roads will interfere with the traffic movement. Construction material transport will increase small scale traffic within the city. Guidelines for safety in construction zone will be prepared by the contractor and traffic diversions will be made with prior permission from Traffic Police Department during the construction phase.
1.21	New or diverted transmission lines or pipelines?	**Yes**	Telephone lines, electric poles and wires, water lines within the proposed project area may need to shift temporarily, only in some places.	**No**. Temporary shifting with prior permissions from the competent authorities and will be restored accordingly.
1.22	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	**NA**		
1.23	Stream crossings?	**Yes**	Crossing of canals at three points. Aquatic impacts, including changes to natural habitat structure and cover, sediment concentrations, water temperature, food supply and fish migration, will be experienced to some extent.	**No.** At present, the said canals are not in healthy state of environment due to draining out sewage or household waste water. However, appropriate measures, such as, trenchless technology will be taken to

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				minimize the impact to least level, at Sewer crossing the canals.
1.24	Abstraction or transfers of water from ground or surface waters?	**Yes**	Abstraction or transfer of water will be required in construction of 3 SPSs. Water required during the civil construction of SPSs will mostly be extracted from surface (e.g., nearby river) sources. Laying of sewer pipe may need to transfer water from trenches in some places.	**No -** Only allocated water source will be used for the project. Water to be abstracted for civil works or operational need could be made available from nearby river.
1.25	Changes in water bodies or the land surface affecting drainage or run-off?	**No**	Changes in land surface in Sewage Pumping Station construction areas will not affect drainage or run-off as the proposed sites can easily be linked with nearby river and no congestion or flooding is anticipated. However, maximum water level in the area and tidal nature of the river should be considered while designing the pumping stations, to being on the safer side. No changes in water bodies or land surface are envisaged for pipe laying.	**No-**Water required for the construction of pumping stations can directly be drawn from the adjacent river and laying pipelines will not require any significant amount of water (if any). Both types of the construction works will in no way affect the drainage or run-off.
1.26	Transport of personnel or materials for construction, operation or decommissioning?	**Yes**	Disruption to traffic flow and increase in air and noise pollution from vehicle movement for the construction purposes along with transport of personnel/ labors.	**Yes –** Dust and noise levels will be elevated by movement of vehicles with construction materials and transport of workers from work camp to work site.
1.27	Long term dismantling or decommissioning or restoration works?	**NA**		
1.28	Ongoing activity during decommissioning which could have an impact on the environment?	**NA**		
1.29	Influx of people to an area in either temporarily or permanently?	**Yes**	Social conflicts between construction workers from other areas and local workers/communities.	**No. -** There might be temporary influx of people to the area as labours and other personnel who will be involved directly or indirectly during the construction period. However, preference will be given to local people in the employment.
1.30	Introduction of alien species?	**NA**		
1.31	Loss of native species or genetic diversity?	**NA**		
1.32	Any other actions?	**NA**		
2. Will construction or operation of the Project use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or in short supply?				
2.1	Land especially undeveloped or agricultural land?	**No**	No changes in land use pattern are envisaged for the construction	**No.** Already acquired land by KWASA will be used for the

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
			of Sewage Collection Network, Gravity Mains and Sewage Pumping Stations. All the sites earmarked for the construction purposes are already developed and do not include any agricultural and productive lands.	construction of SPSs and land strips along the existing roads are owned by the KCC.
2.2	Water?	**Yes**	Both the quality and quantity of water could be affected for the use of nearby water sources for construction purposes and daily use by the workers and other communities involved in the implementation and operation of the project component.	**No.** Construction of only three pumping stations may affect the quantity and quality of the water, but not so significantly. Guidance on proper management practices will be included into the EMP.
2.3	Minerals?	**NA**		
2.4	Aggregates?	**Yes**	Extraction of materials can disrupt natural land contours and stability, and vegetation resulting in accelerated erosion, subsidence, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	**Yes** - major changes in environment at the extraction sites. Impact on large numbers of people nearby of the place of extraction. Khulna city will not be affected.
2.5	Forests and timber?	**NA**		
2.6	Energy including electricity and fuels?	**Yes**	Consumption of Electricity and burning of fuel like Diesel and Petrol.	**Preferably** electricity supply through express feeder connection for running machineries and equipment; alternatively sound proof/super silent Diesel Generator set will be used.
2.7	Any other resources?	**No**	Sand from river bed as construction material.	**No –** It will be collected from existing sand mining quarry.
3. Will the Project involve use, storage, transport, handling or production of substances or materials which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health?				
3.1	Will the project involve use of substances or materials which are hazardous or toxic to human health or the environment (flora, fauna, water supplies)?	**Yes**	Leakage in discharge of fuels like diesel, Petrol, and Oil & Grease will affect human health and environment.	**No.** Temporarily It may contaminate land, water and create public health issues, but proper management will be followed in every step during the implementation period.
3.2	Will the project result in changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)?	**No**	Not anticipated. However, the project will contribute in improving the public health condition of Khulna city dwellers. Failure in quick removal of water in trenches and restoration of sites may create breeding grounds for mosquitoes or insects and contribute in spreading of diseases.	**No-** Diseases due to poor sanitation system will be reduced. Improved sewerage condition will result in improved public health condition of city dwellers; thereby, fewer occurrences of diseases will lessen the burden on health care system and in turn, economic benefit in individual scale will also be enhanced.
3.3	Will the project affect the welfare of people e.g. by changing living conditions?	**No**	Will improve environmental and socio-economic condition of the people.	**No**- A part of Khulna city dwellers will be the major beneficiaries of the improved sewerage system, as the human

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				waste from the houses will be removed rapidly, which otherwise would flow in open drains. In addition to improved environmental conditions, the project will improve the overall health condition of the city as well. This should improve the environment; deliver major improvements in individual and community health perspective and resulting in lowering of medical cost.
3.4	Are there especially vulnerable groups of people who could be affected by the project e.g. hospital patients, the elderly?	**Yes**	Laying pipes along the city streets may cause that problem, but not significantly.	**Not significantly and easily avoidable**- Construction sequencing of work, to minimize the amount of exposed sites, will be followed and trenches will be covered or backfilled as soon as possible.
3.5	Any other causes?	**NA**		
4. Will the Project produce solid wastes during construction or operation or decommissioning?				
4.1	Spoil, overburden or mine wastes?	**Yes**	Can disrupt natural land contours and vegetation resulting in accelerated risk to health injury, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	**No. –** Temporary impact, limited only during construction phase. Adequate arrangement will be made for disposal of wastes by the contractor for construction and operational wastes including restoration of landscape.
4.2	Municipal waste (household and or commercial wastes)?	**Yes**	Construction camp will generate household and other wastes.	**No** - there will be local waste management facilities in place during the construction and operational period.
4.3	Hazardous or toxic wastes (including radioactive wastes)?	**NA**		
4.4	Other industrial process wastes?	**NA**		
4.5	Surplus product?	**NA**		
4.6	Sewage sludge or other sludge from effluent treatment?	**NA**		
4.7	Construction or demolition wastes?	**Yes**	Construction wastes will be produced in Sewage Pumping Station sites, also in some places of pipe laying works. Road digging for laying of pipelines will produce lots of excavated material.	**No -**. Significant amount of construction and demolition wastes will be generated due to building structures in Sewage Pumping Station sites, and excavation of existing road, which will be reused in construction and the remaining wastes will be used for filling of low lying land.
4.8	Redundant machinery or equipment?	**NA**		
4.9	Contaminated soils or other material?	**NA**		
4.10	Agricultural wastes?	**NA**		
4.11	Any other solid wastes?	**NA**		

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
5. Will the Project release pollutants or any hazardous, toxic or noxious substances to air?				
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources?	**Yes**	Air quality: particulate matter and due to the increase in concentration of vehicles-and-heavy equipment exhausted pollutants such as carbon monoxide, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons.	**Yes -** During construction period, emissions will be generated from the vehicles carrying construction materials, heavy machineries/ equipment involved in the construction and Diesel fuelled mobile Generator sets which will be used for power supply or back up.
5.2	Emissions from production processes?	**Yes**	Sewer gases (e.g. hydrogen sulfide, ammonia, methane, esters, and carbon monoxide) may emit during the production processes.	Yes- Hydrogen Sulfide, Methane and Ammonia are critically injurious to health. Proper degasification or ventilation system will be ensured in relevant stages.
5.3	Emissions from materials handling including storage or transport?	**Yes**	During construction phase, dust generation by the unloading of materials like cement, aggregates, metal bars, etc.	**Yes**- Significant because the impact is on the health and welfare of the workers. To address this issue, adequate health safety measures will be ensured.
5.4	Emissions from construction activities including plant and equipment?	**Yes**	Impact in surrounding air and noise environment. Dust generation due to earthworks and other construction activities.	**Yes**- During pre-construction and construction phase, the emissions will be from Plant and machineries, hot mix plant, movement of vehicles, clearing of ground, construction and other related activities Significant because the impact is on the health and welfare of the workers. To address this issue, adequate health safety measures will be ensured.
5.5	Dust or odours from handling of materials including construction materials, sewage and waste?	Yes	During construction phase, air pollution due to dust generation during unloading of construction materials like aggregates, cements, metal bars, etc. and road cutting for pipeline laying.	**Yes**- There may be dust generation during construction, loading and unloading of construction materials. Road cutting (cement and bituminous roads) for pipeline laying works is likely to generate dust and noise. Significant because the impact is on the health and welfare of the workers and city dwellers as well. To address this issue, adequate health safety measures will be ensured.
5.6	Emissions from incineration of waste?	**NA**		
5.7	Emissions from burning of waste in open air (eg slash material, construction debris)?	**NA**		
5.8	Emissions from any other sources?	**NA**		
6. Will the Project cause noise and vibration or release of light, heat energy or electromagnetic radiation?				

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
6.1	From operation of equipment eg engines, ventilation plant, crushers?	**Yes**	**Noise-** During construction period noise will be generated from equipment, machinery, crusher plants and generators.	**No-** only site and time specific.
6.2	From industrial or similar processes?	**NA**		
6.3	From construction or demolition?	**Yes**	**Dust and noise-** During construction phase cutting of roads and demolition of test piles/pile caps may produce dust and noise.	**No-** Site specific only.
6.4	From blasting or piling?	**NA**		
6.5	From construction or operational traffic?	**Yes**	Traffic disturbances due to the transport of construction material, wastes and labors.	Yes - During implementation phase noise and vibrations will be generated at a low scale due to traffic; however arranging smooth running of vehicles causes ambient noise levels to come down.
6.6	From lighting or cooling systems?	**NA**		
6.7	From sources of electromagnetic radiation (consider effects on nearby sensitive equipment as well as people)?	**NA**		
6.8	From any other sources?	**NA**		
7. Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into sewers, surface waters, groundwater, coastal waters or the sea?				
7.1	From handling, storage, use or spillage of hazardous or toxic materials?	**Yes**	**Impact on land and water environment**- Short term accidental spills may happen.	**No**- To avoid contamination from fuel/lubricants, the vehicles and equipment will be maintained and examined regularly. Required precautions will be taken in storage and handling of hazardous materials.
7.2	From discharge of sewage or other effluents (whether treated or untreated) to water or the land?	**No**	Discharge of sewage to the water bodies or land is not anticipated as per the nature of work. Accidental discharge of other effluents may affect the sewer system, increase in sewage flow and in turn contaminate land, water and create public health issues.	**No** - There will not be any direct discharge of sewage into water bodies or land. The sewage from labour camps will be diverting to soak pit before discharging.
7.3	By deposition of pollutants emitted to air, onto the land or into water?	**Yes**	Air quality will be deteriorated by emissions from construction vehicles, equipment, and machineries used for installation of pipelines resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons, and chemical contamination from fuels and lubricants during installation of pipelines can contaminate nearby surface water.	**No**. It is a temporary and partially manageable effect related with construction activities. However, proper mitigation measures will be taken to minimize the effects.
7.4	From any other sources?	**NA**		

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
7.5	Is there a risk of long term build-up of pollutants in the environment from these sources?	**NA**		
8. Will there be any risk of accidents during construction or operation of the Project which could affect human health or the environment?				
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous or toxic substances?	**Yes**	Health hazards arising from inadequately receiving, storing, and handling of hazardous substances.	**No-** Effect is more likely to be site specific and only workers in the site are prone to be affected (if any). However, handling and storage of hazardous materials by the workers must follow proper safety guidance.
8.2	From events beyond the limits of normal environmental protection e.g. failure of pollution control systems?	**NA**		
8.3	From any other causes?	**NA**		
8.4	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslip, etc)?	**No**	Flood and Earthquake hazards.	The project district lies in low seismic zone. Flooding due to heavy rainfall, esp. in monsoon may affect/disrupt the operation severely, though the rainfall trend in past several years doesn't envisage any risk of that kind.
9. Will the Project result in social changes, for example, in demography, traditional lifestyles, employment?				
9.1	Changes in population size, age, structure, social groups etc?	**No**	Temporary influx of workers during construction period.	Since the project will engage local workers as far as possible, demographic changes are not anticipated therefore.
9.2	By resettlement of people or demolition of homes or communities or community facilities e.g. schools, hospitals, social facilities?	**No**	Temporary resettlement/livelihood issues resulting mainly from laying of sewer/pipelines in busy commercial areas.	No demolition works are anticipated. Very temporary livelihood issues may arise, but not significant at all.
9.3	Through in-migration of new residents or creation of new communities?	**NA**		
9.4	By placing increased demands on local facilities or services eg housing, education, health?	**NA**		
9.5	By creating jobs during construction or operation or causing the loss of jobs with effects on unemployment and the economy?	**Yes**	Generation of temporary employment for workers and professionals during the implementation period.	**Yes.** Potential impact is positive and long-term considering the employment during operation.
9.6	Any other causes?	**Yes**	Socio-economic Environment	**Yes.** The dwellers of the Khulna city will be the major beneficiaries of the improved sewerage system. In addition to the improved environmental conditions, the project will improve the overall health condition of the city as diseases due to poor sanitation will be reduced and people should spend

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				less on healthcare and lose fewer working days due to illness, so their economic status should also improve, along with their overall health.
Question - Are there any other factors which should be considered such as consequential development which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality?				
9.1	Will the project lead to pressure for consequential development which could have significant impact on the environment e.g. more housing, new roads, new supporting industries or utilities, etc?	**Yes**	Infrastructure and social development.	**Yes.** Better sanitation facilities in some parts of the city must attract more migration and establishment to the parts, which in turn put pressure for further development in service delivery system, e.g. more housing, more schools, more roads, more utilities, etc., and all these must have greater impacts on the environment.
9.2	Will the project lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g. supporting infrastructure (roads, power supply, waste or waste water treatment, etc) housing development extractive industries supply industries other?	**Yes**	Infrastructure development of the area.	**Yes.** The project will lead to overall development in the area. With time, the supporting infrastructure like roads, power supply, waste or waste water treatment facility, housing development and industrial development will occur, that may have impacts on the environment. However, all these developments will be accompanied with the development of social infrastructure, educational, institutional and other community facilities. These developments will improve the living standard of the people of Khulna city.
9.3	Will the project lead to after-use of the site which could have an impact on the environment?	**NA**		
9.4	Will the project set a precedent for later developments?	**Yes**	The project will benefit the public by contributing to the long-term improvement of sewerage system and community liveability in Khulna city area.	**Yes**. The proposed project will set precedent for development as it is planned to be developed in the environment friendly manner.
9.5	Will the project have cumulative effects due to proximity to other existing or planned projects with similar effects?	**NA**		

Note: 'Yes' relates to those effects which are more likely to be observed during the implementation stage.

'No' relates to those effects which have no or very least likely chance to be observed

'NA' (Not applicable) relates to those aspects or effects which are not related to any interventions under the project and will no way pose any effect at all.

Checklist 2: Scoping Checklist Part 2 - Characteristics of the Project Environment (Environmental Sensitivity)

• Areas which are protected under **Question - Are there features of the local environment on or around the Project location which could be affected by the Project?** international or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the project? • Other areas which are important or sensitive for reasons of their ecology e.g. • Wetlands, • Watercourses or other waterbodies, • the coastal zone, • mountains, • forests or woodlands • Areas used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, overwintering, migration, which could be affected by the project? • Inland, coastal, marine or underground waters? • Areas or features of high landscape or scenic value? • Routes or facilities used by the public for access to recreation or other facilities? • Transport routes which are susceptible to congestion or which cause environmental problems? • Areas or features of historic or cultural importance?	1. No protected areas, wetlands, mangroves, or estuaries in or near the project locations. 2. There are no historical or protected monuments or archeologically significant sites near the proposed sites. 3. There are no Ramsar sites in Khulna 4. No wildlife protected areas in or near the proposed project sites in Khulna. 5. No wildlife or protected forest areas fall in the proposed areas for the development of the component. 6. Available literature revealed that none of the floral species recorded from the study area falls under endangered category. 7. There are no notable ecological resources in the study area. 8. As per the seismic zoning map of Bangladesh, Khulna City falls under the Zone III, which is the lowest earthquake risk zone in Bangladesh. Hence the risk of earthquake at the proposed sites is minimal and so the all the proposed sites are safe. 9. Laying pipelines through populous areas of the city and along different hospitals and clinics, educational and religious institutes will cause temporary air and noise pollution and traffic congestion. Strict environmental management procedure along with traffic management plan will be followed to lessen the effects.
Question - Is the Project in a location where it is likely to be highly visible to many people?	**Yes.**
Question - Is the Project located in a previously undeveloped area where there will be loss of greenfield land?	**No**
Question - Are there existing land uses on or around the Project location which could be affected by the Project? For example: • Homes, gardens, other private property, • Industry, • Commerce, • Recreation, • public open space, • community facilities, • agriculture, • forestry, • tourism, • mining or quarrying	1. The project component/sites are located in KCC owned existing road right of way (RoW) and KWASA-acquired vacant lands. 2. Subproject components will be sitting within the South-eastern part of Khulna city and in its immediate surroundings which have been developed into an urban area with urban facilities for many years, and there is no natural habitat left at the proposed sites.
Question - Are there any plans for future land uses on or around the location which could be affected by the Project?	**No**
Question - Are there any areas on or around the location which are densely populated or built-up, which could be affected by the Project?	Subproject activities will be confined within South-eastern part of the city including some densely populated areas and also in city outskirts. There are no major negative impacts envisaged, because pipeline will be located within ROW alongside the existing roads and can be constructed without causing disturbance to houses, and commercial establishments.
Question - Are there any areas on or around the location which are occupied by sensitive land uses which could be affected by the Project? • hospitals,	Yes. Sewer network will primarily run across South-eastern part of the city, including the densely populated areas and by the sensitive land uses, like hospitals, schools, and mosque/temple and so on. However, the interventions will be temporary and

• schools, • places of worship, • community facilities	proper safety measures will be taken very cautiously.
Question - Are there any areas on or around the location which contain important, high quality or scarce resources which could be affected by the Project? For example: • groundwater resources, • surface waters, • forestry • agriculture, • fisheries, • tourism, • minerals.	**No**
Question - Are there any areas on or around the location of the Project which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, which could be affected by the project?	**No**
Question - Is the Project location susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the project to present environmental problems?	**No.**
Question - Is the Project likely to affect the physical condition of any environmental media? • The atmospheric environment including microclimate and local and larger scale climatic conditions? • Water – e.g. quantities, flows or levels of rivers, lakes, groundwater. Estuaries, coastal waters or the sea? • Soils – e.g. quantities, depths, humidity, stability or erodibility of soils? • Geological and ground conditions?	Effects are too unlikely to be pervasive or critical, as the sites are free from any environmentally sensitive areas/receptors. Emission from the vehicles and construction equipment may pose little increase in pollutants in the air, and any accidental spillage or leakage of oil or bituminous materials into the soil or water may contaminate the media. However, Proper management during construction will be ensured to avoid any consequences.
Question - Are releases from the Project likely to have effects on the <u>quality</u> of any environmental media? • Local air quality? • Global air quality including climate change and ozone depletion • Water quality – rivers, lakes, groundwater. Estuaries, coastal waters or the sea? • Nutrient status and eutrophication of waters? • Acidification of soils or waters? • Soils • Noise? • Temperature, light or electromagnetic radiation including electrical interference? • Productivity of natural or agricultural systems?	Temporary impact on Local air, water and noise quality **m**ay take place.
Question - Is the Project likely to affect the availability or scarcity of any resources either locally or globally? • Fossil fuels? • Water? • Minerals and aggregates? • Timber? • Other non-renewable resources? • Infrastructure capacity in the locality - water, sewerage, power generation and transmission,	**No**

telecommunications, waste disposal roads, rail?	
Question - Is the Project likely to affect human or community health or welfare? • The quality or toxicity of air, water, foodstuffs and other products consumed by humans? • Morbidity or mortality of individuals, communities or populations by exposure to pollution? • Occurrence or distribution of disease vectors including insects? • Vulnerability of individuals, communities or populations to disease? • Individuals' sense of personal security? • Community cohesion and identity? • Cultural identity and associations? • Minority rights? • Housing conditions? • Employment and quality of employment? • Economic conditions? • Social institutions?	The project will lead to overall development in the area, including employment generation. With time, the supporting infrastructure like roads, power supply, waste or waste water treatment, housing development and industrial development will occur, that may have impacts on the environment. However, all these developments will be accompanied with the development of social infrastructure, educational, institutional and other community facilities. These developments will improve the living standard of the Khulna city dwellers.

Checklist 3: Significance of Impacts

Questions to be Considered	
1. Will there be a large change in environmental conditions?	No
2. Will new features be out-of-scale with the existing environment?	No
3. Will the effect be unusual in the area or particularly complex?	No
4. Will the effect extend over a large area?	No
5. Will there be any potential for trans boundary impact?	No
6. Will many people be affected?	Positively affected
7. Will many receptors of other types (fauna and flora, businesses, facilities) be affected?	Business and living standard will improve
8. Will valuable or scarce features or resources be affected?	No
9. Is there a risk that environmental standards will be breached?	No
10. Is there a risk that protected sites, areas, features will be affected?	There is no protected sites
11. Is there a high probability of the effect occurring?	Positive effect
12. Will the effect continue for a long time?	Yes .Positive effect
13. Will the effect be permanent rather than temporary?	Permanent Positive effect
14. Will the impact be continuous rather than intermittent?	Continuous.
15. If it is intermittent will it be frequent rather than rare?	N/A
16. Will the impact be irreversible?	Yes
17. Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No

KSSDP Component 2- NO MITIGATION SCENARIO CHECKLIST

Subproject 2: Construction of Sewage Network, Gravity Mains and Sewerage Pumping Stations (5 locations) at Khulna City (SD2, SD3, SD4 and SD7).

Checklist 1: Scoping Checklist Part 1 - Questions on Project Characteristics

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1. Will construction, operation or decommissioning of the Project involve actions which will cause physical changes in the locality (topography, land use, changes in waterbodies, etc)?				
1.1	Permanent or temporary change in land use, land cover or topography including increases in intensity of land use?	**Yes**	Partial changes in land use are anticipated; Sewage Pumping Stations will be constructed on selected open land areas, but the construction of Sewage Collection Network and Gravity Mains will follow the existing road alignment and the sites will be turned to the previous state once the pipe laying works are done.	**No**- The impact will be negligible. The pumping stations will be constructed on open land spaces acquired by the KWASA, and only 24.71 decimal square meters are required for each of the four sewage pumping stations and one Sewage Pumping Station (for SD3) requires 29.65 decimal. The land spaces earmarked for five pumping stations are now vacant and readily available. Laying pipelines along the existing roads require an MOU with the Khulna City Corporation (KCC) and that will be made before the works are initiated. Land areas or patches to be used for both purposes are already in developed state and there are no environmentally sensitive areas or natural habitat in or near the project locations. If tree felling or demolition work is required at any point, proper procedure will be followed as per existing government rules.
1.2	Clearance of existing land, vegetation and buildings?	**Yes**	Land use in Sewage Pumping Station sites will be changed. All Sewage Pumping Station sites are vacant and vegetation clearance will not be required at those places. Construction of Sewage Collection Network and Gravity Mains may involve vegetation clearance or partial demolition of structures at some point, but with proper consents or authorization.	**No**- All works related to Sewage Pumping Station will be confined in KWASA's acquired land areas. Construction works of Sewage Network and Gravity Mains must require necessary permission from KCC and relevant govt. departments, wherever applicable. Consent from private property owners may require on case-by-case basis, if the implementation works require temporary use of private land at any places.
1.3	Creation of new land uses?	**Yes**	Partly; Construction of each Sewage Pumping Station will turn an open land area to an organized small building structure facilitating urban utility services. The patches along the	**No**- Not significant at all. Pipelines will be laid in open cut method and trenchless technology is suggested at critical sections in order to minimize the construction effects.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
			existing roads for laying pipelines will be turned to the same state once the work is done.	
1.4	Pre-construction investigations e.g. boreholes, soil testing?	**Yes**	Soil investigation will be carried out by the contractor before starting the works.	**No**- Necessary pre-construction investigations will be carried out as per standard specifications. Soil investigation is a must to carry out by the contractor to assess the soil type, soil strata, GW level, soil salinity and other required indicators before starting the works.
1.5	Construction works?	**Yes**	Disruption to traffic flows and sensitive receptors along with nuisance from noise and dust is clearly envisaged during the construction period. Social conflicts between construction workers from other areas and local workers/host communities may arise.	**No** – Temporary work. No significant impact will be envisaged in Sewage Pumping Station sites, as those are KWASA's acquired and confined properties. Still good EHS practices at worksite will be followed all along. The pipelines will be buried below in a trench on the edge of the road within the existing right of way (RoW). There are no impacts of pipe laying on permanent/semi-permanent structures is envisaged. Temporary impacts on movable structures within RoW are envisaged as temporary livelihood issues resulting mainly from laying of pipelines in busy commercial areas. Local labour force will be suggested to be used as far as possible to avoid such conflict if any and proper training on occupational health, safety and sanitation must be provided before engaging into work. These are the general impacts of construction in urban and habitable areas, and there are well developed methods of mitigation that will be suggested in the EMP
1.6	Demolition works?	**No**	It is envisaged primarily that demolition works are not required in any of the sites.	**No –** Restoration of roads is a part of the project. Prior permission from concerned departments such as City Corporation and RHD shall be obtained for road cutting for pipe laying. If demolition is planned at any stage during the implementation period, proper debris

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				management plan will be followed.
1.7	Temporary sites used for construction works or housing of construction workers?	**Yes**	Air and noise pollution from the operation of different machineries and equipment; water and soil pollution from storage and use of fuels, oils, solvents, and lubricants. Unsanitary and poor living conditions for workers in the work Camps.	**No -** Temporary sites will be used for Construction Yards, Labour Camps, and Construction Camps; all the sites will be restored after the construction work. Good Sanitary and living conditions will be ensured in workers' camp.
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations?	**Yes**	The civil work for the subproject includes earth work excavation for sewer trenches, sewer laying, and construction of manholes, shifting of public utilities and providing house service connections. In the built-up areas of the city where there are a variety of human activities, will result in impacts to the environment and sensitive receptors such as schools, religious places, courts, hospitals and the community in general.	**No. -** These anticipated impacts are temporary and for short duration. Also, construction of these project components involves appropriate techniques of civil work**.**
1.9	Underground works including mining or tunnelling?	**Yes**	Laying sewers in open cut method may pose risk to surrounding buildings, utilities and cables**. E**xcavation in narrow streets will pose risk to children and elders in the locality.	**No .**The trenches will be done mechanically with the protection bracings to avoid collapses, and also to avoid any risk to surrounding buildings. Construction sequencing of work, to minimize the amount of exposed sites, will be followed and trenches will be covered or backfilled as soon as possible. Trenchless technique will be applied where it requires to avoid consequences.
1.10	Reclamation works?	NA		
1.11	Dredging?	NA		
1.12	Coastal structures eg seawalls, piers?	NA		
1.13	Offshore structures?	NA		
1.14	Production and manufacturing processes?	NA		
1.15	Facilities for storage of goods or materials?	**Yes**	Improper storage of materials may deteriorate or corrode if exposed to the weather.	**No**. - Construction raw materials like stone/sand, aggregate, reinforced bar etc would be stored in open space but covered with polythene, and chemicals would be stored in covered location with adopting all necessary safety measures.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1.16	Facilities for treatment or disposal of solid wastes or liquid effluents?	**Yes**	Failure in proper disposal of solid wastes or liquid effluents produced in construction sites or worker's camp will cause nuisance to the surroundings and degradation of aesthetics.	**No –** Good practice in working environment and living condition will minimize the cause in the first place. Moreover, contractor must follow all the procedure for management of solid and liquid effluent during the construction period.
1.17	Facilities for long term housing of operational workers?	**NA**		
1.18	New road, rail or sea traffic during construction or operation?	**No**	Only construction vehicles and machineries will create additional traffic during construction.	**No -** Excavation and laying pipelines along public roads will interfere with the traffic. Construction material transport will increase traffic within the city. Traffic diversions will be made with prior permission from Traffic Police during construction phase.
1.19	New road, rail, air, waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?	**No**		
1.20	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	**Yes**	During construction, diversion along existing roads wherever the project components crosses.	**No –** Work along the existing road will progress in sections or sequences, so impacts will be insignificant and temporary. Excavation and laying pipelines along public roads will interfere with the traffic movement. Construction material transport will increase traffic in a small scale within the city. Guidelines for safety in construction zone will be prepared by the contractor and traffic diversions will be made with prior permission from Traffic Police Department during the construction phase.
1.21	New or diverted transmission lines or pipelines?	**Yes**	Telephone lines, electric poles and wires, water lines within the proposed project area may need to shift temporarily, only in some places.	**No**. Temporary shifting with prior permissions from the competent authorities and will be restored accordingly.
1.22	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	**NA**		
1.23	Stream crossings?	**NA**		
1.24	Abstraction or transfers of water from ground or surface waters?	**Yes**	Abstraction of water will be required in construction of 5 SPSs. Water required during the civil construction of SPSs will mostly be extracted from surface (e.g., nearby pond, canals) sources. Laying of sewer pipe may need to transfer water from	**No -** Only allocated water source will be used for the project. Water to be abstracted for civil works or operational need could be made available from nearby surface water sources.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
			trenches in some places.	
1.25	Changes in water bodies or the land surface affecting drainage or run-off?	**No**	Changes in land surface in Sewage Pumping Station construction areas will not affect drainage or run-off and no congestion or flooding is anticipated. No changes in water bodies or land surface are envisaged for pipe laying.	**No-**Water required for the construction of pumping stations can directly be drawn from the adjacent surface water bodies and laying pipelines will not require any significant amount of water (if any). Both types of the construction works will in no way affect the drainage or run-off.
1.26	Transport of personnel or materials for construction, operation or decommissioning?	**Yes**	Disruption to traffic flow and increase in air and noise pollution from vehicle movement for the construction purposes along with transport of personnel/labors.	**Yes –** Dust and noise levels will be elevated by movement of vehicles with construction materials and transport of workers from work camp to work site.
1.27	Long term dismantling or decommissioning or restoration works?	**NA**		
1.28	Ongoing activity during decommissioning which could have an impact on the environment?	**NA**		
1.29	Influx of people to an area in either temporarily or permanently?	**Yes**	Social conflicts between construction workers from other areas and local workers/communities.	**No. -** There might be temporary influx of people to the area as labours, and other personnel who will be involved directly or indirectly during the construction period. However, preference will be given to local people in the employment.
1.30	Introduction of alien species?	**NA**		
1.31	Loss of native species or genetic diversity?	**NA**		
1.32	Any other actions?	**NA**		
2. Will construction or operation of the Project use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or in short supply?				
2.1	Land especially undeveloped or agricultural land?	**No**	No changes in land use pattern are envisaged for the construction of Sewage Collection Network, Gravity Mains and Sewage Pumping Stations. All the sites earmarked for the construction purposes are already developed and not include any agricultural and productive lands.	**No.** Already acquired land by KWASA will be used for the construction of SPSs and land strips along the existing roads are owned by the KCC.
2.2	Water?	**Yes**	Both the quality and quantity of water could be affected for the use of nearby water sources for construction purposes and daily use by the workers and other communities involved in the implementation and operation of the project component.	**No.** Construction of only five pumping stations may affect the quantity and quality of the water, but not so significantly. Guidance on proper management practices will be included into the EMP.
2.3	Minerals?	**NA**		

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
2.4	Aggregates?	**Yes**	Extraction of materials can disrupt natural land contours and stability, and vegetation resulting in accelerated erosion, subsidence, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	**Yes** - major change in environment at the extraction sites. Impact on large numbers of people nearby of the place of extraction. Khulna city will not be affected.
2.5	Forests and timber?	**NA**		
2.6	Energy including electricity and fuels?	**Yes**	Consumption of Electricity and burning of fuel like Diesel and Petrol.	**Preferably** electricity supply through express feeder connection for running machineries and equipment; alternatively sound proof/super silent Diesel Generator set will be used.
2.7	Any other resources?	**No**	Sand from river bed as construction material.	**No –** It will be collected from existing sand mining quarry.
3. Will the Project involve use, storage, transport, handling or production of substances or materials which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health?				
3.1	Will the project involve use of substances or materials which are hazardous or toxic to human health or the environment (flora, fauna, water supplies)?	**Yes**	Leakage in discharge of fuels like diesel, Petrol, and Oil & Grease will affect human health and environment.	**No.** Temporarily It may contaminate land, water and create public health issues, but proper management will be followed in every step during the implementation stage.
3.2	Will the project result in changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)?	**No**	Not anticipated. However, the project will contribute in improving the public health condition of Khulna city dwellers. Failure in quick removal of water in trenches and restoration of sites may create breeding grounds for mosquitoes or insects and contribute in spreading of diseases.	**No-** Diseases due to poor sanitation system will be reduced. Improved sewerage condition will result in improved public health condition of city dwellers; thereby, fewer occurrences of diseases will lessen the burden on health care system and in turn, economic benefit in individual scale will also be enhanced.
3.3	Will the project affect the welfare of people e.g. by changing living conditions?	**No**	Will improve environmental and socio-economic condition of the people.	**Yes**- A part of Khulna city dwellers will be the major beneficiaries of the improved sewerage system, as the human waste from the houses will be removed rapidly, which otherwise would flow in open drains. In addition to improved environmental conditions, the project will improve the overall health condition of the city as well. This should improve the environment; deliver major improvements in individual and community health sector and resulting in lowering of medical cost.
3.4	Are there especially vulnerable groups of people	**Yes**	Laying pipes along the city streets may cause that problem, but not significantly.	**Not significantly and easily avoidable**- Construction sequencing of work, to minimize

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
	who could be affected by the project e.g. hospital patients, the elderly?			the amount of exposed sites, will be followed and trenches will be covered or backfilled as soon as possible.
3.5	Any other causes?	**NA**		
4. Will the Project produce solid wastes during construction or operation or decommissioning?				
4.1	Spoil, overburden or mine wastes?	**Yes**	Can disrupt natural land contours and vegetation resulting in accelerated risk to health injury, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	**No. –** Temporary impact, limited only during construction phase. Adequate arrangement will be made for disposal of wastes by the contractor for construction and operational wastes including restoration of landscape.
4.2	Municipal waste (household and or commercial wastes)?	**Yes**	Construction camp will generate household and other wastes.	**No** - there will be local waste management facilities in place during the construction and operational period.
4.3	Hazardous or toxic wastes (including radioactive wastes)?	**NA**		
4.4	Other industrial process wastes?	**NA**		
4.5	Surplus product?	**NA**		
4.6	Sewage sludge or other sludge from effluent treatment?	**NA**		
4.7	Construction or demolition wastes?	**Yes**	Construction wastes will be produced in Sewage Pumping Station sites, also in some places of pipe laying works. Road digging for laying of pipelines will produce lots of excavated material.	**No -**. Significant amount of construction and demolition wastes will be generated due to building structures in Sewage Pumping Station sites, and excavation of existing road, which will be reused in construction and the remaining wastes will be used for filling of low lying land.
4.8	Redundant machinery or equipment?	**No**		
4.9	Contaminated soils or other material?	**No**		
4.10	Agricultural wastes?	**No**		
4.11	Any other solid wastes?	**No**		
5. Will the Project release pollutants or any hazardous, toxic or noxious substances to air?				
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources?	**Yes**	Air quality: particulate matter and due to the increase in concentration of vehicles-and-heavy equipment exhausted pollutants such as carbon monoxide, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons.	**Yes -** During construction period, emissions will be generated from the vehicles carrying construction materials, heavy machineries/ equipment involved in the construction and Diesel fuelled mobile Generator sets which will be used for power supply or back up.
5.2	Emissions from production processes?	Yes	Sewer gases (e.g. hydrogen sulfide, ammonia, methane, esters, and carbon monoxide) may emit during the production processes.	Yes- Hydrogen Sulfide, Methane and Ammonia are critically injurious to health. Proper degasification or ventilation system will be ensured in relevant stages.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
5.3	Emissions from materials handling including storage or transport?	Yes	During construction phase, dust generation by the unloading of materials like cement, aggregates, metal bars, etc.	**Yes**- Significant because the impact is on the health and welfare of the workers. To address this issue, adequate health safety measures will be ensured.
5.4	Emissions from construction activities including plant and equipment?	Yes	Impact in surrounding air and noise environment. Dust generation due to earthworks and other construction activities.	**Yes**- During pre-construction and construction phase, the emissions will be from Plant and machineries, hot mix plant, movement of vehicles, clearing of ground, construction and other related activities Significant because the impact is on the health and welfare of the workers. To address this issue, adequate health safety measures will be ensured.
5.5	Dust or odours from handling of materials including construction materials, sewage and waste?	Yes	During construction phase, air pollution due to dust generation during unloading of construction materials like aggregates, cements, metal bars, etc. and road cutting for pipeline laying.	**Yes**- There may be dust generation during construction, loading and unloading of construction materials. Road cutting (cement and bituminous roads) for pipeline laying works is likely to generate dust and noise. Significant because the impact is on the health and welfare of the workers and city dwellers as well. To address this issue, adequate health safety measures will be ensured.
5.6	Emissions from incineration of waste?	**NA**		
5.7	Emissions from burning of waste in open air (eg slash material, construction debris)?	**NA**		
5.8	Emissions from any other sources?	**NA**		
6. Will the Project cause noise and vibration or release of light, heat energy or electromagnetic radiation?				
6.1	From operation of equipment eg engines, ventilation plant, crushers?	**Yes**	**Noise-** During construction period noise will be generated from equipment, machinery, crusher plants and generators.	**No-** only site and time specific.
6.2	From industrial or similar processes?	**No**		
6.3	From construction or demolition?	**Yes**	**Dust and noise-** During construction phase cutting of roads and demolition of test piles/pile caps may produce dust and noise.	**No-** Site specific only.
6.4	From blasting or piling?	**NA**		
6.5	From construction or operational traffic?	**Yes**	Traffic disturbances due to the transport of construction material, wastes and labors.	Yes - During Operational Phase noise and vibrations will be generated due to traffic; however arranging smooth running of

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				vehicles causes ambient noise levels to come down.
6.6	From lighting or cooling systems?	**NA**		
6.7	From sources of electromagnetic radiation (consider effects on nearby sensitive equipment as well as people)?	**NA**		
6.8	From any other sources?	**NA**		
7. Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into sewers, surface waters, groundwater, coastal waters or the sea?				
7.1	From handling, storage, use or spillage of hazardous or toxic materials?	**Yes**	**Impact on land and water environment**- Short term accidental spills may happen.	**No**- To avoid contamination from fuel/lubricants, the vehicles and equipment will be maintained and examined regularly. Required precautions will be taken in storage and handling of hazardous materials.
7.2	From discharge of sewage or other effluents (whether treated or untreated) to water or the land?	**No**	Discharge of sewage to the water bodies or land is not anticipated as per the nature of work. Accidental discharge of other effluents may affect the sewer system, increase in sewage flow and in turn contaminate land, water and create public health issues.	**No** - There will not be any direct discharge of sewage into water bodies or land. The sewage from labour camps will be diverted to soak pit before discharging.
7.3	By deposition of pollutants emitted to air, onto the land or into water?	**Yes**	Air quality will be deteriorated by emissions from construction vehicles, equipment, and machineries used for installation of pipelines resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons. and chemical contamination from fuels and lubricants during installation of pipelines can contaminate nearby surface water.	**No**. It is a temporary effect related with construction activities. However, proper mitigation measures will be taken to minimize the effects.
7.4	From any other sources?	**NA**		
7.5	Is there a risk of long term build-up of pollutants in the environment from these sources?	**NA**		
8. Will there be any risk of accidents during construction or operation of the Project which could affect human health or the environment?				
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous or toxic substances?	**Yes**	Health hazards arising from inadequately receiving, storing, and handling of hazardous substances.	**No-** Effect is more likely to be site specific and only workers in the site are prone to be affected (if any). However, handling and storage of hazardous materials by the workers must follow proper safety guidance.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
8.2	From events beyond the limits of normal environmental protection e.g. failure of pollution control systems?	**NA**		
8.3	From any other causes?	**NA**		
8.4	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslip, etc)?	**No**	Flood and Earthquake hazards.	The project district lies in low seismic zone. Flooding due to heavy rainfall, esp. in monsoon may affect/disrupt the operation severely, though the rainfall trend in past several years doesn't envisage any risk of that kind.
9. Will the Project result in social changes, for example, in demography, traditional lifestyles, employment?				
9.1	Changes in population size, age, structure, social groups etc?	**No**	Temporary influx of workers during construction period.	Since the project will engage local workers as far as possible, demographic changes are not anticipated therefore.
9.2	By resettlement of people or demolition of homes or communities or community facilities e.g. schools, hospitals, social facilities?	**No**	Temporary resettlement/livelihood issues resulting mainly from laying of sewer/pipelines in busy commercial areas.	No demolition works are anticipated. Very temporary livelihood issues may arise, but not significant at all.
9.3	Through in-migration of new residents or creation of new communities?	**NA**		
9.4	By placing increased demands on local facilities or services eg housing, education, health?	**NA**		
9.5	By creating jobs during construction or operation or causing the loss of jobs with effects on unemployment and the economy?	**Yes**	Generation of temporary employment for workers and professionals during the implementation period.	**Yes.** Potential impact is positive and long-term considering the employment during operation.
9.6	Any other causes?	**Yes**	Socio-economic Environment	**Yes.** The dwellers of the Khulna city will be the major beneficiaries of the improved sewerage system. In addition to the improved environmental conditions, the project will improve the overall health condition of the city as diseases due to poor sanitation will be reduced and people should spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, along with their overall health condition.
Question - Are there any other factors which should be considered such as consequential development which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality?				
9.1	Will the project lead to pressure for consequential development which could have significant impact on the environment e.g. more	**Yes**	Infrastructure and social development.	**Yes.** Better sanitation facilities in some parts of the city must attract more migration and establishment to the parts, which in turn put pressure for further

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
	housing, new roads, new supporting industries or utilities, etc?			development in service delivery system, e.g. more housing, more schools, more roads, more utilities, etc., and all these must have greater impacts on the environment.
9.2	Will the project lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g. supporting infrastructure (roads, power supply, waste or waste water treatment, etc) housing development extractive industries supply industries other?	**Yes**	Infrastructure development of the area.	**Yes.** The project will lead to overall development in the area. With time, the supporting infrastructure like roads, power supply, waste or waste water treatment facility, housing development and industrial development will occur, that may have impacts on the environment. However, all these developments will be accompanied with the development of social infrastructure, educational, institutional and other community facilities. These developments will improve the living standard of the people of Khulna city.
9.3	Will the project lead to after-use of the site which could have an impact on the environment?	**NA**		
9.4	Will the project set a precedent for later developments?	**Yes**	The project will benefit the public by contributing to the long-term improvement of sewerage system and community liveability in Khulna city area.	**Yes**. The proposed project will set precedent for development as it is planned to be developed in the environment friendly manner.
9.5	Will the project have cumulative effects due to proximity to other existing or planned projects with similar effects?	**NA**		

Note: 'Yes' relates to those effects which are more likely to be observed during the implementation stage.

'No' relates to those effects which have no or very least likely chance to be observed

'NA' (Not applicable) relates to those aspects or effects which are not related to any interventions under the project and will no way pose any effect at all.

Checklist 2: Scoping Checklist Part 2 - Characteristics of the Project Environment (Environmental Sensitivity)

• Areas which are protected under **Question - Are there features of the local environment on or around the Project location which could be affected by the Project?** international or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the project? • Other areas which are important or sensitive for	10. No protected areas, wetlands, mangroves, or estuaries in or near the project locations. 11. There are no historical or protected monuments or archeologically significant sites near the proposed sites. 12. There are no Ramsar sites in Khulna 13. No wildlife protected areas in or near the proposed project sites in Khulna.

reasons of their ecology e.g. • Wetlands, • Watercourses or other waterbodies, • the coastal zone, • mountains, • forests or woodlands • Areas used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, overwintering, migration, which could be affected by the project? • Inland, coastal, marine or underground waters? • Areas or features of high landscape or scenic value? • Routes or facilities used by the public for access to recreation or other facilities? • Transport routes which are susceptible to congestion or which cause environmental problems? • Areas or features of historic or cultural importance?	14. No wildlife or protected forest areas fall in the proposed areas for the development of the component. 15. Available literature revealed that none of the floral species recorded from the study area falls under endangered category. 16. There are no notable ecological resources in the study area. 17. As per the seismic zoning map of Bangladesh, Khulna City falls under the Zone III, which is the lowest earthquake risk zone in Bangladesh. Hence the risk of earthquake at the proposed sites is minimal and so all the proposed sites are safe. 18. Laying pipelines through populous areas of the city and along different hospitals and clinics, educational and religious institutes will cause temporary air and noise pollution and traffic congestion. Strict environmental management procedure along with traffic management plan will be followed to lessen the effects.
Question - Is the Project in a location where it is likely to be highly visible to many people?	**Yes.**
Question - Is the Project located in a previously undeveloped area where there will be loss of greenfield land?	**No**
Question - Are there existing land uses on or around the Project location which could be affected by the Project? For example: • Homes, gardens, other private property, • Industry, • Commerce, • Recreation, • public open space, • community facilities, • agriculture, • forestry, • tourism, • mining or quarrying	3. The project component/sites are located in KCC owned existing road right of way (RoW) and KWASA-acquired vacant lands. 4. Subproject components are within Khulna city and in its immediate surroundings which have been developed into an urban area with urban facilities for many years, and there is no natural habitat left at the proposed sites. 1.
Question - Are there any plans for future land uses on or around the location which could be affected by the Project?	**No**
Question - Are there any areas on or around the location which are densely populated or built-up, which could be affected by the Project?	Subproject activities will run through the middle of the city including the densely populated areas and also in city outskirts. There are no major negative impacts envisaged, because pipeline will be located within ROW alongside the existing roads and can be constructed without causing disturbance to houses, and commercial establishments.
Question - Are there any areas on or around the location which are occupied by sensitive land uses which could be affected by the Project? • hospitals, • schools, • places of worship, • community facilities	Yes. Sewer network will run through the middle of the city, including the densely populated areas and by the sensitive land uses, like hospitals, schools, and mosque/temple and so on. However, the interventions will be temporary and proper safety measures will be taken very cautiously.
Question - Are there any areas on or around the location which contain important, high quality or scarce resources which could be affected by the Project? For example: • groundwater resources, • surface waters, • forestry • agriculture, • fisheries, • tourism,	**No**

• minerals.	
Question - Are there any areas on or around the location of the Project which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, which could be affected by the project?	**No**
Question - Is the Project location susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the project to present environmental problems?	**No.**
Question - Is the Project likely to affect the physical condition of any environmental media? • The atmospheric environment including microclimate and local and larger scale climatic conditions? • Water – e.g. quantities, flows or levels of rivers, lakes, groundwater. Estuaries, coastal waters or the sea? • Soils – e.g. quantities, depths, humidity, stability or erodibility of soils? • Geological and ground conditions?	Effects are too unlikely to be pervasive or critical, as the sites are free from any environmentally sensitive areas/receptors. Emission from the vehicles and construction equipment may pose little increase in pollutants in the air, and any accidental spillage or leakage of oil or bituminous materials into the soil or water may contaminate the media. However, Proper management during construction will be ensured to avoid any consequences.
Question - Are releases from the Project likely to have effects on the <u>quality</u> of any environmental media? • Local air quality? • Global air quality including climate change and ozone depletion • Water quality – rivers, lakes, groundwater. Estuaries, coastal waters or the sea? • Nutrient status and eutrophication of waters? • Acidification of soils or waters? • Soils • Noise? • Temperature, light or electromagnetic radiation including electrical interference? • Productivity of natural or agricultural systems?	Temporary impact on Local air, water and noise quality **m**ay take place.
Question - Is the Project likely to affect the availability or scarcity of any resources either locally or globally? • Fossil fuels? • Water? • Minerals and aggregates? • Timber? • Other non-renewable resources? • Infrastructure capacity in the locality - water, sewerage, power generation and transmission, telecommunications, waste disposal roads, rail?	**No**
Question - Is the Project likely to affect human or community health or welfare? • The quality or toxicity of air, water, foodstuffs and other products consumed by humans? • Morbidity or mortality of individuals, communities or populations by exposure to pollution? • Occurrence or distribution of disease vectors including insects? • Vulnerability of individuals, communities or populations to disease? • Individuals' sense of personal security?	The project will lead to overall development in the area, including employment generation. With time, the supporting infrastructure like roads, power supply, waste or waste water treatment, housing development and industrial development will occur, that may have impacts on the environment. However, all these developments will be accompanied with the development of social infrastructure, educational, institutional and other community facilities. These developments will improve the living standard of the Khulna city dwellers.

• Community cohesion and identity? • Cultural identity and associations? • Minority rights? • Housing conditions? • Employment and quality of employment? • Economic conditions? • Social institutions?	

Checklist 3: Significance of Impacts

Questions to be Considered	
1. Will there be a large change in environmental conditions?	No
2. Will new features be out-of-scale with the existing environment?	No
3. Will the effect be unusual in the area or particularly complex?	No
4. Will the effect extend over a large area?	No
5. Will there be any potential for trans boundary impact?	No
6. Will many people be affected?	Positively affected
7. Will many receptors of other types (fauna and flora, businesses, facilities) be affected?	Business and living standard will improve
8. Will valuable or scarce features or resources be affected?	No
9. Is there a risk that environmental standards will be breached?	No
10. Is there a risk that protected sites, areas, features will be affected?	There is no protected sites
11. Is there a high probability of the effect occurring?	Positive effect
12. Will the effect continue for a long time?	Yes .Positive effect
13. Will the effect be permanent rather than temporary?	Permanent Positive effect
14. Will the impact be continuous rather than intermittent?	Continuous.
15. If it is intermittent will it be frequent rather than rare?	N/A
16. Will the impact be irreversible?	Yes
17. Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No

KSSDP Component 3 - NO MITIGATION SCENARIO CHECKLIST

Subproject 3: Construction of Sewage Treatment Plant (STP-1 and STP-2).

Checklist 1: Scoping Checklist Part 1 - Questions on Project Characteristics

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1. Will construction, operation or decommissioning of the Project involve actions which will cause physical changes in the locality (topography, land use, changes in waterbodies, etc)?				
1.1	Permanent or temporary change in land use, land cover or topography including increases in intensity of land use?	**Yes**	Changes in land use. Construction and operation of STPs in two sites definitely will change the land use pattern. Present seasonal or temporary agricultural lands of both sites will be turned into Waste Treatment Sites, which entails a better urban service provider and in turn, will be benefiting the city dwellers, both in public health issue and personal economic gaining.	**No**- STP site at Labonchora is a low lying seasonal agricultural land, seasonal fish cultivation is also practiced there while inundated, though without proper ownership; STP site by the Khulna- Satkhira Highway is also an open area being used as seasonal agricultural land and seasonal fish cultivation.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1.2	Clearance of existing land, vegetation and buildings?	**No**	Clearance is not necessary for any of the STP sites, which are set to be built on KWASA acquired undeveloped land areas; rather tree plantation in buffer areas of the STPs will enhance/offset the surrounding environmental condition.	Only Khulna-Satkhira STP has some palm/coconut trees and the whole plant will be accommodated easily without felling the trees.
1.3	Creation of new land uses?	**Yes**	Partly; Construction and operation of STPs would change the land uses from seasonally cultivated to land use for urban utility services.	**No**. Not significant, as the current practice is very much seasonal, uncontrolled and not too intensive.
1.4	Pre-construction investigations e.g. boreholes, soil testing?	**Yes**	Geotechnical investigations on both STP sites have been conducted.	N**o.** Geotechnical investigation revealed that mostly silt and clay soil layer is prevailing in STPs site areas, thus no significant effect is anticipated.
1.5	Construction works?	**Yes**	Nuisance from noise and dust is clearly envisaged during the construction period. Social conflicts between construction workers from other areas and local workers/host communities may arise.	**No** – Temporary work. Construction work will be confined in KWASA acquired land spaces, which are clearly vacant and significantly far from any human habitation. Local labour force will be suggested to be used as far as possible to avoid such conflict (if any) and proper training on occupational health, safety and sanitation must be provided before engaging into work. These are the general impacts of construction in urban and habitable areas, and there are well developed methods of mitigation that will be suggested in the EMP
1.6	Demolition works?	**No**	It causes dust pollution. Debris after demolition causes blockage in roads, drains etc, if not properly managed.	Not required at all. STPs are proposed on KWASA's acquired, but clearly vacant land.
1.7	Temporary sites used for construction works or housing of construction workers?	**Yes**	Air and noise pollution from the operation of different machineries and equipment; water and soil pollution from storage and use of fuels, oils, solvents, and lubricants. Unsanitary and poor living conditions for workers in the work Camps.	**No -** Temporary sites will be used for Construction Yards, Labour Camps, and Construction Camps; all the sites will be restored after the construction work. Sanitary condition will be ensured in workers camp.
1.8	Above ground buildings, structures or earthworks including linear structures, cut and fill or excavations?	**Yes**	The civil work for the subproject includes earth filling, construction of process areas and above ground buildings with necessary facilities, pump stations, piping and plumbing, electro-mechanical set up, fencing, etc. for STPs.	**No. -** These anticipated impacts are temporary and for short duration. Also, construction of these project components involves appropriate techniques of civil work**.**

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1.9	Underground works including mining or tunnelling?	**NA**		
1.10	Reclamation works?	NA		
1.11	Dredging?	NA		
1.12	Coastal structures eg seawalls, piers?	NA		
1.13	Offshore structures?	NA		
1.14	Production and manufacturing processes?	NA		
1.15	Facilities for storage of goods or materials?	**Yes**	Improper storage of materials may deteriorate or corrode if exposed to the weather.	**No**. - Construction raw materials like stone/sand, aggregate, reinforced bar, etc. will be stored in open space, but properly covered with polythene, and chemicals will be stored in covered location with adopting all necessary safety measures. Iron plated construction materials would be stored carefully to avoid rust growing on those.
1.16	Facilities for treatment or disposal of solid wastes or liquid effluents?	**Yes**	Treated effluent can cause over flow and other nuisance if not disposed properly .Treated sludge can cause degradation of aesthetics if not disposed/reused properly.	**No.** Facilities in STPs are designed to cater the treatment and disposal of municipal solid wastes in order to avoid any public nuisance, and liquid effluents will be discharged after treatment, following stringent requirement for effluent standards. Contractor must follow all the procedure for management of solid and liquid effluent during construction period.
1.17	Facilities for long term housing of operational workers?	**NA**		
1.18	New road, rail or sea traffic during construction or operation?	**No**	Only construction vehicles and machineries will be the additional traffic during construction period.	**No -** Construction material transport will increase the traffic to a small scale within the city and the site areas, as the sites are relatively serene areas for traffic movement. Traffic diversions will be made with prior permission from Traffic Police department, if required, during construction phase.
1.19	New road, rail, air, waterborne or other transport infrastructure including new or altered routes and stations, ports, airports etc?	**NA**		
1.20	Closure or diversion of existing transport routes or infrastructure leading to changes in traffic movements?	**No**	Traffic management or access to the site.	Existing access to the Labonchora site is well convenient. For Khulna-Satkhira STP site, an access road along the toe line of the

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				proposed Khulna-Mongla Rail line will be constructed.
1.21	New or diverted transmission lines or pipelines?	**Yes**	Supply of utilities. Two new substations with express feeder connections are required to install with new electric poles and wires. Water line also has to be connected to the proposed project area.	**Yes**. These are permanent installations for running the facilities smoothly with prior permissions from the competent authorities.
1.22	Impoundment, damming, culverting, realignment or other changes to the hydrology of watercourses or aquifers?	**NA**		
1.23	Stream crossings?	**NA**		
1.24	Abstraction or transfers of water from ground or surface waters?	**Yes**	Abstraction or transfer of water will be required both in construction and operational phase. Water required during the civil construction of STPs will mostly be extracted from surface (e.g., river or canal) sources.	**No -** Only allocated water source will be used for the project. Water to be abstracted for civil works or operational need could be made available from nearby river/canals.
1.25	Changes in water bodies or the land surface affecting drainage or run-off?	**No**	Changes in land surface in STP areas will not affect drainage or run-off as the proposed sites for STPs can easily be linked with nearby river or canal and no congestion or flooding is anticipated. However, maximum water level in the area and tidal nature of the river should be considered while designing the STPs, to being on the safer side.	Not envisaged
1.26	Transport of personnel or materials for construction, operation or decommissioning?	**Yes**	Disruption to traffic flow and increase in air and noise pollution from vehicle movement.	**Yes –** Dust and noise levels will be elevated to a small scale by the movement of vehicles with construction materials and transport of workers from work camp to work site.
1.27	Long term dismantling or decommissioning or restoration works?	**NA**		
1.28	Ongoing activity during decommissioning which could have an impact on the environment?	**NA**		
1.29	Influx of people to an area in either temporarily or permanently?	**Yes**	Social conflicts between construction workers from other areas and local workers/communities.	**No. -** There might be temporary influx of people to the area as labours and other people who will be involved directly or indirectly during the construction. However, preference will be given to local people in the employment.
1.30	Introduction of alien species?	**NA**		
1.31	Loss of native species or genetic diversity?	**NA**		

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
1.32	Any other actions?	**NA**		
2. Will construction or operation of the Project use natural resources such as land, water, materials or energy, especially any resources which are non-renewable or in short supply?				
2.1	Land especially undeveloped or agricultural land?	**Yes**	Changes in land use pattern-undeveloped land being used mainly for seasonal agriculture will be hosting the STPs.	**No.** Acquired land by KWASA will be used for construction of STPs and other infrastructures.
2.2	Water?	**Yes**	Both the quality and quantity of water could be affected for the use of nearby water sources for construction purposes and daily use by the workers and other communities involved in implementation and operation later on.	**No.** Proper water management plan will be developed and followed by the contractor and regular monitoring will be in place as well. A guidance will also be included into the EMP.
2.3	Minerals?	**NA**		
2.4	Aggregates?	**Yes**	Extraction of materials can disrupt natural land contours and stability, and vegetation resulting in accelerated erosion, subsidence, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	**Yes** - major change in environment at the extraction sites. Impact on large numbers of people nearby of the place of extraction. Khulna city will not be affected.
2.5	Forests and timber?	**NA**		
2.6	Energy including electricity and fuels?	**Yes**	Consumption of Electricity and burning of fuel like Diesel and Petrol.	**Preferably** electricity supply through express feeder connection for running machineries and equipment; alternatively sound proof/super silent Diesel Generator set should be used.
2.7	Any other resources?	**Yes**	Sand from river bed as construction material.	**No.** It will be collected from existing sand mining quarry.
3. Will the Project involve use, storage, transport, handling or production of substances or materials which could be harmful to human health or the environment or raise concerns about actual or perceived risks to human health?				
3.1	Will the project involve use of substances or materials which are hazardous or toxic to human health or the environment (flora, fauna, water supplies)?	**Yes**	Leakage in discharge of fuels like diesel, Petrol, and Oil & Grease, will affect human health and environment.	**No.** Temporarily It may contaminate land, water and create public health issues, but proper management will be followed in every step during the construction / implementation stages.
3.2	Will the project result in changes in occurrence of disease or affect disease vectors (e.g. insect or water borne diseases)?	**No**	Not anticipated. Moreover, the project will contribute in improving the public health condition of Khulna city dwellers.	**No-** Diseases due to poor sanitation system will be reduced. Improved sanitary and disposal condition will result in improved public health condition of city dwellers; thereby, fewer occurrences of diseases will lessen the burden on health care system and in turn, economic benefit in individual scale will also be enhanced.

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
3.3	Will the project affect the welfare of people e.g. by changing living conditions?	**No**	Will improve environmental and socio-economic condition.	A part of Khulna city dwellers will be the major beneficiaries of the improved sanitary system, as the human waste from the houses will be removed rapidly, which otherwise would flow in open drains. In addition to improved environmental conditions, the project will improve the overall health condition of the city as well. This should improve the environment; deliver major improvements in individual and community health sector and resulting in lowering of medical cost.
3.4	Are there especially vulnerable groups of people who could be affected by the project e.g. hospital patients, the elderly?	**No**	Effects on vulnerable groups of people.	STP sites are situated in mostly uninhabited areas, so chances are very unlikely to affect the people of especially vulnerable groups.
3.5	Any other causes?	**NA**		
4. Will the Project produce solid wastes during construction or operation or decommissioning?				
4.1	Spoil, overburden or mine wastes?	**Yes**	Can disrupt natural land contours and vegetation resulting in accelerated risk to health injury, disturbance in natural drainage patterns, ponding and water logging, and water pollution.	**No. –** Temporary impact, limited only during construction phase. Adequate arrangement will be made for disposal of solid wastes by the contractor for construction and operational wastes including restoration of landscape.
4.2	Municipal waste (household and or commercial wastes)?	**Yes**	Construction camp will generate household and other wastes	**No** - there will be local waste management facilities in place during the construction and operational period.
4.3	Hazardous or toxic wastes (including radioactive wastes)?	**NA**		
4.4	Other industrial process wastes?	**NA**		
4.5	Surplus product?	**NA**		
4.6	Sewage sludge or other sludge from effluent treatment?	**Yes**	A reasonable quantity of sewage sludge will be produced from STPs.	**Yes –**Proper sludge treatment and management options will be selected and materialized.
4.7	Construction or demolition wastes?	**Yes**	Construction wastes will be produced in STP sites.	**No -** Subproject components are located away from settlements. Significant amount of construction and demolition wastes will be generated due to building structures in STP sites, which will be reused in construction and the remaining waste will be used for filling of low lying land.
4.8	Redundant machinery or equipment?	**NA**		

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
4.9	Contaminated soils or other material?	**NA**		
4.10	Agricultural wastes?	**NA**		
4.11	Any other solid wastes?	**NA**		
5. Will the Project release pollutants or any hazardous, toxic or noxious substances to air?				
5.1	Emissions from combustion of fossil fuels from stationary or mobile sources?	**Yes**	Air quality: particulate matter and due to the increase in concentration of vehicles and heavy equipment exhausted pollutants such as carbon monoxide, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons.	**Yes -** During construction period, emissions will be generated from the vehicles carrying construction materials, heavy machineries/ equipment involved in the construction and Diesel fuelled Generator sets which will be used for power supply or back up.
5.2	Emissions from production processes?	**Yes**	Methane is produced in the sewer pipes and the clarifier. Nitrous oxide can also be produced and emitted during production processes with nitrite accumulation inside the sewage treatment plant.	**Yes**- Both gases are critically injurious to health. Proper degasification or ventilation system will be ensured in relevant stages.
5.3	Emissions from materials handling including storage or transport?	**Yes**	During construction phase, dust generation by the unloading of materials like cement, aggregates, metal bars, etc. During operation phase, spills or leaks from stored chemicals or gases (e.g. chlorine gas) for use in the water treatment and cleaning processes.	**Yes**. Significant because the impact is on the health and welfare of the workers. To address this issue, adequate health safety measures will be ensured.
5.4	Emissions from construction activities including plant and equipment?	**Yes**	Dust generation due to earthworks and other construction activities.	**Yes.** Significant because the impact is on the health and welfare of the workers. To address this issue, adequate health safety measures will be ensured.
5.5	Dust or odours from handling of materials including construction materials, sewage and waste?	**Yes**	During construction phase, air pollution due to dust generation during unloading of construction materials like aggregates, cements, metal bars, etc. During operation phase, air pollution due to leaks from mishandling of chemicals used in the water treatment (e.g. coagulants, chlorine).	**Yes**. Significant because the impact is on the health and welfare of the workers. To address this issue, adequate health safety measures will be ensured.
5.6	Emissions from incineration of waste?	**NA**		
5.7	Emissions from burning of waste in open air (eg slash material, construction debris)?	**NA**		
5.8	Emissions from any other sources?	**NA**		
6. Will the Project cause noise and vibration or release of light, heat energy or electromagnetic radiation?				

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
6.1	From operation of equipment eg engines, ventilation plant, crushers?	**Yes**	**Noise-** During construction period noise will be generated from equipment, machinery, crusher plants and generators.	**No-** only site and time specific.
6.2	From industrial or similar processes?	**NA**		
6.3	From construction or demolition?	**Yes**	**Dust and noise-** During construction phase demolition of test piles/pile caps may produce dust and noise.	**No-** Site specific only.
6.4	From blasting or piling?	**NA**		
6.5	From construction or operational traffic?	**Yes**	Traffic disturbances due to the transport of construction material and wastes.	**Yes** - During Operational Phase noise and vibrations will be generated due to traffic; however arranging smooth running of vehicles causes ambient noise levels to come down.
6.6	From lighting or cooling systems?	**NA**		
6.7	From sources of electromagnetic radiation (consider effects on nearby sensitive equipment as well as people)?	**NA**		
6.8	From any other sources?	**NA**		
7. Will the Project lead to risks of contamination of land or water from releases of pollutants onto the ground or into sewers, surface waters, groundwater, coastal waters or the sea?				
7.1	From handling, storage, use or spillage of hazardous or toxic materials?	**Yes**	**Impact on land and water environment**- Short term accidental spills may happen.	**No**- To avoid contamination from fuel/lubricants, the vehicles and equipment will be maintained and examined regularly. Required precautions will be taken in storage and handling of hazardous materials.
7.2	From discharge of sewage or other effluents (whether treated or untreated) to water or the land?	**Yes**	Discharge of sewage to the water bodies or land is not anticipated as per the nature of work. Accidental discharge of other effluents may affect the sewer system, increase in sewage flow and in turn contaminate land, water and create public health issues.	**No.** There will not be any direct discharge of sewage into water bodies or land. The sewage from labour camps will be diverting to soak pit before discharging.
7.3	By deposition of pollutants emitted to air, onto the land or into water?	**Yes**	Air quality will be deteriorated by emissions from construction vehicles, equipment, and machineries used for installation of pipelines resulting to dusts and increase in concentration of vehicle-related pollutants such as carbon monoxide, sulphur oxides, particulate matter, nitrous oxides, and hydrocarbons, and chemical contamination from fuels and lubricants during installation of pipelines can contaminate nearby surface water.	**No**. It is a temporary effect related with construction activities. However, proper mitigation measures will be taken to minimize the effects.
7.4	From any other sources?	**NA**		

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
7.5	Is there a risk of long term build-up of pollutants in the environment from these sources?	**NA**		
8. Will there be any risk of accidents during construction or operation of the Project which could affect human health or the environment?				
8.1	From explosions, spillages, fires etc from storage, handling, use or production of hazardous or toxic substances?	**Yes**	Health hazards arising from inadequate design of facilities for receiving, storing, and handling of chlorine and other hazardous chemicals.	**Yes-** Though both the STP facilities are in the urban outskirt areas, the safety of both workers and citizens will be ensured.
8.2	From events beyond the limits of normal environmental protection e.g. failure of pollution control systems?	**NA**		
8.3	From any other causes?	**NA**		
8.4	Could the project be affected by natural disasters causing environmental damage (e.g. floods, earthquakes, landslip, etc)?	**No**	Flood and Earthquake hazards.	The project district lies in low seismic zone. Flooding due to heavy rainfall, esp. in monsoon may affect/disrupt the operation severely, though the rainfall trend in past several years doesn't envisage any risk of that kind.
9. Will the Project result in social changes, for example, in demography, traditional lifestyles, employment?				
9.1	Changes in population size, age, structure, social groups etc?	**No**	Temporary influx of workers during construction period.	Since the project will engage local workers as far as possible, demographic changes are not anticipated therefore.
9.2	By resettlement of people or demolition of homes or communities or community facilities e.g. schools, hospitals, social facilities?	**No**	Both the sites are far from any inhabited areas.	No demolition works are anticipated.
9.3	Through in-migration of new residents or creation of new communities?	**NA**		
9.4	By placing increased demands on local facilities or services eg housing, education, health?	**NA**		
9.5	By creating jobs during construction or operation or causing the loss of jobs with effects on unemployment and the economy?	**Yes**	Generation of temporary employment for workers and professionals during the implementation period.	**Yes.** Potential impact is positive and long-term considering the employment during the operation.
9.6	Any other causes?	**Yes**	Socio-economic Environment	**Yes.** The dwellers of the Khulna city will be the major beneficiaries of the improved sanitary system and centralized sewage treatment plant. In addition to improved environmental conditions, the project will improve the overall health condition of the city as diseases due to poor sanitation will be reduced and people should spend less on

No.	Questions to be considered in Scoping	Yes/No/?	Which Characteristics of the Project Environment could be affected and how?	Is the effect likely to be significant? Why?
				healthcare and lose fewer working days due to illness, so their economic status should also improve, along with their overall health condition.
Question - Are there any other factors which should be considered such as consequential development which could lead to environmental effects or the potential for cumulative impacts with other existing or planned activities in the locality?				
9.1	Will the project lead to pressure for consequential development which could have significant impact on the environment e.g. more housing, new roads, new supporting industries or utilities, etc?	**Yes**	Infrastructure and social development.	**Yes.** Better sanitation facilities in some parts of the city must attract more migration and establishment to the parts, which in turn put pressure for further development in service delivery system, e.g. more housing, more schools, more roads, more utilities, etc., and all these must have greater impacts on the environment.
9.2	Will the project lead to development of supporting facilities, ancillary development or development stimulated by the project which could have impact on the environment e.g. supporting infrastructure (roads, power supply, waste or waste water treatment, etc) housing development extractive industries supply industries other?	**Yes**	Infrastructure development of the area.	**Yes.** The project will lead to overall development in the area. With time, the supporting infrastructure like roads, power supply, waste or waste water treatment facility, housing development and industrial development will occur, that may have impacts on the environment. However, all these developments will be accompanied with the development of social infrastructure, educational, institutional and other community facilities. These developments will improve the living standard of the people of Khulna city.
9.3	Will the project lead to after-use of the site which could have an impact on the environment?	**NA**		
9.4	Will the project set a precedent for later developments?	**Yes**	The project will benefit the public by contributing to the long-term improvement of sanitation system and community liveability in Khulna city area.	**Yes**. The proposed project will set precedent for development as it is planned to be developed in the environment friendly manner.
9.5	Will the project have cumulative effects due to proximity to other existing or planned projects with similar effects?	**NA**		

Note: 'Yes' relates to those effects which are more likely to be observed during the implementation stage.

'No' relates to those effects which have no or very least likely chance to be observed

'NA' (Not applicable) relates to those aspects or effects which are not related to any interventions under the project and will no way pose any effect at all.

Checklist 2: Scoping Checklist Part 2 - Characteristics of the Project Environment (Environmental Sensitivity)

• Areas which are protected under **Question - Are there features of the local environment on or around the Project location which could be affected by the Project?** international or national or local legislation for their ecological, landscape, cultural or other value, which could be affected by the project? • Other areas which are important or sensitive for reasons of their ecology e.g. • Wetlands, • Watercourses or other waterbodies, • the coastal zone, • mountains, • forests or woodlands • Areas used by protected, important or sensitive species of fauna or flora e.g. for breeding, nesting, foraging, resting, overwintering, migration, which could be affected by the project? • Inland, coastal, marine or underground waters? • Areas or features of high landscape or scenic value? • Routes or facilities used by the public for access to recreation or other facilities? • Transport routes which are susceptible to congestion or which cause environmental problems? • Areas or features of historic or cultural importance?	19. No protected areas, wetlands, mangroves, or estuaries in or near the project locations. 20. There are no historical or protected monuments or archeologically significant sites near the proposed sites. 21. There are no Ramsar sites in Khulna 22. No wildlife protected areas in or near the proposed project sites in Khulna. 23. No wildlife or protected areas and none of the project components fall in the forest area. 24. Available literature revealed that none of the floral species recorded from the study area falls under endangered category. 25. There are no notable ecological resources in the study area. 26. As per the seismic zoning map of Bangladesh, Khulna City falls under the Zone III, which is the lowest earthquake risk zone in Bangladesh. Hence the risk of earthquake at the proposed sites is minimal and so the site is safe. 27. The proposed STP sites are free from inhabitation and the surrounding areas are also very scarcely inhabited (within 500 m distance). Some trees and shrubs are present at these sites. 28. Dense plantation in the periphery of STPs, especially in the buffer zone around the sites shall be done to avoid adverse impacts on aesthetics. It is also worth to mention here that proposed technology of STP will minimize foul smelling.
Question - Is the Project in a location where it is likely to be highly visible to many people?	**Not at this moment.**
Question - Is the Project located in a previously undeveloped area where there will be loss of greenfield land?	**No**
Question - Are there existing land uses on or around the Project location which could be affected by the Project? For example: • Homes, gardens, other private property, • Industry, • Commerce, • Recreation, • public open space, • community facilities, • agriculture, • forestry, • tourism, • mining or quarrying	5. The project components/sites are located in KWASA-acquired vacant land areas. 6. Subproject components are at the outskirt of Khulna City, which have been developing into an urban area with urban facilities since many years, and there is no natural habitat left at the proposed sites.
Question - Are there any plans for future land uses on or around the location which could be affected by the Project?	**No**
Question - Are there any areas on or around the location which are densely populated or built-up, which could be affected by the Project?	There are no major negative impacts envisaged, because both of the STP sites are sufficiently away from habitations.
Question - Are there any areas on or around the location which are occupied by sensitive land uses which could be affected by the Project? • hospitals,	**No.** Not for city outskirts, where none of the sensitive land uses are present, except a church nearby the Khulna-Satkhira STP. However, all protective measures will be taken for keeping the Church free from any nuisance or even from any visual impact

• schools, • places of worship, • community facilities	
Question - Are there any areas on or around the location which contain important, high quality or scarce resources which could be affected by the Project? For example: • groundwater resources, • surface waters, • forestry, • agriculture, • fisheries, • tourism, • minerals.	**No**
Question - Are there any areas on or around the location of the Project which are already subject to pollution or environmental damage e.g. where existing legal environmental standards are exceeded, which could be affected by the project?	**No**
Question - Is the Project location susceptible to earthquakes, subsidence, landslides, erosion, flooding or extreme or adverse climatic conditions e.g. temperature inversions, fogs, severe winds, which could cause the project to present environmental problems?	**No.**
Question - Is the Project likely to affect the physical condition of any environmental media? • The atmospheric environment including microclimate and local and larger scale climatic conditions? • Water – e.g. quantities, flows or levels of rivers, lakes, groundwater. Estuaries, coastal waters or the sea? • Soils – e.g. quantities, depths, humidity, stability or erodibility of soils? • Geological and ground conditions?	**No.**
Question - Are releases from the Project likely to have effects on the <u>quality</u> of any environmental media? • Local air quality? • Global air quality including climate change and ozone depletion • Water quality – rivers, lakes, groundwater. Estuaries, coastal waters or the sea? • Nutrient status and eutrophication of waters? • Acidification of soils or waters? • Soils • Noise? • Temperature, light or electromagnetic radiation including electrical interference? • Productivity of natural or agricultural systems?	Temporary impact on Local air, water and noise quality**.** Effects are too unlikely to be pervasive or critical, as the sites are free from any environmentally sensitive areas/receptors. Emission from the vehicles and construction equipment may pose little increase in pollutants in the air, and any accidental spillage or leakage of oil into the ground or water may contaminate the media. However, Proper management during construction will be ensured to avoid any consequences.
Question - Is the Project likely to affect the availability or scarcity of any resources either locally or globally? • Fossil fuels? • Water? • Minerals and aggregates? • Timber? • Other non-renewable resources? • Infrastructure capacity in the locality - water, sewerage, power generation and transmission, telecommunications, waste disposal roads, rail?	**No**
Question - Is the Project likely to affect human or	The project will lead to overall development in the area,

community health or welfare? • The quality or toxicity of air, water, foodstuffs and other products consumed by humans? • Morbidity or mortality of individuals, communities or populations by exposure to pollution? • Occurrence or distribution of disease vectors including insects? • Vulnerability of individuals, communities or populations to disease? • Individuals' sense of personal security? • Community cohesion and identity? • Cultural identity and associations? • Minority rights? • Housing conditions? • Employment and quality of employment? • Economic conditions? • Social institutions?	including health& sanitation and employment generation. With time, the supporting infrastructure like roads, power supply, waste or waste water treatment, housing development and industrial development will occur, that may have impacts on the environment. However, all these developments will be accompanied with the development of social infrastructure, educational, institutional and other community facilities. These developments will improve the living standard of the Khulna city dwellers.

Checklist 3: Significance of Impacts

Questions to be Considered	
1. Will there be a large change in environmental conditions?	No
2. Will new features be out-of-scale with the existing environment?	No
3. Will the effect be unusual in the area or particularly complex?	No
4. Will the effect extend over a large area?	No
5. Will there be any potential for trans boundary impact?	No
6. Will many people be affected?	Positively affected
7. Will many receptors of other types (fauna and flora, businesses, facilities) be affected?	Business and living standard will improve
8. Will valuable or scarce features or resources be affected?	No
9. Is there a risk that environmental standards will be breached?	No
10. Is there a risk that protected sites, areas, features will be affected?	There is no protected sites
11. Is there a high probability of the effect occurring?	Positive effect
12. Will the effect continue for a long time?	Yes .Positive effect
13. Will the effect be permanent rather than temporary?	Permanent Positive effect
14. Will the impact be continuous rather than intermittent?	Continuous.
15. If it is intermittent will it be frequent rather than rare?	N/A
16. Will the impact be irreversible?	Yes
17. Will it be difficult to avoid, or reduce or repair or compensate for the effect?	No

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APPENDIX-3: ENVIRONMENTAL QUALITY STANDARDS OF BANGLADESH

Standards for Air, Schedule – 2 (Density in microgram per cusec meter)

AIR POLLUTANT	STANDARDS	AVERAGEING TIME
Carbon Monoxide (CO)	10 mg/m3 (9 ppm)[a]	8-hour
	40 mg/m3 (35 ppm)	1-hour
Lead (Pb)	0.5 µg/m3	Annual
Oxides of Nitrogen (NOx)	100 µg/m3 (0.053 ppm)	Annual
Suspended Particulate Matter (SPM)	200 µg/m3	8-hour
PM10	50 µg/m3 [b]	Annual
	150 µg/m3 [c]	24-hour
PM2.5	15 µg/m3	Annual
	65 µg/m3	24-hour
Ozone (O3)	235 µg/m3 (0.12 ppm) [d]	1-hour
	157 µg/m3 (0.08 ppm)	8-hour
Sulfur di Oxide (SO2)	80 µg/m3 (0.03 ppm)	Annual
	365 µg/m3 (0.14 ppm) [a]	24-hour

Abbreviation: ppm: Parts Per Million

Notes: *In this schedule Air Quality Standards means Ambient Air Quality Standards

a) Not to be exceeded more than once per year
b) Annual average value will be less than or equal to 50 microgram/cubic meter
c) Average value of 24 hours will be less or equal to 150 microgram/cubic meter for one day each year.
d) Maximum average value for everyone hour each year will be equal or less than 0.12 ppm.

Source: DOE. Schedule 2, Rule-12, ECR, 1997. (Bangladesh Gazette, 19 July 2005).

Standards for Water, Schedule – 3 (A. Standards for Inland Surface Water)

Best Practice based classification		Parameter			
		pH	BOD mg/l	DO mg/l	Total Coliform number/100
a.	Source of drinking water for supply only after disinfecting:	6.5-8.5	2 or less	6 or above	50 or less
b.	Water usable for recreational activity :	6.5-8.5	3 or less	5 of more	200 or less
c.	Source of drinking water for supply after conventional treatment :	6.5-8.5	6 or less	6 of more	5000 or less
d.	Water usable by fisheries:	6.5-8.5	6 or less	5 of more	------
e.	Water usable by various process and cooling industries :	6.5-8.5	10 or less	5 of more	5000 or less
f.	Water usable for irrigation:	6.5-8.5	10 or less	5 of more	1000 or less

Notes:

1. In water used for pisiculture, maximum limit of presence of ammonia as Nitrogen is 1.2 mg/l.
2. Electrical conductivity for irrigation water – 2250 µmhoms/cm (at a temperature of 25°C); Sodium less than 26%; boron less than 0.2%.

Standards for Water, Schedule – 3 (B. Standards for Drinking Water)

Sl.	Parameter	Unit	Standards
1.	Aluminum	mg/l	0.2
2.	Ammonia (NH3)	mg/l	0.5
3.	Arsenic	mg/l	0.05
4.	Balium	mg/l	0.01
5.	Benzene	mg/l	0.01
6.	BOD5 20°C	mg/l	0.2
7.	Boron	mg/l	1.0
8.	Cadmium	mg/l	0.005
9.	Calcium	mg/l	75
10.	Chloride	mg/l	150 – 600*
11.	Chlorinated alkanes		
	carbontetrachloride	mg/l	0.01
	1.1 dichloroethylene	mg/l	0.001
	1.2 dichloroethylene	mg/l	0.03
	tetrachloroethylene	mg/l	0.03
	trichloroethylene	mg/l	0.09
12	Chlorinated phenols		
	- pentachlorophenol	mg/l	0.03
	- 2.4.6 trichlorophenol	mg/l	0.03
13.	Chlorine (residual)	mg/l	0.2
14.	Chloroform	mg/l	0.09
15.	Chromium (hexavalent)	mg/l	0.05
16.	Chromium (total)	mg/l	0.05
17.	COD	mg/l	4
18.	Coliform (fecal)	n/100 ml	0
19.	Coliform (total)	n/100 ml	0
20.	Color	Hazen unit	15
21.	Copper	mg/l	1
22.	Cyanide	mg/l	0.1
23.	Detergents	mg/l	0.2
24.	DO	mg/l	6
25.	Fluoride	mg/l	1
26.	Hardness (as CaCO3)	mg/l	200 – 500
27.	Iron	mg/l	0.3 – 1.0
28.	Kjeldhl Nitrogen (total)	mg/l	1
29.	Lead	mg/l	0.05
30.	Magnesium	mg/l	30 – 35
31.	Manganese	mg/l	0.1
32.	Mercury	mg/l	0.001
33.	Nickel	mg/l	0.1
34.	Nitrate	mg/l	10
35.	Nitrite	mg/l	<1
36.	Odor	mg/l	Odorless
37.	Oil and grease	mg/l	0.01

Sl.	Parameter	Unit	Standards
38.	pH	mg/l	6.5 – 8.5
39.	Phenolic compounds	mg/l	0.002
40.	Phosphate	mg/l	6
41.	Phosphorus	mg/l	0
42.	Potassium	mg/l	12
43.	Radioactive materials (gross alpha activity)	Bq/l	0.001
44.	Radioactive materials (gross beta activity)	Bq/l	0.01
45.	Selenium	mg/l	0.01
46.	Silver	mg/l	0.02
47.	Sodium	mg/l	200
48.	Suspended particulate matters	mg/l	10
49.	Sulfide	mg/l	0
50.	Sulfate	mg/l	400
51.	Total dissolved solids	mg/l	1000
52.	Temperature	°C	20-30
53.	Tin	mg/l	2
54.	Turbidity	JTU	10
55.	Zinc	mg/l	5

Standards for Sound, Schedule – 4

Sl. No.	Category of areas	Standards determined at dBA unit	
		Day	Night
a.	Silent zone	50	40
b.	Residential area	55	45
c.	Mixed area(mainly residential area, and also simultaneously used for commercial and industrial purposes)	60	50
d.	Commercial area	70	60
e.	Industrial area	75	70

Notes:

1. The time from 6 a.m. to 9 p.m. is counted as daytime.
2. The time from 9 p.m. to 6 a.m. is counted as night time.
3. Area up to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/to be identified by the Government is designated as Silent Zones where use of horns of vehicles or other audio signals, and loudspeakers are prohibited

Standards for Odor, Schedule – 8

Parameters	Unit	Standard Limit
Acetaldehyde	ppm	0.5-5
Ammonia	ppm	1-5
Hydrogen Sulfide	ppm	0.02-0.2
Methyl Disulfide	ppm	0.009-0.1
Methyl Sulfide	ppm	0.01-0.2
Styrene	ppm	0.4-2.0
Trim ethylamine	ppm	0.005-0.07

Notes: (1) Following regulatory limit shall be generally applicable to emission/exhaust outlet pipe of above 5-meter height: Q = 0.108 x He2Cm (Where Q = Gas Emission rate Nm3 /hour) He = Height of exhaust outlet pipe (m) Cm =

Above mentioned limit (ppm); (2) In cases where a special parameter has been mentioned, the lower limit shall be applicable for warning purposes, and the higher limit shall be applicable for prosecution purpose or punitive measure.

Standards for Sewage Discharge, Schedule – 9

Parameter	Unit	Standard Limit
BOD	milligram/l	40
Nitrate	milligram/l	250
Phosphate	milligram/l	35
Suspended Solids (SS)	milligram/l	100
Temperature	Degree Centigrade	30
Coliform	Number per 100 ml	1000

Notes:

(1) This limit shall be applicable to discharges into surface and inland waters bodies,

(2) Sewage shall be chlorinated before final discharge.

Standards for Waste from Industrial Units or Projects Waste, Schedule – 10

Sl.	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
1	2	3	4	5	6
1.	Ammoniacal Nitrogen (as elementary N)	mg/l	50	75	75
2.	Ammonia (as free ammonia)	mg/l	5	5	15
3.	Arsenic (as)	mg/l	0.2	0.05	0.2
4.	BOD5 at 20oC	mg/l	50	250	100
5.	Boron	mg/l	2	2	2
6.	Cadmium (as CD)	mg/l	0.05	0.05	0.05
7.	Chloride	mg/l	600	600	600
8.	Chromium (as total Cr)	mg/l	0.5	1.0	1.0
9.	COD	mg/l	200	400	400
10.	Chromium (as hexavalent Cr)	mg/l	0.1	1.0	0.1
11.	Copper (as Cu)	mg/l	0.5	3.0	3.0
12	Dissolved Oxygen (DO)	mg/l			
13.	Electro-conductivity (EC)	Micro mho/ cm	1200	1200	1200
14.	Total Dissolved Solids	mg/l	2,100	2,100	2,100
15.	Fluoride (as F)	mg/l	2	15	10
16.	Sulfide (as S)	mg/l	1	2	2
17.	Iron (as Fe)		2	2	2
18.	Total Kjeldahl Nitrogen (as N)	mg/l	100	100	100
19.	Lead (as Pb)	mg/l	0.1	1.0	0.1
20.	Manganese (as Mn)	mg/l	5	5	5
21.	Mercury (as Hg)	mg/l	0.01	0.01	0.01
22.	Nickel (as Ni)	mg/l	1.0	2.0	1.0
23.	Nitrate (as elementary N)	mg/l	10.0	Not Yet Fixed	10

Sl.	Parameter	Unit	Places for determination of standards		
			Inland Surface Water	Public Sewerage system connected to treatment at second stage	Irrigated Land
24.	Oil and Grease	mg/l	10	20	10
25.	Phenolic Compounds (as C6H5OH)	mg/l	1.0	5	1.0
26.	Dissolved Phosphorus (as P)	mg/l	8	8	15
27.	Radioactive substance	To be specified by Bangladesh Atomic Energy Commission			
28.	pH	mg/l	6 – 9	6 – 9	6 – 9
29.	Selenium (as Se)	mg/l	0.05	0.05	0.05
30.	Zinc (as Zn)	mg/l	5	10	10
31.	Total Dissolved Solids	mg/l	2,100	2,100	2,100
32.	Temperature	Degree Centigrade	40	40	40-Summer
			45	45	45-Winter
33.	Suspended Solids (SS)	mg/l	150	500	200
34.	Cyanide (as Cn)	mg/l	0.1	2.0	0.2

Notes:

(1) These standards shall be applicable to all industries or projects other than those specified under the heading "Standards for sector wise industrial effluent or emission."
(2) Compliance with these standards shall be ensured from the moment an industrial unit starts trial production, and in other cases, from the moment a project starts operation.
(3) These standards shall be inviolable even in case of any sample collected instantly at any point of time. These standards may be enforced in a more stringent manner if considered necessary in view of the environmental conditions of a particular situation.
(4) Inland Surface Water means drains/ponds/tanks/water bodies/ ditches, canals, rivers, springs and estuaries.
(5) Public sewerage system means treatment facilities of the first and second stage and also the combined and complete treatment facilities.
(6) Irrigable land means such land area which is sufficiently irrigated by waste water taking into consideration the quantity and quality of such water for cultivation of selected crops on that land.
(7) Inland Surface Water Standards shall apply to any discharge to a public sewerage system or to land if the discharge does not meet the requirements of the definitions in notes 5 and 6 above.

APPENDIX-4: CRITICAL HABITAT SCREENING AND BIODIVERSITY

SC Environment Ltd

Khulna Sewerage System

Critical Habitat Screening and Biodiversity

Date: 18 June 2020

For Asian Development Bank

Ref: SCE – ADB BAN-12-06-20

Rev: 01

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Date 18 June 2020

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ACRONYMS

ADB	Asian Development Bank
AoA	Area of Analysis
CH	Critical Habitat
CR	Critically Endangered
EN	Endangered
IBAT	Integrated Biodiversity Assessment Tool
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
SPS	Safeguard Policy Statement
VU	Vulnerable
WPDA	World Database on Protected Area

1 INTRODUCTION

1.1 Preamble

The Asian Development Bank (ADB) is considering a loan/grant for sewerage infrastructure improvements within the City of Khulna, Bangladesh. As part of the due diligence process for the loan/grant, ADB wishes to have information on the potential presence of Critical Habitat within the proposed projects potential area of influence. In addition, general information on the biodiversity value of the areas where the project will take place is required for the project development phases if the loan/grant is processed.

Asian Development Bank (ADB) has requested an initial screening study for ecological constraints and in particular for Critical Habitat within the area of influence of the project areas. This report sets out the outcomes of the conducted screening and assessment for the proposed project. The determination of the presence of Critical Habitat is a fundamental part of ADB Safeguard Policy Statement (Asian Development Bank, 2009).

2 PROJECT DESCRIPTION

2.1 Preamble

The following text provides an overview of the proposed project relating to the development of infrastructure at Khulna. This description is provided only for contextual information as the determination of the presence of or potential presence of Critical Habitat is independent of the proposed project, construction activities and operational/maintenance features (IFC, 2019).

2.2 Project Location

The project is located in the Bangladesh district of Khulna, within the city of the same name. The context of the location is presented in Figure 2.1. It can be seen that Khulna is situated in the south west of Bangladesh, some 100 km from the coastline and 55 km from the international border with India.

Figure 2.1 Contextual Location of Project



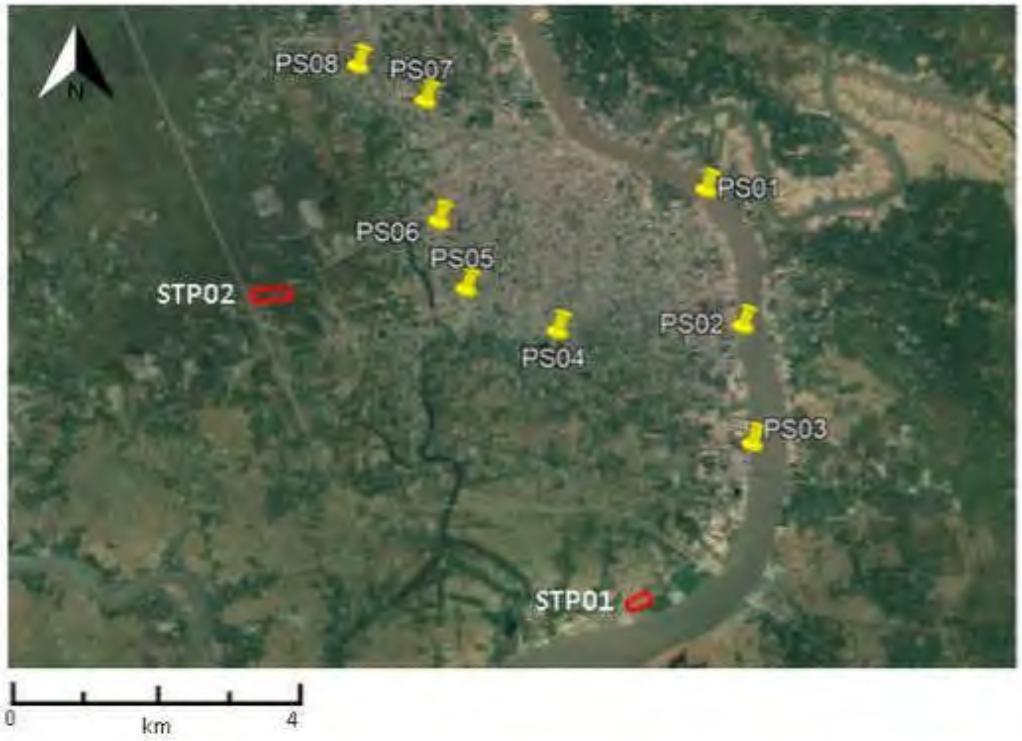
Source: Base Map – Google Earth

The city of Khulna lies on the Bhairab River, just above the confluence of this river with the Madhumati River which forms the Rupsha River. The rivers flow more or less north to south towards the delta. The rivers form part of the wider Ganges - Padma River system.

2.3 Project Description

The project consists of improvement of the existing sewerage system within the city of Khulna. The focus of the work will be the development of two sewerage treatment plants (STP) and eight Pump Stations (PS). The location of these elements is shown in Figure 2.2.

Figure 2.2 Location of Main Project Elements



Source: Base Map – Google Earth

The project elements span a distance of approximately 8 km on a north - south axis and 7 km east – west.

The Pump Stations are within the urbanised area of Khulna City, while the two STP's are in more rural locations. The land use at the pump station locations is a mix of industrial and residential. PS01-PS03 are located close to the western bank of the Rupsha River. STP01 is located downstream of the confluence of the Bhairab and Madhumati Rivers, on the Rupsha River. The project boundary for this STP is shown in Figure 2.3. STP01 covers an area of approximately 50,000 m2.

Figure 2.3 Boundary of STP01



Source: Base Map – Google Earth

STP01 site is formed mainly of agricultural land but is bounded to the north by a large ditch and open areas of water to the south. Review of historical satellite images for the area show that much of the site is subject to seasonal inundation. The most recent images indicate that recent development has taken place to the south and east of the project area. This is shown in Figure 2.4 and appears to be temporary housing areas.

Figure 2.4 STP01 Surrounding Land Use - April 2020



Source: Base Map – Google Earth

STP02 is located in a rural area to the west of the city. The existing land use is agricultural with fields and ponds present. The site, which is shown in Figure 2.5 is approximately 88,000 m2 in area.

Figure 2.5 Boundary of STP02



Source: Base Map – Google Earth

3 SCREENING PROCESS FOR CRITICAL HABITAT

3.1 Process

Two related aspects have been screened. The first is the presence of protected or designated areas which may affect the loan/grant decision making process and the second the potential presence of Critical Habitat1[29] based on an initial risk assessment of the presence of Threatened Species (Critically Endangered (CR) and Endangered (EN) species as defined by the IUCN, and to a lesser extent Vulnerable (VU) species).

The process has utilised the International Finance Corporation's (IFC) recommended approach to identification of Critical Habitat but at a more preliminary screening level. The method is presented as part of the IFC's Performance Standard No 6 of 2012, within the Guidance Note for the Performance Standard which was last updated in June 2019 (IFC, 2019).

3.2 Data Sources

The screening process has involved review of publicly available sources of data relating to protected sites and species conservation status.

[29] Note the use of the term Critical Habitat refers to the definition utilised by ADB in the Safeguard Policy Statement of 2009 and the International Finance Corporation Performance Standard No 6 – Biodiversity.

The following primary sources of data were utilised:

- Integrated Biodiversity Assessment Tool (IBAT);
- The World Database of Key Biodiversity Areas website (WPDA);
- Important Bird Areas (Birdlife International);
- Ramsar website;
- IUCN Redlist;
- UNEP-WCMC (2017) Global Critical Habitat screening layer.

These were supported by general searches for information and data on the project area. Such sources are quoted within the Bibliography section of the report.

4 RESULTS

4.1 Protected Areas

4.1.1 International and National Sites

A review of international and national designated sites based on IBAT and WPDA data indicated that there are three designated areas within 50 km of the project area, these are shown in Figure 4.1.

Figure 4.1 National Designated Sites



Source: Base Map – Google Earth

Sundarbans Reserved Forest

This is an internationally important site, designated as a Ramsar site in 1992 and recently enlarged to an area of 601,700 hectares. The northern boundary of the site lies approximately 30 km south of STP01. Whilst distant there is connectivity between the project area and this designated site via the river.

Dhangmari

Designated in 2012, this is a national wildlife sanctuary which lies on the northern boundary of the Sundarbans Reserved Forest Ramsar site. It covers an area of 3.4 km2 and was designated primarily for its value to river dolphins.

Chandpai

This site is nationally designated as a Wildlife Sanctuary and was first designated in 2012. The site follows a river corridor and sits within the Sundarbans Reserved Forest Ramsar site. The designation covers 5.6 km2 and is managed by the Forestry Department. The site was designated for its importance for river dolphins.

4.2 UNEP Critical Habitat Screening

The base layer from UNEP's Critical Habitat Screening tool shows that potential Critical Habitat may be present to the south of the project area, -focused on the area of the Sundarbans Reserved Forest and the delta area of the rivers flowing into the Bay of Bengal. There are no suggested areas within the project area or a buffer of 30 km around the city of Khulna.

4.3 Potential Critical Habitat Qualifying Species

4.3.1 IFC Process for Critical Habitat Assessment

The screening for Critical Habitat has been conducted based on species which may qualify the habitat as Critical. This has been based on the approach as set out in the

2019 IFC updates to Performance Standard No 6 Guidance note (IFC, 2019). This utilises five criterion to determine if the area under consideration would qualify as Critical Habitat. Three of the criterion (1-3) relate to species and have thresholds which are based on the risk of extinction of species as designated by the IUCN Red List status for each species. Criteria 4 and 5 relate to ecosystems and evolutionary processes and do not utilise thresholds. A summary of the criteria is set out below.

Criterion 1: Critically Endangered and Endangered Species

Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild.

As described in footnote 11 of Performance Standard 6, the inclusion in Criterion 1 of species that are listed nationally/regionally as CR or EN in countries that adhere to IUCN guidance shall be determined on a project-by-project basis in consultation with competent professionals.

Thresholds for Criterion 1 are the following:

(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species).

(b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds.

(c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

Criterion 2: Endemic and Restricted Range Species

For purposes of this Guidance Note, the term endemic is defined as restricted range. Restricted range refers to a limited extent of occurrence (EOO).

- For terrestrial vertebrates and plants, restricted range species are defined as those species that have an EOO less than 50,000 km2.
- For marine systems, restricted range species are provisionally being considered those with an EOO of less than 100,000 km2.
- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart).

The threshold for Criterion 2 is the following:

a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

Criterion 3: Migratory and Congregatory Species

Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem).

Congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis. Examples include the following:

- Species that form colonies.
- Species that form colonies for breeding purposes and/or where large numbers of individuals of a species gather at the same time for non- breeding purposes (for example, foraging and roosting).
- Species that utilise a bottleneck site where significant numbers of individuals of a species occur in a concentrated period of time (for example, for migration).

- Species with large but clumped distributions where a large number of individuals may be concentrated in a single or a few sites while the rest of the species is largely dispersed (for example, wildebeest distributions).
- Source populations where certain sites hold populations of species that make an inordinate contribution to recruitment of the species elsewhere (especially important for marine species).

Thresholds for Criterion 3 are the following:

(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.

(b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

Criterion 4: Highly Threatened or Unique Ecosystems

The IUCN is developing a Red List of Ecosystems, following an approach similar to the Red List for Threatened Species. The client should use the Red List of Ecosystems where formal IUCN assessments have been performed. Where formal IUCN assessments have not been performed, the client may use assessments using systematic methods at the national/regional level, carried out by governmental bodies, recognised academic institutions and/or other relevant qualified organizations (including internationally recognised Non-Government Organizations (NGOs)).

The thresholds for Criterion 4 are the following:

a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.

b) Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

Criterion 5: Key Evolutionary Processes

The structural attributes of a region, such as its topography, geology, soil, temperature, and vegetation, and combinations of these variables, can influence the evolutionary processes that give rise to regional configurations of species and ecological properties. In some cases, spatial features that are unique or idiosyncratic of the landscape have been associated with genetically unique populations or subpopulations of plant and animal species. Physical or spatial features have been described as surrogates or spatial catalysts for evolutionary and ecological processes, and such features are often associated with species diversification. Maintaining these key evolutionary processes inherent in a landscape as well as the resulting species (or subpopulations of species) has become a major focus of biodiversity conservation in recent decades, particularly the conservation of genetic diversity. By conserving species diversity within a landscape, the processes that drive speciation, as well as the genetic diversity within species, ensures the evolutionary flexibility in a system, which is especially important in a rapidly changing climate.

For illustrative purposes, some potential examples of spatial features associated with evolutionary processes are as follows:

- Landscapes with high spatial heterogeneity are a driving force in speciation, as species are naturally selected based on their ability to adapt and diversify.
- Environmental gradients, also known as ecotones, produce transitional habitat, which has been associated with the process of speciation and high species and genetic diversity.
- Edaphic interfaces are specific juxtapositions of soil types (for example, serpentine outcrops, limestone, and gypsum deposits), which have led to the formation of unique plant communities characterized by both rarity and endemism.
- Connectivity between habitats (for example, biological corridors) ensures species migration and gene flow, which is especially important in fragmented habitats and for the conservation of metapopulations. This also includes biological corridors across altitudinal and climatic gradients and from “crest
- to coast.”
- Sites of demonstrated importance to climate change adaptation for either species or ecosystems are also included within this criterion.

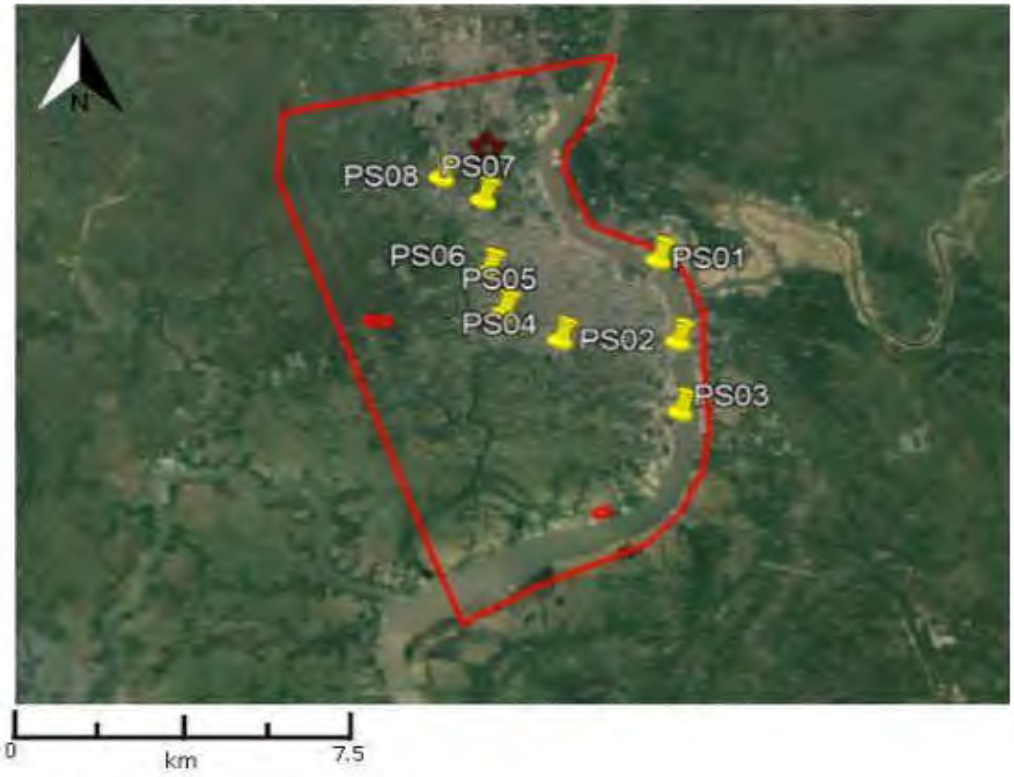
4.3.2 Area of Analysis

The IFC Approach to Critical Habitat Assessment requires the establishment of an Area of Analysis (AoA) to be determined for the assessment. For this initial screening, based on the proposed project layout with its discontinuous elements and a single AoA which encompasses all of the project elements has been selected.

As set out in the IFC Guidance on Critical Habitat Assessment (CHA), the AoA will be based on the general location of the project but the selected AoA should not reflect the projects potential impacts or risks. The AoA is not synonymous with the projects Area of Influence. The guidance suggests selecting boundaries which represent ecological units and/or are physical features within the landscape such as roads or rivers. The selected AoA for the Khulna Sewerage project elements is shown in Figure 4.2. This has been based on a number physical/topographical features. The eastern and southern boundaries are formed by the water course with a buffer on the eastern and southern bank of the river. The AoA therefore includes the three river sections. To the west the boundary is formed by a man made feature which based on satellite images is a road which was under construction in 2020. The northern boundary allows for a 2km buffer from the northern most Pump Station (No. 8).

It is considered that this AoA encompasses the main habitats and ecosystem services which may be affected by the project development.

Figure 4.2 Boundary of Area of Analysis



Source: Base Map – Google Earth

4.3.3 Results Criteria 1 - 3 – IBAT Species Output

Based on an IBAT search for species, a long list of Threatened Species; Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) have been identified as potentially present in the AoA. The screening has used an initial buffer of 50 km from the project area.

The long list of CR, EN and VU species which may be present is shown in Table 4-1. This shows a total of 97 Threatened Species as set out in the IUCN Global Red List of which that there are 17 CR species, 28 EN species and the remaining 52 species are classed as Vulnerable to extinction.

Table 4-1 Long List of Species based on 50 km Buffer

Sl. No	Scientific Name	Common Name	IUCN Status
1	*Glyphis gangeticus*	Ganges Shark	CR
2	*Batagur kachuga*	Red-crowned Roofed Turtle	CR
3	*Batagur dhongoka*	Three-striped Roofed Turtle	CR
4	*Carcharhinus hemiodon*	Pondicherry Shark	CR
5	*Carcharhinus longimanus*	Oceanic Whitetip Shark	CR

Sl. No	Scientific Name	Common Name	IUCN Status
6	*Sphyrna lewini*	Scalloped Hammerhead	CR
7	*Sphyrna mokarran*	Great Hammerhead	CR
8	*Pristis zijsron*	Green Sawfish	CR
9	*Rhina ancylostoma*	Bowmouth Guitarfish	CR
10	*Rhynchobatus australiae*	Bottlenose Wedgefish	CR
11	*Sonneratia griffithii*	A plant species	CR
12	*Pristis pristis*	Largetooth Sawfish	CR
13	*Aythya baeri*	Baer's Pochard	CR
14	*Calidris pygmaea*	Spoon-billed Sandpiper	CR
15	*Gyps bengalensis*	White-rumped Vulture	CR
16	*Sarcogyps calvus*	Red-headed Vulture	CR
17	*Batagur baska*	Northern River Terrapin	CR
18	*Geoclemys hamiltonii*	Spotted Pond Turtle	EN
19	*Orcaella brevirostris*	Irrawaddy Dolphin	EN
20	*Panthera tigris*	Tiger	EN
21	*Rhincodon typus*	Whale Shark	EN
22	*Isurus oxyrinchus*	Shortfin Mako	EN
23	*Anoxypristis cuspidata*	Narrow Sawfish	EN
24	*Platanista gangetica*	South Asian River Dolphin	EN
25	*Eusphyra blochii*	Winghead Shark	EN
26	*Stegostoma tigrinum*	Zebra Shark	EN
27	*Aetomylaeus maculatus*	Mottled Eagle Ray	EN
28	*Mobula tarapacana*	Sicklefin Devilray	EN
29	*Mobula thurstoni*	Bentfin Devilray	EN
30	*Isurus paucus*	Longfin Mako	EN
31	*Acropora rudis*	Coral	EN
32	*Lamiopsis temminckii*	Broadfin Shark	EN
33	*Alopias pelagicus*	Pelagic Thresher	EN
34	*Heritiera fomes*		EN
35	*Holothuria scabra*	Golden Sandfish	EN
36	*Holothuria lessoni*	Golden Sandfish	EN
37	*Thelenota ananas*	Prickly Redfish	EN
38	*Urogymnus polylepis*		EN
39	*Heliopais personatus*	Masked Finfoot	EN
40	*Tringa guttifer*	Spotted Greenshank	EN
41	*Calidris tenuirostris*	Great Knot	EN
42	*Haliaeetus leucoryphus*	Pallas's Fish-eagle	EN
43	*Aquila nipalensis*	Steppe Eagle	EN
44	*Leptoptilos dubius*	Greater Adjutant	EN
45	*Mobula mobular*	Giant Devilray	EN
46	*Carcharias taurus*	Sand Tiger Shark	VU

Sl. No	Scientific Name	Common Name	IUCN Status
47	*Carcharodon carcharias*	White Shark	VU
48	*Crocodylus palustris*	Mugger	VU
49	*Dermochelys coriacea*	Leatherback	VU
50	*Hippocampus histrix*	Thorny Seahorse	VU
51	*Hippocampus trimaculatus*	Three-spot Seahorse	VU
52	*Lepidochelys olivacea*	Olive Ridley	VU
53	*Lutrogale perspicillata*	Smooth-coated Otter	VU
54	*Panthera pardus*	Leopard	VU
55	*Prionailurus viverrinus*	Fishing Cat	VU
56	*Alopias vulpinus*	Common Thresher	VU
57	*Carcharhinus falciformis*	Silky Shark	VU
58	*Urogymnus asperrimus*	Porcupine Ray	VU
59	*Hippocampus kelloggi*	Great Seahorse	VU
60	*Physeter macrocephalus*	Sperm Whale	VU
61	*Rusa unicolor*	Sambar	VU
62	*Nebrius ferrugineus*	Tawny Nurse Shark	VU
63	*Negaprion acutidens*	Sharptooth Lemon Shark	VU
64	*Hemipristis elongata*	Snaggletooth Shark	VU
65	*Taeniurops meyeni*	Blotched Fantail Ray	VU
66	*Heliopora coerulea*	Blue Coral	VU
67	*Carcharhinus albimarginatus*	Silvertip Shark	VU
68	*Pateobatis uarnacoides*	Bleeker's Whipray	VU
69	*Maculabatis gerrardi*	Whitespotted Whipray	VU
70	*Himantura uarnak*	Reticulate Whipray	VU
71	*Alopias superciliosus*	Bigeye Thresher	VU
72	*Pateobatis jenkinsii*	Jenkins' Whipray	VU
73	*Wallago attu*		VU
74	*Halophila beccarii*	Ocean Turf Grass	VU
75	*Ophiophagus hannah*	King Cobra	VU
76	*Stichopus herrmanni*	Curryfish	VU
77	*Mola mola*	Ocean Sunfish	VU
78	*Python bivittatus*	Burmese Python	VU
79	*Mobula alfredi*	Reef Manta Ray	VU
80	*Neophocaena phocaenoides*	Indo-Pacific Finless Porpoise	VU
81	*Mobula birostris*	Giant Manta Ray	VU
82	*Holothuria fuscogilva*		VU
83	*Anacyclus pyrethrum*	Atlas Daisy	VU
84	*Francolinus gularis*	Swamp Francolin	VU
85	*Aythya ferina*	Common Pochard	VU
86	*Rynchops albicollis*	Indian Skimmer	VU
87	*Clanga clanga*	Greater Spotted Eagle	VU

Sl. No	Scientific Name	Common Name	IUCN Status
88	*Aquila heliaca*	Eastern Imperial Eagle	VU
89	*Leptoptilos javanicus*	Lesser Adjutant	VU
90	*Chaetornis striata*	Bristled Grassbird	VU
91	*Clanga hastata*	Indian Spotted Eagle	VU
92	*Aetobatus ocellatus*	Spotted Eagle Ray	VU
93	*Omobranchus smithi*		VU
94	*Sousa chinensis*	Indo-Pacific Humpback Dolphin	VU
95	*Aetomylaeus nichofii*	Banded Eagle Ray	VU
96	*Hippocampus spinosissimus*	Hedgehog Seahorse	VU
97	*Oryza malampuzhaensis*		VU

IFC PS No 6 approach focuses initially on CR and EN for Criterion No 1 and these have been reviewed using IUCN distribution maps, other literature and likely habitat requirements.

A summary of the screening of the CR and EN species is presented in Table 4-2. This provides a note on each species and then an initial assessment of that species likelihood of qualifying the AoA as Critical Habitat based on Criteria 1-3. Many of the species selected by the IBAT search are marine based and focused on the Bay of Bengal and estuarine areas of the river delta to the south of the project area. Whilst, the river in the project area may have some saline intrusion from the marine environment it is not considered part of the marine biome. This is based on an assessment of distribution of the marine species within IUCN Red list mapping which showed marine species being absent from the Khulna area.

Table 4-2 Summary of IBAT CR and EN Species and Potential as Critical Habitat Qualifying Species (Criteria 1 – 3)

Scientific Name	Common Name	IUCN Status	Notes	1	2	3	Qualifying Species?
Glyphis gangeticus	Ganges Shark	CR	IUCN mapping shows this species does not extend as far as Khulna	X	X	X	No
Batagur kachuga	Red-crowned Roofed Turtle	CR	IUCN mapping shows potential presence - species of fast flowing rivers, 500 individuals remain in wild with most in India, considered unlikely to be present in AoA	X	X	X	Based on likely spatial distribution of this species and habitats present it is considered highly unlikely that his species would qualify the AoA as CH
Batagur dhongoka	Three-striped Roofed Turtle	CR	Species of main rivers and tributaries, IUCN mapping shows this species potentially present in AoA.	X	X	X	May be present within the AoA but unlikely to fulfil Criterion 1 – 3
Carcharhinus hemiodon	Pondicherry Shark	CR	Khulna is outside this species range	X	X	X	No
Carcharhinus longimanus	Oceanic Whitetip Shark	CR	Khulna is outside this species range	X	X	X	No
Sphyrna lewini	Scalloped Hammerhead	CR	Khulna is outside this species range	X	X	X	No
Sphyrna mokarran	Great Hammerhead	CR	Khulna is outside this species range	X	X	X	No
Pristis zijsron	Green Sawfish	CR	Khulna is outside this species range, presence in Bangladesh is uncertain	X	X	X	No
Rhina ancylostoma	Bowmouth Guitarfish	CR	Khulna is outside this species range	X	X	X	No
Rhynchobatus australiae	Bottlenose Wedgefish	CR	Khulna is outside this species range	X	X	X	No
Sonneratia griffithii	A plant species	CR	IUCN mapping does not include AoA	X	X	X	No
Pristis pristis	Largetooth Sawfish	CR	Khulna is outside this species range	X	X	X	No
Aythya baeri	Baer's Pochard	CR	IUCN mapping does not include AoA	X	X	X	No
Calidris pygmaea	Spoon-billed Sandpiper	CR	IUCN mapping does not include AoA	X	X	X	No

Scientific Name	Common Name	IUCN Status	Notes	1	2	3	Qualifying Species?
Gyps bengalensis	White-rumped Vulture	CR	Species present in Khulna district potentially present in AoA/ Habitat includes rural areas and urban. Feeds on carrion.	X	X	X	Khulna district is a known area of occupation for this species. This species is partially migratory with resident birds also present. Will range over a wide area depending upon opportunistic food sources. Unlikely to fulfil Criterion 1-3. See (IUCN Bangladesh, 2016), (Alam, et al., 2016) and (MoEF, 2016) for further information
Sarcogyps calvus	Red-headed Vulture	CR	IUCN Red List mapping shows previously present but possibly extinct from AoA. Siddique *et al* consider this species regionally extinct	X	X	X	No
Batagur baska	Northern River Terrapin	CR	Once present throughout Bangladesh this river species is now only found in Sundarbans area of India and Bangladesh,	X	X	X	No
Geoclemys hamiltonii	Spotted Pond Turtle	EN	IUCN distribution map includes AoA, reportedly rare in Bangladesh and declining, Species of water bodies including ponds but also reported to be found on land, especially in winter	X	X	X	May be present within the AoA but unlikely to fulfil Criterion 1 – 3
Orcaella brevirostris	Irrawaddy Dolphin	EN	IUCN mapping shows limit of northern extent in Rupsha is just outside the AoA. However, a study conducted by the IUCN, funded by ADB on river dolphins near to Khulna for a power plant project indicated that this species was present in the AoA.	X	X	X	While the species is likely to be present, it will not meet Criterion 1 – 3
Panthera tigris	Tiger	EN	IUCN mapping indicates not present in AoA	X	X	X	No
Rhincodon typus	Whale Shark	EN	Marine species	X	X	X	No
Isurus oxyrinchus	Shortfin Mako	EN	Marine species	X	X	X	No
Anoxypristis cuspidata	Narrow Sawfish	EN	Marine species	X	X	X	No

Scientific Name	Common Name	IUCN Status	Notes	1	2	3	Qualifying Species?
Platanista gangetica	South Asian River Dolphin	EN	IUCN mapping shows this species as absent from the AoA. However, a study conducted by the IUCN, funded by ADB on river dolphins near to Khulna for a power plant project indicated that this species was present in the AoA. The study showed that there was a healthy breeding population within the rivers. See ADB disclosed EIA (Asian Development	?	X	X	See Table 4-3 for detailed assessment
Eusphyra blochii	Winghead	EN	Marine species	X	X	X	No
Stegostoma tigrinum	Zebra Shark	EN	Marine species	X	X	X	No
Aetomylaeus maculatus	Mottled Eagle Ray	EN	Marine species	X	X	X	No
Mobula tarapacana	Sicklefin	EN	Marine species	X	X	X	No
Mobula thurstoni	Bentfin Devilray	EN	Marine species	X	X	X	No
Isurus paucus	Longfin Mako	EN	Marine species	X	X	X	No
Acropora rudis	Coral	EN	Marine species	X	X	X	No
Lamiopsis temminckii	Broadfin Shark	EN	Marine species	X	X	X	No
Alopias pelagicus	Pelagic	EN	Marine species	X	X	X	No
Heritiera fomes		EN	Khulna is outside this species range	X	X	X	No
Holothuria scabra	Golden	EN	Marine species	X	X	X	No
Holothuria lessoni	Golden	EN	Marine species	X	X	X	No
Thelenota ananas	Prickly Redfish	EN	Marine species	X	X	X	No
Urogymnus polylepis		EN	Marine species	X	X	X	No
Heliopais personatus	Masked Finfoot	EN	Khulna is outside this species range	X	X	X	No
Tringa guttifer	Spotted Greenshank	EN	Winter migrant to Bangladesh – IUCN mapping shows AoA is on northern extent of distribution in winter	X	X	X	No, may be present as passage species but will not fulfil Criterion 3 metrics for qualify AoA as CH
Calidris tenuirostris	Great Knot	EN	Khulna is outside this species range	X	X	X	No
Haliaeetus leucoryphs	Pallas's Fish eagle	EN	Wide ranging species, feeding in rivers and ponds may be present in AoA	X	X	X	May be present but unlikely to meet metrics for Criterion 1 - 3
Aquila nipalensis	Steppe Eagle	EN	Passage bird in AoA, unlikely to be present based on habitat types within AoA	X	X	X	No

Scientific Name	Common Name	IUCN Status	Notes	1	2	3	Qualifying Species?
Leptoptilos dubius	Greater Adjutant	EN	Considered extinct in southern Bangladesh including Khulna area.	X	X	X	No
Mobula mobular	Giant Devilray	EN	Marine species	X	X	X	No

Table 4-3 South Asiatic River Dolphin - Criterion 1 Assessment

Global Status	National Status	Global Population	Local Population	Population in AoA	% of Global Population	% of national population
EN	VU	5000[30]	Unknown (225 in Sundarbans, 125 in Karnaphuli River, 38–58 in Jamuna River and 34–43 in nine groups in Kushiyara River)[31]	34[32]	0.68%	Estimate 7.5%

[30] Based on IUCN Redlist downloaded June 2020
[31] (IUCN, Bangladesh, 2015)
[32] (Asian Development Bank, 2020)

4.4 South Asiatic River Dolphin

For the South Asiatic River Dolphin (also referred to as the Ganges River Dolphin), Table 4-3 provide a summary of existing knowledge of this species. Based on these figures it is possible that this species qualifies the AoA as Critical Habitat as the 0.68% of the global population value exceeds the 0.5% Threshold of the first part of Criterion 1.

The second part Criterion 1 refers to more than five breeding units being present. The IUCN/ADB study suggested that breeding units were present but did not provide an estimate of number of breeding units, however states:

"The most important area determined from the surveys for dolphins is the confluence of Atai-Bhairab-Rupsha Rivers where feeding behavior was recorded and a large number of calves were seen".

Bangladesh has prepared a Conservation Action Plan for this species for 2020 to 2030 (MoEFCC, 2019). The confluence of the Bhairab and Madhumati Rivers and downstream is noted in this document as a likely hot spot for this species.

4.5 Other Species

In addition to the IBAT Proximity search, a specific Freshwater search was conducted. This highlighted two additional species of interest within the wider river basin. These are:

- Chitra indica; and
- Pelochelys cantorii.

Both these turtle species are classified as Endangered in the IUCN global Red List, and CR regionally (IUCN, Bangladesh, 2015). However, they are not directly recorded from the AoA, and therefore are not considered to qualify the area as Critical Habitat.

4.6 Vulnerable Species

For the Vulnerable species identified through the IBAT search, a review of these indicates that none would reach the threshold for Criterion 1, namely loss of a population which would push the IUCN status from VU to either CR or EN.

4.7 Criterion 4 - Highly Threatened or Unique Ecosystems

In addition to the assessment of the extinction threat to species, the IUCN has commenced a program of assessing ecosystems in a similar manner.

The ecosystem within the project area has not been assessed to date.

The ecosystem within the AoA is not considered to be highly threatened, with much of it in urban or agricultural land use. Therefore, the Area of Influence does not meet the thresholds set out in Criterion 4, namely:

- Areas representing ≥5% of the global extent of an ecosystem type meeting
- the criteria for IUCN status of CR or EN.
- Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

4.8 Criterion 5: Key Evolutionary Processes

There are no known key evolutionary processes within the AoA. Such processes often occur where habitats and ecosystems have become isolated, for example on islands. Indicative of key evolutionary process areas would be the presence of a high number of endemic or range restricted species. The AoA is therefore not considered to meet this criterion.

4.9 Protected Areas

ADB SPS states that designated or proposed designation at an international level should be considered as Critical Habitat. Within the AoA there are no internationally designated sites such as Ramsar Sites.

Therefore, under SPS definition, there is no Critical Habitat within the AoA based on designated areas.

5 CONCLUSIONS

5.1 Summary

The screening study has shown that there are no protected areas which would qualify the selected Area of Analysis as Critical Habitat.

However, it is considered that the South Asiatic River Dolphin (*Platanista gangetica*) is likely to be present within the Area of Analysis with population numbers and breeding units which may qualify the AoA or parts of it as Critical Habitat. Additional work will be required to confirm this outcome of the screening process.

5.2 Further work

The Screening Assessment has been conducted based on available data. The assessment points to the need for targeted survey work for the South Asiatic River Dolphin (*Platanista gangetica*).

As an initial step, national and global species specialists shall be consulted. Determination of potential trends in this species numbers within the Khulna area since the IUCN/ADB field work should be determined.

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APPENDIX-5: LABORATORY TEST RESULT FOR WATER QUALITY

Government of the People's Republic of Bangladesh
Office of the Senior Chemist,
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Zonal Laboratory, Khanjahan Ali Road, Rupsha, Khulna.
Phone : 041-721348, Fax: e-mail : wqmsc_khulnazonallab@yahoo.com

Lab Memo: 743(5/14)/DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060737	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated 17/05/2020	Sample Source: Deep Tubewell Others Pump
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Batiaghata
Care Taker: Putimari Bazar Jame Masjid	Union/Paurashava: Jalma, Vill./Ward: Putimari
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	200	mg/L	Titrimetric	-
3	pH	6.5-8.5	8.05	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	511	mg/L	Multimeter	-

Comments:

Test Performed by: Signature	Countersigned/Approved by: Signature
1.) Name: Dipanker Bhattacharjee Designation: Sample Analyzer (Dipanker Bhattacherjee) Sample Analyzer DPHE Zonal Laboratory, Khulna	1.) Name: Md. Aynal Haque Designation: Junior Chemist (Md. Aynal Haque) Junior Chemist, DPHE Zonal Laboratory, Khulna
2.) Name: Designation:	2.) Name: Designation:

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Lab Memo: 743(8/14)/DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060740	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Others Pump.
Sent by: Deputy Managing Director (Eng.). Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Batiaghata
Care Taker: Sarna Jame Masjid	Union/Paurashava: Jalma Vill/Ward: Thikrabanda
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	330	mg/L	Titrimetric	-
3	pH	6.5-8.5	7.9	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	703	mg/L	Multimeter	-

Comments:

Test Performed by: Signature 1.) Name: Dipanker Bhattacharjee Designation: Sample Analyzer (Dipanker Bhattacherjee) Sample Analyzer, DPHE Zonal Laboratory, Khulna 2.) Name: Designation:	Countersigned/Approved by: Signature 1.) Name: Md. Aynal Haque Designation: Junior Chemist (Md. Aynal Haque) Junior Chemist, DPHE Zonal Laboratory, Khulna 2.) Name: Designation:

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Department of Public Health Engineering
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Lab Memo: 743(1/19)DPHE Zonal Lab, Khulna Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHUC2020060733	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Other Pumps
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: Sarnali Trading, 1 No. Custom Ghat	Union/Paurashava:, Vill./Ward: Ward No-22
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	430	mg/L	Titrimetric	-
3	pH	6.5-8.5	7.5	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	770	mg/L	Multimeter	-

Comments:

Test Performed by: Signature	Countersigned/Approved by: Signature
1.) Name: Dipanker Bhattacharjee Designation: Sample Analyzer (Dipanker Bhattacharjee) Sample Analyzer, DPHE Zonal Laboratory, Khulna.	1.) Name: Md. Aynal Haque Designation: Junior Chemist (Md. Aynal Haque) Junior Chemist Zonal Laboratory, Khulna.
2.) Name: Designation:	2.) Name: Designation:

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Lab Memo: 743(2/14)/DPHE, Zonal Lab, Khulna

Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060734	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Other Pumps
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: Motiyakhali Jame Masjid	Union/Paurashava:, Vill./Ward: Ward No-31
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	205	mg/L	Titrimetric	-
3	pH	6.5-8.5	7.95	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	630	mg/L	Multimeter	-

Comments:

Test Performed by: Signature	Countersigned/Approved by: Signature
1.) Name: Dipanker Bhattacharjee Designation: Sample Analyzer (Dipanker Bhattacharjee) Sample Analyzer, DPHE Zonal Laboratory, Khulna	1.) Name: Md. Aynal Haque Designation: Junior Chemist (Md. Aynal Haque) Junior Chemist (Chem) Zonal Laboratory, Khulna
2.) Name: Designation:	2.) Name: Designation:

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Lab Memo: 7403/14)/DPHE, Zonal Lab, Khulna

Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060735	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95 03.14.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Other Pumps
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: Near Laboncharа Sluice Gate	Union/Paurashava:,Vill./Ward: Ward No-31
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

SL#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	100	mg/L	Titrimetric	-
3	pH	6.5-8.5	8.05	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	454	mg/L	Multimeter	-

Comments:

Test Performed by:

1.) Name: Dipanker Bhattacharjee
Designation: Sample Analyzer

2.) Name:
Designation:

Signature

(Dipanker Bhattacherjee)
Sample Analyzer BPHE
Zonal Laboratory, Khulna

Countersigned/Approved by:

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

2.) Name:
Designation:

Signature

(Md. Aynal Haque)
Junior Chemist BPHE
Zonal Laboratory, Khulna

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Department of Public Health Engineering
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Lab Memo: 743(10/1/4)/DPHE, Zonal Lab, Khulna. Date: 21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KH/2020060742	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated: 17/05/2020	Sample Source: Deep Tubewell Others Pump.
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District: Khulna, Upazila/City Corp.: Khulna
Care Taker: Near Nirala Digi	Union/Paurashava:, Vill./Ward: Ward No-24
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	90	mg/L	Titrimetric	-
3	pH	6.5-8.5	8.25	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	398	mg/L	Multimeter	-

Comments:

Test Performed by:

1.) Name: Dipanker Bhattacharjee
Designation: Sample Analyzer

2.) Name:
Designation:

Signature

(Dipanker Bhattacharjee)
Sample Analyzer
Zonal Laboratory, Khulna.

Countersigned/Approved by:

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

2.) Name:
Designation:

Signature

(Md. Aynal Haque)
Junior Chemist
Zonal Laboratory, Khulna

Government of the People's Republic of Bangladesh
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Lab Memo: 743(12/14)DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060744	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Others Pump.
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: Alir Club Para	Union/Paurashava:, Vill./Ward: Ward No-18
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

SL#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	260	mg/L	Titrimetric	-
3	pH	6.5-8.5	8.25	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	640	mg/L	Multimeter	-

Comments:

Test Performed by:

1.) Name: Dipanker Bhattacharjee
Designation: Sample Analyzer

2.) Name:
Designation:

Signature

(Dipanker Bhattacharjee)
Sample Analyzer, BPHE
Zonal Laboratory, Khulna.

Countersigned/Approved by:

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

2.) Name:
Designation:

Signature

(Md. Aynal Haque)
Junior Chemist, BPHE
Zonal Laboratory, Khulna

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Lab Memo: 743(11/14)/DPHE, Zonal Lab, Khulna Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHL2020060743	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Others Pump.
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: Gallamari Kasai Khana	Union/Paurashava:, Vill./Ward: Ward No-25
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	835	mg/L	Titrimetric	-
3	pH	6.5-8.5	7.55	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	4301	mg/L	Multimeter	-

Comments:

Test Performed by:

1.) Name: Dipanker Bhattacharjee
Designation: Sample Analyzer

2.) Name:
Designation:

Signature

21.06.2020
(Dipanker Bhattacharjee)
Sample Analyzer, BPHE
Zonal Laboratory, Khulna.

Countersigned/Approved by:

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

2.) Name:
Designation:

Signature

21.6.2020
(Md. Aynal Haque)
Junior Chemist, BPHE
Zonal Laboratory, Khulna

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Phone : 041-721348, Fax: e-mail : sqmso_khulnazonallab@yahoo.com

Lab Memo: 743/14/181/DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060746	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.18.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Others Pump.
Sent by: Deputy Managing Director (Eng.), Khulna WASA. Khulna.	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: Behind The Dr. Rowshanara Clinic, Karimnagar	Union/Paurashava:, Vill /Ward: Ward No-17
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	630	mg/L	Titrimetric	-
3	pH	6.5-8.5	7.35	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	1105	mg/L	Multimeter	-

Comments:

Test Performed by: Signature	Countersigned/Approved by: Signature
1.) Name: Dipanker Bhattacharjee Designation: Sample Analyzer (Dipanker Bhattacherjee) Sample Analyzer, DPHE Zonal Laboratory, Khulna	1.) Name: Md. Aynal Haque Designation: Junior Chemist (Md. Aynal Haque) Junior Chemist, DPHE Zonal Laboratory, Khulna
2.) Name: Designation:	2.) Name: Designation:

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Lab Memo: 743(13/14)/DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060745	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Deep Tubewell Others Pump.
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: Sirajul Islam Jame Masjid, Islamia College Road	Union/Paurashava:, Vill/Ward: Ward No-16
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	0	N/100ml	MFM	-
2	Hardness	200-500	105	mg/L	Titrimetric	-
3	pH	6.5-8.5	8.3	-	pH Meter	-
4	Total Dissolved Solid (TDS)	1000	422	mg/L	Multimeter	-

Comments:

Test Performed by:

1.) Name: Dipankar Bhattacharjee
Designation: Sample Analyzer

2.) Name:
Designation:

Signature

21.06.2020
(Dipankar Bhattacharjee)
Sample Analyzer, DPHE
Zonal Laboratory, Khulna.

Countersigned/Approved by:

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

2.) Name:
Designation:

Signature

(Md. Aynal Haque)
Junior Chemist, DPHE
Zonal Laboratory, Khulna

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Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110001	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No. : 01)	Union:, Vill.:SPS#1, Custom Ghat
Sample Collection date:	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.061	mg/L	UVS	0.10
2	Phosphate	6.0	2.45	mg/L	UVS	0.10
3	Salinity	-	0.89	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahbouba Sabina Motin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	03.11.2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN20201100002	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000 20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No. : 02)	Union:, Vill.:SPS#2, Motiyakhali Jame Masjid
Sample Collection date	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.04	mg/L	UVS	0.10
2	Phosphate	6.0	0.36	mg/L	UVS	0.10
3	Salinity	-	0.55	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B. UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:

1.) Name: Mahabuba Sabina Molin
Designation: Sample Analyzer
Signature: 03-11-2020

2.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
Signature: 03-11-2020

Countersigned/Approved by:

1.) Name: Mita Sarker
Designation: Senior Chemist
Signature: 03/11/2020

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
03/11/2020

Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

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Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110003	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000 20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No. : 03)	Union:, Vill.:SPS#3, Labonchara Sluice gate
Sample Collection date:	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.03	mg/L	UVS	0.10
2	Phosphate	6.0	0.51	mg/L	UVS	0.10
3	Salinity	-	0.38	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:

1.) Name: Mahabuba Sabina Motin
Designation: Sample Analyzer
Signature: 03-11-2020

2.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyzer
Signature: 03.11.2020

Countersigned/Approved by:

1.) Name: Mita Sarker
Designation: Senior Chemist
Signature: 03/11/2020

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
Signature: 03/11/2020

Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wamc_central_lab@yahoo.com

Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110005	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA. (Sample No. : 05)	Union:, Vill.:STP-1, Mathabanga,Puliman bazar
Sample Collection date,	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.06	mg/L	UVS	0.10
2	Phosphate	6.0	0.57	mg/L	UVS	0.10
3	Salinity	-	0.44	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Mobi Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	03-11-2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110008	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA. (Sample No. :08)	Union:, Vill :STP-2, Thikrabandh
Sample Collection date:	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.07	mg/L	UVS	0.10
2	Phosphate	6.0	0.71	mg/L	UVS	0.10
3	Salinity	-	0.61	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	03.11.2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 357/ CC: DPHE, CL. Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110010	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No.: 10)	Union:, Vill.:SPS#4, Nirala
Sample Collection date:	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.05	mg/L	UVS	0.10
2	Phosphate	6.0	1.55	mg/L	UVS	0.10
3	Salinity	-	0.34	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B. UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khoaru Designation: Sample Analyzer	03-11-2020	2.) Name: Md. Biplob Hossain Designation: Chief Chemist	03/11/2020 Md. Biplob Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN20201110011	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No. : 11)	Union:, Vill.:SPS#5, Kashimnagar, Gollamar
Sample Collection date:	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.03	mg/L	UVS	0.10
2	Phosphate	6.0	0.91	mg/L	UVS	0.10
3	Salinity	-	3.85	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	03.11.2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN20201110012	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority	Dist:Khulna; Upa:
Care Taker: Khulna WASA (Sample No.: 12)	Union:, Vill.:SPS#৪, Sonadanga Truck Terminal
Sample Collection date	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.01	mg/L	UVS	0.10
2	Phosphate	6.0	1.47	mg/L	UVS	0.10
3	Salinity	--	0.60	‰	Multimeter	--

Comments: Sample was collected & supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Motin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	03-11-2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110013	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No. : 13)	Union:, Vill.:SPS#3, Islamia College Road
Sample Collection date:	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.03	mg/L	UVS	0.10
2	Phosphate	6.0	1.72	mg/L	UVS	0.10
3	Salinity	-	0.38	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B. UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:

1.) Name: Mahabuba Sabina Motin — Signature — 03.11.2020
Designation: Sample Analyzer

2.) Name: Md. Saiful Alam Khosru — Signature — 03.11.2020
Designation: Sample Analyzer

Countersigned/Approved by:

1.) Name: Mita Sarker — Signature — 03/11/2020
Designation: Senior Chemist

2.) Name: Md. Biplab Hossain — 03/11/2020
Designation: Chief Chemist

Md. Biplab Hossain
Chief Chemist
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Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN20201110014	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Tube Well
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No. : 14)	Union:, Vill.:SPS#7, Kamrnagar
Sample Collection date	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.04	mg/L	UVS	0.10
2	Phosphate	6.0	0.93	mg/L	UVS	0.10
3	Salinity	-	0.65	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahaniba Sabina Moin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	03-11-2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

Bangabandhu Water Treatment Plant

Khulna WASA, Pathorghata, Rupsha, Khulna-9240

LABORATORY TEST RESULTS

Date: 2020-06-21 Weather: showers

Surface Water					
SL	Sample No	Sampling Location	Test Item		
			Dissolved-Oxygen (mg/L) BDS: 6	COD (mg/L) BDS: 4	Nitrate (mg/L) BDS: 10
1	4	Habibiya Kalkorstan Rupsha River	2.4	8	0.1
2	6	RAB-6 Ghat	2.77	8	0.2
3	7	Hogladanga Canvel	1.56	41	0.4
4	9	Hogladanga Canvel (Ahsan Khan)	2.31	49.9	0.2

Ground Water			
SL	Sample No	Sampling Location	Test Item
			Nitrate (mg/L) BDS: 10
1	1	Somaly Trading	0.3
2	2	Moniyakhali Jame Masjid	1.3
3	3	Labonchora Switch Gate	0.3
4	5	Pottimari Labonchora Mosjid	1
5	8	Jame Mosjid Thikadond Khulna	0.3
6	10	Nirala Digirir Par	0.2
7	11	Gollamari Point	0.5
8	12	KCC Tube (Anm Club)	1.5
9	13	Islamia College Road	0.2
10	14	Karim Nagar	1.9

Laboratory Analyst: 21-06-2020

Approval:

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Office of the Senior Chemist,
Department of Public Health Engineering
Zonal Laboratory, Khanjahan Ali Road, Rupsha, Khulna.
Phone : 041-721348, Fax: e-mail : supdtg_khulnazonallab@yahoo.com

Lab Memo: 743(4/14)/DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060736	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Others
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Batiaghata
Care Taker: Habibia Graveyeard (Surface Water-River)	Union/Paurashava: Jalma. Vill /Ward: Putimari
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	120	N/100ml	MFM	-

Comments:

Test Performed by:

1.) Name: Dipanker Bhattacharjee
Designation: Sample Analyzer

2.) Name:
Designation:

Signature

(Dipanker Bhattacherjee)
Sample Analyzer BPHE
Zonal Laboratory, Khulna

Countersigned/Approval by:

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

2.) Name:
Designation:

Signature

(Md. Aynal Haque)
Junior Chemist BPHE
Zonal Laboratory, Khulna

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Office of the Senior Chemist,
Department of Public Health Engineering
Zonal Laboratory, Khanjahan Ali Road, Rupsha, Khulna.
Phone : 041-721348, Fax: e-mail : sqmzc_khulnazonallab@yahoo.com

Lab Memo: 743(6/14)/DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060738	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Others
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna, Upazila/City Corp.: Khulna
Care Taker: RAB-06 Ghat (Surface Water-River)	Union/Paurashava:, Vill./Ward: Ward No-31
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	148	N/100ml	MFM	-

Comments:

Test Performed by:

1.) Name: Dipanker Bhattacharjee
Designation: Sample Analyzer

2.) Name:
Designation:

Signature

(Dipanker Bhattacherjee)
Sample Analyzer, DPHE
Zonal Laboratory, Khulna.

Countersigned/Approved by:

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

2.) Name:
Designation:

Signature

(Md. Aynal Haque)
Junior Chemist, DPHE
Zonal Laboratory, Khulna

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Department of Public Health Engineering
Zonal Laboratory, Khanjahan Ali Road, Rupsha, Khulna.
Phone : 041-721348, Fax: e-mail : wqmsc_khulnazonallab@yahoo.com

Lab Memo: 743(7/14)/DPHE, Zonal Lab, Khulna. Date: 21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060739	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 ৯ Dated:17/05/2020	Sample Source: Others
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna	District : Khulna, Upazila/City Corp.: Batiaghata
Care Taker: Near Hogladanga Mondir (Surface Water-Khal)	Union/Paurashava: Jalma Vill./Ward: Hogladanga
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	180	N/100ml	MFM	-

Comments:

Test Performed by: Signature

1.) Name: Dipanker Bhattacharjee
Designation: Sample Analyzer

(Dipanker Bhattacherjee)
Sample Analyzer, DPHE
Zonal Laboratory, Khulna

2.) Name:
Designation:

Countersigned/Approved by: Signature

1.) Name: Md. Aynal Haque
Designation: Junior Chemist

(Md. Aynal Haque)
Junior Chemist, DPHE
Zonal Laboratory, Khulna

2.) Name:
Designation:

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Lab Memo: 743(9/14)/DPHE, Zonal Lab, Khulna. Date :21/06/2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: KHU2020060741	Sample Receiving date: 17/06/2020
Ref. Memo No: 46.07.0000.003.95.03.14.442 & Dated:17/05/2020	Sample Source: Others
Sent by: Deputy Managing Director (Eng.), Khulna WASA, Khulna.	District : Khulna. Upazila/City Corp.: Dumuria
Care Taker: Near Jela Karagar (Surface Water-Khal)	Union/Paurashava: Gutudia. VIII./Ward: Chak Ahsankhali
Sample Collection date: 17/06/2020	Date of Testing: 17/06/2020-18/06/2020

LABORATORY TEST RESULTS:

Sl.#	Water Quality Parameters	Bangladesh Standard	Concentration Present	Unit	Analysis Method	LOQ
1	Coliform (Faecal)	0	75	N/100ml	MFM	–

Comments:

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Dipankar Bhattacharjee Designation: Sample Analyzer	21.06.2020 (Dipankar Bhattacharjee) Sample Analyzer, DPHE Zonal Laboratory, Khulna	1.) Name: Md. Aynal Haque Designation: Junior Chemist	(Md. Aynal Haque) Junior Chemist, DPHE Zonal Laboratory, Khulna
2.) Name: Designation:		2.) Name: Designation:	

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Lab Memo. 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110006	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Surface Water
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No. : 06)	Union:, Vill.:STP-1, Mathabanga,Rupsha river
Sample Collection date:	Date of Testing: 28/10/2020-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.11	mg/L	UVS	0.10
2	Biochemical Oxygen Demand (BOD)	0.2	6	mg/L	5 days Incubation	0.1
3	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
4	Cr (Total)	0.05	0.001	mg/L	AAS	0.0003
5	Lead (Pb)	0.05	0.006	mg/L	AAS	0.001
6	Phosphate	6.0	11.2	mg/L	UVS	0.10
7	Salinity	-	0.16	%	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Monabuba Sabrina Mokn Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khasru Designation: Sample Analyzer	03.11.2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Lab Memo: 3571 CC: DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN20201110004	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Suface Water
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa
Care Taker: Khulna WASA (Sample No. : 04)	Union:, Vill: STP-1, Mathabanga, Rupsha river
Sample Collection date:	Date of Testing: 28/10/20220-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.10	mg/L	UVS	0.10
2	Biochemical Oxygen Demand (BOD)	0.2	5	mg/L	5 days incubation	0.1
3	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
4	Cr (Total)	0.05	0.001	mg/L	AAS	0.0003
5	Lead (Pb)	0.05	0.003	mg/L	AAS	0.001
6	Phosphate	6.0	2.9	mg/L	UVS	0.10
7	Salinity	-	0.48	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation

Test Performed by:

1.) Name: Mahbouba Sabina Molin
Designation: Sample Analyzer
Signature: 03-11-2020

2.) Name: Md. Saiful Alam Khosru
Designation: Sample Analyst
Signature: 03.11.2020

Countersigned/Approved by:

1.) Name: Mita Sarker
Designation: Senior Chemist
Signature: 03/11/2020

2.) Name: Md. Biplab Hossain
Designation: Chief Chemist
Signature: 03/11/2020
Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka

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Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110007	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Suface Water
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist: Khulna, Upo:
Care Taker: Khulna WASA (Sample No. : 07)	Union:, Vill.:STP-2, Thikrabandh, Hoghladanga
Sample Collection date:	Date of Testing: 28/10/2020-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.19	mg/L	UVS	0.10
2	Biochemical Oxygen Demand (BOD)	0.2	7	mg/L	5 days Incubation	0.1
3	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
4	Cr (Total)	0.05	0.005	mg/L	AAS	0.0003
5	Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
6	Phosphate	6.0	1.16	mg/L	UVS	0.10
7	Salinity	-	0.20	‰	Multimeter	-

Comments: Sample was collected & supplied by client
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sadna Motin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	03-11-2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com

Lab Memo: 357/ CC, DPHE, CL, Dhaka

Date: 03-11-2020

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2020110009	Sample Receiving date: 28-10-2020
Ref. Memo No: 46.07.0000.003.07.00.000.20-119 & Dated: 22-10-2020	Sample Source: Sutace Water
Sent by:Engr. MD. Kamal Uddin Ahmed ,Deputy Managing Director , Khulna Water Supply & Sewerage Authority.	Dist:Khulna, Upa:
Care Taker: Khulna WASA (Sample No: 09)	Union:, Vill:STP-2, Thikrabandh, Hoghldanga
Sample Collection date:	Date of Testing: 28/10/2020-02/11/2020

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.14	mg/L	UVS	0.10
2	Biochemical Oxygen Demand (5OD)	0.2	18	mg/L	5 days Incubation	0.1
3	Cadmium (Cd)	0.005	0.00015	mg/L	AAS	0.00015
4	Cr (Total)	0.05	0.006	mg/L	AAS	0.0003
5	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001
6	Phosphate	6.0	1.68	mg/L	UVS	0.10
7	Salinity	-	0.45	‰	Multimeter	-

Comments: Sample was collected & supplied by client.
N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Mahabuba Sabina Moin Designation: Sample Analyzer	03-11-2020	1.) Name: Mita Sarker Designation: Senior Chemist	03/11/2020
2.) Name: Md. Saiful Alam Khasru Designation: Sample Analyzer	03.11.2020	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	03/11/2020 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

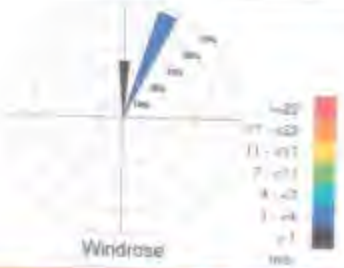
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REPORT ON AIR QUALITY

CRTS No. : CRTS/Civil/R-358 Date : 26-11-2020
Ref. No : 46.07.0000.003.07.00.000 20-125(3) Date : 01-11-2020
Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna
Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna
Test No : C-200205

Monitoring Location	**STP-1 MATHABHANGA** **Coordinates: N 22.762951 E 89.566675**
Date of Monitoring & Measurement Time	10-11-2020 Tuesday 11:45 AM
Weather condition & wind direction(s)	Weather: Sunny & Wind: N, NNE
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016; Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Air Quality Index (AQI) Rating: Good 0 – 50 | Moderate 51 – 100 | Caution 101 – 150 | Unhealthy 151 – 200 | Very Unhealthy | Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (if any)
SPM	$\mu g/m^3$	84	200 (24-hr avg)	42	Good	
PM_{10}	$\mu g/m^3$	77	150 (24-hr avg)	51	Moderate	
$PM_{2.5}$	$\mu g/m^3$	40	65 (24-hr avg)	62	Moderate	
NO_x	$\mu g/m^3$	40	365 (24-hr avg)	40	Good	
SO_2	$\mu g/m^3$	10	100 (Annual avg)	3	Good	
CO	mg/m^3	0.80	10 (8-hr avg)	8	Good	

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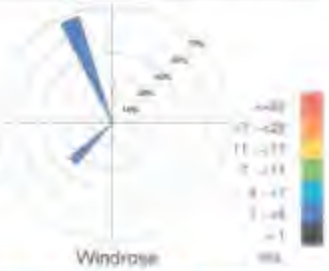
Ref. No. : 46.07.0000.003.07.00.000.20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. : C-200205

Monitoring Location	**STP-2 TIKRABANDH** **Coordinates: N 22.803748 E 89.517679**
Date of Monitoring & Measurement Time	17-11-2020 Tuesday 11:45 AM
Weather condition & wind direction(s)	Weather: Sunny & Wind: NNW, SW
Equipment(s) Model	Particle Sampler(s) – GrayWolf Handheld 3016; Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Air Quality Index (AQI) Rating	Good 0 – 50	Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200	Very Unhealthy 201 – 300	Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (if any)
SPM	$\mu g/m^3$	73	200 (24-hr avg)	37	Good	
PM_{10}	$\mu g/m^3$	67	150 (24-hr avg)	45	Good	
$PM_{2.5}$	$\mu g/m^3$	55	65 (24-hr avg)	85	Moderate	
NO_2	$\mu g/m^3$	93	365 (24-hr avg)	93	Moderate	
SO_2	$\mu g/m^3$	12	100 (Annual avg)	3	Good	
CO	mg/m^3	0.75	10 (8-hr avg)	8	Good	

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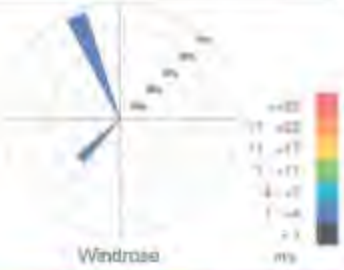
Ref. No: : 46.07.0000.003.07.00.000.20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. : C-200205

Monitoring Location	**SPS-1 CUSTOM GHAT** **Coordinates: N 22.812129 E 89.576111**
Date of Monitoring & Measurement Time	17-11-2020 Tuesday 1:45 PM
Weather condition & wind direction(s)	Weather: Sunny & Wind: NNW, SW
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016; Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Air Quality Index (AQI) Rating: Good 0 – 50 | Moderate 51 – 100 | Caution 101 – 150 | Unhealthy 151 – 200 | Very Unhealthy 201 – 300 | Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (If any)
SPM	µg/m³	106	200 (24-hr avg)	53	Moderate	
PM_{10}	µg/m³	99	150 (24-hr avg)	66	Moderate	
$PM_{2.5}$	µg/m³	70	65 (24-hr avg)	108	Caution	Health Concern
NO_x	µg/m³	112	365 (24-hr avg)	112	Caution	Health Concern
SO_2	µg/m³	32	100 (Annual avg)	9	Good	
CO	mg/m³	0.70	10 (8-hr avg)	7	Good	

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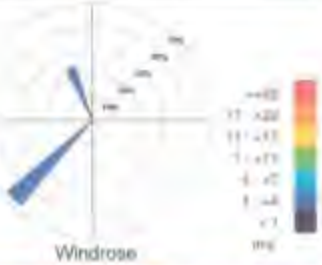
Ref. No. : 46.07.0000.003.07.00.060.20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. : C-200205

Monitoring Location	**SPS-2 MOTIARKHALI KHAL** **Coordinates: N 22.794798 E 89.580758**
Date of Monitoring & Measurement Time	17-11-2020 Tuesday 12:45 PM
Weather condition & wind direction(s)	Weather: Sunny & Wind: SW, NNW
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016 Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Boat repair works, Heavy vehicles


Windrose

Air Quality Index (AQI) Rating	Good 0 – 50	Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200	Very Unhealthy 201 – 300	Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (If any)
SPM	$\mu g/m^3$	166	200 (24-hr avg)	83	Moderate	
PM_{10}	$\mu g/m^3$	137	150 (24-hr avg)	91	Moderate	
$PM_{2.5}$	$\mu g/m^3$	99	65 (24-hr avg)	152	Unhealthy	Harmful impact (sensitive group)
NO_2	$\mu g/m^3$	96	365 (24-hr avg)	96	Moderate	
SO_2	$\mu g/m^3$	28	100 (Annual avg)	8	Good	
CO	mg/m^3	0.78	10 (8-hr avg)	8	Good	

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CRTS No. : CRTS/Civil/R-358 Date : 26-11-2020

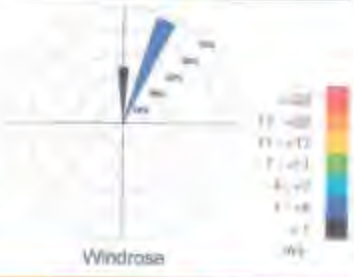
Ref. No. : 46.07.0000.003.07.00.000 20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. : C-200205

Monitoring Location	**SPS-3 LABONCHARA SLUICE GATE** **Coordinates: N 22.779604 E 89.581163**
Date of Monitoring & Measurement Time	10-11-2020 Tuesday 1:00 PM
Weather condition & wind direction(s)	Weather: Sunny & Wind: NNE, N
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016; Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Cement Industry, Motor vehicles



Air Quality Index (AQI) Rating	Good 0 – 50	Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200	[illegible]	Extremely Unhealthy 301+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (If any)
SPM	µg/m³	89	200 (24-hr avg)	45	Good	
PM_{10}	µg/m³	74	150 (24-hr avg)	49	[illegible]	
$PM_{2.5}$	µg/m³	35	65 (24-hr avg)	54	Moderate	
NO_2	µg/m³	73	365 (24-hr avg)	73	[illegible]	
SO_2	µg/m³	15	100 (Annual avg)	4	Good	
CO	mg/m³	0.54	10 (8-hr avg)	5	Good	

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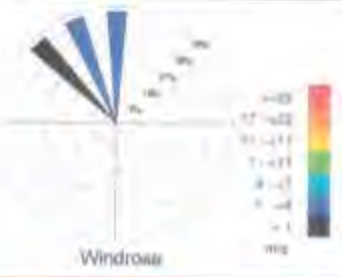
Ref. No. : 46.07.0000.003.07.00.000.20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. : C-200205

Monitoring Location	**SPS-4 NIRALA** **Coordinates: N 22.796017 E 89.566655**
Date of Monitoring & Measurement Time	15-11-2020 Sunday 11:00 AM
Weather condition & wind direction(s)	Weather: Sunny & Wind: N, NNW, NW
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016, Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Air Quality Index (AQI) Rating	Good 0 – 50	Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200	Very Unhealthy 201 – 300	Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (If any)
SPM	µg/m³	53	200 (24-hr avg)	27	Good	
PM_{10}	µg/m³	47	150 (24-hr avg)	31	Good	
$PM_{2.5}$	µg/m³	37	65 (24-hr avg)	57	Moderate	
NO_2	µg/m³	103	365 (24-hr avg)	103	Caution	Health Concern
SO_2	µg/m³	37	100 (Annual avg)	10	Good	
CO	mg/m³	0.45	10 (8-hr avg)	5	Good	

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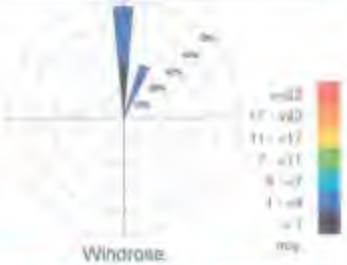
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REPORT ON AIR QUALITY

CRTS No.	: CRTS/Civil/R-358	Date : 26-11-2020
Ref. No.	: 46.07.0000.003.07.00.000.20-125(3)	Date : 01-11-2020
Client	: Eng. Md. Abdullah, Managing Director, KWASA, Khulna	
Name of the Project:	Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna	
Test No.	: C-200205	

Monitoring Location	**SPS-5 KASHIMNAGAR GOLLAMARI** **Coordinates: N 22.801074 E 89.543759**
Date of Monitoring & Measurement Time	10-11-2020 Tuesday 3:30 PM
Weather condition & wind direction(s)	Weather: Sunny & Wind: N, NNE
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016; Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Air Quality Index (AQI) Rating	Good 0 – 50	Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200	Very Unhealthy 201 – 300	Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (if any)
SPM	$\mu g/m^3$	103	200 (24-hr avg)	52	Moderate	
PM_{10}	$\mu g/m^3$	91	150 (24-hr avg)	61	Moderate	
$PM_{2.5}$	$\mu g/m^3$	33	65 (24-hr avg)	51	Moderate	
NO_x	$\mu g/m^3$	65	365 (24-hr avg)	85	Moderate	
SO_2	$\mu g/m^3$	10	100 (Annual avg)	3	Good	
CO	mg/m^3	0.39	10 (8-hr avg)	4	Good	

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REPORT ON AIR QUALITY

CRTS No. : CRTS/Civil/R-358 Date : 26-11-2020

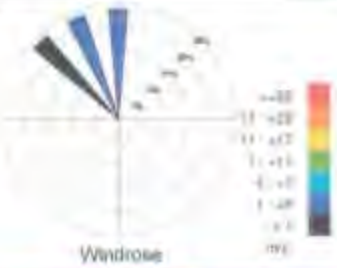
Ref. No. : 46.07.0000.003.07.00.000 20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. : C-200205

Monitoring Location	**SPS-6 TRUCK TERMINAL RD, SONADANGA** **Coordinates: N 22.625175 E 89.540498**
Date of Monitoring & Measurement Time	15-11-2020 Sunday 11:45 AM
Weather condition & wind direction(s)	Weather: Sunny & Wind: N, NNW, NW
Equipment(s) Model	Particle Sampler ~ GrayWolf Handheld 3016; Gas Analyzer ~ GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Air Quality Index (AQI) Rating		Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200		Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (If any)
SPM	$\mu g/m^3$	117	200 (24-hr avg)	59	Moderate	
PM_{10}	$\mu g/m^3$	102	150 (24-hr avg)	68	Moderate	
$PM_{2.5}$	$\mu g/m^3$	40	65 (24-hr avg)	62	Moderate	
NO_x	$\mu g/m^3$	103	365 (24-hr avg)	103	Caution	Health Concern
SO_2	$\mu g/m^3$	21	100 (Annual avg)	8	Good	
CO	mg/m^3	0.28	10 (8-hr avg)	3	Good	

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REPORT ON AIR QUALITY

CRTS No : CRTS/Civil/R-356 Date : 26-11-2020

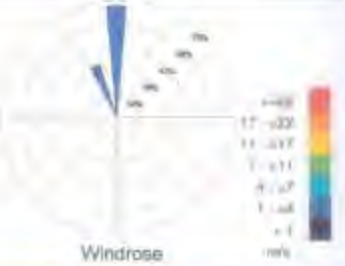
Ref. No. : 46.07.0000.003.07.00.000.20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No : C-200205

Monitoring Location	**SPS-7 KARIM NAGAR SONADANGA** **Coordinates: N 22.825175 E 89.539418**
Date of Monitoring & Measurement Time	15-11-2020 Sunday 11:00 AM
Weather condition & wind direction(s)	Weather: Sunny & Wind: N, NNW
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016; Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Air Quality Index (AQI) Rating	Good 0 – 50	Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200	Very Unhealthy 201 – 300	Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (If any)
SPM	$\mu g/m^3$	82	200 (24-hr avg)	41	Good	
PM_{10}	$\mu g/m^3$	72	150 (24-hr avg)	48	Good	
$PM_{2.5}$	$\mu g/m^3$	39	65 (24-hr avg)	60	Moderate	
NO_x	$\mu g/m^3$	45	365 (24-hr avg)	45	Good	
SO_2	$\mu g/m^3$	14	100 (Annual avg)	4	Good	
CO	mg/m^3	0.33	10 (8-hr avg)	3	Good	

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REPORT ON AIR QUALITY

CRTS No. : CRTS/Civil/R-358 Date : 28-11-2020

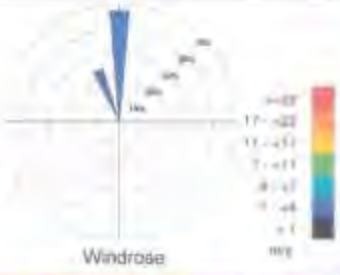
Ref. No. : 46.07.0000.003.07.00.000.20-125(3) Date : 01-11-2020

Client : Eng. Md. Abdullah, Managing Director, KWASA, Khulna

Name of the Project: Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. : C-200205

Monitoring Location	**SPS-8 ISLAMIA COLLEGE RD** **Coordinates: N 22.832049 E 89.531470**
Date of Monitoring & Measurement Time	15-11-2020 Sunday 10:15 AM
Weather condition & wind direction(s)	Weather: Sunny & Wind: N, NNW
Equipment(s) Model	Particle Sampler – GrayWolf Handheld 3016; Gas Analyzer – GrayWolf AdvancedSense Pro
Major air pollution source(s) during monitoring	Motor vehicles



Windrose

Air Quality Index (AQI) Rating	Good 0 – 50	Moderate 51 – 100	Caution 101 – 150	Unhealthy 151 – 200	Very Unhealthy 201 – 300	Extremely Unhealthy 300+

Air pollutants	Unit	Concentrations of air pollutant	Bangladesh National Ambient Air Quality Standard (DoE 2005)	Air Quality Index (AQI) Value	AQI Rating	Remarks (if any)
SPM	$\mu g/m^3$	118	200 (24-hr avg)	59	Moderate	
PM_{10}	$\mu g/m^3$	105	150 (24-hr avg)	70	Moderate	
$PM_{2.5}$	$\mu g/m^3$	48	65 (24-hr avg)	71	Moderate	
NO_x	$\mu g/m^3$	8	365 (24-hr avg)	6	Good	
SO_2	$\mu g/m^3$	5	100 (Annual avg)	1	Good	
CO	mg/m^3	0.16	10 (8-hr avg)	2	Good	

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REPORT ON NOISE QUALITY

CRTS No :CRTS/Civil/R-358 Date:26-11-2020

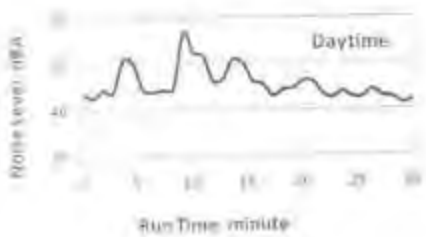
Ref. No. :(46.07.0000.003.07.00.000.20-125(3) Date:01-11-2020

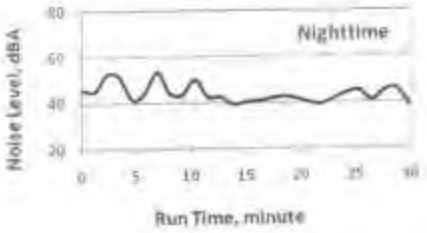
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project : Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. :C-200205

Monitoring Location		**STP-1 MATHABHANGA Coordinates: N 22.762951 E 89.566675**	
Date of Monitoring & Measurement Time		10-11-2020 Tuesday 11:45 AM 17-11-2020 Tuesday 9:00 PM	
Equipment		Environment Meter CEM DT–8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Motor vehicles, Easy bikes, Strong breeze	
Daytime Measurement Result(s) dBA	Max	73	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	43	
	Average	61	
Nighttime Measurement Result(s) dBA	Max	53	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area) 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	38	
	Average	44	
Remarks	Limit Exceedance	8% (Daytime); 2% (Nighttime)	





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REPORT ON NOISE QUALITY

CRTS No :CRTS/Civil/R-358 Date:26-11-2020

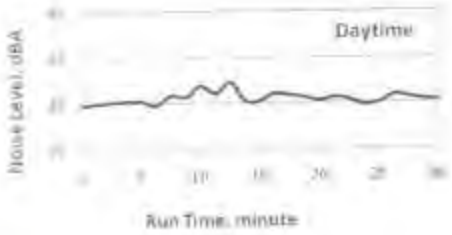
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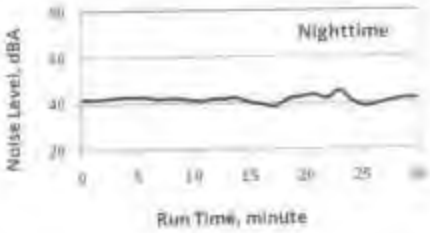
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. :C-200205

Monitoring Location		**STP-2 TIKRABANDH Coordinates: N 22.803748 E 89.517679**	
Date of Monitoring & Measurement Time		17-11-2020 Tuesday 11:45 AM 17-11-2020 Tuesday 11:00 PM	
Equipment		Environment Meter CEM DT-8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Birds sound, Natural breeze	
Daytime Measurement Result(s), dBA	Max	49	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	39	
	Average	42	
Nighttime Measurement Result(s), dBA	Max	45	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	38	
	Average	41	
Remarks	Limit Exceedance	–	





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REPORT ON NOISE QUALITY

CRTS No :CRTS/Civil/R-368 Date: 26-11-2020

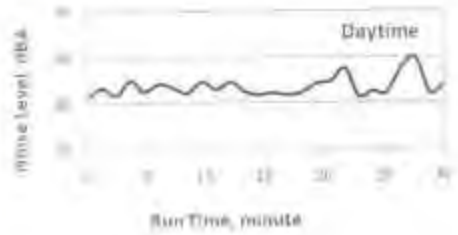
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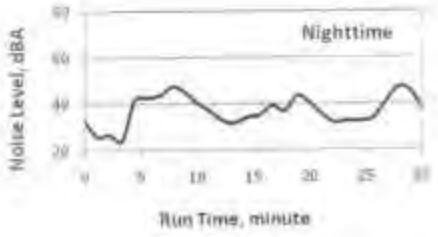
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No :C-200205

Monitoring Location		**SPS-1 CUSTOM GHAT Coordinates: N 22.812129 E 89.576111**	
Date of Monitoring & Measurement Time		17-11-2020 Tuesday 1:45 PM 18-11-2020 Tuesday 11:45 PM	
Equipment		Environment Meter CEM DT–8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Motor Vehicles	
Daytime Measurement Result(s), dBA	Max	59	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	43	
	Average	47	
Nighttime Measurement Result(s), dBA	Max	48	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	24	
	Average	37	
Remarks	Limit Exceedance	—	





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REPORT ON NOISE QUALITY

CRTS No :CRTS/Civil/R-355 Date:26-11-2020

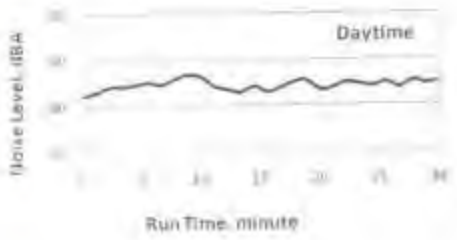
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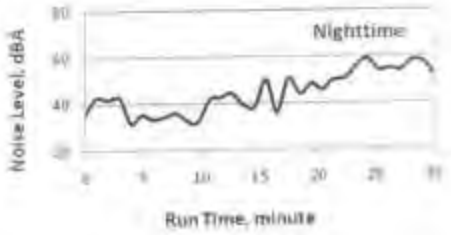
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No :C-200205

Monitoring Location		SPS-2 MOTIARKHALI KHAL Coordinates: N 22.794798 E 89.580758	
Date of Monitoring & Measurement Time		17-11-2020 Tuesday 12:45 PM 19-11-2020 Thursday 12:00 AM	
Equipment		Environment Meter CEM DT–8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Boat repair works, Heavy vehicles	
Daytime Measurement Result(s), dBA	Max	53	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area), 60 (mixed area), 70 (commercial area), 75 (industrial area)
	Min	44	
	Average	49	
Nighttime Measurement Result(s), dBA	Max	59	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area), 50 (mixed area), 60 (commercial area), 70 (industrial area)
	Min	32	
	Average	46	
Remarks	Limit Exceedance	5% (Nighttime)	





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REPORT ON NOISE QUALITY

CRTS No. :CRTS/Civil/R-356 Date:26-11-2020

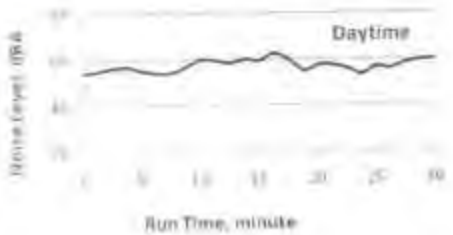
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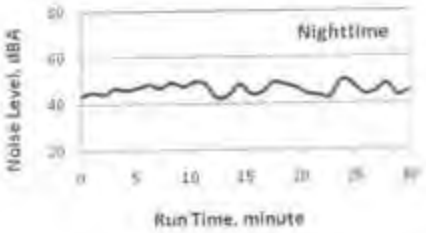
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. :C-200205

Monitoring Location		SPS-3 LABONCHARA SLUICE GATE Coordinates: N 22.779604 E 89.581163	
Date of Monitoring & Measurement Time		10-11-2020 Tuesday 1:00 PM 17-11-2020 Tuesday 10:00 PM	
Equipment		Environment Meter CEM DT–8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Auto Rice Mill, Motor Vehicles	
Daytime Measurement Result(s), dBA	Max	63	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	53	
	Average	57	
Nighttime Measurement Result(s), dBA	Max	50	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	43	
	Average	46	
Remarks	Limit Exceedance	3% (Daytime)	





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REPORT ON NOISE QUALITY

CRTS/ No :CRTS/Civil/R-358 Date:26-11-2020

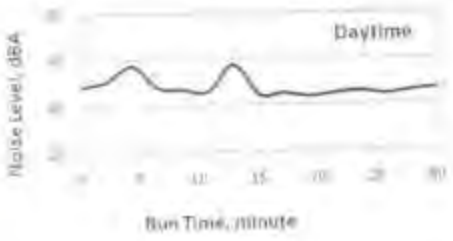
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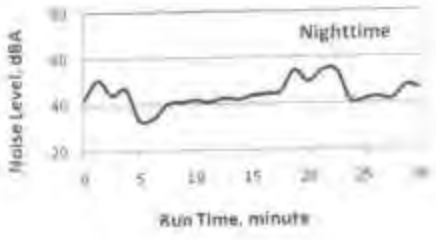
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No :C-200205

Monitoring Location		SPS-4 NIRALA Coordinates: N 22.796017 E 89.556655	
Date of Monitoring & Measurement Time		15-11-2020 Sunday 11:00 AM 18-11-2020 Wednesday 12:00 AM	
Equipment		Environment Meter CEM DT-8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Motor Vehicles, Easy Bikes	
Daytime Measurement Result(s), dBA	Max	58	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	43	
	Average	48	
Nighttime Measurement Result(s), dBA	Max	54	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	33	
	Average	44	
Remarks	Limit Exceedance	2% (Nighttime)	





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REPORT ON NOISE QUALITY

CRTS No. :CRTS/Civil/R-368 Date:26-11-2020

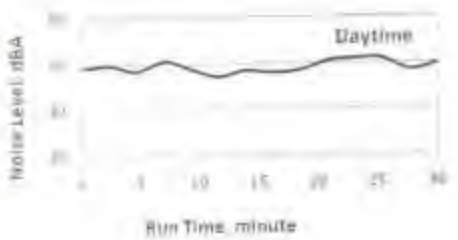
Ref. No. :46.07.0000.003.07.00.000.20-125(3) Date:01-11-2020

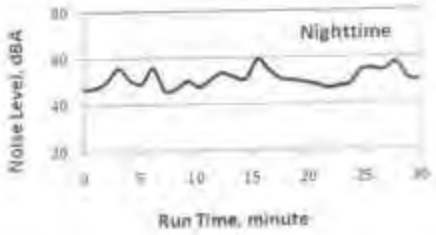
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No :C-200205

Monitoring Location		**SPS-5 KASHIMNAGAR GOLLAMARI Coordinates: N 22.801074 E 89.543759**	
Date of Monitoring & Measurement Time		10-11-2020 Tuesday 3:30 PM 17-11-2020 Tuesday 11:00 PM	
Equipment		Environment Meter CEM DT–6820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Motor Vehicles, Easy Bikes	
Daytime Measurement Result(s), dBA	Max	62	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	54	
	Average	58	
Nighttime Measurement Result(s), dBA	Max	59	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	46	
	Average	51	
Remarks	Limit Exceedance	2% (Daytime); 5% (Nighttime)	





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REPORT ON NOISE QUALITY

CRTS No :CRTS/Civil/R-358 Date:26-11-2020

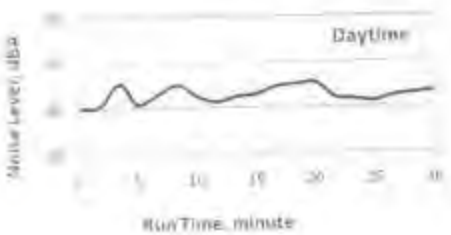
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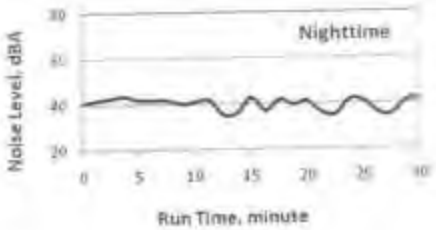
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No :C-200205

Monitoring Location		**SPS-6 TRUCK TERMINAL RD, SONADANGA Coordinates: N 22.825175 E 89.540498**	
Date of Monitoring & Measurement Time		15-11-2020 Sunday 11.45 AM 17-11-2020 Tuesday 11.00 PM	
Equipment		Environment Meter CEM DT–8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Natural breeze, Birds sound	
Daytime Measurement Result(s), dBA	Max	51	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	40	
	Average	46	
Nighttime Measurement Result(s), dBA	Max	43	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	35	
	Average	40	
Remarks	Limit Exceedance	—	





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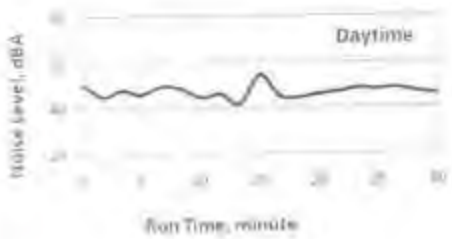
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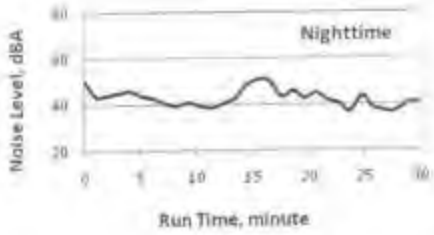
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No. :C-200205

Monitoring Location		**SPS-7 KARIM NAGAR, SONADANGA Coordinates: N 22.625175 E 89.539418**	
Date of Monitoring & Measurement Time		15-11-2020 Sunday 11:00 AM 18-11-2020 Wednesday 9:45 PM	
Equipment		Environment Meter CEM DT–8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Motor vehicles, Easy bikes	
Daytime Measurement Result(s), dBA	Max	54	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	42	
	Average	47	
Nighttime Measurement Result(s), dBA	Max	51	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	37	
	Average	42	
Remarks	Limit Exceedance	1% (Nighttime)	





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REPORT ON NOISE QUALITY

CRTS No :CRTS/Civil/R-368 Date:26-11-2020

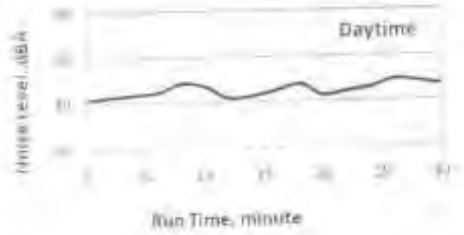
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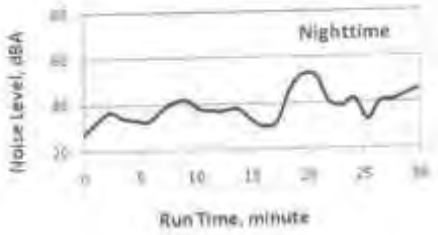
Client :Eng. Md. Abdullah, Managing Director, Khulna WASA, Khulna

Name of the Project :Monitoring of Noise Quality under the Project of Development of Sewerage System of Khulna

Test No :C-200205

Monitoring Location		SP5-8 ISLAMIA COLLEGE ROAD Coordinates: N 22.832049 E 89.531470	
Date of Monitoring & Measurement Time		15-11-2020 Sunday 10:15 AM 18-11-2020 Wednesday 10:30 PM	
Equipment		Environment Meter CEM DT–8820	
Location Category		Mixed area	
Major Noise source(s) during monitoring		Motor vehicles, Easy bikes	
Daytime Measurement Result(s), dBA	Max	49	Daytime Standards of Sound, dBA (ECR 1997) 50 (residential area); 60 (mixed area); 70 (commercial area); 75 (industrial area)
	Min	42	
	Average	45	
Nighttime Measurement Result(s), dBA	Max	53	Nighttime Standards of Sound, dBA (ECR 1997) 40 (residential area); 50 (mixed area); 60 (commercial area); 70 (industrial area)
	Min	28	
	Average	38	
Remarks	Limit Exceedance	1% (Nighttime)	





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APPENDIX-6: ENVIRONMENTAL REQUIREMENTS FOR CONTRACTORS

General Requirements

- **Overview**

The contractor (and any subcontractors) will be required to comply with all of the performance requirements set out in the tender documentation including the statutory consent approvals which may be granted relevant statutory consent authorities. It is the responsibility of the contractor to ensure compliance and to avoid and/or reduce significant adverse effects that have been identified where practicable. Where the contractor diverts from the methodologies and working areas outlined herein and/or defined in the granted planning consent and associated conditions that may be granted, it would be the responsibility of the contractor to obtain the relevant licenses, permits and consents for such changes.

- **Good Housekeeping**

2. The Contractor will employ a “good housekeeping” policy at all times. This will include, but not necessarily be limited to, the following requirements:
    i. General maintenance of working areas and cleanliness of welfare facilities and storage areas;
    ii. Provision of site layout map showing key areas such as first aid posts, material storage, spill kits, material and waste storage, welfare facilities etc.;
    iii. Maintain all plant, material and equipment required to complete the construction work in good order, clean, and tidy;
    iv. Keep construction compounds, access routes and designated parking areas free and clear of excess dirt, rubbish piles, scrap wood, etc. at all times;
    v. Details of site managers, contact numbers (including out of hours) and public information signs (including warning signs) will be provided at the boundaries of the working areas;
    vi. Provision of adequate welfare facilities for site personnel;
    vii. Installation of appropriate security, lighting, fencing and hoarding at each working area;
    viii. Effective prevention of oil, grease or other objectionable matter being discharged from any working area;
    ix. Provision of appropriate waste management at each working area and regular collections to be arranged;
    x. Excavated material generated during construction will be reused on site as far as practicable and surplus materials/soil shall be recovered or disposed of to a suitably authorized waste facility site;
    xi. Effective prevention of infestation from pests or vermin including arrangements for regular disposal of food and material attractive to pests will be implemented. If

infestation occurs the contractor will take appropriate action to eliminate and prevent further occurrence;

xii. Maintenance of wheel washing facilities and other contaminant measures as required in each working area;

xiii. No discharge of site runoff or water discharge without agreement of the relevant authorities;

xiv. Open fires will be prohibited at all times;

xv. The use of less intrusive noise alarms which meet the safety requirements, such as broadband reversing warnings, or proximity sensors to reduce the requirement for traditional reversing alarms;

xvi. Maintenance of public rights of way, diversions and entry/ exit areas around working areas for pedestrians and cyclists where practicable and to achieve inclusive access;

xvii. All loading and unloading of vehicles will take place off the public highway wherever this is practicable; and

xviii. Material handling and/or stockpiling of materials, where permitted, will be appropriately located to minimize exposure to wind. Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.

- **Hours of Working**

3. The timing of construction activities, core working hours and the rate of progress of construction works are a balance between efficiency of construction and minimizing nuisance and significant effects. The core construction working hours for the proposed development will be: (i) 7am – 5pm, and (ii) Tunneling works will occur 24 hours a day, 7 days a week as required.

- **Security**

Security will be the responsibility of the contractor who will provide adequate security to prevent unauthorized entry to or exit from any working areas. The following measures may be used to prevent unauthorized access:

i. Install CCTV and alarm systems where required;

ii. CCTV and security systems will be sited and directed so that they do not intrude into occupied residential properties;

iii. Provide adequate security guards and patrols;

iv. When there is no site activity, close and lock site gates and set appropriate site security provisions in motion;

v. Consult with neighboring properties and local police station and public representative on site security matters as required; and

vi. Prevent access to restricted areas and neighboring properties by securing equipment on site such as scaffolding and ladders.

- **Hoarding and Fencing**

A site boundary in the form of hoarding or fencing will be established around each of the working areas before any significant construction activity commences in that working area. The hoarding/fencing shall be 2.4m high to provide a secure boundary to what can be a dangerous environment for those that have not received the proper training and are unfamiliar with construction operations. Site hoarding also performs an important function in relation to minimizing nuisance and effects including:

i. Noise emissions (by providing a buffer);

ii. Visual impact (by screening the working areas, plant and equipment); and

iii. Dust minimization (by providing a buffer).

The erection of hoarding would be of a similar nature to what is carried out on most construction sites. Mounting posts would be erected by using a mini-digger and the posts would be set in concrete. The size and nature of the posts and hoarding would depend on the requirements for any acoustic mitigation as well as preferences that the contractor may have. Where practicable, hoarding and fencing would be retained and re-configured and re-used between working areas as the construction activities progress.

The following measures will be applied in relation to hoarding and fencing:

i. Maintenance of adequate fencing and hoardings to an acceptable condition to prevent unwanted access to working areas and provide noise attenuation, screening, and site security where required;

ii. Appropriate sight lines/visibility splays will be maintained around working areas to ensure safety of both vehicles and pedestrians is preserved;

iii. Use of different types of fencing and hoarding (e.g. mesh fence of solid hoarding including hoardings used for noise control);

iv. Temporary fences may be used in certain areas, such as for short term occupation of working areas;

v. Display information boards with out of hours contact details, telephone helpline number (for comments/complaints) and information on the works;

vi. Erect notices on site boundaries to warn of hazards on site such as deep excavations, construction access, etc.;

vii. Ensure suitable measures for tree protection are implemented as required;

viii. Keep hoarding and fencing free of graffiti or posters;

ix. Retain existing walls, fences, hedges and earth banks as far as reasonably practicable; and

x. Appropriate positioning of the fencing or hoarding to minimize the noise transmitted to nearby receptors or from plant, equipment and vehicles entering or leaving the working area.

- **Services and Utilities**

Site services shall be installed as part of the enabling works in parallel with the rearrangement and diversion of existing utilities. Working areas will be powered by mains supplies or diesel generators where an electrical supply is not available. The contractor will be responsible for undertaking their own surveys to establish full extent of underground services prior to the commencement of construction to support any surveys already undertaken as part of early design work and statutory consent applications.

- **Lighting**

Site lighting would typically be provided by tower mounted 1000W metal halide floodlights. The floodlights would be angled downwards to minimize spillage to surrounding properties. The following measures will be applied in relation to site lighting:

i. Lighting will be provided with the minimum luminosity sufficient for safety and security purposes. Where practicable, precautions will be taken to avoid shadows cast by the site hoarding on surrounding footpaths, roads and amenity areas;

ii. Motion sensor lighting and low energy consumption fittings will be installed to reduce usage and energy consumption; and

iii. Lighting will be positioned and directed as not to unnecessarily intrude on adjacent buildings and land uses, ecological receptors and structures used by protected species, nor to cause distraction or confusion to passing motorists, river users or navigation lights for air or water traffic.

- **Welfare Facilities**

Welfare facilities will be provided, as appropriate, for construction staff and site personnel such as locker rooms, toilets, showers etc. The location of these will be agreed with KWASA and identified as part of the SEMP/s.

- **Health and Safety**

The contractor would be required to ensure all relevant health and safety, fire safety and security requirements are in place prior to the commencement of construction and in accordance with relevant legislative requirements. Special safety measures delineated by the contractor prior to the commencement of work would be complied with at all times by all construction staff and personnel during construction. Further, contractors would also have to ensure that all aspects of their works comply with good industry practice and all necessary consents, licenses and authorizations that have been put in place for the proposed development.

- **Traffic and Transportation**

The contractor is required to implement the following measures in relation to traffic and transportation during construction:

i. All trucks entering and exiting the site will be covered with tarpaulin;

ii. Adequate parking will be provided to avoid queuing at the site entrances and prevent disruption to neighboring businesses. Construction vehicles will not be allowed to park

on the public road either outside the site or on any of the approach roads leading to the site;

iii. All trucks entering the site will be restricted to suitable speed limits and will be directed to the relevant area by the Site Manager;

iv. Trucks required to wait on site will switch off engines to avoid unnecessary fuel usage and noise;

v. All trucks exiting the site will be required to pass through a wheel wash. A lance will be provided to clean down the bodies and sides of the truck prior to leaving site;

vi. Roads outside the site will be visually inspected on a daily basis and power swept and washed as and when required;

vii. All site staff including truck drivers will be required to abide by the normal rules of the road;

viii. The contractor shall prepare a Detailed Construction Traffic Management Plan (CTMP) covering all construction stages that takes into account other potential construction works in the area. The CTMP will demonstrate how pedestrians, cyclists and motorized vehicles can pass through the works areas safely and that measures are in place which ensure traffic operates in as an efficient manner as possible;

ix. The CTMP will include a detailed consultation plan to deal with third party queries from both residents and retail/ commercial operators.

The contractor will appoint a single point of contact to facilitate the communication of the various traffic management plans and the preparation of a project specific website to aid communications would also be beneficial. As part of the CTMP a Mobility Management Plan will be prepared to ensure access to the site by sustainable travel modes is encouraged. The following measures will need to be considered within the Mobility Management Plan:

i. The provision of showers/ changing rooms for construction staff;

ii. The provision of cycle parking for staff;

iii. The promotion of car sharing among staff, including van pooling to travel between the different work sites;

iv. For works at North Quay, the following individual traffic management measures will be considered:

v. The works will be carried out during a quiet period of the year, possibly late summer however impacts on tourist traffic will also need to be considered.

vi. The works will be carried out utilizing a longer working day (16-24hour basis)

vii. The junction would need to be manned during busy periods to ensure the junction operates efficiently and safely.

- **Air Quality and Climate**

The contractor is required to implement the following measures in relation to air quality and climate during construction:

i. Implementation of ‘standard mitigation’, including the following measures:

ii. Spraying of exposed earthwork activities and site haul roads during dry weather;

iii. Provision of wheel washes at exit points;

iv. Covering of stockpiles;

v. Control of vehicle speeds, speed restrictions and vehicle access; and

vi. Sweeping of hard surface roads.

vii. Erection of a c. 2.4m hoarding will be provided around the working areas to minimize the dispersion of dust from the working areas;

viii. Generators will be located away from sensitive receptors in so far as practicable;

ix. Stockpiles will be located as far as possible from sensitive receptors and covered and/or dampened during dry weather;

x. Employee awareness is also an important way that dust may be controlled on any site. Staff training and the management of operations will ensure that all dust suppression methods are implemented and continuously inspected.

xi. Where asbestos is uncovered on site during construction, the ACM will be double bagged and removed from the site by a competent contractor and disposed of in accordance with the relevant procedures and legislation.

- **Odor Management**

No mitigation measures are required during the construction of the proposed development with regards to odor.

- **Noise and Vibration**

The Noise and Vibration Management Plan (NVMP) will outline how the appointed Contractor(s) will comply with the noise criteria set out in this section and will deal specifically with construction activities in a strategic manner to remove or reduce significant noise and vibration impacts associated with the construction of the proposed development. The NVMP will detail the provision and installation of localized acoustic screens, the best practice noise measures that the appointed Contractor(s) will be required to adhere to for construction activities and the noise and vibration monitoring program that the appointed Contractor(s) will be required to undertake during the construction works. In addition, the appointed Contractor(s) will prepare detailed method statements addressing the likely ground-borne noise and vibration levels that will be generated as a result of the construction activities once the specific details of the proposed plant items and construction methodologies are known. Where considered necessary, structural surveys will be undertaken at sensitive receptors in close proximity to the works to establish their condition and tolerance for vibration impacts. The contractor is required to implement the following measures in relation to noise and vibration during construction:

i. A site representative shall be appointed to be responsible for matters relating to noise and vibration;

ii. Construction of temporary infrastructure (e.g. haul roads) will be with materials that minimize noise and vibration and design of haul roads will minimize reversing;

iii. Internal haul roads shall be well maintained;

iv. Unnecessary revving of engines should be avoided and equipment should be switched off when not required;

v. Rubber linings shall be used in chutes and dumpers etc. to reduce noise;

vi. Drop heights of materials shall be minimized;

vii. Generators will be located away from sensitive receivers and will be enclosed;

viii. Careful selection of equipment, construction methods and programming with the objective of reducing noise and vibration where possible. Only equipment, including road vehicles, conforming to relevant national or international standards, directives and recommendations on noise and vibration emissions, will be used;

ix. Plant and vehicles shall be started sequentially rather than all together;

x. Selecting electrically powered plant that is quieter than diesel or petrol-driven plant, if interchangeable;

xi. Fitting suitable anti-vibration mountings where practicable, to rotating and/or impacting equipment;

xii. Avoiding percussive piling, except where there is an overriding justification;

xiii. Using noise-control equipment such as jackets, shrouds, hoods, and doors, and ensuring they are closed;

xiv. Locating plant, as far as is reasonably practicable, away from receptors or as close as possible to noise barriers or hoardings where these are located between the source and receptor;

xv. Regular and effective maintenance by trained personnel shall be carried out to reduce noise and/or vibration from plant and machinery;

xvi. Ensuring that all plant is maintained regularly to comply with relevant national or international standards and operation of plant and equipment that minimizes noise emissions;

xvii. Ensuring that plant is shut down when not in use;

xviii. Ensuring that air lines are maintained and checked regularly to prevent leaks;

xix. Designing all audible warning systems and alarms to minimize noise. Non-audible warning systems can be used in preference, i.e. cab-mounted CCTV or the use of banksmen.

xx. A c. 2.4m hoarding shall be provided around construction works;

xxi. Rotary drills and busters actuated by hydraulic or electrical power will be used for excavating hard material. In some instances, chemical bursting can be used where nearby sensitive structures are particularly vulnerable to vibration from pneumatic breakers etc.;

xxii. Handling all materials, particularly steelwork, in a manner that minimizes noise. For example, storing materials as far as possible away from sensitive receptors and using resilient mats around steel handling areas;

xxiii. During construction, regular inspections will be undertaken to ensure that the noise and vibration minimizing methods, plant and mitigation identified in the specimen design stage are adopted on site and are working effectively. If applicable, it is proposed that construction method inspections be integrated into any health and safety or quality surveillance regime;

Typically, site activities shall be limited during the day time. However, during the interceptor sewer construction works, the TBM equipment (including generator) will operate on a 24-hour basis. Aside from the 24-hour use of the TBM equipment, it is anticipated that there will be times due to exceptional circumstances that construction work will be necessary outside of normal construction core working hours. Any such working hours outside the normal construction core working hours will be agreed with KWASA. The planning of such works will have regard to nearby sensitive receptors;

i. A Communications Management Plan shall be prepared to provide for effective community liaison to help ensure the smooth running of construction activities and to address any issues that may arise;

ii. Noise monitoring should be undertaken at the start of each new activity to determine the compliance with limit values. This may involve monitoring on a daily basis initially (for the first three weeks), but subject to satisfactory results, this could be relaxed to once a week/twice weekly depending upon the site activities. The frequency will be increased again if particularly noisy activities (such as driven piling) are undertaken;

iii. During tunneling, the most effective pre-emptive measure that to reduce impacts is soil probing prior to tunneling works. Probing prior to tunneling will allow hard obstacles or rock to be identified. If encountered pre- auguring will be undertaken at these locations where hard obstacles have been identified prior to tunneling to minimize noise and vibration impacts. Where ground conditions may be unknown, this measure will be carried out prior to tunneling.

- **Spillage and Leakage**

i. To minimize the risk of spills and/or leaks, standard good practice will be followed with regard to pollution prevention as part of the appointed Contractor's SEMPs;

ii. All in-situ cement works will be monitored by the appointed contractor's EHS Officer to ensure that spill prevention and remediation measures are in place, to minimize the risk and extent of spills and to rapidly deploy clean up equipment;

iii. Machinery maintenance work, re-fueling of construction equipment and the addition of hydraulic oil or lubricants to vehicles / equipment will take place in designated bunded areas within the temporary construction compounds. All waste oil, empty oil containers and other hazardous wastes will be disposed of in compliance with proper care and compliance. All of the construction machinery operating near any watercourse will be systematically checked in order to avoid leaks of oils, hydraulic fluids and fuels; and

iv. Spill-kits and hydrocarbon absorbent packs will be stored in the cabin of each vehicle and operators will be fully trained in the use of this equipment.

- **Landscape and Visual**

The contractor is required to implement the following measures in relation to landscape and visual during construction:

i. The nature of the construction activities in the townscape environment is such that there will always be disruption. Mitigation during construction relates to phasing of construction activity to different working areas sequentially to minimize the duration of significant effects arising from construction activities at any one location, and/or effective pedestrian and traffic management to minimize inconvenience and ensure access is maintained as appropriate.

ii. Reinstated vegetation is undertaken by a suitably qualified landscape contractor, and their contract will include two-year aftercare.

- **Land and Soils**

The contractor is required to implement the following measures in relation to land and soils during construction:

i. The adopted construction techniques will comply with the requirements of statutory bodies.

ii. Precautionary measures will be taken to contain any areas within the planning boundary at risk of contaminated run-off.

iii. Potential pollutants shall be adequately secured against vandalism and will be provided with proper containment according to the relevant codes of practice.

iv. Any spillages will be immediately contained and contaminated soil shall be removed from the proposed development and properly disposed of in an appropriately confined facility.

v. Dust generation shall be kept to a minimum through the wetting down of haul roads as required and other dust suppression measures.

vi. Any stockpiles of earthworks and site clearance material shall be stored on impermeable surfaces and covered with appropriate materials.

vii. Silt traps shall be placed in gullies to capture any excess silt in the run-off from working areas.

viii. Soil and water pollution will be minimized by the implementation of good housekeeping (daily site clean-ups, use of disposal bins, etc.) and the proper use, storage and disposal of these substances and their containers as well as good construction practices.

ix. A contingency plan for pollution emergencies will also be developed by the contractor prior to the commencement of the works and regularly updated during construction. This contingency plan will identify the actions to be taken in the event of a pollution incident which requires the following to be addressed:

    a. Containment measures;
    b. Emergency discharge routes;
    c. List of appropriate equipment and clean-up materials;
    d. Maintenance schedule for equipment;
    e. Details of trained staff, location and provision for 24-hour cover;
    f. Details of staff responsibilities;
    g. Notification procedures;
    h. Audit and review schedule;

x. Excavations shall be kept to a minimum, using shoring or trench boxes where appropriate. For more extensive excavations, a temporary works designer shall be appointed to design excavation support measures in accordance with all relevant guidelines and standards.

xi. All excavated material will, where possible, be reused as construction fill. The appointed contractor will ensure acceptability of the material for reuse for the proposed development with appropriate handling, processing and segregation of the material. This material would have to be shown to be suitable for such use and subject to appropriate control and testing according to the Earthworks

xii. Specification(s). These excavated soil materials will be stockpiled using an appropriate method to minimize the impacts of weathering. Care will be taken in reworking this material to minimize dust generation, groundwater infiltration and generation of runoff. Any surplus suitable material excavated that is not required elsewhere for the proposed development, shall be used for other projects where possible, subject to appropriate approvals/notifications.

xiii. Earthworks operations shall be carried out such that surfaces shall be designed with adequate falls, profiling and drainage to promote safe runoff and prevent ponding and flooding. Runoff will be controlled through erosion and sediment control structures appropriate to minimize the water impacts in outfall areas. Care will be taken to ensure that the bank surfaces are stable to minimize erosion.

xiv. Ground settlements will be controlled through the selection of a foundation type and method of construction which are suitable for the particular ground conditions.

xv. To reduce the amount of dewatering required at any given time, it is likely that the contractor would construct the sewer in sections. Discharge from the dewatering process would be passed to a suitably sized settlement pond or a proprietary silt removal system located within the working area where possible.

xvi. Where compaction occurs due to truck movements and other construction activities on unfinished surfaces, remediation works will be undertaken to reinstate the ground to its original condition. Where practicable, compaction of any soil or subsoil which is to remain in situ along the sites will be avoided.

- **Hydrology and Water Quality**

The contractor is required to implement the following measures in relation to water during construction:

i. During construction, surface water runoff would be collected by the temporary drainage system installed by the contractor and then treated or desilted on-site before discharging into the river/canal;

ii. Earthworks operations shall be carried out such that the surfaces are designed with adequate slope to promote safe runoff and prevent flooding;

iii. Good housekeeping such as site clean ups, use of disposal bins, etc. will be adopted in construction areas;

iv. In order to prevent accidental release of hazardous materials such as fuels, cleaning agents etc. into surface water during construction, all hazardous materials will be stored within appropriately bunded containment areas designed to retain spillages;

v. Temporary bunds will be used for storage of oil/diesel; and

vi. Mitigation during construction will include implementing best practice during excavation and tunneling works to avoid the release of bentonite and prevent sediment running into the drainage network and/or hydrological environment during construction of the proposed development.

- **Resource and Waste Management**

The contractor is required to implement the following in relation to resource and waste management during construction:

i. The contractor is required to prepare, implement and maintain a Construction and Demolition Waste Management Plan throughout construction that addresses the following as a minimum:

   a. Description of the proposed development;

   b. Wastes arising including procedures for minimization/reuse/recycling;

   c. Estimated cost of waste management;

   d. Roles including training and responsibilities for construction and demolition waste;

e. Procedures for education of workforce and plan dissemination program;

f. Record keeping procedures;

g. Waste collectors, recycling and disposal sites including copies of relevant permits or licenses; and

h. Waste auditing protocols.

ii. The Contractor will minimize waste disposal so far as is reasonably practicable;

iii. Source segregation: Where possible metal, timber, glass and other recyclable material will be segregated during construction works and removed off site to a designated facility for recycling. Waste stream color coding, and photographs of wastes to be placed in each container as required, will be used to facilitate segregation. Where waste generation cannot be avoided this will maximize the quantity and quality of waste delivered for recycling and facilitate its movement up the waste hierarchy away from landfill disposal and reduce its environmental impact;

iv. Supply chain partners: The contractor will engage with the supply chain to supply products and materials that use minimal packaging, and segregate packaging for reuse;

v. Waste Auditing: The contractor will record the quantity in tons and types of waste and materials leaving site during the construction phase;

vi. Waste fuels/oils may be generated from equipment used on-site during construction and may be classified as hazardous waste. Such wastes will be stored in a secure, bunded area on-site prior to collection by relevant parties;

vii. Possibilities for re-use of clean non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. Where excavation material may not be re-used within the proposed works the contractor will endeavor to send material for recovery or recycling so far as is reasonably practicable;

- **Population and Human Health**

The contractor is required to implement the following measures in relation to population and human health during construction:

i. Provide for safe pedestrian access at points of entry and exit of construction vehicles;

ii. Stagger works wherever possible and remove hoarding as soon as it is no longer needed to mitigate against severance;

iii. Avoid works that could involve high noise or visual intrusion during major social events.

iv. Provide temporary signaling or manning of important junctions and exit/entry point of the sites.

v. Maintain regular proactive consultation with local residents and businesses,

- **Material Assets**

The contractor is required to implement the following measures in relation to material assets during construction:

i. Landowners will be compensated as appropriate for permanent and temporary land acquisition, in accordance with the relevant legislation.

ii. The details of any individual agreements will be private and confidential and therefore mitigation measures in the form of compensation are not specific or detailed herein.

iii. A Property Protection Scheme will be put in place by KWASA prior to works commencing on site. This will involve advance condition surveys prior to construction for all properties within the zone of influence of the proposed development. If it is determined that any reported minor cosmetic damage has been caused by construction of the proposed development, suitable remedial works will be undertaken to repair the damage to the properties with the use of

iv. the appropriate conservation technique.

v. Mitigation measures for all areas of temporary land acquisition will involve reinstatement to their original condition so far as is reasonably practicable.

vi. Access to all existing properties will be maintained at all times during the construction of the proposed development. This may require temporary alternate access arrangements at some locations. All access will be reinstated upon completion of construction.

vii. Sewer diversions will be undertaken as part of the enabling works prior to the commencement of construction activities. Upon commissioning, the older pipelines being abandoned will be sealed off and/or removed.

viii. Surface water management measures will be adopted along the entire site.

APPENDIX-7: COVID-19 HEALTH AND SAFETY GUIDANCE FOR THE CONSTRUCTION WORKFORCE

Section 1: Pre-requisite for Opening/Reopening Worksite/Campsite

i. Plan to open/reopen worksite at limited scale (i.e. only essential works at worksite). Map essential/unavoidable works that must be attended at this moment. Identify and engage essential labor force initially. Increase labor force step by step as necessary. Do not engage labor until necessary preparation is done as stipulated in the next paragraphs.
ii. Locate the closest medical establishment equipped with COVID -19 response facilities. Establish contact with the medical facility and make agreements with them for cases of potential COVID patient from the work site.
iii. Engage a full time EHS professional at site. Also engage a part-time/fulltime medical professional based on the workforce and project size/type.
iv. Prepare list of potential workforce/labors. With the help of the EHS/medical professional prepare health records of the labors to be engaged. Seek assistance from registered medical centers if required. Keep the record at site office.
v. Purchase thermometer gun, soap, hand sanitizer, disinfectants and PPEs (mask, hand gloves, hard shoes etc.) and keep it at worksite office. Disinfectants can be diluted bleaching power as directed by ICCDR, B or USEPA.
vi. Establish site entrance protocol as depicted in Section 2 below. Redesign the site safety notices/signboards/protocol according to the guidelines provided in this document.
vii. Arrange washbasin, soap and clean water at the entrance of every worksite/campsite. Also keep either a disinfectant tub for shoes or keep disinfectant spray that must be sprayed under the boots/hard shoes of the persons entering worksite. Put signboard/poster in front of the washbasin instructing the workers/staff/site visitors to wash both hands for 20 seconds. The board/poster should also display proper hand washing techniques as per WHO guidelines.
viii. Provide every personnel working in the site with mask, hand gloves and hard shoes for their personal use. Strictly follow the HSE manual at site. The contractor must have a copy of the HSE manual at site. For assistance contact with relevant EAs.
ix. Identify and note a list of commonly used machines/tools and surfaces (e.g. tables, doorknobs, handrail etc.) by workers and camp site dwellers.
x. Make arrangements of electronic payment system affordable for the workers (e.g. bKash, Nagad, Rocket etc.). Update company polices of paid sick leave, medical allowance and medical insurance.

Section 2: Worksite Entrance Protocol

i. Everyone entering the worksite must wear a mask, gloves and hard shoes. Strictly follow and implement the EHS manual at worksite.
ii. At the entrance of the worksite/camp site every personnel must wash their hands for 20 second with maintaining a distance of at least 1m (3 ft) from each other. At this rate 180 person can enter the site in an hour. Depending on this calculation (hourly rate 180pax per washbasin) the contractor can calculate the number of washbasins he/she needs to provide. The wash basins should maintain at least 1.5m distance from each other and the entrance que must maintain 1m distance from each other.
iii. Spray bottom of shoes of every personnel entering worksite/campsite with disinfectant or provide shoe storage for worker storing shoe in poly bag before entering the worksite.
iv. Procure and use a thermometer gun to check temperature of everyone entering the site. If body temperature is found > 37 degrees, send this person to the designated medical facility for further examination and follow instruction of the medical person in-charge.

v. Prepare disinfectant using ICCDR, B or EPA registered household disinfectant formula (e.g. diluted bleaching powder) and disinfect vehicles upon entry to the worksite/campsite.

Section 3: Daily Worksite Protocols

i. A designated EHS/Medical person should stay all time during work. The EHS/Medical person should also monitor campsite. He/she will be in charge of ensuring physical distances (minimum 1m) among workers, disinfecting surfaces that are commonly used and investigate worker/site personnel health and safety.
ii. The designated EHS/Medical person (or assistant) must frequently clean and disinfect highly used tools and machineries by workers and surfaces including doorknobs, handrails, toilets, work surfaces, and common areas such as tables, assembly place etc.
iii. At the start and end of the day disinfect the total worksite. For campsite, disinfect the total area before the worker/camp dwellers are back from site.
iv. Always check if the stock of disinfectant, PPEs, medical supplies are sufficient.
v. Encourage site personnel/camp dwellers to not touch their eyes, mouth or nose if not washed thoroughly with soap recently. Also discourage hand shaking or hugs.
vi. Arrange a mandatory site brief on COVID awareness in the morning. The session must be conducted by the EHS/Medical professional.
vii. Encourage worker/site personnel/camp dwellers to inform the designated ESH/Medical personnel immediately if any colleague starts showing the symptoms of COVID-19.
viii. While worksites are commonly well ventilated (if not make sure the work sites are well ventilated), ensure that the camp sites including the rooms designated for the camp dwellers are well ventilated and spacious.
ix. Before sharing common tools/machines at worksite, ensure to disinfect.
x. Discourage site personnel to gather and gossip at any time, rather encourage physical distance while chatting/discussing.
xi. Keep the day-to-day toolbox meetings as short as possible. Ensure physical distance during meetings.
xii. Increase use for internet/phone-based meetings/site visits as much as possible to avoid travelling and physical communication.
xiii. Restrict worksite personnel to go outside unnecessarily. Also restrict campsite personnel to go outside without any valid cause.
xiv. If any person related at worksite/campsite fall victim to COVID-19 or being kept isolated for pre-caution, consider paid leave with no exception allowed.

Section 4: Everyday Training

i. Train workers on how to properly put on, use/wear, and take off protective clothing and equipment. The on-site EHS/Medical person should be in-charge of these trainings. These trainings must maintain the WHO's social distancing protocol. Make these trainings mandatory at worksites. Provide 10-15 minutes of a workday for such 'training and encouragement' activities.
ii. Encourage respiratory etiquette, including covering coughs and sneezes. Train the site personnel as needed.
iii. Contact with designated professional for any help with training material/knowledge/miscellaneous.

Section 5: Campsite Management

i. Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwelling (both camp site and home). Encourage frequent hand washing and social distancing at campsite.

ii. Ensure a separate covered bin in place at every campsite/worker's dwelling for disposal of used PPEs.
iii. Check and ensure if camps are well ventilated and protected against heat, cold, damp, noise, fire, and disease-carrying animals.
iv. Maintain good housekeeping and social distancing in kitchens, meal rooms, canteens and toilets. Make sure campsites are using sanitary toilets.
v. Ensure personal distance at least 1 meter (3 feet), preferably 2m (6ft) during lunch, dinner and prayer.

Section 6: Knowledge Management and Documentation

i. During CODIV-19 outbreak new information is coming everyday as the science develops. Site management needs to evolve as new information/current protocol emerges. It is difficult for site medical/EHS professional to keep up with the new knowledge/information that is coming every day in absence of fast internet. Hence, he/she should keep in close contact with the designated EAs/ADB professional for updated information and protocol. This documents also needs to be considered as live document and should be updated as necessary.

APPENDIX-8: OUTLINE OF TRAFFIC MANAGEMENT PLAN

Introduction

This Traffic Management Plan (TMP) provides the traffic management procedures to be followed by the vehicle users of Contractors' while implementing the construction/reconstruction works of Khulna Sewerage System Development Project. The vehicle operators should be careful that, road users are not limited to motorists - they include pedestrians, such as school children and people with disabilities, cyclists and emergency vehicles.

Traffic Management Objectives and Strategies

The objectives of the TMP are to:

i. Provide for a safe environment for all road users;
ii. Provide protection to Contractors' operators and the general public from traffic hazards that may arise as a result of the driving of vehicles;
iii. Minimize the disruption, congestion and delays to all road users;
iv. Ensure access to adjacent private/commercial premises is maintained at all times.

To achieve the above objectives, the Traffic Management Plan will:

i. Ensure whenever possible, that a sufficient number of traffic lanes to accommodate vehicle traffic volumes are provided.
ii. Ensure that delays and traffic congestion are kept to a minimum and within acceptable levels
iii. Ensure that appropriate/sufficient warning and information signs are installed and that adequate guidance is provided to delineate the travel paths through the event site.
iv. Ensure that the roads are free of hazards and that all road users are adequately protected from activities of road users
v. Ensure that all needs of road users, motorists, pedestrians, cyclists, public transport passengers and people with disabilities are accommodated at and through the site of the event.

A Traffic Management Plan is a key workplace document that has legal standing. As such it is critical that the structure and content of the Plan is sufficient to explain the potential hazards, the assessed risks and the proposed treatments for the proposed work activities and work site. The TMP should include all of the following. Where any of the following sections are not applicable, the TMP should indicate this accordingly.

<u>Introduction</u>

i. Purpose and Scope,
ii. Objectives and Strategies.

<u>Project Overview</u>

i. Project Location,
ii. Project Details and Site Constraints/Impacts

<u>Project Representatives</u> (Principal for the Works; Principal Contractor)

<u>Safety Plan</u>

i. Occupational Safety and Health;

ii. Competencies;
iii. Responsibilities- Role, responsibility and authority of key personnel, management hierarchy including site representatives and contact details of the responsible personnel;
iv. Communicating TMP requirements;
v. Prior approvals (if any) granted by the RHD (Roads and Highways department), City Corporation or Municipality with relevant reference number.

Trip Hazards & Environmental Conditions

i. Weather;
ii. Vegetation;
iii. Existing signage;
iv. Structures.

Worksite Access

i. Pedestrians;
ii. Cyclists;
iii. Works vehicles;
iv. Emergency vehicles;
v. Public Transport;
vi. Property Access;
vii. School crossings;
viii. Impact on adjoining Road Network;
ix. Heavy and Oversized Vehicles and Loads;
x. Legal and Other Requirements.

Emergency Arrangements and Contingencies

i. Emergency Services;
ii. Dangerous Goods;
iii. Damage/Failure to Services (Traffic signals, street lighting, power, gas);
iv. Contingency Planning (Road crash or vehicle breakdown, serious injury or fatality);
v. Emergency Contacts.

APPENDIX-9: SAMPLE GRIEVANCE REGISTRATION FORM

The _____Project welcomes complaints, suggestions, queries and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.

Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date		**Place of Registration**	
Contact Information/Personal Details			
Name	**Gender**	* Male * Female	**Age**
Home Address			
Place			
Phone no.			
E-mail			
Complaint/Suggestion/Comment/Question Please provide the details (who, what, where, and how) of your grievance below: If included as attachment/note/letter, please tick here:			
How do you want us to reach you for feedback or use on your comment/grievance?			

FOR OFFICIAL USE ONLY

Registered by: (Name of Official Registering Grievance)	
Mode of Communication: Note/Letter E-mail Verbal/Telephonic	
Reviewed by: (Names/Positions of Officials Reviewing Grievance)	
Action Taken:	
Whether Action Taken Disclosed:	Yes No
Means of Disclosure:	

APPENDIX-10: SAMPLE ENVIRONMENTAL SITE INSPECTION REPORT

Project:

Inspection Date: Project Activity Stage:

Weather Condition:

SL.	Issues	Location	Compliance Status[33]			Remarks/Notes
			C	PC	NC	
A. Construction Camp and Site Office						
1.	Locate construction camps at environmental and socially acceptable area					
2.	Environment, Health and Safety Officer designated					
3.	Site Specific Environmental Management Plan (SEMP) in site office					
4.	Health and Safety Plan in site office					
5.	First aid box with first aiding agents in site office					
6.	Fire extinguisher/ protective arrangements					
7.	Emergency contacts in case of any incident					
8.	Incident register book					
9.	Complain/ visitor's comment book					
10.	Installation of materials and equipment storage					
11.	Separate storage of fuel and lubricant					
12.	Installation of safety signboards					
13.	Installation of fences to restrict public access into the camp					
B. Labor Shed						
1.	Establishment of labor shed					
2.	Hygiene and sanitation facilities					
3.	Bin for collecting garbage and food waste					
4.	Wastewater disposal system					

[33] C- Compliance, PC- Partially Compliance, NC- Non-Compliance

SL.	Issues	Location	Compliance Status[33]			Remarks/Notes
			C	PC	NC	
5.	Special facilities for female labor (dress-up, breast feeding, etc.)					
6.	Measures against mosquito, insects, snakes etc.					
C. Roads Safety and Traffic Management						
1.	Implementation of traffic management plan approved by PMU					
2.	Consult with community on schedule of construction activity					
3.	Observation of traffic regulations, installation of traffic signs along the construction sites					
4.	Install bold diversion signs to be visible even at night, and provide flag persons to warn of dangerous conditions (24 hours/as necessary)					
5.	Provide sufficient lighting at night within and in the vicinity of construction sites					
D. Occupational Health and Safety						
1.	Implementation of H&S plan					
2.	PPEs (safety boots, helmets, gloves, protective clothing, breathing mask, goggles and ear protection)					
3.	Fall prevention and protection measures to prevent the hazard of falling more than 2 meters					
4.	Ensure no involvement of child labor					
5.	Installation of safety signboards at the sites					
6.	Installation of reversing signals on the construction vehicles					
7.	Confined the construction sites to restrict public access					
8.	Accident/ Incident records and steps taken					
9.	Tool box meeting on OHS, PPE and others before starting construction					
E. Environmental Quality						
1.	All site personnel have a basic level of environmental awareness training					
2.	Implementation of waste management plan approved by PMU /PMSC					

SL.	Issues	Location	Compliance Status[33]			Remarks/Notes
			C	PC	NC	
3.	Measures for construction waste/ debris management					
4.	Undertake housekeeping at all sites and camps to ensure cleanliness					
5.	Prohibit burning of any kind of waste					
6.	Air quality monitoring and dust controlling measures					
7.	Noise level monitoring and controlling measures					
8.	Water quality monitoring and pollution controlling measures					
9.	Effluents not to be disposed of directly into natural waters, but via settling basins to allow suspended sediment to settle out					
10.	Management of excavated soil					
11.	Restoration of any utility services					
12	Any private property damage					
F. Protection for Biodiversity						
1.	Awareness raising program for managing biodiversity (flora and fauna)					
2.	Conduct fish survey					
3.	Removal of trees require prior approval of PMU/PMSC/FD etc.					
4.	Supply gas for cooking to avoid tree felling					

Collected by	**Reviewed by**
Name:	Name:
Designation:	Designation:
Signature:	Signature:
Date:	Date:

Appendix 11

SAMPLE DAILY MONITORING SHEET FOR CONTRACTORS

KHULNA SEWERAGE SYSTEM DEVELOPMENT PROJECT
Contractor Monitoring Sheet

Name of Subproject:_____
Location of Subproject: _____
Chainage covered (for linear works): _____
Contractor: _____
Contractor EHS Supervisor (or equivalent): _____
Date of monitoring: _____

Summary of Findings

Monitoring Item	Status	Remarks
1. Compliance with Local Permit Requirements	**(Secured / Application Submitted / Not Applicable)**	
Location/zoning permits		
Permit to construct		
Building permit		
Transport / hauling permits		
2. Compliance with IEE Requirements	**(Approved / Under Preparation / Submitted to PMU for Approval)**	
Site-specific EMP (SEMP)		
Corrective Action Plan, if any		
3. Compliance with SEMP		
Construction Site	**(Satisfactory / Needs Improvement / Not Implemented)**	
- Conduct of toolbox talk		
- Use of PPE		
- Rest areas for male and female workers		
- Toilets for male and female workers		
- Medical kits		
- Drinking water supply		
- Dust control		
- Noise control		
- Solid waste management		
- Wastewater management		
- Chemicals storage (fuel, oil, etc.)		
- Siltation or erosion control		
- Heavy equipment staging / parking area		
- Barricades around excavation sites		
- Access to residential houses/shops/businesses		

Monitoring Item	Status	Remarks
- Traffic routing signages		
- Lightings at night		
- Trench shoring / landslide protection		
Construction Workers' Camp Site	**(Available / Needs Improvement / Not Available)**	
- Quarters for male and female workers		
- Sleeping utilities (e.g. beds, pillows, blankets, mosquito nets, etc.)		
- Power/Electricity supply		
- Drinking water supply		
- Toilets for male and female workers		
- General purpose water supply (cooking, washing, bathing)		
- Cooking facilities and areas		
- Solid waste management		
- Wastewater management		
- Pest control		
4. Implementation of GRM	**(Yes / No or None / Under Resolution)**	
Complaints		
Complaints resolution		
5. Environmental Quality Measurement	**(Passed / Failed / Not Applicable)**	
Ambient air quality sampling		
Noise level measurement		
Receiving water quality sampling		

Other Issues: _____

_____

_____

_____

Attachments:
1. Copies of permits secured, if any.
2. Photos taken at worksites, if any.
(photos attached in previous monitoring sheets should not be used again).
3. Laboratory results of environmental quality measurements, if any.

Prepared by: _____
Name, Designation and Signature

APPENDIX-12: SAMPLE SEMI-ANNUAL ENVIRONMENTAL MONITORING REPORT TEMPLATE

I. INTRODUCTION

- Overall project description and objectives
- Description of Project
- Environmental category of the sub-projects
- Details of site personnel and/or consultants responsible for environmental monitoring
- Overall project and sub-project progress and status

No.	Subproject Name	Status of Subproject				List of Works	Progress of Works
		Design	Pre-Construction	Construction	Operational Phase		
		┐	┐	┐	┐		
		┐	┐	┐	┐		
		┐	┐	┐	┐		

Compliance status with National/ State/ Local statutory environmental requirements

No.	Sub-Project Name	Statutory Environmental Requirements	Status of Compliance	Action Required

Compliance status with environmental loan covenants

No. (List schedule and paragraph number of Loan Agreement)	Covenant	Status of Compliance	Action Required

II. COMPLIANCE STATUS WITH THE ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

- Provide the monitoring results as per the parameters outlined in the EMP. Append supporting documents where applicable, including Environmental Site Inspection Reports.

- There should be reporting on the following items which can be incorporated in the checklist of routine Environmental Site Inspection Report followed with a summary in the semi-annual report send to ADB. Visual assessment and review of relevant site documentation during routine site inspection needs to note and record the following:
  a. What are the dust suppression techniques followed for site and if any dust was noted to escape the site boundaries?
  b. If muddy water was escaping site boundaries or muddy tracks were seen on adjacent roads;
  c. Adequacy of type of erosion and sediment control measures installed on site, condition of erosion and sediment control measures including if these were intact following heavy rain;
  d. Are there designated areas for concrete works, and re-fueling?
  e. Are there spill kits on site and if there are site procedure for handling emergencies;
  f. Is there any chemical stored on site and what is the storage condition?
  g. Is there any dewatering activities if yes, where is the water being discharged;
  h. How are the stockpiles being managed?
  i. How is solid and liquid waste being handled on site?
  j. Review of the complaint management system;
  k. Checking if there are any activities being under taken out of working hours and how that is being managed.

Summary Monitoring Table

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Design Phase						
Pre-Construction Phase						
Construction Phase						

Impacts (List from IEE)	Mitigation Measures (List from IEE)	Parameters Monitored (As a minimum those identified in the IEE should be monitored)	Method of Monitoring	Location of Monitoring	Date of Monitoring Conducted	Name of Person Who Conducted the Monitoring
Operational Phase						

Overall Compliance with CEMP/ EMP

No.	Sub-Project Name	EMP/ CEMP Part of Contract Documents (Y/N)	CEMP/ EMP Being Implemented (Y/N)	Status of Implementation (Excellent/ Satisfactory/ Partially Satisfactory/ Below Satisfactory)	Action Proposed and Additional Measures Required

III. APPROACH AND METHODOLOGY FOR ENVIRONMENTAL MONITORING OF THE PROJECT

Brief description on the approach and methodology used for environmental monitoring of the Project

- Monitoring of environmental IMPACTS on PROJECT SURROUNDINGS (ambient air, water quality and noise levels)
- Brief discussion on the basis for monitoring
- Indicate type and location of environmental parameters to be monitored
- Indicate the method of monitoring and equipment to be used
- Provide monitoring results and an analysis of results in relation to baseline data and statutory requirements

As a minimum the results should be presented as per the tables below.

Air Quality Results

Site No.	Date of Testing	Site Location	Parameters (Government Standards)		

Site No.	Date of Testing	Site Location	Parameters (Monitoring Results)		

Water Quality Results

Site No.	Date of Sampling	Site Location	Parameters (Government Standards)					

Site No.	Date of Sampling	Site Location	Parameters (Monitoring Results)					

Noise Quality Results

Site No.	Date of Testing	Site Location	LAeq (dBA) (Government Standard)	
			Day Time	Night Time

Site No.	Date of Testing	Site Location	LAeq (dBA) (Monitoring Results)	
			Day Time	Night Time

IV. SUMMARY OF KEY ISSUES AND REMEDIAL ACTIONS

Summary of follow up time-bound actions to be taken within a set timeframe.

V. APPENDIXES

Photos
Summary of consultations
Copies of environmental clearances and permits
Sample of environmental site inspection report
Others

Appendix 13

Meeting Minutes

Public Consultation

1. Meeting Location: STP-1 site (Mathabhanga)

2. Meeting Date: January 10, 2021

3. Project Name: Khulna Sewerage System Development Project

4. Consultation carried out by: KWASA

5. KWASA Environmental team of presentation Content:

- Safety measures for the Covid 19;
- Project Description;
- Project output and benefit;
- Construction Work**;**
- Proposed alignment; and
- Probable Environmental Issues of the Project (Before, After, and During the Construction)
-

6. Comments of Participants:

Sl No.	Individual	Comments
1.	Md. Tajul Islam Faraji, Businessman	He supported the project for improving the sanitation situation and expected the proper implementation of the project. *KWASA team replied: Quality of the project work will be ensured with the support from the consultant.*
2.	Md. Masud Hossain Faraji, Businessman	He expressed his concern about the air, dust, and noise pollution during construction.

		KWASA team replied: Appropriate measures will be taken including the use of efficient and modern equipment to minimize the environmental impact. Moreover, obligation for the contractor has been kept under the contract the contact to confirm the environmental guidelines.
3.	Ali Hossain Hawlader, Businessman	He underscored the need for the proper treatment of sewerage before disposal to water bodies. *KWASA team replied: Monitoring will be done at every stage of the treatment process to ensure the desired standard of effluent quality*
4.	Md. Nowser Ali Molla, Businessman	He viewed that through the project new job opportunities will be created. *KWASA team commented: The job opportunity will be created during construction and operation as well.*
5.	Md. Moniruzzaman, Businessman	He opined that the issue of emptying the septic tank will be resolved. *KWASA team commented: Environmental hazards during emptying the septic tank will be eliminated.*

List of Attendance: See the attendance sheet (Appendix-14)

Meeting Minutes

Public Consultation

1. Meeting Location: STP-2 site (Tikrabandh)

2. Meeting Date: January 18, 2021

3. Project Name: Khulna Sewerage System Development Project

4. Consultation carried out by: KWASA

5. KWASA Environmental team of presentation Content:

- Safety measures for the Covid 19;
- Project Description;
- Project output and benefit;
- Construction Work**;**
- Proposed alignment; and
- Probable Environmental Issues of the Project (Before, After, and During the Construction)

6. Comments of Participants:

Sl No.	Individual	Comments
1.	Md. Solaiman Hossain, Rtd. Police	He opined the project will help improve the sanitation situation in the city. However, he has a concern about the delay in the completion of the project. *KWASA team replied: Co-ordination with all the stakeholders will be ensured to have the project completed in time.*
2.	Md. Abul Kalam Azad, Service Holder	He expressed his concern about traffic increases during construction. *KWASA team replied: Appropriate measures will be taken including the support from traffic police to minimize the impact.*

3.	Md. Julhaj Ahammad, Service Holder	He viewed that public suffering will be increased during of sewer line through the excavation of the road. *KWASA team replied: Most of the pipeline will be done adopting trenchless technology. Moreover, the diversion road will be constructed as per the requirement to reduce public suffering.*
4.	Mehedi Hasan , Service Holder	He opined for taking measures to prevent air, dust, and noise pollution during construction. *KWASA team replied: Obligation for the contractor has been kept under the contract the contact to confirm the environmental guidelines. KWASA, with the support from the other stakeholders, will exclusively monitor the compliance of the environmental requirement to reduce the impact.*
5.	Md. Saiful Islam, Advocate	He viewed a concern over contamination of water bodies from the sewerage treatment plant. *KWASA team replied: Targeted standard of the effluent will be ensured through the exclusive monitoring at different stages of treatment.*

List of Attendance: See the attendance sheet (Appendix-14)

Appendix 14

Khulna Sewerage System Development Project

Environment: Public Consultation and Information Session

Venue: STP-1: Mathabhanga Date: 10.01.2021

Attendance Sheet

Sl. No.	Name	Occupation	Address	Phone No.	Signature
1	Md. Mojazzel Hossain	Farmer	Mathavanga, Bathiaghata Khulna	01718-350164	
2	Md. Nowser Ali Molla	Business	Labonchura sluice gate, mukta sorok, Labondura	01715-442148	
3	Md. Abul Hossain Akunji	Business	Roken Uddin Sorok, Baikhola, Khulna	01736-558823	
4	Md. Tazed Islam Faraji	Business	Lockpur, Fakirhat, Bagherhat.	01721550543	
5	Md. Masud Hossain	Business	Lockpur, Fakirhat, Bagherhat	01309151684	
6	Ali Hossain Howlader	Business	putimari, Jalma, Bathia-ghata, Khulna	01729 952730	Alihossain
7	Md. Moniruzzaman	Business	Hazi Mohsin Road, Khulna.	01711310 298	

Khulna Sewerage System Development Project

Environmental Public Consultation and Information Session

Venue: Thikrabard (STP-02) **Date:** 18-02-2021

Attendance Sheet

Sl. No.	Name	Occupation	Address	Phone No.	Signature
1.	Monu Molla	Mechanice	Thikrabard	01718-125714	
2.	Md. Delowar	Private Job	Khan Jahan Ali Road	01714-593481	
3.	Md. Abdul Kalam Azad	Service Holder	113/3(KA) Sher-e-Bangla Road N/E, Khulna	01916-342784	
4.	Nurul Islam Gazi	Teacher	Satkhira	01962-895953	
5.	Md. Idris Ali	Farmer	Pikegacha	01940192722	
6.	Md. Nur Islam	Van Driver	Thikrabard, Khulna	01942039822	
7.	Taslim Ahmed	Student	Thikrabard Khulna	01923-569922	
8.	Trok sheikh	Electrician	Do	01952743139	
9.	Abdul Salam	Business	Banagati, Khulna	01993813971	
10.	Md. Mehedi Hasan	Business	Thikrabard Khulna	01779828315	
11	Mehedi Hasan	Service Holder	Charenbarisa, Tala, Satkhira	01930352035	
12	Md. Abdul Jalil	Service Holder	Thikrabard, Khulna	01920687235	
13.	Md. Sobiman Hossain	Rtd. Police.	Thikrabard Khulna	01969957279	
14	Md. Abdul Aziz	Driver	Gallamari, Khulna	01911705574	
15.	Md. Julhaj Ahmed	Service Holder	Sonabaria, Kolaroa, Satkhira	01735832790	