Initial Environmental Examination

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Bangladesh: Narayanganj Green and Resilient Urban Development Project – Water Supply Project

Upgrading of Water Treatment Plant, Deep Tube Wells, and Distribution Network

[Package Number NCC/NGRUDP/W-01]

MAIN REPORT

Prepared by Narayanganj City Corporation, Government of Bangladesh for the Asian Development Bank (ADB).

CURRENCY EQUIVALENTS

(as of 1 January 2024)

Currency unit	–	Bangladesh Taka (BDT)
BDT1.00	=	$0.01
$1.00	=	BDT 108.50

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
COD	–	chemical oxygen demand
DMA	–	district metering area
DMZ	–	district metering zone
DO	–	dissolved oxygen
DOE	–	Department of Environment
DTW	–	deep tube well
EA	–	executing agency
EIA	–	environmental impact assessment
ECA	–	Environmental Conservation Act
ECR	–	Environmental Conservation Rules
ECC	–	environmental clearance certificate
EMP	–	environmental management plan
GOB	–	Government of Bangladesh
GRC	–	grievance redress committee
GRM	–	grievance redress mechanism
IEE	–	initial environmental examination
NCC	–	Narayanganj City Corporation
NGO	–	nongovernment organization
NOC	–	no objection certificate
O&M	–	operation and maintenance
PMU	–	project management unit
REA	–	rapid environmental assessment
ROW	–	right of way
SPS	–	safeguard policy statement
TSS	–	total suspended solid

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

The Government of Bangladesh (GOB), under its Eighth Five-Year Plan targets to provide 100% of the urban population with access to an improved water source, and 80% of city dwellers with safely managed sanitation services by 2026. Narayanganj is the fourth most populated city in Bangladesh and economically important because it is adjacent to Dhaka City. However, capacity and quality of infrastructures necessary to keep pace with the economic development need to be improved, ranging from reliable piped water supply, drainage system and public spaces. Thus, with ADB loan support, Narayanganj City Corporation (NCC) is proposing the Narayanganj Green and Resilient Urban Development Project (NGRUDP or project or overall project) which comprises subprojects on water supply, drainage, and community parks overlooking Shitalakhya River.

The project is aligned with the following impacts: (i) sustainable and inclusive urban development achieved, and (ii) safe and climate-resilient delta area achieved. The project will have the following outcome: NCC's resilience, and access to inclusive, reliable, and sustainable urban services improved. An output of the project will be a climate-resilient and inclusive infrastructure developed and/or improved for NCC. The project will improve and expand the existing water supply system for inclusive, resilient, and safely managed continuous drinking water supply services in the priority area in NCC to serve 0.4 million people. These will include improvements to the existing WTP, an upgrade and expansion of the network with DMA approaches for reducing nonrevenue water, and installation of deep tube wells (DTWs) in selected areas including low-income communities, for supply augmentation. The project will also establish and improve stormwater drainage system in the priority area to reduce water logging and flood risk with climate and disaster-resilient design and nature-based solutions such as introducing soil and vegetation. Further, the project will develop green public parks to improve quality of life of the citizens, with features responsive to women and vulnerable, to provide recreational spaces and reduce urban heat. The public parks will be attached with walkway along the eastern side of the Shitalakshya river that also function as embankment.

Scope of the Subproject. This initial environmental examination (IEE) report covers the Water Supply Contract 1 Subproject under NGRUDP which will upgrade the water supply system based on the overall water supply improvement masterplan of the city. Following are the components:

- **Water treatment plant (WTP)**. Rehabilitation and upgrading of the existing WTP at Godenail with design capacity of 45 million liters per day (MLD). This will involve construction of additional treatment component (Moving Bed Biofilm Reactor (MBBR) unit), to enhance treatment efficiency and meet drinking water standards;
- **Deep tube wells (DTWs)**. Rehabilitation of 17 nos. of existing DTWs;
- **Ovehead tanks (OHTs)**. Rehabilitation of 8 nos. of OHTs; and
- **Transmission and distribution network**. Construction of 4.239 km length of transmission pipelines and 219.88 km of new distribution network in district metered zones (DMZs) 1 and 2 of the overall water supply masterplan for NCC, using combination of HDPE and DI pipes with diameter of 700mm for transmission and range of 100mm – 500 mm for distribution pipes.

The subproject will be awarded under a design-build-operate (DBO) modality, and the DBO Contractors will be responsible for detailed design, construction and operation for 2 years, and an option to extend further the operation phase.

Categorization. In accordance with ADB Safeguard Policy Statement (SPS) 2009, an initial screening using ADB rapid environmental assessment (REA) checklist was conducted for the sites (Appendix 1). Result of this initial assessment reveals that there are no environmentally sensitive areas near the sites and that the subproject is unlikely to cause significant adverse impacts to the environment and people. But with the subproject sites being near Shitalakhya river and other receptors in the urban center of Narayanganj City, the assessment reveals that the subproject may still pose likely negative environmental impacts during construction phase and operations phase. These impacts, however, are deemed manageable and can be mitigated through proper design and engineering measures. Therefore, the project has been classified as Category B for environment, and this initial environmental examination (IEE) is prepared. For national requirement, the project will obtain one Environmental Clearance Certificate (ECC) that will cover all subprojects, which include the water supply subprojects. Therefore, per Government of Bangladesh's Environment Conservation Rules (ECR, 2023), the project falls under Red Category and will require a Location Clearance Certificate and 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 subproject's area of influence; (iv) assess the subproject's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic, and physical cultural resources in the subproject's area of influence; (v) identify mitigation measures and any residual negative impacts that cannot be mitigated; (vi) describe the process undertaken during subproject 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 subproject implementation; (vii) describe the overall project's grievance redress mechanism (GRM) 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 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. The subproject is located within the NCC area with urban setting. The WTP is located within a government property on the western side of Shitalakhya river. The DTWs and OHTs are existing facilities that are within government properties as well. The topography in the whole of NCC is relatively flat. Satellite images and topographical records show that the subproject area is generally higher than the level of Shitalakhya river by 3 – 5 m. Shitalakhya river is primarily used as a vital navigational route and storm water catchment in central Bangladesh, including NCC. There are no known agricultural or fishing activities along this river. There are no land-based or aquatic natural habitats and environmentally sensitive areas (forest area, protected area, wetlands, mangroves, or estuaries) within and immediate vicinities of the proposed subproject sites. The transmission line and distribution network will pass through existing roads in the city. Therefore, all sites and alignments of the subproject components are either within existing rights of way and/or government-owned lands.

There is a persistent waterlogging issue in many parts of NCC due to poor drainage system and pockets of low-lying areas, but there is no historical record of extreme flooding events (i.e. caused by flash floods from river overflows) in the subproject areas. Primary and secondary data on baseline environmental quality reveal mixed results. Ambient air quality shows general compliance with most standard parameters except for particulate matters. Noise level is generally

high all around Narayanganj city compared with the standards, primarily due to the traffic noise that is inherent in urban setting in Bangladesh. Water quality of the Shitalakhya river shows seasonal variation, but generally above the standards due to its use as a major navigational route and discharge point of drains from upstream areas and all over the city conveying combination of storm water, and residential and commercial/industrial discharges. Groundwater quality registered general elevated concentrations in terms of some parameters such as manganese, BOD, COD and coliform, among others.

Assessment of Environmental Impacts and Proposed Mitigation Measures. Potential environmental impacts were identified based on review and analysis of the primary and secondary data or information, stakeholder consultations, and visits to the sites and their vicinities. Impacts were identified by linking environmental components that are likely to be impacted and sources of impacts at the different phases of subproject implementation — design/pre-construction, construction, and operation of the built infrastructure. The impact assessment methodology and risk rating is given in the impacts and mitigation section of the report. In consultation with various experts, including the design team, 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 based on national and/or internationally accepted standards.

Potential impacts to the physical environment. Impacts to air quality, acoustic environment, surface water and groundwater quality, waste disposal, and other forms of nuisance during construction phase are similar to impacts expected from other construction activities elsewhere, which can be mitigated through good international construction and engineering practices. Mitigation measures to avoid all potential impacts are included in the EMP. During the detailed design phase, the DBO Contractor/s will support the PMU in updating the IEE with EMP, and separately develop its site-specific EMP (SEMP) and other allied work plans (e.g. traffic management plan for the transmission and distribution network component), following applicable international best practices that will include World Bank's EHS Guidelines on Construction and Decommissioning Activities.[1] In addition, each DBO Contractor will develop its respective operation and maintenance (O&M) manual for the water supply system based on final detailed design. The O&M manual will be used as reference guide during operation phase in (i) ensuring all components (WTP, DTWs, OHTs, pipelines) operate according to design, including as reference guide for the laboratory operations in the efficient and continuous monitoring of the quality of drinking water delivered to the distribution network; (ii) addressing operational issues from troubleshooting to emergency procedures regarding any part of the water supply system; and (iii) where applicable, effective sludge storage, transport and disposal following international best practices on sludge management. Thus, the O&M manuals will define all the steps required for cost effective, efficient, safe, and reliable water supply system operation, which then lead to avoiding or minimizing impacts to the environment and ensuring drinking water complies with the standards.

Potential impacts to physical cultural resources. None of the existing non-linear components (WTP, OHTs, DTWs) is located near or adjacent any physical cultural resources (PCRs) or heritage sites. The alignments of the distribution network will pass through many roads in residential and commercial areas in NCC, which easements have varying widths in the range of 1 – 20 meters. Some sections of the alignments are also a locally important protected cultural heritage monuments, namely Hajiganj Fort. Site visits reveal that the boundary of this monument

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

is at considerable distance of approximately 10m from the road where pipes will be laid, and that no significant impact is expected. There are also other PCRs found all over Narayanganj City (524 mosques, 61 temples, 5 pagodas and 1 church). Easements and rights of way separate the boundaries of these PCRs from the roads where civil works will be undertaken. These easements and rights of way have varying widths (1 – 20 meters), which are deemed enough to ensure pipelaying during construction phase will not impact the PCRs. Typical and inherent in community setting in Bangladesh are properties or structures, such as mosques or eidgahs (prayer areas), built very near the boundaries of roads. For works in these relatively constricted or congested areas, the excavation protocol provided in this IEE report will be followed to ensure no impact occurs to the PCRs. Additionally, the horizontal directional drilling (HDD) method will be utilized as much as possible to avoid any impact particularly in the congested or busy areas. Where the HDD method is not suitable as per the site condition, then open trench excavation method shall be used. Specific methodologies and protocols are clearly defined in this IEE report for all types of excavation works in narrow roads and areas where fragile structures may be at risk, including the vicinities of heritage site Hajiganj Fort. A detailed chance finds procedure has also been developed to ensure any heritage assets found along the excavation sites are preserved or handled properly per Bangladesh Department of Archaeology. These procedures and protocol are discussed and outlined in this IEE report.

Potential impacts due to asbestos cement (AC) pipes. The existing distribution system in NCC has some pipelines made of AC pipes. Therefore, the subproject implementation may also deal with potential handling of AC pipes during rehabilitation works. Although the general methodology is replacement, no asbestos cement pipe will be extracted from the existing alignments. Any replacement pipes will be installed at specific portions of the alignments that will ensure the existing AC pipes are not disturbed. However, as a precautionary measure for any unwarranted event and accidental exposure to asbestos, the subproject will follow specific protocol on handling and disposal of the AC pipes. This will be integrated as part of the Employer's Requirements in the bidding and contract documents to be issued for this subproject, such as the need to develop an asbestos-containing materials (ACM) Management Plan that follows international best practices on handling, transport and disposal of ACMs like AC pipes. A training on the proper execution of the protocol will be included in the training and capacity program of the overall project.

Potential impacts to biodiversity. Despite being located in a built-up and developed urban area, the subproject sites have been assessed in terms of biodiversity. The Integrated Biodiversity Assessment Tool was 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). Results show that there are no protected areas or key biodiversity areas around the vicinities of the subproject sites. The results also show biodiversity species of concern that could potentially occur within the default 50-km radius. However, the subproject sites are already in a built-up area and the probability of these species of concern being found at the sites is very low. Site visits have also been conducted which confirmed that none of these species are found or sighted at the subproject sites.

Potential impacts due to water source sustainability (water availability). The WTP will abstract raw water supply from Shitalakhya river. After rehabilitation and upgrading of the WTP, the raw water withdrawal rate will remain the same as in the original design of the WTP of 45 MLD. As Shitalakhya river is a large perennial river system in central Bangladesh, the impact of the abstraction by the WTP is considered negligible. The minimum and maximum discharge volume of the Shitalakhya River for the period 2011-2021 was determined to be 112.55 m3/sec during lean season and 1,638.31 m3/sec during a monsoon season, respectively. By comparison,

the design water intake requirement of the WTP will be 45 MLD or 0.52 m3/sec. This amount of abstraction is only equivalent to about 0.50% of the recorded minimum flow and as low as about 0.03% of the maximum flow recorded.

Potential impacts due to water source sustainability (water quality). The deteriorating quality of raw water from Shitalakhya river has an implication to the efficiency of the WTP. A simple rehabilitation of the WTP and retaining its original design as developed in the 1990s will not be enough. An upgrading of the WTP is required as well. The seasonal variation in the quality of the Shitalakhya river was analyzed to help in the design for the upgrading of the WTP. From this analysis, it was found out that the raw water from Shitalakhya has a very high organic load with BOD level reaching as high as 32 mg/l, COD level reaching as high as 62.2 mg/l, and Ammonia-N level reaching as high as 10.675 mg/l. These high levels of organic and inorganic load need to be treated to the NDWQS levels. But to achieve the degree of reduction of pollution load, the upgrading of the WTP will need to include an effective biological treatment process or technology. The introduction of the moving biofilm bed reactor (MBBR) was selected in this regard. Conceptual design and calculations show that with the addition of MBBR unit into the system, the WTP will be able to treat the raw water to comply with the standards. In order to ensure that the drinking water from the WTP meets the drinking water quality standards, DBO Contractor shall strictly follow all required operating parameters, and maintenance works and schedule for the WTP as specified in the O&M Manual. This includes regular monitoring and testing of raw water going into the WTP, and of treated water delivered to the distribution network. As such, DBO Contractor shall ensure the laboratory of the WTP functions efficiently and manned by competent personnel all the time to do the monitoring and testing. For extraordinary circumstances when the quality of raw water exceeds the limit at which the WTP is designed for, the DBO Contractor shall immediately shutdown the WTP to ensure no substandard water is delivered to the distribution lines. Similarly, if a testing of treated water from the clear water reservoir reveals non-compliance with the standards, DBO shall immediately shutdown the WTP and stop the delivery of water to the distribution line. This shall immediately prompt DBO Contractor to trace the cause of failure within the system and implement urgent repair or maintenance work to normalize the operation. Water remaining at the instant in the clear water reservoir can be recycled to the system for full treatment once the WTP returns to normal operation. Details of actions and procedures under these kinds of emergency situations will be part of operation and maintenance (O&M) manual.

Other potential impacts to socio-economic condition. Consultations have been conducted 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. Initial consultations conducted were well participated in by the different stakeholders, such as the ward officials, community-based groups, professional groups (teachers, medical practitioners), labor groups (fishermen, hawkers, drivers), representatives from the Bangladesh Inland Waterways and Transport Authority, and ward residents. All findings from the consultations were considered in the development of environmental management plans (EMPs), especially in identifying the potential impacts of the proposed subproject and developing the corresponding mitigation measures to address these impacts. Overall, wide public acceptance of the subproject has been earned out of these consultation activities. During the detailed design phase, new rounds of consultations will be scheduled to present the final components and designs, and other subproject-related developments to all stakeholders.

Environmental Management Plan. The EMP will guide the environmentally sound construction of the subproject and ensure efficient lines of communication among stakeholders, including the NCC as implementing agency, the project management unit (PMU), consultants, DBO Contractor, and the general public. 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 subproject; (iv) detail specific actions deemed necessary to assist in mitigating the environmental impact of the subproject; and (v) ensure that safety recommendations are complied with. With the various sites of the subproject, the DBO Contractor will be required to develop corresponding site-specific environmental management plans (SEMPs) based on the EMP of this IEE, including other work plans necessary to fulfil related environmental mitigation measures in the EMP (i.e. ACM/Asbestos Management Plan, Traffic Management Plan, Spoil Management Plan, Waste Management Plan, Sewage Facility Design Considerations, and Health and Safety Plan). The DBO Contractor will submit its SEMPs and other work plans to the PMU through the management, design and supervision consultant (MDSC) for approval. The SEMPs and work plans will be able to elaborate further on the environmental impacts specific to each of the subproject sites.

A copy of the EMP and SEMPs, including the other work plans, shall be always kept by DBO Contractor on-site during the construction phase. The DBO Contractor appointed will be responsible for the organization, direction, and execution of environmental management related activities during construction of the proposed subprojects. The DBO Contractor will undertake all activities in accordance with the relevant environmental requirements, including consent documentation and other regulatory and/or statutory and contractual requirements. As the ultimate administrator of the subproject, NCC through the PMU shall likewise keep copy of the EMP and SEMPs, including the other work plans, during construction phase, and during the operation phase or when the subproject infrastructures are completed and used for the purposes.

Implementation Arrangement. The Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC) will be the executing agency and NCC will be the implementing agency for the overall project. A Project Coordination Committee (PCC) will be formed within the NCC to engage with policymakers, obtain guidance on key policy issues and oversee overall project implementation. A Project Management Unit (PMU) will be created under the overall supervision of PCC. The PMU will ensure that the subproject will be implemented in accordance with the ADB SPS and relevant government laws, rules and regulations, including the recently Environmental Conservation Rules, 2023, among others. The PMU will be supported by a Management, Design and Supervision Consultant (MDSC) team, comprising individual consultants that will provide all necessary management and supervision expertise in implementing the project. The management and supervision will come at varying degrees during design phase and pre-construction phase, construction phase, and operation phase.

PMU will be established within NCC to oversee the day-to-day activities of the project and corresponding subprojects. The PMU will be supported by the MDSC team, which will comprise various individual consultants with distinct areas of specialization necessary to support the implementation of the overall project, and thus to all subprojects. MDSC will be responsible for: (i) support to project management and administration by PMU; (ii) contract documents preparation; (iii) review of designs by the DBO contractor; (iv) supervision and monitoring of safeguards implementation; (v) assistance in supervising construction; (vi) support in the conduct of continuing meaningful consultations for the project; (vii) support PMU to ensure that the current investment project is implemented to time and budget constraints, and to provide a clear path for the development of a long-term water supply solution in Narayanganj; (viii) ensure significant improvement in the institutional capacity of NCC in such areas as sustainable O&M and DMA management, revenue enhancement, public awareness, GESI implementation, management

system digitization; and (ix) develop service improvement plans including financial aspects for sustainable O&M; among others.

Consultation, Disclosure and Grievance Redress. The stakeholders were involved in undertaking the IEE through on-site discussions and public consultation. Their views were incorporated into the IEE process and in the planning and development of the subproject. 17 focus group discussions (FGD) have been conducted in various wards of the city. These were participated in by different stakeholders, with each FGD had target group. A total of 248 participants was consulted, consisting of 194 males and 54 females. The participants were informed about the subproject with the aim to improve the efficiency of the water supply system and the quality of drinking water, and to expand its coverage to reach other unserved areas in the city. The participants conveyed their unconditional support to the subproject, and thankful for the government and NCC for taking pragmatic plan aimed at ensuring the availability of safe and adequate water facilities. They also expressed their understanding that the subproject will be very important as part of improving their social life and wellbeing. However, they also expressed their concerns about the possible impacts of the construction activities in their livelihoods, especially to those who are doing businesses near the road alignments of the subproject. In response, NCC assured the participants that the subproject will implement all necessary measures in order to avoid or mitigate potential impacts of activities to livelihoods and to the environment.

This IEE report which documents the environmental assessment process, including updated versions as may be needed in the future, will be made available at public locations in the city and will be disclosed to a wider audience via the ADB and project/NCC websites. Meaningful consultation will be a continuing activity during project implementation, including design period, to ensure that stakeholders are fully engaged in the subproject and have the opportunity to participate in its implementation.

A grievance redress mechanism (GRM) is described within this IEE report to ensure that any public grievance is addressed adequately and efficiently. The 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 of the overall project and/or each individual subproject. The GRM will be proportionate to the potential risks and impacts of the project or subprojects, 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/subproject-affected parties.

Monitoring and Reporting. The PMU, with support from MDSC, will be responsible for monitoring and reporting. The DBO Contractor will also be responsible for its own monitoring based on the EMP, SEMP and work plan activities, and reporting of status and progress of implementation. The DBO Contractor will submit monthly report to PMU through the MDSC. The PMU, with support from MDSC, will conduct its own monitoring of the implementation of the EMP and SEMPs by all contractors (both DBO contractors and civil works contractors). MDSC will support PMU in consolidating all monthly reports from contractors. Based on results of its own monitoring activities and consolidated monthly reports from contractors, PMU, with support from MDSC, will prepare semi-annual environmental monitoring reports (SEMRs) to ADB. PMU and ADB will post the cleared SEMRs on project/NCC website and ADB website, respectively. ADB will monitor the project on an ongoing basis until a project completion report is issued.

Conclusions and Recommendations. It is envisaged that the proposed subproject will contribute to providing reliable, sustainable, and inclusive urban services in NCC, the fourth most populated city in Bangladesh and one of the major growth engines of the country being adjacent

to Dhaka and a vital transport hub. Once implemented, the subproject will have direct benefits to the people of NCC with a reliable and sustainable piped drinking water supply.

The IEE for this subproject has been undertaken based on the location of the WTP, DTWs, OHTs, and distribution network; and on conceptual design prepared for the rehabilitation and upgrading of the WTP. The baseline environmental conditions have been gathered with respect to the subproject locations and NCC as a whole, and all potential impacts to the environment as a result of implementing the subproject have been identified. Based on these impacts, corresponding mitigation measures have been developed and compiled in the EMP.

The abstraction of raw water from Shitalakhya river will be maintained at the original design capacity of 45 MLD, and no additional abstraction will be made as a result of the rehabilitation and upgrading of the WTP. The source sustainability assessment revealed that abstraction of 45 MLD by the WTP will not have any adverse impact on the users and uses of Shitalakhya river. The rate of abstraction has been considered as negligible as far as the discharge flow of this perennial river is concerned, and that this will not affect the level of the river even during lean season. The assessment on the impact of water quality of Shitalakhya river to the operation of the WTP revealed source quality issue and necessitates upgrading of the WTP with additional treatment process or component to help reduce the relatively high pollution load. The moving bed biofilm reactor (MBBR) has been the chosen technology to solve this issue. Per conceptual stage feasibility assessment, the MBBR is an appropriate additional technology for the WTP to ensure treated water comply with the standards. The ultimate design for the upgrading of the WTP will be finalized during the detailed design stage. At the same time, an effective O&M Plan will also be developed to serve as guide for ensuring the efficient functioning of the WTP, and which should include the mandatory regular testing of raw water entering the WTP and of treated water coming out of the clear water reservoir. DBO Contractor shall ensure that treated water being delivered to the distribution line complies with the standards.

The upgrading of the WTP will also include improvement of the sludge management system. The system will adopt a zero-discharge scheme and the dried sluddisposed ofbe disposed properly following international best practices on sludge handling and disposal.

Overall, the full IEE process confirms that the subproject is unlikely to cause significant adverse impacts considered as diverse, irreversible and unprecedented. The construction phase will only involve straightforward civil works and operation phase will only involve common or traditional maintenance works for water supply infrastructures, so impacts will be mainly localized. These impacts can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures in the EMP and O&M manual. On a positive note, the IEE process also confirms the beneficial impacts of the subproject over the long term, with a reliable and sustainable piped drinking water source for the people of NCC.

During the detailed design phase, the DBO Contractor shall prepare the following required work plans and submit to NCC, through the PMU or MDSC, for approval. No works shall commence until any relevant or required work plan is approved.

- ACM/Asbestos Management Plan;
- Traffic Management Plan;
- Spoil Management Plan;

- Waste Management Plan, which shall include the final specific location for dried sludge disposal; and
- Health and Safety Plan (Community and Occupational).

In addition, during the detailed design phase, DBO Contractor of Water Supply Contract 1, in consultation and collaboration with MDSC, shall initiate the development of an O&M Manual. The development of the manual may extend towards the construction phase, but shall be completed prior to the operation phase to provide sufficient time to train all personnel on the effective and efficient operation of the WTP based on the O&M Manual.

This IEE needs to be updated during the detailed design phase to reflect the final design ensuring the compliance with the design measures suggested in this document. The updated IEE shall be submitted to ADB for review, clearance and disclosure during detailed design phase but prior to start of construction. The cleared updated IEE shall be treated as the final IEE. No works can commence until (i) the final IEE cleared by ADB is provided to the DBO Contractor, and (ii) the SEMP, including other work plans, prepared by the DBO Contractor, is approved by PMU. If circumstances would require, the IEE will be further updated for ADB's review during the implementation period. In the event of unanticipated impact and/or any design change and/or non-compliance during subproject implementation period, the IEE shall be updated to include (i) assessment of the unanticipated impact and corresponding mitigation measures; and/or (ii) information on the design change and assessment of associated environmental impacts, if any; and/or (iii) corrective actions, associated cost and schedule; respectively. Further, the PMU shall:

- Include this IEE in the bidding and contract documents;
- Obtain all statutory clearances and ensure relevant conditions or requirements are incorporated in the detailed design;
- Update/revise this IEE based on detailed design and/or if there are unanticipated impacts or significant change in scope in any component of the subproject;
- Conduct safeguards induction to the DBO Contractor after award of contract;
- Ensure DBO Contractor appoints qualified environment, health and safety (EHS) officer prior to start of works;
- Disclose information and establishment of GRM in a timely manner;
- Strictly supervise EMP implementation;
- Continue consultations with stakeholders; and
- Monitor and report status of implementation of the EMP on a regular basis as indicated in the IEE.

This IEE report has been prepared in accordance with ADB SPS requirements for projects classified as Category B for environment. With the above premises considered, the classification of Category B for environment is confirmed. Separately, per ECA, 1995 and ECR, 2023 of Bangladesh, the overall project or NGRUDP is classified under "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 contracts.

I. INTRODUCTION

A. Background

1. The Government of Bangladesh (GOB), under its Eighth Five-Year Plan targets to provide 100% of the urban population with access to an improved water source, and 80% of city dwellers with safely managed sanitation services by 2026. In response to this and to design ensuing investment projects in selected secondary towns and city corporations of Bangladesh, ADB under Project Readiness Financing (PRF) has constituted an Urban Infrastructure Improvement Preparatory Facility (UIIPF) for Bangladesh to help manage the technical and implementation issues upfront and secure high readiness of the ensuing investment projects for ADB financing. Under UIIPF, the Department of Public Health Engineering (DPHE) in preparing water supply and sanitation investment projects where development is lagging.

2. Narayanganj City is the fourth most populated city in Bangladesh and economically important because it is adjacent to Dhaka. The UIIPF facility thus aims to build NCC's capacity to ensure the sustainability of urban infrastructure investments, and their operation and management. As part of capacity building, the facility is supporting the NCC in developing Narayanganj Green and Resilient Urban Development Project (hereafter referred to as "project" or "overall project" or "NGRUDP") comprising preparation of master plans, feasibility studies, detailed design for the proposed infrastructure facilities for water supply, drainage, and river-front development in NCC.

B. Outcome and Outputs of the Project

3. **Outcome**. The project is aligned with the following impacts: (i) sustainable and inclusive urban development achieved, and (ii) safe and climate-resilient delta area achieved. The project will have the following outcome: NCC's resilience, and access to inclusive, reliable, and sustainable urban services improved.

4. **Output 1: Climate-resilient and inclusive infrastructure developed and/or improved.** The project will improve and expand the existing water supply system for inclusive, resilient, and safely managed continuous drinking water supply services in the priority area in NCC to serve 0.4 million people. These will include improvements to the existing WTP, an upgrade and expansion of the network with DMA approaches for reducing nonrevenue water (NRW),[2] and installation of deep tube wells in selected areas including low-income communities, for supply augmentation.[3] The project will also establish and improve stormwater drainage system in the priority area to reduce water logging and flood risk with climate and disaster-resilient design and nature-based solutions such as introducing soil and vegetation. Further, the project will develop total 15 hectares of green public parks to improve quality of life of the citizens, with features responsive to women and vulnerable, to provide recreational spaces and reduce urban heat.[4] The public parks will be attached with total 6 kilometers (km) walkway along the eastern side of the Shitalakshya river that also function as embankment.

[2] Improvements in the existing network will be part of long-term strategy to ensure judicious use of existing water supply, and prepare for switching from ground to surface water source. The phased shift to surface water resource will be based on DWASA's experience in similar projects. Digital applications such as smart water meters, and online billing and collection will be introduced or strengthened to augment revenue and improve operational efficiency.

[3] Sustainability of the ground water yield was confirmed through survey including water quality and impact to depletion. Selected areas where these were not confirmed were excluded from the project scope. The support would be an interim solution to meet the demand until completion of switching to surface water resource using the Meghna river.

[4] The western side of the river has an ongoing government-funded project to develop a road with embankment.

5. Output 2: Capacity and awareness of NCC and local community in climate-resilient, sustainable, and inclusive urban services strengthened. To improve sustainability and quality of services through the facilities developed under output 1, the project will strengthen NCC staff capacity (at least 90% of female staff) in climate-resilient, sustainable, and gender equality and social inclusion (GESI) responsive service delivery. It will develop service improvement plans including financial aspects for sustainable O&M. For water supply, NCC's capacity on O&M will be improved through on-the-job training by the contractor that will be responsible for O&M for the initial five years. DMA management and water quality monitoring will be supported. A water supply master plan will be prepared to improve the services in wider areas in NCC, and to set the longer-term development strategy for transformation toward climate- and disaster-resilience.[5] The project will also support preparation of masterplans for wastewater, solid waste management, and urban planning to improve living environment in an integrated manner, combined with the intervention for drainage, and advance climate and disaster resilience. The project will also support GESI-sensitive community awareness and behavior change campaigns on water, sanitation and hygiene, climate resilience, and sustainable services to maximize the health and economic impact of the investments.[6] This output, together with the infrastructure to be developed under the output 1, is expected to lead to achieving the intended outcome.

6. **Output 3. Institutional capacity and governance of other municipal services strengthened.** To improve other municipal services, the project will support trainings of the NCC staff and elected representatives covering laws, regulations, city planning, and development. An action plan for urban governance and service improvement with monitoring tools will be prepared, involving citizen participation. It will build on NCC's successful past performance in governance improvement. The project will also support establishing a unit within NCC for giving trainings and implementing the action plan. The unit will also function as a data center for assets inventory and digital archiving of documents and records. The project will build capacity of NCC staff to gradually take over full responsibility of these as their routine operation. The project will also strengthen NCC's administrative efficiency through digitalization of management systems in areas such as customers records, asset management, and procurement. For NCC's revenue augmentation including strengthening property tax and municipal fees, a separate technical assistance (TA) by ADB's Office of Markets Development and Public-Private Partnership (OMDP) is under discussion with NCC.[7] Combination of these support is expected to help NCC establish creditworthiness and become an investable city. This output is expected to contribute to achieving the outcome through consolidated financial, administrative, and governance strengthening.

C. Overview and Location of the Overall Project (NGRUDP)

7. The location the overall project (NGRUDP) is within the jurisdiction of Narayanganj City Corporation (NCC), the fourth most populated city in Bangladesh. NCC is about 16 km southeast of the capital city of Dhaka and has a population of about 709,381 as of 2011.[8] The location of NCC shown in Figure 1 below.

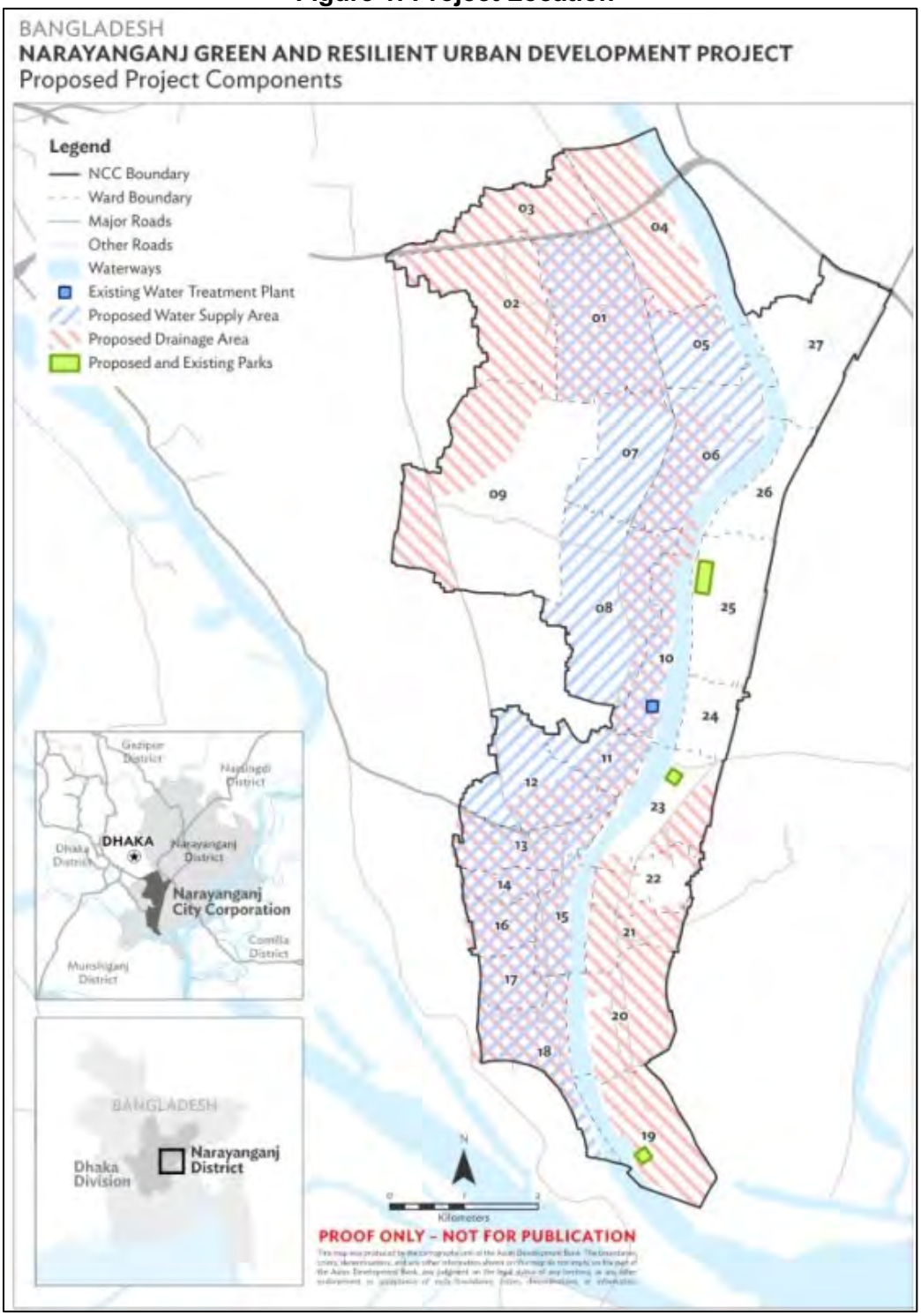
[5] The masterplan will also explore wider climate adaptation responses through new technology, policies, and governance. Output 2 will build on ADB's experience in the ADB. 2014. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Loan Grants to the People's Republic of Bangladesh for the Coastal Towns Environmental Infrastructure Project*. Manila.

[6] For drainage, setting design codes to reduce runoffs, flood risk mapping, and early warning systems will be explored.

[7] The project will support establishing web-based geographic information system mapping and survey to complement the capacity building support through OMDP.

[8] Adjusted Population 2011. Statistical Yearbook of Bangladesh 2022. Bangladesh Bureau of Statistics. June 2023.

Figure 1: Project Location[a]



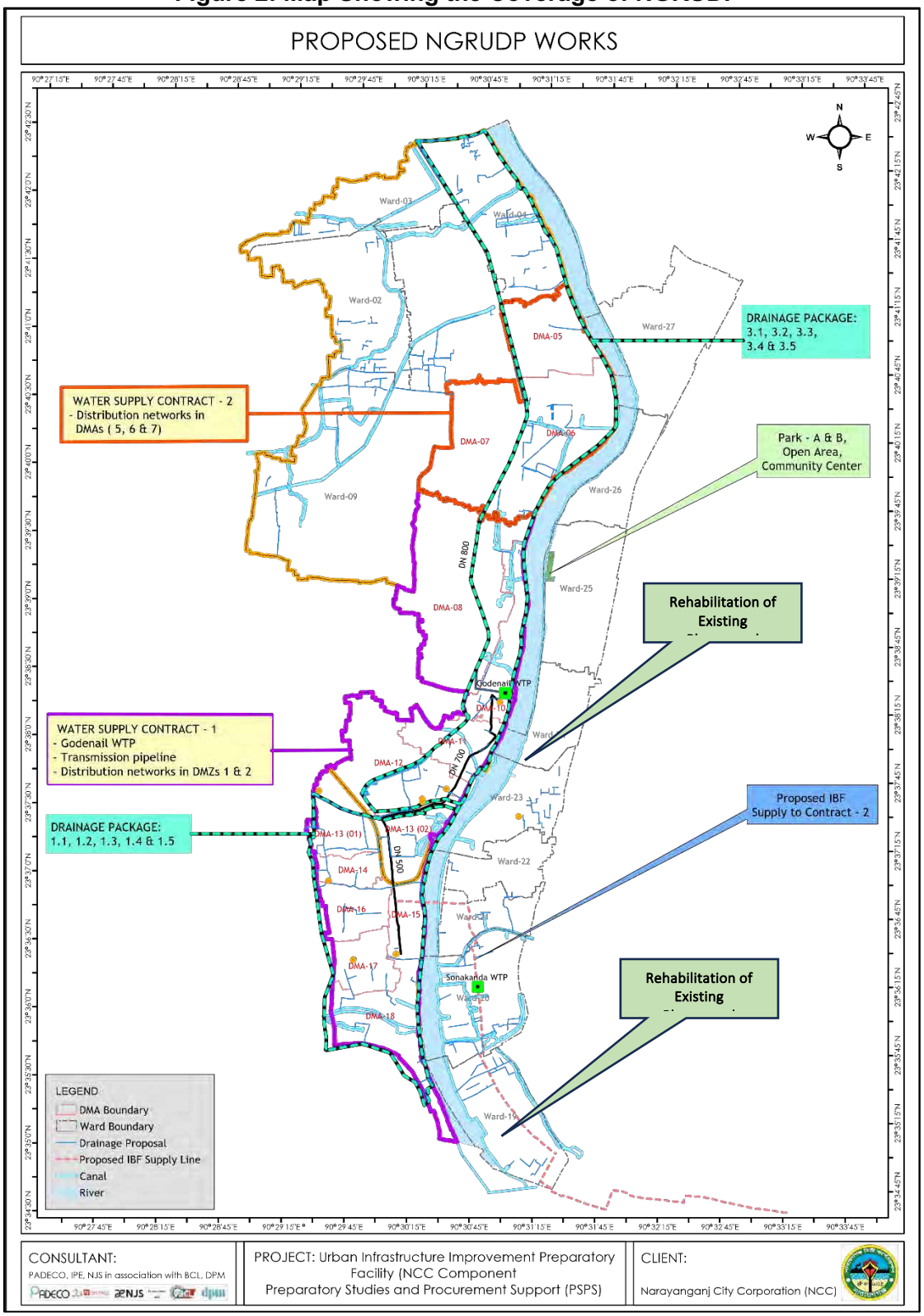
[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

8. NGRUDP will provide reliable, sustainable, and inclusive urban services in NCC. It includes a safely managed drinking water supply, drainage, and public parks; and improved capacity of NCC and local communities which altogether will strengthen climate adaptation and sustainability of urban services. Consistent with Output 1 above, the proposed project will have four subprojects, namely:

(i) **Water Supply Contract 1 Subproject**, which involves the rehabilitation and upgrading of existing WTP at Godenail, rehabilitation of existing DTWs and OHTs, construction of transmission main, and construction of new distribution network in selected District Metering Zone (DMZs) of NCC;
(ii) **Water Supply Contract 2 Subproject**, which involves development of new production tube wells (PTWs) using the induced bank filtration (IBF) technology including construction or installation of disinfection units for each PTW, construction of collector pipeline from these PTWs to existing OHTs in the NCC area, construction of river crossing, and construction of new distribution network in selected District Metering Areas (DMAs) of DMZ3 of NCC;
(iii) **Drainage Subproject**, which involves rehabilitation of existing drainage, rehabilitation of existing natural drainage/canals, and construction of new drainage; and
(iv) **Parks Development Subproject**, which involves rehabilitation and upgrading of four existing parks and public spaces, and construction of a community center building.

9. Figure 2 below shows the location of NCC and the coverage areas of the four subprojects.

Figure 2: Map Showing the Coverage of NGRUDP[a]



[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

D. Purpose of the Initial Environmental Examination

11. This IEE report covers **Water Supply Contract 1 Subproject**. The overall objective of the IEE undertaken for the subproject is to capture the environmental setting of the proposed subproject components, including physical, biological, and socioeconomic conditions; national and local legal frameworks; as well as international environmental agreements that are relevant to the subproject. Based on these, the IEE further identifies and analyses potential direct, indirect, cumulative, and induced impacts and risks of the subproject to these environmental aspects, in the context of the subproject's areas of influence. Subsequently, measures are formulated to address these impacts by avoiding them, or if total avoidance is not possible, at least reduce them to acceptable levels based on GOB or internationally recognized standards. The IEE also identifies the parties who will monitor and report the implementation of these measures. Thus, this IEE report is a documentation of the IEE process undertaken that will provide guidance to NCC, the DBO Contractor and other operators on how to plan, build and operate the subproject in an environmentally responsible manner, ensuring that all negative effects are prevented or mitigated, and positive impacts are enhanced.

E. Methodology

12. This IEE report has been prepared based on available preliminary subproject design, field investigations, stakeholder consultations, and literature and online sources to meet the requirements for environmental assessment process and documentation per ADB SPS, 2009. Environmental assessment was conducted through the following:

(i) Review of the available preliminary subproject designs, in particular to the technology to be employed;
(ii) Primary data collection during site visits and secondary data from various sources, socio-economic, hydrological, topographic, and engineering surveys at subproject sites, meaningful consultation with the stakeholders, including concerned government officials, project personnel and the general public;
(iii) Appropriate assessment of impact of the subproject implementation on cultural and heritage assets, including other public- and private-owned structures, that may likely be disturbed or damaged during construction works;
(iv) Gathering of baseline information from most recent secondary sources on environmental quality such as air quality, noise level, surface water quality, and groundwater quality within the corridor of impact of the subproject, and against which predictions of changes to these environmental media during the construction period will be compared to assess such changes, if any, and their significance; and
(v) Screening and assessment of potential risks on the biological environment, which include the protected areas or critical habitats that may exist around the subproject sites. 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 subproject sites.

13. Field reconnaissance surveys and follow up verification field visits were conducted at subproject sites to establish the potential impacts and categorization of subproject activities. Formal and informal public consultation activities were conducted with the affected stakeholders and communities and kept notes on the impacts of the proposed subproject. The methodology of the IEE study was then conveyed and elaborated to these stakeholders to address all impacts and for those impacts requiring mitigation measures were proposed to reduce impacts within acceptable limits.

14. **Project Area of Influence.** For linear works, a 10 m on both sides of the alignment has been considered and project area of influence. Whereas for spot or stationary structure, a radius of 50 – 100m surrounding the target sites, has been considered as the project area of influence. These distances are approximate and actual corridor of impact may vary depending on the sensitivity of receptors around the different subproject components. The various construction activities under the subproject will have environmental aspects whose impacts may go beyond the distances.

15. **Basis and Scope of Assessment.** Conceptual design and technology, and indicative alignments were provided as basis of the assessment. Preliminary designs, technological specifications and other information such as final cost estimates are not yet finalized. This subproject will be awarded under Design-Build-Operate (DBO) modality. Thus, the IEE has utilized relevant aspects and impacts that could be encountered in conventional water supply projects having components on source development (deep tube wells (DTWs)), water treatment and drinking water distribution network. The IEE has also utilized results of visual observations during transect walks and drive through sample alignments, visits around the vicinity of site-specific components such as the DTWs, on the spot interviews with the locals, and other primary and secondary information available.

F. Structure of the Report

16. 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 overall project along with its background, objectives, and purpose and specific subproject scope of the IEE, among others.

(iii) **Policy, Legal, and Administrative Framework.** This section discusses both ADB SPS and GOB's 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 GOB is a party.

(iv) **Description of the Subproject.** This section describes the proposed subproject in terms of its major components, geographic location, and interaction with the environment in terms of ecological, socio-cultural, and economic standpoint, etc., including any associated facility required by and for the subproject.

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

(vi) **Anticipated Environmental Impacts and Mitigation Measures.** This section predicts and assesses the subproject's likely positive and negative direct and indirect impacts to physical, biological, socioeconomic (including occupational health and safety, community health and safety, and impacts on livelihoods through environmental media), and physical cultural resources in the subproject'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) **Information Disclosure, Consultation, and Participation.** This section (i) describes the process undertaken during subproject 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 subproject design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women; 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 subproject implementation.

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

(ix) **Environmental Management Plan.** This section deals with the set of mitigation and management measures to be taken during subproject 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).

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

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

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

17. 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 2023 (ECR, 2023), which are the primary environmental law and rules of the country.

A. ADB Safeguard Policy Statement, 2009

18. The ADB Safeguards Policy Statement (SPS, 2009) 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 to be under any 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.

19. Initial screening using ADB REA checklist for water supply (Appendix 1) was conducted, and results of the rapid assessment show that the subproject 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.

20. **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 subproject's impact and risks.

21. **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 ADB 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.

22. **Consultation and Participation.** The PMU, with support from MDSC, shall carry out meaningful consultation[9] with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. The consultation process and its results are to be documented and reflected in the environmental assessment report.

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

[9] 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.

24. **Monitoring and Reporting.** PMU, with support from MDSC, shall monitor, measure and document the progress of implementation of the EMP and SEMPs. 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 SEMPs, and compliance issues and corrective actions, if any. Reporting will continue until ADB issues a project completion report.

25. **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.

26. **Pollution Prevention and Control Technologies.** During the design, construction, and operation of the subproject, 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.[10] 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 subproject circumstances, the PMU will provide full and detailed justification for any proposed alternatives that are consistent with the requirements presented in ADB SPS, 2009.

27. **Occupational Health and Safety.** PMU[11] shall ensure that workers[12] 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, as 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) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

28. **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 (if applicable) of the subproject, and will establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts.

29. 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

[10] https://www.ifc.org/en/insights-reports/2000/general-environmental-health-and-safety-guidelines

[11] 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.

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

Safety Guidelines.[13] PMU shall also adhere to necessary protocols in response to infectious diseases such as COVID-19 and any other new diseases that may emerge in the future, consistent with the guidelines of relevant government healthcare agencies and the World Health Organization.

30. **Physical Cultural Resources**. PMU is responsible for siting and designing the subproject 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 the DBO Contractor.

31. **Environmental Audit.** When the 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.

32. **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 the DBO Contractor to (i) comply with all other conditions required by ADB,[14] and (ii) to submit to PMU, for review and approval, site-specific environmental management plans (SEMPs), 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 per EMP; and (iv) budget for SEMP implementation, among others as may be required. No works can commence prior to approval of relevant SEMP. A copy of the EMP and/or approved SEMPs 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 SEMPs constitutes a failure in compliance and shall require corrective actions.

33. **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) DOE-approved EIA (i.e. EIA in compliance with ECR, 2023) 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.

[13] World Bank Group, 2007. *Environmental, Health, and Safety General Guidelines.* Washington, DC. Final - General EHS Guidelines_APRIL 29.doc (ifc.org) Final

[14] 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.

B. Environmental Legislation Framework

1. Overview of the Environmental Approval Process

34. Key legislation governing the environmental approvals process for the proposed overall project (and hence the subproject) is the Bangladesh Environmental Conservation Act, 1995 (ECA, 1995) and the Environmental Conservation Rules (ECR, 2023).

35. According to Rule 5 of ECR, 2023 proposed developments within Bangladesh are classified as one of four categories, as follows:

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

36. The category of a project determines the procedure for issuance of an Environmental Clearance Certificate (ECC). All proposed industrial units and projects that are considered to be low polluting are classified under "Green" and shall be granted Environmental Clearance. For proposed industrial units and projects classified under the Yellow, Orange and Red Categories, a Location Clearance Certificate (LCC) and a subsequent ECC are required from the DOE depending on geographical location of project, extent of project activities and possible pollution load, human health and possible adverse impacts on environment. A detailed description of the approval process for the four categories of industry/projects are documented in Rules 9 – 19 of ECR, 2023.

37. Key milestones in the approvals process are outlined in **Figure 3**. These comprise:

(i) **Location Clearance Certificate:** An LCC will be issued by DOE upon approval of all requirements, including compliance with the site selection requirements as minimum for Yellow category projects. In addition to this compliance with site selection requirements, IEE study is required for Orange category projects and EIA study for Red category projects; and
(ii) **Environmental Clearance Certificate:** The ECC will be issued by DOE upon approval of requirements. ECC is issued to Green category project upon approval of the General Description of project; and to Yellow, Orange and Red category projects after issuance of LCC.

2. Procedure for Obtaining Location Clearance Certificate and Environmental Clearance Certificate

38. The environmental assessment process consists of three stages: screening, IEE, and detailed EIA per ECR, 2023. The ECR also contains the procedures for obtaining the LCC and ECC from the DOE for different categories of proposed industrial units or projects. Any person or organization wishing to establish an industrial unit or project must obtain an LCC and ECC from the Director General of DOE. The application for such certificate must be in the prescribed forms provided together with the prescribed fees laid down in Schedule 6 and Schedule 7, through the deposit of a Treasury *Chalan* in favor of the Director General of DOE. The procedure of getting the LCC and ECC of four categories of project are briefly described as follows and the process flow outlined in Figure below:

(i) **Green:** Projects categorized as Green projects are listed in Schedule 1. The proponent has to submit an application in a prescribed format Form 3: Location Clearance / Environmental Clearance Certificate Application, Rule 9 Sub-Rule (1), Rule 10 Sub-Rule (1), Rule 11 Sub-Rule (1), Rule 12 Sub-Rule (1), Rule 14 Sub-Rule (1), and Rule 23 Sub-Rule (4) along with specified documents;

In addition, as per Schedule 9: Industry or Project Site Selection Guideline, Rule 8 Sub-Rule (kha), Rule 9 Sub-Rule (2), Rule 10 Sub-Rule (2), Rule 12 Sub-Rule (2), and Rule 14 Sub-Rule (2) must be followed by the proponent; and

The Client must Deposit/Pay the mentioned amount of fees to DOE per Schedule 7: Location Clearance or Environmental Clearance Certificate Received and its Renewal Fee; Rule 9 Sub-Rule (3), Rule 10 Sub-Rule (3), Rule 12 Sub-Rule (6), Rule 84 Sub-Rule (3), Rule 21 Sub-Rule (14), Rule 22 Sub-Rule (1), and Rule 23 Sub-Rule (4).

DOE will provide the ECC to the applicant within seven (7) days of application subject to their site investigation and satisfaction on the submitted documents. The ECC needs to be renewed every 5 years.

(ii) **Yellow:** Projects categorized as Yellow are listed in Schedule 1. The proponent has to submit an application in a prescribed format Form 3: Location Clearance / Environmental Clearance Certificate Application, Rule 9 Sub-Rule (1), Rule 10 Sub-Rule (1), Rule 11 Sub-Rule (1), Rule 12 Sub-Rule (1), Rule 14 Sub-Rule (1), and Rule 23 Sub-Rule (4) along with specified documents;

Deposit/pay the mentioned amount of application processing fee to DOE per Schedule 6: Location Clearance or Environmental Clearance Certificate Application Process Fee, Rule 10 Sub-Rule (2), Rule 12 Sub-Rule (2), Rule 14 Sub-Rule (2), and related documents and detail information per Schedule 9: Industry or Project Site Selection Guideline, which shall be followed;

The relevant DOE office will conduct a site visit to the project and prepare a report with justification and opinion. Within 8 working days of receiving the application, the concerned DOE office will notify the applicant to pay the fee specified in Schedule-7, provided the information in the application is satisfactory and the on-site inspection is completed;

The Client must Deposit/Pay the mentioned amount of location clearance fee to DOE per Schedule 7: Location Clearance or Environmental Clearance Certificate Received and its Renewal Fee; Rule 9 Sub-Rule (3), Rule 10 Sub-Rule (3), Rule 12 Sub-Rule (6), Rule 84 Sub-Rule (3), Rule 21 Sub-Rule (14), Rule 22 Sub-Rule (1), and Rule 23 Sub-Rule (4); and

After issuance of LCC, the Client submits its application for issuance of ECC to DOE. DOE will provide the ECC to the applicant within seven (7) days of application subject to their site investigation and satisfaction on the submitted documents. The ECC needs to be renewed every 2 years.

(iii) **Orange:** Projects categorized as Orange require proponents to submit an application in a prescribed format Form 3: Location Clearance / Environmental

Clearance Certificate Application for Location Clearance, along with Deposit /Payment of the mentioned amount of fees for the project to DOE per Schedule 6, submission of related documents and detailed information, an Initial Environmental Examination (IEE) Study report, and compliance with Schedule 9: Industry or Project Site Selection Guideline. After approval from the Authority, the Client must Deposit/Pay the mentioned amount of fees for the project to DOE per Schedule 7 for obtaining the Location Clearance for the project.

The relevant DOE office will visit the project site and prepare a report. This report, along with the application, will be sent to the appropriate ECC committee based on the project's serial number listed in Schedule 1. The ECC committee will review the application and the report and make a decision. The applicant will then be notified to pay the fee listed in Schedule 7 for the LCC issuance;

Within 21 days from payment of fees per Schedule 7, DOE issues the LCC. Upon obtaining the LCC, the Proponent/Client will apply for an ECC from the DOE. The DOE office will then perform a site visit to ensure LCC compliance and review relevant issues. A report justifying the issuance or rejection of the ECC will be prepared and forwarded, along with the application, to the appropriate ECC committee. The committee will make a decision within 20 working days of the application date and issue the ECC. If an initial environmental examination of an Orange Category project reveals significant pollution impacts, the ECC Committee may recommend an Environmental Impact Assessment (EIA). With approval from the Director General, the proponent must conduct the EIA. The ECC needs to be renewed every year.

(iv) **Red:** Projects categorized as Red Projects require proponents to submit an application in a prescribed format Form 3: Location Clearance / Environmental Clearance Certificate Application for Location Clearance, along with Deposit /Payment of the mentioned amount of fees for the project to DOE per Schedule 6, related documents, detail information, draft Terms of Reference (ToR) of Environmental Impact Assessment (EIA) and compliance with Schedule 9: Industry or Project Site Selection Guideline;

Per Schedule 10: Environmental Impact Assessment Scope of Works Guidelines, Rule 14 Sub-Rule (3), a draft Terms of Reference (TOR) will be prepared for the conduct of an Environmental Impact Assessment and submitted to the DOE for approval;

The relevant DOE office will visit the project site to review the documents and all pertinent issues. A report with justifications and findings on the rationale for issuing the location clearance certificate and draft ToR for the EIA will be forwarded to the ECC Committee. Upon receiving the documents, the ECC Committee will review and evaluate them, then submit a report to the Director General (DG) for approval. With the DG's approval, the concerned office will approve the ToR for the EIA within 30 working days;

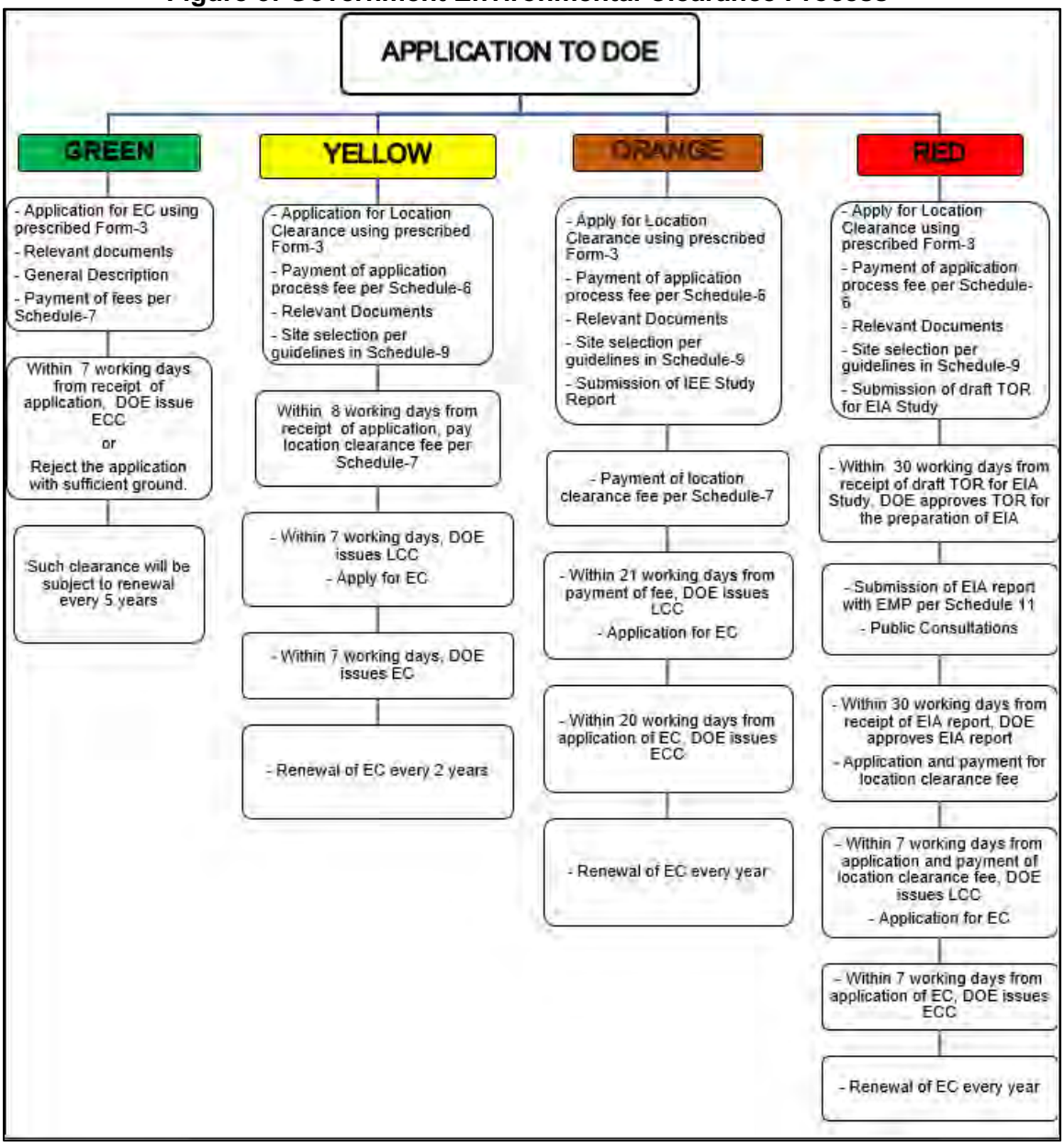
An EIA study shall be prepared based on DOE's approved TOR. An Environmental Management Plan should be prepared as an integral part of the EIA study according to Schedule 11: Industry or Project Environmental Impact Assessment

study Preparation Guidelines, and Rule15 Sub-Rule (3). Public consultations for the EIA study shall be carried out;

The proponent has to submit the EIA report to the ECC Committee as per Schedule 11. If the EIA is approved by the DG, the proponent has to pay the fee specified in Schedule-7 within a maximum of 7 working days and the LCC will be issued within 7 working days of submission of fee to the concerned DOE office; and

After issuance of the LCC, proponent/client will submit the application for issuance of ECC. The relevant DOE office will conduct a site visit to verify the conditions of the LCC and the recommendations of the EIA etc. A report will be prepared and forwarded to the ECC committee. Upon reviewing the reports and documents, the ECC Committee will make recommendations to the DG regarding the issuance of the ECC. Once the DG approves these recommendations, the concerned office will issue the ECC within 30 working days. The ECC needs to be renewed every year.

Figure 3: Government Environmental Clearance Process



DOE = Department of Environment, EC = Environmental Clearance, ECC = Environmental Compliance Certificate, EIA = environmental impact assessment, EMP = environmental management plan, IEE = initial environmental examination, LCC = Location Clearance Certificate, TOR = terms of reference.

3. Government Environmental Categorization

39. Environmental Conservation Rules, 2023 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.

40. 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. While the nature of works under the subproject falls within the Yellow Category, the overall project includes other subproject components that are identified to be within the Red Category. Thus, the overall project needs to comply with the requirements of the stricter classification of Red Category. NCC will obtain one ECC for the entire project (covering all subprojects). Currently, NCC is coordinating with the DOE, and preparing for activities necessary to comply with the requirements under the Red Category classification including the completion of the required EIA. Application for ECC will be submitted once the EIA is approved and LCC is issued by DOE.

Table 1: Categorization of the Project

Subproject/ Component	Interventions	ECR Category
Construction and Rehabilitation of Drinking Water Supply System	Rehabilitation of Water Treatment Plant, Deep Tube Wells, Overhead Tanks, and laying of water pipelines along the existing road network, including crossing water bodies and railway systems.	Red
Construction and Rehabilitation of Drainage System	Construction and/or rehabilitation of drainage canals.	Red
Improvement of Parks and Public Spaces	Rehabilitation of existing parks and public spaces.	Yellow

C. National Environmental Act and Laws

41. Table below provides a summary of policies, plans and strategies which deal with the drinking water supply sector, including climate change.

Table 2: Summary of Relevant National Environmental Acts and Laws

Laws, Regulations, and Standards	Details	Relevance to the Subproject
The Constitution of the People's Republic of Bangladesh	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, biodiversity, 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	The clauses stated in 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 subproject.

Laws, Regulations, and Standards	Details	Relevance to the Subproject
	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.	
Environmental Conservation Act (ECA), 1995 (and subsequent amendments)	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 have been framed with various amendments. 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. The main strategies of the Act can be summarized as: • Declaration of ecologically critical areas (ECAs), and restriction on the operation and process, which can be carried, out or cannot be initiated in the ecologically critical areas. • Regulation in respect of vehicles emitting smoke harmful for the environment. • Environmental clearance.	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 (ECC) from the Director General. The subproject forms part of the overall project that is required to obtain ECC. Additionally, Shitalakhya river is also declared by the Department of Environment as an ECA due to its deteriorating water quality. Therefore, no activity should be allowed that could further pollute this river. This ECA declaration is very relevant to the subproject because the WTP component is adjacent Shitalakhya river and will have the potential to pollute the said river with possible effluents from the facility.

Laws, Regulations, and Standards	Details	Relevance to the Subproject
	• Regulation of the industries and other development activities – discharge permit. • Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes • Promulgation of standard limit for discharging and emitting waste. • Formulation and declaration of environmental guidelines. 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 BDT 100,000, or both.	
Environment Conservation Rules, 2023	The Environment Conservation Rules, 2023 (ECR, 2023) provide the set of rules under the Environment Conservation Act, 1995. These provide, amongst other items, standards and guidelines for: • Categorization of industries and development projects; • Procedure for obtaining environmental clearance; and • Environmental quality standards in relation to inland surface water, coastal	In accordance with the ECR, 2023, the overall 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 and thus with the subproject.

Laws, Regulations, and Standards	Details	Relevance to the Subproject
	water, drinking water, sewage water and industrial waste water quality parameters are mentioned under schedule 2, 3, 4 and 5. Whereas, standards for air pollution and noise, are referenced to the Air Pollution Control Rules, 2022 and Noise Pollution Control Rules, 2006, respectively. ECR, 2023 classifies industrial units and development projects into four categories for the purpose of issuance of Environmental Clearance Certificate (ECC). These categories are: Green; Yellow; Orange; and Red. Per ECR 2023, all existing and new industries and projects in Orange 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.	
Bangladesh Climate Change Strategy and Action Plan 2009	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: • 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. • Comprehensive disaster management to further strengthen the country's already proven disaster management systems to deal with increasingly frequent and severe natural calamities. • 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	This strategy and action plan is relevant to the subproject. The subproject is required to consider in its design mitigation measures that will ensure the infrastructures (e.g. quality of pipes, depth of DTWs) 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.

Laws, Regulations, and Standards	Details	Relevance to the Subproject
	with the likely impacts of climate change. • 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. • Mitigation and low carbon development to evolve low carbon development options and implement these as the country's economy grows over the coming decades. • Capacity building and Institutional strengthening to enhance the capacity government ministries, civil society and private sector to meet the challenge of climate change.	
National Water Policy 1999	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.	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). All these elements are directly associated with the nature of the subproject. The policy also applies to the subproject due to the subproject's potential to pollute surface water bodies and groundwater during construction and operation phases. Therefore, the subproject is bound to comply with

Laws, Regulations, and Standards	Details	Relevance to the Subproject
		the requirements under this policy in its design.
National Safe Drinking Water Supply and Sanitation Policy 1998	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.	This policy covers the subproject as far as managing water supply is concerned. The subproject is one of the means to realize the many objectives, in particular the ones related to improving the water supply system and reducing problems related to water scarcity, etc.
The Forest Act (1927) and the Forest (Amendment) Act (2000)	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.	Although there are no forests around the subproject areas and alignments, the relevance of this Act is only on the potential cutting of trees in some subproject sites or alignments. The subproject will be required to obtain permits on cutting of any trees prior to start of civil works.
Bangladesh Public Procurement Rule (PPR), 2008	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	NCC is a government entity that needs to comply with the environment-related requirements under this Rule, as explicitly specified herein.

Laws, Regulations, and Standards	Details	Relevance to the Subproject
	Protection of the Environment' in the construction works. This clause includes contractor responsibility to 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.	
National Environmental Policy, 2018	The central theme of the policy is to ensure protection and improvement in environment. The policy gives a thrust to sustainable development and long-term use of natural resources. The National Environment Policy contains policy statements and strategic options with regard to population and land-use management, management and utilization of natural resources and other socio-economic sectors, as well as the necessary arrangements for the implementation of the policy.	Subproject will have site-specific impacts and will require implementation of mitigation measures to ensure protection and improvement of the environment.
Environment Court Act, 2000 and subsequent amendments in 2003	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.	This Act covers the subproject because design includes the provision of water treatment technology or process, from which waste may be generated and discharged to the environment. Therefore, the operation phase of the subproject may have the potential to release untreated wastewater into the environment. According to this Act, government can take legal actions if any environmental problem occurs due to the subproject operations.
National Water Act 2013 National Water Rules 2018	Ensures Bangladesh water sources are free from any type of pollution. Pollution from water in urban outfalls and reservoirs, e.g., lakes, canals, ponds and ditches may result in amenity losses, fisheries depletion, health problems and fish and aquatic species contamination.	The subproject is required to implement measures to ensure that water source pollution is avoided, in particular to the Shitalakhya river.
Wetland Protection Act 2000	Advocates protection against degradation and resuscitation of natural waterbodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made	The subproject is required to implement measures to ensure that water bodies around the subproject sites are not impacted.

Laws, Regulations, and Standards	Details	Relevance to the Subproject
	interventions or other causes. Prevents the filling of publicly owned water bodies and depressions in urban areas for preservation of the natural aquifers and environment. Prevents unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.	
National Land Use Policy, 2001	Sets out guidelines for improved land-use and zoning regulations. The main objective 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.	Siting of subproject components need to comply with land use and zoning regulations
The Pourashava Act 2009 / Ordinance issued for the amendment of local government (municipality) ordinance, 2009 and 2010; The Pourashava Ordinance, 1977; Municipal Administration Ordinance, 1960	Provides guidance for subproject integrated community and workers health and hygiene at the construction and operation and maintenance stages of the project.	Mandated coordination with pourashava committees on disaster management measures, water and sanitation and waste management.
Building Construction (Amendment) Act and Building Construction Rules, Bangladesh National Building Code	Regulates technical details of building construction and to maintain standards of building construction	Subproject designs for any building structures need to comply with the Act and Rules.
Air Pollution Control Rules, 2022	APCR, 2022 contains air quality standards based on WHO Guidelines (Interim Goals); emissions limits and technical specifications for key sectors; mandates and coordination mechanisms among relevant line ministries to control both household and outdoor air pollution. The rules elevated the air quality management dialogue and leadership beyond the environment sector, by establishing the National Committee on Air Pollution Control, a muti-sector decision-making body presided by the Cabinet Secretary to coordinate the	Subproject construction activities will potentially generate air pollution (dust and smoke emissions), and thus need to comply with the emission standards specified in the Rules.

Laws, Regulations, and Standards	Details	Relevance to the Subproject
	APCR implementation and instruct relevant agencies on specific interventions to comply with the new rules.	
Noise Pollution (Control) Rules, 2006	The Noise Pollution Rules, 2006 addresses that the sound levels to be no more than 50dB in Silent Zones[a] during daytime (6 am to 9 pm) and 40 dB at night-time (9 pm to 6 am). In residential areas these levels are 55 dB and 45 dB, in mixed area[b] 60 dB and 50 dB, in commercial and industrial areas 70 dB and 60 dB and in industrial areas 75 dB and 70 dB for daytime and night-time respectively.	Subproject activities, particularly the linear works, will be in various locations of NCC with different land uses. Thus, the subproject needs to comply with the corresponding noise level standards at all sites.
Solid Waste Management Rules 2021	The Rules provides a comprehensive set of rules based on national 3R strategy and other national and international policies and guidelines pertaining to solid waste management. It defines the roles and responsibilities of relevant government ministries and agencies, including local government authorities and other stakeholders in implementing solid waste management undertakings. It also includes the environmental requirements necessary for these undertakings, provision of incentives for the promotion of sustainable waste management practices, etc.	The subproject will generate solid wastes and will be required to implement measures to comply with the integrated waste management rules.

[a] The area within 100 meters from hospital, academic institutions or places identified/identifiable by the government
[b] An area, which is primarily a residential area with either or both commercial and industrial parts in it

1. Legislation Relating to Occupational Health and Safety

42. 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.
Bangladesh Labor Rules, 2015	Contractor to implement occupational health and safety measures. Contractor will be liable for compensation for work-related injuries.

Title of Laws and Rules	Relevance
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.
Public Health (Emergency Provisions) Ordinance, 1994	The ordinance calls for special provisions with regard to public health. Whereas if 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.

2. Relevant International Conventions, Treaties

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

Table 4: International Environmental Conventions Relevant to the Subproject 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	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their	01.04.93 (AT) 30.06.93 (entry into force)	Restricting transboundary movements of hazardous wastes (e.g. ACMs) except where it is perceived to be in accordance with

Sl. No.	International Treaties	Ratified/ Accessed (AC)/ Accepted (AT)/ Adaptation (AD)	Relevance
	Disposal (Basel, Switzerland, 1989)		the principles of environmentally sound management.
6	Convention on Biological Diversity, 1992 (Rio de Janeiro)	03.05.1994	Protection of biodiversity during construction and operation.
7	Cartagena protocol on Biosafety to the Convention on Biological Diversity	In the process of Ratification	Protection of biodiversity during construction and operation.
8	Convention on Persistent Organic Pollutants, 2001	In process	Restriction of use of pesticides and herbicides.
9	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.

3. Gaps in Legal and Guiding Instruments

44. 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 2023 set screening criteria to classify industries/ projects based on potential environmental impacts as follows: Green, Yellow, Orange 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. Yellow – compliance with site selection criteria. Orange – compliance with site selection criteria and conduct of IEE required; Red – compliance with site selection criteria, and both IEE and EIA 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 2023) 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., Yellow, Orange, 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	For projects classified under Red Category, public consultation is required based on ECR 2023 Grievance redress mechanism is not mentioned in ECA 1995 and ECR 2023; EIA format required by DOE includes stakeholders' consultation.	Approval of the ToR of EIA by DOE includes mandatory consultation with stakeholders.
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 Requires submission of quarterly, semi-annual, and annual reports to ADB for review	For project classified under Orange and Red Categories, 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		
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 2023 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 2023. 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 Act 2006, and its 2013 amendment.	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

4. Permits and Clearance

45. Per ECA, 1995 (amended 2010) and ECR, 2023, 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.

46. The application and requirement for issuance of ECC are described in the ECR, 2023 and summarized in Part B above. This involves the completion and submission of an application using a form available from the DOE website,[15] 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 ECR, 2023.

[15] Government of Bangladesh. Department of Environment.

47. The ECC is issued within 30 working days from receipt of the application by DOE, provided that LCC has been issued prior. LCC is normally issued within approximately 7 working days from receipt of DOE of the EIA report, provided that such report is approved by DOE. Once issued, ECC is required to be renewed every year from the date of its effectivity for Orange and Red category projects. For the overall project, NCC, through PMU, is responsible for application for ECC. This ECC will cover all subprojects identified under the overall project. Completion of the EIA is ongoing and application for ECC will be submitted once the EIA is approved and LCC is issued by DOE.

D. Applicable Environmental Standards

48. ECR, 2023 also provides the environmental standards applicable to the subproject. The ECR presents the national standards as presented in this chapter. Following requirements of ADB SPS, the subproject 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 subproject shall achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, NCC 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 subproject per ADB SPS requirements.

Table 6: Bangladesh National Drinking Water Quality Standards

Sl No	Parameter	Unit	Standard
1.	1,1 Dichloroethane (1,1 $C_2H_4C_{12}$)	mg/l	0.030
2.	1,2 Dichloroethane (1,2 $C_2H_4C_{12}$)	mg/l	0.030
3.	2,4,6 Trichlorophenol	mg/l	0.200
4.	Aldrin/Dieldrin	mg/l	0.030
5.	Aluminium (Al)	mg/l	0.200
6.	Ammonia (NH_3)	mg/l	1.500
7.	Anionic Detergents	mg/l	0.200
8.	Arsenic (As)	mg/l	0.050
9.	Barium (Ba)	mg/l	0.700
10.	Benzene (c_6H_6)	µS/cm	0.010
11.	Boron (B)	mg/l	1.000
12.	Cadmium (Cd)	mg/l	0.003
13.	Calcium (Ca)	mg/l	75.000
14.	Carbon Tetra Chloride (CCl_4)	mg/l	0.005
15.	Chloride	mg/l	250.000*
16.	Chloroform ($CHCL_3$)	mg/l	0.090
17.	Color	Hazen Unit	15.000
18.	Copper (Cu)	mg/l	1.500
19.	Cyanide (CN)	mg/l	0.050
20.	Fecal Coliform	NFU/100ml	0
21.	Fluoride (F^-)	mg/l	1.000
22.	Free Residual Chlorine	mg/l	0.20
23.	Hardness as $CaCO_3$	mg/l	500.000
24.	Iron (Fe)	mg/l	0.3-1.0

Sl No	Parameter	Unit	Standard
25.	Lead (Pb)	mg/l	0.010
26.	Magnesium (Mg)	mg/l	30-35
27.	Manganese (Mn)	mg/l	0.400
28.	Mercury (Hg)	mg/l	0.001
29.	Nickel (Ni)	mg/l	0.050
30.	Nitrate (NO_3^-)	mg/l	45
31.	Nitrite (NO_2^-)	mg/l	1.000
32.	Odor	---	Odorless
33.	Oil and Grease	mg/l	0.010
34.	Overall Beta variance	BQU/L	1.000
35.	Pentachlorophenol	mg/l	0.009
36.	pH	---	6.5-8.5
37.	Phenols	mg/l	0.002
38.	Potassium	mg/l	12.000
39.	Radioactive Materials Emitting Alpha Radiation	BQU/L	0.100
40.	Selenium (Se)	mg/l	0.010
41.	Silver (Ag)	mg/l	0.020
42.	Sodium (Na)	mg/l	200.000
43.	Sulfate (SO_4^{-2})	mg/l	250.000
44.	Sulfide as H_sS	mg/l	0.050
45.	Suspended Solid (SS)	mg/l	10.000
46.	Temperature	°C	20-30
47.	Tetrachloroethane ($C_2H_4C_{14}$)	mg/l	0.040
48.	Tin (Sn)	mg/l	2.000
49.	Total Chromium (Total Cr)	mg/l	0.050
50.	Total Coliform	NFU/100ml	0
51.	Total Dissolved Solids (TDS)	mg/l	1000.000
52.	Total Kjeldal Nitrogen	mg/l	1.000
53.	Trichloroethane ($C_2H_3C_{13}$)	mg/l	0.020
54.	Turbidity	NTU	5.000
55.	Zinc (Zn)	mg/l	5.000

* 1,000 mg/l in coastal areas
Source: ECR, 2023

Table 7: Bangladesh Inland Surface Water Standards

Best Practice Based classification	pH	DO mg/l	BOD mg/l	NO_3-N mg/l	NH_4-N mg/l	PO_4-P mg/l	Total Cr mg/l	Pb mg/l	Hg mg/l	Total Coliform cfu/100mg	TDS mg/l	COD mg/l
a. Source of drinking water for supply only after disinfecting:	6.5-8.5	≥6	≤2	7.0	0.1	0.1	0.02	0.03	0.001	≤100	1000	10
b. Water usable for recreational activity	6.5-8.5	≥5	≤3	7.0	0.3	0.5	0.2	0.05	0.001	≤50	1000	10

Best Practice Based classification	pH	DO mg/l	BOD mg/l	NO_3-N mg/l	NH_4-N mg/l	PO_4-P mg/l	Total Cr mg/l	Pb mg/l	Hg mg/l	Total Coliform cfu/100mg	TDS mg/l	COD mg/l
c. Source of drinking water for supply after conventional treatment	6-9	≥5	≤3	7.0	0.3	0.5	0.02	0.03	0.001	≤5000	1000	25
d. Water usable by fisheries	6-9	≥5	≤6	7.0	0.3	0.5	0.05	0.1	0.004	≤5000	1000	50
e. Water usable by various process and cooling industries	6.5-8.5	≥1	12	-	2.7	-	0.1	0.1	0.05	-	1000	100
f. Water usable for irrigation	6.5-8.5	-	≤12	5.0	1.5	2.0	0.1	0.1	0.002	≤50000	1000	100

Note: Electrical conductivity for irrigation water 2250 -µS/cm (at a temperature of 25^0C); Sodium less than 26%; boron less than 0.2%.
Source: ECR, 2023

Table 8: Applicable Ambient Air Quality Standards for Bangladesh Projects

Parameter	Bangladesh Ambient Air Quality Standard (µg/m^3) and Averaging Time [a]	WHO Air Quality Guidelines (µg/m^3) Global Update[b] 2021
PM_{10}	50 (1-year) 150 (24-h)	15 (1-year) 45 (24-h)
$PM_{2.5}$	35 (1-year) 65 (24-h)	5 (1-year) 15 (24-h)
SO_2	80 (24-h) 250 (1-h)	40 (24-h)
NO_x	40 (1-year) 80 (24-h)	10 (1-year) 25 (24-h)
CO	5,000 (8-h) 20,000 (1-h)	4 (24-h)
Lead	0.25 (1-year) 0.50 (24-h)	
Ozone (O_3)	180 (1-h) 100 (8-h)	60 (peak season) 100 (8-h)
NH_3	100 (1-year) 400 (24-h)	

ADB = Asian Development Bank, CO = carbon oxide, h = hour, µg/m^3 = microgram per cubic meter, min = minute, NO_x = oxides of nitrogen, $PM_{2.5}$ = particulate matter 2.5, PM_{10} = particulate matter 10, SO_2 = sulfur dioxide, WHO = World Health Organization.

[a] Air Pollution Control Rules 2022

[b] Recommended 2021 WHO Global Air Quality Guidelines. https://www.who.int/

Table 9: Applicable Noise Levels for Bangladesh Projects

Receptor/ Source	National Noise Standard Guidelines[a] (dB)		WHO Guidelines Value For Noise Levels Measured Out of Doors[b] (One Hour LA_q in dBA)	
	Day (06:00-21:00)	Night (21:00-6:00)	07:00 – 22:00	22:00 – 07:00
Industrial area	75	70	70	70
Commercial area	70	60	70	70
Mixed Area	60	50	55	45
Residential Area	55	45	55	45
Silent Zone[c]	50	40	55	45

[a] Noise Pollution Control Rules, 2006

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

[c] 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 10: Applicable Effluent Discharge Standards

Sl. No	Parameter	Unit	Maximum Tolerable Limit at Discharge point except pH		
			Internal Surface Water	2nd Stage process of public sewage	Coastal Areas
1.	Nitrogen (N)	mg/l	50	50	50
2.	Ammonia (NH_3)	mg/l	5	5	5
3.	Arsenic (As)	mg/l	0.2	0.2	0.2
4.	BOD_5 at 20°C	mg/l	30	250	100
5.	Boron (B)	mg/l	2	2	4
6.	Cadmium (Cd)	mg/l	2	1	2
7.	Chlorine (Cl^-)	mg/l	600	600	---
8.	Total Chromium	mg/l	0.5	1	1
9.	COD	mg/l	200	400	250
10.	Hexavalent Cr	mg/l	0.1	2	1
11.	Copper (Cu)	mg/l	3	3	3
12.	Fluoride (F)	mg/l	2	15	15
13.	Sulphide (S)	mg/l	1	--	5
14.	Iron (Fe)	mg/l	3	3	3
15.	Total Kjeldal nitrogen	mg/l	100	--	100
16.	Lead (Pb)	mg/l	0.1	1	2
17.	Manganese (Mn)	mg/l	2	2	2
18.	Mercury (Hg)	mg/l	0.01	0.01	0.01
19.	Nickel (Ni)	mg/l	1	2	5
20.	Nitrite (N)	mg/l	10	--	20
21.	Oil & Grease	mg/l	10	20	20
22.	Phenol (C_6H_5OH)	mg/l	1	5	5
23.	Phosphorus (P)	mg/l	5	--	--
24.	Radioactive Material a) Alpha Particle b) Beta Particle	Micro Curie/L	Standard Set by Bangladesh Atomic Energy Commission	---	----
25.	pH	---	6-9	6-9	6-9

Sl. No	Parameter	Unit	Maximum Tolerable Limit at Discharge point except pH		
			Internal Surface Water	2nd Stage process of public sewage	Coastal Areas
26.	Selenium (Se)	mg/l	0.05	0.05	0.05
27.	Zinc (Zn)	mg/l	5	15	15
28.	Temperature	°C	Not more than 5°C of reservoir water temperature	--	Not more than 5° C of reservoir water temperature
29.	Suspended Solids	mg/l	100	500	100
30.	Cyanide	mg/l	0.1	2.0	0.2
31.	Total Residual Chlorine	mg/l	1.0	--	1.2
32.	Bio Assay Test		90% fishes remain alive after 96 hours in the treated liquid waste	90% fishes remain alive after 96 hours in the treated liquid waste	90% fishes remain alive after 96 hours in the treated liquid waste

Source: ECR, 2023

III. DESCRIPTION OF THE SUBPROJECT

A. Overview of the Water Supply Component of the Overall Project

49. Bangladesh, despite its many economic advancements, has been facing several challenges in urban basic services. Population increase in cities and towns is rapid, reaching 64 million in 2020 from 39 million in 2010.[16] In particular, the water supply system in Narayanganj was established in the 1980s and has been operated by Dhaka Water Supply and Sewerage Authority (DWASA) since then under the same original capacity. Raw water comes from a combination of sources, either groundwater from DTWs and/or surface water abstracted from the Shitalakshya river. With the latter, raw water is being treated in a water treatment plant at Godenail. However, little reinvestment was made in the maintenance or improvement of the system over the intervening years that resulted to treatment inefficiency due to a combination of ineffective treatment components and increased pollution load of raw water coming from the Shitalakhya river. The quality of water from taps became poorer through the years. As a result, incidence of water borne diseases in the project area is high. Lack of sufficient maintenance of pipelines also led to high leakages in the system, and tariff revenue has been low.

50. In order to achieve a sustainable urban development in NCC, the water supply system needs to be improved to cope with the increasing demand and maintain a healthy quality of life of the population. Under the overall project, this goal can be achieved through significant improvement in the water supply system by increasing the number of sources, increasing the capacity of treatment and storage, and expanding the coverage of distribution with the end goal of serving all households with reliable piped water in the near future.

51. The water supply component of the overall NGRUDP covers two subprojects or packages, namely: (i) Water Supply Contract 1 which involves the rehabilitation and upgrading of existing WTP at Godenail, rehabilitation of existing DTWs and OHTs, and construction of new distribution

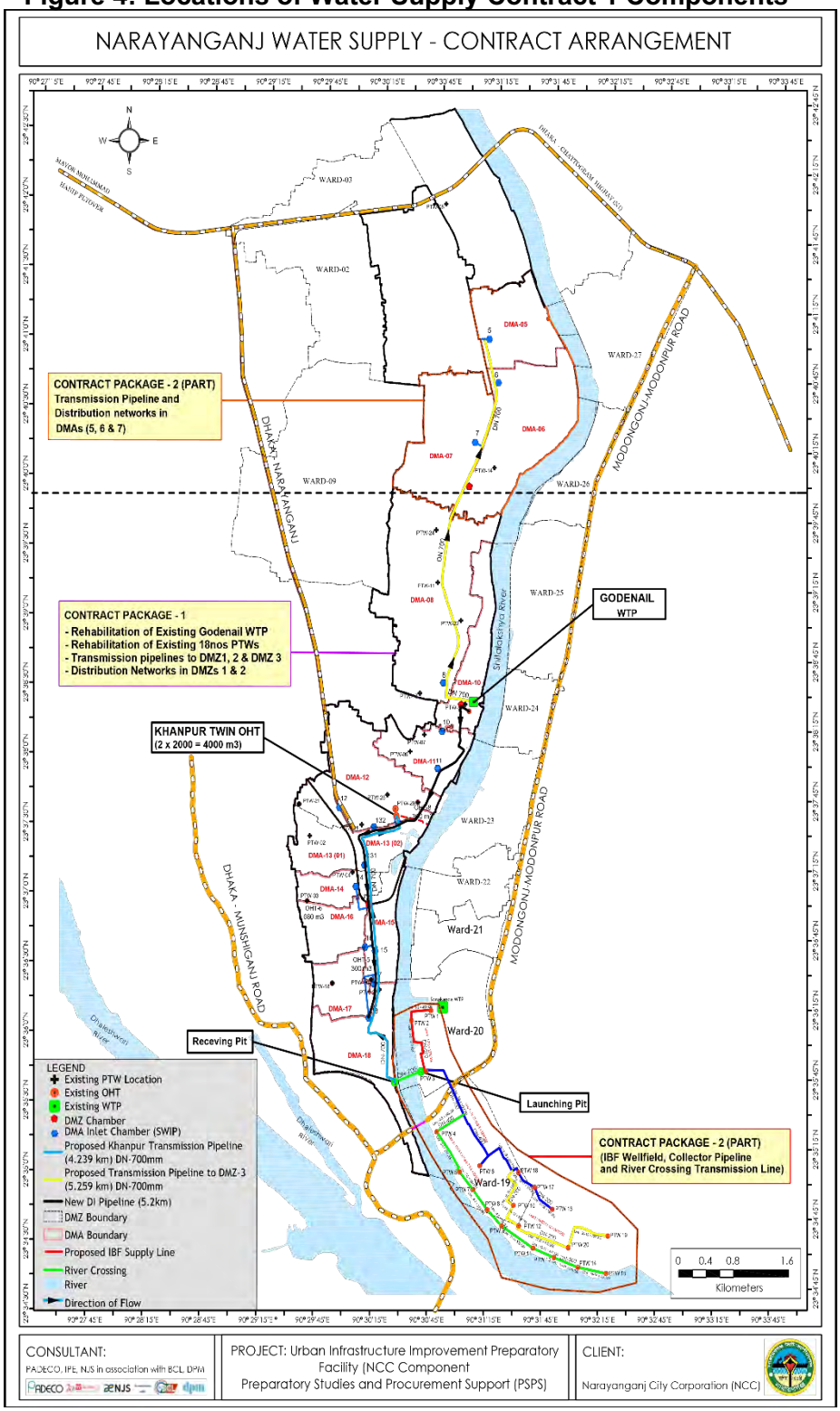
[16] Asian Development Bank (ADB). 2021. *Key Indicators for Asia and the Pacific 2021.* Manila.

network in selected District Metering Zone (DMZs) of NCC; and (ii) Water Supply Contract 2 which involves development of new production tube wells (PTWs) using the induced bank filtration (IBF) technology including construction or installation of disinfection units for each PTW, and construction of transmission pipeline from these PTWs to existing OHTs in the NCC area. These two water supply subprojects will have their separate IEE and corresponding IEE reports prepared. It is envisaged that these two subprojects will improve the drinking water supply system of NCC for the short to medium term. A long-term solution is being prepared which will involve the development of a bigger water treatment plant with Meghna River as a source in the future. However, the implementation of this long-term solution is expected to only commence after 10-15 years from to date.

B. Subproject Location

52. This IEE covers the Water Supply Contract 1 Subproject as described above and explained in detail in this chapter. Figure 4 below shows the locations of the subproject components (see areas bounded by violet line).

Figure 4: Locations of Water Supply Contract 1 Components[a, b]



[a] Coverage of Water Supply Contract 1 Component is bounded by violet line.

[b] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

C. Summary of Subproject Components

53. The Water Supply Contract 1 Subproject will aim to upgrade the water supply system by improving the efficiency of existing water treatment plant (WTP), deep tube wells (DTWs), overhead tanks (OHTs); and installation of new distribution network in selected district metering zones (DMZs) based on the overall water supply improvement masterplan of the city. Water Supply Contract 1 components are classified as follows:

(i) **Water treatment plant (WTP)**. Rehabilitation and upgrading of the existing WTP at Godenail with design capacity of 45 million liters per day (MLD). This will involve construction of additional treatment component (Moving Bed Biofilm Reactor (MBBR) unit), to enhance treatment efficiency and meet drinking water standards;
(ii) **Deep tube wells (DTWs)**. Rehabilitation of 17 nos. of existing DTWs;
(iii) **Overhead tanks (OHTs)**. Rehabilitation of 8 nos. of OHTs; and,
(iv) **Transmission and distribution network**. 4.239 km length of transmission pipelines and 219.88 km of new distribution network in district metered zones (DMZs) 1 and 2 of the overall water supply masterplan for NCC.

54. Description and specifications of each component are summarized in Table 11 below and the locations are illustrated in subsequent figures in this section.

Table 11: Summary of Subproject Components (Water Supply Contract 1)

Infrastructures / Components	Function	Description	Location
Water Treatment Plant (WTP)	To treat raw water to comply with drinking water quality standards	*(existing to be rehabilitated)* Intake structure and raw water pumping system Nos: 1 set of structure Total Capacity: 45 MLD The rehabilitation works will involve installation/replacement of new intake pipes and provision for intake protection structures. *(new to be installed/constructed)* Moving Bed Biofilm Reactor (MBBR) system Nos.: 1 no. MBBR unit, with chemical room The MBBR is a new major upgrading component of the WTP, which will employ technology designed to significantly reduce the organic and inorganic load of raw water from Shitalakhya river, particularly during dry season. The water treated from the MBBR is expected to reduce the pollutants to levels at which the WTP is originally designed for. The upgrading will also include construction of a chemical room comprising storage tanks, feeding tanks with bole tap, and measuring tank. *(existing to be rehabilitated)* Inlet well and chemical dosing system Nos: 1 set of structure	The existing WTP is located in a government-owned land at Godenail in the center of NCC. The site is adjacent the Shitalakhya river. GPS coordinates are as follows: 23.639668N, 90.514887E

Infrastructures / Components	Function	Description	Location
		Total Capacity: 45 MLD The rehabilitation will include installation of mechanical rapid mixing component to ensure complete mixing of chemical during the process. *(existing to be rehabilitated)* Flocculation and sedimentation basins Nos: 2 flocculation basins and 1 4-chamber sedimentation basin (1,413 m^3/chamber) Total Capacity: 45 MLD The rehabilitation works will involve restoration of flocculation chambers and sedimentation basins to ensure original design capacity is restored. *(existing to be rehabilitated)* Filtration (Rapid Sand Filtration) with Backwashing and Underdrainage system Nos: 1 rapid sand filtration with 6 filter units Total Capacity: 45 MLD The rehabilitation works will involve replacement of filter sand and gravel, and replacement of backup valve for the backwashing system. This is to ensure original design capacity is restored. *(existing to be rehabilitated)* Clear Water Reservoirs Nos.: 2 Total Capacity: 4,200 cu.m. (2,100 cu.m. each) The rehabilitation works will involve restoration and/or repair/replacement of components such as chlorination device and high lift pumps. *(existing to be rehabilitated)* Sludge Tanks Nos.: 2 nos. The rehabilitation works will involve restoration of the sludge tanks. *(new to be installed/constructed)* Sludge drying lagoons/beds Nos.: 4 nos. (dimension of 16m x 22m x 1m each lagoon/bed) The construction of new sludge drying lagoons or beds are designed to dry up the sludge from the sludge tanks, prior to disposal. This new component will avoid the current practice of disposing sludge indiscriminately in open areas of the WTP. *(new to be installed/constructed)*	

Infrastructures / Components	Function	Description	Location
		Administration building with laboratory Nos.: 1 no. The new building will replace the existing but old building at the same area in the WTP compound. Design to be finalized during detailed design. *(new to be installed/constructed)* Chlorine storage and injection building Nos.: 1 no. The new building will replace the existing but old building at the same area in the WTP compound. Design to be finalized during detailed design. *(new to be installed/constructed)* Guard house and storage room Nos.: 1 no. The new guard house will replace the existing but old guard house at the same area in the WTP compound. Design to be finalized during detailed design.	
Deep Tube Wells	Additional source of raw water for the drinking water supply system	*(existing to be rehabilitated)* Deep tube wells Nos: 17 Total Capacity: 45 MLD The rehabilitation works will involve cleaning and/or replacement of parts to ensure original design capacity is restored.	Various areas in NCC. See Table 13 for GPS coordinates.
Overhead Tanks	Storage tanks for treated water prior to distribution.	*(existing to be rehabilitated)* Overhead Tanks Nos: 8 Total Capacity: 8,790 m^3 The rehabilitation includes replacement/installation of new flow meters. Others will be rehabilitated by repairing the structural damages, leaks in the tanks and also by replacing dilapidated pipes, valves, malfunctioning overflow valves, pits, ladders, etc. to make all tanks functional with intended efficiencies..*xx*	Various areas in NCC. See Table 16 for GPS coordinates.
Transmission Pipeline	To convey water from new PTWs under Contract 2 going to the Khanpur Twin Towers.	*(new to be installed)* Transmission Pipeline Pipe: DI Diameter: 700mm Length: 4.239 km	This transmission pipeline will commence from the receiving pit at the end of the river crossing pipeline at the south bank of the Mahmudnagar canal to Khanpur Twin Towers. See **Error! Reference source not found.**.
Distribution network	To convey and distribute drinking water from the WTP to the different households and users in DMZs 1 and	*(new to be installed or replaced)* Distribution Pipelines Pipe: HDPE and DI Diameter: 100 mm to 500 mm Length: 219.88 km	The distribution network that will be rehabilitated is located in the NCC area (see Appendix 3 for detailed maps showing alignments)

Infrastructures / Components	Function	Description	Location
	2 of the overall water supply masterplan of NCC.		

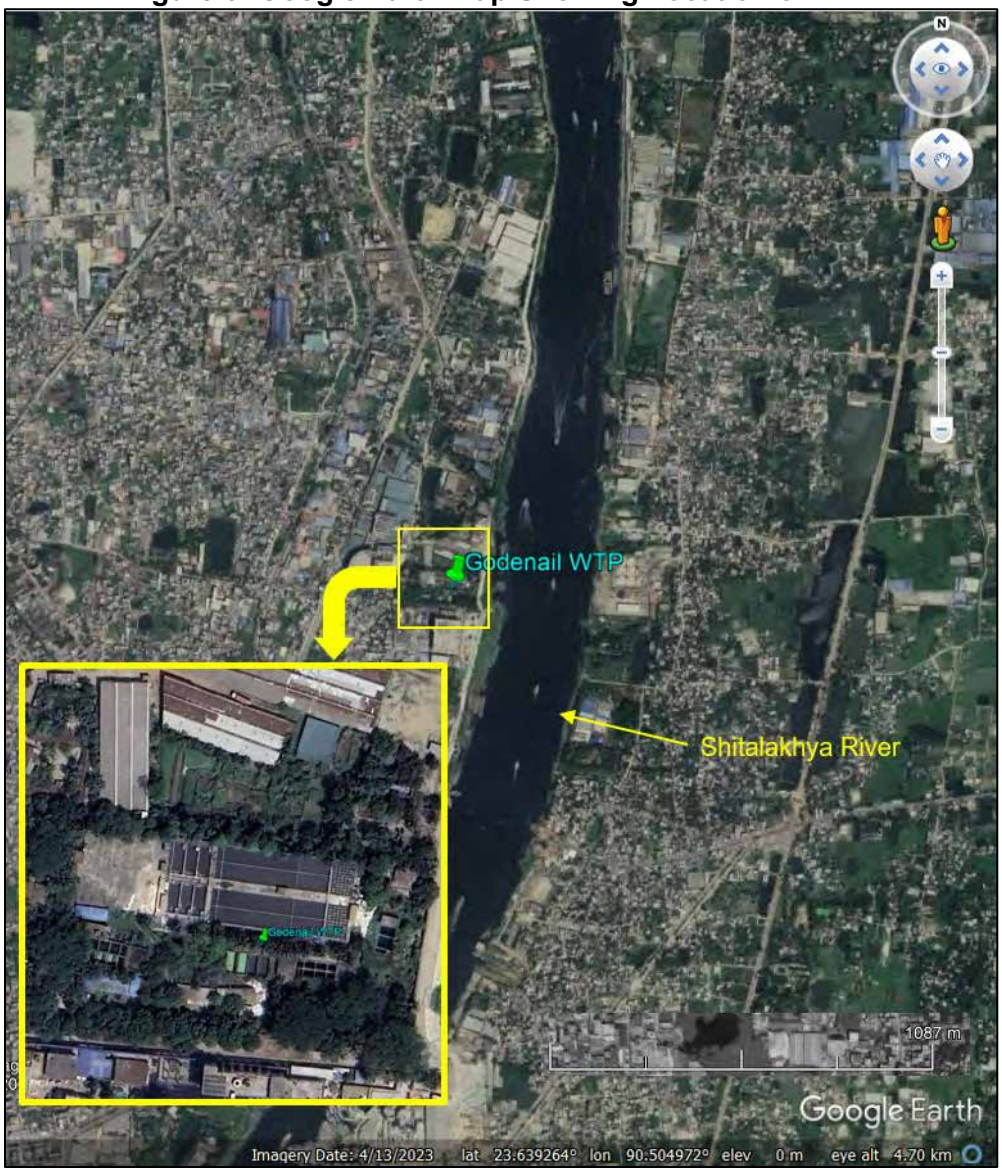
D. Rehabilitation and Upgrading of Godenail WTP

1. Background and Status of the Existing Infrastructure

The Godenail WTP was commissioned in the year 1990, with a design capacity of 45 MLD. The treatment plant was built over a 20,955.05 m^2 land located at the bank of the Shitalakhya river. Google Earth map showing the location of the WTP is in

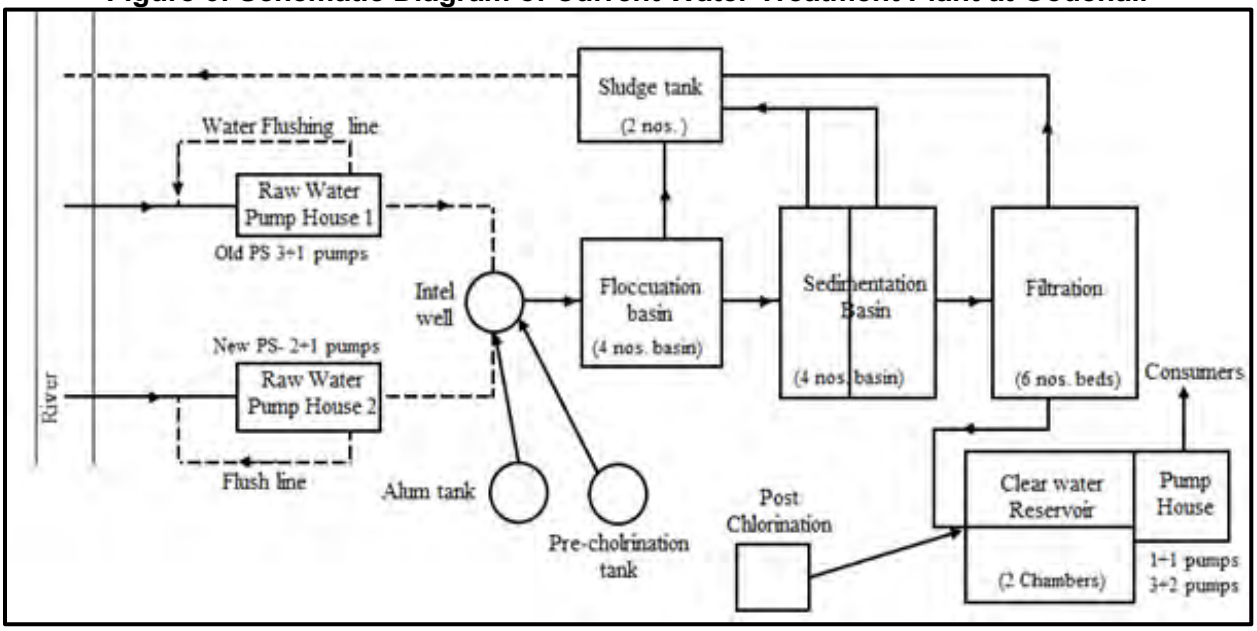
55. Figure 5 below.

Figure 5: Google Earth Map Showing Location of WTP



56. Per design, water is abstracted from the river via raw water pipeline structure. The current components of the WTP are: (i) intake pipe and raw water pumping system, (ii) inlet/receiving well and chemical dosing system (ammonium sulphate, alum and liquid chlorine), (iii) flocculation and sedimentation basins, (iv) filtration system, (v) sludge tanks, and (vi) clear water reservoirs (including post chlorination) and pumping system. The current treatment process is depicted in the following schematic diagram.

Figure 6: Schematic Diagram of Current Water Treatment Plant at Godenail



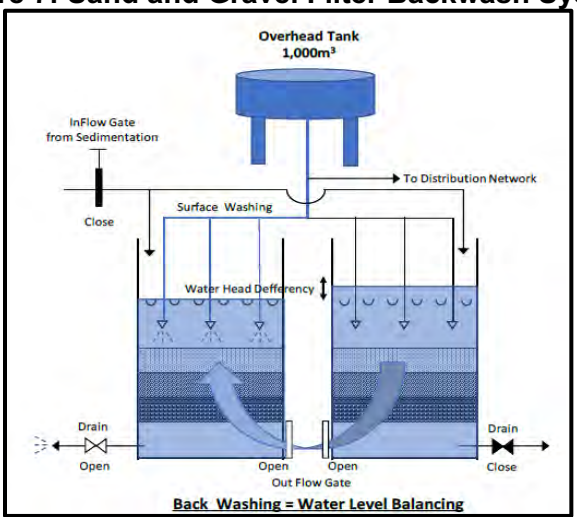
57. **Intake structure and raw water pumping system**. This component consists of intake pipe and grit chamber. Water flows by gravity to the grit chamber from the river through a 800-mm diameter intake pipe. Three new low lift pumps and three old low lift pumps with 55 kW motors in each are being used to pump water from the grit chamber to a receiving basin through 500-mm diameter pipe.

58. **Inlet well and chemical dosing system**. From the receiving basin, the water flows to another tank (inlet well) functioning as a mixing chamber where chemicals are mixed. These chemicals include coagulants (alum) and disinfectants (ammonium sulfate and liquid chlorine).

59. **Flocculation and sedimentation basins**. Raw water from inlet well is pumped into the flocculation basin where flocs form and then settle in the sedimentation basin. There are two flocculation basins which consist of vertical baffling types, and two hopper basins. The sedimentation basins consist of tanks and pipe gallery. Sedimentation basin is configured with four horizontal channel chambers with capacity of 1,413 cu.m. each chamber.

60. **Filtration system**. From the sedimentation basin, the partially treated water flows to the filtration system (rapid sand filter) consisting of six filter units. This filtration system has a backwashing mechanism and underdrainage system. The filter backwash system is shown in the following figure.

Figure 7: Sand and Gravel Filter Backwash System



61. **Sludge Tanks**. There are two sludge tanks which store all the sludge generated from the flocculation, sedimentation and filtration system. The supernatant liquid is discharged back to the Shitalakhya river. These sludge tanks are desludged with the recovered sludge dried in open areas around the WTP.

62. **Clear water reservoirs**. The clear water from the filtration system is pumped into the two clear water reservoirs. Capacity of each chamber is 2,100 cu.m. Post chlorination device is installed over the clear water reservoirs in order to inject liquid chlorine. With high lift pumps, treated water from clear water reservoirs is pumped and stored into 3 overhead tanks from where water is supplied to distribution line. These overhead tanks act as balancing reservoirs.

63. Due to aging and lack of proper maintenance, the efficiency of the WTP has declined over the years. The production capacity has been reduced to 24.6 MLD in an effort to still utilize the facility. Many of the components of the WTP are already not functioning. The original design of the intake does not have the necessary protection structures. The feasibility study for the upgrading of the WTP found that sediments and other debris have already accumulated near the tip of the intake pipe. In addition, rust humps may have formed inside the intake pipe due to deterioration, with shells and other substances may have also adhered to the inner surface of the pipe. All these conditions contribute to insufficient water flow into the intake well. Dredging is carried out every year to clear the siltation around intake point, but this has not been very effective. Figure below shows the current condition at the site.

Figure 8: Current Condition at WTP Site

Overlooking Shitalakhya River from WTP site, the pump house and inlet water chambers on the foreground

Intake Pump House

Receiving Well and Chemical Injection Basin

Flocculation and Sedimentation Basins (capacity not fully utilized)

Chlorine Storage and Chlorine Injection Building

Sludge Tank

Monitoring Room (closed and not being utilized)

Inside the monitoring room (closed and not being utilized)

Existing DTW at site (operating but with some leakages)

OHT serving the WTP

Solid wastes (empty chemical containers) accumulated at site

Solid wastes (packaging materials) accumulated at site

65. **Treated Water Quality**. An assessment of the water quality in three different seasons [i.e. winter/lean (25 February), pre-monsoon/summer (12 May), and monsoon (17 September)] after treatment in WTP on the parameters such as turbidity, conductivity (test for total dissolve solids), Ammonia (NH_3), Manganese (Mn), chemical oxygen demand (COD) and biological oxygen demand (BOD). Results suggest that the facility is unable to meet the Bangladesh national

drinking water quality standards (NDWQS). Table below shows that the results of water quality test conducted on the above-mentioned parameters.

Table 12: Comparison of water quality results of Godenail WTP

S.N	Paramerters	Unit	Test Date '2018.02.25		Test Date '2018.09.17		Test Date '2019.05.12)		Water Quality Standard		
			Intake Point	Delivery Point	Intake Point	Delivery Point	Intake Point	Delivery Point	Bangladesh, ECR'-97	WQ standard in Japan	
										WQ Item	Value
1	pH	-	7.25	7.21	6.8	6.9	7.1	7.1	6.5~8.5	pH	5.8~8.6
2	Turbidity	NTU	**51.3**	**24.1**	50.5	0.8	**27.5**	**5.13**	10	Turbidity	2
3	TDS	mg/L	391	450	94	101.3	243	319	1,000	TDS	Less than 500mg/L
4	Conductivity	μS/cm	**828**	**949**	**184.1**	**192.3**	**455**	**599**	-	Conductivity	100~10μS/cm
5	Total Hardness	mg/L	176	260	68	70	136	148	200~500	Total Hardness	Less Than 300mg/L
6	Alkalinity	mg/L	270	275	50	60	150	140	400	Alkarlinity	More than 10mg/L
7	Color、True	Pt.Co.Unit	**3.5**	**12**	20	2	-	-	15	Color	Less than 5
8	Residual Chlorine	mg/L	-	0.3	-	0.2	-	0.3	0.2~0.5	Residual Chlorine	0.1 mg/L
9	Chloride	mg/L	115	165	19	20	29	63	150~600	Chloride	Less Than 200 mg/L
10	Iron、Fe	mg/L	0.682	0.598	1.116	0.032	0.330	0.05	0.3~1.0	Iron, Fe	0.3 mg/L
11	Manganese	mg/L	**0.205**	**0.196**	0.044	0.046	**0.165**	**0.151**	Less Than 0.1mg/L	Manganese	0.05 mg/L
12	Ammonia-N	mg/L	**10.675**	**8.160**	0.293	0.000	**4.05**	**1.11**	Less Than 0.5mg/L	Anmonia-N	Less than 0.1 mg/L
13	Phosphate- PO4	mg/L	3	2.302	1.087	0.058	1.16	0.21	Less Than 6.0 mg/L	Phosphate- PO4	–
14	Sulfate-SO4	mg/L	65.8	78	23.7	40	36	59	Less Than 400mg/L	Sulfate-SO4	Less Than 200mg/L
15	Nitrate-N	mg/L	2.1	8.1	1.9	1	0.8	2.5	Less Than 10mg/L	Nitrate-N	
16	Aluminium - Al	mg/L	-	0.167	-	0.046	-	0.05	Less Than 0.2mg/L	Aluminium - Al	0.2 mg/L
17	Chromium - Cr^{6+}	mg/L	0.022	0.028	0.003	0.006	0.007	0.01	Less Than 0.05mg/L	Chromium - Cr^{6+}	0.05 mg/L
18	BOD	mg/L	**32**	–	5.5	–	**15.5**	–	Less Than 0.2mg/L	BOD	Less Than 1.0 mg/L
19	COD	mg/L	**62.2**	**36.6**	**9.4**	**3.5**	-	-	Less Than 4mg/L	COD	Less Than 2.5 mg/L
20	Total Coliform	N/100mL	–	0	–	0	0	0	0	Total Coliform	Not detected

2. Rehabilitation and Upgrading Works

66. The poor quality of treated water from the WTP (i.e. "delivery point" column in Table 12 above) suggests the inefficiency of the WTP to treat water towards compliance with the NDWQS. Based on assessment,[17] this is attributed to the deterioration of the WTP components due to lack of regular maintenance. To address this, the rehabilitation of the entire WTP will involve restoration of various original components, replacement of pipes, pumps and other appurtenances, and construction of new structures to replace the old dilapidated structures such as , administration building, chlorine storage and injection building, guard house and storage room.

67. Further, the apparent worsening quality of raw water from the Shitalakhya river also contributed to the inefficient functioning of the WTP (footnote 8). When the WTP was built in 1990 (more than three decades ago), its design was based on the significantly better quality of raw water from the same river during that period. But with the commercialization and industrialization in central Bangladesh, plus the increasing urban population, that took place in the last three decades, the quality of Shitalakhya river has deteriorated significantly due to discharges from these development activities. A simple rehabilitation of the WTP and retaining its original design as developed in the 1990s will not be enough. Treating the high levels of organic and inorganic load to comply with the NDWQS levels of 0.2 mg/l for BOD, 4 mg/l for COD and 0.5 mg/l for Ammonia-N will be difficult for the existing WTP regardless of its rehabilitation.[18] Thus, to address this concern, an upgrading in treatment process has been proposed as well. An additional biological treatment component is needed to help reduce the pollution load of the raw water from

[17] Design Report For Rehabilitation of Godenail Water Treatment Plant. October 2022.
[18] National Drinking Water Quality Standards from ECR, 1997. It is noted that the new ECR, 2023 does not provide the standards for BOD and COD. The standard for Ammonia has been revised to 1.5 mg/l in the new ECR, 2023.

Shitalakhya river. The moving bed biofilm reactor (MBBR) technology was chosen for this purpose, which will be set up as the first stage secondary treatment for the WTP.

68. Both the rehabilitation and upgrading of the WTP will aim at coping up with these negative factors, and thereby bring the production capacity back to the original design of 45 MLD and treat the water to quality within the NDWQS.

69. Furthermore, the existing WTP has no effective sludge management. Accordingly, the sludge generated from the treatment process is just stored or spread over the open spaces within the WTP compound. The supernatant liquid from the sludge tanks is also discharged directly to the Shitalakhya river (footnote 8). Thus, the upgrading of the WTP will also include the setting up of an effective sludge management system through the construction of sludge drying lagoons/beds. The supernatant liquid will be recycled back to the system. The ultimate design for this recycling scheme will be completed during the detailed design phase. No discharge to Shitalakhya river will occur after the rehabilitation is completed.

70. Figures below show the process flow of the existing WTP and the new process flow after the upgrading works.

Figure 9: Existing Process Flow of WTP

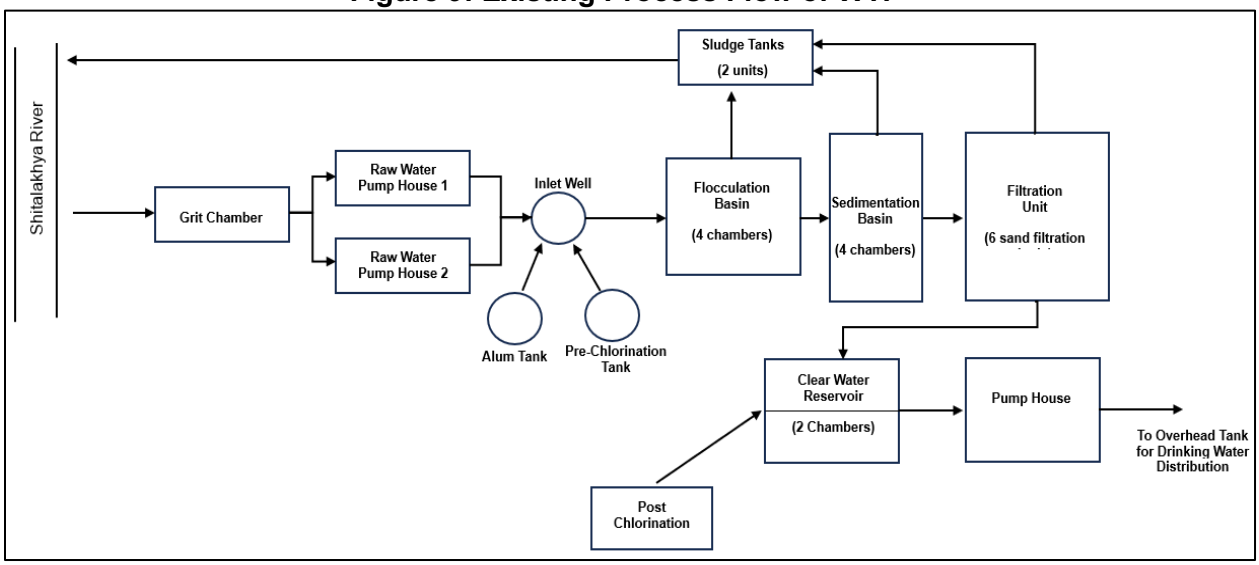
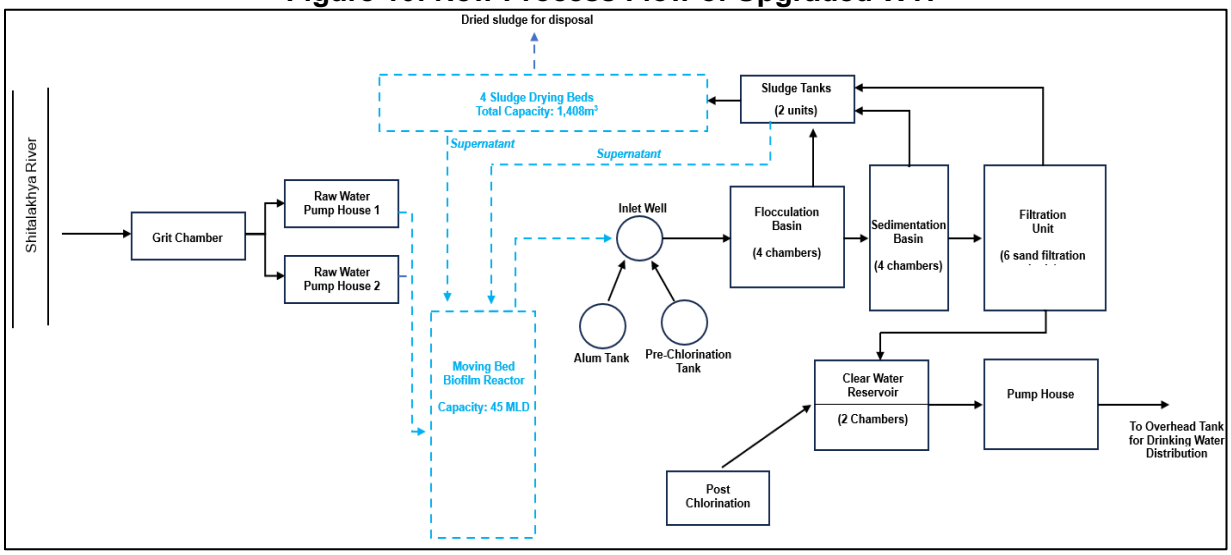


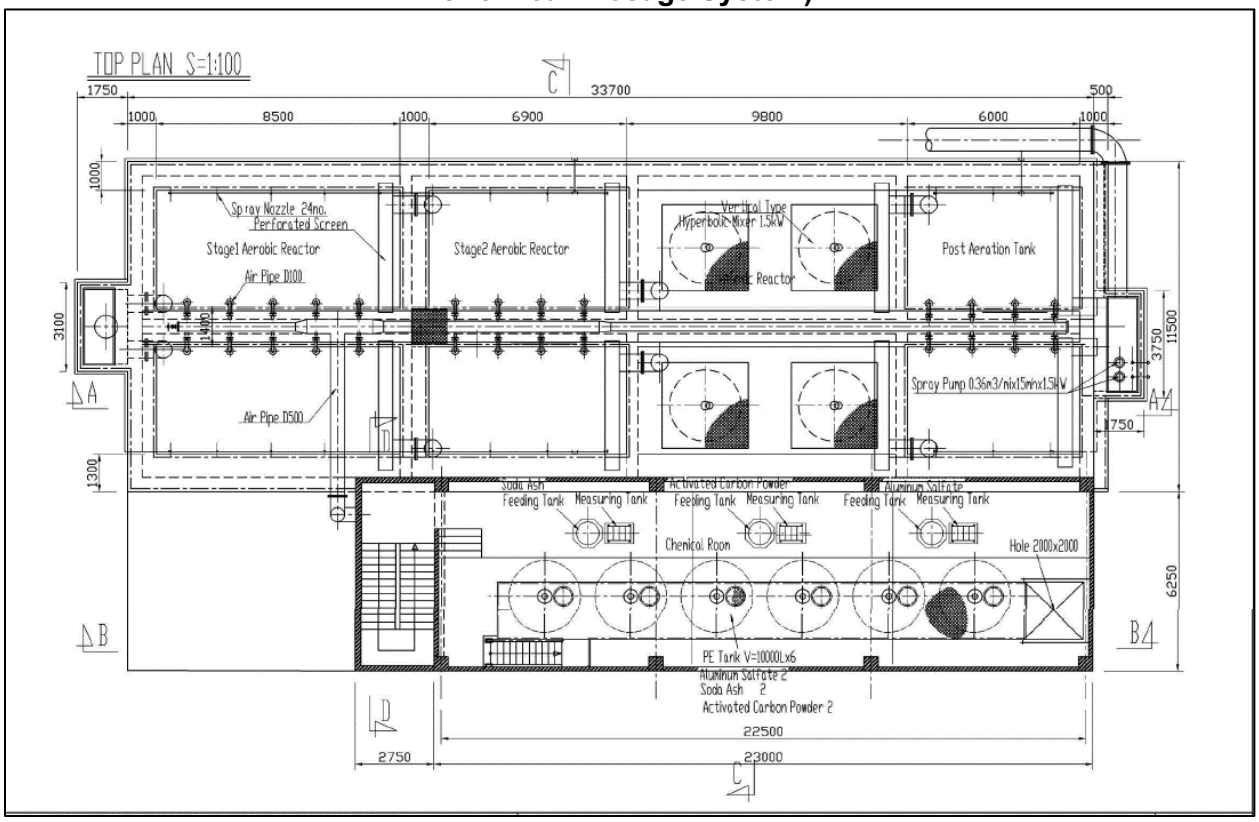
Figure 10: New Process Flow of Upgraded WTP



71. **Construction of Moving Bed Biofilm Reactor (MBBR) System.** The MBBR is the new component that will be added to the overall WTP design. MBBR is an attached growth biological water treatment process in which the microorganisms that carry out the treatment are attached to a solid medium, similar to the mechanism in trickling filter or rotating biological carriers/contactors. The bacteria/activated sludge grow on the interior surface of the solid medium/carriers. The bacteria break down the organic matter from the water and the aeration system keeps the carriers with activated sludge in motion. The carriers can be recycled after a set-period, depending on contamination level of in the inlet/ source water.

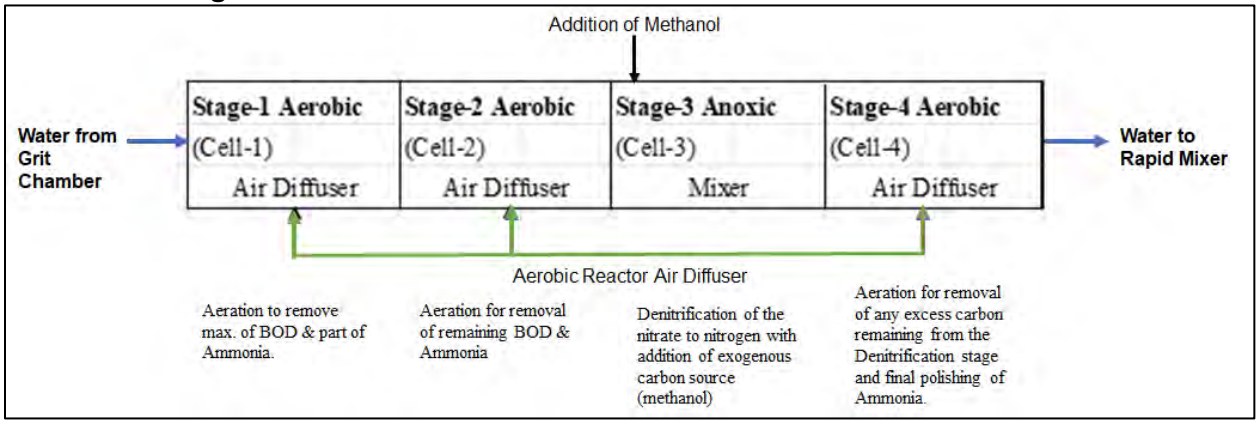
72. The MBBR process will have four-stage aerobic and anerobic treatment as depicted in the following diagrams (**Figure 11** and **Figure 12**).

Figure 11: Top View Plan of MBBR (with Aeration Tank, Ethanol Dosage tank and other Chemical Dosage System)



Source: Design Report For Rehabilitation of Godenail Water Treatment Plant. October 2022.

Figure 12: Schematic Presentation of MBBR Treatment Process



Source: Design Report For Rehabilitation of Godenail Water Treatment Plant. October 2022.

73. A chemical room comprising storage tanks, feeding tanks with bole tap, and measuring tank will be constructed as part of the system.

74. The MBBR process will essentially reduce the high level of BOD and ammonia nitrogen in the raw water from Shitalakhya river. The MBBR will be designed to treat maximum values of source water quality on the following parameters: (i) BOD of 32 mg/L, and NH3-N of 10.7 mg/L. Although still at concept stage and will be finalized during the detailed design, the MBBR would be able to partially treat the water towards the following values: (i) BOD of 3 mg/L, (ii) NH3-N of

1.6 mg/L, (iii) NO3-N of 6.8 mg/L, and (iv) Total N of 9.03 mg/L.[19] Basic calculations have been done, which arrived at these figures. Summary of these calculations are in Appendix 2. With these significant levels of pollution load reduction after the MBBR, it is expected that the rest of the components of the rehabilitated WTP will already be able to fully treat the water towards compliance with the NDWQS.

75. **Rehabilitation of intake structure and raw water pumping system**. The old intake pipe will be fully replaced with new ductile iron pipe of 800mm diameter and connect to the intake pipe of the existing grit chamber. The grit chamber will be cleaned and restored. With the old intake structure built in the 1990s, no appropriate intake protection structures were built. The rehabilitation works will include the necessary protection structure to (i) prevent debris from entering the intake pipe, and (ii) ensure no navigational vessels could damage the intake pipe. All details of the rehabilitation works will be finalized by the DBO contractor during the detailed design phase.

76. **Rehabilitation of the inlet well and chemical dosing system.** The inlet well will be restored and installed with mechanical rapid mixer to ensure complete mixing of chemicals during the process. All details of the rehabilitation works will be finalized by the DBO contractor during the detailed design phase.

77. **Rehabilitation of flocculation and sedimentation basins.** The flocculation and sedimentation basins will be restored by repairing damaged parts and/or replacing defective components such as the baffles or any other smaller parts. All details of the rehabilitation works will be finalized by the DBO contractor during the detailed design phase.

78. **Rehabilitation of the filtration system**. The filtration ponds will be restored and/or repaired for any damaged parts, and the filter sand and gravel will be replaced. The backwashing system will also be restored and/repaired to ensure the filter backwash system works efficiently. All details of the rehabilitation works will be finalized by the DBO contractor during the detailed design phase.

79. **Rehabilitation of sludge tanks.** The sludge tanks will be restored and/or repaired for any damaged parts. All details of the rehabilitation works will be finalized by the DBO contractor during the detailed design phase.

80. **Rehabilitation of clear water reservoirs.** The two clear water reservoirs will be restored and/or repaired for any damaged parts. Damaged mechanical parts such as chlorination devices, and lift pumps will be replaced. All details of the rehabilitation works will be finalized by the DBO contractor during the detailed design phase.

81. **Construction of sludge drying lagoons/beds**. The sludge generated from the flocculation basins, sedimentation basins and rapid sand filter units will need to be handled properly in the WTP. The indiscriminate disposal of sludge in open areas of the WTP or discharge of sludge liquid to the Shitalakhya river is unacceptable as far as environmental management is concerned. Best practices require that sludge should be contained and dried in lined surfaces in order to prevent any potential contamination of soil. Thus, the rehabilitation of the WTP will include the construction of new sludge drying beds. Based on the current assessment of source water quality, turbidity, and therefore amount of coagulant required for settling, about 35 m^3 of sludge is expected to be generated each day of operation. With this, four drying ponds of dimension 16.0

[19] Design Report For Rehabilitation of Godenail Water Treatment Plant. October 2022.

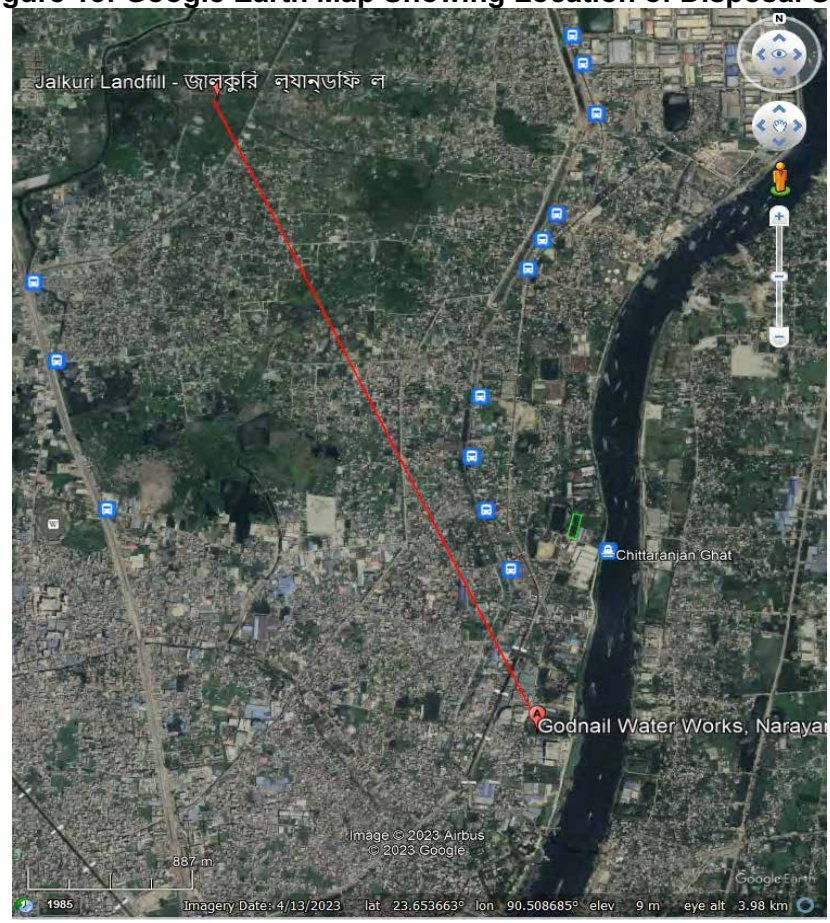
m (width) x 22.0 m (length) x 1.0 m (height) will be required to accommodate sludge generated for 10 days. Based on seasonal temperature, it is estimated that it will take less than 20 days to attain dried cake having 60% - 65% of moisture. Each bed will have perforated pipes below the sand and gravel bed to collect the drained liquid. A layer of sand and gravel each of thickness 200 mm will be spread over the perforated pipes as drainage layers (footnote 8). The ultimate design for the sludge management system will be finalized during the detailed design phase.

E. Sludge Management and Disposal

82. During the detailed design phase, the sludge management system will be designed to ensure effective handling of the dried sludge, including the testing of sludge quality and frequency of sludge disposal. Dried sludge may be used as soil conditioner depending on its quality, or disposed to disposal site at Jalkuri Landfill Site (See Figure 11 and Figure 12).

83. Jalkuri disposal site is about 4.5 km away from the WTP as shown in Figure below. Wide and 2-way city roads connect the city center to this disposal site. There is no potential access issue exists to this disposal site. The disposal of the dried sludge will be dependent on the volume of sludge generation to ensure no accumulation of dried sludge occurs in the WTP complex. Based on initial calculation, disposal is required once every 10-20 days but may be more often when sludge generation is higher during high turbidity seasons. This frequency of disposal will be adjusted accordingly during the operation phase.

Figure 13: Google Earth Map Showing Location of Disposal Site



84. Accordingly, an area in the disposal site will be dedicated for the dried sludge. However, initial assessment revealed that this landfill site is nearing its full capacity, and there is an indication that the wastes are not properly managed due to apparent inadequate heavy equipment and personnel. While the plan of the subproject is to dedicate an area for the sludge disposal within this disposal site, no specific area was identified yet as of the conduct of IEE study. During the detailed design stage, the DBO Contractor will continue to consult with the operator of the landfill site to finalize the specific location for the disposal of the dried sludge. Development of this consultation and final arrangement will be included in the updating of the IEE for the subproject.

Figure 14: Aerial Visual of Jalkuri Sanitary Landfill Site

F. Rehabilitation of Existing Deep Tube Wells

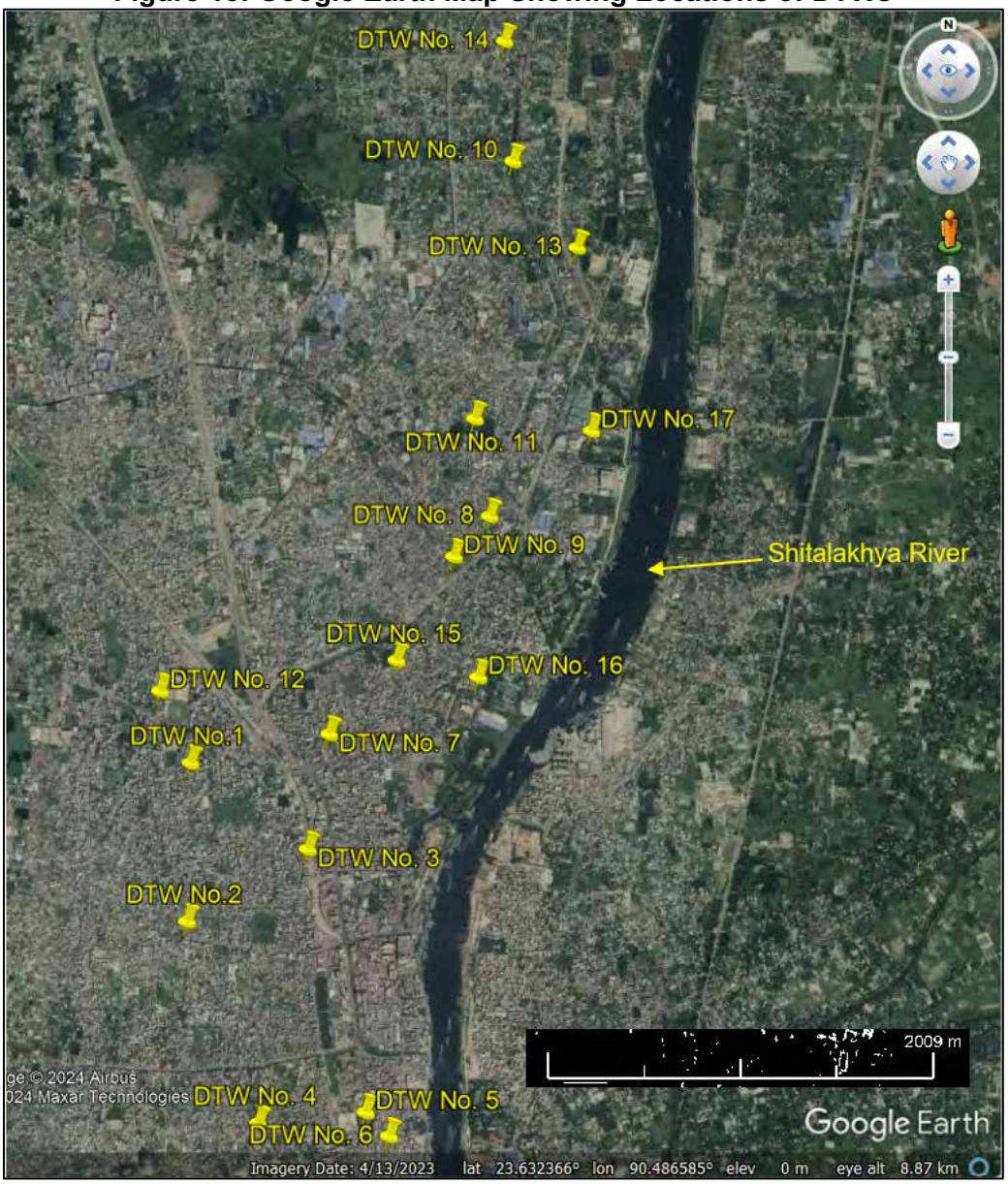
1. Background and Status of Existing Infrastructure

85. There are 17 DTWs within DMZ1 and DMZ2 and operating an average of 22 hours per day, of average capacity of 1,000 liters/minute each. There are online flow meters at the outlets, but non-functional, thus data could not be obtained. The borewells were installed between 2003 and 2017. Currently, 70% water supply in NCC is from ground water and 30% water supply is from surface water. Table 13 below summarizes the locations of these DTWs. Google Earth maps showing the exact locations are in Figure 15. Drawn to scale maps showing these locations are in Appendix 3.

Table 13: Location Details of DTWs to be Rehabilitated

Serial ID	Name of DTW	Latitude	Longitude	DMZ	DMA	Ward_No
1	Bhuiyar Bagh DTW	23.623491	90.493359	DMZ-1	DMA-13 (1)	Ward-13
2	Dewbhog DTW	23.615912	90.493136		DMA-14	Ward-14
3	Golachipa DTW	23.619355	90.499503		DMA-14	Ward-14
4	Paikpara DTW	23.606409	90.496788		DMA-17	Ward-17
5	Nitaigonj DTW	23.606927	90.502371		DMA-15	Ward-15
6	Shitalakhya DTW	23.605805	90.503575		DMA-18	Ward-18
7	Bag E Jannat DTW	23.624874	90.500696	DMZ-2	DMA-12	Ward-12
8	Killarpul Mazar DTW	23.635464	90.509369		DMA-11	Ward-10
9	Poschim Tolla DTW	23.633488	90.507432		DMA-11	Ward-11
10	Chowdhuri Bari DTW	23.653133	90.510961		DMA-8	Ward-08
11	Pathan Tuli DTW	23.640273	90.508659		DMA-8	Ward-08
12	Masdair DTW	23.62695	90.49177		DMA-13 (1)	Ward-12
13	Arambag DTW	23.648791	90.514342		DMA-8	Ward-08
14	Dhanokunda DTW	23.659238	90.510637		DMA-8	Ward-08
15	Khanpur Bank Colony DTW	23.628438	90.504303		DMA-12	Ward-12
16	DC Bungalow DTW	23.627625	90.508614		DMA-12	Ward-12
17	Godenail DTW	23.639668	90.514887		DMA-10	Ward-10

Figure 15: Google Earth Map Showing Locations of DTWs



87. As the ground water availability may reduce overtime, and some of them likely to be contaminated in the far future due to potential land-based pollution sources, existing DTWs will be phased out after construction of a long term water supply system which will source water from the Meghna river, which is about 6km from the NCC area. But the investment for this future system remains a plan for the long term and implementation may only happen in 10 – 15 years from to date. In the short to medium term, the rehabilitated DTWs and WTP will be the primary sources of drinking water for the NCC area.

2. Rehabilitation Works

88. Initial assessment of the conditions of selected DTWs has been undertaken during subproject preparation to gain information as to the likely issues that need to be addressed for the rehabilitation. **Error! Reference source not found.** shows a summary of the results of this i

nitial assessment of physical conditions of the DTWs, and Table 14 shows the quality of groundwater from these existing DTWs. The sampling activities were undertaken in January, February and May 2023, which copies of laboratory results included in Appendix 4. Compared with the NDWQS, the quality of sampled groundwater registered elevated manganese concentration in 14 of the 17 DTWs, elevated BOD in all 17 DTWs, and elevated COD in 13 of the 17 DTWs.

Table 14: Results of Initial Assessment of Condition of DTWs

S. No.	DTW	Pump Condition	Water Availability (lit/min)
1	Bhuiyar Bagh DTW	Flow meter needs replacement	To be determined
2	Dewbhog DTW	Good (as of March 2001). To be assessed.	2700
3	Golachipa DTW	In railway property; no space for new pump. Old Pump is out of order. To be further assessed.	3000
4	Paikpara DTW	Working, but flow meter needs replacement	2600
5	Nitaigonj DTW	Working, but flow meter needs replacement	3100
6	Shitalakhya DTW	Good (as of February 2021). To be assessed.	1500
7	Bag E Jannat DTW	To be assessed.	2800 reduced to 1700
8	Killarpul Mazar DTW	Return valve needs replacement.	2500
9	Poschim Tolla DTW	Flow meter needs replacement. Two existing pumps, with one being installed	To be determined
10	Chowdhuri Bari DTW	To be assessed.	2500
11	Pathan Tuli DTW	To be assessed.	To be determined
12	Masdair DTW	Working, but flow meter needs replacement	1800
13	Arambag DTW	Good (as of 2018). To be assessed.	3000
14	Dhanokunda DTW	To be assessed.	To be determined
15	Khanpur Bank Colony DTW	Flow meter needs replacement.	4400
16	DC Bungalow DTW	To be assessed.	To be determined
17	Godenail DTW	Flow meter needs replacement.	2600

Table 15: Groundwater Quality from Existing DTWs

Parameters	Ammonia	BOD	COD	Coliform (Fecal)	Colour	Cr (Total)	EC	Hardness	Fe	Mn	Nitrogen (Nitrate)	pH	Phosphate	Salinity	(TDS)	Turbidity
Unit	mg/L	mg/L	mg/L	N/100ml	Hazen	mg/L	µS/cm	mg/L	mg/L	mg/L	mg/L		mg/L	%	mg/L	NTU
GW1	0.12	2	12	0	0.9	0.009	420	165	0.8	0.03	0.8	7.4	0.8	0.21	210	0.79
GW2	0.1	11	48	45	0.85	0.009	325	120	0.44	0.03	0.2	7.4	0.94	0.16	162	0.82
GW3	0.14	3	12	0	0.91	0.007	370	130	0.8	0.06	1.2	7.3	0.37	0.18	185	1.4
GW4	0.14	1	4	2	1	0.01	471	225	1.4	0.53	1.3	7.2	1.1	0 .21	208	9.2
GW5	0.1	11	40	0	1.2	0.008	366	140	0.37	0.48	1.9	7.2	0 .20	0.18	183	2
GW6	0.12	5	24	0	0.96	0.01	1550	2100	0.2	2.04	0.1	6.3	0.26	0.78	776	1.1
GW7	0.11	2	8	0	0.9	0.009	415	160	0.26	0.08	0.1	7.1	0.27	0.21	207	0.8
GW8	0.12	1	4	0	0.97	0.011	410	205	0.64	0.24	0.7	7.1	0.38	0.21	205	1.1
GW9	0.1	2	8	20	0.92	0.006	510	140	0.31	0.17	1.5	7	0.46	0.26	255	0.8
GW10	0.1	1	4	2	0.9	0.016	1840	2350	0.23	1.97	0.8	6.5	0.4	0.92	920	1.3
GW11	0.1	2	8	0	0.98	0.008	1245	1300	0.42	2.06	0.7	7.1	0.17	0.62	622	1
GW12	0.12	7	24	0	0.97	0.012	320	195	0.46	0.06	2.3	7.1	0.13	0.16	160	1
GW13	0.1	3	8	0	1	0.006	460	215	0.66	0.31	1	7	0.24	0.23	230	5.1
GW14	0.1	2	8	2	0.96	0.007	760	230	0.6	1.31	1.1	6.8	0.25	0.38	380	1.7
GW15	0.14	1	4	0	1.1	0.009	980	307	0.76	1.35	0.4	6.7	0.13	0.49	490	6.5
GW16	0.12	1	4	0	0.98	0.006	350	180	0.55	0.5	0.7	7.1	0.19	0.18	175	2.1
GW17	0.19	7	32	0	2.3	0.014	2750	2600	3.6	5.21	0.1	6.5	0.44	1.38	1375	35.2
Standards (ECR, 2023)	1.5	0.4[a]	4[a]	0	15	0.05	-	500	0.3-1.0	0.04	45	6.5-8.5	-	-	1000	5

[a] Values for BOD and COD are taken from ECR, 1997. The ECR, 2023 does not have standards for BOD and COD.

89. In view of the results of initial assessment, the following will be covered for the rehabilitation works:

(i) Replacement of flow meters;
(ii) Plastering of pump house structures;
(iii) Repair of pump house doors, windows and steel grills;
(iv) Repair of boundary walls using mild steel angle bars;
(v) Fencing;
(vi) Rehabilitation of chlorination units;
(vii) Introduction of treatment units to treat elevated manganese, BOD and COD concentrations.

90. Complete assessment for all the DTWs will be undertaken during the detailed design stage. Any DTWs or any parts/components thereof that are found to be defective, similar rehabilitation works will be undertaken and funded under the subproject. For DTWs from where sampled water registered non-compliance with the standards for manganese, BOD and COD parameters, the final detailed design should include appropriate treatment for these parameters. This requirement will be included in the subproject cost and in the bidding and contract documents.

G. Rehabilitation of Existing Overhead Tanks

1. Background and Status of Existing Infrastructures

91. There are 8 overhead tanks (OHTs). Each OHT has four sets of pipes – Inlet, Outlet, Overflow and Scour pipe. Each OHT has 20-m staging height. There are no flowmeters or level meters installed in any of the OHTs. Out of the 8 OHTs, only 3 OHTs are currently in operation. These are the Khanpur Zora OHTs 1 and 2, and the Godenail Water Works OHT. These OHTs are within compounds located in the inner boundary of the city. These locations are in relatively flat topography surrounded by pockets of mixed-use communities of residential, commercial, institutional and/or industrial. Within these compounds are typical and common vegetations and trees found elsewhere in the city. No environmentally sensitive features within and around the locations. Typical surroundings of the OHTs is shown in figure below.

Figure 16: Typical Surroundings in OHT Compounds

92. **Khanpur Zora OHTs 1 and 2**. These are two circular elevated tanks constructed in the year 1986 with capacity of 2,000 cu.m. each. Water from Godenail WTP is delivered to these tanks by high lift pumps and is supplied to distribution lines two times daily and 3 hours each occasion (6:00 am to 9:00am and 3:00pm to 6:00pm). Height of both tanks are 20 m (from ground level to the bottom of the elevated tank). From these tanks, water flows down to the distribution network through pipelines with sizes of 300 mm and 500 mm. These tanks are also equipped with overflow pipes with size of 300 mm and drainage pipes with size 200 mm diameter. All pipelines are made of ductile iron (DI) pipes.

93. **Godenail Water Works OHT**. This tank was constructed in the year 1986. Capacity of the circular tank is 1,000 cu.m. This OHT is currently being used together with the two Khanpur OHTs. The tank has a height of 22.30m from ground level to bottom of the tank, inner diameter of 16.10m and average circular tank depth of 6.0m. From this tank, water flows down to the distribution network through a pipeline with sizes of 300mm and of 500mm. Similarly, this tank is also equipped with overflow pipe with size of 300 mm and drainage pipe with size 200 mm diameter. All pipelines are made of ductile iron (DI) pipes.

94. Table 16 below summarizes the locations of the 8 OHTs. Google Earth map showing the locations of these OHTs is shown in Figure 17. Drawn to scale maps showing these locations are in Appendix 3. Preliminary assessment noted that three other OHTs are in good condition and may be operated, while two other OHTs are in poor condition that will require rehabilitation.

Table 16: Details of OHTs in DMZ 1 and DMZ 2 – Geographical Location, Capacity and Operational Status

S. N	OHT_No	Name of OHT	Capacity (m_3)	Latitude	Longitude	DMZ	DMA
1	OHT_04	Paikpara OHT	300	23.606416	90.496567	DMZ-1	DMA-17
2	OHT_05	Nitaiganj OHT	900	23.607218	90.502257	DMZ-1	DMA-15
3	OHT_06	Dewbhog OHT	680	23.616052	90.49314	DMZ-1	DMA-14
4	OHT_07	Masdair OHT	1000	23.627058	90.491605	DMZ-1	DMA-13 (1)
5	OHT_08	DC Bunglow OHT	910	23.627574	90.508549	DMZ-2	DMA-12
6	OHT_01	Godenail OHT	1000	23.639677	90.514685	DMZ-2	DMA-10
7	OHT_02	Khanpur Zora Tank-1	2000	23.626238	90.505372	DMZ-2	DMA-12
8	OHT_03	Khanpur Zora Tank-2	2000	23.625933	90.505409	DMZ-2	DMA-12

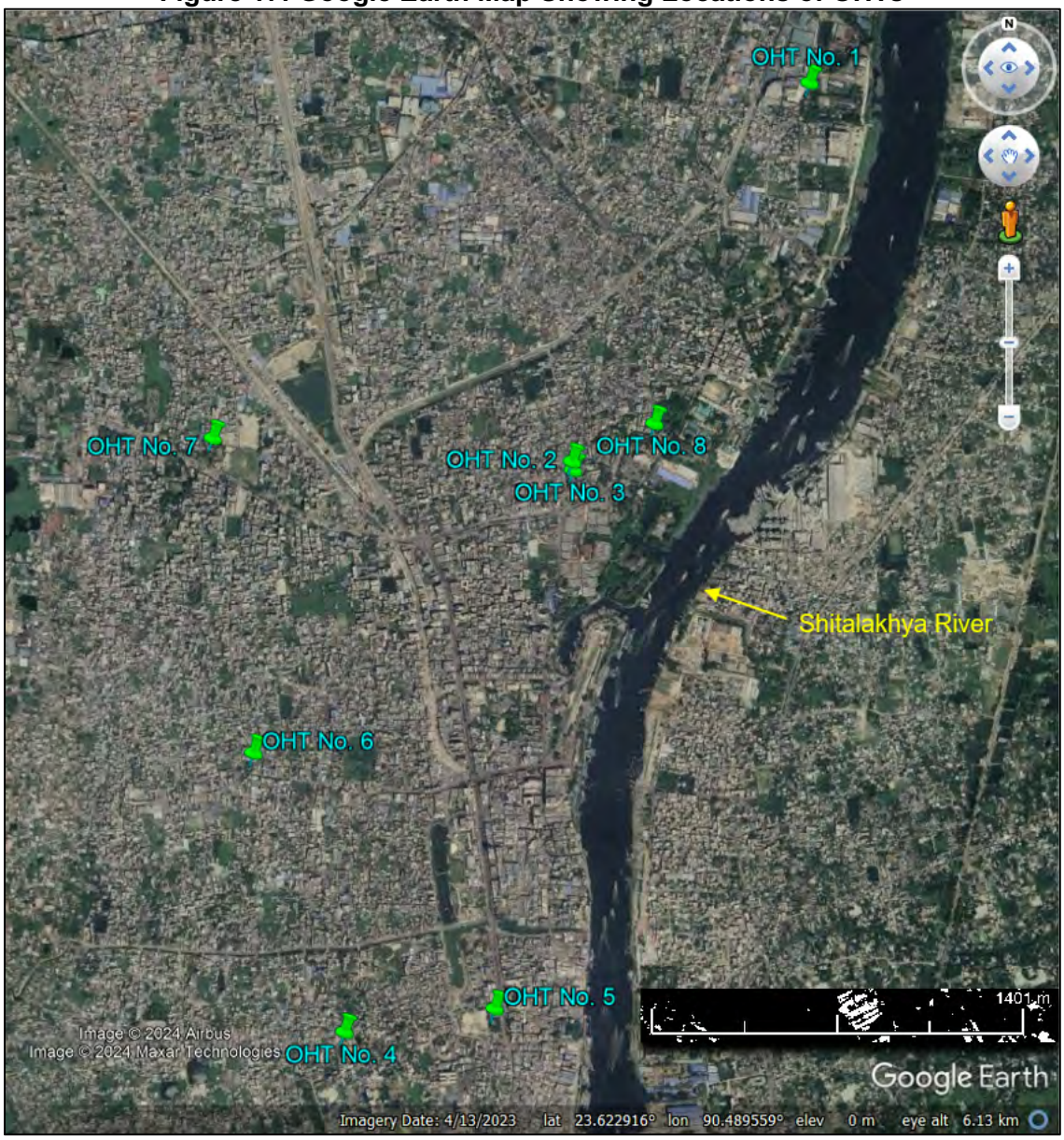
Operational Condition: Good and being operated

- Godenail OHT
- Khanpur Zora Tank-1
- Khanpur Zora Tank-2

Operational Condition:

Paikpara OHT – Good, and can be operated
Nitaiganj OHT – Good, and can be operated
Masdair OHT – Good, and can be operated
Dewbhog OHT – Poor, require rehabilitation
DC Bunglow OHT – Poor, require rehabilitation

Figure 17: Google Earth Map Showing Locations of OHTs



2. Rehabilitation Works

95. The existing OHTs will be rehabilitated by repairing the structural damages, leaks in the tanks and also by replacing dilapidated pipes, valves, malfunctioning overflow valves, flowmeters (if any), pits, ladders, etc. There will be no structural changes, hence no large demolition is envisaged.

H. Construction of New Transmission Pipeline and Distribution Network

1. Background and Status of Existing Infrastructure

96. The existing distribution network in Narayanganj extends to approximately 127.5 km, and comprises ductile iron pipe, uPVC pipe and asbestos cement (AC) which were laid dating back in

the 1970s with recent layout made between 2010 and 2016. Accordingly, AC pipe is estimated to have length of about 10.2 km. Leakage is high and only an intermittent supply is provided to the approx. 30,000 connections. The distribution system covers Wards 8, 10 to 18, 21 to 23, and supplies 58% of the resident population of NCC. The remaining 42% of the population is being served by NCC's borewells and private tube wells.

2. Rehabilitation and Upgrading Works

97. **Transmission Pipeline**. The subproject includes construction of 4.239 km of transmission pipeline that will convey water from the new PTWs constructed under Contract 2 going to the Khanpur Twin Towers. This transmission pipeline will commence from the receiving pit at the end of the river crossing pipeline (covered under Contract 2) that is adjacent the south bank of Mahmudnagar canal. See alignment **Figure 4** (blue line connecting the receiving pit and Khanpur Twin Tower OHT.

98. **Distribution Network**. The rehabilitation and upgrading works for the distribution network will involve replacement of existing network and construction of new alignments to reach unserved areas in NCC. As the pipes of the existing network are already old and leaking, the project will totally replace all these pipes with new ones. High-density polyethylene (HDPE) pipes and ductile iron (DI) pipes will be used for the subproject. Per preliminary design, DI pipes will only be used at the over-crossings such as bridge or culvert crossings. Determination of the lengths of HDPE pipes and DI pipes will be finalized by the DBO Contractor during the detailed design phase.

99. The HDPE pipelines will be laid applying mainly Horizontal Directional Drilling method (HDD). Where the HDD method is not suitable as per the site condition, then open trench excavation method shall be used. The existing utility networks including water supply and domestic gas supply lines will be located through consultation with NCC and utility operators, from existing blueprints and metal detection process such that the existing network are not disturbed. It will be the contractor's responsibility to complete such determination before start of any civil work and NCC will permit only when such determination has been completed to their satisfaction. Additionally, the existing water supply distribution network will continue to work as complete laying of pipeline will take 2-3 years of time. Once the new network is in place, the connection from the old network will be disconnected and households will be connected to the new network. The old network will be abandoned and left it underground. A digitized archive file will be maintained by NCC noting the placement of both old and new network lines, including the asbestos cement pipes. Table below summarizes the locations and measurements of the alignments. Drawn to scale maps showing these alignments are in Appendix 3.

Table 17: Total Length of Proposed New Distribution Pipeline in DMZ 1 and DMZ 2

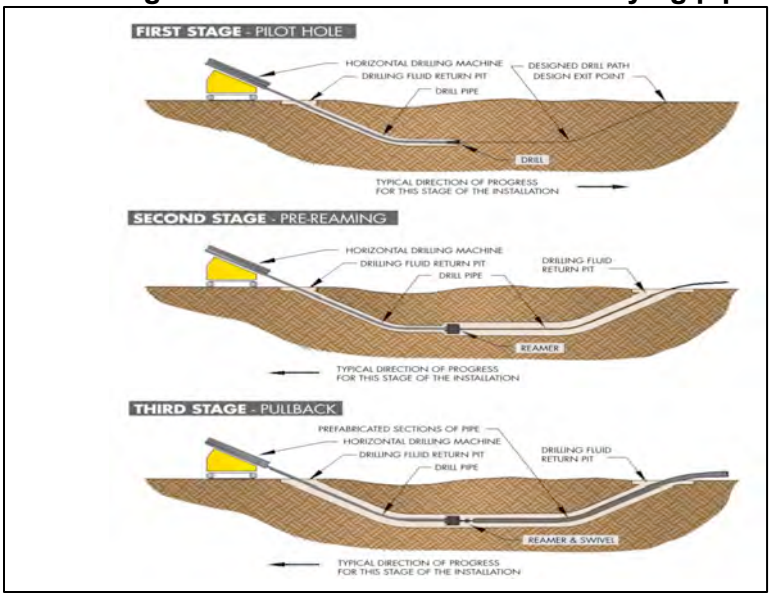
DMZ	DMA	Diameter (mm) Wise Pipe Length (in meter)									Total Length (m)
		100	150	200	250	300	350	400	450	500	
DMZ- 1	18	10,918	3,084	1,134	1,559	1,996		154	15	697	19,557
	17	7,309	2,309	1,321	14	359	348	72	19		11,751
	16	9,403	1,854	677	1,865	783	93	88	50		14,813
	15	10,255	4,039	806	431	203	18		94		15,846
	14	4,494	1,102	1,206	934	66		128			7,930
	13(1)	12,728	2,220	1,530	835	822	253	162	56	307	18,913

DMZ	DMA	Diameter (mm) Wise Pipe Length (in meter)									Total Length (m)
		100	150	200	250	300	350	400	450	500	
Sub-Total											88,810
DMZ- 2	13(2)	8,906	2,422	2,073	898	814	299	82	31	117	15,642
	12	24,549	6,782	601	263	1,347	926		29	12	34,509
	11	10,010	4,177	1,258	115		428	71		14	16,073
	10	9,022	1,941	1,121	486	185	440	825	18	384	14,422
	8	33,247	7,082	2,903	2,098	1,202	1,297	1,820	492	283	50,424
Sub-Total											131,070
Total – DMZ 1 and DMZ 2											**219,880**

3. Methodology for the Construction Works

100. **Horizontal Directional Drilling method**. Directional boring, also referred to as horizontal directional drilling (HDD), is a minimal impact trenchless method of installing underground utilities such as water pipelines in a relatively shallow arc or radius along a prescribed underground path using a surface-launched drilling rig. Directional boring offers significant environmental advantages over traditional cut and cover pipeline/utility installations. The technique is routinely used over conventional trenching when minimal surface disturbance is required such as at narrow lanes of Narayanganj. Directional boring/HDD is generally accomplished in three principal phases. First, a small diameter pilot hole is drilled along a directional path from one surface point to another. Next, the bore created during pilot hole drilling is enlarged to a diameter that will facilitate installation of the desired pipeline. Lastly, the pipeline is pulled into the enlarged hole, thus creating a continuous segment of pipe underground exposed only at the two initial endpoints. Figure below illustrates the process.

Figure 18: Stages of HDD Trechless Method of laying pipes



101. **Open Trench Method**. When the HDD method is not possible given any circumstances on the ground, the open trench excavation method will be used. In order to avoid any significant impact or potential damage to structures along the alignments, a set of protocol for excavation will be followed. Chapter V hereof provides a set of guidelines/protocol that can be adopted to address any anticipated impacts due to excavation activities within or near heritage sites, busy areas, residential areas, narrow lanes with sensitive or fragile structures, etc.

102. **AC Pipes.** NCC estimated that AC pipes have aggregate length of about 10.2 km which are laid in various parts of the existing network. The rehabilitation and upgrading of the distribution network will include identification of the locations of these pipes, including the depths, and documenting them as part of records of NCC. This record will allow NCC to monitor and/or restrict any future excavation activities in these areas and ensure that the abandoned AC pipes are not touched or damaged. NCC will implement this monitoring and/or restriction as part of its mandate in issuing necessary permits or licenses for any construction activities in the NCC area.

I. Implementation Schedule

103. The overall project is to be implemented over a period of 7 years. The detailed design stage has to be completed for a period of 6 months, and the construction period will cover about 18 months. The operation period for the contractor would be for 5 years, thereafter the asset(s) will be transferred to NCC.

IV. DESCRIPTION OF THE ENVIRONMENT

A. Introduction

104. This chapter provides the environmental baseline of the proposed subproject. Baseline data includes an inventory of parameters describing physical environment, ecological or biological environment, socio-economic environment, and physical cultural resources. Covering these environmental domains, data has been compiled for the following specific sub-domains:

(i) Land Environment;
(ii) Water Environment;
(iii) Atmospheric Environment;
(iv) Acoustic Environment;
(v) Ecological Environment;
(vi) Socio-economic Environment; and
(vii) Physical Cultural Resources.

105. Baseline environmental data gathering used both primary and secondary sources. The Integrated Biodiversity Assessment Tool (IBAT) was used to screen and assess potential risks on the protected areas or critical habitat that may exist around the subproject sites. Results of this screening were validated at the subproject sites and with relevant government agencies.

106. Statistical data on socio-economic environment used in this IEE report are the latest data available from official and published records of the government. The recency of some sets of data are as of previous years because these are the most recent data officially published or released so far. Nevertheless, the sources of data are indicated in the respective illustrations or tabulations.

B. Subproject Influence Area

107. The subproject influence area or impact zone varies per the type of interventions and the environmental and socio-economic settings of the area where the subproject is to be implemented. NCC jurisdiction is about 72.4 sq. km. that is occupied by 27 wards. And within this area and wards, the impact zones of the various components of the subproject may be contiguous, non-contiguous, or overlapping. For example, for the WTP, DTWs, and OHTs components, the areas of influence may only be defined within the 50 – 100m distance from the boundaries of the sites; while for the distribution network component, the area of influence may only be 10 – 15m on each side of the alignments especially if these are located along the existing rights of way. However, in alignments nearby residential or busy areas, the areas of influence may extend beyond 15m due to access issues.

C. Land Environment

1. Topography

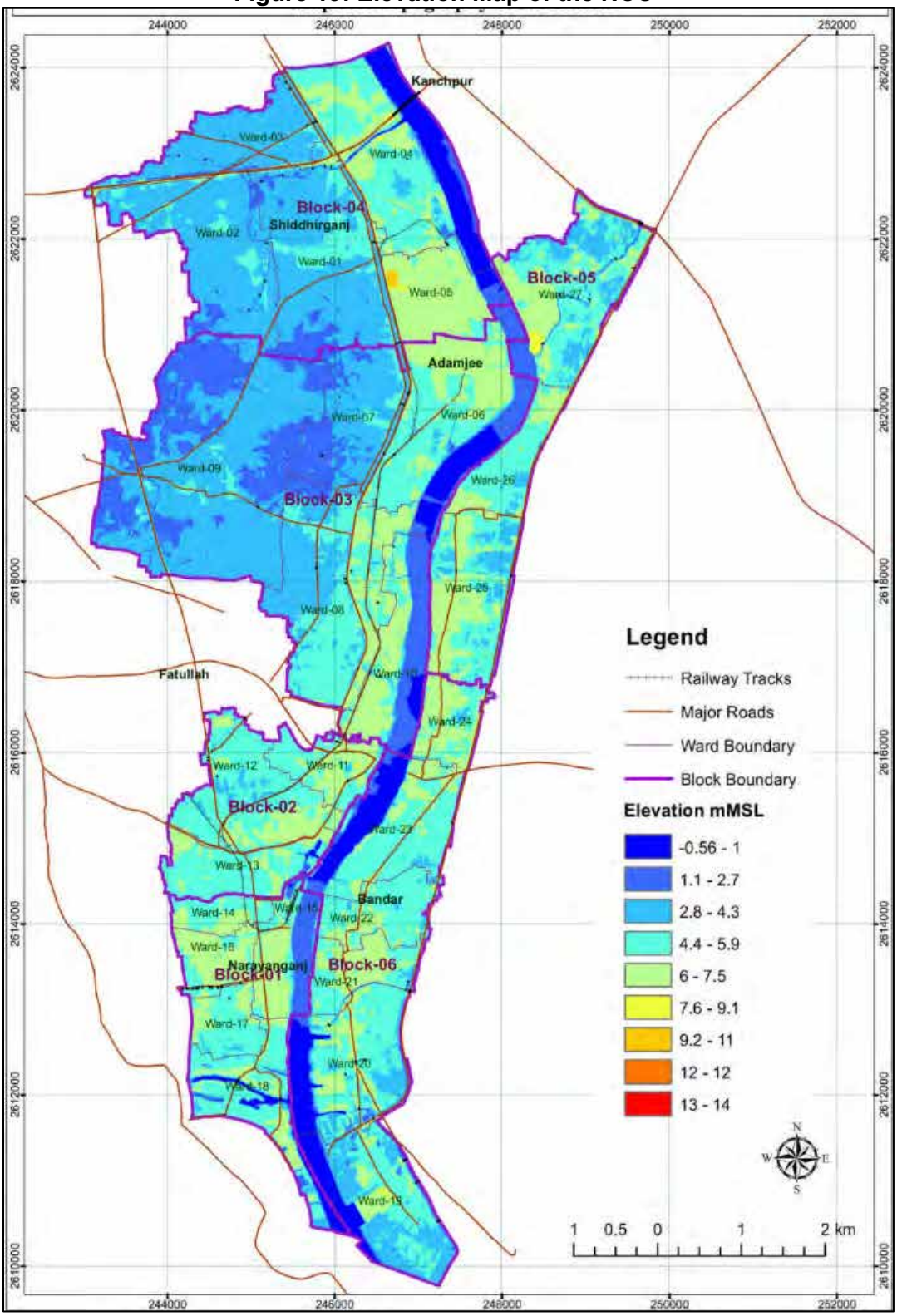
108. Block-wise elevation of NCC is prepared in the NCC Action Area Plan in 2016. Table and Figure below show a summary of the findings. It is revealed that Block 3 has comparatively lower elevation than all other blocks with an average elevation of 3.71m and the land slope of Block 1, Block 2, Block 3 and Block 4 are to the opposite direction of Shitalakhya River. It is noted that the outfall of some runoff of these blocks is Buriganga River, which is located at the South-West of the subproject area. Block 2 has comparatively higher elevation than other blocks with an average elevation of 5.43 m. The subproject area overlaps all these blocks. All drains within the subproject area flow down to the Shitalakhya river on the eastern side.

Table 18: Elevation of NCC as Block wise spot height

Values	**Block-01**	**Block-02**	**Block-03**	**Block-04**	**Block-05**	**Block-06**
Maximum Elevation (m, MSL)	8.711	8.802	8.144	13.954	10.115	9.224
Minimum Elevation (m, MSL)	-0.102	-0.292	-0.369	0.151	0.433	-0.561
Average Elevation (m, MSL)	**5.031**	**5.430**	**3.711**	**4.093**	**5.249**	**4.584**
Standard Deviation	1.664	0.788	1.604	1.623	1.212	1.910
Variance	2.769	0.620	2.572	2.633	1.469	3.648

Source: Topographic Survey, NCC Action Area Plan, 2016

Figure 19: Elevation Map of the NCC[a]



Source: Topographic Survey, NCC Action Area Plan, 2016

[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

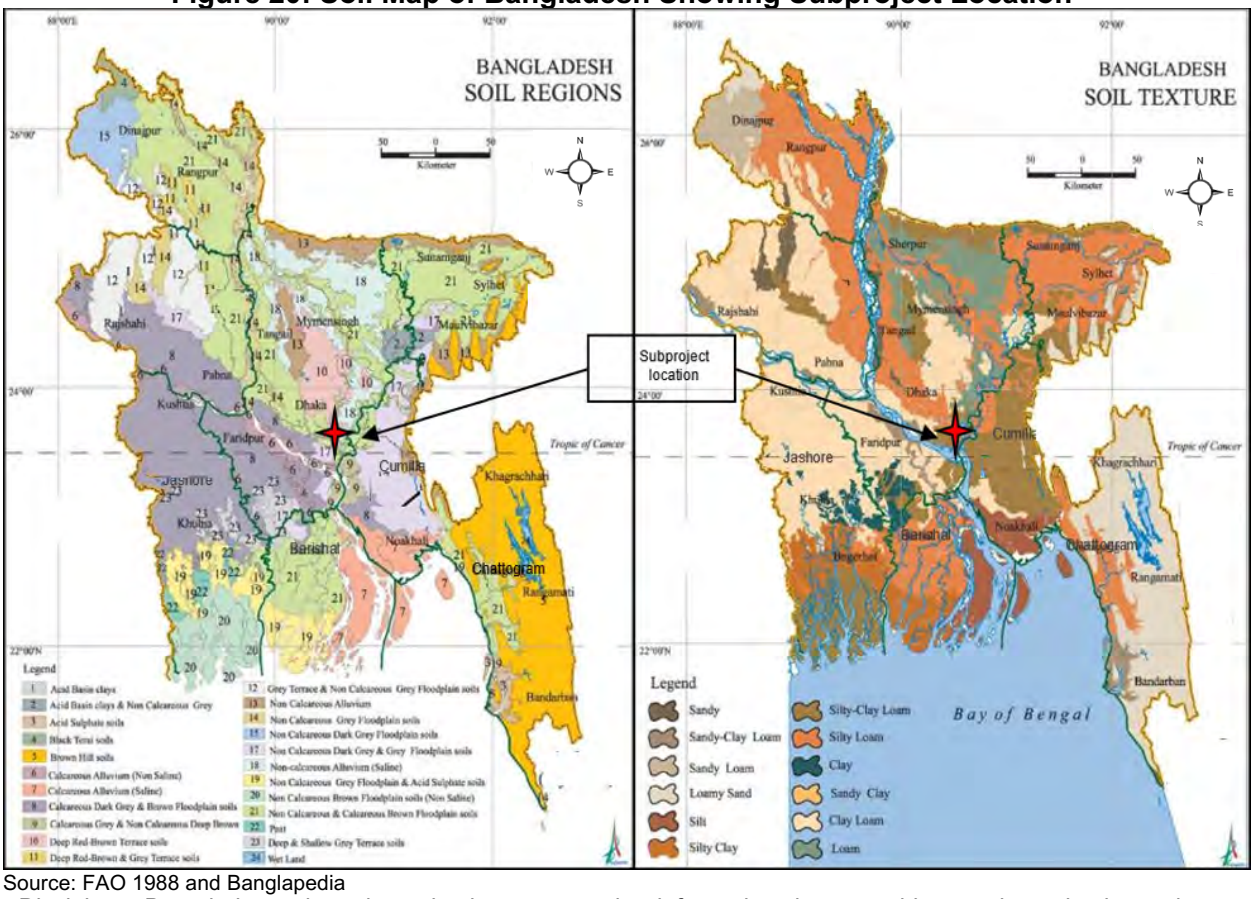
2. Geology and Soil

109. Dhaka region, where NCC lies, is situated on the southern tip of a Pleistocene terrace, the Madhupur Tract. Two characteristic geological units cover the region and surrounding areas; the Madhupur Clay of the Pleistocene age and alluvial deposits of recent age. The Madhupur Clay is the oldest sediment exposed in and around the area and characterized by reddish plastic clay with silt and very fine sand particles. This Madhupur Clay unconformable overlies the Dupi Tila Sand of Plio Pleistocene age, which is composed of medium to coarse yellowish-brown sand and occasional gravel.

110. The channels and depressions within the city are floored by recent alluvial floodplain deposits and are subdivided into Lowland Alluvium and Highland Alluvium. The alluvial deposits are composed of fine sand, silt and clay in different combinations.

111. The alluvial soils of these floodplains mainly consist of ridges of loamy material like silty clays and silty sands with large areas of shallow clays in the basins. The soil pattern can become more irregular close to river channels due to more recent deposits. With regard to the youngest activities (natural as well as anthropogenic) organic soils of swamps may be found locally as well as areas where the ground level has been raised using loose sands (hydraulic sand filling) dredged and pumped from nearby rivers.

Figure 20: Soil Map of Bangladesh Showing Subproject Location[a]



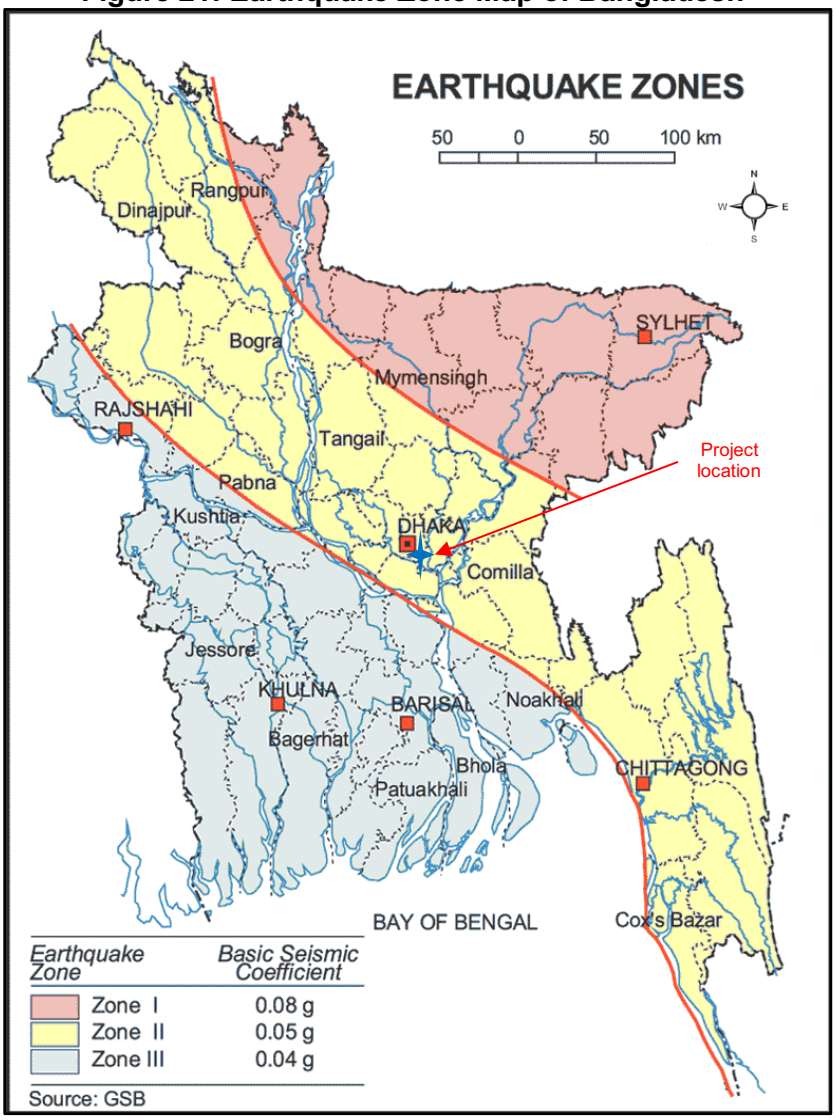
Source: FAO 1988 and Banglapedia

[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

3. Seismicity

112. Narayanganj is in central Bangladesh which is neither a high seismic risk area nor high wind area. The seismicity map of Bangladesh shows that Narayanganj lies in Zone-2 which shows intermediate level of seismic activity. As per tectonic classification, the area falls under Faridpur trough of Western platform flank which is adjacent to the hinge line. Tectonically this area is inactive and no apparent major structure like fault or fold exists in the region that might be geologically significant.

Figure 21: Earthquake Zone Map of Bangladesh[a]



Source: Geological Survey of Bangladesh. https://gsb.portal.gov.bd/

[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

4. Land Use

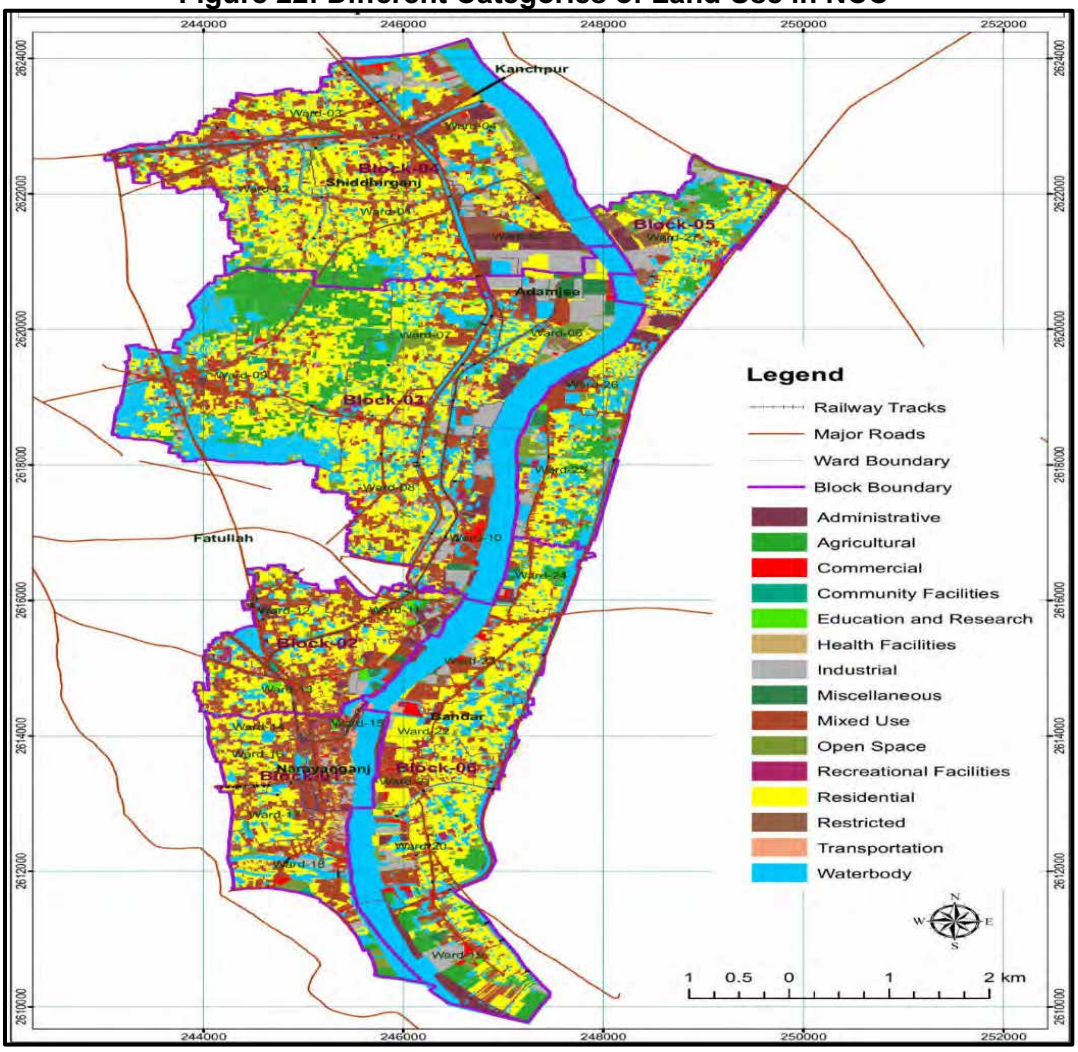
113. The main uses of land of the city comprise administrative, agricultural, residential, commercial, educational, research, health facilities, community facilities, industrial, mixed use, open space, recreational facilities, restricted, transportation and communication water body and miscellaneous. Table 19 and Figure 23 below show that the residential area is highest (30.65%) followed by water bodies, (23.4%), mixed use (20.19%), etc. in the NCC area. Whereas agricultural and industrial setting are about 5.7 and 5.04 %, respectively. Recreational facilities establishment is lowest.

Table 19: Distribution Land Uses in NCC

Land Use	Area in acre	
	Total	%
Administrative	525.59	4.51
Agricultural	658.90	5.66
Commercial	174.68	1.5
Community Facilities	55.18	0.47
Education and Research	74.58	0.64
Health Facilities	4.47	0.04
Industrial	586.43	5.04
Miscellaneous	131.16	1.13
Mixed Use	2350.21	20.19
Open Space	587.64	5.05
Recreational Facilities	45.47	0.39
Residential	3568.51	30.65
Restricted	85.52	0.73
Transportation and Communication	69.09	0.59
Water body	2723.68	23.4
Grand Total	**11641.11**	**100**

Source: NCC Action Area Plan, 2016

Figure 22: Different Categories of Land Use in NCC[a]



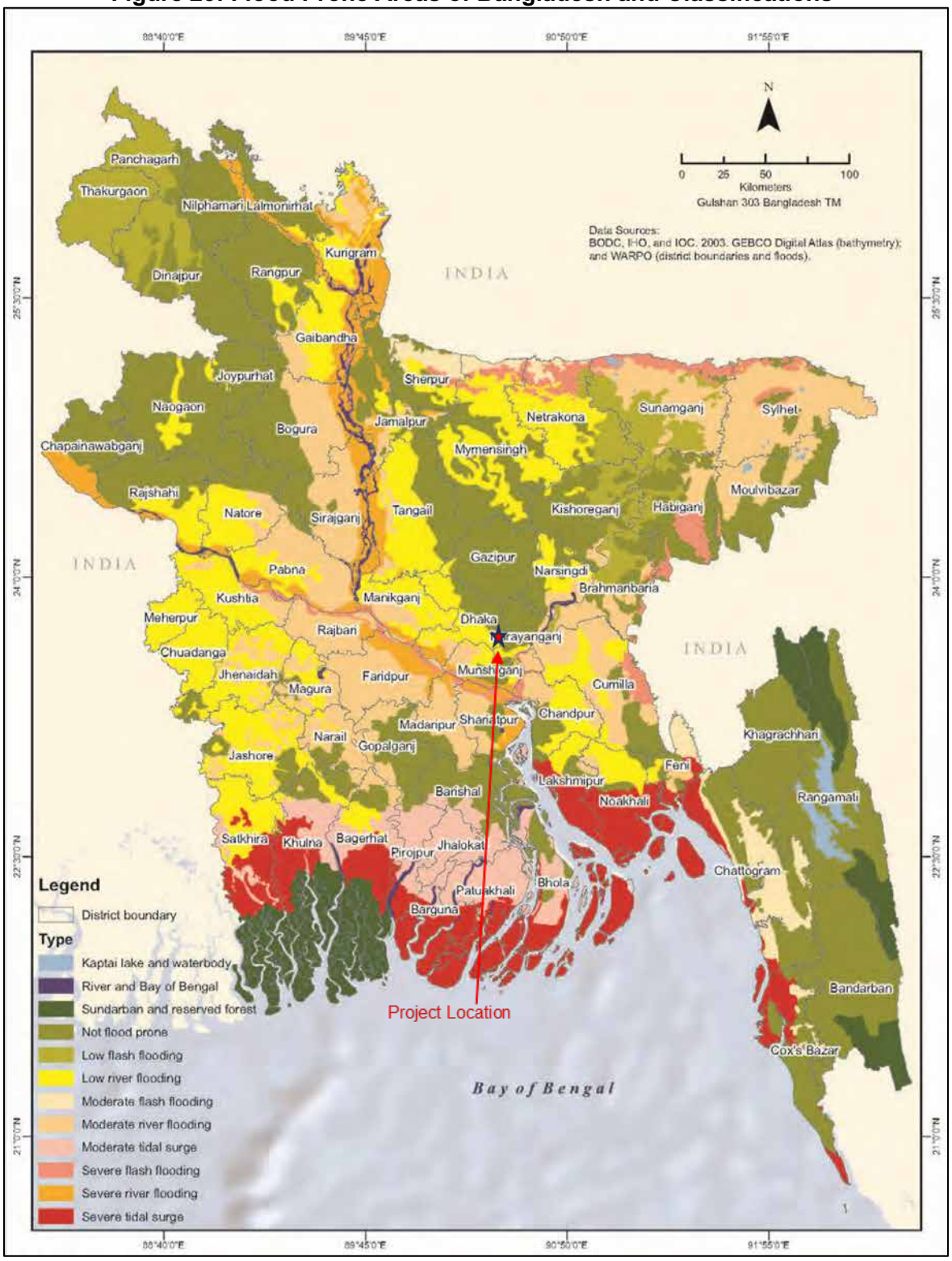
Source: NCC.

[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

5. Other Natural Hazards

114. Flooding is a common phenomenon in Bangladesh. The major cause of flood is monsoon rainfall runoff from upstream catchments, with more than 90 percent from outside Bangladesh. A flood season in Bangladesh may start as early as May and can continue until November. Five floods during the last fifty years were extensive and devastating, and these are the floods of 1955, 1974, 1987, 1988, and 1998. Figure below shows that NCC generally falls within a no flood zone, but low river/flash flooding is likely in the southern part of the NCC which is near the subproject sites.

Figure 23: Flood Prone Areas of Bangladesh and Classifications[a]



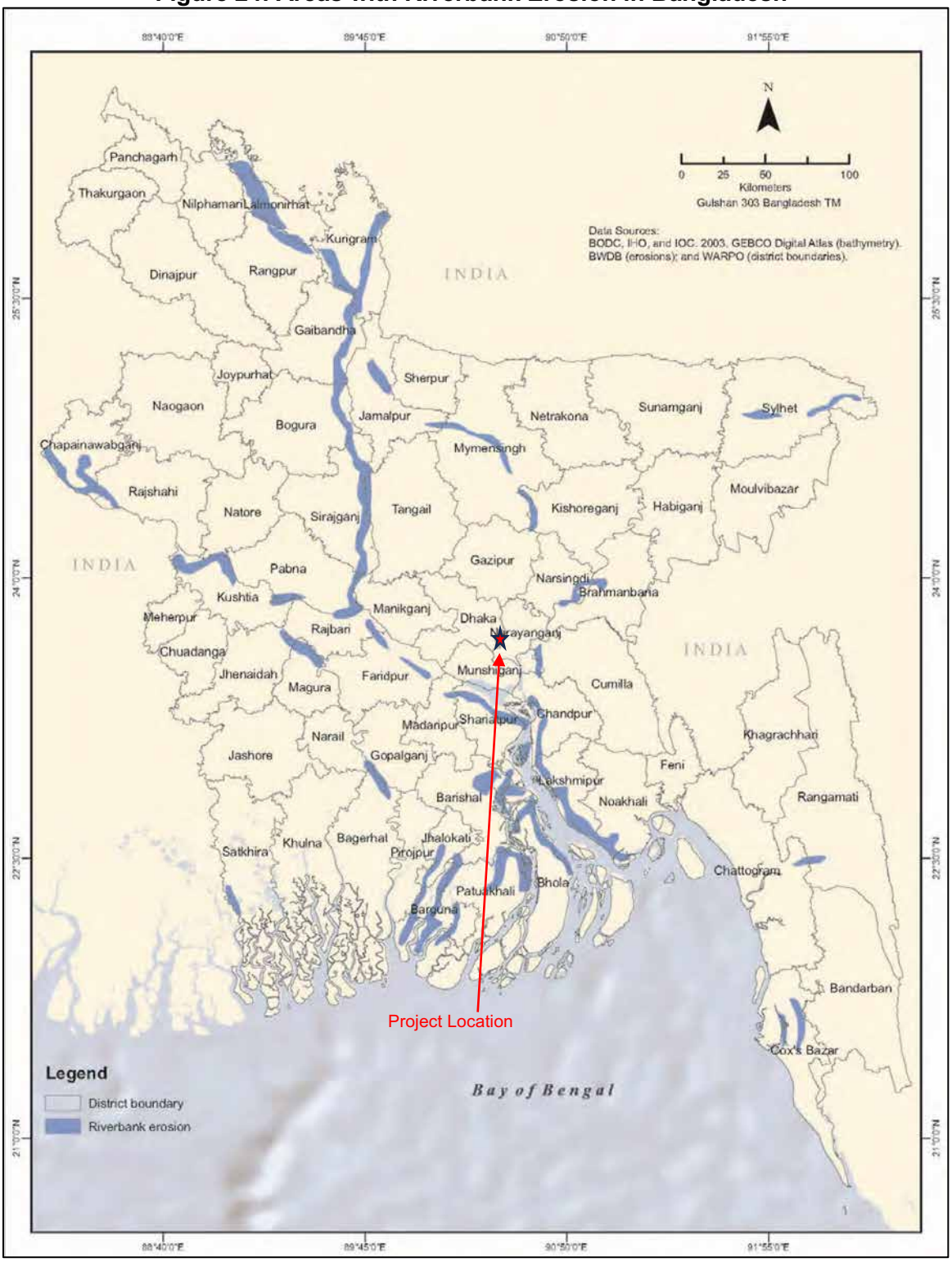
Source: Bangladesh Climate and Disaster Risk Atlas. ADB. December 2021

[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

115. Although the subproject sites are located near the Shitalakhya river, areas adjacent to the river have no historical record of riverbank erosion.[20] Figure below shows the maps confirming that the subproject area is not within erosion-prone landscape.

[20] Studies undertaken by ADB that led to the publication of Bangladesh Climate and Disaster Risk Atlas dated December 2021.

Figure 24: Areas with Riverbank Erosion in Bangladesh[a]



Source: Bangladesh Climate and Disaster Risk Atlas. ADB. December 2021

[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

D. Water Environment

1. Surface Water Bodies

116. Shitalakhya River is the major channel in the Narayaganj City, which are the ultimate discharge points of smaller streams. Shitalakshya River is about 110 km in length, which originates from the northern part of central Bangladesh, and traverses various towns and cities down to the southern tip of NCC where it meets with Daleshwari, Brahmaputra and Meghna rivers. The width of this river varies from about 100m in the upper reach and to about 300m near Narayanganj. Its highest discharge in the last 10 years has been measured at 1,638.31 m^3/s. The river is navigable throughout the year and shows little erosional tendency. Several heavy industries, such as manufacturing companies and factories, jute mills, navigational vessel ports, etc., stand on the banks of Shitalakshya river. Shitalakhya River passes through the NCC jurisdiction, and practically separating the city into two areas (Siddhirganj Pourashava and Narayanganj Pourashava on the west, and Kadam Rasul Pourashava on the east). Per Drainage Masterplan of NCC,[21] there are about 30 major canals in the project area. Majority of canals in NCC end towards Shitalakhya River. Meanwhile, Daleshwari river is on the western side of NCC, while Bahmaputra river and Meghna River are on the eastern side of NCC. Other canals and streams flowing through the different Upazilas (sub-districts) end towards these rivers, depending on the terrain allowing natural hydraulic or gravity flows. Narayanganj lies in monsoon flood affected area. The approximate flooding is about 5 – 6 feet at certain places. [22,23]

2. Surface Water Quality

117. Surface water quality testing was done along the Shitalakhya river at Demra ghat in 2020. Water quality parameters used were pH, BOD, DO and SS. Results are in table below and show that Shitalakhya river has relatively high level of pollutants based on the standard values for sources per ECR, 2023. However, technical assessment revealed that Shitalakhya river water can still be considered as a source of drinking water, provided that properly designed treatment plant or facility is in place.[24] The location of Demra Ghat sampling site is in figure below.

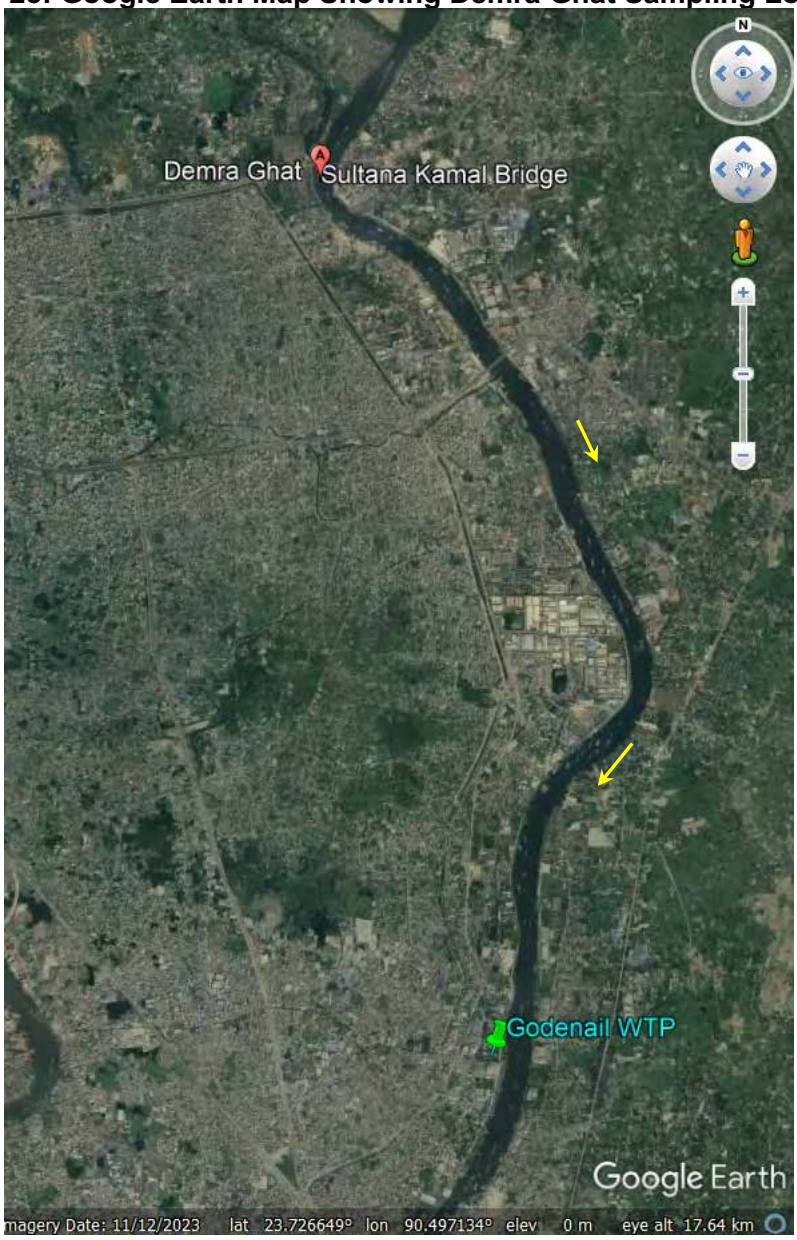
Table 20: Water Quality of Shitalakhya River (Year 2020)

Parameters	River Quality Standards[a]	Year 2020											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
BOD, mg/l	≤3	10	19	49	9.6	9.6	9.6	10			14	8	18
pH, units	6-9	7.8	7.29	7.19	7.4	7.12	7.88	7.32	-	-	6.99	7.23	7.48
SS, mg/l	-	38.8	4.5	24	14	14	20	24			21	15	15
DO, mg/l	≥5	0	0	0	1.3	1.9	3.5	4.5			2.9	1.6	0.8
Turbidity, NTU	-	12	16	34.2	23.6	23.4	21.1	20.1			16.6	37	86.9

Source: Feasibility Report on Rehabilitation and Expansion Existing Water Supply Infrastructure, 2022
[a] Standards per ECR 2023 on Sources of Drinking Water for Supply after Conventional Treatment.

[21] Drainage Masterplan for Narayanganj City Corporation. 2023.
[22] Banglapedia: National Encyclopedia of Bangladesh. https://en.banglapedia.org/.
[23] Feasibility Report on Rehabilitation and Expansion Existing Water Supply Infrastructure, 2022
[24] Design Report For Rehabilitation of Godenail Water Treatment Plant. October 2022.

Figure 25: Google Earth Map Showing Demra Ghat Sampling Location



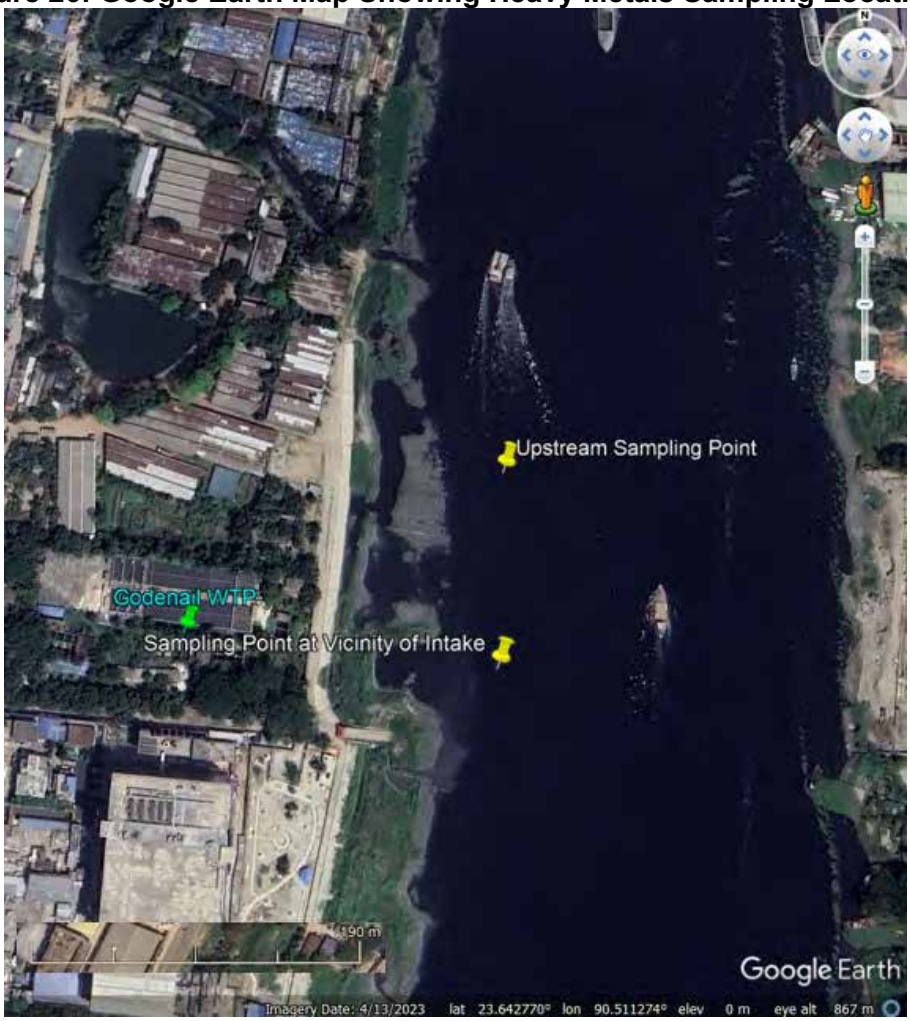
118. Primary data was gathered for Shitalakhya river water quality in December 2022 to determine the level of pollution in terms of heavy metal parameters. Samples were taken at about 100 m upstream of the intake point of the WTP and at the vicinity of the intake point. Results show that the quality of river is within the standards for the tested parameters, as tabulated below. However, when compared with the national drinking water quality standards, the values for lead concentration appear to be marginally above the limit.

Table 21: Water Quality of Shitalakhya River on Heavy Metals

			Date of Sampling: 21 December 2022	
Parameters	**River Quality Standards[a]**	**NDWQS**	Upstream of Intake	Intake
Arsenic, mg/l	-	0.05	0.002	0.003
Cadmium	-	0.003	0.00015	0.00015
Copper, mg/l	-	1.5	0.03	0.03
Chromium (Total), mg/l	0.02	0.05	0.005	0.005
Lead, mg/l	0.03	0.01	0.014	0.027
Nickel, mg/l	-	0.05	0.03	0.03
Zinc, mg/l	-	5.0	0.03	0.02

[a] Standards per ECR 2023 for surface water sources of drinking water supply but requiring conventional treatment.

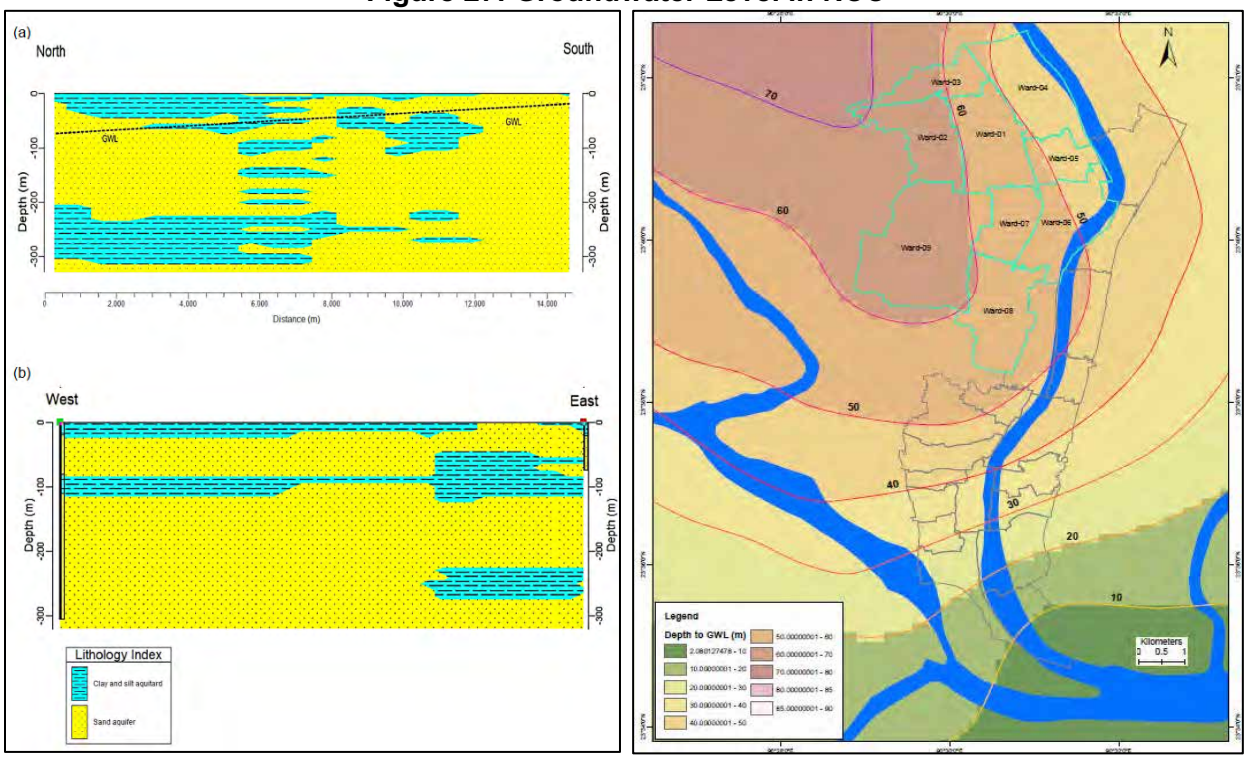
Figure 26: Google Earth Map Showing Heavy Metals Sampling Locations



3. Groundwater Level and Quality

119. **Groundwater Level**. Groundwater is abundant in Bangladesh. Water tables are generally shallow, and aquifers are productive. The main aquifer, which is the source of water supply, is found at a depth of greater than 50m. Ground water level (GWL) of shallow aquifer is decreasing day by day and safe drinking water is not accessible to a great extent in the NCC area. The water table depth map of Narayanganj area below shows that the groundwater is flowing from the south to the northern part of Narayanganj area. In the southern part of Narayanganj area adjacent to the Dhaleswari river, the maximum depth of GWL is about 6m below ground level (bgl) in the upper aquifer and about 15m bgl in the lower aquifer. But in the northern part of the NCC area the depth of GWL is more than 70m bgl.[25]

Figure 27: Groundwater Level in NCC



Source: Feasibility Study for Setting Up IBF System on Bank fo Dhaleswari-Shitalakhya Rivers in Southern Narayanganj. Bangladesh. 2022.

120. **Groundwater Quality**. To establish the baseline groundwater quality data in the vicinity of the subproject locations, groundwater sampling was carried out on 21 December 2022 from the existing DTWs that are to be rehabilitated under the subproject. The locations of these DTWs are in Figure 15 and Table 13, while corresponding results are presented in Table 15. Compared with the NDWQS, the quality of groundwater registered general elevated concentrations in terms of manganese, BOD and COD parameters. There are other parameters that are also exceeding the standards such as hardness, turbidity, iron, TDS, and coliform.

[25] Feasibility Study for Setting Up IBF System on Bank fo Dhaleswari-Shitalakhya Rivers in Southern Narayanganj. Bangladesh. 2022.

E. Atmospheric Environment

1. Climate and Meteorology

121. Bangladesh is located in a sub-tropical monsoon zone and has four main seasons namely pre-monsoon or summer (March to May), monsoon (June to September) and post-monsoon (October to November) and lean or winter (November to February). Climatic variations on temperature, rainfall, humidity and wind speed are recorded in the nearest meteorological station at Narayanganj, Bangladesh Meteorological Department (BMD).

122. In subproject area, temperature varies from 28.8 to 29.5°C during April to September. Temperature ranges from 7.2 to 14.8 °C during winter from November to February. Pre-monsoon or summer is hot and humid from March to May with annual average temperature ranging from 18.9 to 29.5°C. Long periods of steady rainfall persisting over several days are common during the monsoon, but sometimes, local high intensity rainfall of short duration is also occurring during other seasons of the year. About seventy (75%) percent of rainfall over Bangladesh occurs between the months from June to September. Climatic variations on temperature, rainfall, humidity and wind speed of the meteorological stations are presented in table below.

Table 22: Monthly Average of Climate Variables of Narayanganj City, 2012-2021

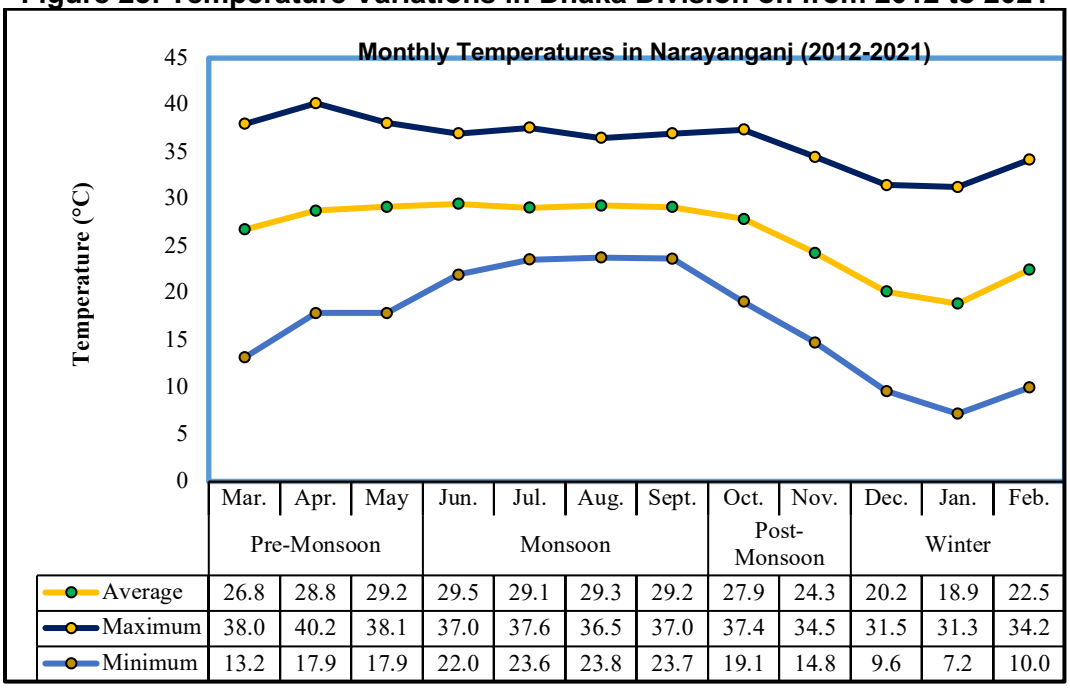
Seasons	Pre-Monsoon/Summer			Monsoon			Post-Monsoon			Lean/Winter		
Months	**Mar.**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**	**Jan.**	**Feb.**
Average Temp °C	26.8	28.8	29.2	29.5	29.1	29.3	29.2	27.9	24.3	20.2	18.9	22.5
Avg. Max Temp °C	32.6	34.2	33.9	33.3	32.6	32.9	33.2	32.4	30.1	25.9	24.9	28.7
Avg. Min Temp °C	21.6	24.3	25.4	26.6	26.7	26.8	26.7	24.6	19.8	16.0	14.0	17.1
Maximum Temp °C	38.0	40.2	38.1	37.0	37.6	36.5	37.0	37.4	34.5	31.5	31.3	34.2
Minimum Temp °C	13.2	17.9	17.9	22.0	23.6	23.8	23.7	19.1	14.8	9.6	7.2	10.0
Avg. Rainfall (mm)	0.78	3.89	4.75	6.70	9.27	5.77	4.19	3.21	0.35	0.19	0.04	0.63
Avg. Humidity (%)	63.4	70.3	75.9	78.6	77.9	76.9	78.9	76.7	72.4	78.5	71.6	65.0

Source: Dhaka Meteorological Station, Bangladesh Meteorological Department (2012-2021)

2. Temperature

123. The meteorological data on temperature as monthly highest maximum, monthly lowest minimum, monthly and annual mean temperature were collected for the period of 2012 to 2022 from meteorological station at Dhaka. Temperature varies from 28.8 to 29.5°C during April to September and from 18.9 to 24.3°C during November to January. Summary data on highest maximum and lowest minimum temperatures from 2012 to 2022 are presented in Figure 28. Annual average temperatures range from 18.9 to 29.5°C.

Figure 28: Temperature Variations in Dhaka Division on from 2012 to 2021



	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
	Pre-Monsoon			Monsoon				Post-Monsoon		Winter		
Average	26.8	28.8	29.2	29.5	29.1	29.3	29.2	27.9	24.3	20.2	18.9	22.5
Maximum	38.0	40.2	38.1	37.0	37.6	36.5	37.0	37.4	34.5	31.5	31.3	34.2
Minimum	13.2	17.9	17.9	22.0	23.6	23.8	23.7	19.1	14.8	9.6	7.2	10.0

Source: Dhaka Meteorological Station. Bangladesh Meteorological Department. 2022

3. Ambient Air Quality

124. Narayanganj City is one of the congested cities of Bangladesh with high concentrated population, busy marketplaces and heavy traffic on the main arteries of the city. There are cement plants and power plants at the west-side of the Shitalakhya river which crosses through the city. Additionally, there are many jute mills along the side of the river, which emissions contribute to the air pollutants in the city.

125. To establish the baseline air quality data in the vicinity of the subproject locations, ambient air quality monitoring was carried out during the period 25 January – 4 February 2023. The locations of monitoring are in Figure 29 and Table 23 below and corresponding results are presented in Table 24 below. Copies of laboratory analysis is in Appendix 5. In general, the particulate matter (PM10 and PM2.5) is relatively high in subproject area.

Figure 29: Map Showing Ambient Air Sampling Locations

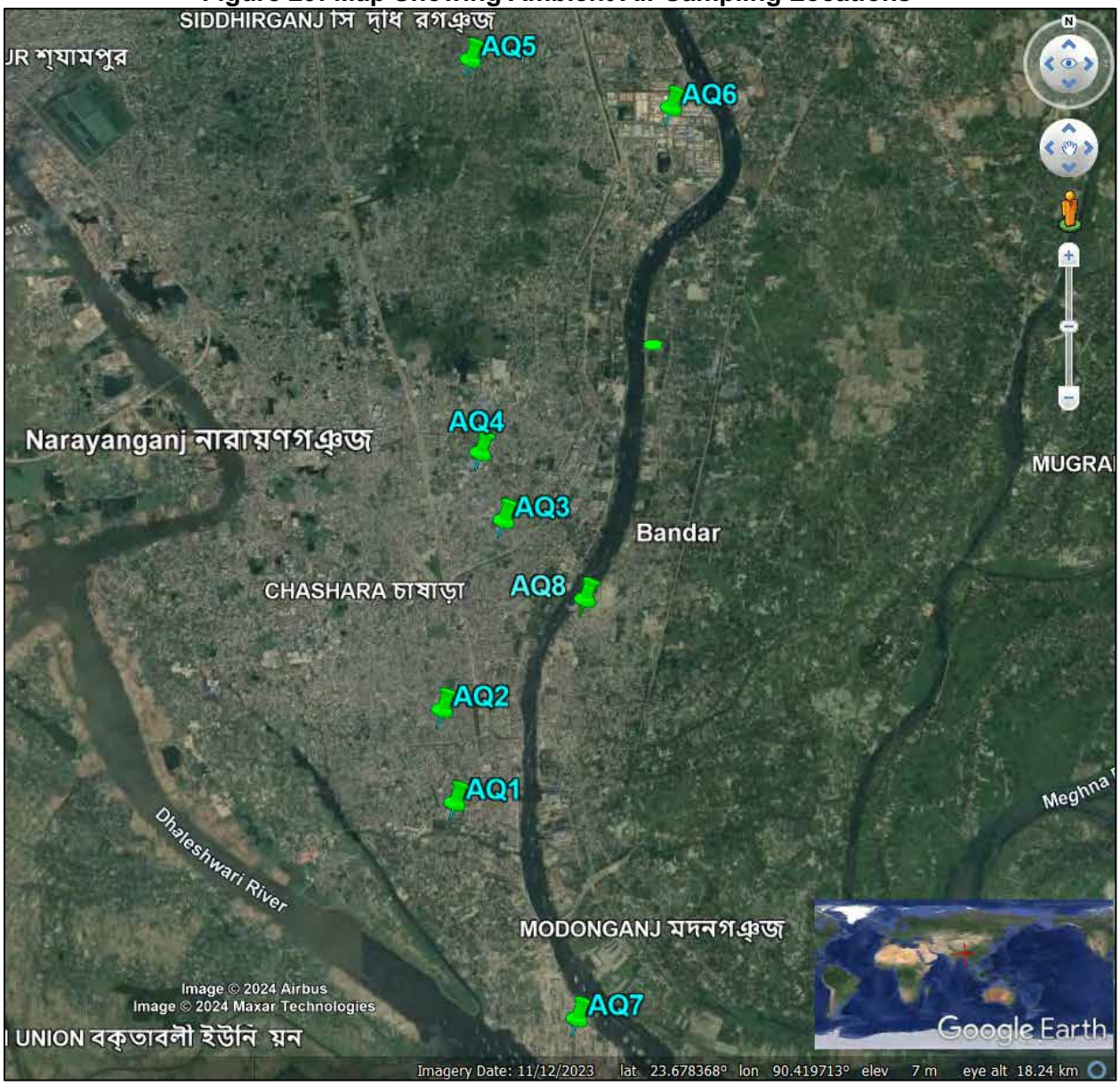


Table 23: Ambient Air Sampling Dates and Location Details

Location Code	Location Name	Sampling Location
AQ1	Ranada Prasad Saha University, 12 Sahed Bappi Sharoni, Narayanganj	23°36'5.48"N 90°29'50.01"E
AQ2	Bara Dewbhog, 1 Mobarak Shah Rd, Narayanganj	23°36'41.67"N 90°29'44.81"E
AQ3	Shirin Selina Home, Narayanganj	23°37'55.85"N 90°30'11.56"E
AQ4	Fakir Knitwear Ltd., Fakir Rd, Fatullah	23°38'22.57"N 90°30'1.75"E
AQ5	Chairman Bari, Siddhirganj	23°40'59.39"N 90°29'58.41"E
AQ6	Adamjee EPZ Road, Siddhirganj	23°40'40.09"N 90°31'25.46"E
AQ7	Crown Cement Factory Ltd. Road, Muktarpur, Narayanganj	23°34'42.2"N 90°30'41.3"E

Location Code	Location Name	Sampling Location
AQ8	AKIJ Flour Mills Limited, Nabigonj, Narayanganj	23°37'24.88"N 90°30'46.23"E

Table 24: Ambient Air Quality Within NCC (Working Day)

Location	Sampling Date	Ambient Air Pollutants' Concentration in µg/m^3							CO mg/m^3
		PM_{10}	$PM_{2.5}$	SO_2	NO_2	Pb	NH3	O3	
AQ1	25.01.2023	353.87	177.43	30.25	61.79	0.031	2.48	41.39	2.33
AQ2	25.01.2023	133.28	101.35	30.19	33.98	BDL	0.00	21.71	0.15
AQ3	26.01.2023	182.85	122.97	27.68	52.24	0.070	0.00	13.02	0.20
AQ4	-	-	-	-	-	-	-	-	-
AQ5	01.02.2023	108.18	68.33	14.49	22.18	0.068	0.00	42.90	0.31
AQ6	01.02.2023	190.75	98.89	105.67	75.63	0.059	6.04	29.11	1.80
AQ7	02.02.2023	205.97	94.61	43.24	47.88	0.034	6.04	29.12	1.80
AQ8	02.02.2023	93.78	59.89	16.07	19.66	BDL	0.00	18.44	0.14
Durations, hr		**24**	**24**	**24**	**24**	**24**	**24**	**8**	**8**
Air Pollution (Control) Rules, 2022		**150**	**65**	**80**	**80**	**0.50**	**400**	**100**	**05**
Method of Analysis		*Light Scattering Nephotometer*	*Light Scattering Nephotometer*	*High Sensitivity Electrochemical*	*High Sensitivity Electrochemical*	*High Sensitivity Electrochemical*	*High Sensitivity Electrochemical*	*Mixed Metal Oxide*	*High Sensitivity Electrochemical*

Note: * Air Pollution (Control) Rules, 2022, Legend: PM_{10} -Particulate Matter of a diameter of 10 microns or less. $PM_{2.5}$ -Particulate Matter of a diameter of 2.5 microns or less, SO_2 –Sulphur Dioxide; NO_2 –Nitrogen Dioxide; NH3 (ammonia); O_3 –Ozone; CO –Carbon Monoxide, BDL – Below detection limit

Table 25: Ambient Air Quality Within NCC (Non-Working Day)

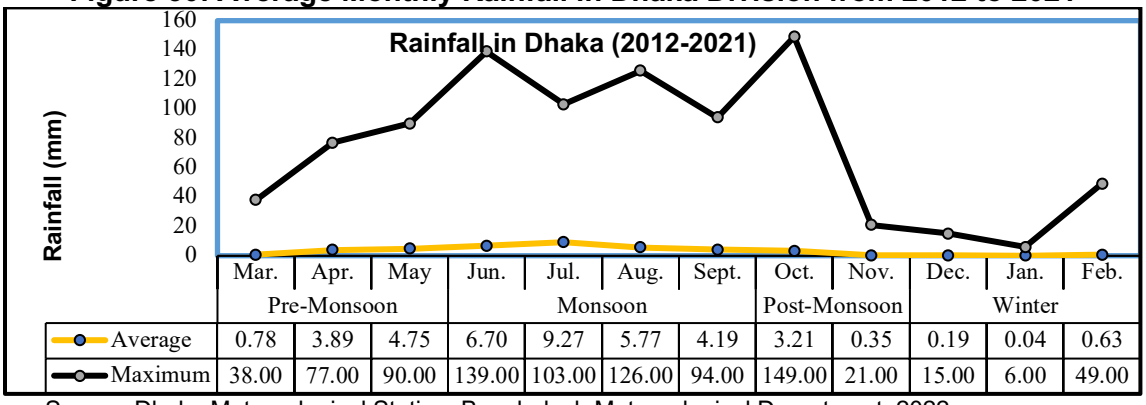
Location	Sampling Date	Ambient Air Pollutants' Concentration							
		PM_{10}' µg/m3	**$PM_{2.5}$** µg/m3	**SO_2** µg/m3	**NO_2** µg/m3	**Pb** µg/m3	**NH3** µg/m3	**O3** µg/m3	**CO** mg/m3
AQ1	25.01.2023	256.59	159.58	66.24	39.65	0.032	4.39	38.93	1.19
AQ2	25.01.2023	128.72	96.72	27.20	45.67	BDL	0.00	14.36	0.20
AQ3	26.01.2023	147.53	106.85	20.81	24.15	0.021	0.00	51.97	0.17
AQ4	-	-	-	-	-	-	-	-	-
AQ5	01.02.2023	113.99	82.42	26.67	13.21	0.065	0.00	37.78	0.18
AQ6	01.02.2023	226.16	133.19	89.03	73.79	0.060	5.27	33.06	2.03
AQ7	02.02.2023	335.70	131.59	59.84	66.04	0.052	4.85	42.28	1.61
AQ8	02.02.2023	116.76	84.29	37.99	26.67	BDL	0.00	9.15	0.21
Durations, hr		**24**	**24**	**24**	**24**	**24**	**24**	**8**	**8**
Air Pollution (Control) Rules, 2022		**150**	**65**	**80**	**80**	**0.50**	**400**	**100**	**05**
Method of Analysis		*Light Scattering Nephotometer*	*Light Scattering Nephotometer*	*High Sensitivity Electrochemical*	*High Sensitivity Electrochemical*	*High Sensitivity Electrochemical*	*High Sensitivity Electrochemical*	*Mixed Metal Oxide*	*High Sensitivity Electrochemical*

Note: * Air Pollution (Control) Rules, 2022, Legend: PM_{10} -Particulate Matter of a diameter of 10 microns or less. $PM_{2.5}$ -Particulate Matter of a diameter of 2.5 microns or less, SO_2 –Sulphur Dioxide; NO_2 –Nitrogen Dioxide; NH3 (ammonia); O_3 –Ozone; CO –Carbon Monoxide, BDL – Below detection limit

4. Rainfall

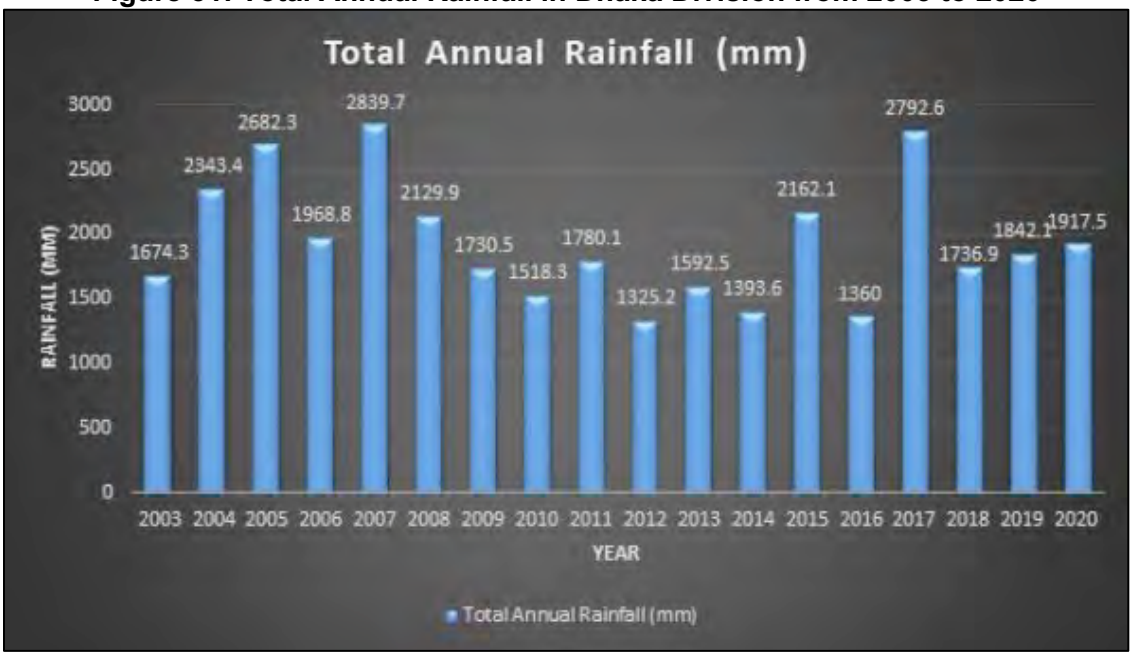
126. The rainfall data on daily, monthly and annual total for the 10-years from 2012 to 2021 of Dhaka meteorological station were collected. About 15% of the annual rainfall occurs in the pre-monsoon season. About 80% occur in the wet season and only 5% during the winter months. Monthly highest maximum and average monthly rainfall is illustrated in **Figure 30** below, and the annual total rainfall is illustrated in Figure 31 below**.** Long periods of steady rainfall persisting over several days are common during the monsoon, but sometimes, local high intensity rainfall of short duration is also occurring. About seventy five percent of rainfall over Bangladesh occurs between the months from June to September.

Figure 30: Average Monthly Rainfall in Dhaka Division from 2012 to 2021



Source: Dhaka Meteorological Station. Bangladesh Meteorological Department. 2022

Figure 31: Total Annual Rainfall in Dhaka Division from 2003 to 2020

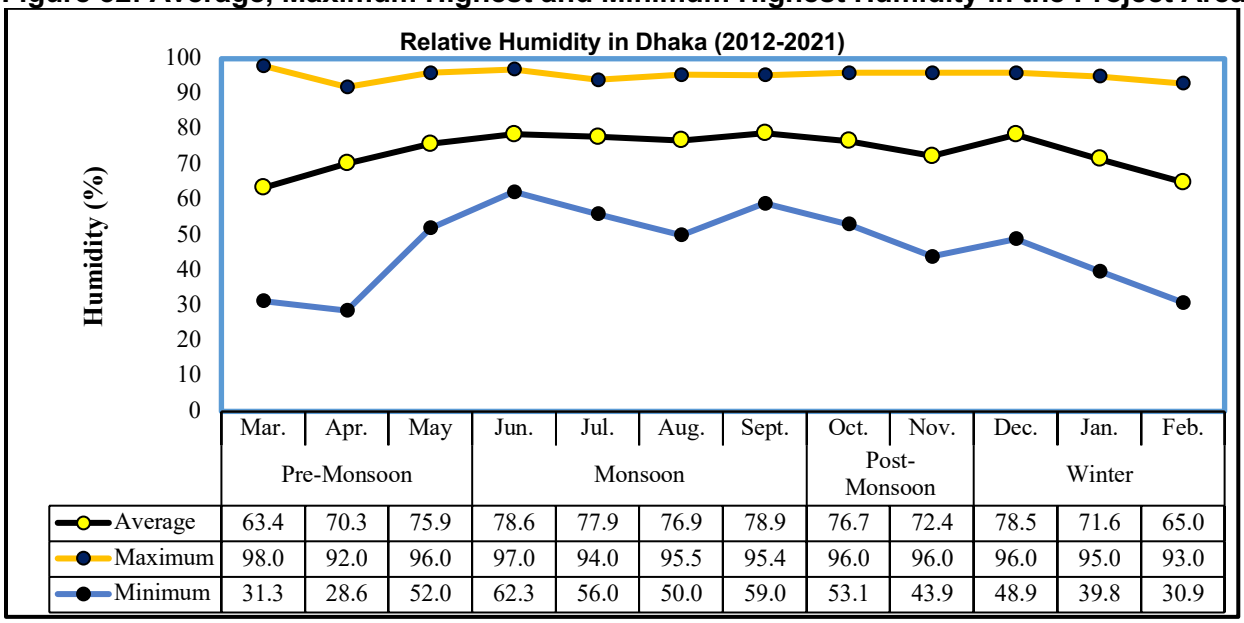


Source: Drainage Masterplan for Narayanganj City Corporation. 2023. Data taken from Bangladesh Meteorological Department.

5. Humidity

127. The humidity data on monthly maximum and minimum, monthly and average over the 10 years shows that, 80-85 percent humidity in the hot season is common and the humidity remains high year-round, producing thick fogs in winter in the study area of the project. Based on the collected data, a summary on highest maximum, lowest minimum and average humidity in percentage is given in figure below.

Figure 32: Average, Maximum Highest and Minimum Highest Humidity in the Project Area



	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
	Pre-Monsoon			Monsoon				Post-Monsoon		Winter		
Average	63.4	70.3	75.9	78.6	77.9	76.9	78.9	76.7	72.4	78.5	71.6	65.0
Maximum	98.0	92.0	96.0	97.0	94.0	95.5	95.4	96.0	96.0	96.0	95.0	93.0
Minimum	31.3	28.6	52.0	62.3	56.0	50.0	59.0	53.1	43.9	48.9	39.8	30.9

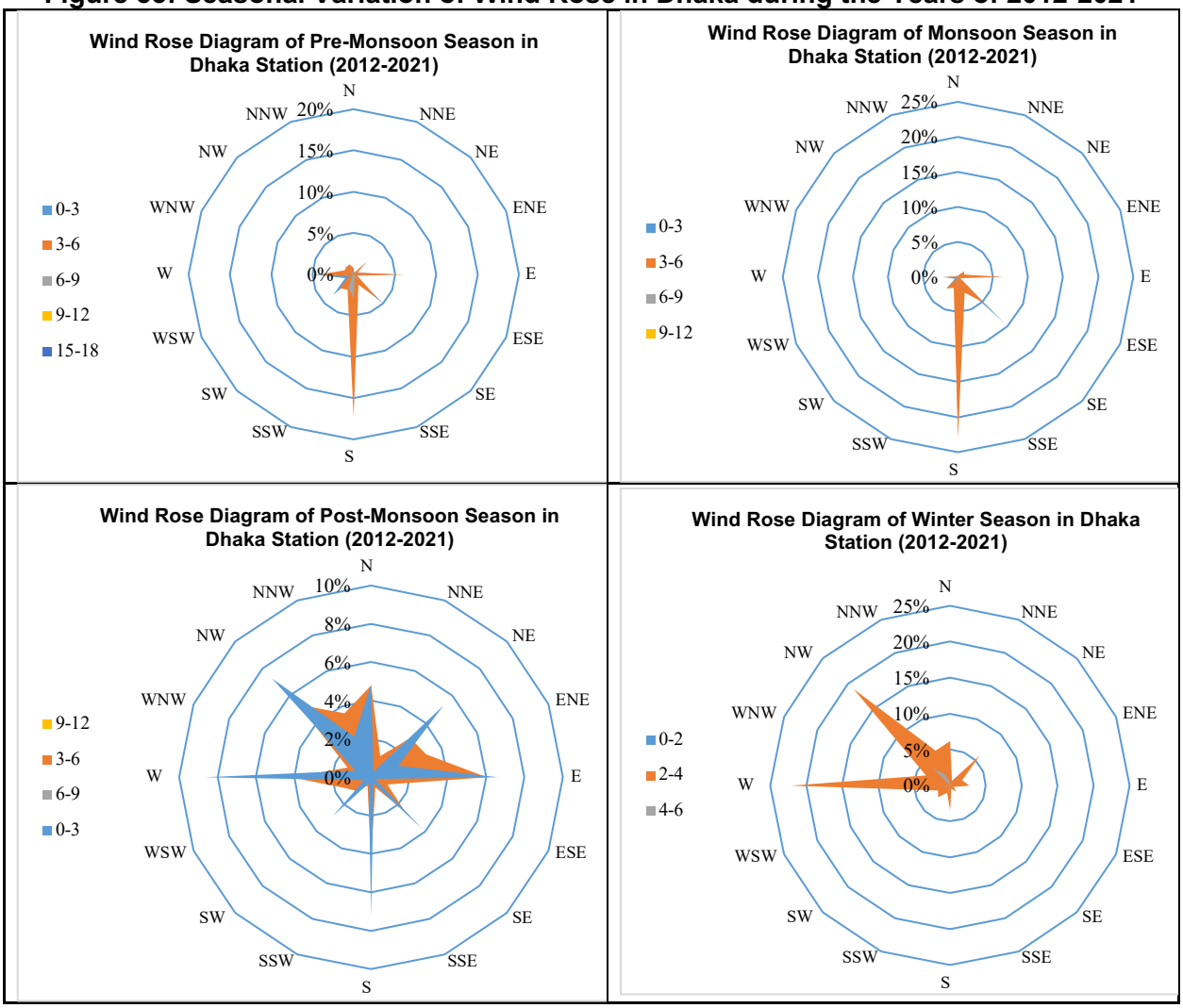
Source: Dhaka Meteorological Station. Bangladesh Meteorological Department. 2022

6. Wind

128. The most important and crucial weather aspect may be the wind. Knowing the direction and velocity is crucial because of this. The Wind Rose model, which depicts the project area's predominant wind conditions based on seasonal change, is used to understand wind variables. The wind rose shows how many hours a year the wind blows in the specified direction. The region is predominantly characterized by South, West, West-Southwest, North, and North-West wind flow, according to the wind rise diagrams. The whole wind speed spectrum in a year was dominated by winds of 0 to 18 knots.

129. Due to climatic fluctuations brought on by the monsoons, wind direction fluctuates in the project region. Beginning in the middle of March and lasting until near the end of September is the south-westerly monsoon. Monsoon winds blow continuously from the south from March to October; in January, winds come from the west and northwest. The month of February is uneventful, with gloomy mornings in particular. Figure below shows the seasonal monthly maximum wind speed direction rose plot from 2012 to 2021 duration.

Figure 33: Seasonal Variation of Wind Rose in Dhaka during the Years of 2012-2021



Source: Dhaka Meteorological Station. Bangladesh Meteorological Department. 2022

F. Acoustic Environment

130. **Ambient Noise Level.** To establish the baseline noise levels in the vicinity of the subproject locations, monitoring of noise levels was carried out during the period 25 January – 4 February 2023. These measurements were taken from various wards of the NCC area and may not be necessarily within the immediate vicinities of the subproject sites. However, with the observed ground conditions, noise level may not deviate significantly from one location to another within the city. Further validation of site-specific baseline noise level will be undertaken prior to construction activities. Assuming these high level of noise are confirmed during the design phase/pre-construction phase, there is a need for integration of noise protection measures during construction, especially in and around the settlements. The locations of monitoring are in Figure 34 and Table 26 below, and corresponding results are presented in Table 27 below. Based on results, there is generally a high level of noise for both daytime and nighttime on either working days or non-working days as compared to the standards. Copies of laboratory analysis results are in Appendix 6.

Figure 34: Map Showing Noise Level Measurement Locations

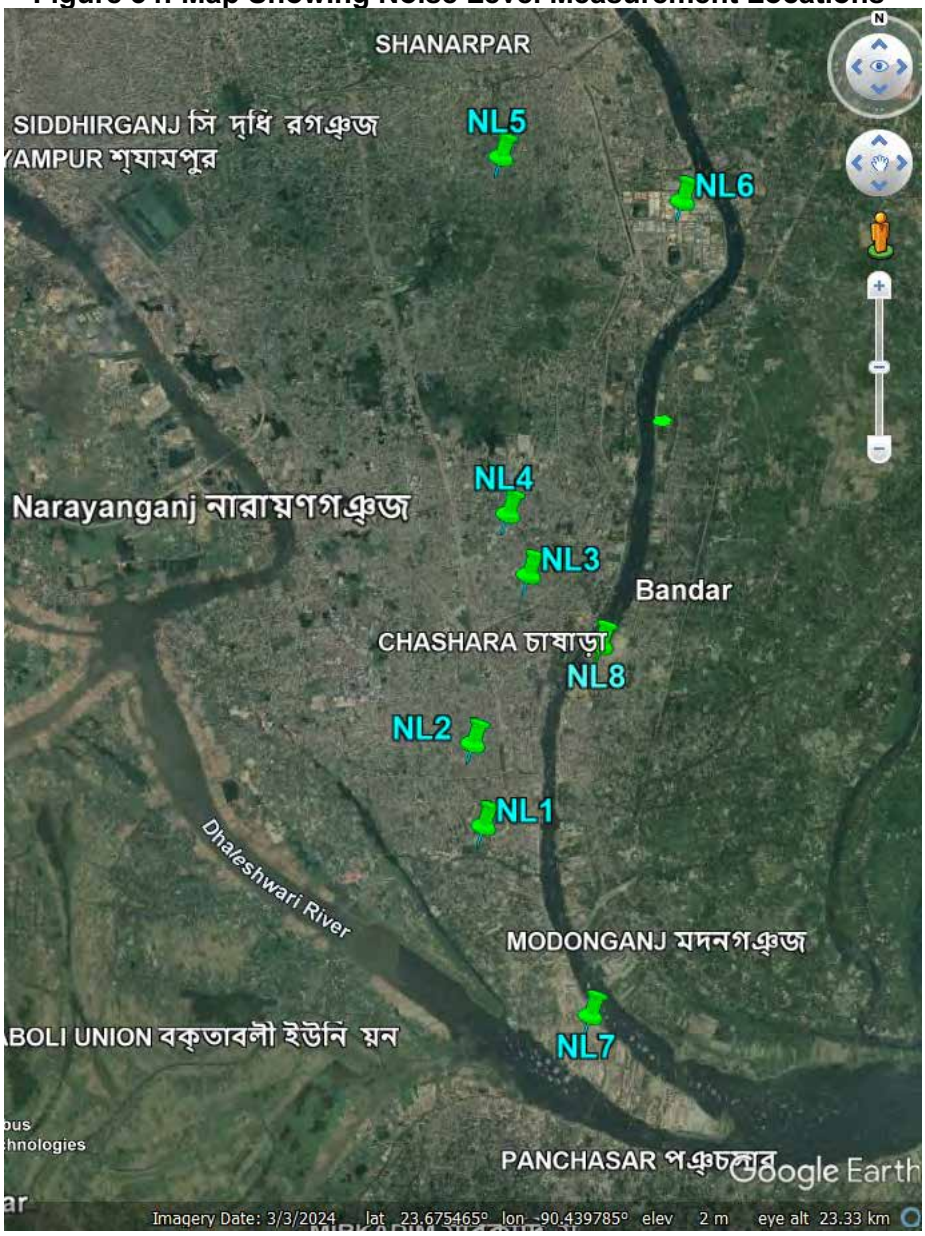


Table 26: Noise Level Measurement Dates and Location Details

Location Code	Location Name	Sampling Location	Monitoring date
Working Day			
NL1	Ranada Prasad Saha University, 12 Sahed Bappi Sharoni, Narayanganj	23°36'5.48"N 90°29'50.01"E	25 Jan.2023
NL2	Bara Dewbhog, 1 Mobarak Shah Rd, Narayanganj	23°36'41.67"N 90°29'44.81"E	25 Jan 2023
NL3	Shirin Selina Home, Narayanganj	23°37'55.85"N 90°30'11.56"E	26 Jan 2023
NL4	Fakir Knitwear Ltd., Fakir Rd, Fatullah	23°38'22.57"N 90°30'1.75"E	26 Jan 2023
Non- Working Day			
NL1	Ranada Prasad Saha University, 12 Sahed Bappi Sharoni, Narayanganj	23°36'5.48"N 90°29'50.01"E	27 Jan 2023

Location Code	Location Name	Sampling Location	Monitoring date
NL2	Bara Dewbhog, 1 Mobarak Shah Rd, Narayanganj	23°36'41.67"N 90°29'44.81"E	27 Jan 2023
NL3	Shirin Selina Home, Narayanganj	23°37'55.85"N 90°30'11.56"E	28 Jan 2023
NL4	Fakir Knitwear Ltd., Fakir Rd, Fatullah	23°38'22.57"N 90°30'1.75"E	28 Jan 2023
Working Day			
NL5	Chairman Bari, Siddhirganj	23°40'59.39"N 90°29'58.41"E	01 Feb 2023
NL6	Adamjee EPZ Road, Siddhirganj	23°40'40.09"N 90°31'25.46"E	01 Feb 2023
NL7	Crown Cement Factory Ltd. Road, Muktarpur, Narayanganj	23°34'42.2"N 90°30'41.3"E	02 Feb 2023
Non- Working Day			
NL5	Chairman Bari, Siddhirganj	23°40'59.39"N 90°29'58.41"E	03 Feb 2023
NL6	Adamjee EPZ Road, Siddhirganj	23°40'40.09"N 90°31'25.46"E	03 Feb 2023
NL7	Crown Cement Factory Ltd. Road, Muktarpur, Narayanganj	23°34'42.2"N 90°30'41.3"E	04 Feb 2023

Table 27: Primary Baseline Noise Level Measurements Within NCC

SL. No	Ward No	Leq_{day}	Leq_{night}	L_{max}	L_{min}	Standard	
						Day(dB)	Night(dB)
NL1-WD	Ward-18	67.74	60.41	92.5	45.6	**50**	**40**
NL1-NWD		66.41	59.96	89.6	32.1		
NL2-WD	Ward-16	59.29	56.95	80.0	30.8	**60**	**50**
NL2-NWD		63.56	55.21	90.8	37.8		
NL3-WD	Ward-12	64.68	58.76	85.1	30.8	**55**	**45**
NL3-NWD		63.28	57.87	90.2	41.0		
NL5-WD	Ward-2	62.89	56.89	90.0	30.8	**55**	**45**
NL5-NWD		62.97	55.22	86.4	32.1		
NL6-WD	Ward-6	78.99	68.88	103.2	42.3	**75**	**70**
NL6-NWD		74.99	68.70	93.6	32.1		
NL7-WD	-	73.39	57.16	97.9	40.8	**75**	**70**
NL7-NWD		77.78	68.93	95.9	40.8		
Standard (ECR'1997) & Noise Pollution (Control) Rules 2006							
Silent area						50	40
Residential area						55	45
Mixed area						60	50
Commercial Area						70	60
Industrial area						75	70
World Bank/IFC Standard							
Residential; Institutional; Educational						55	45
Industrial						70	70

G. Ecological Environment

1. Terrestrial Environment

131. **Flora**. Generally, the terrestrial environment of NCC comprises the different natural and man-made resources. Natural resources include roadside trees and vegetation, homestead trees, woody plants, herbs, shrubs, climbers and other plants on cultivated lands. . None of these

species is considered endangered or critically endangered or of national significance. Being considered a developed and built-up area with modified urban setting, NCC is mostly surrounded now by a combination of residential, commercial and institutional establishments. There are no natural habitats or forests that will be encroached or affected by the subproject. No protected species per IUCN Red List was observed during field visits within the 100 – 200-meter radius and immediate surroundings of the subproject sites. Table and figure below show the typical flora species found in the NCC area.

Table 28: Flora Species Found in NCC Area

Bangla Name	English Name	Scientific Name	Uses
Aam	Mango	*Mangifera indica*	Fruit tree
Neem	Neem	*Azadirachta indica*	Medicinal
Meheguni	Mahogoni	*Swietenia macrophylla*	Timber
Sojne		*Moringa oleifera*	Medicinal
Kathal	*Jacjfruit*	*Artocarpus heterophyllus*	Fruit tree
Narikel	Coconut	*Cocos nucifera*	Fruit tree
Taal	Plum	Borassus flabellifer	Fruit tree
Jaam	Black Barry	Syzygium jambolanum	Fruit tree
Kola	Banana	Musa acuminata	Fruit tree
Koroi		Albizia procera	Medicinal

Figure 35: Typical Vegetations Found Along Alignments

132. **Fauna**. Common animals found in the NCC area are the domesticated animals like dogs and cats. Other species include reptiles such as snake, house lizard, soft-shell, turtle, toad, frog, squirrel, fruit bat, field and house mice, and flying box. Some of these species also thrive in inlad water boides in the area such as the ponds or canals. There are also some avian species that can be found in the NCC area. The commonly spotted birds include kingfishers, house crow,

house sparrow, little fern, etc. but little occurrences. None of these species is considered endangered or critically endangered or of national significance.

2. Aquatic Environment

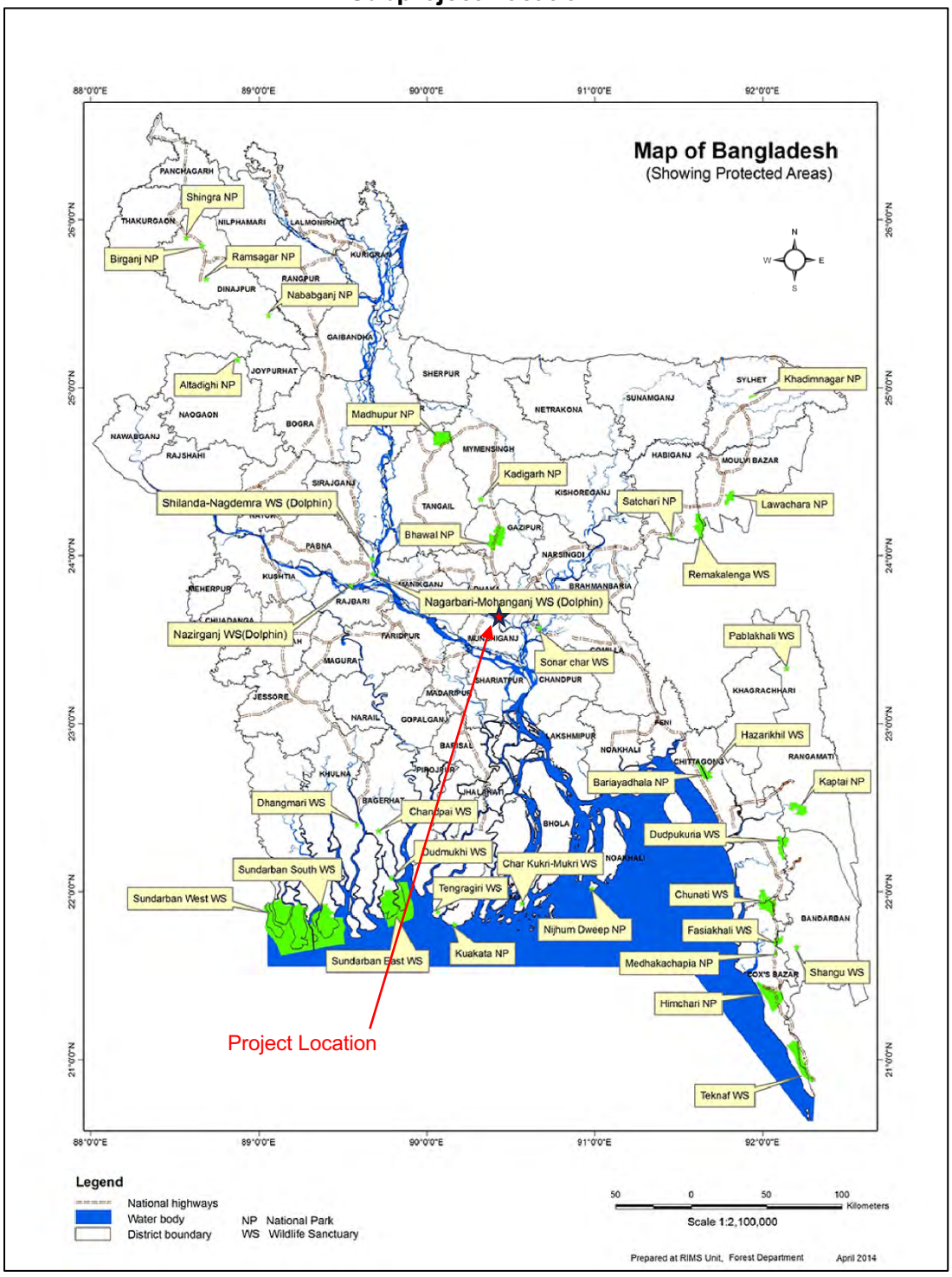
133. The quality of water in the Shitalakhya river that traverses NCC area has continued to deteriorate in the past two decades due to rapid urbanization and poor sewerage and sanitation in the city, including pollution load contribution from upstream municipalities and cities. Nevertheless, monitoring of the quality of this river reveals the presence of dissolved oxygen which may indicate the survival of microscopic aquatic species such as phytoplankton and other species that could adapt to polluted waters. However, no known species of commercial value and appropriate for human consumption has been observed in this river. Based on site visits and consultations with locals, there are no fishing grounds that exist along this river from upstream down to the confluence point with Daleshwari river. All along in the past two decades, Shitalakhya river has only been used as a navigational route for industrial, commercial and local ferries.

134. Although Shitalakhya river is not used as a fishing ground, other inland ponds, ditches and swamps in the NCC area are used for fishing or fish production. Fishes include catfishes (magur and shing), major carps (katla, rui, and mrigal), minor carps (puti), and others (tengra, boal, mola, shol). Native waterfowl and migratory birds, freshwater turtles and other reptiles and amphibians depend on these inland water bodies. No species considered endangered or critically endangered or of national significance is present in the area. Most of the waterbodies like the canal and ditches are covered with water hyacinths.

3. Protected Areas

135. There are no protected areas within or around the subproject sites. Per screening conducted, the closest Protected Area is Bhawal National Park which is already about 50km away. Further research with Bangladesh Forest Department revealed that there is also a wildlife sanctuary (Sonar Char Wildlife Sanctuary) close to NCC, but this is likewise about 50km away. The following map shows the location of NCC relative to various protected areas in Bangladesh.

Figure 36: Map Showing Protected Areas of Bangladesh and Their Proximity to Subproject Location[a]



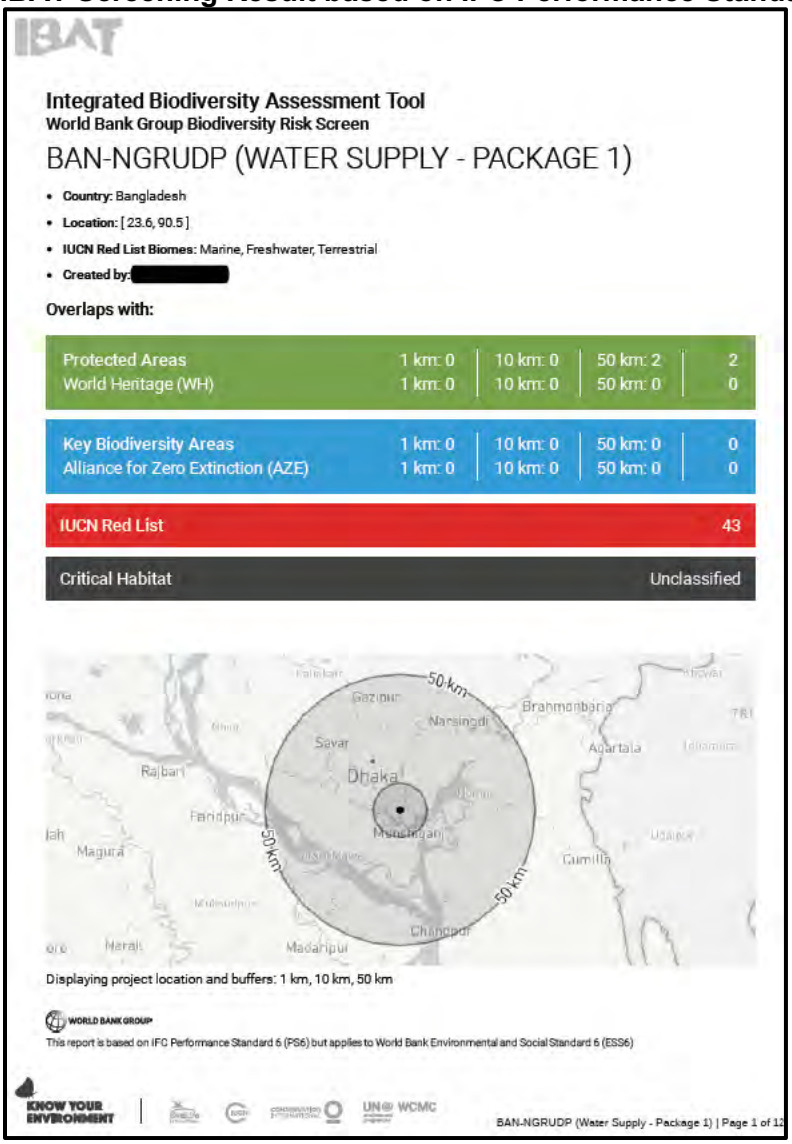
Source: Management Effectiveness Assessment of Protected Areas of Bangladesh. Bangladesh Forest Department. 2016

[a] Disclaimer: Boundaries, colors, denominations or any other information shown on this map do not imply, on the part of ADB, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.

4. Critical Habitat

137. Despite being located in a built-up and developed urban area, the subproject sites have been assessed in terms of critical habitat status. A screening using the Integrated Biodiversity Assessment Tool (IBAT) was undertaken to screen and assess potential risks on sensitive areas or critical habitat that may exist around the subproject sites (default area of analysis of 50 km radius). IBAT screening results confirmed that there are no protected areas or key biodiversity areas around the vicinities of the project sites, and the closest protected area is Bhawal National Park which about 50km away. The IBAT screening also shows biodiversity species potentially to occur within the default 50-km radius. However, the subproject sites are already a built-up area and the probability of these species being found at the sites is very low. Site visits have also been conducted which confirmed that none of these species are found or sighted at the subproject sites. Snapshot of the summary of the screening results is shown in figure below and the full set of results is in Appendix 7.

Figure 37: IBAT Screening Result based on IFC Performance Standard 6 (PS6)



H. Socio-Economic Environment

138. The NCC is a city corporation in the Narayanganj Sadar Upazila of Narayanganj District. The NCC was established through the merging of three former independent municipalities, namely: Narayanganj Pourashava, Siddhirganj Pourashava, and Kadam Rasul Pourashava. As a result, NCC is composed of 27 wards from these three municipalities or pourashavas. Relative to the Shitalakhya river, Narayanganj and Siddhirganj Pourashavas are situated on the western side while Kadam Rasul Pourashavac on the eastern side. As a result, NCC jurisdiction now covers areas on both sides of Shitalakhya river.

5. Demography

139. NCC's total area is 72.43 square kilometers with estimated population of 709,381 as of 2011.[26] Numbers of households are 60,290 in Siddhirganj Pourashava, 66,045 in Narayanganj Pourashava, and 39,302 in Kadam Rashul Pourashava. The average household size is higher in Narayanganj Pourashava than the other two pourashavas. Likewise, the sex ratio was higher in Narayaganj Pourashava than the other two pourashavas. Literacy rate of women was lower than of men in all three pourashavas. (footnote 18). Table below provides a summary of the demographic data in NCC.

Table 29: Household Data, Literacy Rate and Sex Ratio in the Study Area (NCC)

Ward/Union	Total Households	Average Household Size	Literacy Rate %		Sex Ratio
			Male	Female	
Siddhirganj Pourashava					
Ward-01	8,623	4.2	73.7	69.1	108
Ward-02	5,739	4.4	69.9	65.6	106
Ward-03	8,044	4.4	78.6	74.0	111
Ward-04	5,655	4.1	64.3	61.0	110
Ward-05	4,278	4.3	66.2	61.3	103
Ward-06	5,845	4.3	55.7	49.9	105
Ward-07	5,196	4.2	69.7	66.0	104
Ward-08	10,568	4.0	68.6	60.4	108
Ward-09	6,342	4.3	68.0	61.6	104
	60,290				
Narayanganj Pourashava					
Ward-01	5,094	4.0	74.8	63.9	109
Ward-02	5,843	4.2	70.6	62.9	109
Ward-03	9,565	4.2	74.1	66.4	108
Ward-04	10,004	4.6	76.4	69.7	108
Ward-05	6,552	4.5	77.7	72.3	109
Ward-06	5,453	4.4	72.3	65.9	112
Ward-07	7,920	4.4	68.2	63.9	105
Ward-08	8,198	4.3	70.3	65.3	104
Ward-09	7,416	4.1	60.2	57.6	105
	66,045				
Kadam Rasul Pourashava					
Ward-01	2,723	4.3	58.8	53.4	102
Ward-02	4,109	4.3	60.2	55.8	98
Ward-03	5,039	4.3	67.0	59.9	105
Ward-04	7,289	4.2	70.7	65.6	104
Ward-05	7,114	4.3	57.5	51.9	104

[26] Adjusted Population 2011. Statistical Yearbook of Bangladesh 2022. Bangladesh Bureau of Statistics. June 2023.

Ward/Union	Total Households	Average Household Size	Literacy Rate %		Sex Ratio
			Male	Female	
Ward-06	5,028	4.0	65.1	60.7	98
Ward-07	2,954	4.3	64.6	59.2	104
Ward-08	1,655	4.1	71.6	61.3	103
Ward-09	3,391	4.0	70.3	62.0	108
	39,302				
Total	**165,637**				

Source: Population & Housing Census-2011. Community Report: Narayanganj

6. Economy and Employment

140. NCC has a hoary history of development of industries and commerce of the country. Industrial use occupies 5.04% of the areas mostly along Shitalakhya river. Very limited agricultural practice can be seen in Bandar and Siddhirganj region. Narayanganj has become the center of apparel industry in Bangladesh. There was once a time that all sorts of products such as jute and oilseed were exported through the Narayanganj port. The first ever jute mill of the country Bawa Jute Mills, is situated in the Kadam Rasul Pourashava. Sonargaon, which is an important place in Narayanganj, was also very popular for garment products. Narayanganj, as a prime river port, became the center for collection and export of various raw materials due to its direct linkages with Chittagong. Thus, Narayanganj was declared as a port under Sea Custom Act, 1878.

141. Economic growth of NCC has been increasing tremendously for the last decade. A large increase of population became apparent mainly due to in-migration brought about by employment opportunities provided by the expansion of commercial and industrial activities in the NCC and Narayanganj Sadar Upazila. There are many industries and manufacturing companies established in and around the NCC and Narayanganj Sadar Upazila. These companies include textile mills, garments and other type of industries. Most of the employed population of the project area are involved in the services sector, then followed by employment in the industrial and agricultural sectors. Employment in agriculture includes direct farming, sharecropping, and agricultural labor. Table below shows the distribution of employment in NCC.

Table 30: Occupation of People in the Study Area (NCC)

Ward/Union	Population Aged 7+ years and Above Not Attending School but Employed		Field activities/ Occupation					
			Agriculture		Industry		Service	
	Male	Female	Male	Female	Male	Female	Male	Female
Siddhirganj Pourashava								
Ward-01	1,663	612	115	4	344	329	1,204	279
Ward-02	1,372	331	75	6	387	160	910	165
Ward-03	1,573	606	51	3	493	312	1,029	291
Ward-04	1,868	792	96	7	700	393	1,072	392
Ward-05	1,198	475	21	4	283	213	894	258
Ward-06	2,491	702	14	2	572	446	1,905	254
Ward-07	1,137	386	58	-	413	302	666	84
Ward-08	2,745	1,464	59	7	916	689	1,770	768
Ward-09	1,869	563	322	11	311	131	1,236	421
	15,916	5,931	811	44	4,419	2,975	10,686	2,912
Narayanganj Pourashava								
Ward-01	1,037	702	9	-	537	511	491	191

Ward/Union	Population Aged 7+ years and Above Not Attending School but Employed		Field activities/ Occupation					
			Agriculture		Industry		Service	
	Male	Female	Male	Female	Male	Female	Male	Female
Ward-02	1,312	630	19	-	315	228	978	402
Ward-03	2,339	1,474	25	6	1,057	682	1,257	786
Ward-04	1,794	1,131	57	17	724	415	1,013	699
Ward-05	1,589	406	94	15	763	192	732	199
Ward-06	1,771	860	13	6	1,287	585	471	269
Ward-07	2,121	698	16	-	730	259	1,375	439
Ward-08	1,992	547	19	-	530	159	1,443	388
Ward-09	3,216	979	39	5	1,188	360	1,989	614
	17,171	7,427	291	49	7,131	3,391	9,749	3,987
Kadam Rasul Pourashava								
Ward-01	922	232	161	76	337	83	424	73
Ward-02	1,261	307	59	8	501	182	701	117
Ward-03	1,683	576	27	10	553	332	1,103	234
Ward-04	2,212	699	23	3	322	236	1,867	460
Ward-05	2,859	1,146	100	36	1,029	547	1,730	563
Ward-06	1,117	354	43	4	263	201	811	149
Ward-07	635	304	78	2	355	243	202	59
Ward-08	374	183	30	2	161	120	183	61
Ward-09	843	290	51	5	378	209	414	76
	11,906	4,091	572	146	3,899	2,153	7,435	1,792
Total	**44,993**	**17,449**	**1,674**	**239**	**15,449**	**8,519**	**27,870**	**8,691**

Source: Population & Housing Census-2011, Community Report: Narayanganj

7. Educational Institution

142. As per survey under the Narayaganj City Corporation Area Action Plan, there are 977 educational structures in NCC area among which, 54.48% pucca (permanent solid), 31.63% semi-pucca and 16.45% katcha or kutcha (made of various light temporary materials such as timber/ wood/ corrugated iron sheet) structures. A total of 153 primary schools, 79 kindergartens and 30 informal and non-formal educational institute, 83 high schools, 31 colleges, 15 madrasas and 2 universities are located in NCC area.

8. Religion

143. Majority of the population of all Wards are Muslims followed by Hindus, Christians, Buddhists, and others. Table below shows a complete picture of the population by religious affiliation in NCC.

Table 31: Population by Religion in the Study Area

Ward	Total Population	Muslim	%	Hindu	%	Christian	%	Buddhist	%	Others	%
Siddhirganj Pourashava											
Ward-01	36,592	36,080	99	482	1	11	0	12	0	7	0
Ward-02	25,585	25,184	98	399	2	2	0	-	-	-	-
Ward-03	35,947	35,422	99	471	1	30	0	21	0	3	0

Ward	Total Population	Muslim	%	Hindu	%	Christian	%	Buddhist	%	Others	%
Ward-04	23,385	23,042	99	303	1	21	0	1	0	18	0
Ward-05	18,421	17,902	97	503	3	15	1	1	0	-	-
Ward-06	25,100	24,898	99	199	1	3	0	-	-	-	-
Ward-07	21,888	21,706	99	139	1	11	1	28	0	4	0
Ward-08	42,704	41,629	98	1,050	3	17	0	8	0	-	-
Ward-09	27,138	26,931	99	205	1	2	0	-	-	-	-
	256,760	252,794		3,751		112		71		32	
Narayanganj Pourashava											
Ward-01	20,489	17,736	87	2,731	13	17	0	5	0	-	-
Ward-02	24,550	22,252	91	2,273	9	18	0	7	0	-	-
Ward-03	40,187	36,758	91	3,397	8	26	0	6	0	-	-
Ward-04	47,079	38,786	82	8,231	17	43	0	16	0	3	0
Ward-05	29,431	16,371	56	13,057	44	3	0	-	-	-	-
Ward-06	24,096	13,399	56	10,687	44	9	0	1	0	-	-
Ward-07	34,496	33,498	97	976	3	10	0	5	0	7	0
Ward-08	35,518	33,812	95	1,705	5	1	-	-	-	-	-
Ward-09	30,484	25,511	84	4,960	16	7	0	6	0	-	-
	286,330	238,123		48,017		134		46		10	
Kadam Rasul Pourashava											
Ward-01	11,822	11,628	98	190	2	-	-	4	0	-	-
Ward-02	17,694	17,556	99	137	1	-	-	-	-	1	0
Ward-03	22,176	20,053	90	2,111	10	-	-	11	0	1	0
Ward-04	30,728	26,432	86	4,282	14	8	0	6	0	-	-
Ward-05	30,572	28,708	93	1,856	6	7	0	-	-	1	-
Ward-06	20,308	20,077	99	230	1	1	0	-	-	-	-
Ward-07	12,636	12,305	97	325	3	6	0	-	-	-	-
Ward-08	6,812	6,158	90	645	9	1	0	-	-	8	0
Ward-09	13,543	13,256	98	238	2	46	0	3	0	-	-
	166,291	156,173		10,014		69		24		11	
Total	**709,381**	**647,090**		**61,782**		**315**		**141**		**53**	

Source: Population & Housing Census-2011, Community Report: Narayanganj

9. Health Facilities and Other Community Facilities

144. There are health facilities in NCC, which include 37 different types of government and private hospitals and 44 clinics. There is only one tertiary hospital in NCC area which is the Narayanganj 200 Beds Hospital in Khanpur.

145. There are also other community facilities in NCC which include mosques, temples, churches, community centers, auditoriums, mazars (tombs), etc. There are a total of 524 mosques, 61 temples, 5 pagodas and 1 church in the study area. In addition, there are cinema halls, stadium, swimming pools, theme parks, etc. that serve as recreational facilities for city dwellers.

10. Settlement and Housing

146. The predominant housing structures in the study area are in Ward-08 in Kadam Rasul Pourashava, with 59.7% made of katcha or kutcha (made of various light temporary materials such as timber/ wood/ corrugated iron sheet); in Ward-05 of Kadam Rasul Pourashava, with

59.8% made of semi-pucca; in Ward-04 of Narayanganj Pourashava, with 66.1% made of pucca; and in Ward-03 of Narayanganj Pourashava, with 6.7% made of *Jhupri* (hut). Table below shows the summary of the type of structures of dwellings in NCC.

Table 32: Type of Structures of Houses in the Study Area (NCC)

Ward/ Union	Number of Households	Percentage of Type of Housing Structures			
		Pucca	Semi pucca	Kutcha	Jhupri
Siddhirganj Pourashava (Municipality)					
Ward-01	8,623	39	47	14	0
Ward-02	5,739	38	40	22	0
Ward-03	8,044	39	56	6	-
Ward-04	5,655	30	45	23	2
Ward-05	4,278	34	36	30	-
Ward-06	5,845	21	27	51	1
Ward-07	5,196	23	53	21	2
Ward-08	10,568	16	40	44	0
Ward-09	6,342	27	29	44	0
	60,290				
Narayanganj Pourashava (Municipality)					
Ward-01	5,094	26	38	37	0
Ward-02	5,843	32	40	27	1
Ward-03	9,565	47	33	13	7
Ward-04	10,004	66	26	8	1
Ward-05	6,552	59	34	7	1
Ward-06	5,453	64	25	7	4
Ward-07	7,920	50	36	9	6
Ward-08	8,198	55	34	11	1
Ward-09	7,416	35	39	24	2
	66,045				
Kadam Rasul Pourashava (Municipality)(Bandar Upazila)					
Ward-01	2,723	14	38	47	1
Ward-02	4,109	21	30	47	2
Ward-03	5,039	21	47	32	0
Ward-04	7,289	38	44	17	0
Ward-05	7,114	18	60	22	1
Ward-06	5,028	20	44	36	0
Ward-07	2,954	14	49	35	2
Ward-08	1,655	8	32	60	0
Ward-09	3,391	11	35	54	-
	39,302				
Total	**165,637**				

Source: Population & Housing Census-2011, Community Report: Narayanganj

11. Water Supply and Electricity

147. The sources of drinking water supply in NCC include piped/tap water and tube wells. Table below shows the data as to the sources of drinking water in the different wards of the three pourashavas of NCC. It can be gleaned that a large number of households of NCC area uses tube wells because these do not have access to piped water supply.

148. As of 2011, ward-wise electricity connection is in the range of 96.2 – 99.7%. Table below also shows the extent of access to electricity in the different wards of NCC.

Table 33: Drinking Water Sources and Electricity Facilities in Study Area (NCC)

Ward / Union	Number of Households	Source of Drinking Water in (%)			Electricity Connection in (%)
		Tap water	Tube well	Other	
Siddhirganj Pourashava					
Ward-01	8,623	90.6	8.5	0.9	99.5
Ward-02	5,739	91.7	7.3	0.9	99.3
Ward-03	8,044	6.1	93.5	3.5	99.4
Ward-04	5,655	2.2	94.3	0.1	96.9
Ward-05	4,278	5.8	32.2	62.1	99.1
Ward-06	5,845	38.6	35.8	25.6	99.5
Ward-07	5,196	22.1	75.4	2.5	98.3
Ward-08	10,568	46.7	51.1	2.1	98.9
Ward-09	6,342	5.0	90.3	4.8	97.6
	60,290				
Narayanganj Pourashava					
Ward-01	5,094	87.6	12.0	0.4	99.2
Ward-02	5,843	90.4	9.3	0.3	99.6
Ward-03	9,565	69.8	28.8	1.3	96.2
Ward-04	10,004	71.3	26.2	2.5	99.4
Ward-05	6,552	85.7	12.5	1.8	99.7
Ward-06	5,453	73.9	22.4	3.7	99.4
Ward-07	7,920	57.5	40.7	1.8	99.3
Ward-08	8,198	63.7	35.6	0.8	99.7
Ward-09	7,416	42.5	52.9	4.6	99.0
	66,045				
Kadam Rasul Pourashava					
Ward-01	2,723	9.5	88.2	2.3	98.7
Ward-02	4,109	53.7	45.0	1.4	96.3
Ward-03	5,039	60.5	37.2	2.2	99.0
Ward-04	7,289	56.2	41.6	2.2	98.8
Ward-05	7,114	19.3	79.1	1.6	98.5
Ward-06	5,028	77.3	19.5	3.2	98.1
Ward-07	2,954	39.7	52.9	7.4	98.7
Ward-08	1,655	11.6	86.7	1.7	97.6
Ward-09	3,391	0.1	82.3	17.6	97.7
	39,302				
Total	**165,637**				

Source: Population & Housing Census-2011, Community Report: Narayanganj

12. Sanitation

149. Generally, most of the households in NCC have sanitary facilities. The difference only lies on whether these are water-sealed or not. However, in poorer areas in the outskirts of the city, there is evidence that significant number of households do not have access to hygienic latrine facilities. Accordingly and with the lesser population density in these areas, some residents defecate in open spaces. Table below shows the result of a census on sanitation facilities in NCC.

Table 34: Sanitation Coverage in Study Area (NCC)

Ward/Union	Number of Households	Percentage of Toilet Facility			
		Sanitary (with water-seal)	Sanitary (no water-seal)	Non-Sanitary	None
Siddhirganj Pourashava					
Ward-01	8,623	62.9	35.8	1.3	0.0

Ward/Union	Number of Households	Percentage of Toilet Facility			
		Sanitary (with water-seal)	Sanitary (no water-seal)	Non-Sanitary	None
Ward-02	5,739	45.2	47.2	7.6	0.1
Ward-03	8,044	65.6	33.0	1.4	0.0
Ward-04	5,655	34.1	57.4	8.2	0.3
Ward-05	4,278	26.3	49.1	24.5	0.0
Ward-06	5,845	27.2	62.2	10.6	0.1
Ward-07	5,196	36.2	58.7	5.0	0.1
Ward-08	10,568	12.9	53.0	33.9	0.3
Ward-09	6,342	21.8	62.4	15.7	0.1
	60,290				
Narayanganj Pourashava					
Ward-01	5,094	31.7	61.3	6.8	0.2
Ward-02	5,843	38.7	53.5	7.8	0.0
Ward-03	9,565	52.4	36.3	11.0	0.3
Ward-04	10,004	57.5	38.0	4.0	0.5
Ward-05	6,552	40.8	55.7	3.5	0.0
Ward-06	5,453	54.4	39.6	5.6	0.3
Ward-07	7,920	63.2	28.0	5.2	3.6
Ward-08	8,198	72.1	22.7	5.2	0.0
Ward-09	7,416	6.8	81.2	10.2	1.8
	66,045				
Kadam Rasul Pourashava					
Ward-01	2,723	34.3	57.2	7.5	1.0
Ward-02	4,109	18.0	39.6	41.3	1.2
Ward-03	5,039	29.9	33.1	36.9	0.2
Ward-04	7,289	47.8	39.8	12.4	0.0
Ward-05	7,114	33.2	61.8	4.5	0.5
Ward-06	5,028	38.0	52.9	8.7	0.4
Ward-07	2,954	32.2	44.2	22.7	0.9
Ward-08	1,655	13.2	67.9	18.7	0.2
Ward-09	3,391	5.0	75.5	19.2	0.4
	39,302				
Total	**165,637**				

Source: Population & Housing Census-2011, Community Report: Narayanganj

13. Solid Waste Management

150. An estimation of solid waste generation by NCC in 2017 reveals around 898.60 tons per day, with characteristics of which is about 70% organic, 14% textiles, and 11% plastics. There is no efficient and organized waste segregation in the city. Some recyclable materials are collected by private collectors for recycling by their own or exported to retailers or to neighboring countries.[27] Generally, wastes are collected, transported and disposed in existing dumpsites. However, coverage of this waste management is limited due to lack of resources, both manpower and equipment. Thus, much of the solid wastes are dumped in many open spaces and low-lying areas, resulting to clogging of natural and man-made drains in many part of the city. Dumpsites are also operating beyond capacity. The Jalkuri Sanitary Landfill Site that is planned to be used by the project (NGRUDP) is likewise approaching its full capacity. Nevertheless, even with limited resources, NCC continuous to adopt responsible management of wastes through the promotion

[27] Feasibility Study On Solid Waste Management System For Narayanganj City. JICA. June 2019.

of the 3-R (reduce, reuse, recycle) strategy of the national government. Figure 13 and Figure 14 show the location and aerial view of Jalkuri Sanitary Landfill Site.

14. Roads and Transport

151. According to Narayanganj City Corporation Action Area Plan, 2016, the total road length in NCC area is about 609 km, of which katcha road is 211 km, semi-pucca road is 82 km and pucca road is 316 km. NCC is connected with Dhaka through three roads, meter-gauge rail line, and rivers (through Buriganga and Shitalakhya rivers).

152. Based on the roads classification in Bangladesh,[28] the roads in the subproject area are mostly upazila roads, union roads and village roads. Upazila and union roads are typically those roads connecting Upazila and Union headquarters with other Upazila and Union headquarters, growth centers or local markets or with each other. Village roads are typically those roads connecting villages or wards with Union headquarters, local markets, farms and ghats or with each other. Traffic conditions along these roads vary depending on locations, with most congested part along roads near marketplaces or in the central business district of NCC. Most of these roads are designed as two-lane roads, but many structures such as markets and shops have encroached some portions of these roads, and thereby narrowing the usable width leading to frequent traffic jams particularly during day time. Roads farther from the central business district of NCC generally have light to moderate traffic situation. Traffic condition at night time is normally light in most parts of NCC.

153. There are also relatively wider roads in the subproject area which are under the administration of either the Roads and Highways Department or LGED. These are the four-lane roads that connect the inner NCC roads to the highways in central Bangladesh. Traffic jams is also a normal scene along many sections these roads due to high volume of traffic and busy markets in the area particularly during day time. Photos of these typical types of roads in NCC are shown in Figure 41. Per observation, most of the roads in NCC are paved roads, but with sections that have deteriorated due to the impact of frequent flooding, weakening or breaking of the paved roads due to stress, erosions, etc.

I. Physical Cultural Resources

154. Narayanganj has historical importance for its relics of settlements of 12 Bhuiyan such as the Hajiganj Fort or Khizpur and Sonakanda Fort. These two forts are considered as protected monuments and are under the management of the Department of Archaeology. Protection and management of these heritage sites are covered under the Antiquities Act, 1968 and Antiquities Preservation Rules, 1986. These Act and Rules prohibit the destruction or damage to antiquities in the country, which include the Hajiganj Fort and Sonakanda Fort. While these prohibitions and restrictions pertain to activities within the boundaries of the heritage sites, there are no explicit rules pertaining to development activities outside the boundaries of said sites. However, as a precautionary measure, it is important for the subproject to inform the Department of Archaeology of the excavation activities it will undertake along the roads near these two heritage sites, including the chance finds protocol that will be adopted during construction activities.

[28] Draft Final Report on Study 01 & 02. Developing a Framework Regarding Involvement of Upazila Parishad / Union Parishad / Local community / Stakeholders for Rural Road Maintenance and Road Safety Programme for Participation in Management and Funding. LGED. January 2023.

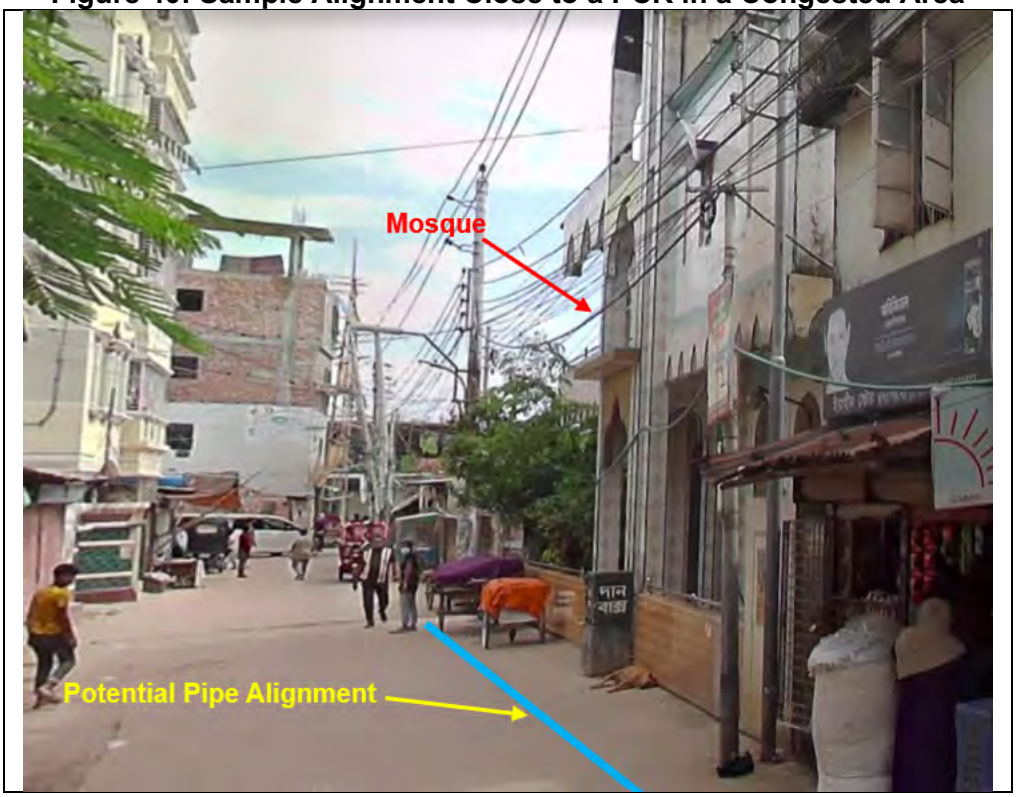
155. On site assessment specific to Hajiganj Fort, it was found out that its distance to the alignment is at around 10m. Figures below show ground level photo and map relative to the location of the heritage structure.

Figure 38: Photo of Hajiganj Fort

Figure 39: Map Showing Hajiganj Fort and Nearest Alignment

156. In addition, there are 524 mosques, 61 temples, 5 pagodas and 1 church in the NCC area. Easements and rights of way separate the boundaries of these physical cultural resources (PCRs) from the roads where civil works will be undertaken. These easements and rights of way have varying widths (1 – 20 meters), which are deemed enough to ensure pipelaying during construction phase will not impact the PCRs. Typical and inherent in community setting in Bangladesh are properties or structures, such as mosques or eidgahs, built very near the boundaries of roads. For works in these relatively constricted or congested areas, the excavation protocol provided in this IEE report (see Chapter V Section C) will be followed to ensure no impact occurs to the PCRs. A sample of this typical PCR that is very near the road is in Figure below.

Figure 40: Sample Alignment Close to a PCR in a Congested Area



V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

158. 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.[29]

159. 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 subproject entails development of water supply infrastructures, which will be permanent, decommissioning is not applicable to this specific subproject.

160. The subproject area will require extensive site preparation for all the components. Environmental clearance from the DOE to start the construction works is also necessary. The

[29] Environmental Impact Assessment by Larry W. Canter. McGraw-Hill Publications. 1996

proposed major activities will involve excavation and earth filling during construction and pipelaying works, construction of labor camps, site preparation, transportation of machinery and ancillaries, storage of equipment and materials for construction, erection of all equipment and machineries, etc. The subproject 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.

B. Impact Assessment

1. Methodology

161. 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 subproject interventions, it was necessary to single out every activity under the subproject; thereafter a detail understanding of the existing environmental and socio-economic settings of the subproject area was made. The significance of potential impacts was assessed using the criteria and methodology given below.

162. **Impact Magnitude.** Interventions associated with this subproject involves traditional construction activities in site-specific works at the WTP, DTW and OHT sites, and linear works such as pipelaying along the ROWs of existing roads. Allied works include laying pipelines, and backfilling. Depending on the types of activities, potential impacts of the subproject has been categorized as major, moderate, minor or negligible 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 15 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

Parameter	Major	Medium/Moderate	Minor	Negligible
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

163. **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 subproject'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

164. **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

165. The above methodology is also used to assess the residual impact after all the mitigation measures proposed have been applied. Normally, when the significance of residual impact is rated as either low or negligible, it means the mitigation measures are effective to address the impacts. However, when the significance of residual impact results to a rating in the range of

moderate to high or critical, it means the mitigation measures are not effective enough to address the issues. In this case, either change in design or compensatory/offset measure is necessary.

C. Summary of Impacts

166. The subproject'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								
Natural Hazards	Long term	Local	No	Certain	Medium	Mild	Moderate	Negligible
Raw Water Availability	Long term	Local	No	Certain	Medium	Mild	Moderate	Negligible
Raw Water Quality (Shitalakhya River)	Long term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Competing Use of Water Resources (Surface and Ground)	Long term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Land Subsidence	Long term	Local	No	Likely	Medium	Mild	Moderate	Negligible
Salinization/Saltwater Intrusion	Long term	Local	Yes	Occasional	Medium	Mild	Moderate	Negligible
Disruption of existing utilities and services	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Health hazard from asbestos-containing materials	Long term	Local	Yes	Occasional	Medium	Mild	Moderate	Negligible
Spoil Disposal Planning	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Sludge Disposal Planning	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Physical Cultural Resources	Long term	Global (due to potential Outstanding Universal Value or OUV)	No	Occasional	Medium	Mild	Moderate	Negligible
Consents, Permits, NOCs, Clearances etc.	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
DBO Contractor Mobilization	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Construction camps / workers' accommodation	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Updating of IEE and Preparation of SEMP	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Community awareness	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible

Potential Impacts	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
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
Impact to Topography and Aesthetics	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Impact to Structures Due to Excavation Works	Short term	Local	No	Likely	Medium	Mild	Moderate	Negligible
Impact to Surface Water	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Impact to Groundwater Quality	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Impact to Ambient Air Quality	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Impact to Noise and Vibration Level	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Impact to Underground PCRs (Relics)	Long term	Global (due to potential OUV)	Yes	Likely	Medium	Mild	Moderate	Negligible
Impact to Community Health and Safety	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Impact to Occupational Health and Safety	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Impact on Local Festivals and Cultural Practices	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Impact to Terrestrial Flora and Fauna Resources	Short term	Local	Yes	Occasional	Medium	Mild	Moderate	Negligible
Impact o Socio-economic Resources	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Impact on Employment	Short term	Local	Yes	Certain	Minor	Mild	Positive	Positive
Post-construction Waste Management, Disposal and Site Restoration	Short term	Local	Yes	Certain	Medium	Mild	Moderate	Negligible
Operation and Maintenance Phase								
Impact to Surface Water Quality	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Impact to Groundwater Quality	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Impact to Ambient Air Quality	Short term	Local	Yes	Occasional	Medium	Mild	Moderate	Negligible
Impact to Noise Level	Short term	Local	Yes	Occasional	Medium	Mild	Moderate	Negligible

Potential Impacts	Duration of Impact	Spatial Extent	Reversible or not	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance after Mitigation
Impact due to Waste Generation	Short term	Local	Yes	Occasional	Medium	Mild	Moderate	Negligible
Impact to Community Health and Safety	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Impact to Occupational Health and Safety	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible
Impact of Chlorinated Flushing Water	Short term	Local	Yes	Likely	Medium	Mild	Moderate	Negligible

D. Anticipated Impacts and Mitigation Measures During Design Phase and Pre-Construction Phase

1. Natural Hazards

167. **Impact.** The seismicity map of Bangladesh shows that Narayanganj lies in Zone-2 which shows intermediate level of seismic activity (see **Figure 21** in Chapter IV hereof). While the subproject area did not experience significant seismic events or earthquakes in years, there is a likelihood Narayanganj and its vicinities being in Zone 2 will be impacted by one at any time without warning. Apart from this potential seismic event, other extreme natural events such as unprecedented flooding could also potentially disturb the land within the NCC area. All these events cause damage to any infrastructures that will be built over the lands, including land subsidence or landslides in areas bordering water bodies. Damage to the WTP components, DTWs, OHTs, and distribution pipelines is likely.

168. **Mitigation.** Mitigation measures include the following:

(i) The structural designs of the WTP components, DTWs, and OHTs shall comply with relevant guidance such as Bangladesh National Building Code, building permits (or equivalent construction- and design-related permits) in Seismic Zone 2 areas, etc. to ensure the structures are within the standards;
(ii) Ensure design depths of new DTWs, locations, and projected water availability are based on scientific study on sustainability of groundwater in these areas, taking into consideration the impact of climate change over the long term; and
(iii) Use of construction materials that could withstand potential stresses brought about by extreme weather events, temperatures, pressures, etc.

2. Source Sustainability, and Seasonal Water Availability and Quality.

169. **Impact Due to Availability –** Firstly, the rehabilitation of the WTP will not involve increasing the intake capacity. The original 45 MLD capacity of the WTP as it was designed and built in the 1990s will be maintained. Therefore, no additional abstraction of water from Shitalakhya river is envisaged. Secondly, the minimum and maximum discharge volume of the Shitalakhya River for the period 2011-2021 was determined to be 112.55 m^3/sec during lean season and 1,638.31 m^3/sec during a monsoon season, respectively (See Table 39 below). By comparison, the design water intake requirement of the WTP will only be 0.52 m^3/sec. This amount of abstraction is equivalent to about 0.50% of the recorded minimum flow and as low as about 0.03% of the maximum flow recorded. As the Shitalakhya river is a big perennial river system in central Bangladesh, these levels of abstraction of water by the WTP will not have any considerable effect over the flow regime of the river. There are no other uses of the Shitalakhya river other than a major navigational route for Bangladesh. Other economic uses include ferry transport and dredging businesses for some of the locals but are considered non-consumptive in nature. Summary of the discharge flow rates of Shitalakhya river is in the table below.

Table 39: Water Discharge Volume (2011-2021).

		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Water Discharge (m^3/sec)	Max	1,297.71	763.42	784.79	1,149.98	1,087.76	1,053.43	1,375.03	808.77	1,057.20	1,638.31	945.60
	Min	112.55	322.29	124.33	172.83	591.00	161.41	499.39	221.41	320.74	289.70	340.49
	Ave	526.80	564.80	392.60	585.00	810.90	502.20	892.90	558.10	553.10	726.60	629.00

Source: Design Report for Rehabilitation of Godenail Water Treatment Plant. October 2022. (Data/Figures taken from Bangladesh Water Development Board).

170. **Mitigation.** Based on analysis, the subproject will not be negatively impacted in terms of availability of water from Shitalakhya river. No mitigation measure is required.

171. **Impact Due to Water Quality**. Shitalakhya river is a branch of the Old Brahmaputra river extending from the northeastern part of Dhaka region down to the southern tip of Narayanganj where it meets with Daleshwari, Brahmaputra and Meghna rivers. Shitalakhya river is a big perennial river that is used primarily as a navigational route in central Bangladesh which passes through various towns and cities. Due to heavy agricultural activities, commercialization and industrialization in this part of Bangladesh, Shitalakhya river is also one receiver of discharges from these sources. In Narayanganj alone, many large-, medium-, and small-sized industries are located on both banks of the river. Discharges from these sources, including the ever-increasing domestic sources in the area, have deteriorated the quality of the river. Per assessment during the environmental study, no fishing ground or livelihood dependent on aquatic life exists in any section of the river.

172. As discussed in Chapter III hereof, an assessment of the water quality of Shitalakhya river in the vicinity of the intake point revealed water quality parameters significantly exceeding the standards for inland water source on BOD, nitrate, and phosphate. In some occasions, other parameters were also exceeded such as COD, DO, chromium and total coliform parameters, as summarized in Table below**.**

Table 40: Quality of Raw Water Source (Shitalakhya River) Compared With Inland Water Quality Standard Parameter Per ECR, 2023

Parameters	Monitoring /Sampling Dates							ECR, 2023 Standards (Source of Drinking Water Supply After Conventional Treatment)
	25 Feb 2018 (intake)	17 Sep 2018 (intake)	12 May 2019 (intake)	Jan 2022 (intake)	21 Dec 2022 (intake)	21 Dec 2022 (100m upstream of intake)	21 Dec 2022 (100m downstream of intake)	
pH	7.250	6.800	7.100	-	-	-	-	6 – 9
TDS, mg/l	391.000	94.000	243.000	-	-	-	-	1,000
DO, mg/l	-	-	-	0.18	-	-	-	≥ 5
BOD, mg/l	32.000	5.500	15.500	-	-	-	-	≤ 3
COD, mg/l	62.200	9.400	-	-	-	-	-	25
NO_3-N, mg/l	2.100	1.900	0.800	-	-	-	-	7.0
NH_4-N, mg/l	10.675	0.293	4.050	-	-	-	-	0.3
PO_4-P, mg/l	3.000	1.087	1.160	-	-	-	-	0.5
Cr, mg/l	0.022	0.003	0.007	-	0.005	0.005	0.005	0.02
As, mg/l	-	-	-	-	0.003	0.002	0.003	-
Cd, mg/l	-	-	-	-	0.00015	0.00015	0.00015	-
Cu, mg/l	-	-	-	-	0.03	0.03	0.03	-
Pb, mg/l	-	-	-	-	0.027	0.014	0.013	0.03
Hg, mg/l	-	-	-	-	-	-	-	0.001
Ni, mg/l	-	-	-	-	0.03	0.03	0.03	
Zn, mg/l	-	-	-	-	0.02	0.03	0.02	
Total Coliform, N/100ml	-	-	0.000	Too Numerous to Count	-	-	-	≤ 5,000

173. With very high organic and inorganic load in the raw water, simple rehabilitation of the WTP per original design may not be able to treat the raw water to comply with the NDWQS. Thus, there is a need to design the upgrading of the WTP to deal with the poorer quality of raw water.

174. **Mitigation Measures**. The upgrading of the WTP will need to include additional treatment process in order to reduce the high organic and ammonia nitrogen load of the raw water. The moving bed biofilm reactor (MBBR) technology was chosen as the additional component for this purpose, which will be set up as the first stage secondary treatment and will be sequenced after the primary treatment. The MBBR will be able to help reduce the pollution load of the raw water from Shitalakhya river. A full discussion of this measure is included in Chapter III hereof.

175. During the design, the DBO Contractor shall ensure that the following are strictly considered. These requirements shall also be included explicitly in the Employer's Requirements of bidding and contract documents:

(i) Ensure that treatment system design is based on robust raw water quality information, duly accounting for likely quality fluctuations in the life of project;
(ii) Include detailed assessment of raw water quality at intake and confirm that water quality parameters selected are appropriate and representative of the pollution sources (including types of industries) to design treatment system;
(iii) Provide technical solutions to safeguard the treatment system efficiency, such as: defining the boundary limits / WTP inlet raw quality standards, and outlet limits for treated water (drinking water standards); automated system to alert and initiate action in case of breach of such limits; online continuous monitoring system for critical water quality parameters, for raw and stage-wise treatment, and treated water; protocols / standard operating procedures for system operation and maintenance; identify the risks and prepare a risk management plan to eliminate or mitigate risks; emergency response plans; establish preventive, emergency and periodic maintenance protocols; duly consider resource requirements (personnel, technology, spare parts etc.);
(iv) Consider capacity of NCC to operate and maintain the proposed treatment system, and recommend appropriate operating mode and capacity building measures; and
(v) Include environmental audit of the existing Godnail WTP covering regulatory compliance, and environment safeguards aspects. Include proper backwash and sludge management and disposal facilities.

3. Potential **Competing** Use of Water Resource

176. **Impact.** The intake is located at the Shitalakhya river within the jurisdiction of NCC. Along this stretch of the river from upstream to downstream section at the confluence point with Daleshwari river, the river is primarily used as an intercity navigational and local transport route. While there is no fishery-related or any agricultural activities in the downstream of this river, other major economic activities out of this river are the local ferry transport and dredging businesses. The abstraction of water by the WTP may impact and pose possible water resource sharing issues with these businesses.

177. **Mitigation**. The feasibility study conducted for the rehabilitation and upgrading of the WTP included assessment on the sustainability of Shitalakhya river as source of raw water. The annual discharge volumes of the river over the past more than 10 years were gathered. The set of data was analyzed to determine whether or not the abstraction by the WTP will have any significant

impact to the river and thus to its existing uses. Table 39 above shows the discharge data for the period 2011 – 2021.

178. By reiteration of the illustration above, the WTP will only be abstracting maximum of 0.52 m^3/sec (conversion of 45MLD). This amount of abstraction is only equivalent to about 0.50% of the recorded minimum flow and as low as about 0.03% of the recorded maximum flow of the river. These rates of abstraction are regarded as very negligible which will not have significant effect to the level or depth of Shitalakhya river. No impact is expected on transport ferries and other navigational vessels traversing the channel at any given time. Therefore, the abstraction of water by the WTP from Shitalakhya river does not have any significant competing issues with the current use of the river.

4. Potential Operational Phase Impacts of Subproject to Surface Water Quality, Groundwater Quality, Ambient Air Quality and Noise level

179. **Impacts**. Apart from design considerations on the ability of the WTP system to treat any discharge to comply with the effluent and emission standards, there may be some operational issues not related to design that could impact the Shitalakhya river, groundwater, ambient air quality, noise level, and community and occupational health and safety in the area during the operation phase of the subproject. These include potential discharge of chemicals and untreated wastewater including sludge, seepage of leachates, pollutive emissions from equipment/machineries, noise from repair works, and community and occupational health and safety hazards that may arise. All these potential impacts need be addressed during the design phase as well.

180. **Mitigation**. DBO Contractor will develop an O&M Manual that will include mitigation measures, such as, among others, the following:

For Surface Water Quality:

(i) Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume;
(ii) Institute good housekeeping practices at all sections of the WTP;
(iii) Recycle used or spent water to avoid discharge to the river. If recycling is not possible, ensure that wastewater such as supernatant liquid from the sludge treatment and drying is treated to comply with national effluent standards prior to discharge to the river;
(iv) Conduct effluent quality monitoring per monitoring plan;
(v) Conduct water quality monitoring at the upstream and downstream portions of Shitalakhya river per monitoring plan;
(vi) No discharge of generated sludge to the Shitalakhya river;
(vii) Ensure to operate the sludge drying beds and store dried sludge in appropriate packing prior to transport to disposal site or prior to reuse, whichever is the adopted option; and
(viii) In case of landfill disposal, transport dried sludge to designated dried sludge disposal site on a regular basis to avoid accumulation of dried sludge at the WTP area.

For Groundwater Quality

(i) Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume;

(ii) Ensure that temporary storage area of dried sludge at the WTP compound is lined with impervious materials;
(iii) Conduct ground water quality monitoring in the area per monitoring plan;
(iv) In case when disposal is the option for sludge management, undertake operation and maintenance at the sludge disposal site to ensure that:
  a. Impervious lining is in place and maintained,
  b. Sludge is properly spread and compacted,
  c. Sludge volume is within capacity limit of the disposal site, and
  d. Storm water canal around the sludge disposal site is installed and working properly;
(v) Identify new sludge disposal site in anticipation of full capacity utilization of existing disposal site. Site selection should consider all criteria presented in this environmental management plan; and
(vi) Undertake environmentally responsible site rehabilitation and bio-remediation works on fully utilized sludge disposal sites.

For Ambient Air Quality

(i) Regular maintenance of all WTP components;
(ii) Regular maintenance of other equipment (e.g. generator sets) and vehicles to ensure compliance with national emissions standards;
(iii) Prohibit burning of any liquid or solid wastes; and
(iv) Conduct ambient air quality monitoring at strategic locations per monitoring plan. Ensure that sampling locations are based on the wind and dust/smoke dispersion direction at the site.

For Noise Level

(i) Provide prior information of the scheduled noise-intensive maintenance works to nearby residents;
(ii) In subproject areas that are near
(iii) Use silencers for all equipment;
(iv) Maintain maximum of noise level of 45 dB(A) at the nearest residence relative to the specific worksite;
(v) Conduct noise level monitoring per monitoring plan. Ensure to conduct sampling during peak period of operation. Important areas to test are at locations nearest the community residents;
(vi) If using generators, use generator set with capacity just enough for the electricity needs;
(vii) Ensure generator set complies with the noise standards; and
(viii) Ensure generator set has acoustic enclosure and silencer (if necessary) in the exhaust muffler.

For Community Health and Safety

(i) Follow international best practices on community health and safety such as those in World Bank EHS Guidelines on Water and Sanitation. The following should be included:
  a. Ensure that treatment capacity is adequate to meet anticipated demand;
  b. Construct, operate and maintain the WTP in accordance with national requirements and internationally accepted standards[30] to meet national

[30] See, for example, American Water Works Association Standard G100-05: Water Treatment Plant Operation and Management.

water quality standards or, in their absence, WHO Guidelines for Drinking Water Quality;[31]

c. Evaluate the vulnerability of the WTP, DTWs, and OHTs; and implement appropriate security measures, such as:
   i Background checks of employees;
   ii Perimeter fencing and video surveillance with the compounds;
   iii Improved electrical power feeds to the facilities; and
   iv Redundant electrical power systems significantly reduce the vulnerability risk to essential operations;

(ii) In case of excessively poor quality of raw water that is beyond the limits the WTP is designed for, the DBO Contractor, in consultation with NCC through PMU and MDSC, shall immediately shut down the WTP to ensure no damage can occur in the various components and avoid delivering partially treated water into the distribution lines. Under this scenario, the DBO Contractor of the WTP, under the supervision of NCC through PMU and MDSC, shall undertake drinking water rationing to all affected households in the NCC area. To ensure effective dissemination of information as to the occurrence of such incident and the scheduling of water rations, DBO Contractor shall use all platforms of communication (TV, radio, internet, social media). The DBO Contractor shall also provide the necessary information as to when the water supply can be normalized;

(iii) The stability and integrity of the distribution system including the DTWs and OHTs will be monitored periodically to detect any problems and allow remedial action if required. Recurrence of pipe bursts and leakage problems can be managed by the leak detection, rectification and water auditing surveys. DBO Contractor will be required to ensure that the leak detection and rectification time is minimized;

(iv) For any excavation works related to these O&M issues, the methodologies and protocols developed for the construction phase (see Table 43) shall be strictly followed; and

(v) Noise abatement measures developed for the construction phase shall be strictly followed.

For Occupational Health and Safety

(i) All relevant provisions of the Bangladesh Labour Act, 2006 (and its 2013 amendment) and any of its amendments, and relevant WHO guidelines;

(ii) Follow international best practices on occupational health and safety such as those in Section 4.2 of World Bank EHS Guidelines on Water and Sanitation,[32] which include the following elements, whichever are applicable:

a. Accidents and Injuries
   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 deep water tanks;
   iii Implement a confined spaces entry program that is consistent with applicable national requirements and internationally accepted

[31] Refer to the WHO website at http://www.who.int for the most recent version of the Drinking Water Guidelines.

[32] IFC World Bank Group. 2007. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines/watersanitation_firstconsultation

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 hazards;

vi Implement fire and explosion prevention measures in accordance with internationally accepted standards;

vii When installing or repairing components adjacent to roadways, implement procedures and traffic controls, such as:

- 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 vehicles; and

viii Locate all underground utilities before digging.

a. Chemical Exposure and Hazardous Atmospheres

i Implement a training program for the WTP operator and other workers of the whole water supply system, who handle 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 If applicable, conduct radiation surveys at least annually, especially in areas where radionuclides are removed;

vii Limit wastes entering the sewer system;

viii Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance.

ix Use personal gas detection equipment while working in confined space;

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, particularly in enclosed spaces. 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; and

xiii Rotate personnel among the various WTP operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.

(ii) For potential encounter and handling of AC pipes during abandonment of the old pipeline network, and re-alignment and/or reconnection works to the household meters, follow the protocols in the AMP developed for the subproject during the pre-construction phase. Among others, the comply with the following:

a. Existing AC pipes, where intact, shall be left in-situ and not disturbed. Where the AC pipe is damaged and where there is a risk of asbestos particles becoming airborne, the NCC (or any other operator in the future) shall follow all necessary procedures in the AMP;

b. Ensure all personnel and laborers are trained to enable them understand health risks associated with asbestos from AC pipes, how to identify AC pipes, and how to properly handle AC pipes based on the AMP it developed for the subproject; and

c. Maintain an updated record of AC pipe alignments identified or encountered since the start of implementing the subproject. This record shall be kept as official record and may be used as reference by NCC management. Other development projects may be implemented elsewhere the city and this record will provide NCC with accurate information as to the locations of the AC pipes, which should not be disturbed or destroyed during any of these development activities in the future.

(iii) Follow established occupational health and safety protocol on infectious diseases such as COVID-19; and

(iv) Provide regular health check-ups, sanitation and hygiene, health care, and control of diseases for the workforce.

5. Land Subsidence Due to Groundwater Abstraction

181. The subproject involves rehabilitation of existing DTWs in NCC, which are additional sources of drinking water supply for the whole system. These existing DTWs were already in operation for decades in NCC and no observed land subsidence has occurred at any of these sites. However, their continuous use over the long term may induce land subsidence in the area. This potential impact is also one concern of Water Supply Contract 2 Subproject which will develop the additional PTWs as supplementary sources of drinking water for the water supply system of NCC. A hydrological study and modeling has been conducted in support of the said subproject. The results of the study and modeling also apply to the water Supply Contract 1 Subproject (the subject of this IEE report), considering that the groundwater regime and aquifer in the study encompass a wide area covering the entire NCC and beyond.

182. The expert who led the hydrological study and modeling provided an assessment on the potential land subsidence due to groundwater abstraction in the subproject area. The

documentation of this follow-on assessment is appended to the main report of the study and modeling. See Appendix 8. Firstly, the expert noted on facts and data from literature[33] as follows:

(i) Many of the world′s largest river deltas are sinking due to sediment loading, compaction, and tectonics, but also recently because of groundwater extraction, hydrocarbon extraction, and reduced aggradation;
(ii) Land subsidence of 0 to >10mm/year is seen in Dhaka, with variability likely related to local variations in shallow subsurface sediment properties. Outside of the city, rates vary from 0 to >18mm/year, with the lowest rates appearing primarily in Pleistocene Madhupur Clay and the highest rates in Holocene organic-rich muds; and
(iii) Results demonstrate that subsidence in this delta is primarily controlled by local stratigraphy, with rates varying by more than an order of magnitude depending on lithology.

183. The expert assessed the correlation of these established facts and figures to the results of the hydrological study in the subproject area. Accordingly, the bore log data taken from the area of the study showed that the whole vertical sequence of the sediments does not contain any significant organic rich mud at all. Dewatering of sediments will take place only in the uppermost 10 to 35m thick predominantly sandy sediments. Therefore, the possibility of land subsidence due to the impact of abstraction through induced bank filtration (IBF) system is expected to be very low or insignificant. This IBF system is designed to abstract water from groundwater source, and thus similar to the nature and use of the existing DTWs under the subproject.

184. In view of the above, impact due to land subsidence is considered insignificant. No mitigation measure is required.

6. Salinization Due to Groundwater Abstraction

185. Groundwater salinization may only be caused by several natural and man-made factors. Natural sources of salinity include geological processes in an area (geogenic factor) and saltwater intrusion from coastal waters to the freshwater aquifers inland. Anthropogenic sources include salts from irrigation waters and other human activities overground. Based from the environmental baseline monitoring undertaken during the assessment for the subproject, salinity of groundwater from existing deep tube wells in NCC reveal relatively low levels in the range of 0.16 – 0.92%. See **Error! Reference source not found.** in Chapter IV hereof. Despite the use of these DTWs i n the past several decades, the results indicate that there is no significant groundwater salinization in the NCC area at this stage. This may be attributed to the fact that the area is bounded by many perennial rivers that could provide more than enough replenishment to the groundwater aquifer. Further, the NCC is also relatively far from the coastal area and that potential seawater intrusion is highly unlikely. In a latest monitoring of groundwater quality by the DOE in Barishal District, which is in the southern part and closest to NCC, results show that chloride content is within the NDWQS as shown in the following table.

[33] Higgins, Stephanie & Overeem, Irina & Steckler, Michael & Syvitski, Jaia & Seeber, Leonardo & Akhter, Syed. (2014). InSAR Measurements of Compaction and Subsidence in the Ganges-Brahmaputra Delta, Bangladesh. Journal of Geophysical Research: Earth Surface. 119. 10.1002/2014JF003117.

Table 41: Groundwater Quality In Barishal District (Southern Part of Narayanganj)

Specific Sampling Locations in Barishal District	pH			Electric Conductivity, µmohos/cm			Chloride, mg/l			Total Alkalinity, mg/l		
DC Office	7.2	7.0	7.0	218	216	216	124	122	122	120	118	118
Upazila Office	7.4	7.0	7.0	220	216	216	126	122	122	122	118	118
Sadar Hospital	7.0	7.2	7.2	216	218	218	122	124	124	118	120	120
Sher-E Bangla Medical College Hospital	7.2	7.4	7.4	218	220	220	124	126	126	120	122	122
BM College Sadar	7.04	7.4	7.4	220	220	220	126	126	126	122	122	122
Syed Hatim Ali Govt College	7.0	7.2	7.2	216	218	218	122	124	124	118	120	120
Barishal Zila School	7.2	7.0	7.0	218	216	216	124	122	122	120	118	118
Natullabad Bus Stand	7.4	7.0	7.0	220	216	216	126	122	122	122	118	118
Chowmatha Bazar, Sadar	7.0	7.4	7.4	216	220	220	122	126	126	118	122	122
Battala Bazar, Sadar	7.2	7.2	7.2	218	218	218	124	124	124	120	120	120
ECR, 1997 Standards	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	-	-	-	150 – 600	150 – 600	150 – 600	200 - 500	200 - 500	200 - 500
ECR, 2023 Standards	6.5 – 8.5	6.5 – 8.5	6.5 – 8.5	-	-	-	250	250	250	500	500	500

Source: Surface and Ground Water Quality Report 2016. Bangladesh Department of Environment. December 2017.

186. Barishal district is in the southern section of NCC. The above results in terms of chloride content indicate that no saltwater intrusion as of yet in this district that is closer to the coastal area of Bangladesh. Even while in theory that groundwater abstraction may induce salinization of the aquifer due to saltwater intrusion, the results of monitoring would indicate that there is no immediate or significant issue as far as this type of impact to the groundwater in NCC is concerned. However, continuous monitoring and recording of groundwater salinity is necessary for the subproject (and the overall project as a whole) to observe if there will be any uptrend in the salinity or chloride concentration in groundwater in the NCC area in the years to come. Reasonably, any indication of increase in groundwater salinity in the future may not automatically be attributed to the groundwater abstraction by the overall project, and that more scientific causal analysis will be necessary. As such, monitoring and recording of the trend is important for future reference and studies.

7. Disruption of existing utilities and services

187. **Impacts.** All alignments of the subproject linear works will pass through roads in the different parts of NCC. There is high likelihood that these alignments or sites will cross, intercept and/or align with existing utilities and services, such as underground and overground cables, electricity posts, etc., already installed in these areas. Any damage to these utilities will disrupt the daily lives and livelihood activities of the people affected. The potential impacts arising from disruption and damage to public utilities are summarized in following table**.**

Table 42: Potential Impacts of Disruption to Public Utilities

Disrupted or Damaged Utility	Potential Impacts
Electricity Posts and Cables[a]	Interruption of electric supply
	Personal injury due to electrocution
	Cost of Repair/Delay to Works
Water Pipelines[b]	Interruption of water supply
	Cost of Repair/Delay to Works
Telephone and/or Internet Cables[c]	Interruption of communication system
	Cost of Repair/Delay to Works

[a] Owned by Bangladesh Power Development Board
[b] Owned by NCC

[c] Various telecom companies in Bangladesh, depending on location

188. **Mitigation Measures.** Recorded drawings of underground utility services are not always accurate, and the DBO Contractor shall accurately locate all services, by trial pits, if necessary, before work commences in any given area. Nevertheless, accidents could 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 DBO Contractor shall be responsible for the expeditious repair of accidental damage.

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

190. DBO Contractor shall liaise with each of the agencies (e.g. Roads and Highway Department, Dhaka Power Distribution Company, and Telecom Companies) 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 NCC to carry out the necessary works at the time required and at NCC cost. The tender documents shall contain sufficient information on utilities at the sites to permit the DBO Contractor to include the cost of the works for which it is responsible in the bid.

8. Health Hazard from Asbestos-Containing Materials (ACMs)

191. **Impacts**. With the assessment of the existing distribution network in the entire NCC area, it was determined that aggregate of 10.2 km of the network is made of asbestos cement (AC) pipe. For the rehabilitation plan, the first option and priority is to avoid touching or disturbing these AC pipes. Therefore, replacement pipes will be installed or laid away from the alignment of existing pipelines to avoid any potential damage to them including AC pipes. However there may be instances particularly in narrower lanes that AC pipes might still be accidentally encountered and/or damaged during construction phase or even during the operation phase.

192. Handling asbestos cement pipes may result to the generation of asbestos dust and fibers, which could go airborne and harm the workers and the public. When inhaled, asbestos fibers may cause long term health issues such as asbestosis and other lung inflammation and diseases including cancer.

193. **Mitigation Measures**. Apart from the operational measures suggested above that will be included in the O&M Manual, it should be reiterated that the priority of the subproject is to not touch or disturb the AC pipes. The following mitigation measures are only put in place as precaution in case there will be unintended encounter of AC pipes during implementation. There are two levels of managing health risks related to asbestos – during design stage and finalization of bidding and contract documents, and during pre-construction phase by the winning DBO Contractor.

Design, and Bidding and Contract Document Preparation Stage.

(i) The bidding and contract documents need to recognize the presence of asbestos-containing materials (ACM) such as asbestos cement (AC) pipes in the distribution network or any other existing facilities that will be rehabilitated under the subproject, including extent such as length or volume, as may be available.
(ii) If sufficient information is not available from the Employer (NCC) or PMU, the bidding and contract documents need to emphasize the need to conduct field survey together with the winning bidder to identify the alignments having AC pipes or infrastructures having ACMs prior to any mobilization;
(iii) All costs related to the development and implementation of ACM Management Plan (AMP) shall be borne by the DBO Contractor. Appropriation or budgeting should include, among others, the following:
    a. Training of workers about the health hazards of asbestos to themselves and their families;
    b. Work clothing or PPEs required when handling ACMs;
    c. Double changing rooms and wash facilities to prevent dust from going home on street clothes; and
    d. Periodic medical examinations of workers.

Pre-construction Phase by the DBO Contractor.

(i) Develop and implement an asbestos-containing materials (ACM) Management Plan (AMP) that includes identification of hazards, the use of proper safety gear, and handling and disposal methods. The AMP should be able to provide all explanations that are understandable to ordinary laborers or employees of the DBO Contractor. The DBO Contractor may refer to ADB's Good Practice Guidance for the Management and Control of Asbestos (Protecting Workplaces and Communities from Asbestos Exposure Risks).[34] A sample AMP is in Appendix 9, which was developed under an ADB technical assistance that supported a similar type of ADB-funded project in the water sector in South Asia. In summary, the AMP should include the best practices in handling and disposal of ACM, such as, among others, the following:

Working Safely at Sites:

    a. When working with ACMs such as AC pipes, wear the appropriate PPEs including respirator or dust mask;
    b. Make sure the mask has two straps to hold it firmly in place. Don't use masks that only have one;
    c. Also wear a hard hat, gloves, disposable coveralls with a hood, and safety glasses or goggles to protect eyes;
    d. Do not eat, drink or smoke in the work area as the dust may be inhaled or eaten. Wash hands and face with soap and water before meal breaks and when finished work for the day;
    e. Do not use power tools. Asbestos fibers can be released if power tools are used for anything other than for the removal of screws;
    f. Do not water blast or scrub with a stiff broom or brush. If the material has been accidentally water blasted or has suddenly deteriorated in some way, call a licensed asbestos removal contractor;

[34] https://www.adb.org/publications/good-practice-management-control-asbestos

g. Wet gently with water when removing asbestos cement pipes, use a pump spray to lightly dampen the pipes and keep the dust down. Remember not to water blast ACMs;
h. Avoid drilling and cutting into asbestos products. Do not drill holes through and never cut. Instead remove the entire product and replace it with a non-asbestos product;
i. Do not drop fiber pipes to minimize breakage. Remove them carefully. Lower them to the ground;
j. Lay plastic sheeting under the work area to prevent any dust contaminating the ground. Use 200 micron thick plastic sheeting or bags; these must not be made from recycled materials or re-used for any other purpose;
k. The work area has to be barricaded and there should be no unauthorized person allowed. Only trained ACM expert or workers should be allowed to handle the ACM along with the EHS Expert of DBO Contractor.
l. When working near houses, advise residents to close windows and doors and seal vents to stop dust getting into the houses;
m. All the broken AC pipes have to collected and stacked properly with 200 micron plastic wrapping with winning signage;
n. Do not leave plastic sheet lying about where they may be further broken or crushed by people or traffic;
o. Remove all ACM by the trained handler; and
p. During dry climatic conditions, due care must be taken to see that no waste broken pipes or fittings are left loose and outside the confined area and may be dampened as required.

Disposal of AMC:

q. Due care has to be taken to collect the dampened waste in a permissible standard bags with proper warning signage's.
r. The plastic bags must have legible note:
   Waste Type:
   - ❑ Date of packing:
   - ❑ Qty/Numbers:
   - ❑ Packed by:
   - ❑ Warning Signage:
   - ❑ Disposal:

s. The wastages packed have to be disposed off to Treatment, Storage or Disposal Facility(TSDF). If there are no TSDF in Bangladesh, the packed ACMs shall be shipped overseas for proper disposal following all protocols on transboundary shipment of toxic and hazardous wastes, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal of which Bangladesh is a signatory. This shall be included in the relevant sections of the bid and contract documents to ensure legally binding condition for the contractor. As such, contractor is obliged to exert all efforts not to touch or damage the existing AC pipes to avoid the responsibility of disposing ACMs at its own cost.

(ii) The AMP shall be submitted to PMU for approval;
(iii) Ensure all its personnel and laborers are trained to enable them understand health risks associated with asbestos from AC pipes, how to identify AC pipes, and how to properly handle AC pipes based on the AMP it developed for the subproject;

(iv) With support from the PMU and prior to mobilization, conduct reconnaissance of alignments believed to be where AC pipes are laid and undertake determination or sampling following related protocol in the AMP;
(v) Based on the reconnaissance, establish a recording system that will note the locations of AC pipes. This record shall be maintained and updated during construction phase should there be other additional AC pipe alignments identified or encountered during pipelaying works; and
(vi) Submit to PMU updated records of AC pipe alignments as part of its regular monitoring reports to PMU.

9. Spoil Disposal

194. **Impact.** With the nature of works, the subproject is expected to generate spoils during construction phase due to excavation activities along alignments, including excavation works at the WTP, DTWs and OHT sites, if any. Most of these spoils will be used to cover trenches after pipeline installation, and thus, excess spoils will be minimal. However, even if minimal, and assuming no other uses for excess spoils, their indiscriminate or unmanaged disposal will negatively impact the environment, such as siltation and clogging of canals, damage to paved roads, and safety to pedestrians and community as a whole. This may also result to other forms of nuisance to surrounding communities wherever these are disposed.

195. **Mitigation**. Prior to award of contract, NCC will identify a location for the disposal of excess spoils that will be generated during the construction phase. The disposal location will need to obtain clearance from relevant government agencies having jurisdiction over such location. No award of the contract shall be made until disposal location and relevant clearance are obtained.

10. Sludge Disposal

196. **Impact**. While the impact of sludge disposal will occur during the operation phase of the WTP, it is important that the sludge disposal site is identified during the detailed design phase when the expected ultimate sludge generation volume is likewise estimated. With this, the appropriate location for its disposal should be identified. If no site is identified at this stage, there is a possibility that sludge might be mishandled or indiscriminately disposed of during the operation phase.

197. **Mitigation**. DBO Contractor to finalize the sludge management strategy for the WTP by identifying the best option for sludge disposal. If DBO Contractor opts for disposal to existing landfill site at the Jalkuri Landfill Site, coordinate with the management of NCC and Jalkuri Landfill Site to finalize the exact location of sludge disposal in the area. DBO Contractor, with support from MDSC, will conduct a due diligence on the appropriateness of the selected site and ensure the following:

(i) Not near or adjacent to canals or bodies of water;
(ii) Lined with clay or any impervious materials; and
(iii) Covered to prevent inundation during rains.

198. As an alternative, if DBO contractor will explore other sludge disposal schemes such as recycling or reuse of the dried sludge as soil conditioner in agricultural lands, the DBO Contractor and MDSC need to undertake required studies to ensure the feasibility of this scheme in the context of local situation and national regulations. International best practices also show that this is an economic and viable option for sludge management, but the feasibility of this alternative needs to be established and approved first by the Department of Environment and/or by the

Ministry of Agriculture prior to adoption. In addition, the agricultural land or area at which the dried sludge will be applied shall be identified upfront.

199. As such, for whatever mitigation option is selected by the DBO Contractor during the detailed design stage, details of final arrangement or option selected shall be included in the updating of the IEE. Such updated IEE shall be submitted to ADB for clearance to ensure all ADB SPS requirements pertaining to sludge handling and disposal are complied with accordingly.

11. Physical Cultural Resources

200. **Impact**. The alignments of the distribution network may pass through near or adjacent locally important cultural heritage monuments. Damage to these physical cultural resources (PCRs) could create conflict with the local people and the government.

201. **Mitigation**. Ensure that the bidding and contract document has the condition for DBO Contractor to undertake specific steps on how to avoid impacts to these PCRs, such as the following:

(i) Mandatory visit to all alignments to identify all possible PCRs that may be affected by the pipelaying works, such as mosques, eidgahs (prayer areas), heritage sites, and other locally important monuments. Results should be recorded and put to the attention of the engineers in charge during construction phase;
(ii) Strictly follow methodologies and protocols developed for all types of excavation works as discussed in this IEE; and
(iii) Develop other mitigation measures that will be used during subproject implementation that may not be available in the methodologies and protocols discussed in this IEE. However, these mitigation measures shall be consistent or aligned with the established methodologies and protocols, with the intent to protect any PCRs found at the subproject sites.

12. Consents, Permits and Clearances

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

203. **Mitigation.** All of the necessary consents, permits, and clearances shall be obtained before the start of civil works and acknowledged 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) BIWTA;
(iii) NCC; and
(iv) Other agencies as may be determined during the detailed design phase by the DBO Contractor.

13. DBO Contractor Mobilization

204. **Impact**. DBO Contractor's fielding of equipment and manpower to the sites will likely impact baseline site conditions and potentially damage private properties and public properties,

including cultural heritage sites. Safety of both workers and the community will also be likely affected due to movements of both workers and construction equipment.

205. **Mitigation**. Immediately after award of its contract, the DBO Contractor shall undertake all pre-mobilization works and plans in order to ensure impacts are avoided on natural environment and man-made structures specific to different subproject sites, including any disturbance to existing customs, movements and way of life of local people in these locations. No mobilization and civil works shall be undertaken unless the following have been complied with by the DBO Contractor:

(i) Developed the required site-specific EMPs (SEMPs) and these are approved by PMU with support from MDSC;
(ii) Developed a Traffic Management Plan covering all subproject sites and their vicinities, in coordination with local traffic police. DBO Contractor shall have traffic management plan in place prior to the excavation. Sample outline for Traffic Management Plan is in Appendix 10;
(iii) Developed a Spoil Management Plan and Waste Management Plan that will include information on the government-approved disposal site and the route from subproject locations to the said site. Sample outlines for the Spoil Management Plan and Waste Management Plan are in Appendix 11 and Appendix 12, respectively;
(iv) Established environmentally sound sewage facilities for all offsite facilities and offices, including construction camps to ensure no pollutive discharge to Shitalakhya river. Design considerations for sewage facilities are in Appendix 13; and
(v) Developed a Health and Safety Plan approved by PMU with support from MDSC. The plan will include specific steps to manage potential spread of infectious diseases. Sample outline for Health and Safety Plan is in Appendix 14.

206. During the detailed design phase, DBO Contractor, in consultation and collaboration with MDSC, shall initiate the development of a robust O&M Manual for the WTP. The development of the manual may extend towards the construction phase but shall be completed prior to the operation phase to provide sufficient time to train all personnel on the effective and efficient operation of the WTP based on the O&M Manual. The O&M Manual shall include all important elements such as, among many others, the following:

(i) A detailed description of all components of the entire WTP, their corresponding functions and importance for the whole system;
(ii) Detailed drawings of all the components of the WTP;
(iii) Organogram of the manpower and personnel of the WTP;
(iv) List of all chemicals being stored at the WTP, where they are stored, and their corresponding safety data sheets;
(v) Health and safety protocols for all aspects of the water treatment and supply operation, ranging from how to lift heavy objects to what to do if someone is exposed to chlorine gas, etc.;
(vi) Standard operating procedures to be followed in carrying out any given operation. For example, what are the specific procedures or instructions for starting up, operating and shutting down each of the water treatment processes, equipment, and machines; system for delivery of the water from the clear water reservoir to the overhead tanks; the details of the various parameters that need to be controlled

(such as the flow rate through a rapid gravity sand filter, maximum flow rate permissible through the delivery system, etc.);

(vii) Procedures to follow in cases of emergencies or critical situations, such as when the raw water quality exceeds the design limit of the WTP or when the treated water quality from the clear water reservoir exceeds the drinking water quality standards, etc.; and

(viii) The required maintenance works for each of the WTP components, checking (daily routine checks, weekly routine checks, monthly routine checks, and so on), schedules, and the responsible personnel for these maintenance activities.

14. Construction Camps or Workers' Accommodation

207. **Impact**. There may be instances that workers will need to stay within or near the construction sites. Contractors would normally provide construction camps or accommodation at these sites. However, the haphazard construction of these camps without basic amenities could result in social stress and eventual degradation of the local environment.

208. **Mitigation**. The DBO Contractor will need to ensure that the camps or accommodations be provided with sanitary amenities at designated areas. In addition to any local regulations, DBO Contractor will need to follow the standards for workers accommodation pertaining to *"Workers' accommodation: processes and standards. A guidance note by IFC and the EBRD" 2009*.[35] This shall include environmentally sound sewage facilities to manage septage/sewage from construction camps and DBO Contractor's offices, which should be incorporated in the facility designs. Construction notes for environmentally sound sewage facilities are in Appendix 13.

15. Updating of IEE and Preparation of SEMP

209. PMU with support of MDSC will update IEE based on final detailed designs by the DBO Contractor, and submitted to ADB for review, clearance, and disclosure prior to commencement of work. DBO Contractor shall be responsible for preparing the SEMPs. The SEMPs shall be based on the EMP in this IEE report, with details on staff, implementation schedules, monitoring procedures, and resources, including costs for implementing measures against infectious diseases that may arise during subproject implementation. The SEMPs 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. DBO Contractor will submit its SEMPs to PMU, and PMU will review and approve accordingly. The approved SEMPs will be the basis for monitoring by PMU and MDSC. The SEMPs will allow PMU, construction supervision engineer to focus on what are specific items expected from the DBO Contractor regarding environmental safeguards on a day-to-day basis. With the SEMPs, PMU can easily verify the associated environmental requirements each time the DBO Contractor will request approval for work schedules.

16. Community Awareness

210. Consultations have been undertaken during the subproject preparation and during the approval stage of the overall project. However, before the start of subproject implementation, the local population should be well aware of the final schedule. There should be regular interaction

[35] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_gpn_workersaccommodation

with the local population and make them understand the subproject activities. Without proper interaction with local communities and/or with stakeholders may lead to confusion and agitation and non-cooperation of local people. Important information needed to be disseminated to the people are, among others, the following:

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

17. EMP Implementation Training

211. Often lack of proper training to implement the EMP stipulated in the bid document leads to mismanaged environmental safeguards. Therefore, EMP training for the DBO Contractor, workers and implementing agency is necessary before construction goes on-board. MDSC will provide the training needs before construction starts. This training will aim to ensure all involved parties (DBO Contractor, workers and representatives from NCC through the PMU) understand the nature and purpose of EMP implementation, including spoils management, standard operating procedures for construction works; community and occupational health and safety, core labor standards and laws, applicable environmental laws, etc.

E. Anticipated Impacts and Mitigation Measures During Construction Phase

212. This IEE report covers various components that have varying degree of impacts during their construction. This sub-chapter is a compendium of all proposed mitigation measures for potential impacts that are likely to occur during construction phase. Some identified impacts and measures may not be applicable to one component but are applicable to other component/s.

1. Sources of Materials

213. **Impacts.** Extraction of construction materials that will be used for the subproject (cement, sand, aggregates) can disrupt natural land contours and vegetation resulting in accelerated erosion, disturbance in natural drainage patterns, ponding and water logging, and water pollution.

214. **Mitigation.** PMU, with support from MDSC, will guide the subproject DBO Contractor in minimizing the use of non-renewable resources and rock-based materials. The DBO Contractor will be responsible for:

(i) Sourcing construction materials, including aggregates, etc., from legitimate suppliers authorized by the government; and
(ii) Maintain a construction material register at the site.

2. Impact to Topography and Aesthetics

215. Excavation, pipelaying and other construction works for the subproject will affect the topography and aesthetics at the sites due to accumulation of unmanaged spoils and construction debris.

216. **Mitigation**. DBO Contractor to implement the Spoil Management Plan, and in addition, the following measures (if not specifically included in the Spoil Management Plan and Waste Management Plan):

(i) Avoid storing spoils at the vicinity of excavation or construction sites for a long period of time. Haul spoils on a regular basis to ensure more efficient handling and management at the disposal sites following the Spoil Management Plan;
(ii) Dispose only in the designated disposal areas identified under the subproject;
(iii) Ensure adequate compaction, and drainage system around the disposal areas;
(iv) Ensure disposal areas are utilized up to their capacity limit only and in accordance with the required sloping and leveling/grading specification approved under the subproject; and
(v) If disposal area reaches the limit, utilize another designated disposal area approved under the subproject.

3. Impact to Structures During Excavation

217. Some alignments also pass through various roads (including many narrow roads) with old and fragile residential and commercial buildings on both sides. The foundation of these structures could be damaged due to vibration, or collapse of excavated trench.

Figure 41: Typical Roads in Narayanganj City Corporation


Widest Road


4-lane Road with Vendors


Typical Alley/Road in a Residential Area


Typical Road in a Residential Area

Typical Road in Commercial Area

Narrow Alley in a Residential Area

218. **Mitigation**. Excavation shall be avoided during rainy days and seasons all throughout the subproject area. For excavation of more than 1m depth or depending on site condition, shoring shall be applied to avoid any sort of collapse and maintaining safety of lives and property. Proper barricade and signage boards shall be installed during excavation to avoid unauthorized person entering into the construction site. Shoring shall be in place in each excavated trench along the alignment. Excavated materials shall be handled properly; which shall be loaded to dump truck and shall be taken to temporary storage area (spoils to be used for backfilling or reinstatement works) or disposal site (for the excess spoils). In case of narrow roads, use of smaller loaders or vans will be adopted for collection and intermediate transfer to dump trucks. This will avoid damage of property walls or structures along these narrow roads. The excavated material shall not be stored along the excavated trench. Table below provides some methodologies that need to be followed by the DBO Contractor.

Table 43: Excavation MethodbyBy Area Type[a]

Excavation in all areas: ● Materials from excavated trench will be transported and stacked to the nearest open space to be decided by the Engineer-in-Charge (or equivalent) or the place allocated by DBO Contractor. For loading and unloading, small tippers will be used. This excavated material shall be brought back to the site of work for filling the trench. Shoring sheeting and bracing will be carried out accordingly depending on depth of excavation and nearness to structures. ● In case the presence of water is likely to create unstable soil conditions, a well point system erected on both sides of the trench shall be employed to drain the immediate area of the trench prior to excavation operation. A well point system consists of a series of perforated pipes driven into the water bearing strata on both sides of a trench and connected with a header pipe and vacuum pump. If excavation is deeper than necessary, the same shall be fitted and stabilized before laying the pipes. ● The proposed excavation at any one time shall be limited to such lengths, which does not cause inconvenience to surrounding inhabitants and road traffic. All excavations left unattended shall be adequately protected with approved fencing and barricades and with flashing lights where required. ● Bypass way of at least 1 m for people will be provided with proper barricades and placing chequered plates supported on channels. ● Any archaeological artifacts identified during trench excavation will follow the chance finds procedure.
Industrial zone, wide streets ● The excavation of trenches for pipelines shall be done mechanically using appropriate equipment and some portions manually. ● The excavation of trench will be carried out for every 15 to 25 m, or where at least two pipes can

be installed. ● Excavation will be carried out during the night time as far as possible. ● Vibration limit of 50 mm/sec Peak Particle Velocity. Frequency limit of not less than 10Hz. ● Any archaeological artifacts identified during trench excavation will follow the chance finds procedure.
Residential areas, narrow lanes. ● The excavation of trenches for pipelines shall be done half mechanically and half manually using appropriate equipment. ● Small equipment and vehicle will be used especially small JCBs for excavation, small tipper trucks, compactor vibration machine, etc. ● Hand ramming is proposed for compaction and small vibration machine is allowed in these areas but must not exceed vibration limits. ● Vibration limit of 10 mm/sec Peak Particle Velocity. Frequency limit of not less than 10Hz. ● The excavation of trench will be carried out for every 8 to 25 m, or where at least one pipe can be installed. ● Excavation will be carried out during the night time as far as possible, or depending on the extent of use of the road lanes during day time. If the road lane is not a busy area during the day, excavation will be carried out during the day to avoid disturbance to sleeping residents during night time.
Areas with fragile buildings or structures ● The excavation of trenches for pipelines shall be done full manually using appropriate equipment. ● Hand ramming or small vibration machine where unavoidable is allowed in these areas, and must not exceed vibration limits. ● Vibration limit of 5 mm/sec Peak Particle Velocity . Frequency limit of not less than 10Hz. ● The excavation of trench will be carried out for every 8 to 10 m, or where at least one pipe can be installed. ● Excavation will be carried out only during day to more easily identify chance finds. Pipe installation and site reinstatement may proceed at night time if required. ● Equipment and heavy machines will not be used for trench excavation or compaction if works are adjacent cultural heritage structures. ● Excavation work will be carried out in piece meal approach.

[a] Adopted from a result of expert study and recommendations for excavation activities within or near heritage sites, busy areas, residential areas, narrow lanes with sensitive or fragile structures, etc. ADB-funded NEP-Kathmandu Valley Wastewater Management Project. 2020.

4. Impact to Surface Water Quality

219. The locations of the subproject components are near to Shitalakhya river and other smaller canals in the city. Excavation and construction activities may result to accidental spills of chemicals and siltation that could threaten or further deteriorate the quality of these receiving bodies of water.

Figure 42: Vicinity of WTP and Sample Alignment Near Shitalakhya River

Aerial view of vicinity of the WTP site

Overlooking Shitalakhya river from WTP Compound

Typical Alignment Near Shitalakhya River

220. **Mitigation**. DBO Contractor will need to implement the following measures:

(i) Dispose excess spoils only in the designated disposal areas identified under the subproject;
(ii) Avoid storing spoils at the vicinity of site for a long period of time. Haul spoils on a regular basis to ensure more efficient handling and management at the disposal sites. Use temporary storage sites for spoils that will be used for backfilling, but location should be away from sites so as not to create any negative impact on aesthetics in the area;
(iii) To minimize excess spoils for disposal, use some for beneficial purposes such as in any other construction activities, or to raise the level of low-lying areas;
(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) Silt traps to be provided at construction area near receiving bodies of water;
(vi) No equipment or machinery shall be operated outside the work areas;
(vii) Avoid spillage of fuels, chemicals and lubricants. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110% by volume;

(viii) Ensure that drains are not blocked with excavated soil;
(ix) Locate stockyards away from canals or receiving bodies of water;
(x) Ensure construction camps, and DBO Contractor's offices are provided with sanitary amenities at designated areas. In addition to any local regulations, DBO Contractor will need to follow the standards for workers accommodation pertaining to *"Workers' accommodation: processes and standards. A guidance note by IFC and the EBRD" 2009*;[36]
(xi) Clean up of the area after the completion and prior to the onset of monsoon season; and
(xii) Avoid scheduling of excavation work during the monsoon season. Earthworks should be undertaken during dry season.

5. Impact to Groundwater Quality

221. The subproject is planned to be implemented in 2 – 4 years. With this kind of undertaking, contractors normally establish their site offices, storage sites and workers' camps. Operational activities and use of these facilities during the construction period could potentially contaminate groundwater resource due to seepage of liquid wastes and chemicals from the sites.

222. **Mitigation**. In addition to the mitigation measures described to prevent impact to surface waters, DBO Contractor will need to implement the following measures:

(i) Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume;
(ii) Ensure refueling area has lining to avoid seepage of unavoidable spills during refueling. Ensure to clean up spills immediately and all used cleaning materials are disposed properly;
(iii) Ensure to provide portable toilets in all construction camps to discourage injecting septic wastes on land;
(iv) Avoid cutting of trees or vegetations within and around the construction camps and sites; and
(v) Conduct ground water quality monitoring, particularly at sites near fuel depot or refueling site and construction camps. Ensure to conduct at least one sampling every six months. Important parameters to test are Oil and Grease, and Fecal Coliform.

6. Impact to Ambient Air Quality

223. Excavation and construction activities will result to generation of dust that could remain airborne within and around the subproject sites. Operation of construction heavy equipment and vehicles will also result to release of emissions. The dust and emissions are significant factors that could degrade the ambient air quality in the area, which in turn affect the general wellbeing of the residents in households or establishments nearby.

224. **Mitigation**. DBO Contractor will need to implement the following measures:

[36] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_gpn_workersaccommodation

(i) Conventional dust control measures such as use of water sprays and minimizing hauling and vehicle movements during windy times of the day or night;
(ii) Proper covering (e.g. tarpaulin) of hauling equipment such as dump trucks during transport of materials or spoils;
(iii) Provide temporary barriers or covers around active site excavation areas;
(iv) Limit vehicles speed at work site enough to not cause vigorous suspension of dust;
(v) Prohibit idling of heavy equipment or vehicles for a long time;
(vi) Regular maintenance of heavy equipment and vehicles to ensure compliance with national vehicle emissions standards;
(vii) Prohibit burning of any liquid or solid wastes;
(viii) Conduct regular visual inspections to identify and address other potential sources of dust emissions; and
(ix) Conduct ambient air quality monitoring at strategic locations at least once every six months. Ensure that sampling locations are based on the wind and dust/smoke dispersion direction at the site.

7. Impact to Noise and Vibration Level

225. Excavation and construction activities will result to generation of noise that could disturb the construction workers, staff, and community people. Use of machinery for excavation and compaction will also result to vibration that could damage sensitive and old structures at the subproject sites.

226. **Mitigation**. DBO Contractor will need to implement the following measures:

(i) Provide prior information of the scheduled works to nearby residents;
(ii) Use silencers for all equipment;
(iii) Avoid delivery of raw construction materials during night time;
(iv) Avoid noise-intensive activities at night time;
(v) Horns should not be used unless it is necessary to warn others or animals of the vehicle's approach and prevent any potential accident;
(vi) Minimize drop heights during delivery and stacking of raw construction materials;
(vii) Use sound barriers to lessen the noise from sites;
(viii) Maintain maximum of noise level of 45 dB(A) at the nearest residence relative to the specific worksites;
(ix) Conduct noise level monitoring. Ensure to conduct at least one sampling every six months and when construction activities are at peak. Important areas to test are at locations nearest the community residents and construction camps;
(x) Use pumping equipment with low level noise generation;
(xi) If using generators, ensure generator set complies with the noise standards;
(xii) Ensure generator set has acoustic enclosure and silencer (if necessary) in the exhaust muffler; and
(xiii) Depending on site, strictly comply with vibration limits as indicated in Table 43 when using excavation and compacting equipment.

8. Impact to Underground Physical Cultural Resources

227. **Impacts.** Bangladesh is home to many old and ancient structures. Narayanganj city is one area with a number of historical sites. Although the alignments or sites will not encroach areas or boundaries of overground historical structures, there is a possibility that chance finds such as underground relics or structures considered as physical cultural resource (PCR) will be

encountered and impacted during excavation either along the pipelaying alignments or other subproject site-specific areas.

228. **Mitigation.** As a precautionary approach, the DBO Contractor will need to implement measures, including the excavation methods (see Table 43). In the event of chance finds, the DBO Contractor will need to strictly implement the following chance finds protocol:

(i) Require the DBO Contractor to coordinate immediately with PMU and Bangladesh Department of Archaeology (or its local office in Narayanganj, if any) for any suspicion of chance finds during excavation works;
(ii) Stop work immediately to allow further investigation if any finds are suspected; and
(iii) Request authorized person from the Bangladesh Department of Archaeology to observe when excavation resumes for the identification of the potential chance finds, and comply with further instructions.

9. Community Health and Safety

229. **Impacts.** Numerous threats could be encountered in the vicinity of the subprojects, including storage camps or yards and workers' camps. Easy access by pedestrians, animals, and other community people to the sites could expose them to these threats, such as the dangers due to moving heavy equipment or electrocution at the sites. There may also be risk of accidental fall of these community people or animals in excavated areas.

230. In case of communicable diseases such as COVID19, there is a serious threat of spreading the virus in the communities surrounding the subproject sites due to interaction of DBO Contractor's staff and construction workers with the locals. This can lead to possible loss of human lives.

231. **Mitigation.** DBO Contractor will need to implement the following measures:

(i) Appoint full time EHS officer per contract requirement;
(ii) Install warning signs, warning tapes, hard barricades, and notices around the work site perimeter to avoid unauthorized entry. For excavated sections that cannot be isolated or enclosed due to access issues for the community or residents, ensure to cover these with steel planks or durable wood planks during off-work hours. If during work hours that these excavated sections, especially the deep trenches, cannot be covered entirely, provide steel planks or durable wood planks with handrails that can be used by pedestrians;
(iii) Install sturdy fence around storage camps or yards and workers' camps;
(iv) Assign guards around the subproject sites, including storage camps or yards and workers' camps, on a 24/7 basis;
(v) Provide lighting all around the subproject site, including storage camps or yards and workers' camps, to ensure the perimeter is well-lit at nighttime;
(vi) Follow a code of conduct for workers, which should include restricting workers in designated areas, no open defecation, no littering, no firewood collection, no setting of fire except when needed but in designated places, no trespassing, no unauthorized overstaying at construction sites, and no obligation to undertake potentially dangerous work without the use of proper personal protective equipment, among others;

(vii) Follow international best practices on community health and safety such as those in Section 4.3 of World Bank EHS Guidelines on Construction and Decommissioning Activities;[37] The community health and safety plan shall ensure the following:

a. implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction and decommissioning;
b. restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community;
c. removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials; and
d. implement measure to prevent proliferation of vectors of diseases at work sites;
e. adequate space and lighting, temporary fences, shining barriers and signage at active work sites;
f. contractor's preparedness in emergency response;
g. adequate dissemination of GRM and contractor's observance and implementation of GRM; and
h. upon availability, local people should be given an opportunity for work in the subproject activities;

(viii) Follow international best practices on traffic safety such as those in Section 3.4 of the World Bank Environmental Health and Safety (EHS) Guidelines on Community Health and Safety;[38] The community health and safety plan should include the following:

a. Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include:
   - Emphasizing safety aspects among drivers;
   - Improving driving skills and requiring licensing of drivers;
   - Adopting limits for trip duration and arranging driver rosters to avoid overtiredness;
   - Avoiding dangerous routes and times of day to reduce the risk of accidents;
   - Use of speed control devices (governors) on trucks, and remote monitoring of driver actions;
b. Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure.

[37] IFC World Bank Group. 2007. https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-construction-and-decommissioning-en.pdf

[38] IFC World Bank Group. 2007. https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-community-health-and-safety-en.pdf

Where the project may contribute to a significant increase in traffic along existing roads, or where road transport is a significant component of a project, recommended measures include:

a. Minimizing pedestrian interaction with construction vehicles;
b. Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns);
c. Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents;
d. Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic; and
e. Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions.

(ix) Follow the established community and occupational health and safety protocol on emerging infectious diseases such as COVID-19;
(x) Maintain a complaint logbook at the site and take action promptly of complaints;
(xi) Schedule transport and hauling activities by avoiding peak traffic periods;
(xii) Clean wheels and undercarriage of haul trucks prior to leaving construction sites;
(xiii) Educate drivers and advice to limit speed between 20-25 km/h while traversing settlement areas and avoid use of horn unless necessary to prevent accidents; and
(xiv) Earmark parking place for construction equipment and vehicles when idling; no parking shall be allowed on the roads, that may disturb the traffic movement.

10. Occupational Health and Safety

232. **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, including asbestos cement (AC) pipes. 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, extended working hours of workers could lead to risk of accidents due to fatigue.

233. Given the experience with COVID-19 pandemic, concern is high for the site workers' safety and health. Clustering and gathering of workers can easily trigger spread of diseases. Such a situation is dangerous and could potentially lead to loss of human lives. The health risk is also very high within the construction camps due to possibility of high density and unhygienic living conditions.

234. **Mitigation.** The DBO Contractor will need to implement its health and safety protocols approved by PMU or MDSC. This will contain normal internationally accepted procedures in relation to the risks imposed by the nature of the work to be undertaken, including risks associated with emerging infectious diseases. The DBO Contractor shall ensure all authorized persons present on all sites, be they DBO Contractor 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, including other precautionary measures against airborne diseases.

235. In particular, the DBO Contractor shall implement the following mitigation measures:

(i) Appoint full time EHS officer per contract requirement;
(ii) All relevant provisions of the Bangladesh Labour Act, 2006 (and 2013 amendment) and relevant WHO guidelines will be adhered to, concerning the provision of adequate measures to avoid contracting and/or spreading diseases during construction phase;
(iii) 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,[39] which include the following elements, whichever are applicable:

a. Communication and Training
   i Training of all workers on occupational health and safety prior to construction works;
   ii Conduct of orientation to visitors on health and safety procedures at work site;
   iii Signages strategically installed to identify all areas at work site, including hazard or danger areas;
   iv Proper labeling of equipment and containers at construction and storage sites; and
   v Suitable arrangements to cater for emergencies, including: first aid equipment; personnel trained to administer first aid; communication with, and transport to, the nearest hospital with an accident / emergency department; monitoring equipment; rescue equipment; firefighting equipment; and
   vi communication with nearest fire brigade station;

b. Physical Hazards
   i. Use of personal protective equipment (PPE) by all workers such as earplugs, safety shoes, hard hats, masks, goggles, etc. as applicable, and ensure these are used properly;
   ii. Avoidance of slips and falls through good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths, cleaning up excessive waste debris and liquid spills regularly, locating electrical cords and ropes in common areas and marked corridors, and use of slip retardant footwear;
   iii. Use of bracing or trench shoring on deep excavation works;
   iv. Adequate lighting in dark working areas and areas with night works;
   v. Rotating and moving equipment inspected and tested prior to use during construction works. These shall be parked at designated areas and operated by qualified and trained operators only;
   vi. Specific site traffic rules and routes in place and known to all personnel, workers, drivers, and equipment operators; and
   vii. Use of air pollution source equipment and vehicles that are well maintained and with valid permits;

c. General Facility Design and Operation

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

i. Regular checking of integrity of workplace structures to avoid collapse or failure;
ii. Ensuring workplace can withstand severe weather conditions;
iii. Enough work spaces available for workers, including exit routes during emergencies;
iv. Fire precautions and firefighting equipment installed;
v. First aid stations and kits are available. Trained personnel should always be available who can provide first aid measures to victims of accidents;
vi. Secured storage areas for chemicals and other hazardous and flammable substances are installed and ensure access is limited to authorized personnel only;
vii. Good working environment temperature maintained;
viii. Worker camps and work sites provided with housekeeping facilities, such as separate toilets for male and female workers, drinking water supply, wash and bathing water, rest areas, and other lavatory and worker welfare facilities; and
ix. Maintain records and make reports concerning health, safety and welfare of persons, and damage to property. Take remedial action to prevent a recurrence of any accidents that may occur.

(iv) For potential encounter and handling of AC pipes, follow the protocols in the AMP developed for the subproject during the pre-construction phase. Among others, the comply with the following:
a. Existing AC pipes, where intact, shall be left in-situ and not disturbed. Where the AC pipe is damaged and where there is a risk of asbestos particles becoming airborne, the contractor shall follow all necessary procedures in the AMP;
b. Ensure all personnel and laborers are trained to enable them understand health risks associated with asbestos from AC pipes, how to identify AC pipes, and how to properly handle AC pipes based on the AMP it developed for the subproject;
c. Inform PMU if AC pipes are encountered;
d. Maintain an updated record of all AC pipe alignments identified or encountered during the pre-construction reconnaissance survey and during pipelaying and excavation works; and
e. Submit to PMU updated records of AC pipe alignments as part of its regular monitoring reports to PMU;

(v) Follow established occupational health and safety protocol on emerging infectious diseases;
(vi) Provide regular health check-ups, sanitation and hygiene, health care, and control of diseases for the workforce;
(vii) Provide at cost all labor and materials and construct/install and maintain site safety, hard barricading, flexible green net, signboards, and lightings throughout the construction site;
(viii) Launch awareness programs concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards;
(ix) Make available ambulance facility at the construction site and camp site, if any;
(x) 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; and

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

11. Impact on Local Festivals and Cultural Practices

236. Alignments of distribution network may pass through near or adjacent locally important cultural and religious sites such as mosques, 138veral, etc. where religious or local festivities are celebrated. Construction activities may have the potential to disrupt the smooth transition of these celebrations.

237. **Mitigation**. DBO Contractor shall follow religious and city festival calendar to avoid impact upon local celebrations. Construction works need to be avoided or minimized during the festivals. If excavation works or construction works have been done but remain unrestored approaching a certain festivity, alternative access to mosques and other important sites must be considered or set up.

12. Impact to Terrestrial Flora and Fauna Resources

238. While the critical habitat screening and results of site visits show no likely presence of endangered and critically endangered species per IUCN Red List, the construction phase of the subproject may pose impact to other flora and fauna resources in the immediate vicinity of the sites. Typical vegetations found along the alignments are presented in the Chapter 4 Section B of this IEE report. These vegetations were determined to be common and abundant species found elsewhere in Bangladesh.

239. **Mitigation**. The DBO Contractor will ensure that awareness training on environmental safeguards is provided to all construction workers, which will include the following reminders that need to be observed and complied with during the construction period:

(i) Avoid any cutting of trees and shrubs at the construction site. The spaces are wide enough for any activities without cutting any of the trees or locally important plants, if any;
(ii) Prohibit use of wood as fuel at construction camp sites, if any;
(iii) Provide LPG/kerosene to workforce staying at the construction camp sites; and
(iv) Prohibit the harvest and trade of any plants or poaching of animals found in the area.

13. **Impacts** on Socioeconomic Resources

240. Construction works may result in temporary loss of livelihoods and interruption of social and economic activities in some alignments. In areas where there are shops or other commercial activities, these could lose some business if access is difficult for customers.

241. **Mitigation.** The DBO Contractor will ensure the following:

(i) Adopt the GRM of the project, and respond to grievances;
(ii) 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.
(iii) 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. Handrails may be provided to ramps or planks depending on the width of excavations;

(iv) In critical areas such as institutions, operating hours are factored into work schedules and workforce is increased for speedy completion;

(v) Advance information on works to be undertaken including appropriate signage is provided; and

(vi) The diversion is done in coordination with the traffic police division for necessary rerouting of traffic and traffic management.

14. Impact on Job Opportunities

242. Primarily a positive impact, the subproject 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 and laborers are expected to be recruited locally from within the native/local workforce.

F. Anticipated Impacts and Mitigation Measures During Post-Construction Phase

243. **Impact**. The activities of the subproject will result to sorts of construction and demolition debris wastes after the construction period. These include excess spoils that were generated at the end of the construction period, various scraps from distribution pipelaying and DTW and OHT rehabilitation works, debris from demolition of structures in the WTP site (administration building, chlorine storage and injection building, storage building, guard house), etc. This also includes all other wastes found in the WTP site such as chemical containers and packaging materials that have accumulated there for years. See figure below. Due to the volume and hazardous nature of some of these wastes, indiscriminate disposal or ignoring their proper disposal could be dangerous to the environment and the people in the vicinity of the subproject sites.

Figure 43: Waste Accumulation at the WTP Site

Unmanaged empty chemical containers at the WTP site

Unmanaged packaging materials at the WTP Site

244. Mitigation. Immediately within one week after construction phase, the DBO Contractor shall collect all the wastes at the different sites and implement the following. DBO Contractor may opt to outsource this to qualified entities in NCC, provided that DBO Contractor's EHS personnel strictly supervise the cradle-to-grave management of all these wastes. All costs related to management of these wastes shall be borne by the DBO Contractor, or as per agreement in the DBO contract documents.

(i) Segregate or sort all wastes according to nature (recyclable, non-recyclable, hazardous, non-hazardous or any combination);
(ii) Ensure to handover (or sell as the case may be) recyclable wastes to authorized recycling entities in Bangladesh. DBO Contractor shall coordinate this action with NCC through the PMU;
(iii) Ensure to dispose non-recyclable and non-hazardous wastes to appropriate disposal sites. These may be collected, transported and disposed similar to how solid wastes in the city is managed. Thus, DBO Contractor shall coordinate with NCC through the PMU in this regard;
(iv) Ensure to transport and dispose hazardous wastes using authorized hazardous waste transporters and treaters in Bangladesh. DBO Contractor shall coordinate all actions for these wastes with NCC through the PMU; and
(v) Ensure the sites are cleared with all wastes disposed accordingly, and compliance with this measure shall be included as one of the conditions for payment to the DBO contractor as regards the WTP upgrading works.

G. Anticipated Impacts and Mitigation Measures During Operation Phase

245. Anticipated impacts of subproject during operation and maintenance (O&M) will be related to the actual operation of the WTP at Godenail; repair of damages in the OHTs and DTWs and/or repair of leaks, pipe bursts, and pipe replacement in the distribution pipelines.

246. For some anticipated impacts of the WTP operations and repair of pipelines, these are likely to be not significant, as proper design would have been made for the WTP and selection of good quality materials such as pipes shall mean that leaks in the distribution lines are minimal. However, any repair works may still create impacts to both environment and the people, such as

those related to discharge of effluent from the WTP to Shitalakhya river, increase of noise level in repair sites, and risks of accidents to community people and workers during repairs.

1. Surface Water Quality

247. **Impact**. Potential discharge of chemical and untreated wastewater including sludge from the WTP could deteriorate the quality of Shitalakhya river.

248. **Mitigation.** DBO Contractor will implement an O&M Manual developed as early as the design phase that includes mitigation measures, such as, among others, the following:

(i) Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume;
(ii) Institute good housekeeping practices at all sections of the WTP;
(iii) Recycle used or spent water to avoid discharge to the river. If recycling is not possible, ensure that wastewater such as supernatant liquid from the sludge treatment and drying is treated to comply with national effluent standards prior to discharge to the river;
(iv) Conduct effluent quality monitoring per monitoring plan;
(v) Conduct water quality monitoring at the upstream and downstream portions of Shitalakhya river per monitoring plan;
(vi) No discharge of generated sludge to the Shitalakhya river;
(vii) Ensure to operate the sludge drying beds and store dried sludge in appropriate packing prior to transport to disposal site or prior to reuse, whichever is the adopted option; and
(viii) In case of landfill disposal, transport dried sludge to designated dried sludge disposal site on a regular basis to avoid accumulation of dried sludge at the WTP area.

249. In addition, NCC shall take all initiatives under its power to exert efforts in improving the quality of Shatalakhya river through the following example activities:

(i) Monitor and require all industries within NCC's jurisdiction that are operating along Shatalakhya to ensure no discharge of pollutive effluents to the Shitalakhya river. NCC shall link this requirement to all permits it issues to all the industries within the city;
(ii) In relation to (i) above, liaise and coordinate with DOE to control the pollution of Shitalakhya river, and it particular to prevent disposal of untreated / partially treated industrial wastewater into the river. NCC shall coordinate with DOE to ensure that effluent treatment plants (ETPs) are established and effectively operated for each industry; and
(iii) Create public awareness on the need to conserve Shitalakya river and improving its water quality.

2. Groundwater Quality

250. **Impact.** The operation of the WTP could lead to pollution of groundwater due to potential seepage of chemicals and untreated wastewater from the WTP site. Likewise, in the case of landfilling option for treated sludge, the operation of a landfill site could also lead to pollution of the groundwater due to seepage of leachate.

251. **Mitigation.** DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following:

(i) Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume;
(ii) Ensure that temporary storage area of dried sludge at the WTP compound is lined with impervious materials;
(iii) Conduct ground water quality monitoring in the area per monitoring plan;
(iv) In case when disposal is the option for sludge management, undertake operation and maintenance at the sludge disposal site to ensure that:
    a. Impervious lining is in place and maintained,
    b. Sludge is properly spread and compacted,
    c. Sludge volume is within capacity limit of the disposal site, and
    d. Storm water canal around the sludge disposal site is installed and working properly;
(v) Identify new sludge disposal site in anticipation of full capacity utilization of existing disposal site. Site selection should consider all criteria presented in this environmental management plan; and
(vi) Undertake environmentally responsible site rehabilitation and bio-remediation works on fully utilized sludge disposal sites.

3. Ambient Air Quality

252. **Impact.** Emissions from equipment/machineries (e.g. generators) and vehicles at the site could contribute to the degradation of ambient air quality in the area.

253. **Mitigation.** DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following:

(i) Regular maintenance of all WTP components;
(ii) Regular maintenance of other equipment (e.g. generator sets) and vehicles to ensure compliance with national emissions standards;
(iii) Prohibit burning of any liquid or solid wastes; and
(iv) Conduct ambient air quality monitoring at strategic locations per monitoring plan. Ensure that sampling locations are based on the wind and dust/smoke dispersion direction at the site.

4. Noise Level

254. **Impact.** The operation of the WTP and repair works at any of the DTWs, OHTs and distribution pipelines are potential source of noise that could impact both the workers and the surrounding communities. These sources of noise could be from operating machineries and equipment, and/or maintenance works at the site.

255. **Mitigation**. DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following:

(i) Provide prior information of the scheduled noise-intensive maintenance works to nearby residents;
(ii) In subproject areas that are near
(iii) Use silencers for all equipment;

(iv) Maintain maximum of noise level of 45 dB(A) at the nearest residence relative to the specific worksite;
(v) Conduct noise level monitoring per monitoring plan. Ensure to conduct sampling during peak period of operation. Important areas to test are at locations nearest the community residents;
(vi) If using generators, use generator set with capacity just enough for the electricity needs;
(vii) Ensure generator set complies with the noise standards; and
(viii) Ensure generator set has acoustic enclosure and silencer (if necessary) in the exhaust muffler.

5. Waste Generation

256. **Impact**. Operation of the WTP will generate wastes that may accumulate at the WTP site and immediate vicinity. Indiscriminate disposal of these wastes will cause pollution to the immediate environment and deteriorate aesthetics in the areas affected.

257. **Mitigation**. The DBO Contractor of the WTP will be required to implement a Waste Management Plan that will be followed in handling and disposing wastes generated during O&M activities. This includes management on the disposal of spent chemicals used in the water treatment plant and all other solid wastes generated at the site. The waste management plans should comply with all the relevant government rules and regulations.

6. Community Health and Safety

258. **Impact**. Operational failure due to either malfunctioning component or excessively poor quality of raw water going beyond what the WTP is design to treat could lead to degradation of drinking water quality and disruption on the continuous supply of drinking water to the residents of NCC. Also, neighboring community is likely to be temporarily disrupted due to hazards brought about by malfunctioning water supply system. Further, with a remote possibility, sabotage on the operation of the WTP, DTWs, OHTs, and pipelines by unscrupulous individuals or entities could totally damage the whole water supply system leading to more prolonged disruption of water supply. Hazards may also be expected during maintenance works.

259. **Mitigation**. DBO Contractor for the Water Supply Contract 1 components will develop and implement its O&M Manual developed as early as the design phase that includes mitigation measures, such as, among others, the following:

(i) Follow international best practices on community health and safety such as those in World Bank EHS Guidelines on Water and Sanitation. The following should be included:
  a. Ensure that treatment capacity is adequate to meet anticipated demand;
  b. Construct, operate and maintain the WTP in accordance with national requirements and internationally accepted standards[40] to meet national water quality standards or, in their absence, WHO Guidelines for Drinking Water Quality;[41]

[40] See, for example, American Water Works Association Standard G100-05: Water Treatment Plant Operation and Management.
[41] Refer to the WHO website at http://www.who.int for the most recent version of the Drinking Water Guidelines.

c. Evaluate the vulnerability of the WTP, DTWs, and OHTs,; and implement appropriate security measures, such as:
   i Background checks of employees;
   ii Perimeter fencing and video surveillance with the compounds;
   iii Improved electrical power feeds to the facilities; and
   iv Redundant electrical power systems significantly reduce the vulnerability risk to essential operations;

(ii) In case of excessively poor quality of raw water that is beyond the limits the WTP is designed for, the DBO Contractor, in consultation with NCC through PMU and MDSC, shall immediately shut down the WTP to ensure no damage can occur in the various components and avoid delivering partially treated water into the distribution lines. Under this scenario, the DBO Contractor of the WTP, under the supervision of NCC through PMU and MDSC, shall undertake drinking water rationing to all affected households in the NCC area. To ensure effective dissemination of information as to the occurrence of such incident and the scheduling of water rations, DBO Contractor shall use all platforms of communication (TV, radio, internet, social media). The DBO Contractor shall also provide the necessary information as to when the water supply can be normalized;

(iii) The stability and integrity of the distribution system including the DTWs and OHTs will be monitored periodically to detect any problems and allow remedial action if required. Recurrence of pipe bursts and leakage problems can be managed by the leak detection, rectification and water auditing surveys. DBO Contractor will be required to ensure that the leak detection and rectification time is minimized;

(iv) For any excavation works related to these O&M issues, the methodologies and protocols developed for the construction phase (see Table 43) shall be strictly followed; and

(v) Noise abatement measures developed for the construction phase shall be strictly followed.

7. Occupational Health and Safety

260. **Impact**. Health and safety issue in water supply operations arise from the management of the WTP components, handling of chemicals, and/or maintenance works on the WTP, DTWs, OHTs, and pipelines, including potential encounter with AC pipes, among others. Staff and workers are also at risk of accidents due to moving vehicles, and other unit operations at these facilities. Staff and workers are also exposed to high level of pollution from exhaust of vehicles and machinery, and noise. Further, extended working hours of these personnel could lead to risk of accidents due to fatigue.

261. Similarly, with the experience during the COVID19 pandemic, clustering and gathering of workers can easily trigger spread of diseases. Such a situation is dangerous and could potentially lead to loss of human lives.

262. **Mitigation.** The DBO Contractor of the WTP and distribution network shall prepare its health and safety protocols as part of the O&M Manual. This will contain normal internationally accepted procedures in relation to the risks imposed by water supply operations, including risks associated with emerging infectious diseases such COVID-19. The DBO Contractor shall ensure all authorized persons present at the work sites, be they staff or workers, representatives of the implementing agency, or other visitors, are aware of any site-specific safety requirements and are supplied with hard hats and other personal protective equipment appropriate for an individual's

purpose or work being undertaken, including other precautionary measures against infectious diseases.

263. In particular, the DBO Contractor (for WTP and distribution network) will develop and implement its O&M Manual that includes mitigation measures, such as, among others and whichever are applicable, the following:

(i) All relevant provisions of the Bangladesh Labour Act, 2006 (and its 2013 amendment) and any of its amendments, and relevant WHO guidelines;

(ii) Follow international best practices on occupational health and safety such as those in Section 4.2 of World Bank EHS Guidelines on Water and Sanitation,[42] which include the following elements, whichever are applicable:

a. Accidents and Injuries

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 deep water tanks;

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 hazards;

vi Implement fire and explosion prevention measures in accordance with internationally accepted standards;

vii When installing or repairing components adjacent to roadways, implement procedures and traffic controls, such as:

- 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 vehicles; and

viii Locate all underground utilities before digging.

a. Chemical Exposure and Hazardous Atmospheres

i Implement a training program for the WTP operator and other workers of the whole water supply system, who handle 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;

[42] IFC World Bank Group. 2007. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines/watersanitation_firstconsultation

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 If applicable, conduct radiation surveys at least annually, especially in areas where radionuclides are removed;

vii Limit wastes entering the sewer system;

viii Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance.

ix Use personal gas detection equipment while working in confined space;

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, particularly in enclosed spaces. 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; and

xiii Rotate personnel among the various WTP operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials.

(v) For potential encounter and handling of AC pipes during abandonment of the old pipeline network, and re-alignment and/or reconnection works to the household meters, follow the protocols in the AMP developed for the subproject during the pre-construction phase. Among others, the comply with the following:

a. Existing AC pipes, where intact, shall be left in-situ and not disturbed. Where the AC pipe is damaged and where there is a risk of asbestos particles becoming airborne, the NCC (or any other operator in the future) shall follow all necessary procedures in the AMP;

b. Ensure all personnel and laborers are trained to enable them understand health risks associated with asbestos from AC pipes, how to identify AC pipes, and how to properly handle AC pipes based on the AMP it developed for the subproject; and

c. Maintain an updated record of AC pipe alignments identified or encountered since the start of implementing the subproject. This record shall be kept as official record and may be used as reference by NCC management. Other development projects may be implemented elsewhere the city and this record will provide NCC with accurate information as to the locations of the AC pipes, which should not be disturbed or destroyed during any of these development activities in the future.

(vi) Follow established occupational health and safety protocol on infectious diseases such as COVID-19; and
(vii) Provide regular health check-ups, sanitation and hygiene, health care, and control of diseases for the workforce.

8. Discharge of Chlorinated Flushing Water

264. **Impact.** Chlorinated water discharge due to flushing and disinfection of pipeline by chlorine may affect aquatic organisms and plants by altering reproduction rates, increasing species mortality, and changing the characteristics of the entire local ecosystem. In addition, as chlorine filters down to the water table, it can stress plant respiration and change the quality of drinking water.

265. **Mitigation.** DBO contractor must dechlorinate the flushing using PMU approved agents such as sodium thiosulphate, sodium ascorbate or hydrogen peroxide etc. Free chlorine residual (FCR) measurements of the discharge water must be taken to confirm at least <0.2 mg/L residual chlorine (as per ECR, 2023 drinking quality standard) levels to verify 147verall147nt147ion. However, dechlorinated water should be discharged to the approved outlet which can handle the amount of discharge without overflow. On the other hand, an alternative method is to capture the disinfected water and contain it on site to allow the chlorine to dissipate. A minimum of 2 days containment period, including exposure to sunlight, is recommended before the water can be discharged to the environment, but not before FCR measurements of the discharge water have been taken to confirm at least < 0.2 mg/L residual chlorine.

266. The people of NCC will be the major beneficiaries of the improved water supply system, as they will be provided with a constant supply of better-quality water into their homes at the appropriate pressure. The subproject will improve the overall health condition of the target areas in the city as water borne diseases will be reduced, so people would spend less on healthcare and lose fewer working days due to illness, thus improving their overall health, economic status, and better quality of life. This will also improve the environmental condition in these areas.

H. Cumulative Impact

267. The subproject activities, including excavation activities for linear works, would take place in existing road rights-of-way and on segmentation approach. Works will happen at certain locations at a given time that may affect small or localized areas only. The likely main impacts assessed that may have cumulative effects with the impacts of other development works in the city, would be the potential additional contribution of dust emissions and potential traffic disruption. However, the subproject excavation activities are too small in nature and will involve mitigation measures to reduce dust pollution. Linear works will happen on segmentation approach to limit the potential impact area, together with other mitigation measures to avoid traffic congestion particularly in the busy areas. As such, no impacts that have cumulative effects is envisaged.

VI. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Consultation and Information Disclosure

268. Meaningful stakeholder consultation and participation is part of the subproject preparation and implementation strategy. Consultation and participation will ensure information is provided and feedback is obtained and considered on the implementation of the subproject. Affected

persons will be consulted at various stages of subproject preparation to ensure: (i) incorporation of views/concerns of affected persons, particularly the vulnerable, on environmental impacts and mitigation measures; (ii) identification of any help required by affected persons during rehabilitation; and (iii) avoidance of potential conflicts for smooth subproject implementation.

269. Meaningful consultation will also provide adequate opportunities for participation of all stakeholders and inclusion of the vulnerable in subproject process. This is also the avenue where relevant information on any major changes to the subproject will be shared with beneficiaries, affected persons, vulnerable groups, and other stakeholders.

1. Objective and Purpose

270. The objectives of the consultations are to inform the project-affected people about the subproject, the present status of environmental, social and ecological condition in the area, potential impacts of the proposed subproject, suggested measures to mitigate these impacts, and at the same time to seek other possible solutions to these impacts from them. The consultations are also an avenue to reduce conflict through the early identification of controversial issues about the subproject and work with the stakeholders to find acceptable solutions; increase public confidence about the proponent, reviewers and decision makers, and develop a proposal which is truly sustainable which will be integrated into the subproject design.

2. Identification of Stakeholder

271. Consultations were organized both formally and informally at different levels including focus group discussions at the ward and community settlement level. During the field survey, significant efforts were made to identify the possible categories of stakeholders and their stakes. The stakeholders identified during field visits were the ward officials, community-based groups, professional groups (teachers, medical practitioners), labor groups (fishermen, hawkers, drivers), representatives from the Bangladesh Inland Waterways and Transport Authority, and ward residents. All those stakeholders had different types of stakes according to their professions.

3. Summary Public Consultation Meetings

272. **Consultation Methodology.** The consultation methods adopted for these public meetings were a combination of short introductory speeches, presentation of overall project and subproject details utilizing photos and maps, and two-way discussions. The use of visual aids and materials enabled the participants to comprehend the issues easily, encouraging them to participate in the discussions more effectively and provide informed comments and opinions.

273. 17 focus group discussions (FGD) have been conducted in various wards of the city. These were participated in by different stakeholders, with each FGD had target group. A total of 248 participants was consulted, consisting of 194 males and 54 females. Summary of FGD participation is shown in table below. Minutes of meeting is in Appendix 15.

Table 44: Summary of FGD Participation

Sl. No.	Date	Locations Names	Participants Group	Ward No	No of Participants		
					Male	Female	Total
1	11-09-2023	Wapda Coloni; Bow Bazar ;ATP	Small Business	04	12	00	12
2	11-09-2022	Siddhirganj Pool (east pairadi)	Businessmen	01	17	00	17

Sl. No.	Date	Locations Names	Participants Group	Ward No	No of Participants		
					Male	Female	Total
3	13-09-2022	Shimul Para, Behari colony Poket gat, Adomge	Bihari	06	15	00	15
4	13-09-2022	Kadamtoly Maddo Posshimpara , Siddirganj	Businessmen with Day labor	07	13	00	13
5	13-09-2022	Railline , Adarsha Bazar	Business	08	13	00	13
6	15-09-2022	Mirpara, Ghat road	Female group	10	00	17	17
7	15-09-2022	Chashara Haziganj Rail line road	Small business group	12	13	00	13
8	16-09-2022	Majdair Bazar, Fotullah Narayanganj	Low Income Group	13	17	00	17
9	16-09-2022	Maigdair Bazar, Fotullah Narayanganj	Women Labor	13	00	14	14
10	17-09-2022	Sahid Suharawardi Sarak near Bus terminal	Hawkers group	15	17	00	17
11	18-09-2022	Maisdair, Fatullah Narayanganj (Begum Rokeya Kh. High School)	Teacher Group	13	07	03	10
12	18-09-2022	Deuvog Pakka Road Sadar Narayanganj	Child Laborers	16	13	00	13
13	18-09-2022	Chasara, Sadar, Narayanganj	Auto Rickshaw Driver Group	13	17	00	17
14	19-09-2022	1 No. Baburail Boubazar Noyapara More Narayanganj	Business & Job holder Group	16	17	00	17
15	20-09-2022	Paikpara	House owner group	17	04	10	14
16	21-09-2022	15, Bangobondhu road Sadar Narayanganj	Doctor & Nurse group	15	03	10	13
17	20-09-2022	3 No. Ghat *Mossho Arothder* (Fish) Business Somity Narayanganj	Fish Businessmen	15	16	00	16
Total					194	54	248

274. Overall, participants were supportive and thankful of the subproject. They expressed their understanding that the project will be very important as part of improving their social life and wellbeing. Concerns related to compensations are addressed in related social safeguard documents under the subproject. Summary of the findings that are relevant to environmental safeguards is as follows:

(i) The participants informed that they have heard the Government planning regarding new Water Network of adequate and safety water. They heard it from different corners, mainly from the NCC officials, public representatives, etc.;

(ii) Participants shared that their present water supply condition is very poor. They are getting inadequate water with 40/50 lpcd, which is also has undesirable color and smell;

(iii) Their present water supply pipe network is not in good shape, and they always search for alternative source;

(iv) In general and amidst the anxieties of some, most of the participants supported the NCC's plan and expressed that the project will give them better water, improve their families' health and reduce health cost, give relief from water borne diseases and help them time to develop or improve their livelihood. Accordingly, they will be benefit economically;

(v) After presenting all project details, potential impacts and mitigation measures to be adopted, the participants received the information well with no negative reactions or feedbacks. This implied that the proposed environmental management and mitigation measures are acceptable to the participants. At the end, the participants have given thanks to the government and NCC for taking pragmatic plan aimed at ensuring the availability of safe and adequate water facilities through improved water supply system.

Figure 44: Sample Photos Taken During Consultation Meetings

Fishermen Group

Professional Group (Teacher)

Land Owner Group

Professional Group (Doctor, Nurse)

Small Business Group

Low Income Group

Women Labor Group

Hawkers Group

Child Labor Group

Auto Rickshaw Driver Group

Business & Job Holder Group

Small Business Group

Business Group (Mixed)

Ethnic Group (Bihari)

Day Labor Group

Business Group

 **Female Mixed Group**	

4. Information Disclosure

275. Preliminary subproject information was disclosed through the different consultations done. Once the detailed designs of the various components are finalized, the same will be disseminated again, including more formally by making written documents and other materials available in form and at locations which can be easily accessed by stakeholders, such as the NCC, PMU and ward community offices. This will also include providing summary reports in the local language and posted at public locations in the wards and community settlement area. The aim is to provide wider reach and means for the receipt of comments from the general public. Subsequently, all documents will be disclosed on ADB and NCC websites. A copy of this IEE report will also be disclosed on the ADB and NCC websites.

B. Future Consultations and Communication Plan

276. Meaningful consultations with stakeholders will continue throughout subproject implementation as necessary to address issues related to environmental assessment. The consultation process will be continued and expanded during the subproject implementation to ensure stakeholders participate fully in subproject execution, as well as to implement a comprehensive information, education, and communication plan.

277. For the benefit of the community, the IEE report will be made available at (i) offices of executing and implementing agencies, (ii) ward offices; and (iii) DBO Contractor's offices at the subproject sites. It will be ensured that the hard copies of IEE report are kept at places which are conveniently accessible to people, as a means to disclose the document and at the same time creating wider public awareness. An electronic version of the IEE report will be placed in the official website of executing and implementing agencies and the ADB website after clearance of the IEE by ADB. Moreover, all semi-annual environmental monitoring reports during subproject implementation will be available at both NCC and ADB websites.

278. Future consultation and disclosure activities shall include the following:

1. Consultations During Construction Phase

(i) Public meetings with affected communities to present the final detailed design, discuss and plan work programs and allow issues to be raised, if there still any, and addressed once construction has started; and

(ii) Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and to provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation.

2. Information Disclosure

(i) Public information campaigns (via newspaper, flyers, and media) to explain the subproject's final detailed design to the wider population of the subproject area and prepare them for disruptions they may experience once construction is underway;
(ii) Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in local language;
(iii) Formal disclosure of completed subproject reports by making copies available at convenient locations in the subproject area, and informing the public of their availability; and
(iv) Providing a mechanism through which comments can be made.

Table 45: Indicative Communication Plan for the Subproject

Responsible Entity	Target Stakeholders	Key Concerns	Communication Method	Frequency / Schedule	Key Messages
Project Preparation					
NCC Management	Relevant government agencies - Ministry of Finance - Department of Environment	Progress of project approval by the government - financial - environmental clearance	- Meetings - Presentations - Written communications	As needed during project preparation	Agreements and solutions to getting approval
Detailed Design					
NCC / PMU / DBO Contractors	Ward Officials Media Nongovernment Organizations Community-Based Organizations Women's Groups NCC Residents	All aspects of environmental impacts expected from the subproject / project.	- Community consultation meetings - Focus group discussions - Emails or written communications - Press Conferences	At least once in every target area during the detailed design phase	Update on Environmental Management Plan and Mitigation Measures
Construction Phase					
NCC / PMU / DBO Contractors / Civil Works Contractors	Media Nongovernment Organizations Community-Based Organizations	- On-target project implementation - Delays of project implementation - Other public concerns	- Press Conferences - Emails or written communications - NCC website - Disclosed Semi-Annual Environmental Monitoring Reports (SEMRs) on ADB and NCC websites	At least once every semester	- Progress of project implementation - Information on project implementation delays

Responsible Entity	Target Stakeholders	Key Concerns	Communication Method	Frequency / Schedule	Key Messages
	Ward Officials Women's Groups Ward Residents	- Disruptions due to construction works - Community health and safety issues - Community residents' concerns	- Community consultation meetings - Focus group discussions - One-on-one consultations - NCC website - Disclosed SEMRs on ADB and NCC websites	- Once prior to starting construction works in a particular area - As needed during construction period in a particular area	- Scheduling of works - Community health and safety measures to be in place during construction works
Operation Phase					
NCC / PMU / DBO Contractors	All stakeholders	- Operation and maintenance issues on the water supply system	- Press conferences - Press releases (print or broadcast media) - NCC Website - Social media platforms	As needed	- Solutions to O&M issues and target dates to resolve issues - Mitigation measures to address / or offset measures to temporary impacts of O&M issues.

VII. GRIEVANCE REDRESS MECHANISM

279. A project-specific grievance redress mechanism (GRM) will be established to receive, evaluate, and facilitate the resolution of affected persons' concerns, complaints, and grievances about the social and environmental performance at the level of the overall project, including the subproject. The GRM will aim to provide a time-bound and transparent mechanism to voice out and resolve social and environmental concerns associated with the project.

280. The common GRM will provide an accessible and trusted platform for receiving and facilitating the 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.

281. The project area-wide public awareness campaigns will ensure that knowledge of the grievance redress procedures is generated. The PMU will conduct awareness campaigns to ensure that all affected persons and vulnerable households are made aware of grievance redress procedures and entitlements.

282. Affected persons will have the flexibility of conveying grievances/suggestions by dropping grievance redress/suggestion forms in complaints/suggestion boxes to be installed by PMU. Grievances can be sent by post, or by writing in a complaints register in the PMU office. The option of registering complaints on the NCC website can be explored, as this option is not

available currently. Careful documentation of the 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 will be undertaken. The PMU social and environmental officers will have the overall responsibility for timely grievance redress on environmental and social safeguards issues and for registration of grievances, related disclosure, and communication with the aggrieved party. A copy of a proposed outline of a grievance registration form is given in Appendix 16. All the documents made available to the public 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.

A. Existing NCC Grievance Mechanism

283. The current methods of registering complaints include complaint registration at the Office of the Executive Engineer at Godenail Water Treatment Plant, complaint registration through the concerned elected representatives (ward councilors and the Mayor). Complaints are currently conveyed through emails, phone calls, WhatsApp messages, etc. The complaint receiving person channels the grievance to the concerned officer/department of NCC for resolution. Larger issues are resolved in consultation with the Mayor of NCC. The existing grievance redress process is currently not formalized.

B. Proposed Narayanganj Green and Resilient Urban Development (NGRUD) Project Grievance Mechanism

284. The existing NCC grievance redress processes will be integrated into the proposed project specific grievance redress mechanism which will be established for the project. In case of grievances that are immediate and urgent in the perception of the complainant, the Assistant Engineer/ DBO Contractor safeguard personnel – Social and Environment / Social and Environment Officer from PMU 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 DBO Contractor, will be posted at all construction sites in visible locations. A representative of affected persons from each settlement will be a special invitee when grievances of a particular settlement are being discussed by the GRC.[43] Given below is the proposed grievance redress mechanism for the project.

(i) **Local level**: The on-site contractors Safeguards (social and environment) Officer/ Assistant Engineer of the PMU/ Social and Environment Officer, NCC will receive and record the complaint at the subproject site. Alternatively, the complaint can be registered by phone call, message, email, or on the NCC website and this will be reverted to the onsite personnel for 1st level resolution. The complaint will be reviewed by local level GRC comprising of: (i) Deputy Project Director, NCC, who will be the Convener; other members include Social and Environment officer, NCC; (iii) Councilor- reserved seat; (iv) Councilor- concerned ward; (v) GRM Focal (Chief Social Welfare Officer) (vi) Assistant Engineer NCC (designated as member secretary) (iv) Contractors' safeguards personnel- social and environment (v) Resettlement/ Environment Specialist of the MDSC. The first level or the local level officers/ GRC will try to resolve the issue on-site in consultation with the aggrieved party. This will be done within 7 days of receipt of a complaint/ grievance;

[43] Any travel expenses incurred by affected persons and their representatives (special invitees) to attend the GRC meetings shall be covered under the budgetary provision made for GRC.

(ii) **Project level**: All grievances that cannot be redressed within 7 days at the local level will be brought to the notice of the Project GRC, comprising of Project Director who will be the Convener; other members include Deputy Project Director (sectoral); Social Safeguards Officer (PMU); Environment Safeguards Officer (PMU); Team Leader, MDSC (designated as member secretary) and Social and Environment Specialist, MDSC. The Project level GRC will resolve the grievance within 14 days of receipt of a complaint/ grievance; and

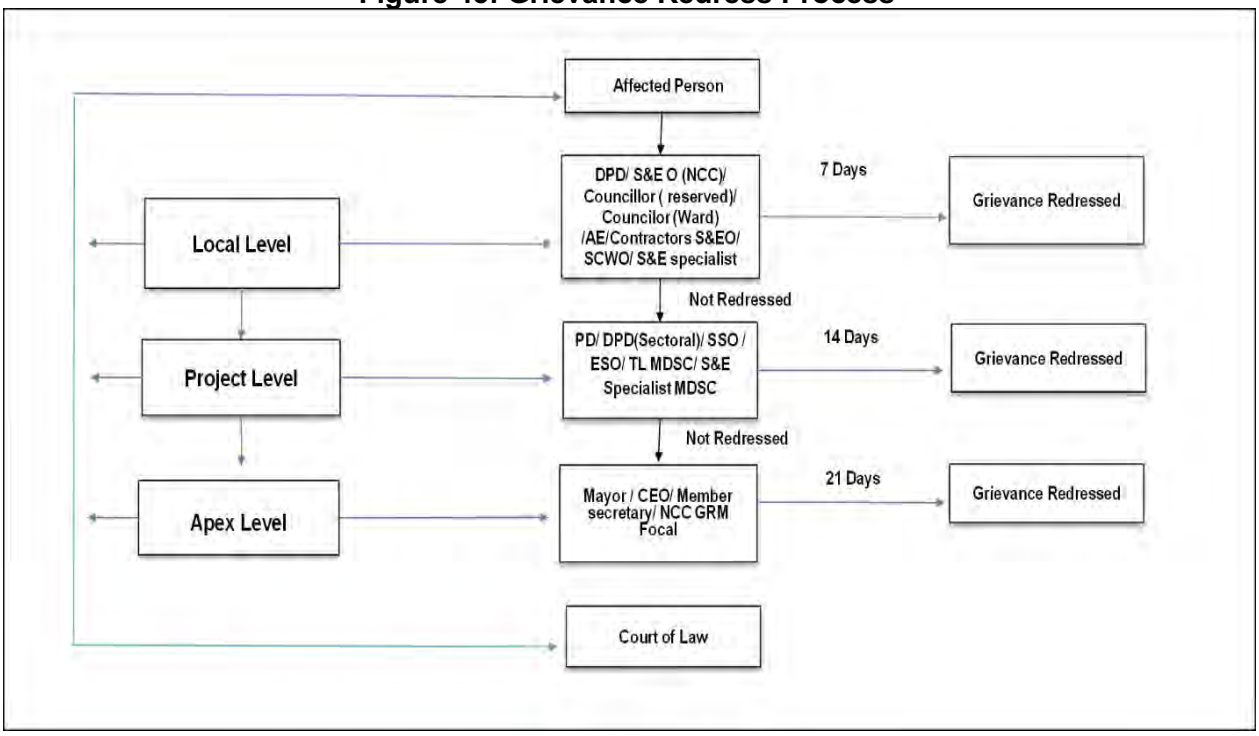
(iii) **Apex level**: If the grievance is not resolved at the Project level, the grievance will be referred to the Apex level, headed by the Honorable Mayor. Chief Executive Officer will support the grievance process. Other members include the Project Director who will be the Member secretary; and NCC GRM focal officer. The grievance at this level will be resolved within 21 days of its receipt.

285. Despite the project GRM, an aggrieved person shall have access to the country's legal system at any stage. This can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

286. **ADB's Accountability Mechanism.** In the event that 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 at ADB headquarters or the ADB Bangladesh Resident Mission. People who are, or may in the future be, adversely affected by the project may submit complaints to ADB's Accountability Mechanism. The Accountability Mechanism provides an independent forum and process whereby people adversely affected by ADB-assisted projects can voice, and seek a resolution of their problems, as well as report alleged violations of ADB's operational policies and procedures. Before submitting a complaint to the Accountability Mechanism, affected people should make an effort in good faith to solve their problems by working with the concerned ADB operations department. Only after doing that, and if they are still dissatisfied, should they approach the Accountability Mechanism.[44]

[44] https://www.adb.org/who-we-are/accountability-mechanism/main

Figure 45: Grievance Redress Process



AE= Assistant Engineer; CEO= Chief Executive Officer; CSWO= Chief Social Welfare Officer; DPD= Deputy Project Director; ESO = Environmental Safeguards Officer; GRM = Grievance Redress Mechanism; MDSC= Management Design and Supervision Consultant; NCC = Narayanganj City Corporation; PD = Project Director; S&E = social and environment; S&EO= Social and Environment Officer; SSO = Social Safeguards Officer; TL = Team Leader.

287. **Record-keeping.** The PMU will keep records of grievances received, including contact details of the complainant, the date the complaint was received, the nature of the grievance, agreed corrective actions and the date these were affected and the outcome. The number of grievances recorded and resolved and the outcomes will be available in the PMU office, as well as reported in monitoring reports submitted to ADB on a semi-annual basis. All resolutions shall be communicated to the aggrieved party/complainant(s).

288. **Periodic review and documentation of lessons learned**. The PMU will periodically review the functioning of the GRM and record information on the effectiveness of the mechanism, especially on the overall project's ability to prevent and address grievances.

289. **Costs.** All costs involved in resolving the complaints (meetings, consultations, communication, and reporting/ information dissemination) will be borne by the PMU.

VIII. ENVIRONMENTAL MANAGEMENT PLAN

A. Introduction

290. The purpose of this EMP is to provide a framework that outlines how NCC and the DBO contractor appointed (or any sub-contractor) will manage and where practicable, minimize negative environmental effects during the design, construction and operation of the subproject.

Construction is considered to include all site preparation, preparatory works, excavation, materials delivery, materials and waste removal, construction activities and associated engineering works.

291. This EMP identifies the minimum requirements regarding the appropriate mitigation, monitoring, inspection and reporting mechanisms that need to be implemented throughout design, construction and operation periods of the subproject. Compliance with this EMP does not absolve the DBO Contractor or its subcontractors (during construction phase) and/or the subproject operators other than the DBO Contractor, if any, (during operation phase) from compliance with all legislation and bylaws relating to construction phase and operation phase activities, respectively.

292. This EMP provides a framework to:

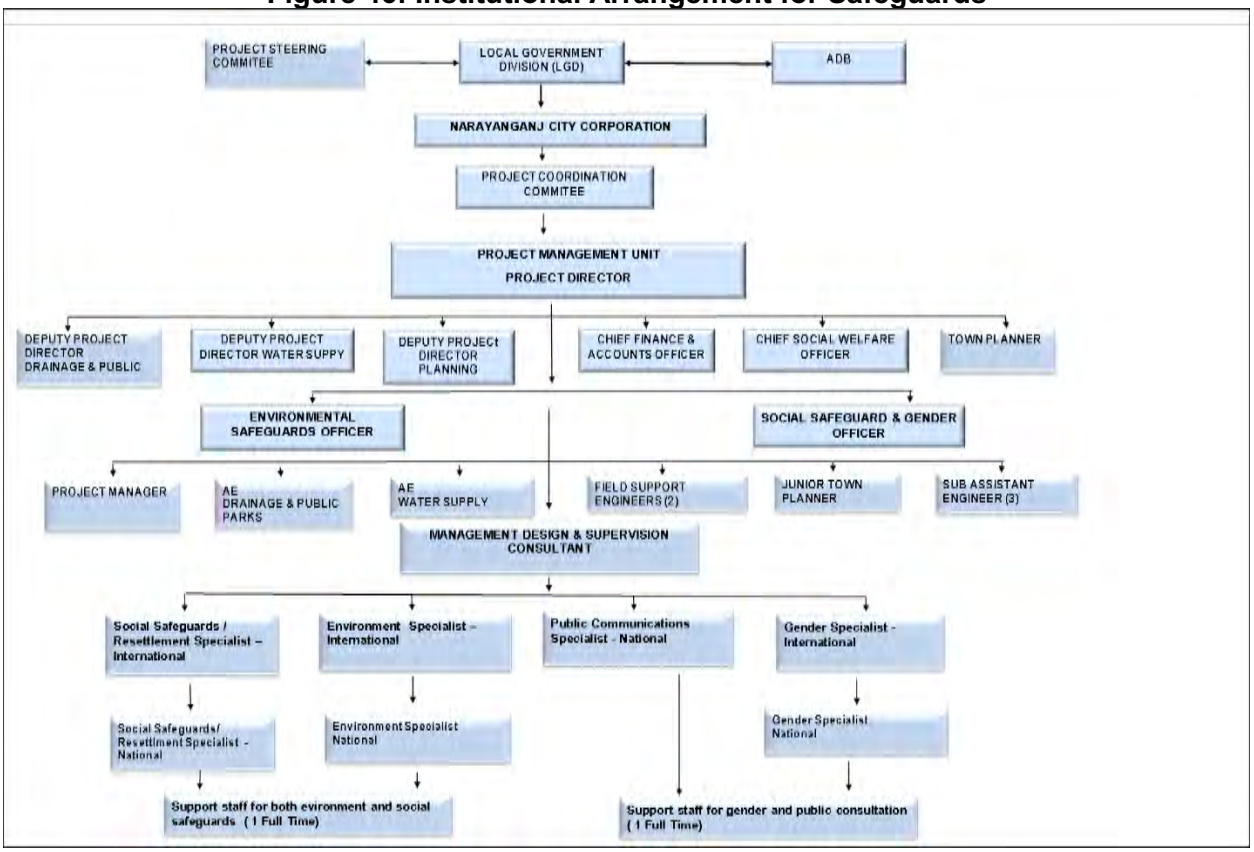
(i) Describe the subproject for environmental management during design, construction and operation phases;
(ii) Implement those monitoring and mitigation measures identified in this IEE;
(iii) Outline the principles and minimum standards required of the DBO Contractor during the development of its SEMPs;
(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 subproject throughout all phases of subproject implementation.

B. Institutional Arrangement

293. The Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC) will be the executing agency and NCC will be the implementing agency for the overall project. A Project Coordination Committee (PCC) will be formed within the NCC to engage with policymakers, obtain guidance on key policy issues and oversee overall project implementation.

294. A Project Management Unit (PMU) will be created under the overall supervision of PCC. The PMU will ensure that the subproject will be implemented in accordance with the ADB SPS and relevant government laws, rules and regulations, including the recently Environmental Conservation rules, 2023, among others. The PMU will be supported by a Management, Design and Supervision Consultant (MDSC) team, comprising individual consultants that will provide all necessary management and supervision expertise in implementing the overall project. The management and supervision will come at varying degrees during design phase and pre-construction phase, construction phase, and operation phase. Figure below outlines the institutional arrangement for the project in terms of safeguards supervision and implementation.

Figure 46: Institutional Arrangement for Safeguards



295. **Project Management Unit.** The PMU established within NCC, headed by a Project Director, will continue to implement the project and will be responsible for overall planning, management, coordination, supervision, and progress monitoring of the project. The PMU will be staffed with at least one (1) environmental safeguards officer who will lead the efficient overall implementation of environmental safeguards. The environmental safeguards officer will be supported by environment specialist and other consultants of MDSC in implementing and/or monitoring environmental safeguards compliance under the project, including in the conduct of capacity development and training. The responsibilities of the environmental safeguards officer are:

(i) Ensure that IEE reports are included in the bidding and contract documents;
(ii) Ensure availability of budget for safeguard activities in the bidding and contract documents;
(iii) Ensure 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 subproject site;
(iv) Review and confirm draft IEE reports are finalized based on final detailed designs;
(v) Ensure that no civil works shall commence until corresponding final IEE report is cleared by ADB;

(vi) Review and provide recommendations on the approval of site-specific EMPs (SEMPs), including other required work plans, of the contractors;
(vii) Provide oversight on environmental management aspects of the project, and ensure the EMPs, SEMPs and other required work plans are implemented by the contractors;
(viii) Establish a system to monitor environmental safeguards of the project including monitoring the indicators set out in the monitoring plan of the EMPs;
(ix) 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;
(x) Review, monitor and evaluate effectiveness with which the EMPs and SEMPs are implemented, and recommend necessary corrective actions to be taken;
(xi) Undertake field monitoring to validate compliance with the EMPs, SEMPs and other required work plans;
(xii) With support from MDSC, consolidate monthly environmental monitoring reports from the contractors. Based on these monthly reports and on results of PMU's own field monitoring and validation activities, prepare and submit semi-annual environmental monitoring reports (SEMRs) to ADB;
(xiii) Ensure timely disclosure of final IEE reports, SEMRs, and other safeguard documents in project website and in a form accessible to the public;
(xiv) Address any grievances brought about through the grievance redress mechanism (GRM) in a timely manner per the IEEs (GRM is discussed in Section VI hereof);
(xv) Undertake regular review of safeguards-related loan covenants, and the compliance during project implementation; and
(xvi) With support from MDSC, organize periodic capacity building and training programs on safeguards for project stakeholders, including PMU personnel and contractors.

296. **Management, Design and Supervision Consultant (MDSC)**. The MDSC team will have one International Environment Specialist Consultant and one National Environment Specialist Consultant 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; and in fulfilling all other tasks necessary to ensure the project complies with all environmental safeguard requirements. Specific tasks of the Environment Specialist Consultants are the following:

(i) Support the PMU in fulfilling all responsibilities as enumerated in the preceding paragraph;
(ii) Update/Finalize the initial environmental examination (IEE) report including environmental management plans (EMP) based on final detailed design of the subprojects and in accordance with ADB SPS and national laws, regulations, policies and guidelines;
(iii) Conduct 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 reports;
(v) Ensure relevant provisions from the updated/final IEE reports and EMPs are incorporated in the bid and contract documents;
(vi) Support in implementing the grievance redress mechanism and ensure members of the grievance committee have the necessary capacity to resolve project-related issues/concerns;

(vii) Together with the social safeguards experts, conduct safeguards capacity building to ensure PMU and contractors have the capacity to implement, monitor, and report on implementation of EMPs, resettlement plans and indigenous peoples plans (if any); and
(viii) Monitor implementation of EMPs at all work sites, including all potential safeguard issues identified in the safeguard documentation mentioned above;
(ix) Monitor any unanticipated environmental risks or impacts that arise during construction, implementation or operation of the subprojects that were not considered in the IEE reports and EMPs. Prepare corrective action plans and ensure that these are implemented by the contractors and reported accordingly in environmental monitoring reports to ADB; and
(x) Undertake all other tasks to ensure the project complies with ADB SPS and national environmental laws, rules, and regulations.

297. **DBO Contractor (and subcontractor/s, if any)**. The IEE reports with EMPs will form part of bidding and contract documents and verified by PMU. The DBO Contractor will be required to designate their respective environment, health and safety officers (or equivalent) to ensure effective implementation of EMP and SEMPs, including other specific work plans, during civil works. DBO Contractor is to carry out all environmental mitigation and monitoring measures outlined in its contract and this IEE report. The DBO Contractor will be required to submit to PMU, for review and approval, corresponding SEMP and other required work plans per this IEE report. These plans should be able to provide information on (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 per EMP; and (iv) budget for SEMP and EMP implementation, among others. No works can commence until corresponding SEMPs and required work plans are approved by PMU.

298. Specifically, the DBO Contractor will have the following responsibilities, among others, that will be included in the bid and contract documents:

(i) Ensure that the infrastructure development works are carried out in an environmentally friendly manner, minimizing environmental impacts while ensuring the health and safety of all its workers and the minimizing disturbance to the surrounding environment and communities;
(ii) Consideration of ADB SPS, national regulations and the EMP during bid preparation and cost estimation;
(iii) Hire or designate a full time Environment, Health and Safety Officer (or equivalent) responsible for compliance to ADB SPS requirements, national regulations and the EMP/SEMP and other required work plans. The officer/staff must have a clear terms of reference and responsibilities to ensure that all environmental concerns are properly managed;
(iv) Ensure regular reporting to the PMU on work progress and alert management on any potential issues or delays;
(v) Strictly follow health and safety measures at the subproject sites;
(vi) Obtain the necessary permits and clearances, if any is required for the DBO Contractor, to implement the subproject;
(vii) Ensure that all worker recruitment and OHS requirements are complied;
(viii) Take necessary corrective action to rectify any non-conformance, including actions related to grievances;
(ix) Institute an emergency plan for natural calamities/disasters and accidents at the site;

(x) Follow chance finds procedures to discovery of any physical cultural artifact;
(xi) Ensure any sub-contractors/suppliers who are utilized within the context of the contract comply with the environmental requirements of the EMP. The contractor will be held responsible for non-compliance on their behalf; and
(xii) Supply method statements for all activities requiring special attention as specified and/or requested by the MDSC environment specialist for the duration of the contract.

299. A copy of the EMP/approved SEMP and other required work plans 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.

C. Environmental Management Plan Matrix

300. Consistent with Section V, the following tables summarize the impacts and mitigation measures relative to the subproject.

Table 46: Environmental Impacts and Mitigation Measures (Water Supply Contract 1 Components)

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
1. Design and Pre-Construction Phase				
1.1 Natural Hazards	Likelihood of seismic events and other extreme events such as flooding, landslides, etc. due to natural hazards that could affect the subproject structures.	• The structural designs of the WTP components, DTWs and OHTs shall comply with relevant guidance such as Bangladesh National Building Code, building permits (or equivalent construction- and design-related permits) in Seismic Zone 2 areas, etc. to ensure the structures are within the standards; • Ensure design depths of new DTWs, locations, and projected water availability are based on scientific study on sustainability of groundwater in these areas, taking into consideration the impact of climate change over the long term; and • Use of construction materials that could withstand potential stresses brought about by extreme weather events, temperatures, pressures, etc.	PMU/ MDSC/ DBO Contractor	PMU
1.2 Raw Water Source Quality Sustainability	This poor quality of raw water may impact the functioning of the WTP and that the treated water may not be able to comply with the NDWQS.	• The upgrading of the WTP will include additional treatment process in order to reduce the high organic and inorganic load of the raw water. The moving bed biofilm reactor (MBBR) technology was chosen as the additional component for this purpose, which will be set up as the first stage secondary treatment and will be sequenced after the primary treatment. The MBBR will be able to help reduce the pollution load of the raw water from Shitalakhya river.	DBO Contractor	PMU/ MDSC
1.3 Environmental Quality	Apart from design considerations on the ability of the WTP system to treat any discharge to comply with the effluent and emission standards, there may be some operational issues not related to design that could cause impact to the Shitalakhya river, groundwater, ambient air quality, noise level, and community and occupational health and safety in the area during the operation phase of the subproject. These include potential discharge of chemicals and untreated wastewater including sludge, seepage of leachates, pollutive emissions from equipment/machineries, noise from repair works, and community and occupational health and safety hazards that	DBO Contractor will develop an O&M Manual that will include mitigation measures that address all potential operational issues related to surface water quality, groundwater quality, ambient air quality, noise leve, and community and occupational health and safety. These measures are enumerated in Chapter V Section C.5 of this IEE report or in Part 3 (Operation Phase) below in this table.	DBO Contractor	PMU/ MDSC

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
	may arise. All these potential impacts need be addressed during the design phase as well.			
1.4 Disruption of Public Utilities/services	Utility lines within or in the vicinities of the subproject sites may need to be moved. Otherwise, these may be damaged disrupting or interrupting services to consumers.	• 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; • Require DBO Contractor 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; and • Reconnection of utilities will be completed at the shortest practicable time before construction commences.	PMU/MDSC	PMU
1.5 Risk of health hazard from asbestos-containing materials (ACMs)	There is a potential for encounter of asbestos cement (AC) pipes during construction phase. Damage to asbestos cement pipes may result to the generation of asbestos dust and fibers, which could go airborne and harm the workers and the public. When inhaled, asbestos fibers may cause long term health issues such as asbestosis and other lung inflammation and diseases including cancer.	<u>During Design, and Bidding and Contract Document Preparation Stage.</u> • The bidding and contract documents need to recognize the presence of asbestos-containing materials (ACM) such as asbestos cement (AC) pipes in the distribution network or any other existing facilities that will be rehabilitated under the subproject, including extent such as length or volume, as may be available. • If sufficient information is not available from the Employer (NCC) or PMU, the bidding and contract documents need to emphasize the need to conduct field survey together with the winning bidder to identify the alignments having AC pipes or infrastructures having ACMs prior to any mobilization; • Bidding and contract document to include line items for all costs related to the development and implementation of ACM Management Plan (AMP) shall be borne by the DBO Contractor. Appropriation or budgeting should include, among others, the following:	DBO Contractor, MDSC	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		○ Training of workers about the health hazards of asbestos to themselves and their families; ○ Work clothing or PPEs required when handling ACMs; ○ Double changing rooms and wash facilities to prevent dust from going home on street clothes; and ○ Periodic medical examinations of workers. <u>Pre-construction Phase by the DBO Contractor.</u> • Develop and implement an asbestos-containing materials (ACM) Management Plan (AMP) that includes identification of hazards, the use of proper safety gear, and handling and disposal methods. The AMP should be able to provide all explanations that are understandable to ordinary laborers or employees of the DBO Contractor. The DBO Contractor may refer to ADB's Good Practice Guidance for the Management and Control of Asbestos (Protecting Workplaces and Communities from Asbestos Exposure Risks).[45] The AMP should include the best practices in handling and disposal of ACM, such as, among others, those enumerated in Chapter V Section B of this IEE report. • The AMP shall be submitted to PMU for approval; • Ensure all its personnel and laborers are trained to enable them understand health risks associated with asbestos from AC pipes, how to identify AC pipes, and how to properly handle AC pipes based on the AMP it developed for the subproject; • With support from the PMU and prior to mobilization, conduct reconnaissance of alignments believed to be where AC pipes are laid and undertake determination or sampling following related protocol in the AMP; • Based on the reconnaissance, establish a recording system that will note the locations of AC pipes. This record shall be maintained and updated during construction phase should there be other		

[45] https://www.adb.org/publications/good-practice-management-control-asbestos

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		additional AC pipe alignments identified or encountered during pipelaying works; and • Submit to PMU updated records of AC pipe alignments as part of its regular monitoring reports to PMU.		
1.6 Spoil Disposal	Linear works excavation normally generates excess spoils. Indiscriminate and unmanaged disposal of this will result to negative environmental impacts (siltation and clogging of canals, damage to roads, safety to community) and other nuisance to communities.	• Prior to award of contract, NCC will identify a location for the disposal of excess spoils that will be generated during the construction phase. • The disposal location will need to obtain clearance from relevant government agencies having jurisdiction over such location. • No award of the contract shall be made until disposal location and relevant clearance are obtained.	PMU/MDSC	PMU
1.7 Sludge Disposal	Without identifying the disposal site for generated sludge by the WTP as early as during the detailed design stage, there is a possibility that sludge might be mishandled or indiscriminately disposed of during the operation phase.	• DBO Contractor to finalize the sludge management strategy for the WTP by identifying the best option for sludge disposal. • If DBO Contractor opts for disposal to existing landfill site at the Jalkuri Landfill Site, coordinate with the management of NCC and Jalkuri Landfill Site to finalize the exact location of sludge disposal in the area. DBO Contractor, with support from MDSC, will conduct a due diligence on the appropriateness of the selected site and ensure the following: (i) Not near or adjacent to canals or bodies of water; (ii) Lined with clay or any impervious materials; and (iii) Covered to prevent inundation during rains. • If DBO contractor will adopt recycling or reuse of the dried sludge as soil conditioner in agricultural lands, the DBO Contractor and MDSC need to: (i) undertake required studies to ensure the feasibility of this scheme in the context of local situation and national regulations.	DBO Contractor / MDSC	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		(ii) Obtain approval of the DOE and MOA on the use of sludge as soil conditioner; and (iii) Identify the agricultural land or area at which the dried sludge will be applied.		
1.8 Physical Cultural Resources	Excavation works may have the potential to damage cultural heritage monuments and other PCRs.	Include in bidding and contract document the condition for DBO Contractor to undertake the following steps in order to avoid impacts to PCRs: • Mandatory visit to all alignments to identify all possible PCRs that may be affected by the pipelaying works, such as mosques, eidgahs, heritage sites, and other locally important monuments; • Strictly follow methodologies and protocols developed for all types of excavation works as discussed in this IEE; and • Develop other mitigation measures that will be used during subproject implementation that may not be available in the methodologies and protocols discussed in this IEE. However, these mitigation measures shall be consistent or aligned with the established methodologies and protocols, with the intent to protect any PCRs found at the subproject sites.	PMU/MDSC	PMU
1.9 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. Permissions and clearances are required from the following government agencies and departments: o Department of Environment; o BIWTA; o NCC; and o Other agencies as may be determined during the detailed design phase by the DBO Contractor. • Include in detailed design drawings and documents all conditions and provisions in all permits, clearances, NOCs, etc., if necessary.	DBO Contractor, MDSC	PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
1.10 DBO Contractor Mobilization	Fielding of equipment and manpower to the sites will likely impact baseline site conditions and potentially damage private properties and public properties, including cultural heritage sites. Safety of both workers and the community will also be likely affected due to movements of both workers and construction equipment	DBO Contractor to ensure the following are complied prior to mobilization: • Developed the required SEMPs and these are approved by PMU with support from MDSC; • Developed a Traffic Management Plan covering all subproject sites and their vicinities, in coordination with local traffic police. DBO Contractor shall have traffic management plan in place prior to the excavation; • Developed a Spoil or Waste Management Plan that will include information on the government-approved disposal site and the route from subproject locations to the said site; • Established environmentally sound sewage facilities for all offsite facilities and offices, including construction camps to ensure no pollutive discharge to Shitalakhya river; • Developed a Health and Safety Plan approved by PMU with support from MDSC. The plan will include specific steps to manage potential spread of COVID-19 and other emerging infectious diseases; and DBO Contractor to ensure the following are complied prior to operation: • In consultation and collaboration with MDSC and DBO contractors of other water supply packages, developed an O&M Manual. The development of the manual may extend towards the construction phase, but shall be completed prior to the operation phase. The O&M Manual shall include all important elements such as, among many others, the following: o A detailed description of all components of the entire WTP, their corresponding functions and importance for the whole system; o Detailed drawings of all the components of the WTP; o Organogram of the manpower and personnel of the WTP;	DBO Contractor,	PMU MDSC

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		○ List of all chemicals being stored at the WTP, where they are stored, and their corresponding safety data sheets; ○ Health and safety protocols for all aspects of the water treatment and supply operation, ranging from how to lift heavy objects to what to do if someone is exposed to chlorine gas, etc.; ○ Standard operating procedures to be followed in carrying out any given operation. For example, what are the specific procedures or instructions for starting up, operating and shutting down each of the water treatment processes, equipment, and machines; system for delivery of the water from the clear water reservoir to the overhead tanks; the details of the various parameters that need to be controlled (such as the flow rate through a rapid gravity sand filter, maximum flow rate permissible through the delivery system, etc.); ○ Procedures to follow in cases of emergencies or critical situations, such as when the raw water quality exceeds the design limit of the WTP or when the treated water quality from the clear water reservoir exceeds the drinking water quality standards, etc.; and ○ The required maintenance works for each of the WTP components, checking (daily routine checks, weekly routine checks, monthly routine checks, and so on), schedules, and the responsible personnel for these maintenance activities.		
1.11 Construction Camps or Workers' Accommodation	When camps or accommodation are constructed, there is a likelihood that these are built without amenities resulting to social stress and degradation of the local environment	• Ensure that the camps or accommodations be provided with sanitary amenities at designated areas. In addition to any local regulations, DBO Contractor will need to follow the standards for workers accommodation pertaining to "Workers' accommodation: processes and standards. A guidance note by IFC and the EBRD" 2009.[46]	DBO Contractor	PMU, MDSC

[46] https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/publications/publications_gpn_workersaccommodation

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		• Designed environmentally sound sewage facilities for all offsite facilities and offices, including construction camps to ensure no pollutive discharge to Shitalakhya river. Design considerations for sewage facilities are in Appendix 13. This should be incorporated in the facility designs.		
1.12 Updating of IEE and SEMP Preparation	Without updated IEE and SEMP, works will not commence resulting to delay in the project implementation.	• Ensure IEEs are updated based on final detailed designs, and submitted to ADB for final review, clearance and disclosure. • Ensure SEMPs are prepared and submitted to PMU for approval.	DBO Contractor/ MDSC/PMU	PMU
1.13 Community Awareness	Consultations will be needed prior to civil works construction to enable communities around the subproject sites understand of the final schedule. Without proper interaction with local communities and or with stakeholders may lead to confusion and agitation and non-cooperation of local people.	Undertake another round of consultation to inform the people of the following: • Refresher on the overview and objectives of the subproject; • Preliminary and/or final detailed design of subproject components; • Schedule of implementation; • Potential environmental and social impacts (positive and negative) of the subproject, and the proposed mitigation measures for the perceived negative impacts; and • Grievance redress mechanism and contact details of the subproject.	PMU, MDSC, DBO Contractor	PMU
1.14 EMP Implementation Training	Lack of proper training to implement the EMP leads to mismanaged environmental safeguards.	• Ensure to provide EMP training to DBO Contractors, workers and representatives from NCC prior to construction works.	MDSC	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.	• Sourcing construction materials, including aggregates, etc., from legitimate suppliers authorized by the government; and • Maintain a construction material register at the site.	DBO Contractor	MDSC, PMU
2.2 Topography and Aesthetics	Excavation, pipelaying and other construction works for the subproject will affect the topography and aesthetics at the sites due to potential accumulation of unmanaged spoils and construction debris.	Implement the Spoil Management Plan, and in addition, the following measures (if not specifically included in the Spoil Management Plan): • Avoid storing spoils at the vicinity of construction sites for a long period of time. Haul spoils on a	DBO Contractor	MDSC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		regular basis to ensure more efficient handling and management at the disposal sites; • Dispose only in the designated disposal areas identified under the subproject; • Ensure adequate compaction, and drainage system around the disposal areas; • Ensure disposal areas are utilized up to their capacity limit only and in accordance with the required sloping and leveling/grading specification approved under the subproject; and • If disposal area reaches the limit, utilize another designated disposal area approved under the subproject.		
2.3 Excavation for Linear Works	With alignments passing through various roads with varying widths, excavation activities may pose damage to structures due to vibration or collapse of excavated trenches.	• Excavation shall be avoided during rainy days and seasons all throughout the subproject area. • For excavation of more than 1m depth or depending on site condition, shoring shall be applied to avoid any sort of collapse and maintaining safety of lives and property. • Proper barricade and signage boards shall be installed during excavation to avoid unauthorized person entering into the construction site. Shoring shall be in place in each excavated trench along the alignment. • Excavated materials shall be handled properly; which shall be loaded to dump truck and shall be taken to temporary storage area (spoils to be used for backfilling or reinstatement works) or disposal site (for the excess spoils). In case of narrow roads, use of smaller loaders or vans will be adopted for collection and intermediate transfer to dump trucks. This will avoid damage of property walls or structures along these narrow roads. The excavated material shall not be stored along the excavated trench. Institute excavation methods based on the type of areas affected. Some methodologies below, which should be considered by the DBO Contractor. <u>*Excavation in all areas:*</u> • Materials from excavated trench will be transported and stacked to the nearest open space to be decided by the Engineer-in-Charge (or equivalent)	DBO Contractor	PMU MDSC

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		or the place allocated by DBO Contractor. For loading and unloading, small tippers will be used. This excavated material shall be brought back to the site of work for filling the trench. Shoring sheeting and bracing will be carried out accordingly depending on depth of excavation and nearness to structures. • In case the presence of water is likely to create unstable soil conditions, a well point system erected on both sides of the trench shall be employed to drain the immediate area of the trench prior to excavation operation. A well point system consists of a series of perforated pipes driven into the water bearing strata on both sides of a trench and connected with a header pipe and vacuum pump. If excavation is deeper than necessary, the same shall be fitted and stabilized before laying the pipes. • The proposed excavation at any one time shall be limited to such lengths, which does not cause inconvenience to surrounding inhabitants and road traffic. All excavations left unattended shall be adequately protected with approved fencing and barricades and with flashing lights where required. • Bypass way of at least 1 m for people will be provided with proper barricades and placing chequered plates supported on channels. • Any archaeological artifacts identified during trench excavation will follow the chance finds procedure. *Areas with fragile buildings or structures:* • The excavation of trenches for pipelines shall be done full manually using appropriate equipment. • Hand ramming or small vibration machine where unavoidable is allowed in these areas, and must not exceed vibration limits. • Vibration limit of 5 mm/sec Peak Particle Velocity . Frequency limit of not less than 10Hz. • The excavation of trench will be carried out for every 8 to 10 m, or where at least one pipe can be installed. • Excavation will be carried out only during day to more easily identify chance finds. Pipe installation		

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		and site reinstatement may proceed at night time if required. • Equipment and heavy machines will not be used for trench excavation or compaction if works are adjacent cultural heritage structures. • Excavation work will be carried out in piece meal approach. *Residential areas, narrow lanes:* • The excavation of trenches for pipelines shall be done half mechanically and half manually using appropriate equipment. • Small equipment and vehicle will be used especially small JCBs for excavation, small tipper trucks, compactor vibration machine, etc. • Hand ramming is proposed for compaction and small vibration machine is allowed in these areas but must not exceed vibration limits. • Vibration limit of 10 mm/sec Peak Particle Velocity. Frequency limit of not less than 10Hz. • The excavation of trench will be carried out for every 8 to 25 m, or where at least one pipe can be installed. • Excavation will be carried out during the night time as far as possible, or depending on the extent of use of the road lanes during day time. If the road lane is not a busy area during the day, excavation will be carried out during the day to avoid disturbance to sleeping residents during night time. *Industrial zone, wide streets:* • The excavation of trenches for pipelines shall be done mechanically using appropriate equipment and some portions manually. • The excavation of trench will be carried out for every 15 to 25 m, or where at least two pipes can be installed. • Excavation will be carried out during the night time as far as possible. • Vibration limit of 50 mm/sec Peak Particle Velocity. Frequency limit of not less than 10Hz. • Any archaeological artifacts identified during trench excavation will follow the chance finds procedure.		

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
2.4 Surface Water Quality	Land preparation, grading and other site clearance activities for the DTWs, and linear works excavation may result to numerous impacts such as siltation and pollution of canals in the area particularly the Shitalakhya river.	• Dispose excess spoils only in the designated disposal areas identified under the subproject; • Avoid storing spoils at the vicinity of site for a long period of time. Haul spoils on a regular basis to ensure more efficient handling and management at the disposal sites. Use temporary storage sites for spoils that will be used for backfilling, but location should be away from sites so as not to create any negative impact on aesthetics in the area; • To minimize excess spoils for disposal, use some for beneficial purposes such as in any other construction activities, or to raise the level of low-lying areas; • 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; • Silt traps to be provided at construction area near receiving bodies of water; • No equipment or machinery shall be operated outside the work areas; • Avoid spillage of fuels, chemicals and lubricants. Fuel and other petroleum products stored at storage areas away from water drainage and protected by impermeable lining and bunded 110% by volume; • Ensure that drains are not blocked with excavated soil; • Locate stockyards away from canals or receiving bodies of water; • For effluents from construction camps and DBO Contractor's offices, provide treatment arrangements such as retention ponds and septic tanks which should be incorporated in the facility designs. Environmentally sound sewage facility design has to be prepared by the DBO Contractor and agreed with PMU; • Clean up of the area after the completion and prior to the onset of monsoon season; and • Avoid scheduling of excavation work during the monsoon season. Earthworks should be undertaken during dry season.	DBO Contractor	MDSC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
2.5 Groundwater Quality	Construction activities could potentially contaminate groundwater resource due to seepage of liquid wastes and chemicals from construction sites and construction camp sites.	Ensure to implement the following: • Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume; • Ensure refueling area has lining to avoid seepage of unavoidable spills during refueling. Ensure to clean up spills immediately and all used cleaning materials are disposed properly; • Ensure to provide portable toilets in all construction camps to discourage injecting septic wastes on land; and • Conduct ground water quality monitoring, particularly at sites near fuel depot or refueling site and construction camps. Ensure to conduct at least one sampling every six months. Important parameters to test are Oil and Grease, and Fecal Coliform.	DBO Contractor	MDSC, PMU
2.6 Ambient Air Quality	Construction activities could result to generation of dust that could remain airborne within and around the subproject sites, and degrade the ambient air quality in the area. This could affect the general wellbeing of residents in the area.	Ensure to implement the following: • Conventional dust control measures such as use of water sprays and minimizing hauling and vehicle movements during windy times of the day or night; • Proper covering (e.g. tarpaulin) of hauling equipment such as dump trucks during transport of materials or spoils; • Provide temporary barriers or covers around active site grading areas; • Limit vehicles speed at work site enough to not cause vigorous suspension of dust; • Prohibit idling of heavy equipment or vehicles for a long time; • Regular maintenance of heavy equipment and vehicles to ensure compliance with national vehicle emissions standards; • Prohibit burning of any liquid or solid wastes; • Conduct regular visual inspections to identify and address other potential sources of dust emissions; and • Conduct ambient air quality monitoring at strategic locations at least once every six months. Ensure that sampling locations are based on the wind and dust/smoke dispersion direction at the sites.	DBO Contractor	MDSC, PMU
2.7 Noise Level	Excavation and construction activities will result to generation of noise that could disturb	Ensure to implement the following:	DBO Contractor	MDSC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
	the construction workers, staff, and community people.	• Provide prior information of the scheduled works to nearby residents; • Use silencers for all equipment; • Avoid delivery of raw construction materials during night time; • Avoid noise-intensive activities at night time; • Horns should not be used unless it is necessary to warn others or animals of the vehicle's approach and prevent any potential accident; • Minimize drop heights during delivery and stacking of raw construction materials; • Use sound barriers to lessen the noise from sites; • Maintain maximum of noise level of 45 dB(A) at the nearest residence relative to the specific worksites; • Conduct noise level monitoring. Ensure to conduct at least one sampling every six months and when construction activities are at peak. Important areas to test are at locations nearest the community residents and construction camps; • Use pumping equipment with low level noise generation; • If using generators, ensure generator set complies with the noise standards; • Ensure generator set has acoustic enclosure and silencer (if necessary) in the exhaust muffler; and • Depending on site, strictly comply with vibration limits as indicated in Table 43 of this IEE report when using excavation and compacting equipment.		
2.8 Underground Physical Cultural Resources	There is a possibility of chance finds. Excavation activities could damage potential underground heritage assets.	Ensure to implement the following protocol: • strictly follow the protocol which would require the DBO Contractor to coordinate 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.	DBO Contractor	MDSC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
2.9 Community Health and Safety	The construction sites and construction activities could pose danger to pedestrians, animals and other community people due to moving heavy equipment, electrocution, or excavated areas. Spread or outbreak of diseases could be a threat as well.	Ensure to implement the following: • Install warning signs, warning tapes, hard barricades, and notices around the site perimeter to avoid unauthorized entry; • Assign guards around the subproject sites on a 24/7 basis; • Provide lighting all around the subproject site to ensure the perimeter is well-lit at nighttime; • Follow a code of conduct for workers, which should include restricting workers in designated areas, no open defecation, no littering, no firewood collection, no setting of fire except when needed but in designated places, no trespassing, no unauthorized overstaying at construction sites, and no obligation to undertake potentially dangerous work without the use of proper personal protective equipment, among others; • 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;[47] The community health and safety plan shall ensure the following: ○ implement risk management strategies to protect the community from physical, chemical, or other hazards associated with sites under construction and decommissioning; ○ restricting access to the site, through a combination of institutional and administrative controls, with a focus on high risk structures or areas depending on site-specific situations, including fencing, signage, and communication of risks to the local community; ○ removing hazardous conditions on construction sites that cannot be controlled affectively with site access restrictions, such as covering openings to small confined spaces, ensuring means of escape for larger openings such as trenches or excavations, or locked storage of hazardous materials;	DBO Contractor	MDSC, PMU

[47] IFC World Bank Group. 2007. https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-construction-and-decommissioning-en.pdf

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		○ implement measure to prevent proliferation of vectors of diseases at work sites; ○ adequate space and lighting, temporary fences, shining barriers and signage at active work sites; ○ contractor's preparedness in emergency response; ○ adequate dissemination of GRM and contractor's observance and implementation of GRM; and ○ upon availability, local people should be given an opportunity for work in the subproject activities; • Follow international best practices on traffic safety such as those in Section 3.4 of the World Bank Environmental Health and Safety (EHS) Guidelines on Community Health and Safety;[48] The community health and safety plan should include: ○ Adoption of best transport safety practices across all aspects of project operations with the goal of preventing traffic accidents and minimizing injuries suffered by project personnel and the public. Measures should include: ▪ Emphasizing safety aspects among drivers; ▪ Improving driving skills and requiring licensing of drivers; ▪ Adopting limits for trip duration and arranging driver rosters to avoid overtiredness; ▪ Avoiding dangerous routes and times of day to reduce the risk of accidents; ▪ Use of speed control devices (governors) on trucks, and remote monitoring of driver actions; ○ Regular maintenance of vehicles and use of manufacturer approved parts to minimize potentially serious accidents caused by equipment malfunction or premature failure. Where the project may contribute to a significant increase in traffic along existing roads, or where		

[48] IFC World Bank Group. 2007. https://www.ifc.org/content/dam/ifc/doc/2000/2007-general-ehs-guidelines-community-health-and-safety-en.pdf

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		road transport is a significant component of a project, recommended measures include: o Minimizing pedestrian interaction with construction vehicles; o Collaboration with local communities and responsible authorities to improve signage, visibility and overall safety of roads, particularly along stretches located near schools or other locations where children may be present. Collaborating with local communities on education about traffic and pedestrian safety (e.g. school education campaigns); o Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents; o Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic; and o Employing safe traffic control measures, including road signs and flag persons to warn of dangerous conditions. • Follow the established community and occupational health and safety protocol on emerging infectious diseases such as COVID-19; • Maintain a complaint logbook at the site and take action promptly of complaints; • Schedule transport and hauling 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 while traversing settlement areas and avoid use of horn unless necessary to prevent accidents; and Earmark parking place for construction equipment and vehicles when idling; no parking shall be allowed on the roads, that may disturb the traffic movement.		
2.10 Occupational	Health risks and safety problems for workers are concerns in all construction projects. Safety risks and health issues arise from	Ensure to implement the following:	DBO Contractor	MDSC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
Health and Safety	storage, handling and transport of hazardous construction material, including asbestos cement (AC) pipes. Construction workers are also at risk of accidents due to various hazards (moving vehicles, high level of pollution from dust, exhaust of vehicles and machinery and noise). Further, extended working hours of workers could lead to risk of accidents due to fatigue. Construction workers are also exposed to possible disease outbreak at the work sites or construction camps.	• All relevant provisions of the Bangladesh labor Law, 2006, other national regulations related to occupational health and safety as tabulated in Chapter II of this IEE report, 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,[49] which include the following elements, whichever are applicable: ○ Communication and Training ▪ Training of all workers on occupational health and safety prior to construction works; ▪ Conduct of orientation to visitors on health and safety procedures at work site; ▪ Signages strategically installed to identify all areas at work site, including hazard or danger areas; ▪ Proper labeling of equipment and containers at construction and storage sites; and ▪ Suitable arrangements to cater for emergencies, including: first aid equipment; personnel trained to administer first aid; communication with, and transport to, the nearest hospital with an accident / emergency department; monitoring equipment; rescue equipment; firefighting equipment; and ▪ communication with nearest fire brigade station; ○ Physical Hazards ▪ Use of personal protective equipment (PPE) by all workers such as earplugs, safety shoes, hard hats, masks, goggles, etc. as applicable, and ensure these are used properly;		

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

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		▪ Avoidance of slips and falls through good house-keeping practices, such as the sorting and placing loose construction materials or demolition debris in established areas away from foot paths, cleaning up excessive waste debris and liquid spills regularly, locating electrical cords and ropes in common areas and marked corridors, and use of slip retardant footwear; ▪ Use of bracing or trench shoring on deep excavation works; ▪ Adequate lighting in dark working areas and areas with night works; ▪ Rotating and moving equipment inspected and tested prior to use during construction works. These shall be parked at designated areas and operated by qualified and trained operators only; ▪ Specific site traffic rules and routes in place and known to all personnel, workers, drivers, and equipment operators; and ▪ Use of air pollution source equipment and vehicles that are well maintained and with valid permits; o General Facility Design and Operation ▪ Regular checking of integrity of workplace structures to avoid collapse or failure; ▪ Ensuring workplace can withstand severe weather conditions; ▪ Enough work spaces available for workers, including exit routes during emergencies; ▪ Fire precautions and firefighting equipment installed; ▪ First aid stations and kits are available. Trained personnel should always be available who can provide first aid measures to victims of accidents; ▪ Secured storage areas for chemicals and other hazardous and flammable substances are installed and ensure		

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		access is limited to authorized personnel only; ▪ Good working environment temperature maintained; ▪ Worker camps and work sites provided with housekeeping facilities, such as separate toilets for male and female workers, drinking water supply, wash and bathing water, rest areas, and other lavatory and worker welfare facilities; and ▪ Maintain records and make reports concerning health, safety and welfare of persons, and damage to property. Take remedial action to prevent a recurrence of any accidents that may occur. • For potential encounter and handling of AC pipes, follow the protocols in the AMP developed for the subproject during the pre-construction phase. Among others, the comply with the following: o Existing AC pipes, where intact, shall be left in-situ and not disturbed. Where the AC pipe is damaged and where there is a risk of asbestos particles becoming airborne, the contractor shall follow all necessary procedures in the AMP; o Ensure all personnel and laborers are trained to enable them understand health risks associated with asbestos from AC pipes, how to identify AC pipes, and how to properly handle AC pipes based on the AMP it developed for the subproject; o Inform PMU if AC pipes are encountered; o Maintain an updated record of l AC pipe alignments identified or encountered during the pre-construction reconnaissance survey and during pipelaying and excavation works; o Submit to PMU updated records of AC pipe alignments as part of its regular monitoring reports to PMU. • Follow established occupational health and safety protocol on emerging infectious diseases such as the COVID19;		

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		• Provide regular health check-ups, sanitation and hygiene, health care, and control of diseases for the workforce; • Provide at cost all labor and materials and construct/install and maintain site safety, hard barricading, flexible green net, signboards, and lightings throughout 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 ambulance facility at the construction site and camp site, if any; • 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; and • Provide insurance to the workers. Health and safety training for all site personnel is very important and must be mandatory.		
2.11 Local Festivals and Cultural Practices	Construction activities may disrupt religious or local festivities.	• DBO Contractor shall follow religious and city festival calendar to avoid impact upon local celebrations. • Construction works need to be avoided or minimized during the festivals. • If excavation works or construction works have been done but remain unrestored approaching a certain festivity, alternative access to mosques and other important sites must be considered or set up.	DBO Contractor	MDSC, PMU
2.12 Terrestrial Flora and Fauna Resources	Construction phase activities may pose impact to other flora and fauna resources in the immediate vicinity of the sites.	DBO Contractor need to observe and comply with the following: • Avoid any cutting of trees and shrubs at the construction site. The spaces are wide enough for any activities without cutting any of the trees or locally important plants, if any; • Prohibit use of wood as fuel at construction camp sites, if any; • Provide LPG/kerosene to workforce staying at the construction camp sites; and • Prohibit the harvest and trade of any plants or poaching of animals found in the area.	DBO Contractor	MDSC, PMU
2.13 Socioeconomic Resources	Construction works may result in temporary loss of livelihoods and interruption of social and economic activities in some alignments.	Ensure to implement the following: • Adopt the GRM of the project, and respond to grievances;	DBO Contractor	MDSC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
	In areas where there are shops or other commercial activities, these could lose some business if access is difficult for customers.	• 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. Handrails may provided to ramps or planks depending on the width of excavations; • 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; and • The diversion is done in coordination with the traffic police division for necessary rerouting of traffic and traffic management.		
2.14 Job Opportunities	(Positive Impact) Subproject activities will create significant temporary employment for construction workers, equipment maintenance and support staff.	(Intensification or enhancement measure) As much as possible when expertise is available, DBO Contractor to recruit from local workforce.	DBO Contractor	MDSC, PMU
3. Post-Construction Phase				
3.1 Waste Clean-up and Restoration	The activities of the subproject will result to sorts of construction and demolition debris wastes after the construction period. These include excess spoils that were generated at the end of the construction period, various scraps from distribution pipelaying and DTW and OHT rehabilitation works, debris from demolition of structures in the WTP site (administration building, chlorine storage and injection building, storage building, guard house), etc. This also includes all other wastes found in the WTP site such as chemical containers and packaging materials that have accumulated there for years. See figure below. Due to the volume and hazardous nature of some of these wastes, indiscriminate disposal or ignoring their proper disposal could be dangerous to the environment and the people in the vicinity of the subproject sites.	Immediately within one week after construction phase, the DBO Contractor shall collect all the wastes at the different sites, and implement the following. DBO Contractor may opt to outsource this to qualified entities in NCC, provided that DBO Contractor's EHS personnel strictly supervise the cradle-to-grave management of all these wastes. All costs related to management of these wastes shall be borne by the DBO Contractor, or as per agreement in the DBO contract documents. • Segregate or sort all wastes according to nature (recyclable, non-recyclable, hazardous, non-hazardous or any combination); • Ensure to handover (or sell as the case may be) recyclable wastes to authorized recycling entities in Bangladesh. DBO Contractor shall coordinate this action with NCC through the PMU; • Ensure to dispose non-recyclable and non-hazardous wastes to appropriate disposal sites.	DBO Contractor	MDSC, PMU

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		These may be collected, transported and disposed similar to how solid wastes in the city is managed. Thus, DBO Contractor shall coordinate with NCC through the PMU in this regard; • Ensure to transport and dispose hazardous wastes using authorized hazardous waste transporters and treaters in Bangladesh. DBO Contractor shall coordinate all actions for these wastes with NCC through the PMU; and Ensure the sites are cleared with all wastes disposed accordingly, and compliance with this measure shall be included as one of the conditions for payment to the DBO contractor as regards the WTP upgrading works.		
4. Operation and Maintenance (O&M) Phase				
4.1 Surface Water Quality	Potential discharge of chemical and untreated wastewater including sludge from the WTP could deteriorate the quality of Shitalakhya river.	DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following: • Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume; • Institute good housekeeping practices at all sections of the WTP; • Recycle used or spent water to avoid discharge to the river. If recycling is not possible, ensure that wastewater such as supernatant liquid from the sludge treatment and drying is treated to comply with national effluent standards prior to discharge to the river; • Conduct effluent quality monitoring per monitoring plan; • Conduct water quality monitoring at the upstream and downstream portions of Shitalakhya river per monitoring plan; • Avoid discharge of generated sludge to the Shitalakhya river; • Ensure to operate the sludge drying beds and store dried sludge in appropriate packing prior to transport to disposal site or prior to reuse, whichever is the adopted option; and • In case of landfill disposal, transport dried sludge to designated dried sludge disposal site on a	DBO Contractor /NCC	NCC

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		regular basis to avoid accumulation of dried sludge at the WTP area.		
		NCC shall take all initiatives under its power to exert efforts in improving the quality of Shatalakhya river through the following example leads: • Monitor and require all industries within NCC's jurisdiction that are operating along Shatalakhya to ensure no discharge of pollutive effluents to the Shitalakhya river. NCC shall link this requirement to all permits it issues to all the industries within the city; • In relation to (i) above, liaise and coordinate with DOE to control the pollution of Shitalakhya river, and it particular to prevent disposal of untreated / partially treated industrial wastewater into the river. Consistent with DOE's requirements, NCC may take into consideration the requirement of establishing/constructing and effective operation of an appropriate ETP for each industry; and • Create public awareness on the need to conserve Shitalakya river and improving its water quality.	NCC	NCC
4.2 Groundwater Quality	The operation of the WTP could lead to pollution of groundwater due to potential seepage of chemicals and untreated wastewater from the WTP site. Likewise, in the case of landfilling option for treated sludge, the operation of a landfill site could also lead to pollution of the groundwater due to seepage of leachate.	DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following: • Store fuel, oil and other chemicals in secure, managed areas with lined impervious floors and bunded with 110% by volume; • Ensure that temporary storage are for the dried sludge at the WTP compound is lined with impervious materials; • Conduct ground water quality monitoring in the area per monitoring plan; • In case when disposal is an option for sludge management, undertake operation and maintenance at the sludge disposal site to ensure that: o Impervious lining is in place and maintained, o Sludge is properly spread and compacted, o Sludge volume is within capacity limit of the disposal site, and o Storm water canal around the sludge disposal site is installed and working properly;	DBO Contractor /NCC	NCC

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		• Identify new sludge disposal site in anticipation of full capacity utilization of existing disposal site. Site selection should consider all criteria presented in this environmental management plan; and • Undertake environmentally responsible site rehabilitation and bio-remediation works on fully utilized sludge disposal sites. •		
4.3 Ambient Air Quality	Emissions from the various operating components of the WTP including other equipment and vehicles at the site could contribute to the degradation of ambient air quality in the area.	DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following: • Regular maintenance of all WTP components; • Regular maintenance of other equipment and vehicles to ensure compliance with national emissions standards; • Prohibit burning of any liquid or solid wastes; and • Conduct ambient air quality monitoring at strategic locations per monitoring plan. Ensure that sampling locations are based on the wind and dust/smoke dispersion direction at the site.	DBO Contractor /NCC	NCC
4.4 Noise Level	The operation of the WTP and repair works at any of the DTWs, OHTs and distribution pipelines are potential source of noise that could impact both the workers and the surrounding communities. These sources of noise could be from operating machineries and equipment, and/or maintenance works at the site.	DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following: • Provide prior information of the scheduled noise-intensive maintenance works to nearby residents; • Use silencers for all equipment; • Maintain maximum of noise level of 45 dB(A) at the nearest residence relative to the specific worksite; • Conduct noise level monitoring per monitoring plan. Ensure to conduct sampling during peak period of operation. Important areas to test are at locations nearest the community residents; • If using generators, use generator set with capacity just enough for the electricity needs; • Ensure generator set complies with the noise standards; and • Ensure generator set has acoustic enclosure and silencer (if necessary) in the exhaust muffler.	DBO Contractor /NCC	NCC
4.5 Waste Generation	Operation of the WTP will generate wastes that may accumulate at the WTP site and immediate vicinity. Indiscriminate disposal of these wastes will cause pollution to the	The DBO Contractor of the WTP will be required to implement a Waste Management Plan that will be followed in handling and disposing wastes generated during O&M activities. This includes management on the disposal of spent chemicals	DBO Contractor /NCC	NCC

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
	immediate environment and deteriorate aesthetics in the areas affected.	used in the water treatment plant and all other solid wastes generated at the site. The waste management plan should comply with all the relevant government rules and regulations.		
4.6 Community Health and Safety	Operational failure due to malfunction of components or excessively poor quality of raw water or sabotage on the operation of the WTP, DTWs, OHTs and pipelines, could lead to degradation of drinking water quality and disruption on the continuous supply of drinking water to the residents of NCC. Neighboring community is likely to be temporarily disrupted due to hazards brought about by malfunctioning water supply system. Hazards may also be expected during maintenance works.	DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following: • Follow international best practices on community health and safety such as those in World Bank EHS Guidelines on Water and Sanitation. The following should be included: ○ Ensure that treatment capacity is adequate to meet anticipated demand; ○ Construct, operate and maintain the WTP in accordance with national requirements and internationally accepted standards[50] to meet national water quality standards or, in their absence, WHO Guidelines for Drinking Water Quality;[51] ○ Evaluate the vulnerability of the WTP, DTWs and OHTs and implement appropriate security measures, such as: ▪ Background checks of employees; ▪ Perimeter fencing and video surveillance with the compounds; ▪ Improved electrical power feeds to the facilities; and ▪ Redundant electrical power systems significantly reduce the vulnerability risk to essential operations; • In case of excessively poor quality of raw water that is beyond the limits the WTP is designed for, the DBO Contractor, in consultation with NCC through PMU and MDSC, shall immediately shut down the WTP to ensure no damage can occur in the various components and avoid delivering partially treated water into the distribution lines. Under this scenario, the DBO Contractor, under the supervision of NCC through PMU and MDSC, shall undertake drinking water rationing to all affected households in the NCC area. To ensure	DBO Contractor /NCC	NCC

[50] See, for example, American Water Works Association Standard G100-05: Water Treatment Plant Operation and Management.
[51] Refer to the WHO website at http://www.who.int for the most recent version of the Drinking Water Guidelines.

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		effective dissemination of information as to the occurrence of such incident and the scheduling of water rations, DBO Contractor shall use all platforms of communication (TV, radio, internet, social media). The DBO Contractor shall also provide the necessary information as to when the water supply can be normalized; • The stability and integrity of the system will be monitored periodically to detect any problems and allow remedial action if required. Recurrence of pipe bursts and leakage problems can be managed by the leak detection, rectification and water auditing surveys. NCC, as the operator of the water supply system, will be required to ensure that the leak detection and rectification time is minimized; • For any excavation works related to these O&M issues, the methodologies and protocols developed for the construction phase (see Table 43) shall be strictly followed; and • Noise abatement measures developed for the construction phase shall be strictly followed.		
4.7 Occupational Health and Safety	Health and safety issue in water supply operations arise from the management of the WTP components, handling of chemicals, and/or maintenance works on the WTP, DTWs, OHTs and pipelines, among others. Staff and workers are also at risk of accidents due to moving vehicles, and other unit operations at these facilities. Staff and workers are also exposed to high level of pollution from exhaust of vehicles and machinery, and noise. Further, extended working hours of these personnel could lead to risk of accidents due to fatigue. With the experience during the COVID19 pandemic, clustering and gathering of workers can easily trigger spread of	DBO Contractor will develop and implement an O&M Manual that will include mitigation measures, such as, among others, the following: • All relevant provisions of the Bangladesh Labour Act, 2006 (and its 2013 amendment) and any of its amendments, and relevant WHO guidelines; • Follow international best practices on occupational health and safety such as those in Section 4.2 of World Bank EHS Guidelines on Water and Sanitation,[52] which include the following elements, whichever are applicable: o Accidents and Injuries ▪ 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;	DBO Contractor / NCC	NCC

[52] IFC World Bank Group. 2007. https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines/watersanitation_firstconsultation

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
	diseases. Such a situation is dangerous and could potentially lead to loss of human lives.	▪ Use PFDs when working near deep water tanks; ▪ 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 hazards; ▪ Implement fire and explosion prevention measures in accordance with internationally accepted standards; ▪ When installing or repairing components adjacent to roadways, implement procedures and traffic controls, such as: • 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 vehicles; and ▪ Locate all underground utilities before digging. o Chemical Exposure and Hazardous Atmospheres ▪ Implement a training program for the WTP operator and other workers of the whole water supply system, who handle 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;		

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		▪ 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); ▪ If applicable, conduct radiation surveys at least annually, especially in areas where radionuclides are removed; ▪ Limit wastes entering the sewer system; ▪ Ventilate enclosed processing areas and ventilate equipment, such as pump stations, prior to maintenance. ▪ Use personal gas detection equipment while working in confined space; ▪ 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, particularly in enclosed spaces. 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; and ▪ Rotate personnel among the various WTP operations to reduce inhalation of air-stripped chemicals, aerosols, and other potentially hazardous materials. • For potential encounter and handling of AC pipes during abandonment of the old pipeline network, and re-alignment and reconnection works to the household meters, follow the protocols in the AMP		

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		developed for the subproject during the pre-construction phase. Among others, the comply with the following: o Existing AC pipes, where intact, shall be left in-situ and not disturbed. Where the AC pipe is damaged and where there is a risk of asbestos particles becoming airborne, the NCC (or any other operator in the future) shall follow all necessary procedures in the AMP; o Ensure all personnel and laborers are trained to enable them understand health risks associated with asbestos from AC pipes, how to identify AC pipes, and how to properly handle AC pipes based on the AMP it developed for the subproject; and o Maintain an updated record of AC pipe alignments identified or encountered since the start of implementing the subproject. This record shall be kept as official record and may be used as reference by NCC management. Other development projects may be implemented elsewhere the city and this record will provide NCC with accurate information as to the locations of the AC pipes, which should not be disturbed or destroyed during any of these development activities in the future. • Follow established occupational health and safety protocol on infectious diseases such as COVID-19; and • Provide regular health check-ups, sanitation and hygiene, health care, and control of diseases for the workforce.		
4.8 Discharge of Chlorinated Flushing Water	Chlorinated water discharge due to flushing and disinfection of pipeline by chlorine may affect aquatic organisms and plants by altering reproduction rates, increasing species mortality, and changing the characteristics of the entire local ecosystem. In addition, as chlorine filters down to the water table, it can stress plant respiration and change the quality of drinking water.	DBO contractor must dechlorinate the flushing using PMU approved agents such as sodium thiosulphate, sodium ascorbate or hydrogen peroxide etc. Free chlorine residual (FCR) measurements of the discharge water must be taken to confirm at least <0.2 mg/L residual chlorine (as per ECR, 2023 drinking quality standard) levels to verify 192verall192nt192ion. However, dechlorinated water should be discharged to the approved outlet which can handle the amount of discharge without overflow. On the other hand, an alternative method	DBO Contractor / NCC	NCC

Project Activity/ Field	Impacts	Mitigation Measures	Responsibility	
			Implementation	Monitoring
		is to capture the disinfected water and contain it on site to allow the chlorine to dissipate. A minimum of 2 days containment period, including exposure to sunlight, is recommended before the water can be discharged to the environment, but not before FCR measurements of the discharge water have been taken to confirm at least < 0.2 mg/L residual chlorine.		

D. Capacity Building

301. In order to ensure smooth implementation and monitoring of the EMP, it is important that all key implementation stakeholders have the necessary capacity and knowledge about the requirements of ADB SPS and relevant government environmental laws, rules and regulations. The MDSC Environmental Specialist will train and assist key stakeholders, particularly NCC and PMU, in developing the capacity. An indicative training program outlined below will be utilized by the MDSC Environment Specialist in the conduct of training.

302. The proposed capacity building program will include:

(i) sensitization of NCC and PMU staff and stakeholders on environmental management, including on the ADB, and Government of Bangladesh requirements on environment;
(ii) capacity building programs to improve the capability of environment staff at all levels in carrying out/monitoring and implementing environmental management measures for the subproject; and
(iii) capacity building programs on environmental issues including quality monitoring.

303. The MDSC 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 skills set will be devised after assessing the capabilities of the members of the Training Program and the requirements of the subproject. 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 table below.

Table 47: Training Modules for Environmental Management

Program	Description	Participants	Form of Training	Duration	Trainer /Agency
Introduction and sensitization to environment issues	Sensitization on environmental concerns Environmental impacts of water supply projects, drainage projects, and urban developments such as green space and parks improvements. Environmental regulations of the Government and ADB SPS Coordination between departments for	NCC engineers / management team, officials responsible for implementing the overall project and subprojects, and other NCC Officials and PMU Environmental Safeguards Officer Contractors (both DBO contractors and civil works contractors)	Workshop	One-day workshop during construction	MDSC Environment Specialist

Program	Description	Participants	Form of Training	Duration	Trainer /Agency
	implementation of environmental issues.				
Training on hazards, health, safety and environmental issues pertaining to the overall project and subprojects.	Sensitization and training for engineering and management professionals, to be involved in on-site execution and operation of the overall project and subprojects. Special training on handling and disposal of asbestos-containing materials such as asbestos cement pipes. Special training on testing, handling and disposal of sludge from WTP operations.	NCC engineers/ Management Team, PMU Environmental Safeguards Officer Contractors (both DBO contractors and civil works contractors)	Workshops, site visits	Two days before and during construction	MDSC Environment Specialist and Health and Safety Specialist Asbestos Expert (may be hired by MDSC as resource person during the training) Hazardous Materials Management Expert (may be hired by MDSC as resource person during the training)
EMP implementation	Implementation of EMP Identification of environment impacts Monitoring and reporting for EMP Public interactions and consultations Coordination for consents with various departments	NCC engineers, officials responsible for implementing the overall project and subprojects, and other NCC Staff, PMU Environmental Safeguards Officer Contractors (both DBO contractors and civil works contractors)	Lectures and field visit	Two-day session at construction stage	MDSC Environment Specialist

Program	Description	Participants	Form of Training	Duration	Trainer /Agency
	Monitoring formats, filling and review of impacts				

IX. MONITORING AND REPORTING

304. NCC through the PMU will monitor the progress of EMP implementation. The PMU, with support from MDSC, will undertake site inspections and document review to verify compliance with the EMP and progress toward the final outcome. The DBO Contractor will conduct day to day implementation of the SEMPs.

305. The DBO 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 DBO Contractor's EHS manager (or equivalent) on a daily basis. A sample daily monitoring sheet which can be used by the DBO Contractor is in Appendix 17. This monitoring sheet is indicative which can be further enhanced depending on the actual situations at construction sites.

306. PMU, with support from MDSC, shall also conduct its own monitoring activities consistent with the indicators in the EMP to confirm that all environmental safeguard measures are properly implemented at the subproject site, including in the surrounding communities. A sample monitoring sheet which can be used by PMU or MDSC is in Appendix 18. Similarly, this monitoring sheet is indicative which can be further enhanced depending on the actual situations and other needs of information during the implementation phase.

307. PMU, with support from MDSC, shall consolidated its own findings with the reports from the contractors. Based on consolidated information, PMU shall accomplish semi-annual environmental monitoring reports (SEMRs) for the overall project, 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 available in the Project Administration Manual.

308. ADB will carry out the following monitoring actions to supervise the subproject:

(i) On a need basis, conduct visits when potential adverse environmental or social impact exists;
(ii) Conduct supervision missions with detailed review by ADB's environment/social safeguard specialists and/or officers and/or consultants for components 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 PMU 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.

309. ADB's monitoring and supervision activities are carried out on an on-going basis until a project completion report is issued. ADB issues completion report within 1-2 years after the project is physically completed and in operation.

Table 48: Environmental Quality Monitoring Plan[a]

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards	Responsibility	
						Implementation	Monitoring
1. Design / Pre-Construction Phases							
1.1	Air Quality Sampling	PM2.5, PM10, Sox, Nox, CO	Subproject sites (WTP, DTWs, OHTs, transmission/ distribution lines)	At least once for each site	National Ambient Air Quality Standards	DBO Contractor or through a nationally recognized laboratory sourced by DBO Contractor	PMU, MDSC
1.2	Noise Level Measurement	Noise levels at daytime and night time in dBA	Subproject sites (WTP, DTWs, OHTs, transmission/ distribution lines)	At least once for each site	National Noise Level Standards	DBO Contractor or through a nationally recognized laboratory sourced by DBO Contractor	PMU, MDSC
.1.3	Surface Water Quality (Shitalakhya river)	BOD, TSS, oil and grease, fecal coliform	Upstream and downstream of Shitalakhya river relative to the locations of the subproject sites	At least once	National Standard for Inland Surface water	DBO Contractor or through a nationally recognized laboratory sourced by DBO Contractor	PMU, MDSC
1.4	Groundwater quality (for construction and drinking purposes)	Groundwater level, All drinking water quality standards	Subproject sites (WTP, DTWs, OHTs, transmission/ distribution lines)	At least once for each site	National Drinking Water Quality Standard	DBO Contractor or through a nationally recognized laboratory sourced by DBO Contractor	PMU, MDSC
2. Construction Phase							
2.4	Air Quality Sampling	PM2.5, PM10, Sox, Nox, CO	Subproject sites (active construction areas)	At least once every six months throughout the construction period.	National Ambient Air Quality Standards	DBO Contractor or through a nationally recognized laboratory sourced by DBO Contractor	PMU, MDSC
2.5	Noise Level Measurement	Noise levels at daytime and night time in dBA	Subproject sites and vicinities (relative to active construction areas)	At least once every six months with daytime and night time readings,	National Noise Level Standards	DBO Contractor or through a nationally recognized	PMU, MDSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards	Responsibility	
						Implementation	Monitoring
				throughout the construction period.		laboratory sourced by DBO Contractor	
2.6	Groundwater quality (for construction and drinking purposes)	Groundwater level, All drinking water quality standards	Groundwater source at the subproject sites (if any) (active construction areas)	At least once every six months throughout the construction period	National Drinking Water Quality Standard	DBO Contractor or through a nationally recognized laboratory sourced by DBO Contractor	PMU, MDSC
2.7	Surface Water Quality (Shitalakhya river)	BOD, TSS, oil and grease, fecal coliform	Upstream and downstream of Shitalakhya river relative to the locations of the subproject sites	At least once in six months	National Standard for Inland Surface water	DBO Contractor or through a nationally recognized laboratory sourced by DBO Contractor	PMU, MDSC
3. Operation Phase							
3.1	Air Quality Sampling	PM2.5, PM10, Sox, Nox, CO	WTP Site and Vicinity	At least once every six months throughout the operation period.	National Ambient Air Quality Standards	DBO Contractor (DBO contract period) or NCC/PMU (after turnover); or through a nationally recognized laboratory sourced by ongoing operator	PMU, MDSC
3.2	Noise Level Measurement	Noise levels at daytime and night time in dBA	WTP Site and Vicinity	At least once every six months with daytime and night time readings, throughout the operation period.	National Noise Level Standards	DBO Contractor (DBO contract period) or NCC/PMU (after turnover); or through a nationally recognized laboratory sourced by ongoing operator	PMU, MDSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards	Responsibility	
						Implementation	Monitoring
3.3	Groundwater quality (for construction and drinking purposes)	Groundwater level, All drinking water quality standards	WTP Site and Vicinity	At least once every six months throughout the operation period	National Standard for Drinking water	DBO Contractor (DBO contract period) or NCC/PMU (after turnover); or through a nationally recognized laboratory sourced by ongoing operator	PMU, MDSC
3.4	Surface Water Quality (Shitalakhya river)	BOD, TSS, oil and grease, fecal coliform	Upstream and downstream of Shitalakhya river relative to the locations of the WTP site	At least once every six months throughout the operation period	National Standard for Inland Surface water	DBO Contractor (DBO contract period) or NCC/PMU (after turnover); or through a nationally recognized laboratory sourced by ongoing operator	PMU, MDSC
	Sludge Quality	Sludge volume Index (SVI), sludge quality (incl. presence of Heavy metals), pH, fecal coliform, helmiths	Sampling location at sludge drying bed at the WTP site.	At least once in six months	Bangladesh Standards and Guidelines for Sludge Management.	DBO Contractor (DBO contract period) or NCC/PMU (after turnover); or through a nationally recognized laboratory sourced by ongoing operator	PMU, MDSC

[a] All environmental quality sampling should follow methodologies and sampling periods per relevant rules and/or guidelines (ambient air quality, noise level, and water quality)

Table 49: EMP Implementation Monitoring Plan

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards or Methods	Responsibility	
						Implementation	Monitoring
1. Design / Pre-Construction Phases							
1.1	Design measures addressing risks of climate change	Design elements included to ensure infrastructure can withstand seismic events, flooding, landslides, etc. On DTWs, siting and depths considered climate change.	PMU / MDSC Office / DBO Contractor Office	Once after final detailed design is completed	Bangladesh National Building Code	MDSC / DBO Cotractor	PMU
1.2	Raw Water Source Quality Sustainability	The upgrading of the WTP includes additional treatment process in order to reduce the high organic and inorganic load of the raw water.	DBO Contractor Office	Once after final detailed design is completed	Final detailed design	DBO Contractor	PMU/ MDSC
1.3	Design phase consideration for an environmentally effective and efficient operation	O&M Manual preparation is initiated and/or prepared	DBO Contractor Office	Once during detailed design phase	O&M Manual draft	DBO Contractor	PMU/ MDSC
1.4	Disruption of Public 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 sites	Monthly – prior to start of construction	Utility relocation plan	PMU/DBO Contractor (together with relevant utility authority)	PMU, MDSC
1.5	Planning for ACMs	ACM Planning requirement is included in the bidding and contract documents	PMU / MDSC Office,	On ongoing basis prior to floating of bidding documents Once prior to contract award	Bidding Documents Contract Documents	MDSC	PMU

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards or Methods	Responsibility	
						Implementation	Monitoring
		ACM prepared by DBO Contractor following requirements in the EMP/IEE.	DBO Contractor Office	On ongoing basis during detailed design phase	ACM Plan draft	DBO Contractor	PMU/ MDSC
1.6	Spoil disposal site identification	Spoil disposal site identified and corresponding clearance (or equivalent) is obtained.	PMU / MDSC Office,	On ongoing basis prior to contract award	Written confirmation of disposal site location. Clearance (or equivalent) issued.	MDSC	PMU
1.7	Sludge management and disposal	Sludge Management Plan is prepared based on the requirements of or options provided in the EMP/IEE.	DBO Contractor Office	On ongoing basis during detailed design phase	Sludge Management Plan draft	DBO Contractor	PMU/ MDSC
1.8	Physical cultural resources	Condition for DBO Contractor to follow the chance finds protocol as discussed in the EMP/IEE are included in the bidding and contract documents.	PMU / MDSC Office,	On ongoing basis prior to floating of bidding documents On ongoing basis prior to contract award	Bidding Documents Contract Documents	MDSC	PMU
1.9	Tree Removal	Check whether trees were preserved at the sites	For all the subproject areas	On an ongoing basis from start of mobilization to construction phase.	IEE requirement (avoidance of cutting of trees)	DBO Contractor	PMU, MDSC
1.10	Consents, Permits, NOCs, Clearances, etc.	All valid permits, clearances and NOCs, are in place during the detailed design or pre-construction phase at the latest.	PMU / MDSC Offices, DBO Contractor office or site office	Ongoing basis; prior to start of construction	Copies of permits, clearances and NOCs.	PMU, MDSC, DBO Contractor	PMU, MDSC
1.11	Updating of IEE and Preparation of SEMPs and all pre-construction sub-plans	Updated IEE based on final detailed design has been done. SEMP and all sub-plans per EMP/IEE requirements have been prepared by DBO Contractor and approved by PMU/MDSC	DBO Contractor Office	On ongoing basis during detailed design phase	Updated IEE report Approved SEMP Approved sub-plans	DBO Contractor	PMU/ MDSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards or Methods	Responsibility	
						Implementation	Monitoring
1.12	Construction camps or workers' accommodation	Construction camps are established or built following standard requirements and recommendations in the EMP/IEE.	Construction camp sites	At least weekly or may be needed	EMP (including standards per IFC and EBRD; and Sewage Facility Design)	DBO Contractor	PMU, MDSC
1.13	Community awareness	Continuing consultations done per EMP requirements	DBO Contractor Office	On ongoing basis during detailed design phase	Reports of consultations done	DBO Contractor	PMU/ MDSC
1.14	EMP Implementation Training	EMP implementation training to DBO Contractors, workers and NCC personnel has been conducted prior to construction works.	MSDC Office	On ongoing basis during detailed design phase/pre-construction phase	Reports of training done	MDSC	PMU
2. Construction Phase							
2.1	Construction camps or workers' accommodation	Construction camps are maintained based on the EMP/IEE requirements.	Construction camp sites	At least weekly or may be needed	EMP (including standards per IFC and EBRD; and Sewage Facility Design)	DBO Contractor	PMU, MDSC
2.2	Sources of Materials	Materials are sourced per EMP requirements	Storage areas at the different subproject sites	At least once every 6 months for MDSC throughout the construction period.	Materials register or record of purchase by DBO Contractor	DBO Contractor	PMU, MDSC
2.3	Excavation and other construction activities	All mitigation measures for potential impacts arising from excavation and other construction activities as defined in the EMP are implemented effectively and efficiently (see EMP in **Error! R eference source not found.**): - Land topography and aesthetics - Terrestrial flora and fauna resources	Construction camps, work sites (active construction areas)	Daily by DBO Contractor throughout the construction period. At least once every 6 months for MDSC throughout the construction period.	SEMP and other sub-plans, EMP; Complaints register DBO Contractor monthly monitoring reports	DBO Contractor	PMU, MDSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards or Methods	Responsibility	
						Implementation	Monitoring
		- Surface water quality - Groundwater quality - Ambient air quality - Noise level at site and vicinity - Chance finds - Community and occupation health and safety - Local festivals and cultural practices - Grievances/ complaints					
2.4	Socioeconomic benefit	Local labor employment, income level status	Subproject sites	At least once in six months during the construction period.	Primary survey and consultations	MDSC (to be led by the Social Safeguard Officer)	PMU, MDSC
2.5	Community awareness and consultation	Progress of continuing community awareness and consultation	At the community areas and/or subproject sites (active construction areas)	At least once every six months	Minutes of meetings Record of attendees list Photolog	DBO Contractor, MDSC	PMU, MDSC
3. Post-Construction Phase							
3.1	Post-construction site clean up	All post-construction site clean up activities per EMP requirements have been done effectively	All subproject sites	At least once after construction phase but prior to final payment related to construction activities completed.	DBO Contractor monthly reports Related DBO Contractor activity reports	DBO Contractor	PMU, MDSC
4. Operation Phase							
4.1	Surface water quality	All mitigation measures related to protection of surface water body, in particular to Shitalakhya river, per O&M Manual (and EMP) are implemented effectively and efficiently	WTP Site	Daily or as often as possible	O&M Manual; EMP; Sludge Management Plan Complaints register Other contract provisions (DBO contract period)	DBO Contractor (DBO contract period) NCC/PMU (after turnover of facilities)	MDSC, NCC-PMU

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards or Methods	Responsibility	
						Implementation	Monitoring
4.2	Groundwater quality	All mitigation measures related to protection of groundwater per O&M Manual (and EMP) are implemented effectively and efficiently	WTP Site DTW Sites	Daily or as often as possible	O&M Manual; EMP; Sludge Management Plan Complaints register Other contract provisions (DBO contract period)	DBO Contractor (DBO contract period) NCC/PMU (after turnover of facilities)	MDSC, NCC-PMU
4.3	Ambient air quality	All mitigation measures related to avoidance or minimization of air pollution per O&M Manual (and EMP) are implemented effectively and efficiently	WTP Site DTW Sites	Daily or as often as possible	O&M Manual; EMP; Complaints register Other contract provisions (DBO contract period)	DBO Contractor (DBO contract period) NCC/PMU (after turnover of facilities)	MDSC, NCC-PMU
4.4	Noise level	All mitigation measures related to avoidance or minimization of noise pollution per O&M Manual (and EMP) are implemented effectively and efficiently	WTP Site DTW Sites OHT Sites	Daily or as often as possible	O&M Manual; EMP; Complaints register Other contract provisions (DBO contract period)	DBO Contractor (DBO contract period) NCC/PMU (after turnover of facilities)	MDSC, NCC-PMU
4.5	Waste Management	Check storage, transportation, disposal, handling of all types of wastes (e.g., empty chlorine containers, packaging materials, engine filters, other garbage, etc.) at the WTP Site.	WTP Site	At least weekly (for DBO Contractor) At least once in six months (for MDSC)	O&M Manual; EMP; Complaints register Other contract provisions (DBO contract period)	DBO Contractor (DBO contract period) NCC/PMU (after turnover of facilities)	PMU, MDSC
4.6	Community and Occupational Health and Safety	Complaints, Accident/Incident Records	WTP Site and all active sites with repair and maintenance works.	On an ongoing basis.	O&M Manual; EMP; Complaints register Other contract provisions (DBO contract period) No accident records	MDSC, DBO Contractor	PMU, MDSC
4.7	Discharge of Chlorinated Flushing Water	Activity and chlorine test reports	Treated water discharge points prior to OHTs.	At least once during commissioning stage.	Laboratory analysis	MDSC, DBO Contractor	PMU, MDSC

Sl. No.	Monitoring Attributes	Parameters to be Monitored	Location	Frequency	Standards or Methods	Responsibility	
						Implementation	Monitoring
			Newly installed OHTs Distribution oines				

A. Environmental Budget

310. Costs for implementing the EMP in this IEE report include monitoring costs during construction and capacity building costs on environmental management, which are absorbed into the DBO Contractor's work contract. The costs for training proposed include the costs incurred toward site visits, travel to the training program by participants, printing of training materials, and other logistic arrangements. The costs involved towards preparation of training material and training are covered in the consultancy budget for the MDSC. These costs are presented in table below.

311. The cost estimates mentioned in table below are indicative amounts. These shall be reviewed by the DBO Contractor, and assessed if enough for implementing the EMP. Any budget shortfall, including other necessary measures identified during the implementation phase, shall be supplemented from the provisional sum of the DBO Contractor's contract.

312. As such, these costs must be included in the Contract documents along with a copy of IEE. The EMP implementation shall be integrated into the Project Administration Manual (PAM).

Table 50: Cost Estimates to Implement the EMP[a]

Particulars	Stage	Unit	Total number	Rate (BDT)	Cost (BDT)	Costs covered by
Mitigation Measures						
Environmental mitigation / enhancement measures integrated into the designs and costs included as part of civil works, including OHS measures[b]	Pre-construction / Construction	year	6	1,085,000	6,510,000	DBO Contractor
Sub-Total (A)					6,510,000	
Monitoring Measures						
Air Quality monitoring	Pre-Construction Phase	Lump sum	-	-	200,000	DBO Contractor
Air Quality monitoring	Construction Phase	Lump sum	-	-	1,000,000	DBO Contractor
Noise level	Pre-Construction Phase	Lump sum	-	-	10,000	DBO Contractor
Noise level	Construction Phase and Operation Phase	Lump sum	-	-	100,000	DBO Contractor
Water Quality monitoring	Pre-Construction Phase	Per location	2	15,000	30,000	DBO Contractor
Water Quality monitoring	Construction Phase and	Per location	40	15,000	600,000	DBO Contractor

Particulars	Stage	Unit	Total number	Rate (BDT)	Cost (BDT)	Costs covered by
	Operation Phase					
Sludge Quality monitoring	Operation Phase	Per sampling	10	15,000	150,000	DBO Contractor
Various Monitoring (Adequacy of solid waste management system, chemical and waste disposal, implementation of community and occupational health and safety measures)[d]	Construction, Post construction and operation	Lump sum	-	-	200,000	DBO Contractor / PMU
Sub-Total (B)					2,290,000	
Capacity Building						
Introduction and sensitization to environmental issue	Preconstruction	Lump sum	-	-	50,000.00	MDSC
Training on hazards, health, safety, and environmental issues	Preconstruction	Lump sum	-	-	100,000.00	MDSC
EMP implementation	Construction	Lump sum	-	-	100,000.00	MDSC
Sub-Total I					250,000.00	
Total (A+B+C)					**BDT 8,800,000** **BDT 250,000**	DBO Contractor MDSC
Total (in $) @ BDT108.50 per $					**$ 81,106.00** **$ 2,304.15**	DBO Contractor MDSC

[a] Assuming implementation period by the DBO Contractor is 10 years from 2024 – 2034. After implementation period by the DBO Contractor, all mitigation and monitoring measures for the operation phase shall be continued by NCC.

[b] This line item should include OHS-related costs as applicable: (i) PPEs for general construction works, (ii) PPEs for excavation works and works at heights and confined spaces, (iii) barricading, (iv) related training, (v) audits, (vi) emergency handling and specialized equipment, (vii) installation and maintenance of welfare facilities, (viii) equipment inspection and tagging, (ix) medical fitness of personnel and workers, and (x) human resources on EHS/OHS (e.g. EHS Supervisor or equivalent). Indicative list that DBO Contractor should consider is in Appendix 17.

[c] This sludge quality testing activity should be a continuing activity of the operator during the entire lifetime of WTP operation. However, for purposes of this IEE, costing is estimated for 5 years only.

[d] NCC may utilize general checklists developed for monitoring contractor's activities, such as implementation of EMP, including OHS measures. See Appendix 18.

X. CONCLUSIONS AND RECOMMENDATIONS

313. It is envisaged that the proposed subproject will contribute to providing reliable, sustainable, and inclusive urban services in NCC, the fourth most populated city in Bangladesh and one of the major growth engines of the country being adjacent to Dhaka and a vital transport hub. Once implemented, the subproject will have direct benefits to the people of NCC with a reliable and sustainable piped drinking water supply.

314. The IEE for this subproject has been undertaken based on the location of the WTP, DTWs, OHTs, and distribution network; and on conceptual design prepared for the rehabilitation and upgrading of the WTP. The baseline environmental conditions have been gathered with respect to the subproject locations and NCC as a whole, and all potential impacts to the environment as a result of implementing the subproject have been identified. Based on these impacts, corresponding mitigation measures have been developed and compiled in the EMP.

315. The abstraction of raw water from Shitalakhya river will be maintained at the original design capacity of 45 MLD, and no additional abstraction will be made as a result of the rehabilitation and upgrading of the WTP. The source sustainability assessment revealed that abstraction of 45 MLD by the WTP will not have any adverse impact on the users and uses of Shitalakhya river. The rate of abstraction has been considered as negligible as far as the discharge flow of this perennial river is concerned, and that this will not affect the level of the river even during lean season. The assessment on the impact of water quality of Shitalakhya river to the operation of the WTP revealed source quality issue, and necessitates upgrading of the WTP with additional treatment process or component to help reduce the relatively high pollution load. The moving bed biofilm reactor (MBBR) has been the chosen technology to solve this issue. Per conceptual stage feasibility assessment, the MBBR is an appropriate additional technology for the WTP to ensure treated water comply with the standards. The ultimate design for the upgrading of the WTP will be finalized during the detailed design stage.

316. The upgrading of the WTP will also include improvement of the sludge management system. The system will adopt a zero-discharge scheme and the dried sludge will be disposed properly following international best practices on sludge handling and disposal.

317. Overall, the full IEE process confirms that the subproject is unlikely to cause significant adverse impacts considered as diverse, irreversible and unprecedented. The construction phase will only involve straightforward civil works and operation phase will only involve common or traditional maintenance works for water supply infrastructures, so impacts will be mainly localized. These impacts can be mitigated to standard levels without difficulty through proper engineering design and the incorporation or application of recommended mitigation measures and procedures in the EMP and O&M manual. On a positive note, the IEE process also confirms the beneficial impacts of the subproject over the long term, with a reliable and sustainable piped drinking water source for the people of NCC.

318. During the detailed design phase, the DBO Contractor shall prepare the following required work plans, whichever are applicable, and submit to NCC, through the PMU or MDSC, for approval. No works shall commence until any relevant or required work plan is approved.

(i) ACM/Asbestos Management Plan;
(ii) Traffic Management Plan;
(iii) Spoil Management Plan;

(iv) Waste Management Plan, which shall include the final specific location for dried sludge disposal; and
(v) Health and Safety Plan (Community and Occupational).

319. In addition, during the detailed design phase, DBO Contractor for Water Supply Contract 1, in consultation and collaboration with MDSC, shall initiate the development of an O&M Manual. The development of the manual may extend towards the construction phase, but shall be completed prior to the operation phase to provide sufficient time to train all personnel on the effective and efficient operation of the WTP based on the O&M Manual.

320. This IEE needs to be updated during the detailed design phase to reflect the final design ensuring the compliance with the design measures suggested in this document. The updated IEE shall be submitted to ADB for review, clearance and disclosure during detailed design phase but prior to start of construction. The cleared updated IEE shall be treated as the final IEE. No works can commence until (i) the final IEE cleared by ADB is provided to the DBO Contractors, and (ii) the SEMP, including other work plans, prepared by the DBO Contractors, is approved by PMU. If circumstances would require, the IEE will be further updated for ADB's review during the implementation period. In the event of unanticipated impact and/or any design change and/or non-compliance during subproject implementation period, the IEE shall be updated to include (i) assessment of the unanticipated impact and corresponding mitigation measures; and/or (ii) information on the design change and assessment of associated environmental impacts, if any; and/or (iii) corrective actions, associated cost and schedule; respectively. Further, the PMU shall:

(i) Include this IEE in the bidding and contract documents;
(ii) Obtain all statutory clearances and ensure relevant conditions or requirements are incorporated in the detailed design;
(iii) Update/revise this IEE based on detailed design and/or if there are unanticipated impacts or significant change in scope in any component of the subproject;
(iv) Conduct safeguards induction to the DBO Contractors after award of contract;
(v) Ensure DBO Contractors appoint their respective qualified environment, health and safety (EHS) officer prior to start of works;
(vi) Disclose information and establishment of GRM in a timely manner;
(vii) Strictly supervise EMP implementation;
(viii) Continue consultations with stakeholders; and
(ix) Monitor and report status of implementation of the EMP on a regular basis as indicated in the IEE.