Updated Environmental Impact Assessment (EIA) Report for Dhaka Mass Rapid Transit Development Project (MRT Line-1)

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Dhaka Mass Transit Company Limited

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PREFACE

Dhaka Mass Transit Company Ltd (DMTCL) is now implementing Dhaka Metro Rail MRT Line 1 Project. The initial Environmental Impact Assessment (EIA) report of the Project was prepared in 2017 under the Feasibility Study of the project. Based on the report, an Environmental Clearance Certificate (ECC) for the Project was issued by the Department of Environment (DoE) on 05th November 2017. Later, the ECC was renewed on an annual basis. The latest renewal of ECC was issued on 15th November 2020 which is valid until 04th November 2021.

Since the project has now entered into detailed design stage and many of the project components and elements have now been specified and confirmed, an updated version of the EIA report has been prepared (this report). This version of the report supersedes the 2017 EIA report and it will be submitted to DoE for further renewal of ECC.

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ABBREVIATIONS

ADB	:	Asian Development Bank
AIDS	:	Acquired Immunodeficiency Syndrome
AQI	:	Air Quality Index
BDT	:	Bangladesh Taka
BICC	:	Bashundhara International Convention Center
BLT	:	Ballastless Track
BMD	:	Bangladesh Meteorological Department
BOD	:	Biochemical Oxygen Demand
BR	:	Bangladesh Railway
BRT	:	Bus Rapid Transport
BUET	:	Bangladesh University of Engineering and Technology
CCL	:	Cash Compensation under Law
CEMP	:	Construction Environmental Management Plan
COD	:	Chemical Oxygen Demand
COVID	:	Coronavirus Disease
DC	:	Deputy Commissioner
DG	:	Director General
DHUTS	:	Dhaka Urban Transportation Network Development Study
DMA	:	Dhaka Metropolitan Area
DMRTDP	:	Dhaka Mass Rapid Transit Development Project
DMTCL	:	Dhaka Mass Transit Company Limited
DNCC	:	Dhaka North City Corporation
DO	:	Dissolved Oxygen
DOE	:	Department of Environment
DPP	:	Development Project Proposal
DSCC	:	Dhaka South City Corporation
DTCA	:	Dhaka Transport Coordination Authority
DWASA	:	Dhaka Water and Sewage Authority
EC	:	Electric Conductivity
ECC	:	Environmental Clearance Certificate
ECR	:	Environment Conservation Rules
ECS	:	Environmental Construction Specifications
EHS	:	Environment Health Safety
EIA	:	Environmental Impact Assessment

EMO	:	Environmental Management Officer
EMP	:	Environmental Management Plan
EQS	:	Environmental Quality Standards
ERR	:	Emergency Response Plan
ES	:	Engineering Service
FST	:	Floating Slab Track
GC	:	General Consultant
GHG	:	Greenhouse Gas
GOB	:	Government of Bangladesh
GRM	:	Grievance Redress Mechanism
HIA	:	Historical Importance and Archaeological
HIV	:	Human Immunodeficiency Virus
IEE	:	Initial Environmental Examination
IMG	:	Independent Monitoring Group
IUCN	:	International Union for Conservation of Nature
JICA	:	Japan International Cooperation Agency
KII	:	Key Informant Interview
LA	:	Land Acquisition
LAP	:	Land Acquisition Plan
MRT	:	Mass Rapid Transit
MSS	:	Mass Spring System
NEMAP	:	National Environmental Management Action Plan
NGO	:	Non-government Organizations
NOC	:	No Objection Certificate
PAP	:	Project Affected Person
PM	:	Particulate Matter
RAP	:	Resettlement Action Plan
RSS	:	Receiving Sub-station
RSTP	:	Revised Strategic Transport Plan
SHICS	:	Sheikh Hasina International Cricket Stadium
SRC	:	Speed Restriction Curves
STP	:	Strategic Transport Plan for Dhaka
TBM	:	Tunnel Boring Machine
TC	:	Total Coliform
TDS	:	Total Dissolved Solid
TSS	:	Total Suspended Solid

UG	:	Underground
UNO	:	Upazila Nirbahi Officer
UP	:	Union Parishad
USA	:	United States of America
USD	:	United States Dollar
USEPA	:	United States Environmental Protection Agency
VPT	:	Vibration Proof Track
WARPO	:	Water Resource Planning Organization
WB	:	World Bank

EXECUTIVE SUMMARY

E1 INTRODUCTION

E1.1 Project Background

A JICA funded study in 2009-10 (known as DHUTS 1) examined the 2005 Strategic Transport Plan (STP) of Dhaka, and MRT Line 6 between Uttara and Motijheel was selected as the preferred route for initial development. A subsequent JICA study (known as DHUTS 2) carried out feasibility of MRT Line 6. STP was revised in 2015 with grant from JICA and approved by the GoB in 2016. According to the Revised Strategic Transport Plan (RSTP), MRT Line 1 and MRT Line 5N was identified as the next priority Project. The feasibility study of the MRT Line 1 was conducted between 2016 and 2018 following the JICA mission in 2016. A preparatory level EIA was prepared at that time and submitted to the Department of Environment (DoE) for Environmental Clearance Certificate (ECC). An Environmental Clarence Certificate (ECC) was issued for the Project.

This project will be implemented through Dhaka Mass Transit Company Limited (DMTCL). A loan agreement for the engineering service (E/S) was signed in 2017 between the Government of Bangladesh (GoB) and the Japan International Cooperation Agency (JICA) for implementation of the Project. A consortium of firms, NKDOS Consortium, has been appointed for basic design, detailed design, preparation of bidding documents, tender assistance, updating of Environmental Impact Assessment (EIA) & Resettlement Action Plan (RAP), preparation of Land Acquisition Plan (LAP), assisting implementation of LAP & RAP, assisting institutional development and utility relocation, and planning of non-rail business strategy design of the Project.

E1.2 Project Status

The project is currently under detailed design phase. A consortium of seven consulting firm, NKDOS Consortium, led by Nippon Koei of Japan, is working as Engineering Services consultant from 9th December 2018. Earlier, the JV of KS Consultants and EQMS Consulting Limited has prepared the EIA for this project. For the detailed design phase, it has been deemed necessary to update the previous baseline data, for future monitoring and comparison during the Construction Phase. For this reason, the EIA has been updated by the Project's E/S consultant, NKDOS Consortium under the direction of DMTCL.

E1.3 Purpose of the Study

The main purpose of the Environmental Impact Assessment (EIA) is to identify, evaluate and report the environmental and socio-economic effects. The process includes identification of mitigative measures that will be used to reduce or eliminate potential adverse effects, where appropriate.

An EIA report was prepared in 2017 under the JICA Feasibility Study for MRT Line-1. Now, the detail design of the project, including alignment, stations, and depot are being prepared. Therefore, an updated version of the report, including a new baseline study is required. This updated version of the report will also serve the purpose of the renewal of ECC from DOE. EQMS Consulting Limited has been contracted by NKDOS Consortium to carry out the study.

E1.4 Methodology

Methodology adopted for the preparation of this updated EIA report are as follows:

- Study of the relevant documents on policy, legal and administrative framework and their review, particularly on environmental aspects and effluent discharge limits, health and safety requirements, identification of sensitive areas and endangered species, land use, land acquisition etc.
- Pilot survey has been conducted to collect baseline information in devised formats;
- Analysis of collected data has been conducted;
- Documenting baseline conditions through environmental monitoring and sampling of the project area;
- Documentation of baseline conditions has been conducted through on-site environmental monitoring and sampling;
- Application of simplified noise modeling to determine the noise level at the receptor due to construction activities and train operation;
- Identification of major project activities, both during construction and operational phases of the project.
- Identification and prediction of environmental impacts of project activities on the surrounding environment
- Identification of the most significant environmental and social impacts and suggestions for mitigation measures in order to reduce/eliminate negative impacts and to enhance positive impacts.
- Arrangement of public consultation meeting and disclosure meeting to consult with potentially affected people as well as community people;
- Development of Environmental Management Plan (EMP) for both construction phase as well as operational phases of the project.

E2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

According to the Section 12 of the Environment Conservation Act 1995, no project can be established or undertaken without obtaining Environmental Clearance Certificate from the Director General, in the manner prescribed by the Environment Conservation Rules 1997. Therefore, every development projects/industry, which are specified under the Schedule–1 of the Environment Conservation Rules 1997, require obtaining site and environmental clearance from the Department of Environment. According to the Rule 7 (1) of the Environment Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project, in consideration of their site and impact on the environment and will be classified into the four categories, i.e. green, orange A, orange B and red. Infrastructure development for MRT Line 1 will fall under the Red category. Thus, EIA study is required to be carried out for the project which have already been carried out and the ECC are being renewed every year since 2017.

In addition to ECC, Other laws and ordinances concerning resettlement, land acquisition and compensation are relevant to the project. The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Act-2017.

E3 PROJECT DESCRIPTION

The MRT Line-1 is comprised of two routes; among them, one route extends from Kamlapur Railway Station to Shahjalal International Airport, whereas another route will be originated from depot and will meet former route near Natun Bazar Station. The Airport line will be a fully underground metro, while the Purbachal line will be constructed as partly elevated and partly underground metro. The Purbachal line will be started from Natun Bazar as underground line and after Kuril it will be elevated line till depot. Total

length of MRT Line-1 will be 29.8 km with 19 stations; among them, 12 will be underground station and 07 will be elevated station. **Figure E-1** is showing the route alignment and the stations for the MRT Line-1 Project. There will be a depot with an area of 39 ha in the eastern end of Purbachal on the bank of Shitalakshya River.

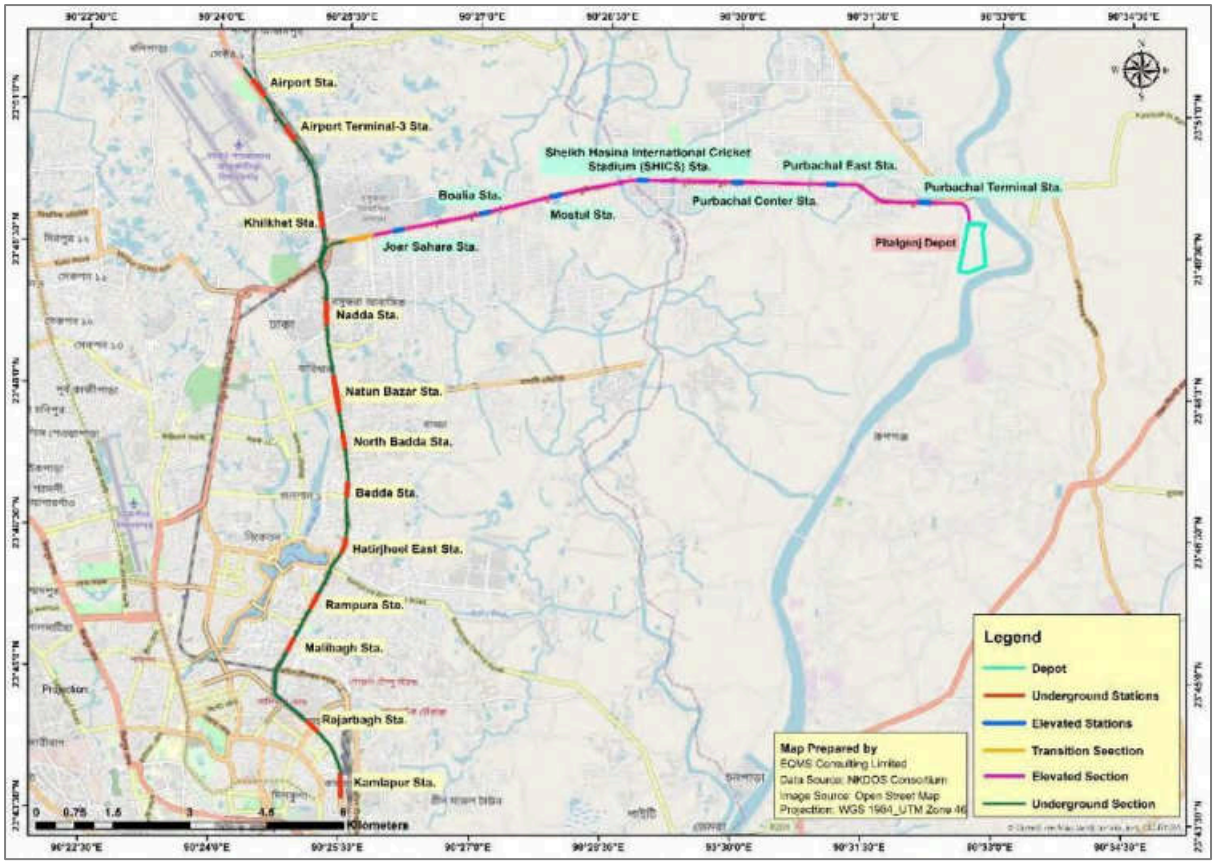


Figure E0-1: Map Showing the MRT Line 1 Alignment with Station Locations

The design of elevated stations will be like the stations of MRT Line-6. The length of the platform of elevated stations will be 180 m (8 cars each 20m, so 160 + 10 at each end). All underground stations will be standard station, except special stations in Malibagh, Natun Bazar and Nadda. All stations will be constructed as open cut method. Inner length and width of a station would be 250 m and 20 m. The standard station will be constructed in the 2 level whereas special station will be constructed in the 3 level. There is a provision of joining the MRT line 1 and MRT line 6 in the Kamlapur station. The vertical depth of the standard station varies from 16 m to 18.6 m whereas special station depth will be up to 28 m.

E4 ENVIRONMENTAL BASELINE DATA

E4.1 Physical Environment

Seismicity: Dhaka city falls in seismic zone II of the seismic zoning map of Bangladesh which means the city is at moderate risk (basic seismic coefficient is 0.5 g).

Topography: The surface elevation of the area Dhaka ranges between 1 and 14 m and most of the built-up areas located at the elevations of 6-8 m.

Land use: Due to rapid urban growth of Dhaka city, Dhaka's land use has been changing since 1967. While the vegetation of area is almost fixed at 70,000 ha in the past 40 years, the current water body reduced to

a quarter since 1967, which is 5,520 ha in 2010 from 206,868 ha in 1967. The built-up area increased by about 5,000 ha in the period of 1989 to 1999 and by 7,500 ha in the period of 1999 to 2010.

Urban Drainage and Water Resource: In recent years, major inundations occurred in 1988 and in 1998, bringing about significant damages to infrastructures. During these inundations, water level in Buriganga River in the western part of Dhaka exceeded 7.0 m. The maximum depth to water table in the central part of the city i.e. Tejgaon and Sabujbagh areas, observed from BWDB piezometers, is about 67 to 57 m below ground surface that is about 55 m at Mirpur and 20-34 m at Mohammadpur, Dhanmondi and Sutrapur areas close to the river periphery.

Climate: The monthly variation of the average maximum temperature is between 39.6°C to 30.1°C. The monthly variation of the average minimum temperature is 22.5°C to 6.5°C. The average monthly rainfall during monsoon (June-September) season from 1980-2013 is 332 mm/month.

E4.2 Ecological Environment

Different tree species, birds, amphibians, reptiles and mammals were found during the initial study in 2017 in the depot area. Bengal Monitor (*Varanus bengalensis)* has been found Near Threatened according to the IUCN red list status 2015 whereas rests of the species are Least Concern.

E4.3 Environmental Quality

An environmental baseline study was conducted during the preparation of initial EIA report in 2017. And a second round of baseline study have been conducted during this updating of the EIA report in 2019-2020. The findings of both studies as well as a comparison of findings in similar locations are available in main part of the report. Here, a brief description of the findings of both studies is given.

Air Quality: In 2017, the concentration of ambient air pollutants was monitored in 06 locations during February-March. Air Monitoring was carried out for seven parameters, including $PM_{2.5}$, PM_{10}, NOx, SO_2, O_3, CO, and Lead. The results show that all the parameters are within permissible limits, except for the concentration of PM_{10}, $PM_{2.5}$ and NO_2. In 2019-2020, the same number of parameters were monitored during the second-round baseline survey. However, the number of monitoring locations were increased to 23. The findings show that the concentration of $PM_{2.5}$ were over standard in most of the locations, while PM_{10} has exceeded the limit in some stations. Rest of the parameters are found within limits. Total 6 monitoring stations are same between initial baseline study and supplementary baseline study. The comparison study shows that the concentrations of particulate matter have been reduced in most of the monitoring locations, except in Joar Sahara Station where the concentration of PM_{10} and $PM_{2.5}$ have increased in supplemental baseline study compared to initial baseline study.

Noise Level: In 2017, the noise level monitoring has been conducted in 09 locations along the alignment. The result indicates that the equivalent noise levels at 08 locations are greater than the prescribed limit. On the other hand, the number of noise monitoring locations were increased to 23 during the supplementary baseline study in 2019-2020. In this second round of monitoring, the noise levels are found more than standard limits in all monitoring stations. Comparison between two monitoring result shows that noise level has been increased at 8 locations during supplementary baseline study compare to the initial baseline study in 2017 whereas only Joar Sahara station noise level has been decreased.

Surface Water Quality: Total three surface water samples were collected from different locations along the alignment in 2017. It was found that the concentrations BOD, COD, and TSS in all samples were very high. In contrast, Dissolved Oxygen level in two samples were less compared to the national standard. In 2019-2020, five samples were taken during the supplementary baseline survey. In this study, the

concentration of DO and BOD are found out of range in 03 and 01 locations, respectively. The other parameters are within the standard range.

E4.4 Social Environment

The data provided in this section are mostly based on the Population and Housing Census 2011. Although these data are very old, but these are the latest available data that may differ from current situation. According to 2011 census, total population of the wards on which the project area is located is 1212231 with total household number 274468. Average household size of the project area is 4.5 which is similar to the national average (4.5). Only 5% household heads are illiterate and about 9.83% have completed the secondary school level and more than 9% of them are graduates. Most of the people are engaged with service-related jobs followed by business and industrial jobs. The household types are dominated by Pucca house (58.6%) followed by semi-pucca (26%). The population of the study area dominated by The Muslim community (94.66%) in terms of faith.

E5 SCREENING AND SCOPING

The Project was classified as" Red" under Environmental Conservation Rules 1997 of Bangladesh and "A" according to the JICA Environmental Guidelines, and thus EIA is necessary to be conducted.

In order to assess the likely significant environmental and social impacts, potential environmental and social impacts of the Project were preliminarily identified based on the project description and overall environmental and social conditions in and around MRT Line-1 project. The impacts of pollution, natural and social environments, health and safety, emergency risk, and others were classified as A to D in accordance with the following criteria, assuming no specific measures toward the impacts are taken:

1) A-/A+: Significant negative/positive impact
2) B-/B+: Some negative/positive impact
3) C-/C+: Impacts are not clear, require more investigation
4) D: Impacts are negligible, no further study required

Scoping matrix can be found under section 5.3.

E6 ANTICIPATED ENVIRONMENTAL IMPACTS AND THEIR MITIGATION MEASURES

All the identified environmental components with their impacts have been discussed in details in chapter 6 with the mitigation measures and residual impacts. Potential impacts due to the construction and operation of the MRT line-1 are presented below.

E6.1 Noise Impacts

Noise generated by construction activity is analyzed based on combined equipment sound power level for different workplace conditions. The equivalent noise level at the receptors are determined based on the distance of the receptors. The following criteria have been set for this project noise level standard during construction:

- If the ambient noise level is less than the national standard, then the noise standard for the project will be the national standard + 10 decibels;
- If the existing noise level is higher than the national standard, then the noise level for the project will be the ambient noise level + 10 decibels, but it cannot be more than 85 decibels.

Analysis of the data shows that there is unlikely to be additional noise that goes above the project noise level standard for construction work, except at night, when more stringent standard will be applied.

Noise impacts occur during operation are analyzed through a method proposed by K. Ishii (used in MRT Line 6) that incorporates noise power levels from rolling motion of the train, structure noise and vehicle onboard equipment noise. These are converted to equivalent noise levels at 7.5 m and the receptors level, then combined into an equivalent combined noise level (A rated decibels). Input variables include track curvature (200 m, 400 m and >500 m) and type (ballast-less or vibration-proof); and train operating variables (train length, speed and headway). Results are tabulated and compared with the project standard, which is based on the DoE ambient noise standard. At the Purbachal line (elevated section), 1.5 m parapet wall will be adopted to control the noise level. From the above discussion it is seen that no additional mitigation measures other than parapet wall will be required during train operation.

E6.2 Vibration Impact

Vibration impacts during operations depend on track type, curvature, and train speed. Equations are used to predict vibration decibels (VdB) at source (base of pier) and at a distance of 12.5 m. Bangladesh does not have a vibration limit, so the USFTA vibration standard of 90 VdB for construction period and Japanese standard of 60 VdB for operation period are adopted for use on the project which have also been adopted for MRT line 6 project.

As like as the noise level, vibration proof track is also not required for the elevated section. At the pier face, the vibration will be quite higher than the 60 VbB. But at the 12.5 distance, all the range in three curvature are within the standard range. In the elevated section, the receptor point is quite far from the sources. Minimum distance will be at least 25m, where all the predicted vibration level is well below the standard range. So, no additional measures are needed for the elevated section. For the underground portion, there could be natural resonance while running the train. So, vibration proof track has been proposed at all along the underground route line.

E6.3 Air Pollution

Air pollution is the major concern during the construction phase. The major concern under the air pollution is mainly the black smoke from the construction equipment and dust from the mismanagement of spoil. Proper mitigation measures are proposed to control the air pollution during construction phase. In the operation period, the impact will be positive as the emission and dust could be reduced as the project will use electricity for the operation instead of diesel and also due to decrease of traffic number in this route line.

E6.4 Surface Water Pollution

Surface water might be polluted during the both construction stage and operation stage. During the construction stage, major sources of polluting the surface water are the storage site of hazardous material, workshop area, effluents from the construction yard, sewages from the office and camp area. During the operation phase, major source will be the sewages from the station area and the Depot area and also washout from the workshop area in the Depot area. Proper mitigation measures have been proposed to avoid such impact which need to be followed strictly during the both construction and operation stage.

E6.5 Ground Water Pollution

There will be limited impact on the ground water due to the construction and operation stage of the MRT Line 1. In the Dhaka city area, normally ground water extraction started from a depth of 100m and up to

300m. Also, the construction will be continued in the build area. So, no disturbance at all on the ground water table. Only the limited impact will be pressure on the ground water table in the limited place where ground water will be extracted for both construction and operation purpose. Also, there will be very limited chance to deteriorate the quality of the groundwater from the washout of the of the workshop area if the mitigation measures are properly implemented.

E6.6 Soil Pollution

During the construction phase there will be possibility of leakage of the hazardous material into the soil which will deteriorate the soil quality. So, proper mitigation measures have been proposed to mitigate the impact.

During the operation phase, the impact will be limited in the depot area where the workshop will be located. Mitigation measures are also provided for the operation period also to avoid the impact.

E6.7 Waste

During the construction stage, there will be several sources of waste from the construction activities. Main concern of waste is large amount of soil which will come from the tunnel boring activities, piling in the elevated section area and open cut method from the station construction work. Besides these wastes, there will be domestic wastes also which will come from the accommodation camp, site offices and construction yard area. Also, there will be hazardous wastes and biomedical wastes also during the construction period. Separate management plan has been proposed for managing all kind of wastes in the construction sites.

During the operation phase, the sources will be very limited and will be only in the station area and the depot area. Separate mitigation measures provided for managing the wastes during the operation period in subsection 6.7. These need to be followed to avoid the impact.

E6.8 Urban Drainage

The main impact during construction is from silt runoff that can inconvenience people and clog drainage systems. Silt-laden water will not be allowed to discharge from sites. Organic contamination in the form of spills of fuel, oil and chemicals will be strictly prohibited.

Drainage during operations (from the viaduct, station canopies and the depot site) is accounted for in the design of facilities. Water quality is unlikely to be affected. There will be STP to treat the sewage water prior to discharge.

E6.9 Protected Area

In or around the project sites, there is no protected area. So, no mitigation measures are required in this case for both the construction and operation period.

E6.9 Biota and Ecosystem

The Project is not expected to have a significant impact on the biota and ecosystem, whether arboreal (in the Depot and in the Purbachal route) or aquatic (in the adjacent lake of Purbachal, Balu River, Hatirjheel lake and Shitalakhsya River). Trees found in the centerlines of roadways in the Purbachal area used for the rail alignment are relatively small and offer no significant habitat for birds. These trees will need to be removed to make way for construction, but can later be replanted elsewhere. A few larger trees will need to be removed at the Depot area. The list is not finalized yet and under study of the RAP report and will confirm in the Final report. In the operation stage, there will be no impact on the biota and ecosystem.

E6.10 Involuntary Resettlement

In the depot area, significant number of people will be displaced for the construction of the Depot. The final number is not confirmed yet and will be updated in the final report. Also, in the underground station area there will be some affected businessmen who will be in consider also under the RAP study. Proper compensation will be provided to them under the RAP study. So, no additional mitigation measures are required in this case. In the operation phase, there will be no issue of the involuntary resettlement.

E6.11 Local Economics

There will be few businessmen in the underground station area who will be affected during the construction period. They will be compensated as per the RAP study. In the operation phase, it is expected that new employment opportunity will come in or around the MRT Line 1 project area. So, there will be positive impact in the operation period.

E6.12 Cultural heritages

As per the HIA study of the MRT Line 1, total 6 numbers of archaeological sites have been spotted which have both positive and negative impact during the operation phase. But during the construction phase, these archaeological sites will face temporarily negative impact. But proper mitigation measures in other section will reduce this impact

E6.13 Local Conflict of Interest

In the construction phase, local conflict may arise between the local people and the project's staff and labor (who will come from different parts of the country). However, separate security plan has been proposed in the construction phase to avoid such issue. In the operation phase there will be no unskilled labor. All the staff will be recruited following the local law. So, there shouldn't be any discrimination during the operation period.

E6.14 Infectious disease

Infectious disease may arise during the construction phase as many workforces will come from the different parts of the country. So, to avoid such infectious disease, mitigation measures discussed in section 6.20.1.1 need to be implemented. During the operation period, there is no possibility of such infectious diseases.

E6.15 Working Condition

In the construction phase, there will be risks related to occupational health and safety related issue. So separate management plan related to working condition needs to be prepared which will include all the safety related instructions to the all workers and staffs. In the operation stage, there will be also possibility of the safety related issues. But for mitigating such impact, several teams will work.

E6.16 Children Rights

Due to the construction of the depot area, many children will be displaced with their family. Also, institutions will be affected. So, this will be taken care under the RAP study. No additional mitigation measures are required. In the operation phase, the children can move from one place to another for their education purpose. So, this a good positive impact on children.

E6.17 Global Warming

During the construction phases there will be emission of GHG gases from the construction equipment. But regular maintenance of the equipment will reduce the GHG emission. During the operation phase, the Project will bring reduction in greenhouse gas emissions in comparison with a base case scenario without the project.

E6.18 Accident

During the construction phases, there might be accidents from different construction activities. So proper mitigation measures are required to avoid such accidents.

During the operation stage, there will be only possibility of fire in the station area. But there will be firefighting measures to avoid such impact.

E7 EVALUATION OF IMPACT

In this chapter, impact evaluation has been carried out considering mitigation measures and without mitigation measures. Evaluation scoring has been given for individual impact so that the effectiveness of mitigation measures can be justified. Detail of the scoring is given in section 7 of this report.

E8 ENVIRONMENTAL MANAGEMENT PLAN

E8.1 Management Plan

Prior to start of site works, Site Specific Environmental Management Plans in the form of the following specific management plans shall be prepared by the contractor and submitted to the project supervision consultant for approval. Detail management plan is presented in section 8.3.

- Air Quality Management Plan
- Noise and Vibration Management Plan
- Water Pollution Prevention Plan
- Waste Management Plan
- Spill Management Plan
- Traffic Management Plan
- Occupational Health and Safety Plan
- Emergency Response Plan

E8.2 Monitoring Plan

The Contractor and the DMTCL will allocate separate budget for environmental and social management plan implementation, training, environmental monitoring, analysis and reporting, verification monitoring and capacity building. It should be noted that cost for many in-built mitigation measures, such as, air pollution control measure, acoustic enclosures for noise control, water and water treatment etc. need to be included in the It should be noted that costs for various mitigation measures such as air pollution control, noise control, water purification, etc. need to be included in the contractor's contract and / or operating costs.

Air quality, noise, water quality monitoring will be conducted for regular basis before construction, during the construction and operation period. Detail of the environmental monitoring plan has been depicted in the section 8.4 of this report.

E8.3 Reporting

The environmental contract specifications will be prepared following this EIA and EMP and all the mitigation and monitoring measures included in this report will be implemented by the Contractor. The Environmental Supervision Consultant will strongly monitor the activities and proposed mitigation measures. Flowchart for environmental monitoring and reporting during construction is presented in subsection 8.5 of this EIA report.

E9 STAKEHOLDER CONSULTATION

The EIA contains a Stakeholder Analysis, which identifies the organizations and groups as stakeholders in the project development. Stakeholders include governments, institutions and groups of individuals affected either beneficially or adversely, directly or indirectly, by the Project. Stakeholders benefiting from the Project include virtually all groups which are engaged in educational, economic and cultural pursuits in the area. Local governments benefit through the increase in economic activity due to the Project.

E9.1 Public Consultations

The EIA reports on the extensive public consultation undertaken during the baseline surveys. Two environmental public consultation meetings were held during the design phase targeting a cross-section of interest groups in two area. Following introductory presentations, NKDOS presented project details along with key findings of the environmental impact assessment, and highlighted control measures incorporated into the design and recommended by the EIA in the Environmental Management Plan. After the presentation, the floor was opened for questions and suggestions from the attendees. Several key points were raised by stakeholders that have been taken into consideration in the EIA. The detail of the public consultation meeting is given in section 9.1 to 9.3 of this report.

Besides of the public consultation meeting, key informant interviewee also has been performed during the baseline study. All the ward councilor of the proposed route line has been interviewed for their valuable opinion and it's included under the section 9.4 of this EIA report.

E10 CONCLUSIONS AND RECOMMENDATIONS

This main objective of the present study is to update the initial EIA report prepared in 2017 for MRT Line 1 following the JICA's Environmental and Social Consideration Guidelines. Different data collection techniques have been used to conduct the baseline study which include literature review, observation, and environmental baseline survey. The EIA is prepared through identifying the potential impacts, assessing them and recommending possible mitigation measure for adverse impacts. The potential adverse environmental impacts of the Projects include air pollution, land acquisition, involuntary resettlement, loss of livelihood, noise and vibration pollution, loss of vegetation, water pollution, etc. On the other hand, there would be some positive impacts of the project that include enhancement of land and utilization of local resources, social infrastructure and services, development of local economy, reduction in GHG emission, etc. The project also has a positive impact in terms of employment opportunities during both construction and operational phase. In addition, there will be enhancement of economic activities around the stations of the MRT Line 1. It can be concluded on positive note that after the implementation of Environmental Management Plan and Monitoring Plan, the project will have negligible impact on environment and will also lead to sustainable transport development of the Dhaka city.

CHAPTER 1

1 INTRODUCTION

1.1 Project Background

Dhaka is the capital and the most populated city of Bangladesh having a population of 21,006,000 as of 2020, a 3.56% increase from 2019 (Source: Macrotrends, who prepared the estimate based on UN World Population Prospect)[1]. The metro area population of Dhaka in 2019 was 20,284,000, a 3.61% increase from 2018[1]. Currently, transportation system in the Dhaka Metro Area depends mostly on road transport which creates severe traffic jam and resulting in associated health hazards. With the ongoing population and economic growth, the number of vehicles will also be increased and will ultimately worsen the scenario.

Considering the trend in few years back, the government of Bangladesh (GOB) formulated the "Strategic Transport Plan for Dhaka" (STP) in 2005 in cooperation with the World Bank (WB). Since the STP was officially approved by the GOB, it was expected that the projects outlined in STP will be implemented gradually to improve the urban transportation situation. Japan International Cooperation Agency (JICA) conducted the Dhaka Urban Transportation Network Development Study (DHUTS) Phase 1 from March 2009 with the DTCA as its counterpart agency. The study's objectives were to conceptualize the basic urban development scenario for the DMA by 2025 and to select priority projects that would help to build such a scenario. That study recommended the MRT Line 6 as a priority project. As a result, JICA conducted the feasibility study on MRT Line 6 under DHUTS Phase 2. Following these studies, the GOB and JICA concluded the loan agreement on the "Dhaka Mass Rapid Transit Development Project" on February 2013 to construct MRT Line 6.

STP was revised in 2015 with grant from JICA and Revised Strategic Transport Plan (RSTP) was approved by government in 2016. According to the Revised Strategic Transport Plan (RSTP) 2016, it has been proposed to build two BRT lines and five MRT lines to develop public transport in Dhaka city by 2035. The north section of BRT line 3 (from Gazipur-Airport) is now under construction with ADB, AFD and GoB support. Meanwhile, the detailed design of the southern section of BRT line 3 (from Airport-Mohakhali) has also been completed.

RSTP identified MRT Line-1 and MRT Line 5 N as next priority projects. Accordingly, JICA dispatched a mission on the project to GOB from March 7, 2016 to March 10, 2016 in order to develop scope and implementing arrangements of a further survey which would study feasibility of the project. The feasibility study of the MRT Line-1 was conducted between 2016 and 2018.

Subsequently, JICA also committed to finance the implementation of Line 1, in order to alleviate traffic congestion and reduce air pollution; thereby improve the urban environment and contribute to economic development. The loan agreement for the engineering service (E/S) for the Project was signed with JICA on 29th June, 2017 (Loan No BD-P95).

A contract for engineering services (E/S) for basic design, detailed design, preparation of bidding documents, tender assistance, updating of Environmental Impact Assessment (EIA) & Resettlement Action Plan (RAP), preparation of Land Acquisition Plan (LAP), assisting implementation of LAP & RAP,

[1] Dhaka, Bangladesh Metro Area Population 1950-2021. https://www.macrotrends.net/cities/20119/dhaka/population. Retrieved 2020-12-30.

assisting institutional development and utility relocation, and planning of non-rail business strategy was signed on 10th October, 2018 between DMTCL and NKDOS Consortium, which is a seven firm joint venture group led by Nippon Koei of Japan. The services started from 9th December, 2018.

1.2 Description of the project

The length of the MRT Line-1 will be 29.8 km with 19 stations and one depot on the right bank of Shitalakhya River next to Purbachal area. The alignment of MRT Line-1 consists of two lines; one line connects Kamlapur with the Hazrat Shahjalal International Airport (hereafter the “Airport Line”). This line runs through an underground tunnel that starts from the Kamlapur Station of Bangladesh Railway (BR), headed westward under the Outer Circular Road, northward under the Rampura DIT Road and Pragati Sharani Road, crosses the Kuril flyover, and proceeds under the New Airport Road to its destination at Hazrat Shahjalal International Airport.

The airport line has a total of 14.77 km underground section that connects 12 underground stations. The second line separates from the Airport Line at Natun Bazar Station and headed towards the Purbachal area (hereafter the "Purbachal Line"). It has an underground section from Pragati Sarani to Kuril followed by the elevated section from East side of Kuril Flyover to Purbachal. Purbachal line will proceed eastward directly over the median strip of the Purbachal Highway from Kuril Transition to the Purbachal Terminal Station. However, on curved sections of the road, the line will run over service roads. The highway crosses six river bridges 70-80m long, and the line will run directly over these bridges. Out of total 29.8 km, the Purbachal line will be 15.03 km viaduct section comprising total 7 viaduct stations. The route of the MRT Line-1 is shown in **Figure 1-1**.

The underground tunnel will be constructed by TBM method, where outer diameter of the tunnel is 7m. The standard length of station is 250m. The metro tunnels will range from 20m to 50m below the ground in different locations with average depth of 30 meter.

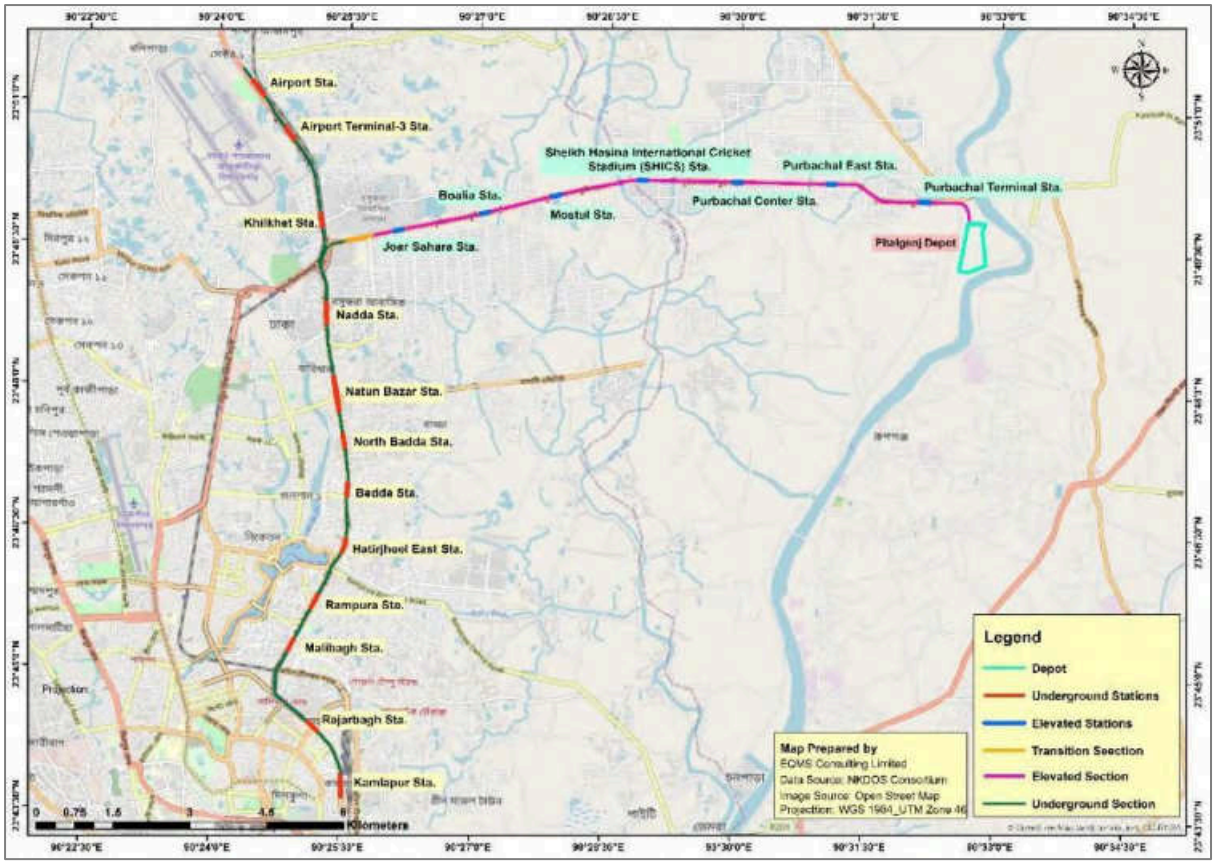


Figure 1-1: Map Showing the MRT Line-1 Alignment with Station Locations

1.3 Project Status

This project is currently under detailed design phase. Previously, the JV of KS Consultants and EQMS Consulting Limited has prepared the EIA for this project. The EIA has designated locations along the alignments for air quality monitoring, noise level measurement and water quality analysis, excluding the depot area, which at that time was under study. It has been deemed necessary to conduct another sampling for detail design phase at all the designated stations along the alignment including the Purbachal Depot area to update the baseline data previously gathered, for future monitoring and comparison during the Construction Phase. For this reason, the EIA has been updated by the Project's E/S consultant NKDOS.

1.4 Purpose of the Study

The main purpose of the Environmental Impact Assessment (EIA) is to identify, evaluate and report the environmental and socio-economic effects of the MRT line-1 project. Another important purpose of the study is to assess the baseline environmental condition of project location, including different parameters of several components of the environment. The process includes identification of mitigative measures that will be used to reduce or eliminate potential adverse effects, where appropriate.

An initial EIA report was prepared in 2017 under the JICA Feasibility Study for MRT Line-1. The previously prepared report was based on feasibility study of the project. Now, the detail design of the project, including alignment, stations, and depot are being prepared. Besides, the environmental components are changing over the time as their influencing factors are also changing. Therefore, an updated version of the report, including a new baseline study is required. This updated version of the report will also serve

the purpose of the renewal of ECC from DOE. EQMS Consulting Limited has been contracted by NKDOS Consortium to carry out the study.

1.5 Scope of the Work

The major scope of work under the EIA updating are as follows:

- A baseline survey for Noise level, Air Quality, and Surface Water Quality following the same sampling stations mentioned in the previous EIA conducted for the Project, as well as at some additional locations.
- Upgrading EIA for new/modified/confirmed facilities following the EIA process as prescribed by the EIA Rules and Regulations of Bangladesh.
- Identification of the locations of Floating Slab Track (FST) like Mass Spring System (MSS) as a measure of noise reduction, using a simplified noise analysis model based on ambient noise and anticipated operational noise.
- Consideration of construction environmental standards based on MRT Line 6 example.
- Public Consultations with the stakeholders at two (02) locations along with an information disclosure seminar involving all the stakeholders to disseminate the outcome of the updated EIA, including the impacts and their remedial measures.
- Assisting in renewal of issued Environmental Clearance Certificate (ECC) for the project.
- Estimation of carbon reduction due to implementation of the project

1.6 Methodology

Methodology adopted for the EIA updating study are as follows:

- Study of the relevant documents on policy, legal and administrative framework and their review, particularly on environmental aspects and effluent discharge limits, health and safety requirements, identification of sensitive areas and endangered species, land use, land acquisition etc.
- Pilot survey has been conducted to collect baseline information in devised formats;
- Analysis of collected data has been conducted;
- Documenting baseline conditions through environmental monitoring and sampling of the project area;
- Documentation of baseline conditions has been conducted through on-site environmental monitoring and sampling;
- Application of simplified noise modeling to determine the noise level at the receptor due to construction activities and train operation;
- Identification of major project activities, both during construction and operational phases of the project.
- Identification and prediction of environmental impacts of project activities on the surrounding environment
- Identification of the most significant environmental and social impacts and suggestions for mitigation measures in order to reduce/eliminate negative impacts and to enhance positive impacts.
- Arrangement of public consultation meeting and disclosure meeting to consult with potentially affected people as well as community people;

- Development of Environmental Management Plan (EMP) for both construction phase as well as operational phases of the project.

1.7 Outline of the Report

All the activities have been chronologically organized in this report which is a great assistance to the reader for better understanding. **Table 1-1** represents the outline of this report.

Table 1-1: Outline of the Report

Chapter	Description
Chapter 1	Focuses on project background, brief description, project status, and purpose of the study, Scope of work, and methodology.
Chapter 2	Provides an insight on policy, legal and administrative framework that are applicable for this project.
Chapter 3	Discusses about the details of the project activity.
Chapter 4	Discusses about the findings of the monitoring of supplemental environmental baseline study.
Chapter 5	Screening and Scoping for this EIA Report
Chapter 6	Discusses about the potential environmental impacts during construction and operation period and mitigation measures of identified impacts.
Chapter 7	Presents the evaluation of impacts assigning a score for each impact according to JICA guidelines.
Chapter 8	Discusses about the environmental management and monitoring plan for construction and operation period.
Chapter 9	Includes the findings of stakeholder engagement and public consultation.
Chapter 10	Formulates an emergency response plan and disaster impact assessment.
Chapter 11	Presents conclusion of the study as well as some recommendations.

CHAPTER 2

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 Introduction

To address the environmental and social risks of any project and its associated components; to protect and conserve the environment from any adverse impacts, the GoB has specified regulations, policies and guidelines.

The activities of the proposed MRT Line-1 project falls under the '**RED**' category according to the Bangladesh Environment Conservation Rules (ECR) 1997 and therefore, need to conduct EIA studies to obtain site and Environmental Clearance from the DoE. In addition, as it is a JICA funded project, the Environmental and Social Guidelines of JICA is applicable for this project.

MRT line-1 project obtained ECC in 2017 and also received yearly renewable. Now, the project is under detail design stage. Therefore, supplementary baseline survey has been conducted. Also, the existing EIA report will be updated based on the route alignment, station location and design as well as depot location.

The following activities have been carried out under the updated EIA study.

- Identification of national legal obligations, legislative provisions, and policy guidelines in relation to the interventions which will be required to review under the EIA study of the Dhaka MRT Line-1 project;
- Identification of the international legal obligations and relevant provisions of multilateral environmental agreements related to the proposed project interventions.

2.2 Metro Rail Act (2015) in Bangladesh

The Metro Rail Act, 2015 includes the legal obligations for the construction, operation, maintenance, control and associated rules and regulations for Bangladesh. The act is initially applicable in Dhaka, Narayanganj, Munshiganj, Manikganj, Gazipur and Narsingdi district since 2nd February 2015. It will be applicable in other districts from second phase. License will be issued for metro rail construction and operation under this act. It also includes all technical aspects, entry, fare, insurance and all other associated penal code that are connected with metro rail.

2.3 Environment and Social Related Legislation and Policy in Bangladesh

The main Acts and Regulations guiding environmental protection and conservation in Bangladesh are outlined in the following subsections.

2.3.1 Bangladesh Environmental Conservation Act, 1995 (subsequent amendments in 2000 and 2002)

The provisions of the Act authorize the Director General of the Department of Environment (DOE) to undertake any activity that is deemed fit and necessary to conserve and enhance the quality of environment and to control, prevent and mitigate pollution. The main highlights of the act are:

- Declaration of Ecologically Critical Areas;
- Obtaining Environmental Clearance Certification;
- Regulation with respect to vehicles emitting smoke harmful for the environment;

- Regulation of development activities from environmental perspective;
- Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Promulgation of acceptable limits for discharging and emitting waste; and
- Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of the environment;

2.3.2 Environment Conservation Rules (ECR), 1997 (subsequent amendments in 2002 and 2003)

The Environment Conservation Rules, 1997 are the first set of rules promulgated under the Environment Conservation Act, 1995. These Rules provide for, inter alia, the following:

- The National Environmental Quality Standards (EQS) for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise and vehicular exhaust;
- Categorization of industries, development projects and other activities on the basis of actual (for existing industries/development projects/activities) and anticipated (for proposed industries/development projects/activities) pollution load;
- Procedure for obtaining Environmental Clearance;
- Requirements for undertaking IEE and EIA's as well as formulating EMP's according to categories of industries/development projects/activities; and
- Procedures for damage-claim by persons affected or likely to be affected due to polluting activities or activities causing hindrance to normal civic life.

Depending upon the location, size and severity of pollution loads, projects/activities have been classified in ECR, 1997 into four categories as Green, Orange A, Orange B and Red respectively.

2.3.3 National Environmental Policy, 2018

The Bangladesh National Environmental Policy, 2018, sets out the basic framework for environmental action together with a set of broad sectoral action guidelines. Key elements of the Policy are:

- Encourage collection and promotion of low carbon emission technology in the country;
- Identifying and controlling all types of environmental pollution and degradation activities;
- Ensure sustainable, long-term and environmentally friendly use of all-natural resources;
- To take PPP for the development of the environment;
- Maintain and streamline the environmental policies and strategies among other policy strategies in the interest of sustainable development;
- Ensure the EIA and SEA in all necessary sectors;
- Take action to reduce poverty through environmental protection;
- Strengthen observations on proper compliance with environmental laws and regulations.

The policy also states that EIA's should be conducted before projects are undertaken and the DoE is directed to review and approve all Environmental Impact Assessments.

The GoB has developed a policy framework that requires environmental issues to be incorporated into economic development planning. Key environmental legislation with their applicability for the project is presented in **Table *2-1***.

Table 2-1: Applicability of Key Environmental Legislation at a Glance

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
Acts/Rules			
Environment Conservation Act, 1995 and its amendment in 2000, 2002 and 2010	• Declaration of Ecologically Critical Areas (ECAs); • Obtaining Environmental Clearance Certificate (ECC); • Regulation for vehicles emitting smoke harmful for the environment; • Regulation of development activities from an environmental perspective; • Promulgation of standards for quality of air, water, noise and soils for different areas and different purposes; • Promulgation of acceptable limits for discharging and emitting waste; • Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation, & improvement of the environment.	Applicable	According to the Act "no industrial unit or project shall be established or undertaken without obtaining an ECC from the DG" of DoE. Therefore, the provisions of the act apply to all of the project intervention phases during the project life cycle.
Environment Conservation Rules, 1997 and its amendment in 2002, 2003, 2005, 2007, 2008, 2010, 2017 and 2020	• NEQS for ambient air, surface water, groundwater, drinking water, industrial effluents, emissions, noise, & vehicular exhaust; • Categorization of industries, development projects and other activities based on actual (for existing industries/development projects/ activities) and anticipated (for proposed industries/development projects/activities) pollution load; • Procedure for obtaining ECC; • Requirements for undertaking IEE and EIA's as well as formulating EMP according to categories of industries/ development projects/activities; and • Procedure for damage-claim by persons affected or likely to be	Applicable	The subject project falls under the "Red" category and requires clearance before the commencement of any project activities. Besides, it is stipulated that environmental quality standards and other relevant requirements shall be complied during the project life cycle.

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
	affected due to polluting activities or activities causing hindrance to normal civic life.		
Environment Court Act, 2010	• Establishment of one or more environment courts in each district and one or more special magistrate courts in each district; • Also provides the jurisdictions of environment court, the penalty for violating courts order, trial procedure in special magistrate court, power of entry and search, procedure for investigation, procedure and power of environment court, authority of environment court to inspect, appeal procedure and formation of the environment appeal court.	Applicable	The court has jurisdiction, under the act's provisions, over trial for an offense or compensation under environmental law, imposing penalties for violation, etc.
Wildlife (Conservation and Security) Act, 2012	• Prohibition related to capturing, killing, shooting, or trapping wildlife. No person shall hunt any wild animal without a license; • Determination of threatened flora and fauna in four (4) schedules; • Prohibitions, entry and declaration procedure of protected areas (sanctuary, national park, community conservation area, safari park, eco-park, botanical garden, wild animal breeding center, landscape zone or corridor, buffer zone, core zone, special biodiversity conservation area, national heritage, memorial tree, sacred tree, and kunjaban, etc.); • No person, institution, or company shall establish or operate any industrial factory or brick-field within 2 (two) kilometers from the boundary of a sanctuary.	Not Applicable	No project activities are going to undertake within the buffer zone of the eco-sensitive zone notified in this act.

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
Bangladesh Water Rules, 2018	• Provision of No Objection Certificate for the establishment of projects related to flood control and management project; surface water extraction, supply and use related project and part of the project; irrigation project using surface water; construction of hydraulic structures; water conservation project; flood-affected plain land and wetland development project; groundwater for industrial use; riverbank protection and river control; river excavation and dredging project; canal excavation and re-excavation project; fisheries development in surface water project; groundwater extraction, supply, & use related project & part of the project; and others project; • According to the Clause-16 of the rules, a NOC should be taken from DG of WARPO, District Committee/DC, Upazila Committee/UNO, and Union Committee/Chairman based on the total investment of the specific project.	Applicable	Applicable- As the subject project will required surface/ground water extraction during construction period. Therefore, a NOC will be required prior to use surface/ground water.
The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry)	• Declare any forests land or wasteland as protected forests. • May stop public or private way or watercourse in the interest of preservation of the forest. • Declare a reserved forest area as Village Forests • Declare an area as Social forests or launch a social forestry programme in Govt. land or private land with permission.	Not Applicable	No forestland will be required to be diverted;
The Private Forests Ordinance, 1959	• Conservation of private forests and for the afforestation on wastelands;	Applicable	Many trees will be cut down in depot area. Detail survey is going on under RAP; proper compensation will be paid

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
			as per RAP entitlement policy.
The Penal Code	• Chapter XIV of the Penal Code provides offences affective public health, safety, convenience, decency and morals; Section 277: Falling Water or Public Spring or Reservoir; Section 278: Making Atmosphere Noxious to Health; • Section 284: Negligent Conduct with Respect to Poisonous Substance; Section 285: Negligent Conduct with Respect to Fire or Combustible Matter; • Section 286: Negligent Conduct with Respect to Explosive Substance. • Section 277: whoever voluntarily corrupts or fouls the water of any public spring or reservoir, to render it less fit for the purpose for which it is ordinarily used will be punished under the law. • Section 278: whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the Neighborhood or passing along a public way will get punishment.	Applicable	It is required to take all the measures proposed and suggested by DoE, Bangladesh during both construction and operation phase to minimize the environmental pollution
The Protection and Conservation of Fish Act, 1950 and The Protection and Conservation of Fish Rules, 1985	• Prohibit or regulate the construction, temporary or permanent of weirs, dams, bunds, embankment and other structures	Not Applicable	No dam or embankment is required for the project activity
The Explosive Act, 1884	• To prevent any accident due to explosive storage, use or transportation due to careless handling/management	Applicable	Possibly Applicable depending on quantity of fuel storage. Fuel will be stored and used at site for running various construction machinery and equipment

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
Water Pollution Control Ordinance 1970	• Prevention of water pollution	Applicable	Applicable primarily during construction stage (e.g., sewage and equipment washing and maintenance liquid waste discharges from construction camps) Operation Stage: In depot area, there will be Waste Water Treatment Plant. The waste water will go through an oil-water separator before coming to the treatment plant. In stations, the sewage will be discharged to the existing sewage line of DWASA wherever it is available. Otherwise, aerator or septic tank will be installed in the stations if any sewage line is not available.
Water Supply and Sanitation Act, 1996	• Management and Control of water supply and sanitation in urban areas	Applicable	Required for all development projects. Regulatory authority is Ministry of Local Government, Rural Development and Cooperatives
The ground Water Management Ordinance 1985	• Management of Ground Water Resources; • Tube well shall not be dug in any place without permission from Upazila Parishad.	Applicable	Applicable, if tube wells boring required to develop water supply system at construction camps. Permission should be taken if ground water is needed to be used, before digging tube wells.
The Embankment and Drainage Act 1952	• An Act to consolidate the laws relating to embankment and drainage and to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of lands and for their protection from	Applicable	Required for the construction of drainage facility at the Construction Yard and the Depot Area. Regulatory authority is Ministry of Water Resources and Flood

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
	floods, erosion and other damage by water.		Control Department (FCD).
Wetland Protection Act 2000	• Adhere to a formal environmental impact assessment (EIA) process, as set out in EIA guidelines and manuals for water sector projects or related to alteration of natural drainage. • No construction of roads if likely to affect the flow of navigable waterways without clearance from concerned authority's Upland flow in water channels to preserve eco-system.	Not Applicable	Site is not situated at wetland area
Antiquities Act 1968	• Governs preservation of the national cultural heritage, protects and controls ancient monuments, regulates antiquities as well as the maintenance, conservation and restoration of protected sites and monuments, controls planning, exploration and excavation of archaeological sites	Not applicable	No structure of national cultural heritage will be affected due to project development. Regulatory authority is Ministry of cultural Affairs.
The Building Construction Act 1952 (with amendments)	• An Act to provide for the prevention of haphazard construction of building and excavation of tanks which are likely to interfere with the planning of certain areas in Bangladesh.	Applicable	The project involves development of infrastructure. Regulatory authority is Ministry of Public Works.
The Vehicle Act, 1927 The Motor Vehicles Ordinance, 1983 The Bengal Motor Vehicle Rules, 1940	• To regulate vehicular exhaust emissions.	Applicable	Heavy vehicle movement is involved during construction and operation phase. Regular maintenance and up keeping of the vehicles should be carried out. Regulatory authority is BRTA.
Acquisition and Requisition of Immovable Property Act, 2017	• Current GOB Act and Guidelines, relating to acquisition and requisition of land; • According to the law, the affected person will get an additional 200% of assessed value for land	Applicable	Land acquisition will be carried out at Depot Area. Regulatory authority is Deputy Commissioner.

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
	and an additional 100% for structures, trees, crops, and other assets; • This law deals with social and economic impacts as a consequence of land acquisition;		
Bangladesh Labour Law, 2006, Bangladesh Labour Act, 2013 and Bangladesh Labour Rules, 2015	• Provides health, safety, and well-being of workforce during project life cycle. In addition, it also stipulated that children under 18 years are not allowed to be employed during project life cycle and therefore, this law requires to be complied.	Applicable	skill, semiskilled and temporary workers are likely to be involved in the project
Noise Pollution (Control) Rules 2006	• Prevention of Noise pollution • Standards for noise levels	Applicable	Noise will be generated due to the construction activity
Public Health Emergency Provisions Ordinance, 1994	• Calls for special provisions with regard to public health. In case of emergency, it is necessary to make special provisions for preventing the spread of disease, safeguarding the public health, and providing adequate medical service, and other services essential to the health of respective communities and workers during construction-related work.	Applicable	This will be needed for all the employees during the construction period.
The Employees State Insurance Act, 1948	• Health, injury, and sickness benefit should be paid.	Applicable	Needed for the all employees.
Employers Liability Act, 1938	• It is expedient to declare that certain defences shall not be raised in suits for damages in respect of injuries sustained by workmen.	Applicable	Covers accidents, risks and damages with respect to employment injuries.
Dhaka Metropolitan Building (Construction, Development, Protection and Removal) Rules, 2008	• Under the Section 18 of Building Construction Act, 1952 (Act no. II of 1953), Bangladesh Government published the Dhaka Metropolitan Building (Construction, Development, Protection and Removal) Rules 2008 as gazette. The act will be considered for the area of Dhaka Metropolitan under the Town Improvement Act, 1953	Applicable	NOC needs to obtain for the MRT Line-1 as per the section 9 of chapter 2. Also, section 3, 4 and 8 under chapter 2 refers the approval for design of any project, NOC for land use and NOC for special project respectively.

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
	(Act No. XIII of 1953). Under this act, land related NOC, special project related NOC, Design related approval NOC for special project etc. are included		
Detailed Area Plan (DAP)	• RAJUK publishes land use maps referred to as "Comprehensive Detailed Area Plan on RS Mauza [base] Map" that both fix and designate land uses. The first phase of the Dhaka Metropolitan Development Plan (DMDP) was prepared in 1997. It is seen as a progressive plan that will provide order to the structure and growth of the City. The preparation of Detailed Area Plans (DAP) is the third and last tier of the Development Plan, done in 2010. These covered growth areas with detailed studies and developed detailed maps for the urbanized area. Most areas along the alignment are outside already urbanized except for Joar Sahara to Purbachal area.	Applicable	Covers the area which could be filled for development purpose and which area is restricted to fill for any development activities.
Bangladesh National Building Code (BNBC)	BNBC was first drafted in 1993 but not formally reviewed and updated. In 2006 the Building Construction Act was amended to include a new section 18 A, empowering the government to promulgate the building code as a legally binding document. The new edition of Bangladesh's building code is the Bangladesh National Building Code 2020 (BNBC 2020). • The provisions of this Code shall extend to the design, construction, usage or occupation, modification, movement, demolition and repair of any building or structure and any equipment installed or related therein or attached therein, except as otherwise provided for in other laws and regulations governing and regulating	Applicable	Cover the requirement for the structural design

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
	buildings. • If, in any event, various parts of this Code have different specifications for materials, design or construction methods, or other conditions, then the most restrictive specification shall be governed. • The special provision shall be applicable in the event of any discrepancy between a general requirement and a particular requirement.		
Policies			
National Environment Policy, 2018	For sustainable development	Applicable	The proposed project has likeliness of having an impact on the surrounding environment.
National Landuse Policy, 2001	• Deals with several land uses including agriculture (crop production, fishery, and livestock), housing, forestry, industrialization, railways and roads, tea and rubber • Identifies land use constraints in all these sectors	Applicable	land use change from seasonal cultivable land and residential area to urban Area
National Environment Management Action Plan 1995	Conservation of natural habitats, bio-diversity, energy, sustainable development and improvement of life of people	Applicable	Usage of energy efficient material, green building techniques, reduction of carbon foot prints etc.
National Conservation Strategy	Sustainable development for project activity	Applicable	Usage of energy efficient material, green building techniques, reduction of carbon foot prints etc.
National Fisheries Policy, 1998	• Preservation, management, and exploitation of fisheries resources in inland open water • Fish cultivation and management in inland closed water. • Prawn and fish cultivation in coastal areas • Preservation, management, and exploitation of sea fishery	Not Applicable	No areas of fish production are likely to be impacted by the project

Name	Summary of Applicable Legislation	Applicability	Applicable Permit and Requirement
	resources		
The National Forest Policy (1994)	Conserve the existing forest areas and to increase forest cover of country and increase the reserve forest.	Not Applicable	No diversion of forest land is involved
The National Energy Policy, 1995	Protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology.	Not Applicable	Energy efficient materials and techniques should be explored
The National Water Policy, 2000	To ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management.	Applicable	Applicable, if Ground water is required to be withdrawn for fulfilling water requirement at construction phase Conjunctive use of water should be explored
The National Water Management Plan, 2001	Addresses options for water quality, considerations behind measures to clean up waste water pollution, where effluent discharge monitoring and zoning regulations for new projects are emphasized;	Applicable	This is an infrastructure development project and are likely to be generate waste water from batching plant Installation of effluent treatment facility within the premises.

2.4 Regulatory Requirements for the Proposed Project

The Government of Bangladesh has framed various laws and regulation for protection and conservation of Biological Environment. These legislations with applicability to this project are summarized in below.

2.4.1 Environmental Clearance from DoE, Bangladesh

Department of Environment (DoE) under the Ministry of Environment, Forest and Climate Change is responsible for granting the environmental clearance to a project. In addition, there are other ministries to deal with specific area of importance to the country like Forests, Water, etc. According to the Section 12 of the Environment Conservation Act 1995, no project will be established or undertaken without obtaining permission, in the manner prescribed by the Environment Conservation Rules 1997, an Environmental Clearance Certificate from the Director General of DoE. Therefore, every development projects/industry, which are specified under the Schedule–1 of the Environment Conservation Rules 1997, require obtaining a Site Clearance Certificate and Environmental Clearance Certificate (ECC) from DoE. According to the Section 7 (1) of the Environment Conservation Rules 1997; for the purpose of issuance of Environmental Clearance Certificate (ECC), every project will be classified into the four categories considering their site and impact on the environment, such as Green, Orange A, Orange B, and Red. Infrastructure development for MRT Line-1 falls under the Red category. Thus, EIA study is required to be carried out to satisfy the requirements of ECC of the project. An initial EIA study has been already been conducted for the proposed project complying with the approved ToR from DoE in 2017 and DoE issued

an Environmental Clearance Certificate (ECC) in favor of DMTCL for the MRT Line-1 project on 5th November 2017. After obtaining ECC on 5th Nov 2017, yearly renewal has been made in 2018, 2019 and 2020, and the current ECC is valid until 2021. The copy of all ECC can be found in **Appendix-A**. Since the project entered into design phase and the environmental quality data became outdated, an updated EIA report has been prepared which will serve the purpose of further ECC renewal. The steps for obtaining environmental clearance certificate (ECC) from DoE have been provided in **Figure 2-1**.

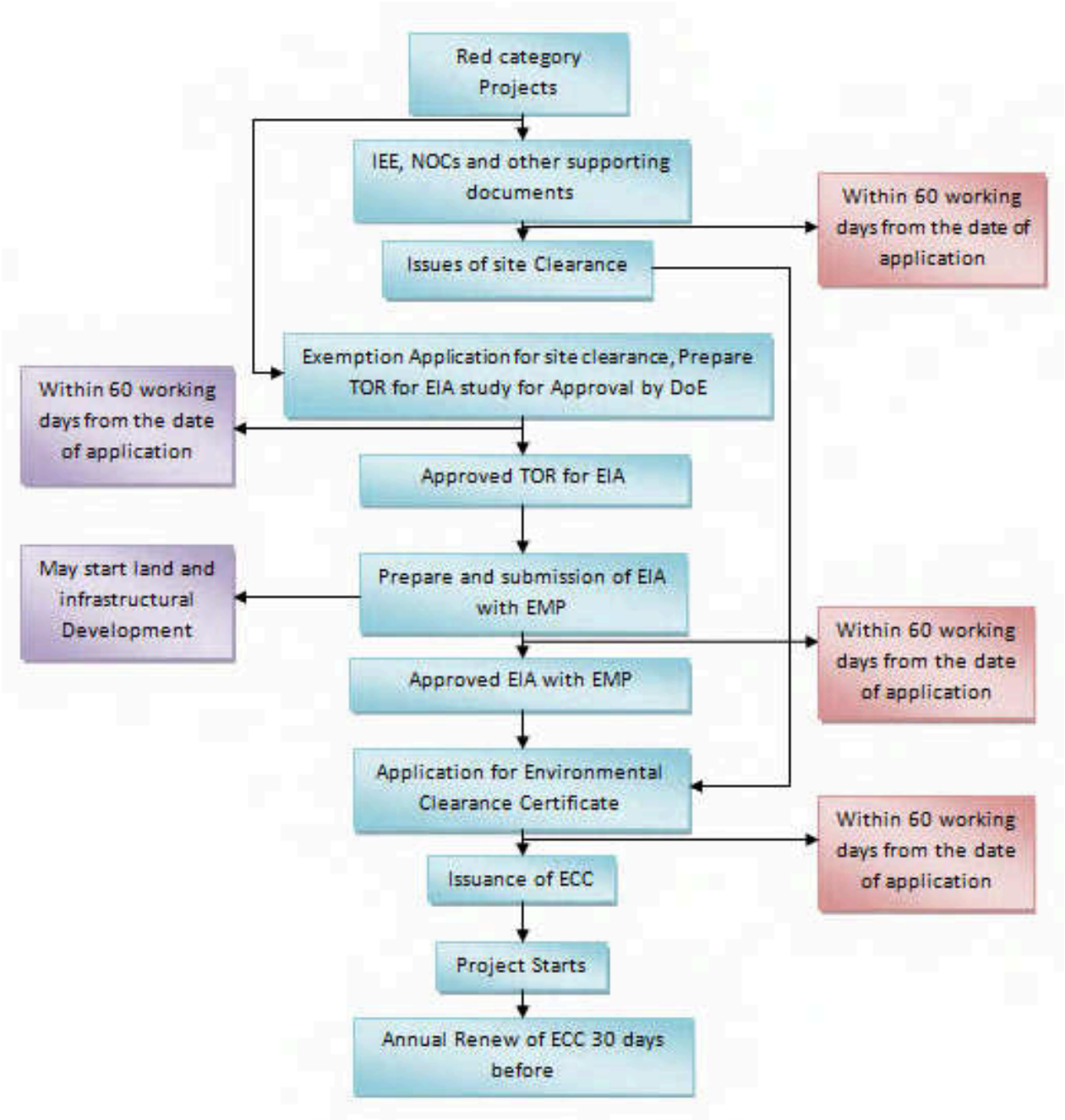


Figure 2-1: Steps for Obtaining Environment Clearance from DoE

2.4.2 The Acquisition and Requisition of Immovable Property Act 2017

The principal legal instrument governing land acquisition in Bangladesh is the Acquisition and Requisition of Immovable Property Act-2017. The 2017 Act requires that compensation be paid for (i) land and assets permanently acquired (including houses, trees, and standing crops,); and (ii) any other impacts caused by

such acquisition. The Act stipulates some rules and considerations for ensuring fair compensation of acquired properties. According to the Act-2017, the Deputy Commissioner (DC) determines and considers:

i. market price of acquired land by averaging corresponding price of previous 12 months from the date of serving notice under section-4 (u/s-4) for each type of land within the vicinity;

ii. Fair compensation for structures, trees and standing crops on the acquired land during Joint Survey.

iii. Compensation for detachment from the residual productive land.

iv. Compensation for loss of income generated from the acquired land.

v. Shifting cost of housing and commercial structures in case of displacement.

vi. May undertake appropriate step/action to resettle households displaced from homestead with living /housing structures.

vii. If acquired land has standing crops cultivated by tenant (*bargadari*), the law requires that part of the compensation money be paid in cash to the tenants.

Compensation payments or "awards" determines by the Deputy Commissioner popularly known as Cash Compensation under Law (CCL).

The Acquisition and Requisition of Immovable Property Act-2017 have some provisions adjusting determined value with the current market price of acquired properties. These are as follows:

a. The Deputy Commissioner will pay additional 200% of assessed/determined price for land.

b. The Deputy Commissioner will pay additional 100% of assessed/determined value for structures, trees, standing crops and other affected properties.

The Resettlement Action Plan (RAP) for the project was prepared in 2018 in compliance with the Resettlement Framework (RF) prepared based on relevant national (GoB) Law with the policy of the JICA Guidelines for Environmental and Social Considerations and World Bank OP 4.12. A RAP Implementing Social Consulting Firm is now engaged by Dhaka Mass Transit Company Limited (DMTCL) for updating the original RAP for the MRT Line-1 project, which was prepared in 2018 under the F/S. Subsequently, the updated RAP will be implemented after obtaining relevant approvals.

2.5 JICA Guidelines

2.5.1 Overview of Guidelines

JICA environmental Guidelines which is applied to the Project is "Guidelines for Environmental and Social Considerations" (April 2010).

The JICA Guidelines confirm that project proponents are undertaking appropriate environmental and social considerations, through various measures, so as to prevent or minimize the impact on the environment and local communities which may be caused by the projects for which JICA provides funding, and not to bring about unacceptable effects. It will thus contribute to the sustainable development of developing regions. In its confirmation of environmental and social considerations, JICA places importance on dialogue with all involved partners (e.g. the host country, local governments, borrowers and project proponents) regarding environmental and social considerations. Transparent and accountable processes, as well as active participation of key stakeholders (e.g. local residents and local NGOs affected by the project) in all stages of the project are highly considered. The JICA Guidelines has

been formulated keeping consistency to the World Bank Operational Policy. In many cases, the JICA Guidelines referred the World Bank Operational Policy.

The JICA Guidelines provide following four categories of projects as per its environmental classification system.

- Category A: A proposed project is classified as Category A if it is likely to have significant adverse impact on the environment and society. Borrowers and related parties must submit Environmental Impact Assessment (EIA) reports. For projects that will result in large-scale involuntary resettlement, basic resettlement plans must be submitted. EIA and other reports need to be submitted through the borrower before the JICA environmental reviews.
- Category B: A proposed project is classified as Category B if its potential adverse environmental impact is less adverse than that of Category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily
- Category C: A proposed project is classified as Category C if it is likely to have minimal or little adverse impact on the environmental and society.
- Category FI: A proposed project is classified as Category FI if it satisfies all of the following:
    - JICA's funding of the project is provided to a financial intermediary or executing agency etc.;
    - the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the subprojects cannot be specified prior to JICA's approval of funding (or assessment of the project); and
    - Those sub-projects are expected to have a potential impact on the environment.

The Project, as per the above categorization, falls under Category A for the purpose of environmental investigations. Final EIA report approved by DoE needs to be laid open for public inspection at the JICA headquarter 120 days before a loan agreement for category A projects.

2.5.2 JICA Requirements related to Land Acquisition and Compensation

The key principles of JICA policy on involuntary resettlement, land acquisition and compensation are summarized below:

- Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives;
- When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken;
- People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels;
- Compensation must be based on the full replacement cost as much as possible;
- Compensation and other kinds of assistance must be provided prior to displacement. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12;
- In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people;

- Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans;
- Appropriate and accessible grievance mechanisms must be established for the affected people and their communities;

The above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principles based on World Bank OP 4.12 are as follows.

- Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits;
- Eligibility of Benefits include the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who do not have formal legal rights to land at the time of census, but have a claim to such land or assets, and the PAPs who have no recognizable legal right to the land they are occupying;
- Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based;
- Support should be provided for the transition period (between displacement and livelihood restoration;
- Particular attention must be paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children and ethnic minorities;
- In addition to the above core principles on the JICA policy, it also emphasizes a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanisms; time schedule for implementation; and detailed Financial Plan.

2.5.3 Gaps between Environmental Regulations of GoB and the JICA Guidelines

There are gaps about categorization process, necessity of alternative study and information disclosure as shown in **Table 2-2**.

Table 2-2: Major Gaps between Environmental Regulations of GoB and the JICA Guidelines

Aspect of Operational Framework	JICA	GoB	Harmonized Operational Framework
Environmental Policy and Regulations	JICA Guidelines for Environmental and Social Consideration 2010	• Environment Conservation Act (1995) • Environment Conservation Rules (1977) • EIA Guidelines for Industries	-

Aspect of Operational Framework	JICA	GoB	Harmonized Operational Framework
Analysis of Alternative	Environmental impact must be assessed and examined from the earliest possible planning stage. Alternative studies shall be made to avoid or minimize adverse impact and must be examined and incorporated into the project plan.	ECA (1995) and ECR (1997) do not clearly ask for identification and assessment of alternatives.	Alternative study shall be made to minimize the project impact
Public Consultation Meeting	In case of projects with potential adverse effects on environment, information on projects needs to be known at early stage and stakeholders, such as local people, should be adequately consulted. The consultation results need to be considered in projects. (Holding consultations is highly desirable, especially at scoping stage and when the draft report is being prepared)	No public disclosure is required as per ECR. Although there are descriptions recommending public participation in EIA, any detailed regulations for local consultation is not laid down.	Public consultation shall be implemented throughout the preparation and implementation stages of the Project. During preparation of the EIA report, consultations were implemented at scoping stage and when the draft report was prepared.
Disclosure of EIA report	According to the guideline, EIA report shall be disclosed 120 days before the loan agreement. The stakeholders should have access to the report.	There is no regulation for the time of EIA disclosure.	Setting up the time of EIA disclosure can guarantee people to access the report

2.6 Administrative Framework for the Dhaka Metro

The Dhaka Mass Transit Company Limited is the administrative body for the implementation of the Dhaka Mass Rapid Transit Development Project, and is constituted by an order from the Cabinet on 21 Jan 2013, with a capital of Tk 100 billion, and the Road Division of the Ministry of Road Transport and Bridges owning 98.8 per cent of shares, and balance owned equally by the Dhaka Transport Coordination Authority, the Prime Minister's Office, and finance, rail, home and local government ministries.

As per the MRT Line-1 project organogram, there is a position of Additional Project Director (EHS, LA and Resettlement). Under him, there are positions of Project Manager, Deputy Project Manager, and Assistant Project Manager. This section of DMTCL will monitor and coordinate all environmental related activities.

CHAPTER 3

3 PROJECT DESCRIPTION

3.1 Project Location

MRT Line-1 is one of the high prioritized lines of metro rail network of Dhaka city. This line will be consisting of elevated and underground sections that makes the line first ever underground metro of Dhaka. The location of proposed line is mostly confined within RAJUK area, including both developed and developing area. The depot of MRT Line-1 will be constructed in eastern end of Purbachal New Town on the right bank of Shitalakshya River. The Purbachal New Town is the biggest planned township in Bangladesh. The town is now under development and human settlement has not yet established.

The MRT Line-1 is comprised of two routes; among them, one route extends from Kamlapur Railway Station to Shahjalal International Airport (hereafter as 'Airport line'), whereas another route will be originated from depot and will meet former route near Natun Bazar Station (hereafter as 'Purbachal line'). The Airport line will be a fully underground metro, while the Purbachal line will be constructed as partly elevated and partly underground. From Natun Bazar it starts as underground line and after Kuril it is elevated line till depot. After starting from Kamlapur Railway Station, the Airport line goes westward under Outer Circular Road, then it turns northward under Rampura DIT Road and Pragati Sharani Road. After crossing Kuril Flyover, it proceeds to its terminus at Shahjalal International Airport under the New Airport Road. On the other hand, the elevated portion of Purbachal line originates at depot and turns westward. Then, it goes through median of Purbachal Highway maintaining almost straight line and meets Airport line at Natun Bazar Station. From depot to Kuril, it will be elevated line, whereas from Kuril to Natun Bazar Station it will be underground line.

3.2 Existing Transportation System

The nature of existing transportation system (both public and private) along the alignment of MRT Line-1 predominantly consists of bus, car, microbus, and CNG auto-rikshaw. The Purbachal Route currently does not provide public transport system, while the public transport system along Airport Route mostly consists of bus, car (taxi service), and CNG auto-rickshaw. On the other hand, the elevated section of Purbachal New Town goes through an under-developing area without any human settlement. Currently, there is a highway named Purbachal Highway, which is being used by different inter-district vehicles, including bus, car, microbus, truck, CNG auto-rikshaw, leguna, etc. The elevated section is planned to be constructed on the median of this highway. The beneficiary of this elevated section will be the future residents of Purbachal Town. In contrast, the Airport route goes throw a built-up area occupied by both residential and commercial zones. Therefore, the beneficiary of this section will be city residents as well as inter-district commuters. Moreover, passengers from Shahjalal International Airport will also use this route for inner and outer-city commuting. Furthermore, the passengers of Kamlapur Railway Station will also use this underground section.

3.3 MRT Line-1

It is estimated that the existing transportation structure will not be able to accommodate the future increasing of passengers and vehicles. Therefore, a Mass Rapid Transport System consisting of elevated and underground metro rail is planned for construction. The metro rail is considered as a sustainable approach for increasing city commuters that will minimize the environmental impact as well as traffic

congestion of existing transportation system. This MRT Line -1 will connect Shahjalal International Airport with Purbachal New Town and Kamlapur Railway Station.

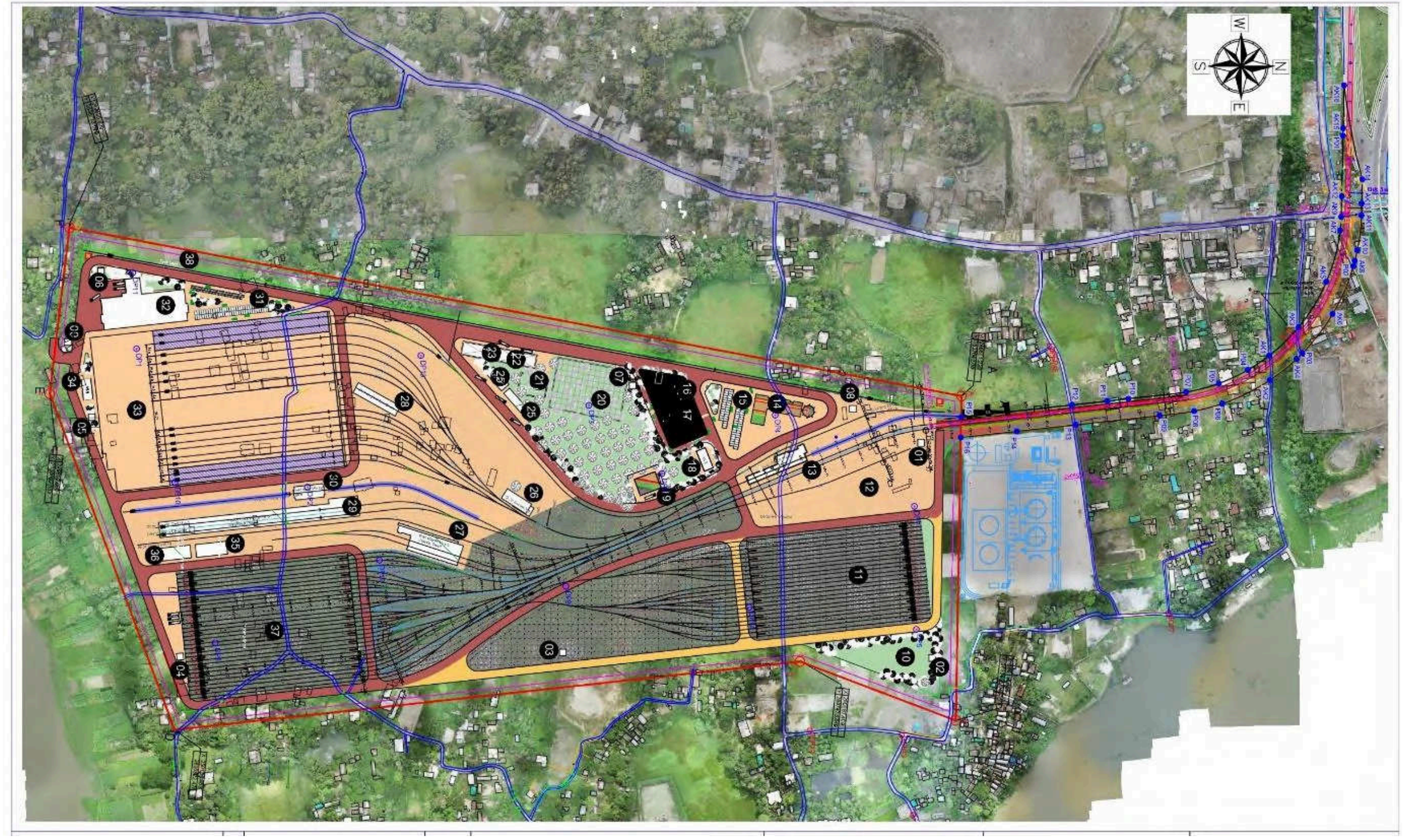
Total length of MRT Line-1 will be 29.8 km with 19 stations; among them, 12 will be underground station and 07 will be elevated station. There will be a depot with an area of 39 ha in the eastern end of Purbachal on the right bank of Shitalakshya River. The length of underground and elevated section is 14.77 and 15.03 km, respectively. The depth of underground metro tunnel varies from 20 m to 50 m in different locations with an average depth of 30 m. The length and width of the platform of elevated and underground stations can vary.

The underground line will be constructed by TBM method, while the underground station will be constructed through open cut method. The underground tunnel will be consisting of shielded tunnels for single track rail. Typically, tunnels running directly beneath the roads will be arranged horizontally in two rows side by side. However, if there are any underground obstacles, the tunnels will be built with two tiers configuration.

The Airport Line will branch off to the Purbachal Line at Natun Bazar. There will be two tunnels between Natun Bazar and Nadda Station, and after Nadda there will be four tunnels. The elevated section of the Purbachal line begins at the above ground exit/entrance built on the east side of the Kuril flyover, and will proceed eastward directly over the median strip of the Purbachal Highway to the Purbachal Terminal station. However, on curved sections of the road, the line will run over service roads. The highway crosses six river bridges 70-80m long, and the line will run directly over these bridges.

3.4 Depot

The depot of MRT Line-1 will be constructed in the eastern end of Purbachal town on the right bank of Shitalakshya River. About 39 ha land will be required for depot construction. A portion of the land of depot will be kept for future extension, which will be used as construction yard during construction stage. The location of depot is very nearer to Purbachal terminal station, which will reduce out-of-service time of rolling stock. **Figure 3-1** shows the layout of depot.



Source: NKDOS

Figure 3-1: Layout of Depot Area

3.4.1 Topography and Geology

The proposed depot area is mostly covered by swamp or low-lying land. Around 61% of depot area (about 23 ha) is swamp land that comprised of very soft clay. The upper soil layer of depot is mostly covered by medium stiff clay and very soft clay. There is a layer comprised of dense sand beneath the upper soil layer. **Figure 3-2** shows the soil profile of depot area.

3.4.2 Number of Stabling Tracks

The required number of train set is estimated at 25 sets in 2025, 33 sets in 2035, and 39 sets in 2056. Six train sets will be kept at stations in off-time operation and two train sets will be at the depot for washing, inspection and/or repair work. Therefore, the number of train sets that should be kept at storage tracks is shown in **Table 3-1**. The space needed between storage tracks is 4m, but it is necessary to widen it to 4.5m every three or four tracks in order to install the pole for supporting the overhead wire.

Table 3-1: Number of Train Sets Kept on Storage Track

Year	No. of Train Set	No. of Train Set Kept		No. of Train Set Kept at Station
		On Storage Tracks	On Other Tracks	
2025	25	17	2	6
2035	33	25	2	6
2056	39	31	2	6

Source: NKDOS

3.4.3 Inspection and Light Repair Track

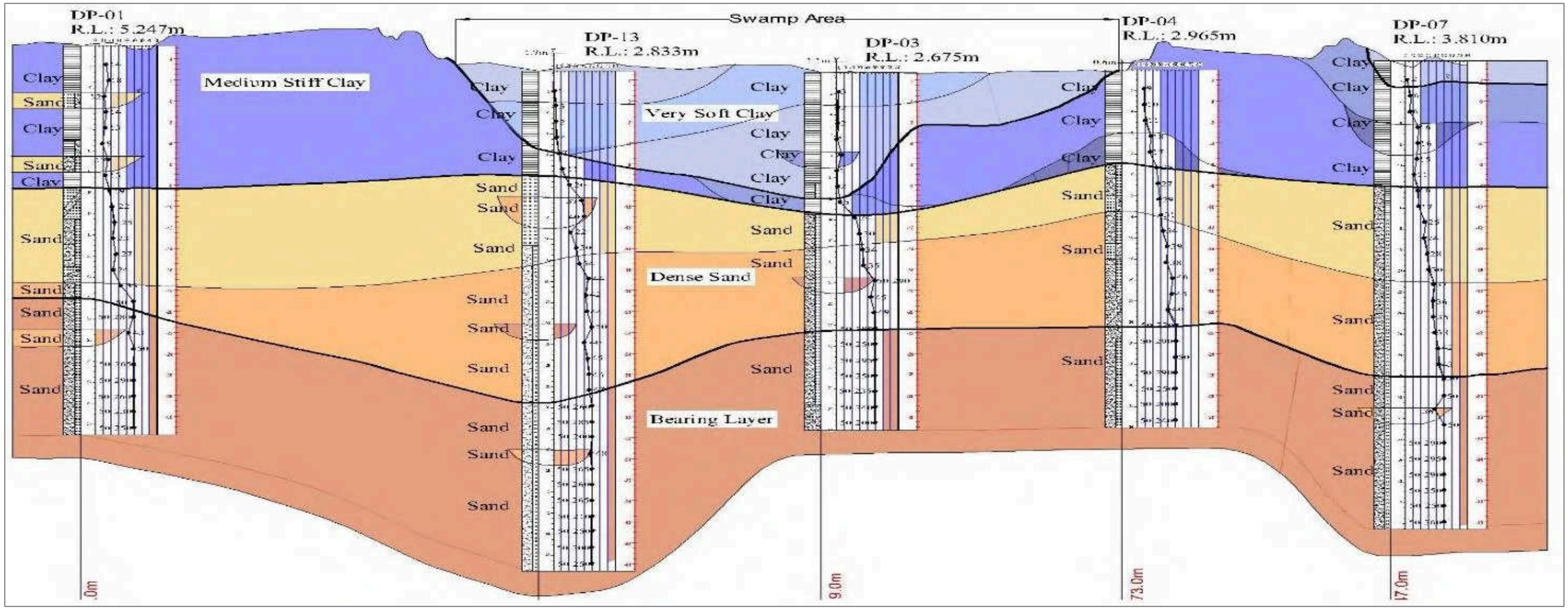
Inspection and light repair track are those where daily, periodical, and extraordinary inspections and light repair works are carried out. This type of inspection is called monthly inspection that covers the renewal of consumables and it takes about 08 hours to conduct. However, for this inspection, two tracks are needed and more than one track is needed for the extraordinary inspection work. A shed will be constructed for these tracks. The distance between two tracks will be 06 m. specifications may change in course of design finalization.

3.4.4 Cleaning Track

The cycle of the Rolling Stock washing work is about once a week, and it takes 2~3 hours each time. Assuming that the Rolling Stock washing work is once a week and the capacity of the Rolling Stock washing per track per day is four train sets, the following calculation can be made: 40 train sets(total)/7days =5.7 train sets/day. The track space for the washing tracks is 6 m in consideration of the washing work area.

3.4.5 Automatic Washing Track

Car washing by washing machine will be carried out once every 2-3 days. In consideration of the maintenance of the automatic washing machine, a bypass track will be constructed. The train will use the bypass track when the washing machine is not operated.



Source: NKDOS

Figure 3-2: Subsoil Stratification of Depot Area

3.4.6 Wheel Truing Track

The cycle of the wheel truing depends on the train's kilometrage, but the normal practice is every eight months or so. When a flat spot in the wheel is observed, wheel truing for the whole bogie wheels is carried out. One-wheel truing takes approximately 30 minutes. This has an impact on the train operation schedule as the track requires one train set length.

3.4.7 Workshop

There will be a workshop in depot for maintenance and repairing works of rolling stocks. The workshop will be equipped with both ground level track and track-on-pile of elevated track for facilitating maintenance and repairing works of rail coach and engines. The Workshop will also be used for cleaning and washing of the rail cars.

3.4.8 Testing Track

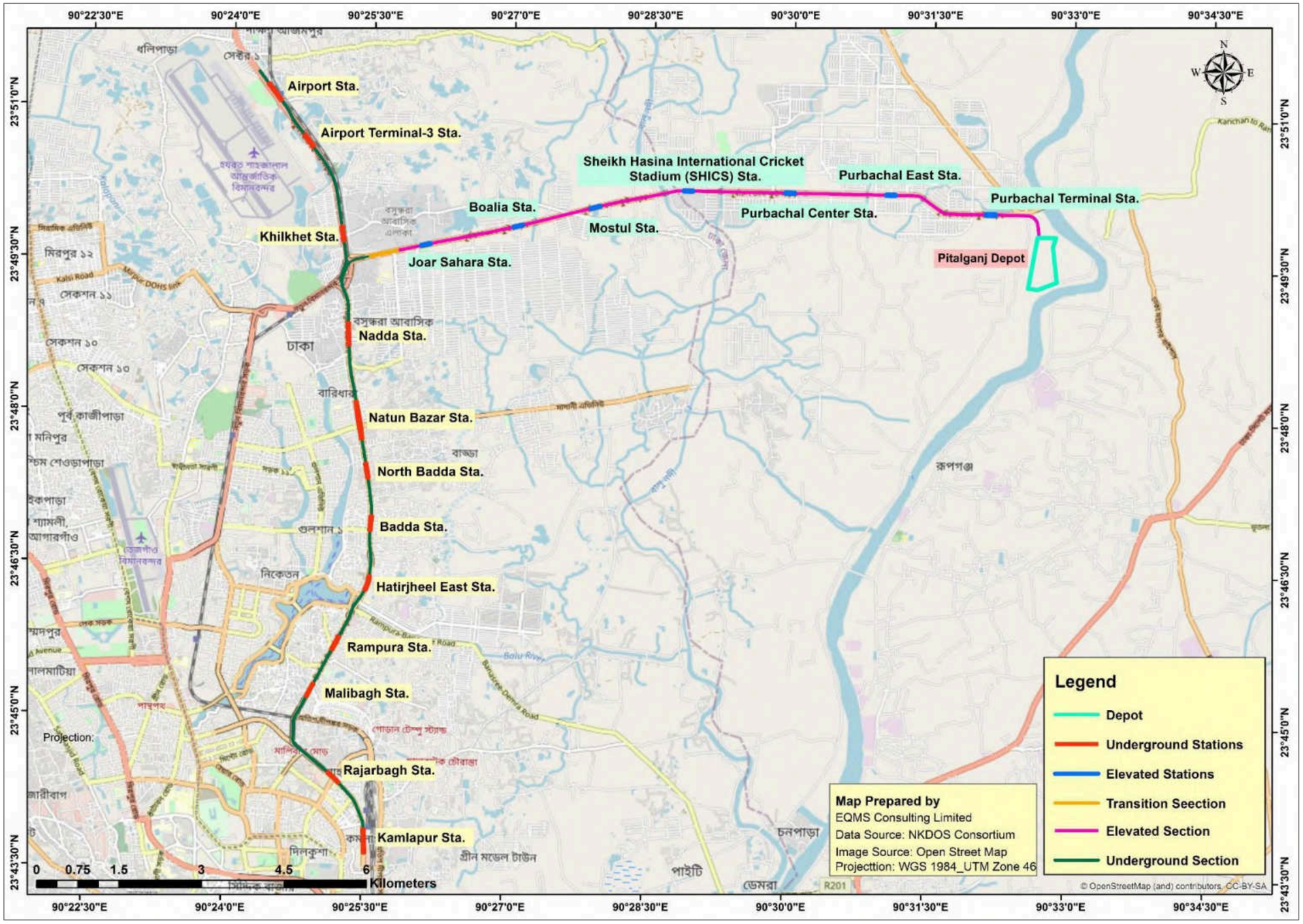
Before leaving the workshop, the repaired train shall have an operational test on the testing track, which preferably should be as long as possible. If the track is not less than 500m, as minimum testing of a braking test, acceleration and deceleration test, shall be implemented.

3.4.9 Facility Maintenance Vehicle

Typically, several types of equipment such as track measuring machine, rail grinding wagon, multiple tie tamper and hopper wagon are needed for track maintenance. And for the electrical facility, several pieces of equipment such as an overhead wire measuring machine, a wagon for transporting the overhead wire roll, and a motor car for pulling trolleys are needed. Required number of maintenance vehicles will be used, whatever necessary, and they will be kept in depot.

3.5 Alignment

The MRT Line-1 consists of two lines, e.g. Airport line and Purbachal line. The Airport line will be completely underground, while the Purbachal line will be mostly elevated. A small section of Purbachal line from Natun Bazar to Kuril will be underground line. From Kuril it will continue as an elevated line until its terminus at Purbachal Depot. Future extension plan includes a northbound line from airport to Gazipur and a southbound line from Kamlapur to the Jhilmil residential area in Keraniganj. **Figure 3-3** shows the map of the alignment of MRT Line-1, including the locations of stations.



Source: NKDOS

Figure 3-3: Route Alignment of MRT Line-1

Airport Line

The Airport Line, which runs through an underground tunnel, starts at the Kamlapur station of Bangladesh Railway (BR), travels westward under the Outer Circular Road, northward under the Rampura DIT Road and Pragati Sharani Road, crosses the Kuril flyover, and proceeds under the New Airport Road to its destination at Dhaka International Airport. The underground tunnel will consist of shielded tunnels for single tracks. Typically, tunnels running directly underneath roads will be arranged horizontally in two rows side by side. However, if there are any underground obstacles, the tunnels will be built in a two-tier configuration. In this project, a typical arrangement will need to be made at the fly-over between Rajarbagh and Malibagh, the Rampura Bridge, and the Kuril fly-over.

Purbachal Line

The Airport Line will branch off to the Purbachal Line at Natun Bazar. There will be two tunnels between Natun Bazar and Nadda, and after Nadda there will be four tunnels. The elevated section of the Purbachal line begins at the above ground exit/entrance built on the east side of the Kuril fly-over, and will proceed eastward directly over the median strip of the Purbachal Highway to the Purbachal Terminal station. However, on curved sections of the road, the line will run over service roads. The highway crosses six river bridges 70-80m long, and the line will run directly over these bridges.

The design standards for alignment construction will be in accordance with the rules and regulations of "Bangladesh MRT Engineering Standards" (2014.12 DTCA, JICA). The specifications required for alignment are given in **Table 3-2**. Specification may change in course of design finalization.

Table 3-2: Specifications of Alignment and Track

Items		Description
Track gauge		1435 mm
Maximum design speed		110 km/h
Maximum operating speed		100 km/h
Minimum radius	Maine line	400 m
	Min. radius in-between stations	160 m
	Stations	400 m or greater
Car length		20 m
Track Centre interval	Tangent sections	4.0 m
Platform length	8-car trains in future	170 m
Platform width	Island type	10 m
	Separate type	11 m

Source: NKDOS

3.5.1 Rail Levels and Required Clearances

With regard to the overburden thickness of a single-track shielded tunnel, the tunnel will have a diameter of at least 7 m, and the rail level of underground stations will be at -16.0 m from the existing ground surface or deeper. The rail level at the Natun Bazar station will be restricted to 16 m taking into account its intersection with Line 5. There will be two-tiered platforms at Malibagh and Nadda Station. The standard clearance between shielded tunnels and that between a shielded tunnel and nearby structures will be equal to or greater than the tunnel diameter. The standard rail level in elevated sections will be +13.0 m from the existing ground surface.

3.6 Design Constraints and Control Points

There are some physical structures along the alignment of MRT Line-1 that influences the design. The design has been conducted based on the technical standard for the MRT of Bangladesh. Different alternative options have been analyzed during the design stage. The obstacles or controlling factors have been considered carefully during design to minimize the impacts on the surface structure as well as considering the resettlement cost.

3.7 Stations

Total 19 stations will be constructed in MRT Line-1; among them, 12 stations will be underground and 07 stations will be elevated. Taking into account the railway station sphere, the inter-station distance will vary from 0.85 km to 2.7 km. **Table 3-3** shows the locations of the stations. The details of the stations may change during design finalization.

Table 3-3: Tentative details of the stations of MRT Line-1

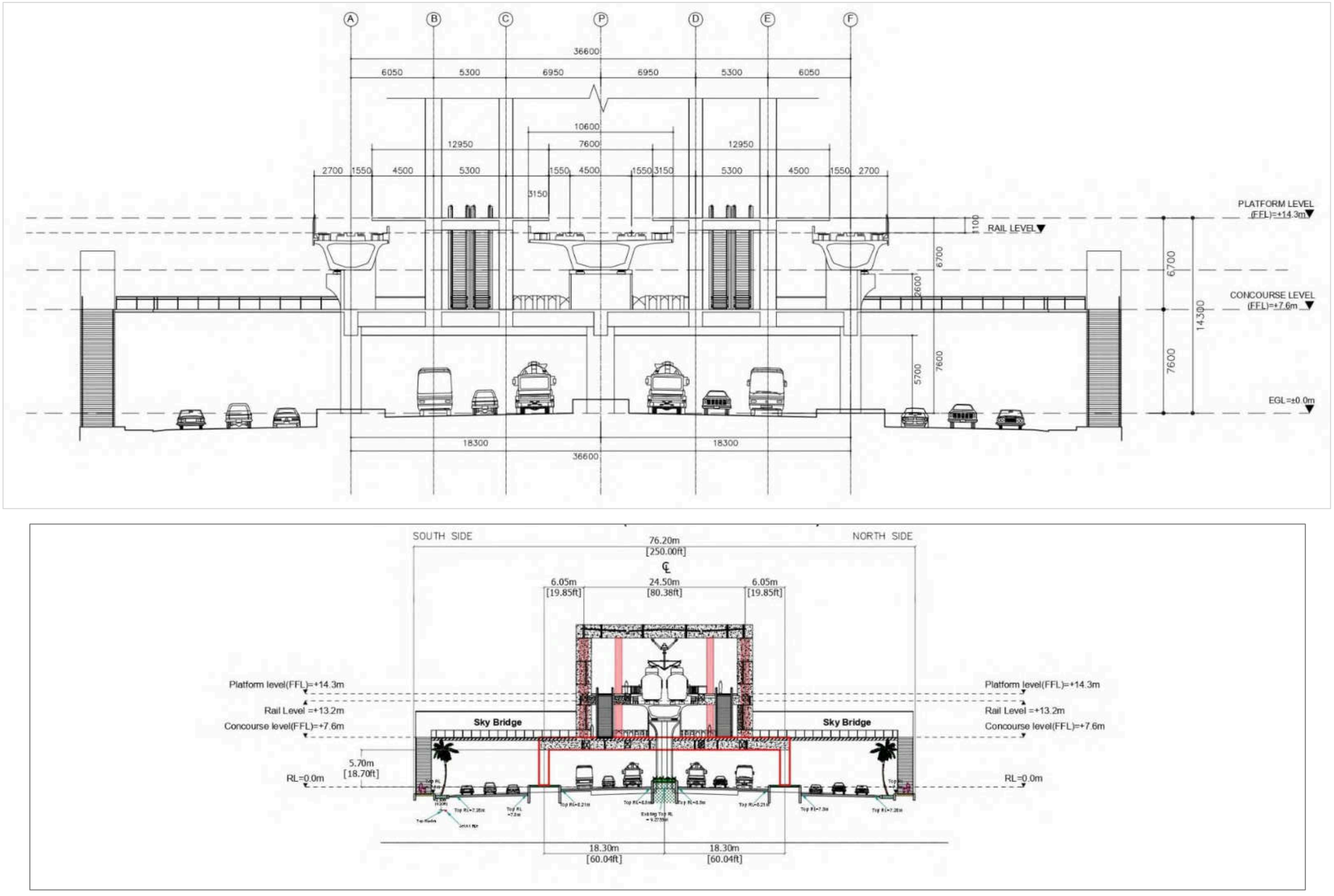
Sl.	Route	Station Name	Chainage (km)	Distance from previous station(km)	Type
1	Airport line	Kamlapur	0.125		Underground
2		Rajarbagh	1.249	1.12	Underground
3		Malibagh	3.355	2.11	Underground
4		Rampura	4.307	0.95	Underground
5		Hatirjheel East	5.490	1.18	Underground
6		Badda	6.551	1.06	Underground
7		North Badda	7.583	1.03	Underground
8		Natun Bazar	8.568	0.98	Underground
9		Nadda	10.152	1.58	Underground
10		Khilkhet	12.617	2.47	Underground
11		Airport Terminal 3	14.044	1.43	Underground
12		Airport	14.890	0.85	Underground
13	Purbachal line	Joar Sahara	12.884	2.73	Elevated
14		Boalia	14.567	1.68	Elevated
15		Mostul	16.521	1.68	Elevated
16		Sheikh Hasina International Cricket Stadium (SHICS)	17.918	1.67	Elevated
17		Purbachal Center	19.461	1.54	Elevated
18		Purbachal East	21.418	1.96	Elevated
19		Purbachal Terminal	23.594	2.18	Elevated

Source: NKDOS

3.7.1 Station Design Concept

Elevated Station

The design of elevated stations will be more or less like the stations of MRT Line-6. The length of the platform of elevated stations will be 180 m (8 cars each 20m, so 160+10 m at each end), including 10 m extra length at both ends. The platform can accommodate a train consist of maximum 08 cars. **Figure 3-4** shows the cross section of typical elevated station.



Source: NKDOS

Figure 3-4: Cross Section of Typical Elevated Station in Purbachal (upper) and RAJUK New Town

Underground Station

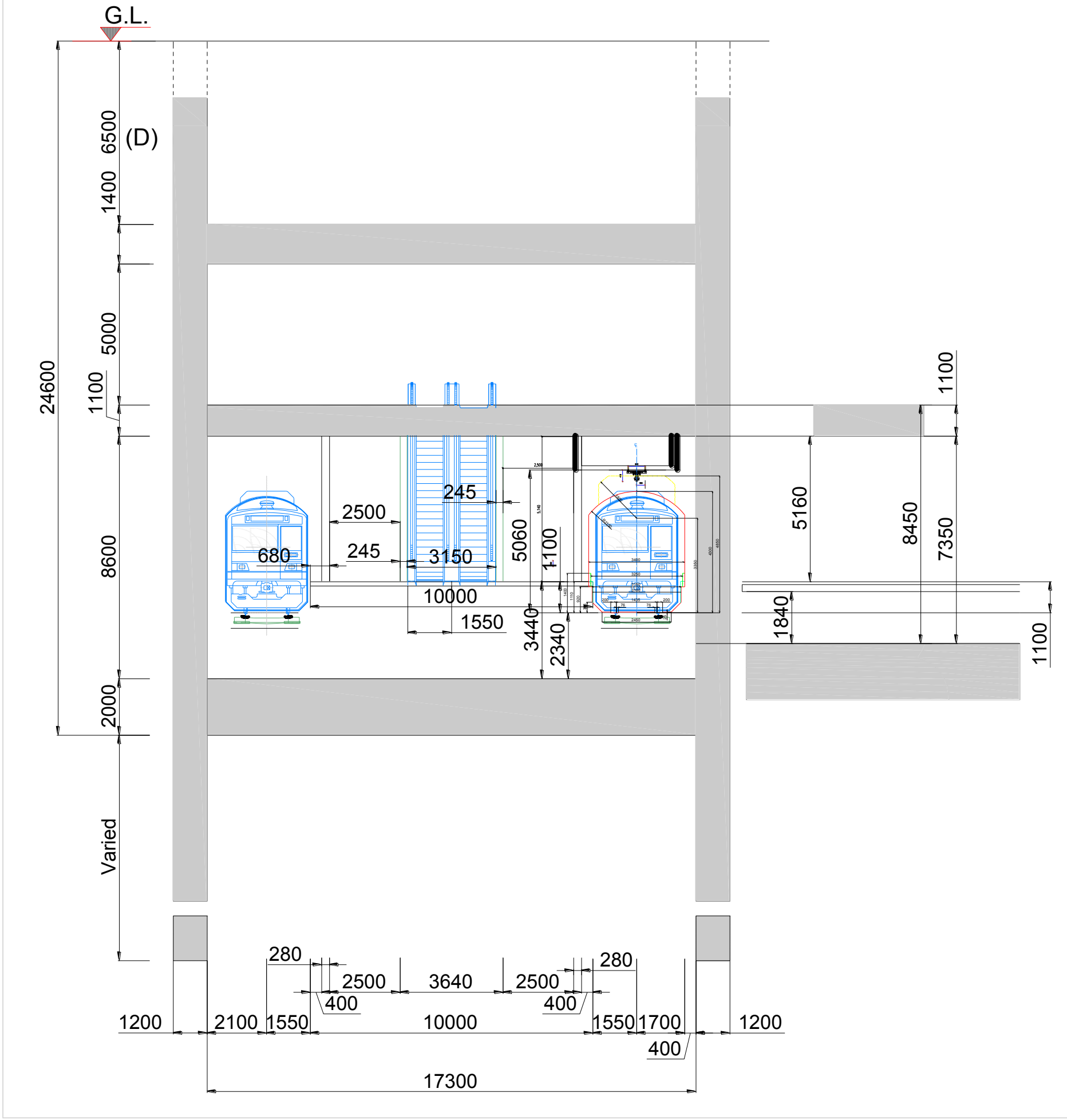
A standard type of station is basically 2 levels with an island platform in an underground section which can accommodate facilities. Taking into account the liner type, Malibagh station and Nadda station consist of 3 levels in the underground section, whose overhead clearance at the B1 floor is 5m in consideration of the facilities.

Tracks are located at the B2 floor and the width of the platform is 11 m for platform screen doors and the length is 180 m corresponding to 8 cars.

Taking into account the structures above, the width of the station is about 20 m and 2 pillars are put in. The ends of the station accommodate the shaft for departure or arrival of the TBM, so the widths are slightly wider.

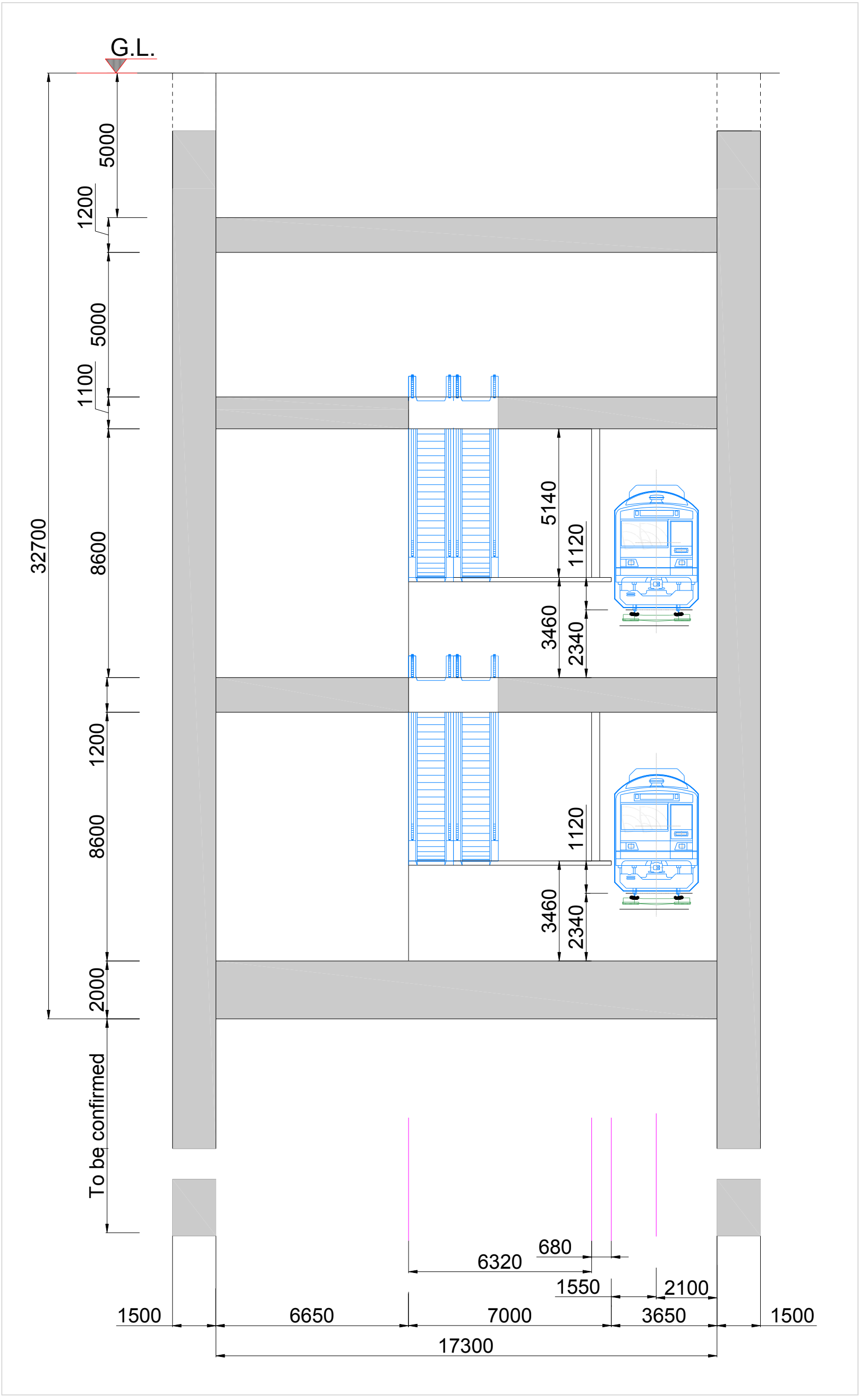
Exits to the ground level, a ventilation tower, and a drain pump etc. will be installed in each station accordingly.

Underground stations will be constructed as open cut method. Inner length and width of a station must be 250 m and 20 m. The standard station will be constructed in the 2 level whereas special station will be constructed in the 3 level. There is a provision of joining the MRT Line- 1 and MRT Line-6 in the Kamlapur station. The vertical depth of the standard station varies from 16 m to 18.6 m whereas special station depth will be up to 28 m. The typical cross section of Standard station and special station are shown in the following **Figure 3-5** and **Figure 3-6**, respectively.



Source: NKDOS

Figure 3-5: Cross Section of Standard Underground Station



Source: NKDOS

Figure 3-6: Cross Section of Special Underground Station

3.8 Rolling Stock

An eight-car train will be manufactured to meet the traffic forecast demand for Line 1 of the Dhaka Mass Rapid Transit System. Rolling Stock Specifications are shown in the following **Table 3-4**. Initially, 25 trains with 8 cars will be produced under this JICA project. Specifications may change in course of design finalization and will be updated later as part of addendum.

Table 3-4: Specifications of Rolling Stock

Item	Description	Specification
Line Profile	Track Gauge	1,435mm
	Minimum curve radius on a main track	160 m
	Design speed	110 km/h
	Maximum train operating speed at the elevated section and at the underground section	100 km/h 80km/h
Car body dimension	Body Length of Middle car	20,000 mm
	Body Length of End car	20,300 mm
	Body Width	Within 3,000 mm
	Floor height (above rail level)	1,150 mm
	Car body material	Stainless steel or aluminum alloy
Passenger Doors	Number of Passenger Doors per Car Side	4
	Width of Passenger Door	1,300mm
	Height of Passenger Door	1,850mm
Bogie	Gauge	1,435 mm
	Distance between two bogies	13,800 mm
	Bogie wheel Base	2,100 mm
	Wheel Diameter	860 mm
Passenger Capacity (Pax = passengers)	2332 pax. at 180% congestion ratio	
Power Requirements	Peak per Train (Approximate)	6.0 MW
	Average per Train (Approximate)	4.2 MW
Air Conditioning	Self-Contained Package Type	-
	Saloon Interior Temperature	24˚C
	Saloon Interior Relative Humidity	60%
Train Information System	On Board Information for the Train Driver and On-Board diagnostics for Maintenance	-

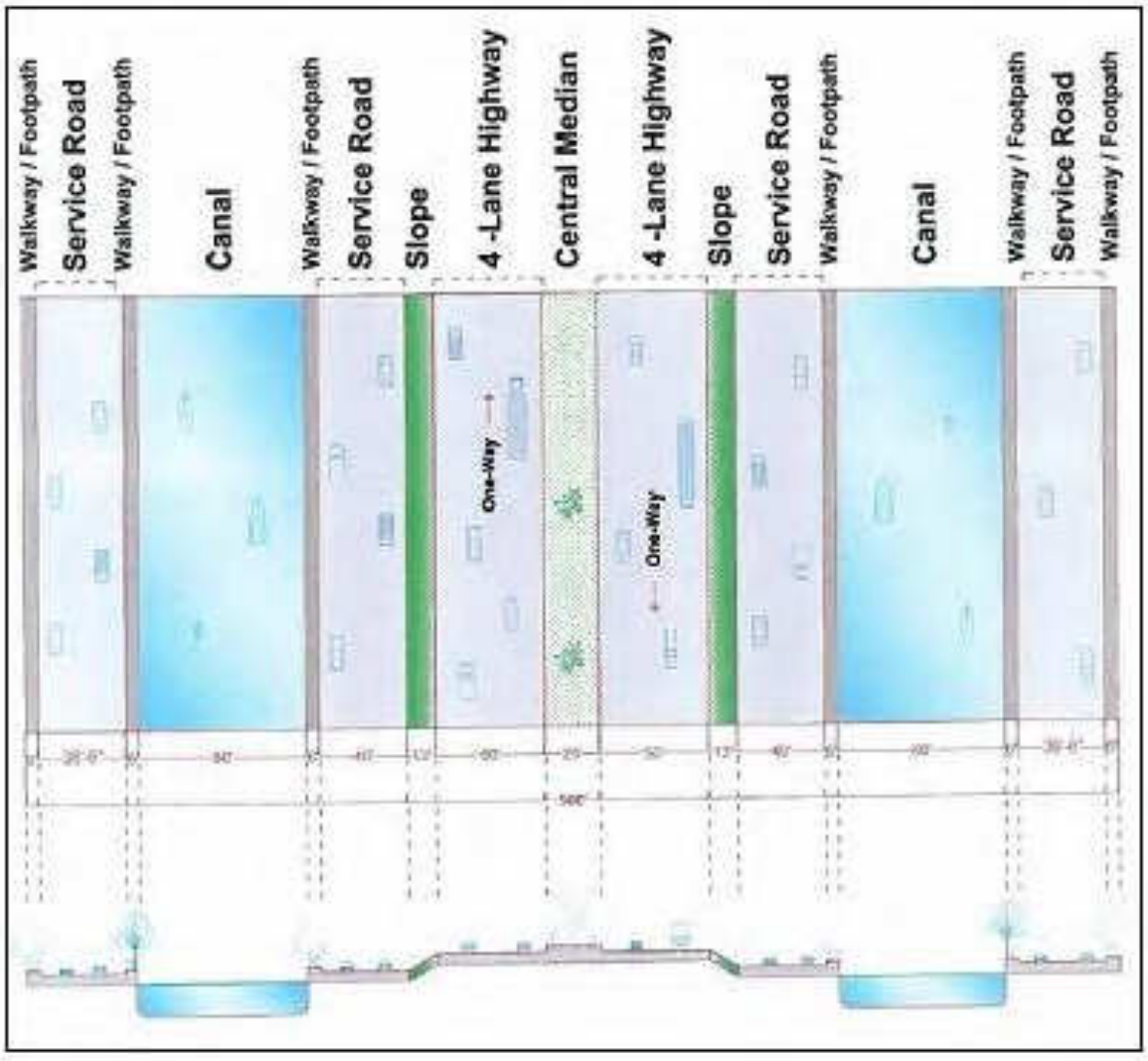
Source: NKDOS

3.9 Construction Methodology

3.9.1 Elevated Structure

The Dhaka MRT Line-1 will adopt the PC box girder as the standard superstructure instead of PC-I section girder in consideration of its workability in an urban area, short construction period and high rigidity. The PC one shell type box girder will be adopted in MRT Line-1 because of lighter weight and easy maintenance. Further, optimum length of Girder will be 30m as a result of comparison study among several lengths and their construction costs. In consideration of the effects on road traffic, MRT Line-1 will adopt the same type of Girder on the Purbachal Line.

Purbachal elevated line will be constructed through the center line of the road whose width in total is 500 ft. and there have a provision of two canals at both sides of the road. Currently, these canals are under construction, the Highway at the centre of the road and the service roads on both the sides are under construction. Then, this line will contain 6 river bridges. There is a big bridge over Balu River whose width is about 100m and the amount of water is huge and the others are relatively small bridges. **Figure 3-7** shows the road plan along the Purbachal Line.



Source: DTCA

Figure 3-7: Road Plan along the Purbachal Line

3.9.2 Underground Structure

Tunnel Construction

Since tunnel will be constructed with a close proximity of building and other infrastructures, sophisticated machines and highly skilled tunnel excavation workers would be needed. To conduct safe construction, Closed Face Shield Machine will be used. Among several types of Tunnel Boring Machine (TBM), 'slurry pressure type shield machine' is recommended as it can meet desired requirements.

Underground Station Construction

Underground stations will be constructed through open-cut (cut and cover) method. Cut and cover construction involves using excavation equipment to dig a large trench or rectangular hole in the ground which is then covered by a concrete deck. Once the deck is in place, surface activity can largely resume as construction works continue below. During construction of the stations, poured concrete or pre-cast panels are used to form the various levels and internal structures, similar to the construction of the underground basements of high-rise buildings. At first, Diaphragm Wall will be installed at both sides of the station. Secondly, excavation will be started and steel strut will be installed. Then, deck will be placed for vehicle movement and construction works will be continued beneath the deck.

With reference to the geotechnical data obtained from the boring at the Kuril fly-over, D-wall shall be adopted for the following reasons.

- Less noise or vibration to surrounding residences
- High rigidity
- Further taking into account water proofing, and construction cost saving, the D-wall shall be used as a permanent structure. Then the underground station boxes are constructed by the Open-cut method.

3.10 Project Activities

The activities of MRT Line-1 Project can be divided into three phases, e.g., pre-construction phase, construction phase, and operation phase. The major activities involving in these phases are listed below:

Pre-construction Phase

- Selection of final route alignment. (Route is selected by the JICA feasibility study team)
- Planning and Utility Diversion specially in the open cut area and viaduct section if there is any utility line
- Land acquisition for the depot area as well as road side area where underground station will be constructed by open cut method
- Preparation of construction site

Construction Phase

- Depot construction
- Tunneling from Kamlapur station to Airport Station
- Elevated line construction from Joar Sahara to Purbachal Terminal Station
- Station Construction (12 underground stations construction by open cut method and 7 elevated station construction)
- Manufacturing of girder for elevated section and RC segment for underground tunnel in the construction yard

Operation Phase

- Test run of the MRT Line-1
- Commercial operation
- Maintenance of the station
- Washing and repairing of the train in the depot
- Automatic ticketing system maintenance
- Maintenance of the continuous power supply system
- Implement the environmental management plan

3.11 Project Schedule

The civil and architectural works of viaducts and stations of elevated portion as well as tunnel and stations of underground portions may start from early 2022. It is expected that the civil and architectural works, electrical and mechanical works, rolling stock works will be completed by 2028. After successful trial run, commercial operations will commence.

3.12 Resources and Utilities Demand

3.12.1 Land Requirement

A preliminary Resettlement Action Plan (RAP) report of MRT Line-1 was prepared during the F/S. Many of the Project components were not finalized during the F/S. Thus, RAP is being updated now. It is reported that around 39 ha land will be required for depot (including depot access corridor). Some additional land will be required in different pockets along the route, mainly in the station areas for entry/exit, ventilation shaft, etc. RAP is being updated now and correct values will be known after completion of RAP.

3.12.2 Water Requirement

The water requirement during the construction stage will be calculated during the detail design stage. Water requirement during operation stage has been estimated as 575,000m^3/year.

3.12.3 Electricity Requirement

Based on preliminary estimation, the electricity requirement for train operation is 467MWH/Year and 38million KWH/year for station operation. Exact values will be known after the completion of detail design.

3.12.4 Manpower Requirement

An approximate number of 10,000 staff will work at one time at its peak construction. During operation period, about 1000 staff will be required.

3.12.5 Raw Material Requirement

Huge quantity of cement, aggregate, iron bar, ballast, wood will be required during the construction stage. The quantity of raw materials will be estimated during the detail design stage.

3.13 Cost Estimation

As per the Project's Development Project Proposal (DPP), total implementation cost was estimated at BDT 52,561 cr (about USD 6.5 billion, considering 80 BDT to 1 USD), of which, approximately ~75% is expected to be financed by JICA (BDT 39,450 cr, USD 4.9 billion), while GOB will contribute ~25% (BDT 13,111 cr, USD 1.6 billion).

3.14 Alternative Analysis

3.14.1 No Project Scenario

This sub-section describes whether there would be any benefit if the project is not implemented. In Dhaka Metropolitan Area (DMA), chronic traffic congestion has become significant problem. Expected population increase and economic growth will cause expansion of traffic congestion, deterioration of environment and economic loss.

In case that MRT Line-1 is not implemented, no land acquisition and involuntary resettlement are expected. However, sustainable growth of local industry will be hampered. The environment of the area will deteriorate further by the traffic congestion and air pollution. The population of Dhaka is growing day by day through reproduction and rural-urban migration. In the perspective of a fast-growing city, the metro rail is the most favorable alternative to facilitate a sustainable public transportation system.

The benefits of a metro rail system include:

1. Requires 1/5th energy per passenger/km compared to road-based system;
2. Causes no air pollution in the city;
3. Causes lesser noise level;
4. Occupies no road space if underground and only about 2 meters width of the road if elevated;
5. Carries same amount of traffic as 5 lanes of bus traffic or 12 lanes of private motor cars (either way), if it is a medium capacity system;
6. Metro rail is more reliable, comfortable and safer than road-based system;
7. Reduces journey time by between 50% and 75% depending on road conditions;
8. Provides benefits in terms of savings in road infrastructure.

Some negative impacts will not happen if the project is not implemented, but the benefit of the project may be more beneficial even with some negative impacts and their mitigation measures. In short, it can be concluded that the necessity of building this metro rail in Dhaka is inevitable.

3.14.2 Comparison of Structure Types

3.14.2.1 Selection of Structure Type for Kamalapur-Airport Section

Considering the vicinity of the alignment, the study team examined following three structures of the Airport line during feasibility study (See **Figure 3-8**).

Plan A: All sections will have underground structures.

Plan B: The section between Kamlapur Station and Malibagh Station, underground structure; other sections, elevated structure.

Plan C: The section between Kamlapur Station and Malibagh Station, underground structure; the section between Rampura Station and Natun Bazar Station, elevated structure; the section between Nadda Station and Kuril flyover, underground structure; and the remaining section, elevated structure.

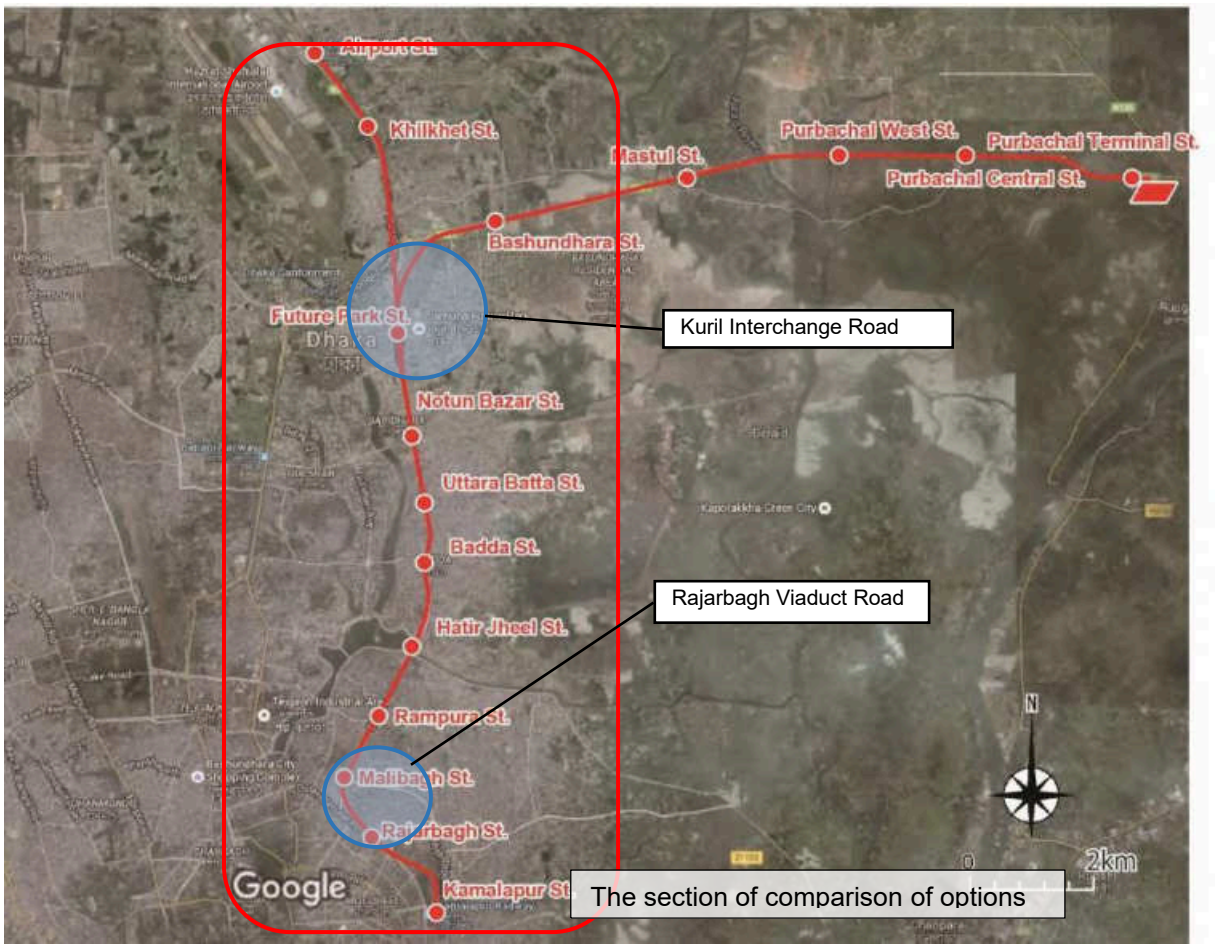
The above plans were compared in terms of the following aspects:

- Social Environment: land acquisition, affected households
- Biological Environment: protected area, biological diversity (marsh), flood risk, landscape
- Pollution Prevention: noise/vibration, air pollution, water pollution, ground settlement

- ❖ Technical Aspect: construction cost, road traffic, construction difficulty, convenience for passengers

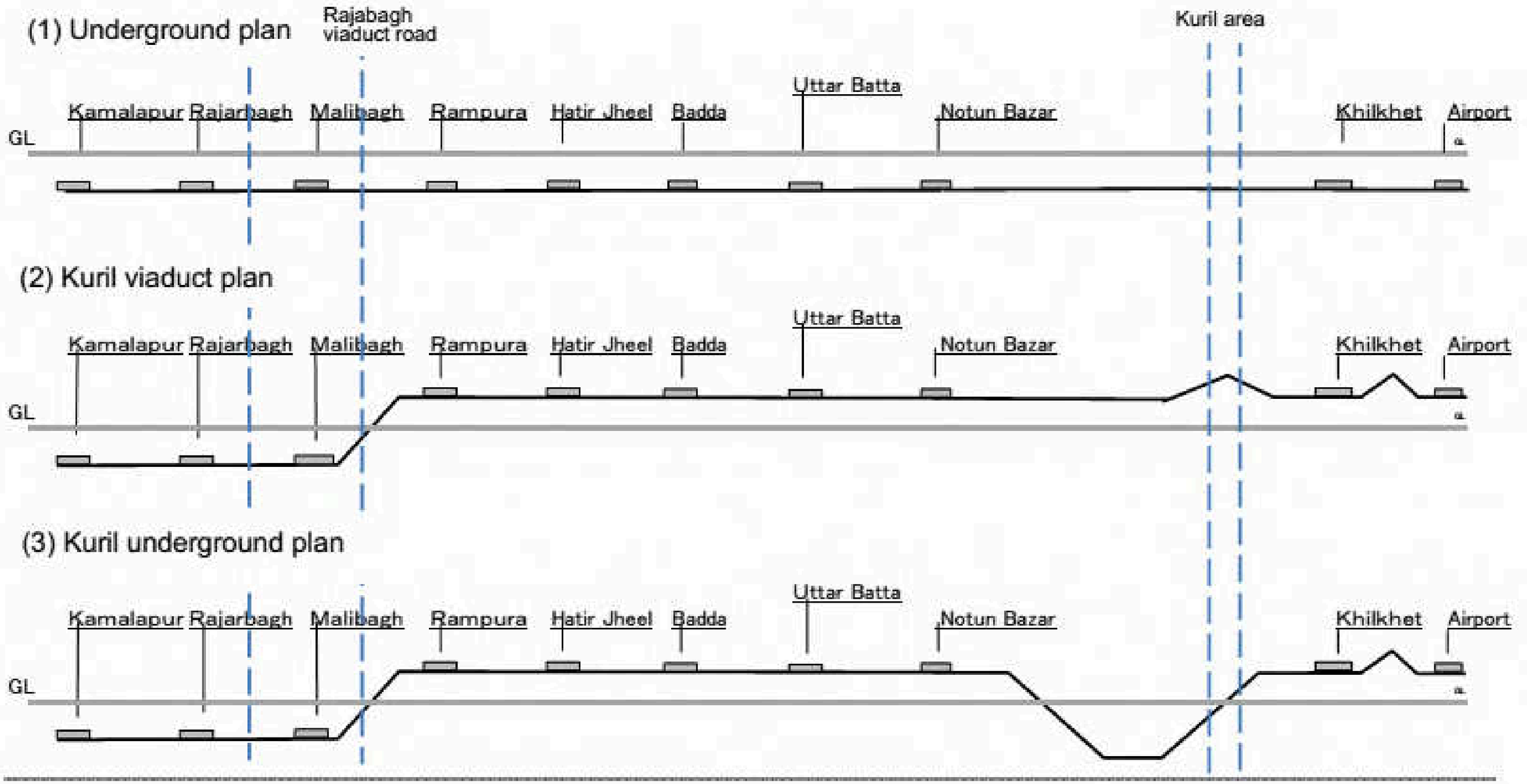
Since the project is a railway which passes through the urban area of Dhaka city, major criteria are avoidance or minimization of negative impacts on living environment of local resident, pollution control and social environment including land acquisition and involuntary resettlement.

The results of the comparison are shown in **Figure 3-9**. The underground plan is superior to the other options on air pollution, noise and vibration. The underground plan occurs the most excavation soil than the other options. However, because negative impacts on the environment and health can be minimized under appropriate management of excavation soil, the underground plan is recommended.



Source: Feasibility Study Report, 2018

Figure 3-8: Scope of Kuril viaduct plan and Kuril underground plan



Source: Feasibility Study Report, 2018

Figure 3-9: Structure of the Options

3.14.2.2 Selection of Structural Shape for Kuril to Purbachal Section

Three types of structural shape, e.g. elevated structure, underground structure, and banking are proposed for MRT Line-1. A comparison of different structure types is given in **Table 3-5**. Considering the characteristics of three types of structure, elevated structure is selected for Purbachal line.

Table 3-5: Comparison of Structure Type

Items	Elevated Structure	Underground Structure	Banking
Outlook			
Social Environment			
Land Acquisition	If the road shape is smaller than the curve radius, land acquisition for MRT is necessary	Excluding incidental facilities of station building, ventilation tower, etc. No land acquisition required.	On current routes, the impact of embankment is enormous.
Number of affected households	A lot	Least	Quite a lot
Width of Land	Width of the site at completion is around 2.5mm between stations.	Basically, it is unnecessary in the inter-station area.	Width of the site at completion is about 16m between stations
Natural Environment			
Protected Area	There are no protected areas along the railroad tracks. There is a river (Balu River) designated as ECA, and it is necessary to prevent further deterioration of the environment	There are no protected areas along the railroad tracks. Although there is a river (Balu River) designated as ECA, there is no influence due to the underground structure.	There are no protected areas along the railroad tracks. There is a river (Balu River) designated as ECA, and it is necessary to prevent further deterioration of the environment.
Biodiversity	Nature such as vegetation remains in the Purbachal area, but it is presumed that there is no big influence.	Nature such as vegetation remains in the Purbachal area, but due to the underground structure, the influence is estimated to be very small.	Nature such as vegetation remains in the Purbachal area, but it is presumed that there is no big influence. Because of the embankment structure, there is a possibility that the movement of animals may be obstructed
Risk of flood	No special measures are necessary.	• An emergency drainage system (pump) is placed. • Flood gates required	• There is a possibility that the embankment will stop the drainage. Additional drains are needed to minimize floods.
Pollution Control			
Noise (Vehicles outside)	Noises are generated along the railroad tracks.	There is no noise along the	Noises are generated along the railroad tracks.

Items	Elevated Structure	Underground Structure	Banking
	However, it can be mitigated by installing soundproof walls.	railway	However, it can be mitigated by installing soundproof walls.
Noise (Vehicles inside)	Small	Very big	Small
Air Pollution	There is concern about the impact of exhaust and dust of construction machinery during construction.	The impact of exhaust and dust of the construction machinery at construction is the smallest.	The impact of exhaust gas and dust of the construction machinery during construction gives much cause for concern.
Water pollution	There is a river (Balu River) designated as ECA, and it is necessary to prevent further deterioration of the environment.	There is a possibility that groundwater will be affected during construction. Although there is a river (Balu River) designated as ECA, there is no impact due to the underground structure.	There is a river (Balu River) designated as ECA, and it is necessary to prevent further deterioration of the environment. It is necessary to pay attention to the generation of turbid water from the embankment.
Ground subsidence	No ground subsidence occurs.	There is a possibility of ground level subsidence during tunnel excavation.	There is a possibility of ground subsidence in soft ground.
Construction Period	Shorter than underground structure	The longest	Can be shortened if ground improvement is not required.
Technical aspect			
Construction Cost	Inexpensive compared to the underground structure	Extremely expensive	Cheaper than elevated structure
Operation/ Maintenance	Easy access and easy maintenance	• High maintenance cost. • Periodic inspections should be conducted, in particular, leakage investigations that cause electrocution.	Easy access
Disaster Prevention	• Relatively safe • Easy in comparison with underground structure	Fire in a tunnel will be a big problem.	• Relatively safe • Easy in comparison with underground structure
Earthquake Resistance	The structure is designed in consideration of the seismic load	Subsurface structures are difficult to be affected by earthquakes, but underground structures are designed in consideration of the seismic load.	The embankment structure is designed in consideration of the seismic load.
Scenery from a Window	Good	Not good	Good
Landscape	The shape of the structure must be designed in consideration of the landscape.	There is no influence on the landscape.	The shape of the structure must be designed in consideration of the landscape.

Items	Elevated Structure	Underground Structure	Banking
Physical Condition	It is necessary to build structure to avoid bridges over the Balu River	It is necessary to make it linear so as to avoid the piles of the six existing bridges	Even if it is reinforced embankment, the impact on the road is serious. In addition, underpass is necessary in order not to provide a railroad crossing
Overall Assessment	Evaluated comprehensively, it is the most suitable structure.	There is no merit corresponding to cost.	The impact on the road is serious, and merit is little compared with the elevated structure.

Source: Feasibility Study Report, 2018 (Table 4.5.1)

CHAPTER 4

4 ENVIRONMENTAL BASELINE

4.1 Introduction

Environmental baseline surveys determine the characteristics of an area prior the development of a project and establish the initial environmental status. More specifically, baseline data describes the current physical, biological, and socioeconomic conditions of the immediate area and any area the project is predicted to affect. A baseline study is essential to determine the level of impact expected and to enable the monitoring of impacts after the development has occurred. Data for this chapter are collected from both primary and secondary sources. The primary source of data includes field survey, laboratory testing, and public consultation. On the other hand, secondary source of data includes literature review, maps, previous reports, journals, etc.

Baseline data are the data collected about various factors of the project study. This includes:

- **Physical**: the area, the soil properties, the geological characteristics, the topography, watershed properties, etc.;
- **Physico-chemical**: water, air, noise levels, etc.;
- **Biological**: factors related to life such as habitats, aquatic life, fisheries, terrestrial habitats and flora and fauna;
- **Socioeconomic**: demography, social structure, economic conditions, developmental capabilities, displacement of locals, etc.;
- **Cultural**: Location and state of archaeological and or religious sites.

A baseline study was conducted during the preparation of initial EIA report in 2017. Environmental parameters change over the time, because the influencing factors are changing. Moreover, the project has now entered into design phase and many of the project components have been updated and finalized. Therefore, the present baseline study has been conducted as part of the updating of EIA report. The following sections present the findings of both previous and current baseline study, wherever applicable.

4.2 Surface Water Quality

Surface water samples have been tested for two times. Firstly, samples were taken during baseline survey of preparatory EIA study in 2017. Then, surface water samples were taken again during the supplemental environmental baseline study in 2019. The findings of both studies are given below.

4.2.1 Methods

Water samples were collected as grab water sample in a pre-washed 5-litre plastic jerry can and 1-liter sterilized clean PET bottle for complete physico-chemical tests respectively.

The samples were analyzed as per standard procedure/method given in Standard Method for Examination of Water and Wastewater Edition 20, published by APHA. Details of the analysis method and protocol are presented in **Table 4-1.** The samples were analyzed for parameters covering Bacteriological and physico-chemical characteristics which include certain heavy metals and trace elements.

Table 4-1: Methods of Water Parameter Analysis

Sl.	Parameter	Test method
1.	Temperature (˚C)	Digital thermometer
2.	pH	Hanna Combo Meter (Temperature, pH, EC, TDS)
3.	Dissolved Oxygen (DO)	Lutron 5509 Dissolved Oxygen Meter
4.	Biochemical Oxygen Demand (BOD)	5 Day Incubation
5.	Chemical Oxygen Demand (COD)	CRM
6.	Coliform (Fecal)	MFM
7.	Colour	UVS
8.	Total Suspended Solid (TSS)	Gravity Multimeter
9.	Total Dissolved Solid (TDS)	Ion Electrode Method

Note: AAS: Atomic Absorption Spectrophotometer, UVS- UV- Visible Spectrophotometer, MFM- Membrane Filtration Method

The quality of surface water was compared with the standards for Inland Surface Water, Environment Conservation Rules (ECR), 1997-Schedule 3 (a). The standards have been presented along with the monitoring results of surface water quality for comparison.

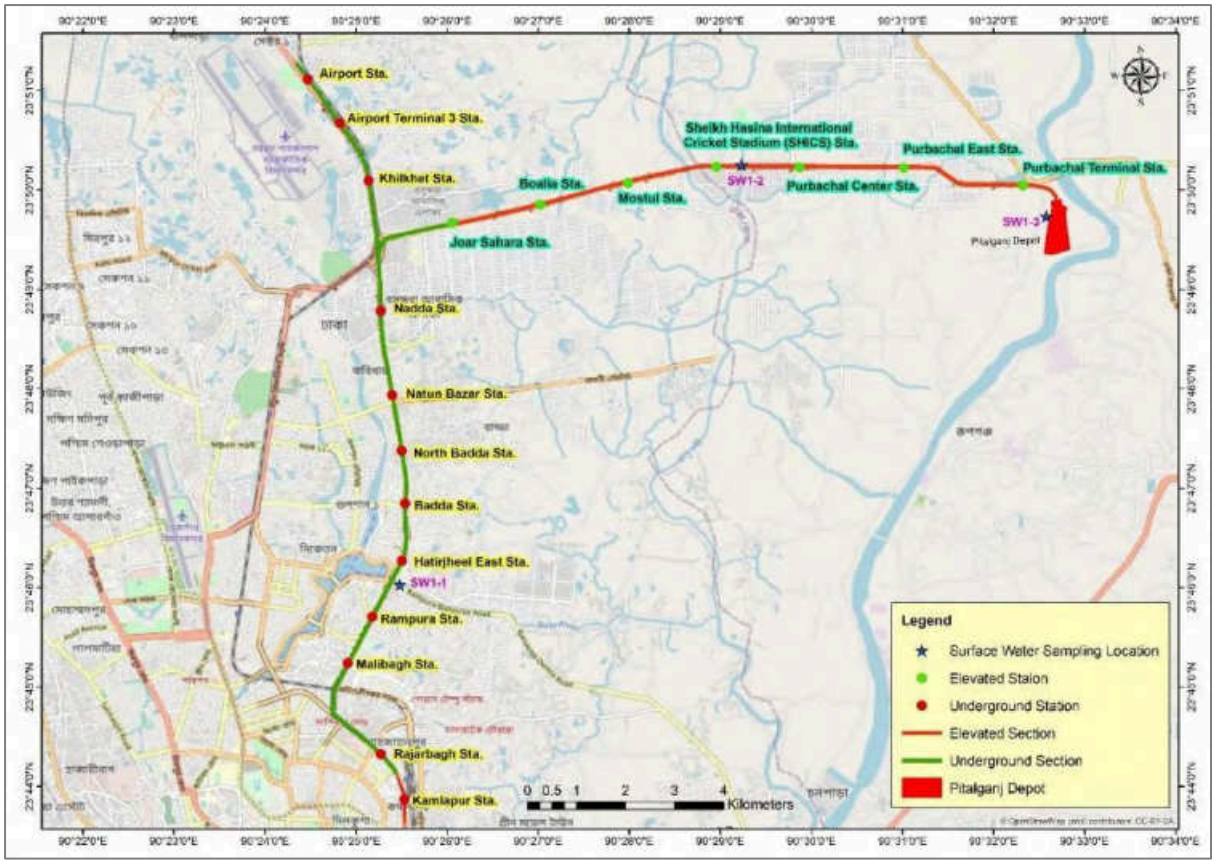
4.2.2 Baseline Study 2017

Surface water samples were taken once from 3 different locations for MRT Line-1. Surface water samples were collected from 19th to 22nd March 2017. Detail Sampling Locations are provided in the following **Table 4-2** and depicted in **Figure 4-1**.

Table 4-2 : Surface water Sampling Location of MRT Line-1 in 2017

No.	Location	Geographic Coordinate
SW1-1	Hatirjheel Canal	23° 46.033'N 90° 25.481'E
SW1-2	Balu River	23° 50.251'N 90° 29.235'E
SW1-3	Depot Site of Line 1	23°49'44.1"N 90°32'34.9"E

Source: EIA Report of MRT Line-1, 2017



Source: EIA Report of MRT Line-1

Figure 4-1: Surface Water Sampling Location of MRT Line-1 during EIA Study in 2017

Surface water quality of the collected samples is poor compare to the Bangladesh inland surface water quality standard. The main causes of the degraded water quality are liquid waste discharge as well as sewage discharge in the surface water body. The Surface water quality of MRT Line-1 is shown in the **Table 4-3.**

Table 4-3: Surface Water Quality Analysis Result during EIA study in 2017

Parameter	Unit	SW 1-1	SW 1-2	SW 1-3	Standard for Inland Surface Water*					
					a	b	c	d	e	f
Colour	Hazen	1.1	1.3	3.2	-	-	-	-	-	-
Temperature	˚C	26.9	28.7	28.5	-	-	-	-	-	-
pH	-	7.37	8.43	7.42	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
DO	mg/l	1.5	3.2	2.4	6 or above	5 or more	6 or more	5 or more	5 or more	5 or more
BOD	mg/l	24	12	7	2 or less	3 or less	6 or less	6 or less	10 or less	10 or less
COD	mg/l	88	44	32	-	-	-	-	-	-
TSS	mg/l	46	31	15	-	-	-	-	-	-

Parameter	Unit	SW 1-1	SW 1-2	SW 1-3	Standard for Inland Surface Water*					
					a	b	c	d	e	f
Coliform (Fecal)	N/100ml	1080	996	33	50 or less	200 or less	5000 or less	---	5000 or less	1000 or less
TDS	mg/l	540	140	160	-	-	-	-	-	-

EQMS laboratory (for Temp., pH, DO, TDS) and Department of Public Health and Engineering Lab (for BOD, COD, Coliform, Colour, TSS); Analysis date: 22/03/2017- 30/04/2017 and 30/04/2017-22/05/2017

*Note: Standards are from ECR 1997-Schedule 3(a) as follows:
a- Source of drinking water for supply only after disinfecting
b- Water usable for recreational activity
c- Source of drinking water for supply after conventional treatment
d- Water usable by fisheries
e- Water usable by various process and cooling industries
f- Water usable for irrigation

Source: EIA Report of MRT Line-1

From the **Table 4-3**, pH concentration of the surface water in all the samples did not cross the Bangladesh standard. BOD and COD concentration of all the samples are very high. Dissolved Oxygen levels of all samples are less compared to the inland surface water quality standard of Environment Conservation Rules (ECR), 1997-Schedule 3 (a). TSS concentrations of all samples are very high.

Fecal coliform concentrations are very high in all samples except SW 1-3 and cross the Bangladesh standard limit. The result indicates surface water contamination by human activities.

4.2.3 Supplemental Environmental Baseline Study 2019-2020

Locations of Surface Water Sampling

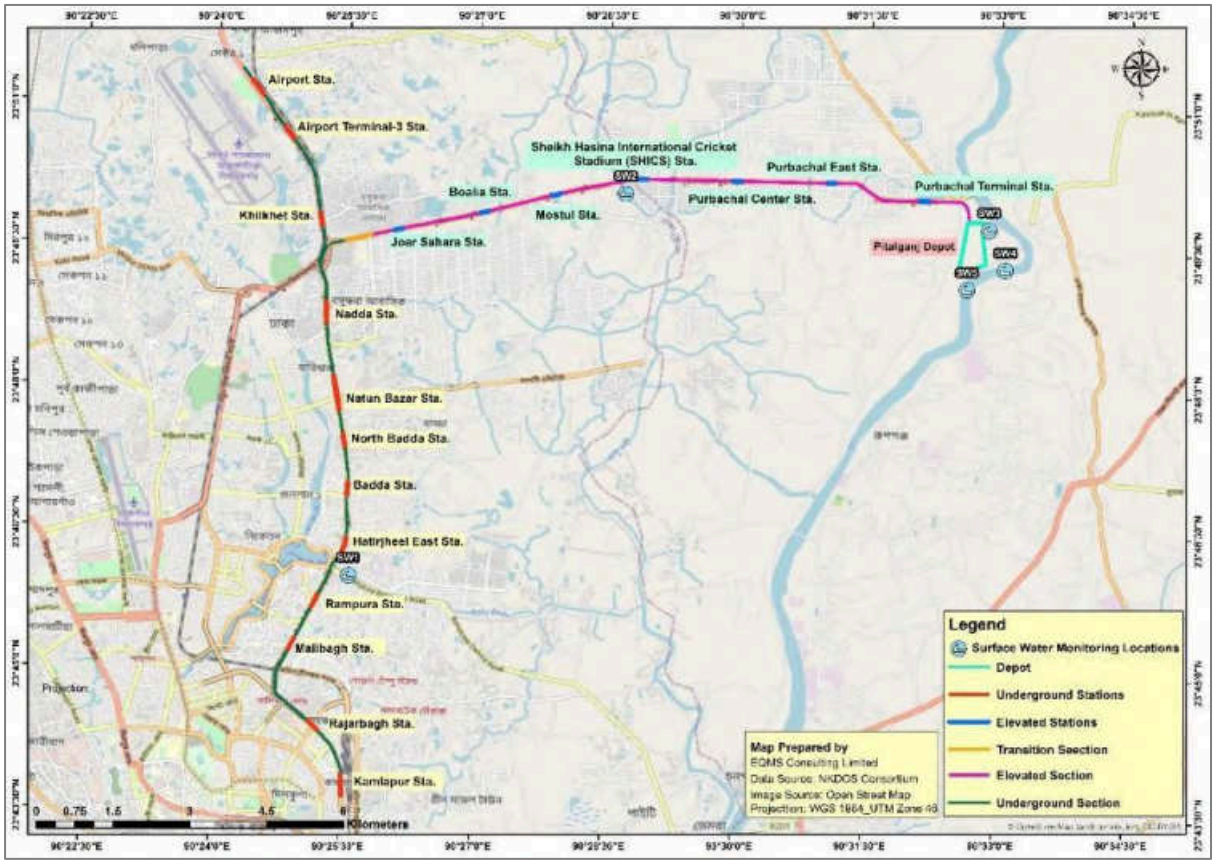
Surface water samples have been collected from five locations on November 27, 2019. The locations have been selected considering the streams flowing and crossing through MRT Line-1 alignment. **Table 4-4** shows the name of locations with their coordinates. Rampura Canal is a narrow stream that crossed the MRT Line-1 alignment at Rampura Bridge and meets Hatirjheel Lake. This canal generally drains surface runoff and point source pollution discharge from sewerage drains. The second surface water sample was taken from Balu River. The sampling point is situated at the southern side of alignment and nearer to the SHICS Station. There is a pond at the north-eastern part of depot. The third surface water sample was taken from the pond. The Purbachal Depot is situated on the right bank of the Shitalakhya River. Therefore, there is a possibility that the construction works might contribute to the pollution of the river water. Hence, two samples were taken from the river, including one sample from upstream and another from downstream of the river. It is noted that the river is already polluted due to industrial discharge in the river. The water samples were collected during dry season and the color of water was natural during sample collection in all water body except Balu River, which was murky at the time of sample collection. **Figure 4-2** shows the map of sampling points.

Table 4-4: Surface Water Sampling Location during Supplemental Environmental Baseline Study

No.	Location	Geographic Coordinates
SW1	Rampura Canal (Downstream Point)	23°45'59.52"N 90°25'34.44"E
SW2	Balu River	23°50'4.96"N 90°28'41.37"E

No.	Location	Geographic Coordinates
SW3	Pond in Depot Site	23°49'45.42"N 90°32'52.96"E
SW4	Upstream of Shitalakhya River	23°49'20.11"N 90°33'4.41"E
SW5	Downstream of Shitalakhya River	23°49'7.30"N 90°32'38.07"E

Source: Field Survey 2019



Source: Field Survey 2019

Figure 4-2: Surface Water Sampling Locations during Supplemental Environmental Baseline Study

Results of Surface Water Testing

Surface water samples were taken in dry season, when surface water pollution is most. It is recommended that the contractor should take surface water sample again prior to starting of construction works and will submit to the Consultant and Employer. The testing results of surface water samples is shown in **Table 4-5**. The results show that the level of pH varies from 7.21 to 7.86, while the standard level of pH is 6.5 to 8.5 as per the ECR 1997. The temperature of surface water sample ranges from 26.1 to 28.9°C. The concentration of DO indicates that water collected from Rampura Canal, Balu River, and Downstream of Shitalakshya River have lower concentration of DO in comparing to standard level. On the other hand, water sample collected from the Pond at Depot and Upper stream of Shitalakshya River comply the DO standard of Bangladesh. This finding implies that the water of Rampura Canal, Balu River and Downstream of Shitalakshya River has higher amount of pollutants, i.e. organic materials that consumed more volume of dissolved oxygen. In case of BOD, only one location out of five, e.g. Rampura Canal shows higher concentration of BOD, while other locations complied with the standard limit. The higher concentration of BOD means the presence of higher amount of organic pollutants that require higher volume of dissolved

oxygen to breakdown. The concentration of COD in all locations extends from 4 to 88 mg/l. The highest of concentration of COD is found in Rampura Canal that suggest high pollution in this water body. The baseline study also assessed the level of TSS in all sampling locations. Among five sampling locations, Rampura Canal shows the maximum concentration of TSS. Another two parameters, color and TC, have also been measured and the results are shown in **Table 4-5**. It is noted that there is no standard of COD, TSS, and Color for inland water body in environmental conservation rules of Bangladesh. Surface water test result lab sheet is presented in **Appendix-B**.

Table 4-5: Surface Water Quality Analysis Result during during Supplemental Environmental Baseline Study in 2019

Parameter	Unit	SW1	SW2	SW3	SW4	SW5	Standard for Inland Surface Water*					
							a	b	c	d	e	f
Colour	Hazen	37.5	24	17.1	4.2	5.1	-	-	-	-	-	-
Temperature	˚C	26.6	27.8	26.1	28.9	28.4	-	-	-	-	-	-
pH	-	7.54	7.21	7.63	7.86	7.63	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
DO	mg/l	4.2	0.3	6.6	8.1	4.3	6 or above	5 or more	6 or more	5 or more	5 or more	5 or more
BOD	mg/l	24	2	3	1	1	2 or less	3 or less	6 or less	6 or less	10 or less	10 or less
COD	mg/l	88	8	12	4	4	-	-	-	-	-	-
TSS	mg/l	15	18	46	3	5	-	-	-	-	-	-
TC	N/100 ml	48	192	46	28	16	≤50	≤200	≤5000	-	≤5000	≤1000

*Note: ECR 1997 Schedule 3(a)

a- Source of drinking water for supply only after disinfecting

b- Water usable for recreational activity

c- Source of drinking water for supply after conventional treatment

d- Water usable by fisheries

e- Water usable by various process and cooling industries

f- Water usable for irrigation

4.3 Air Quality

Ambient air quality has been monitored two times. At first, air quality was monitored during preparatory EIA study in 2017. Later, ambient air quality is monitored again in 2019-2020 during supplemental environmental baseline study. The findings from both monitoring are given below.

4.3.1 Methods

The particulate and gaseous samples collected during the monitoring have been analyzed as per the procedures specified in **Table 4-6**. Total seven parameters (PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, Pb and O_3) of ambient air quality have been analyzed for each location.

Table 4-6: Methodology for Analysis of Ambient Air Quality

Sl.	Parameter	Analysis Procedure
1.	PM_{10}	Gravimetric method

Sl.	Parameter	Analysis Procedure
2.	$PM_{2.5}$	Gravimetric method
3.	SO_2	Colorimetric method at 560nm using spectrophotometer (West-Gaeke method)
4.	NOx	Colorimetric method at 540 nm using spectrophotometer (Jacob and Hochheiser method)
5.	Ozone (O_3)	UV Photometric
6.	Lead (Pb)	ED-XRF using Teflon Filter
7.	CO	Digital CO meter (HTC ™)

As per the national standard, O_3 and CO need to be monitored for 8 hours to compare with the national standard whereas standard for PM_{10}, $PM_{2.5}$ and SO_2, is 24-hour. NO_x and Pb need to be monitored for annual basis as per the national standard guideline. So, standard duration is varying from parameter to parameter. Considering all these issues, conversion factors have been used for the calculation of the parameters in the standard timelines from 8-hour monitoring period. Many agencies (e.g. New York State Dept. of Environmental Conservation, California Office of Environmental Health Hazards Assessment, USEPA, Ontario Ministry of Environment) face the same problems and have had to adapt by applying a conversion process using Pasqual's (1961) air mass dispersion tables defining six air mass stability classes (**Table 4-7**) and a set of meteorological conditions (**Table 4-8**). Using the simple power law principle Schroeder and Jugloff (2012) described the steps for converting eight-hour readings to 24-hour/annual values. (Schroeder & Jugloff, 2012). The stability classes (**Table 4-7**) are related to average wind speed, daytime solar radiation and night-time cloud cover (**Table 4-8**), refining these relationships, was also developed by Pasquill.

Table 4-7: Pasquill-Gifford Air Dispersion Stability Classes and Associated Dispersion Exponents[2]

Stability Class	P	Definition
A	0.5	Very Unstable
B	0.5	Unstable
C	0.333	Slightly Unstable
D	0.2	Neutral
E	0.167	Slightly Stable
F	0.167	Stable

Table 4-8: Pasquill-Gifford Air Dispersion Stability Classes and Associated Dispersion Exponents[2]

Surface Wind Speed		Day Time Incoming Solar Radiation		Night time Cloud Cover	
m/s	Strong	Moderate	Slight	>50%	<50%
<2	A	A-B	B	E	F
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
>6	C	D	D	D	D

[2] Julie Schroeder and Denis Jugloff (2012), Interpretation of 24-hour sampling data: Development of 24-hour ambient air quality criteria and their use in Ontario, Human Toxicology & Air Standards Section, Standards Development Branch, Ontario Ministry of the Environment, Toronto, ON, Canada

Weather data was not recorded during the monitoring period. So, from Bangladesh context, the annual average wind speed in Dhaka area is about <2 m/s. So, considering the wind speed, from **Table 4-8** (1st row as the average wind speed in all the area is <2 m/s), the Project stability class was calculated as 0.39 (see below):

$$P = \frac{0.5 + 0.5 + 0.167}{3}$$

$$= 0.389 \approx 0.39$$

The value of exponential factor is calculated based on the stability class of study area (**Table 4-7**). According to wind speed, the stability class of the study area is A, B, E, and F. Hence, the value of P will be average of the respected P values of these stability classes. This suggests a somewhat unstable air mass, resulting in considerable dilution of an eight-hour sample when spread out over a 24-hour period. In order to provide 24-hour averages for the five parameters, the following power-law equation as defined in Schroeder and Jugloff 2012 was applied:

$C_{long} = C_{short} (t_{short}/t_{long})^p$

Where,

C_{long} = Expected output in specific time period
C_{short} = Outcome during Monitoring Period
t_{short} = Specific time period during monitoring (in minutes)
t_{long} = Expected time period (in minutes)
p = Exponential factor where the value is 0.39

This generalized approach was applied to all data, and the 24-hour/annual averages generated in order to be able to compare Project results to GoB standards.

The air quality monitoring machine (Hazz scanner HIM 6000) has been run for 8 hours in peak traffic time (from 10.00 or 11.00 am to 6.00 or 7.00 pm) and the conversion equation was used to convert the data from specific time period to expected time period.

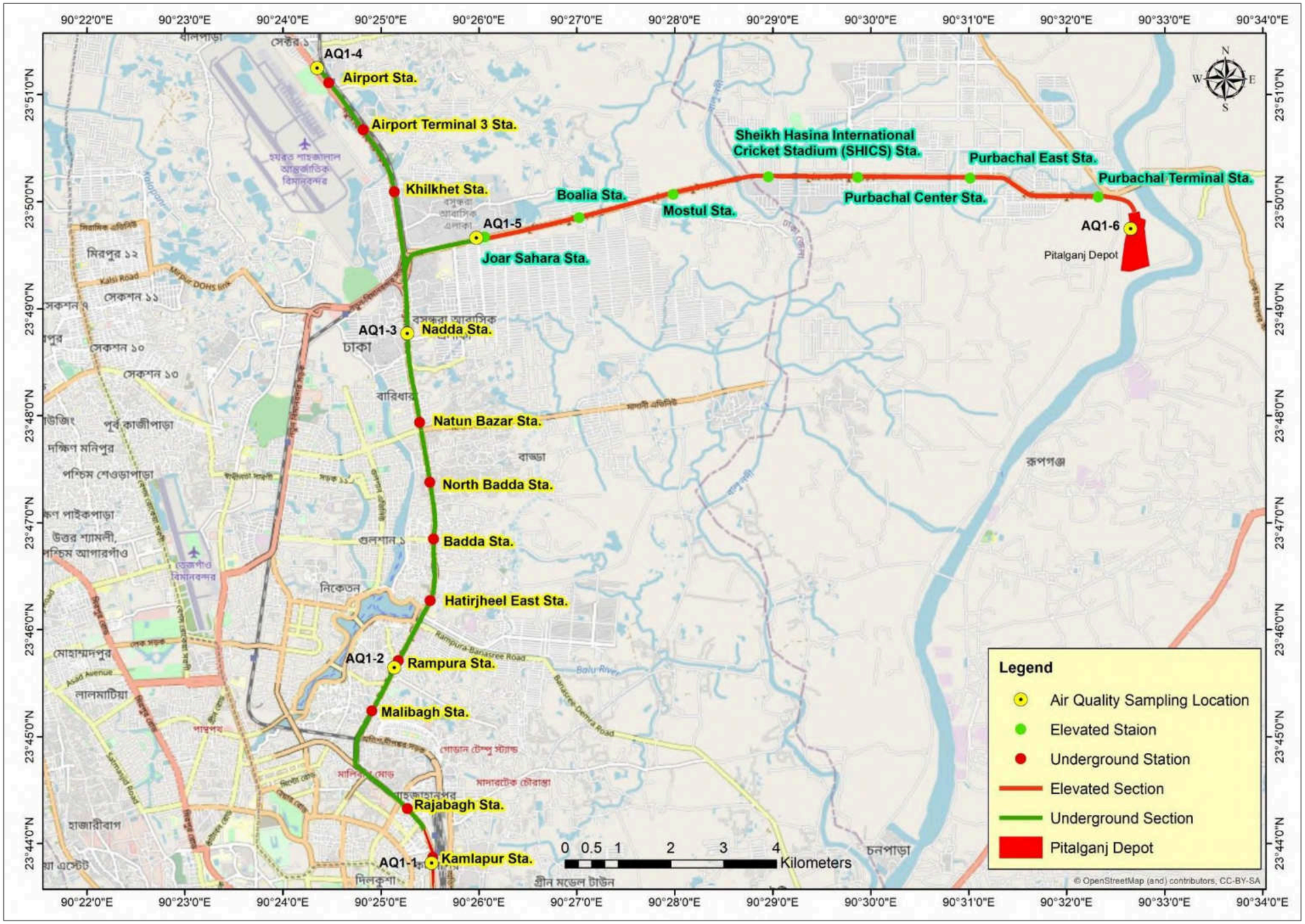
4.3.2 Baseline Study 2017

Air Quality Samples have been taken from total 6 different Locations for MRT Line-1. Air quality sampling locations is provided in the **Table 4-9** and depicted in **Figure 4-3**.

Table 4-9: Air Quality Sampling Location of MRT Line-1

No.	Location	Geographic Coordinate
AQ1-1	Kamlapur Station	23°43'48.99"N 90°25'31.01"E
AQ 1-2	Rampura Station	23°45'38.70"N 90°25'8.10"E
AQ 1-3	Nadda Station	23°48'46.1"N 90°25'16.2"E
AQ 1-4	Airport Station	23°51'14.9"N 90°24'20.9"E
AQ 1-5	Joar Sahara Station	23°49'39.7"N 90°25'58.5"E
AQ 1-6	Depot Site of Line 1	23°49'44.8"N 90°32'39.2"E

Source: EIA Report of MRT Line-1, 2017



Source: EIA Report of MRT Line-1

Figure 4-3: Air Quality Sampling Location of MRT Line-1 during EIA Study

Total seven parameters (PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, Pb and O_3) of ambient air quality have been analyzed for each location. Out of seven parameters, the PM_{10}, $PM_{2.5}$ concentration exceed the National Ambient Air Quality Standard (**Table 4-10**) in the Kamlapur, Rampura, Nadda and Airport stations of MRT Line-1 whereas NO_2 concentration exceeds the NAAQS in the Kamlapur, Rampura, Nadda station. Rest of the parameters (SO_2, CO, Pb and O_3) concentrations was present well within the NAAQS in all stations of MRT Line-1. The result of the Air Quality has been provided in **Table 4-11**.

Table 4-10: National Ambient Air Quality Standards for Bangladesh

Pollutant	Standard	Average Time
CO	10 mg/m^3 (9 ppm)	8 hours
	40 mg/m^3 (35 ppm)	1 hours
Pb	0.5 µg/m^3	Annual
NO_x	100 µg/m^3 (0.053 ppm)	Annual
PM_{10}	50 µg/m^3	Annual
	150 µg/m^3	24 hours
$PM_{2.5}$	15 µg/m^3	Annual
	65 µg/m^3	24 hours
O_3	235 µg/m^3 (0.12 ppm)	1 hours
	157 µg/m^3 (0.08 ppm)	8 hours
SO_2	80 µg/m^3 (0.03 ppm)	Annual
	365 µg/m^3 (0.14 ppm)	24 hours

Source: Environmental Conservation Rules 1997 and subsequent amendment in 2005

Table 4-11: Ambient Air Quality of MRT Line-1

Location	Present Concentration in µg/m^3						CO (ppm)
	PM_{10}	$PM_{2.5}$	NO_2	SO_2	O_3	Pb	
Kamlapur Station	310.7	125.4	112.6	21.2	20.6	0.07	4.9
Rampura Station	286.5	108.5	107.1	22.8	15.6	0.05	1.7
Nadda Station	231.2	95.7	103.4	17.0	13.4	0.03	0.8
Airport Station	275.6	103.6	98.4	17.6	10.2	0.04	0.6
Joar Sahara Station	123.4	58.4	43.2	11.3	6.6	BDL	0.1
Depot Site of Line 1	82.2	45.6	28.5	8.1	3.4	BDL	0.05
Standard ECR1997	**150**	**65**	**100**	**365**	**157**	**0.5**	**9**
Duration	24 hours	24 hours	Annual	24 hours	8 hours	Annual	8 hours

EQMS Laboratory, Sampling Date: 28th February, 2017 to 5th March, 2017, Analysis date: 1st-15th March, 2017

Note: BDL- Below Detection Limit

Source: EIA Report of MRT Line-1

Exceeding Standard Level

Test results are illustrated in **Table 4-11**. According to the ambient air quality test results, it can be summarized that the particulate matter is high in the project area. The value of PM_{10} and $PM_{2.5}$ of Kamlapur, Rampura, Nadda and Airport stations are higher than the standard limit of ECR'97. It could be the resultant of the surrounding environment in urban areas. NO_2 of Kamlapur, Rampura and Nadda stations are also higher than the standard limit of ECR'97. Whereas SO_2, CO, O_3 and Pb are well within the permissible limits compared to ECR'97 of GOB.

4.3.3 Supplemental Environmental Baseline Study 2019-2020

Monitoring Locations of Air Quality

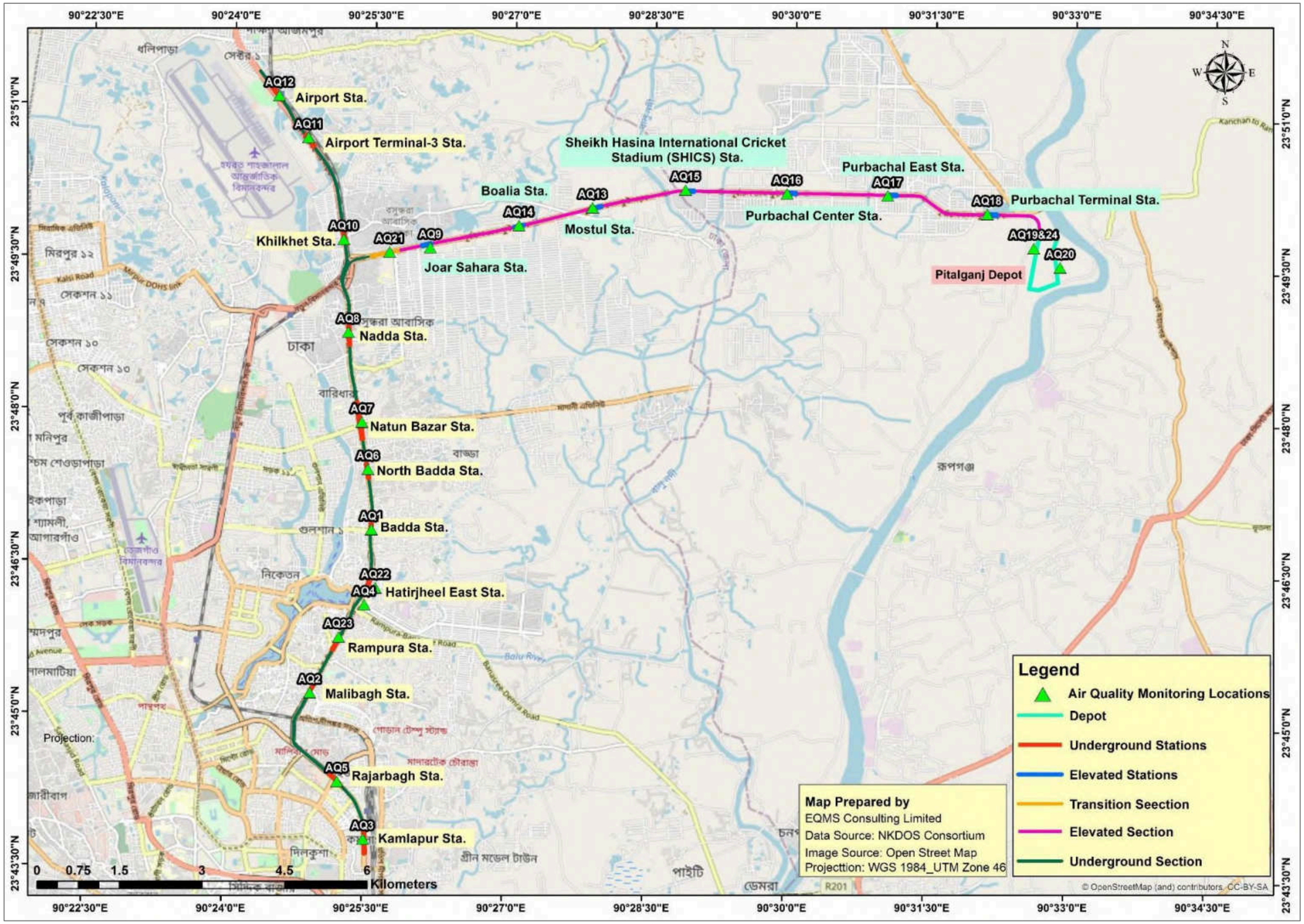
Ambient air quality has been monitored in 23 locations along the alignment of MRT Line-1 from December 10, 2019 to January 05, 2020. **Table 4-12** shows the name of the locations along with their sampling ID and coordinates. One monitoring location has been selected in every stations. In addition, two locations have been selected in depot area. Besides, air quality also monitored in transition section and in the proposed location of receiving sub-station (RSS) of MRT Line-1. During monitoring in station areas, the existence of any sensitive receptors like school, college, madrasa, hospital, clinic, mosque, temple, etc. were given priority for selecting monitoring point. In absence of any sensitive receptor, air quality monitoring location was selected at roadside in the station area.

Table 4-12: Air Quality Sampling Location

Sl.	Locations	Sampling ID	Coordinates
1.	Badda Station (In front of Gulshan Commerce College)	AQ1	23°46'50.99"N 90°25'32.82"E
2.	Malibagh Station (In front of Lab-Aid Diagnostic Center)	AQ2	23°45'14.03"N 90°24'55.15"E
3.	Kamlapur Station (Near AL Arabia Madrasa)	AQ3	23°43'48.06"N 90°25'30.88"E
4.	Hatirjheel East Station (Near East West University)	AQ4	23°46'6.53"N 90°25'29.10"E
5.	Rajarbagh Station (In front of Motijheel Government Boys' High School)	AQ5	23°44'21.80"N 90°25'13.48"E
6.	North Badda Station (In front of BIMS College)	AQ6	23°47'26.63"N 90°25'29.94"E
7.	Natun Bazar Station (In front of Jamia Madania Baridhara Mosque)	AQ7	23°47'54.45"N 90°25'25.49"E
8.	Nadda Station (In front of Faith International School)	AQ8	23°48'47.44"N 90°25'15.84"E
9.	Joar Sahara Station	AQ9	23°49'38.17"N 90°26'7.41"E
10.	Khilkhet Station (In front of RPGCL Mosque)	AQ10	23°49'42.20"N 90°25'11.80"E
11.	Airport Terminal 3 Station (Beside the Dhaka Elevated Expressway Construction Yard Gate)	AQ11	23°50'41.91"N 90°24'47.93"E

Sl.	Locations	Sampling ID	Coordinates
12.	Airport Station (In front of Airport Railway Station)	AQ12	23°51'6.43"N 90°24'28.83"E
13.	Mostul Station	AQ13	23°50'3.46"N 90°27'51.16"E
14.	Boalia Station	AQ14	23°49'52.18"N 90°27'4.10"E
15.	SHICS Station	AQ15	23°50'14.85"N 90°28'50.65"E
16.	Purbachal Center Station	AQ16	23°50'13.67"N 90°29'55.89"E
17.	Purbachal East Station	AQ17	23°50'13.54"N 90°31'0.63"E
18.	Purbachal Terminal Station	AQ18	23°50'3.58"N 90°32'4.80"E
19.	Depot Site Location 1 (North West Corner)	AQ19	23°49'43.89"N 90°32'34.91"E
20.	Depot Site Location 2 (South East Corner)	AQ20	23°49'32.80"N 90°32'52.04"E
21.	Transition section (Opposite to BICC gate)	AQ21	23°49'35.21"N 90°25'41.38"E
22.	RSS (Hatirjheel - East Merul Badda Jame Mosque)	AQ22	23°46'16.62"N 90°25'35.97"E
23.	Rampura Station (In front of Delta Specialized Hospital)	AQ23	23°45'47.16"N 90°25'12.99"E

Source: Field Survey, 2019



Source: Field Survey 2019-2020

Figure 4-4: Air Quality Sampling Location of MRT Line-1 during Supplemental Environmental Baseline Study

Results of Air Quality Monitoring

The summary findings of air quality monitoring in all monitoring locations are presented in **Table 4-13**. The table shows both the average of 8-hour-long observed value as well as the standard time period as per the instruction of ECR 1997. The results show a variation in the concentration of particulate matter like PM_{10} and $PM_{2.5}$. PM_{10} concentration has been exceeded national ambient air quality standard in total 07 monitoring locations during baseline survey. The PM_{10} concentration has been exceeded at six stations (Rajarbagh, Joar Sahara, Airport Terminal-3, Airport, SHICS, Purbachal Center) and Depot Site Location-1. Among these, Rajarbagh, Joar Sahara, Airport Terminal-3, and Airport Stations are located in built-up area with heavy traffic movement. Moreover, the monitoring was conducted in dry season that increased the possibility of finding over standard particulate matter due to weather factors. On the other hand, SHICS and Purbachal Center are not located in built-up area but these locations also experience significant volume of traffic movement as the Purbachal Highway is being used for inter-district communication. Also, some construction works were going on during the monitoring period. These would be a probable reason behind the findings of higher concentration of PM_{10}.

$PM_{2.5}$ concentrations have been found higher than national ambient air quality standard in total 18 monitoring locations out of 23 locations. Among 19 station locations, $PM_{2.5}$ concentrations exceed at 16 stations. The $PM_{2.5}$ concentrations were well within the national standard at Malibagh, Natun Bazar, Nadda station, Depot site location 1 and Depot site location 2. Most of the monitoring locations with over standard concentration of $PM_{2.5}$ are located in built-up area except SHICS, Purbachal Center, Purbachal East, and Depot Site Location-1. In urban areas, $PM_{2.5}$ is normally associated with local emissions from automobile exhausts and road dust. Emissions from combustion of gasoline, oil, diesel fuel or wood produce much of the $PM_{2.5}$ pollution found in outdoor air, as well as a significant proportion of PM_{10}. Most of the monitoring locations experience significant volume of traffic movement. This phenomenon explains the findings of higher concentration of $PM_{2.5}$. Apart from the particulate matter, the concentration of other pollutants, such as CO, NOx, SO_2, O_3, Pb are found within the standard limits in all monitoring stations.

Several studies found that both local, regional, and long-distance trans-boundary sources are responsible for air pollution, especially by particulate matter, in Dhaka city. Begum et al. (2010a) found that the coarse particles in the air of Dhaka are mainly dominated by local source, whereas fine particles are originated from both local and transboundary sources[3]. Another study by Begum et al. (2013) found that about 22 and 36% PM in the air of Dhaka city are emitted from brick kiln and motor vehicles[4]. The main sources of particulate matter in the air of Dhaka are wood burning, soil dust, brick kilns, fugitive pb, road dust, Zn sources, motor vehicles, and sea salt (Begum and Hopke 2019)[5]. Among the transboundary routes, middle India, Iran and Middle East, Afghanistan, Tajikistan are main sources from where pollutants enter Dhaka through north-west and western wind movement (Rana et al. 2016)[6]. In addition, marine air enters Dhaka from southern direction that carry salt particle. Due to these reasons, there is a prevalence of particulate matter in the air of Dhaka, which is also observed from the results of baseline study. **Figure 4-5** shows the hourly Air Quality Index (AQI) values of Dhaka City during ambient air quality sampling period of baseline

[3] Begum BA, Biswas SK, Markwitz A, Hopke PK (2010a) Identification of Sources of Fine and Coarse Particulate Matter in Dhaka, Bangladesh. *Aerosol and Air Quality Research* 10: 345-353

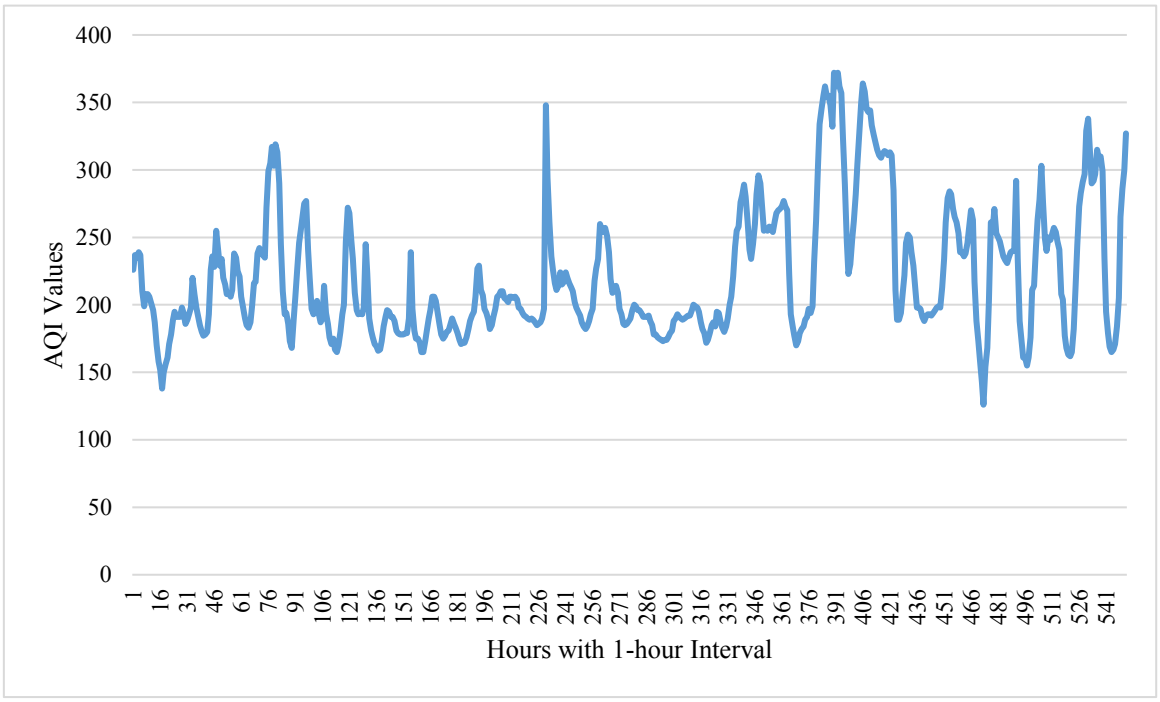
[4] Begum BA, Hopke PK, Markwitz A (2013) Air pollution by fine particulate matter in Bangladesh. *Atmospheric Pollution Research* 4(1): 75-86

[5] Begum BA and Hopke PK (2019) Identification of Sources from Chemical Characterization of Fine Particulate Matter and Assessment of Ambient Air Quality in Dhaka, Bangladesh. *Aerosol and Air Quality Research* 19: 118-128

[6] Rana MM, Mahmud M, Khan MH, Siversten B and Sulaiman N (2016) Investigating Incursion of Transboundary Pollution into the Atmosphere of Dhaka, Bangladesh. *Advances in Meteorology*. http://dx.doi.org/10.1155/2016/8318453

study collected from the database of US Embassy Air Quality Monitoring Station. The graph shows that almost all values are more than 150. A large portion of the values lies within the range of 150 to 200 that indicate “unhealthy” air quality. Another large portion of the values belongs to the range of 200 to 300 that indicate the air quality as “Very unhealthy”. Moreover, some days in the last week of December even reached “hazardous” level of air quality (AQI>300). Overall, the ambient air quality of Dhaka is inherently poor, especially in dry season even without any construction.

The baseline monitoring has been conducted in dry season. Therefore, weather characteristics have an important role to the concentration of pollutants, especially dust particles. During monsoon season the concentration of particulate matter in air may reduce due to wet weather.



Source: US Embassy Dhaka Database

Figure 4-5: Hourly AQI values of Dhaka City during air quality sampling period (from 10/12/2019 to 05/01/2020)

Table 4-13: Test Result of the Ambient Air Quality in MRT Line-1

Location	Code No.	Date	Period	Concentration (µg/m³)						
				PM_{10}	$PM_{2.5}$	CO(PPM)	NO_x	SO_2	O_3	Pb
Badda Station (In front of Gulshan Commerce College)	AQ1	26/11/2019	8 Hr.	139.97	95.48	0.62	139.33	52.63	27.46	<0.02
			As per Standard	102.91	70.20	0.62	19.63	38.70	27.46	BDL
Malibagh Station (In front of Lab-Aid Diagnostic Center)	AQ2	28/11/2019	8 Hr.	125.63	79.69	0.64	111.24	52.24	24.04	<0.02
			As per Standard	92.36	58.59	0.64	15.68	38.41	24.04	BDL
Kamlapur Station (Near AL Arabia Madrasa)	AQ3	1/12/2019	8 Hr.	194.08	110.91	0.97	287.74	21.98	25.52	<0.02
			As per Standard	142.69	81.54	0.97	40.55	16.16	25.52	BDL
Hatirjheel East Station (Near East West University)	AQ4	2/12/2019	8 Hr.	174.89	103.91	0.38	89.49	20.18	19.87	<0.02
			As per Standard	128.99	76.39	0.38	12.61	14.83	19.87	BDL
Rajarbagh Station (In front of Motijheel Government Boys' High School)	AQ5	3/12/2019	8 Hr.	214.53	109.46	0.37	73.41	26.66	25.91	<0.02
			As per Standard	157.72	80.47	0.37	10.34	19.60	25.91	BDL
North Badda Station (In front of BIMS College)	AQ6	4/12/2019	8 Hr.	155.03	96.39	0.55	191.09	32.25	25.79	<0.02
			As per Standard	113.98	70.87	0.55	26.93	23.71	25.79	BDL
Natun Bazar Station (In front of Jamia Madania Baridhara Mosque)	AQ7	5/12/2019	8 Hr.	101.47	71.72	0.70	130.62	21.94	21.25	<0.02
			As per Standard	74.60	52.73	0.70	18.41	16.13	21.25	BDL
Nadda Station (In front of Faith International School)	AQ8	8/12/2019	8 Hr.	112.61	81.98	0.47	168.10	35.30	25.58	<0.02
			As per Standard	82.79	60.27	0.47	23.69	25.95	25.58	BDL
Joar Sahara Station	AQ9	9/12/2019	8 Hr.	425.47	166.81	0.58	113.45	30.47	19.22	<0.02
			As per Standard	312.81	122.64	0.58	15.99	22.40	19.22	BDL
Khilkhet Station (In front of RPGCL Mosque)			8 Hr.	202.43	115.93	0.83	243.96	51.06	32.51	<0.02

Location	Code No.	Date	Period	Concentration (µg/m³)						
				PM_{10}	$PM_{2.5}$	CO(PPM)	NO_x	SO_2	O_3	Pb
	AQ10	10/12/2019	As per Standard	148.83	85.23	0.83	34.38	37.54	32.51	BDL
Airport Terminal 3 Station (Beside the Dhaka Elevated Expressway Construction Yard Gate)	AQ11	11/12/2019	8 Hr.	220.26	129.19	0.81	272.89	87.40	23.68	<0.02
			As per Standard	161.93	94.98	0.81	38.45	64.26	23.68	BDL
Airport Station (In front Airport Railway Station)	AQ12	12/12/2019	8 Hr.	242.63	162.41	0.64	191.06	81.12	28.83	<0.02
			As per Standard	178.38	119.40	0.64	26.92	59.64	28.83	BDL
Mostul Station	AQ13	15/12/2019	8 Hr.	171.38	115.60	0.13	27.33	20.94	4.28	<0.02
			As per Standard	126.00	84.99	0.13	3.85	15.39	4.28	BDL
Boalia Station	AQ14	17/12/2019	8 Hr.	160.29	119.02	0.12	32.92	15.86	3.12	<0.02
			As per Standard	117.85	87.50	0.12	4.64	11.66	3.12	BDL
SHICS Station	AQ15	18/12/2019	8 Hr.	258.28	180.51	0.15	26.13	14.05	3.96	<0.02
			As per Standard	189.89	132.71	0.15	3.68	10.33	3.96	BDL
Purbachal Center Station	AQ16	19/12/2019	8 Hr.	283.66	188.27	0.26	105.83	53.81	6.26	<0.02
			As per Standard	208.54	138.42	0.26	14.91	39.56	6.26	BDL
Purbachal East Station	AQ17	22/12/2019	8 Hr.	193.58	122.01	0.18	94.77	48.35	14.70	<0.02
			As per Standard	142.32	89.70	0.18	13.35	35.55	14.70	BDL
Purbachal Terminal Station	AQ18	23/12/2019	8 Hr.	184.40	128.59	0.15	76.56	57.70	12.56	<0.02
			As per Standard	135.57	94.54	0.15	10.79	42.42	12.56	BDL
Depot Site Location 2 (South East Corner)	AQ19	29/12/2019	8 Hr.	105.81	69.89	0.07	27.77	22.54	5.26	<0.02
			As per Standard	77.79	51.39	0.07	3.91	16.57	5.26	BDL

Location	Code No.	Date	Period	Concentration (µg/m^3)						
				PM_{10}	$PM_{2.5}$	CO(PPM)	NO_x	SO_2	O_3	Pb
Transition section (Opposite to BICC gate)	AQ20	30/12/2019	8 Hr.	133.54	91.24	0.18	61.21	56.06	5.16	<0.02
			As per Standard	98.18	67.08	0.14	8.63	41.22	3.80	BDL
RSS (Hatirjheel - East Merul Badda Jame Mosque)	AQ21	31/12/2019	8 Hr.	172.81	105.51	0.31	52.68	39.95	14.84	<0.02
			As per Standard	127.05	77.57	0.31	7.42	29.37	14.84	BDL
Rampura Station (In front of Delta Specialized Hospital)	AQ22	1/1/2020	8 Hr.	177.24	120.25	0.61	202.85	44.89	25.71	<0.02
			As per Standard	130.31	88.41	0.61	28.59	33.00	25.71	BDL
Depot Site Location 1 (North West Corner)	AQ23	5/1/2020	8 Hr.	119.62	88.21	0.13	29.84	16.70	6.08	<0.02
			As per Standard	87.94	64.85	0.10	4.20	12.28	6.08	BDL
Standard as per ECR, 1997 (Amendment in 2005)				**150**	**65**	**9**	**100**	**365**	**157**	**0.5**
Standard Time Period as per ECR, 1997 (Amended in 2005)				**24 hr.**	**24 hr.**	**08 hr.**	**Annual**	**24 hr.**	**8 Hr.**	**Annual**

Source: Field Survey 2019-20 and EQMS Laboratory Analysis

Table 4-14 shows a comparison between the baseline air quality of same locations from two baseline studies in 2017 and 2019-2020. In 2017, ambient air quality was monitored in six locations, whereas the air quality was monitored in 23 locations during supplemental baseline study in 2019-2020. The findings show that the concentrations of particulate matter have been reduced in most of the monitoring locations, except in Joar Sahara Station where the concentration of PM_{10} and $PM_{2.5}$ have increased in supplemental baseline study compared to initial baseline study. The comparison of gaseous pollutants show a mixed results where the concentration of some pollutants (e.g. NO_2) decreased and the concentration of some pollutants (e.g. SO_2) increased.

Particulate air quality of Dhaka is usually poor in winter months. Meteorological conditions (a cold air inversion during the winter months) and multiple trans boundary sources of air particulate are trapped under the inversion layer that leads to repeated high readings for the concentrations of these parameters. It is difficult to directly attribute local contribution to the inherently poor Dhaka air quality during dry season. In mid-April 2021, it was reported that Dhaka air quality was one of the poorest in the world. It is to be noted that Dhaka was under strict lockdown at that time with very limited local particulate pollution contribution.

The concentration of particulate matter in ambient air depends on several factors, such as surrounding activities (traffic movement, construction activities, and road surface dust), weather condition (wind speed and direction, relative humidity), etc. In case of $PM_{2.5}$, the concentrations were found lower in three monitoring stations (Kamalapur, Rampura, and Nadda) and higher in three monitoring stations (Airport, Joar Sahara, and Depot). During 2017 monitoring, flyover construction was ongoing in Rampura and Mouchak which might have been contributed to higher concentration of PM in Rampura and Kamalapur. In short, the weather condition and surrounding activities can affect ambient particulate matter concentration.

US Embassy Dhaka has a continuous air quality monitoring station and publish daily Air Quality Index (AQI) for Dhaka City (https://bd.usembassy.gov/embassy/air-quality-data/). The Air Quality Index (AQI) on air quality monitoring days are given in **Table 4-15** based on US Embassy Data. The AQI of Dhaka during second baseline monitoring in Kamalapur and Rampura Stations were lower than the AQI of Dhaka city during first baseline monitoring in these locations. The concentration of $PM_{2.5}$ was also found lower during second baseline monitoring in these two locations. On the other hand, the AQI of Dhaka during second baseline monitoring in Airport, Johar Sahara, and Depot was higher than the AQI during first baseline monitoring in these three locations. The concentration of $PM_{2.5}$ in these locations was also found higher during the second baseline study. In short, there is a synchronization between the changes of $PM_{2.5}$ concentration and AQI values of Dhaka city in all locations on respective days, except in Nadda Station. The AQI of Dhaka on second test day in Nadda Station was higher than first test day, but the concentration of $PM_{2.5}$ was found lower during second monitoring. The synchronization between the changes in $PM_{2.5}$ concentration and AQI of Dhaka in most of the locations supports the monitoring results. However, please note that the reference of AQI is only for supportive information and may not reflect complete scenario of the testing days.

Table 4-14: Comparison between Ambient Air Quality during Initial Baseline Study and Supplemental Baseline Study

Locations	PM_{10} (µg/m³)		$PM_{2.5}$ (µg/m³)		NO_2 (µg/m³)		SO_2 (µg/m³)		O_3 (µg/m³)		Pb (µg/m³)		CO (ppm)	
	2017	2019-20	2017	2019-20	2017	2019-20	2017	2019-20	2017	2019-20	2017	2019-20	2017	2019-20
Kamalapur St.	310.7	142.69	125.4	81.54	112.6	40.55	21.2	16.16	20.6	25.52	0.07	BDL	4.9	0.97
Rampura St.	286.5	130.31	108.5	88.41	107.1	28.59	22.8	33.00	15.6	25.71	0.05	BDL	1.7	0.61
Nadda St.	231.2	82.79	95.7	60.27	103.4	23.69	17.0	25.95	13.4	25.58	0.03	BDL	0.8	0.47
Airport St.	275.6	178.38	103.6	119.40	98.4	26.92	17.6	59.64	10.2	28.83	0.04	BDL	0.6	0.64
Joar Sahara St.	123.4	312.81	58.4	122.64	43.2	15.99	11.3	22.40	6.6	19.22	BDL	BDL	0.1	0.58
Depot	82.2	87.94	45.6	64.85	28.5	4.20	8.1	12.28	3.4	6.08	BDL	BDL	0.05	0.10
Standard (ECR 1997)	**150**		**65**		**100**		**365**		**157**		**0.5**		**9**	
Standard avg. period	**24 hr**		**24 hr**		**Annual**		**24 hr**		**8 hr**		**Annual**		**8 hr**	

Table 4-15: AQI Values on Test Days during First and Second Baseline Studies

Air Quality Monitoring Locations	2017		2019-2020	
	Date	AQI of Dhaka City during monitoring dates	Date	AQI of Dhaka City during monitoring dates
Kamalapur St.	28/02/2017	236.6	01/12/2019	196.7
Rampura St.	01/03/2017	232.8	01/01/2020	209.9
Nadda St.	02/03/2017	243.4	08/12/2019	258.1
Airport St.	03/03/2017	175	12/12/2019	214.6
Joar Sahara St.	04/03/2017	164.3	09/12/2019	206.3
Depot	05/03/2017	143.2	05/01/2020	177

The baseline monitoring was conducted for just one day (for 08 hours) at every location. It is not always possible to conclude by comparing two monitoring (for a short period) results in different months. The comparison of annual average and monthly average of same months can provide a clear scenario.

Several studies show the different trend of particulate matter concentration of Dhaka city for different AQM Stations. For example, Begum and Hopke (2018) found a decreasing trend of $PM_{2.5}$ based on the data from 1996 to 2015 measured in Atomic Energy Center (AEC) Station (**Figure 4-6**)[7]. The CAMS data of DoE from 2012 to 2019 shows an upward trend in BARC Station and downward trend in Sangsad Bhaban and Darrussalam Stations (Parvin 2019) (**Figure 4-7**)[8]. According to World Air Quality Report prepared by IQAir, the annual average concentration of $PM_{2.5}$ in 2018, 2019, and 2020 was 97.1, 83.3, and 77.1 µg/m^3. This short-term data (three-years-long from 2018 to 2020) also shows a decreasing trend of fine particulate matter.[9,10,11]

[7] Begum BA and Hopke J (2018) Ambient Air Quality in Dhaka Bangladesh over Two Decades: Impacts of Policy on Air Quality. *Aerosol and Air Quality Research* 18: pp 1910-1920

[8] Parvin M (2019) Atmospheric particulate and black carbon in Dhaka city – a contributor to climate change. Dhaka: Bangladesh Institute of Development Studies.

[9] IQAir (2018). *World air quality report: Region and city PM2.5*. Goldach: IQAir. https://www.iqair.com/worldmost-polluted-cities/world-air-quality-report2018-en.pdf

[10] IQAir (2019). *World air quality report: Region and city PM2.5*. Goldach: IQAir. https://www.greenpeace.org/static/planet4-thailandstateless/2020/02/91ab34b8-2019-world-air-report.pdf

[11] IQAir (2020). *World Air Quality Report: Region and City PM2.5*. Goldach: IQAir. https://www.iqair.com/world-most-pollutedcities/world-air-quality-report2020-en.pdf

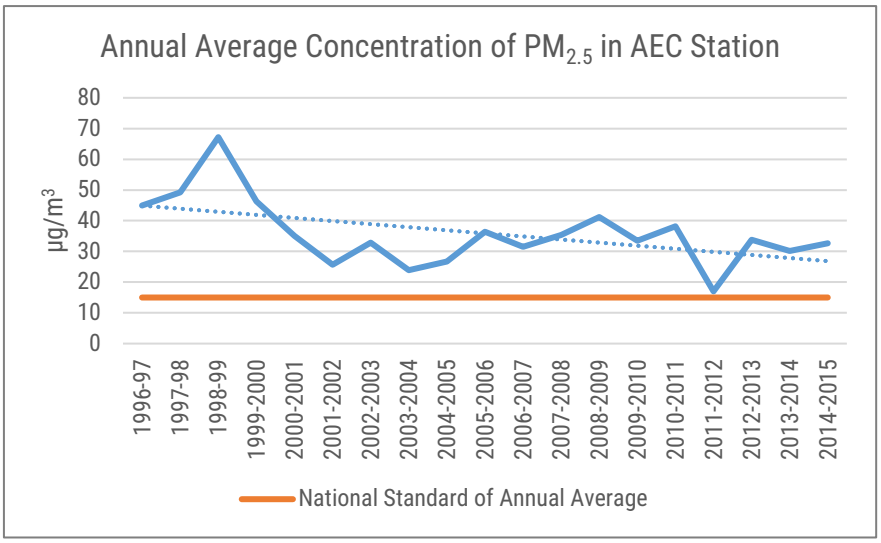


Figure 4-6: Trend of Annual Average Concentration of $PM_{2.5}$ in AEC Station

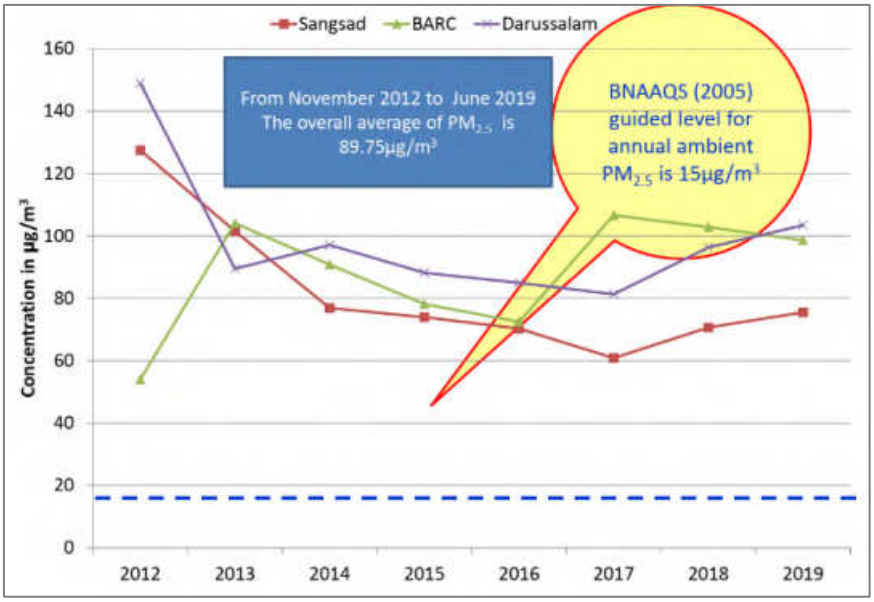


Figure 4-7: Annual Average Concentration of $PM_{2.5}$ at Three different Stations in Dhaka

4.4 Noise Level

Noise level has been monitored for two times. Firstly, noise level was monitored during the preparation of preparatory EIA in 2017. Then, noise level is monitored again during supplemental environmental baseline study in 2019. The summary findings of both monitoring are given below.

4.4.1 Method

Noise level monitoring was carried out for 24 hours (once) during monitoring period with 1-min equivalent sound pressure levels. At all the locations, measurement was taken at 1-min intervals over a 24-hour period. Further to that the equivalent noise levels have been converted to hourly equivalent noise levels. Finally, the measurements were done by dividing the 24 hours into two parts, i.e. daytime, which is considered from 0600 to 2200 hours and night from 2200 to 0600 hours. At each location, day time Leq has been computed from the hourly sound pressure level values measured between 0600 to 2200 hours and night time Leq has been computed from the hourly sound pressure level values measured between

2200 to 0600 hours. The sound level is recorded in form of A-weighted equivalent continuous sound pressure level (Leq) values with the use of A-weighting filters in the noise measuring instrument.

4.4.2 Baseline Study 2017

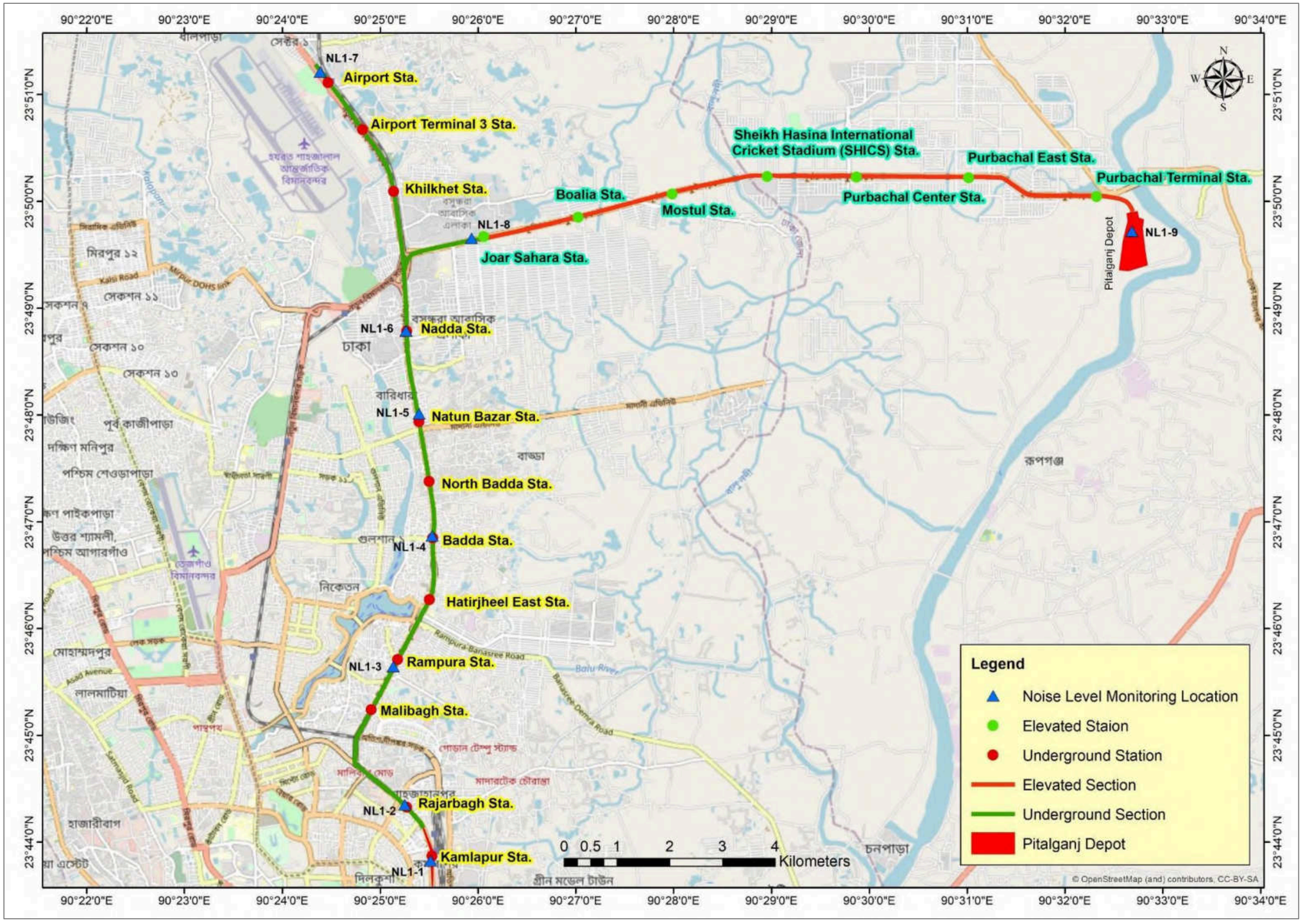
Noise levels were recorded at nine locations in the study area during the monitoring period. Noise levels were recorded in the form of sound pressure levels with the help of a digital sound level meter. The details of noise monitoring locations are given in **Table 4-16** and depicted in **Figure 4-8**.

The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. These locations are chosen in such a way that a representative data could be recorded all over locations. The sound level is recorded in form of A-weighted equivalent continuous sound pressure level (Leq) values with the use of A-weighting filters in the noise measuring instrument.

Table 4-16: Noise Level Sampling Location of MRT Line-1

No.	Location	Geographic Coordinate
NL1-1	Kamlapur Station	23°43'49.48"N 90°25'30.93"E
NL1-2	Rajarbagh Station	23°44'21.0"N 90°25'15.0"E
NL1-3	Rampura Station	23°45'38.6"N 90°25'08.0"E
NL1-4	Badda Station	23°46'52.1"N 90°25'31.9"E
NL1-5	Natun Bazar Station	23°48'00.6"N 90°25'23.8"E
NL1-6	Nadda Station	23°48'47.21"N 90°25'15.77"E
NL1-7	Airport Station	23°51'12.7"N 90°24'23.2"E
NL1-8	Joar Sahara Station	23°49'39.2"N 90°25'56.1"E
NL1-9	Depot Site of Line 1	23°49'43.2"N 90°32'41.1"E

Source: EIA Report of MRT Line-1



Source: EIA Report of MRT Line-1

Figure 4-8: Noise Level Monitoring Location of MRT Line-1 during EIA Study

The recorded noise levels in the study area are detailed in **Table 4-17** and summarized in **Table 4-18**. The summary result shows that the values of Leq_{day} have been exceeded in six locations out of nine locations. On the other hand, the values of Leq_{night} have been exceeded in seven locations out of nine monitoring locations.

Table 4-17: Hourly Equivalent Noise Level in the Monitoring Locations in 2017

Hour	NL1-1	NL1-2	NL1-3	NL1-4	NL1-5	NL1-6	NL1-7	NL1-8	NL1-9
1:00-1:59 AM	64.5	61.3	63.1	62.8	61.0	60.2	62.1	56.9	42.5
2:00-2:59 AM	65.9	58.0	62.6	60.1	59.0	58.4	60.9	52.8	43.6
3:00-3:59 AM	63.5	59.4	60.9	64.6	60.3	57.9	62.1	51.2	41.5
4:00-4:59 AM	66.2	60.9	61.8	60.6	62.7	62.5	64.0	50.0	43.6
5:00-5:59 AM	64.6	62.5	63.9	65.9	63.7	66.0	66.2	52.1	46.8
6:00-6:59 AM	68.5	61.7	66.4	67.6	65.7	67.7	68.8	55.8	47.1
7:00-7:59 AM	67.9	65.7	70.0	73.0	65.0	70.9	69.7	61.3	53.4
8:00-8:59 AM	70.6	67.3	71.8	72.6	69.9	71.7	70.1	63.4	50.6
9:00-9:59 AM	72.2	69.9	70.8	73.6	72.0	73.7	71.2	68.1	52.9
10:00-10:59 AM	69.6	70.9	68.7	71.0	71.3	72.7	70.5	67.1	56.4
11:00-11:59 AM	67.2	71.5	67.6	70.2	70.1	66.3	71.9	65.4	52.4
12:00-12:59 PM	70.7	66.7	70.6	69.2	70.4	67.6	69.4	66.2	54.2
13:00-13:59 PM	67.2	66.6	67.8	68.7	69.6	64.6	65.3	64.7	55.8
14:00-14:59 PM	69.4	64.3	72.6	71.9	70.8	70.9	68.8	63.3	54.7
15:00-15:59 PM	72.5	66.6	67.8	68.8	68.6	68.8	70.2	69.2	53.6
16:00-16:59 PM	67.9	69.2	68.1	66.8	71.7	67.5	69.3	67.9	53.4
17:00-17:59 PM	73.8	70.4	71.2	73.7	73.7	69.1	69.8	66.1	55.8
18:00-18:59 PM	70.5	68.8	73.7	73.9	71.9	68.2	71.3	68.5	54.2
19:00-19:59 PM	67.8	69.0	70.0	70.9	70.6	69.9	70.0	67.8	50.4
20:00-20:59 PM	68.8	68.9	71.0	71.0	68.7	70.2	68.6	65.2	45.8
21:00-21:59 PM	69.0	66.1	69.3	69.4	67.1	65.7	70.6	64.2	46.5
22:00-22:59 PM	67.4	65.6	67.0	67.3	66.7	67.6	69.4	60.8	45.8
23:00-23:59 PM	65.4	63.6	65.3	68.1	62.7	64.7	68.0	61.8	46.2
00:00-00:59 AM	63.2	60.9	64.9	65.3	59.6	61.7	65.1	57.9	42.7

Source: Field Study by EQMS, Monitoring Date: 28th February, 2017 – 10th March, 2017

Table 4-18: Noise Level Analysis of the MRT Line-1

Code	L_{max}	L_{min}	Leq_{day}	Leq_{night}	L90	L50	L10	Area Setting*	Standard**	
									Day	Night
NL1-1	92.9	57.4	70.8	66.8	62.5	65.5	71.1	Commercial	70	60
NL1-2	83.2	42.6	68.3	63.0	59.4	63.7	69.9	Commercial	70	60
NL1-3	91.8	60.1	70.5	65.2	63.3	66.6	71.4	Commercial	70	60
NL1-4	84.8	61.2	71.7	65.9	62.4	66.8	72.5	Commercial	70	60
NL1-5	86.0	58.4	70.8	63.5	61.2	64.1	71.3	Commercial	70	60
NL1-6	87.3	63.1	70.4	64.7	60.2	63.8	70.2	Commercial	70	60
NL1-7	83.7	61.8	69.7	67.6	60.4	64.6	70.1	Commercial	70	60
NL1-8	79.4	49.3	65.7	56.4	56.9	59.4	66.3	Commercial	70	60
NL1-9	65.8	394	53.7	44.7	42.8	48.2	54.7	Residential	55	45

Monitoring Date: 28th February, 2017 – 10th March, 2017

* Area setting (according to the ECR, 1997)

**Standard according to the ECR, 1997 and subsequent amendment in 2006

Source: EIA Report of MRT Line-1

Exceeding Standard Level

Ambient daytime noise level (Leq_{day}) was recorded in the range of 53.7 to 71.7 dB (A). Whereas, ambient night time noise level (Leq_{night}) in the study area were 44.7 to 67.6 dB (A). Maximum noise levels ($L_{maximum}$) at the monitoring locations were recorded in the range of 65.8 to 92.9 dB (A) and the minimum noise levels ($Leq_{minimum}$) at the monitoring locations were recorded in the range of 39.4 to 63.1 dB (A).

From the analysis data it has been found that most of the noise level of monitoring station exceeds the ECR, 1997 standard during the night time. Noise level exceeds the standard level due to the huge number of traffic movement during day and night time.

4.4.3 Supplemental Environmental Baseline Study 2019-2020

Locations of Noise Level Monitoring

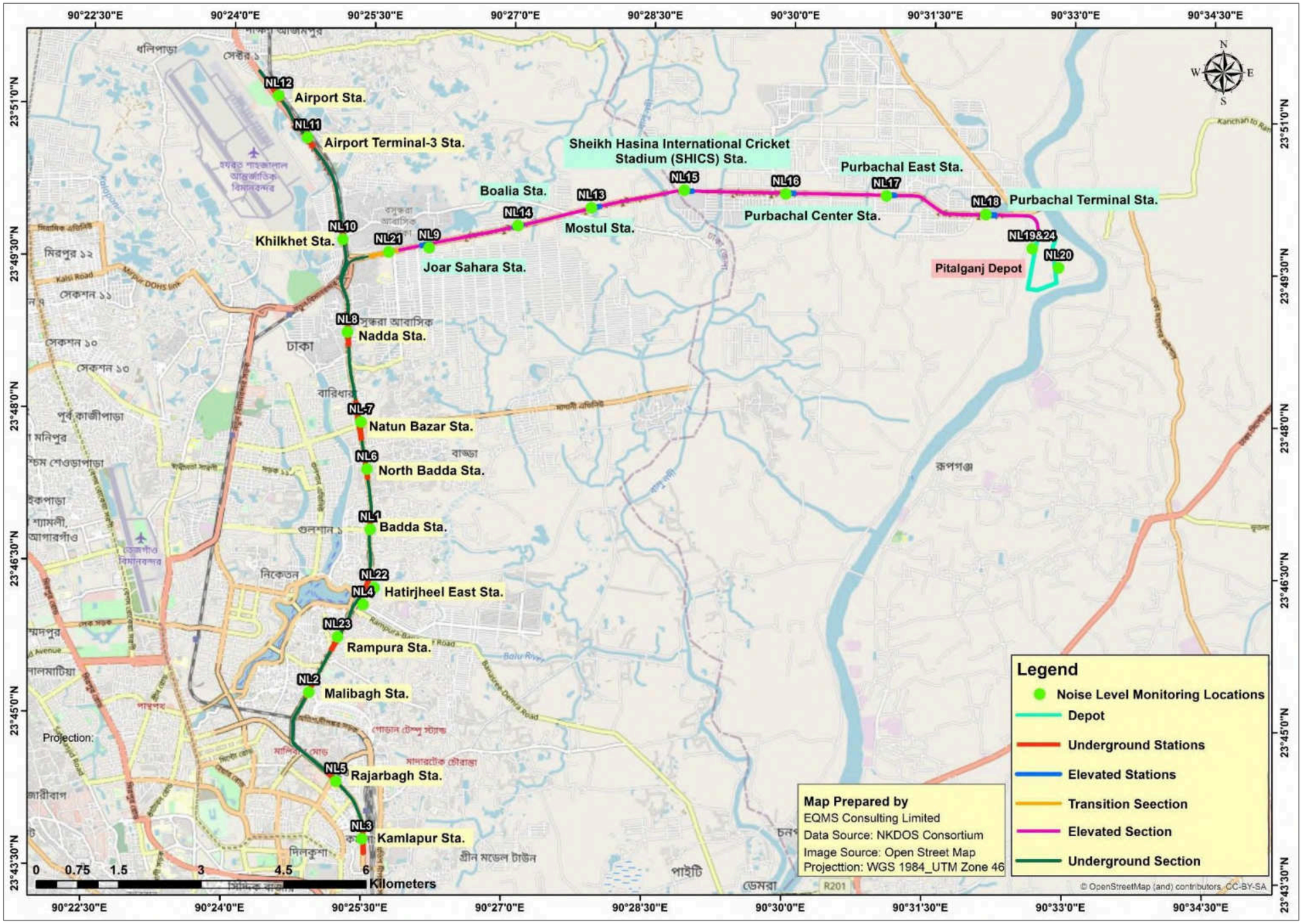
Ambient noise level has been monitored in 23 locations, including 19 stations and 2 depot locations from December 10, 2019 to December 28, 2019. In addition, noise monitoring has also been conducted in another two locations, such transition section and RSS of MRT Line-1. **Table 4-19** shows the name of monitoring locations along with their location ID and coordinates. In depot area, noise level was monitored in two locations, e.g. the north-west and south-east corners. During noise level monitoring in station areas, all three types of area, such as silent zone, mixed, and residential area have been covered. The silent zone includes mosque, hospital, and diagnostic centers. In future, activities will be increased in the transition area and the RSS area as well. So those two points have also been monitored.

Table 4-19: Noise Level Sampling Locations

Sl.	Location	Location ID	Geographic Coordinate
1.	Badda Station (In front of Gulshan Commerce College)	NL1	23°46'50.99"N 90°25'32.82"E
2.	Malibagh Station (In front of Lab-Aid Diagnostic Center)	NL2	23°45'14.03"N 90°24'55.15"E

Sl.	Location	Location ID	Geographic Coordinate
3.	Kamlapur Station (Near Al Arabia Madrasa)	NL3	23°43'48.06"N 90°25'30.88"E
4.	Hatirjheel East Station (Near East West University)	NL4	23°46'6.53"N 90°25'29.10"E
5.	Rajarbagh Station (In front of Motijheel Government Boys' High School)	NL5	23°44'21.80"N 90°25'13.48"E
6.	North Badda Station (In front of BIMS College)	NL6	23°47'26.63"N 90°25'29.94"E
7.	Natun Bazar Station (In front of Jamia Madania Baridhara Mosque)	NL7	23°47'54.29"N 90°25'24.96"E
8.	Nadda Station (In front of Faith International School)	NL8	23°48'47.44"N 90°25'15.84"E
9.	Joar Sahara Station	NL9	23°49'38.17"N 90°26'7.41"E
10.	Khilkhet Station (In front of RPGCL Mosque)	NL10	23°49'42.20"N 90°25'11.80"E
11.	Airport Terminal 3 Station (Beside the Dhaka Elevated Expressway Construction Yard Gate)	NL11	23°50'41.91"N 90°24'47.93"E
12.	Airport Station (In front of Airport Railway Station)	NL12	23°51'6.43"N 90°24'28.83"E
13.	Mostul Station (In front of Mostul Police Box)	NL13	23°50'3.46"N 90°27'51.16"E
14.	Boalia Station	NL14	23°49'52.18"N 90°27'4.10"E
15.	SHICS Station	NL15	23°50'14.85"N 90°28'50.65"E
16.	Purbachal Center Station	NL16	23°50'13.67"N 90°29'55.89"E
17.	Purbachal East Station	NL17	23°50'13.54"N 90°31'0.63"E
18.	Purbachal Terminal Station	NL18	23°50'3.58"N 90°32'4.80"E
19.	Depot Site Location 1 (North West Corner)	NL19	23°49'43.89"N 90°32'34.91"E
20.	Depot Site Location 2 (South East Corner)	NL20	23°49'32.80"N 90°32'52.04"E
21.	Transition section (Opposite to ICCB gate)	NL21	23°49'35.21"N 90°25'41.38"E
22.	RSS (In front of Hatirjheel - East Merul Badda Jame Mosque)	NL22	23°46'16.62"N 90°25'35.97"E
23.	Rampura Station (In front of Delta Specialized Hospital)	NL23	23°45'47.16"N 90°25'12.99"E

Source: Field Survey 2019-2020



Source: Field Survey 2019-2020

Figure 4-9: Noise Level Monitoring Location of MRT Line-1 during Baseline Study

Results of Noise Level Monitoring

Table 4-20 shows the summary findings of Leq Day and Leq Night calculation in all monitoring locations. The noise level was monitored for 24 hours continuously in a single monitoring point. According to ECR 1997, day time extends from 06 am to 09 pm, while night time extends from 09 pm to 06 am. The monitoring locations were classified into three different classes, namely silent zone, residential zone, and mixed zone based on the Bangladesh Environmental Conservation Rules 1997. The silent zone includes NL1-NL8, NL10, and NL22-NL23 monitoring locations where noise levels were found higher than standard level 50 and 40 dBA during day and night time, respectively. During day time, the noise level in silent zone varies from 74.22 dBA at Natun Bazar Station to 82.01 dBA at Nadda Station. On the other hand, during night time, noise level varies from 59.19 dBA at Rajarbagh Station to 74.07 dBA at Kamlapur Station in silent zone.

The mixed zone includes NL9, NL11-NL18, and NL21 monitoring locations. All monitoring locations of mixed zone have exceeded the standard noise limit of 60 and 50 dBA during day and night time, respectfully. The noise level during day time in mixed zones varies from 61.62 dBA at Joar Sahara Station to 75.6 dBA at Airport Terminal-3 Station. On the other hand, the noise level during night time in mixed zones extend from 56.10 dBA at Purbachal Terminal Station to 72.49 dBA at Airport Terminal-3 Station. In both day and night times, Airport Terminal-3 Station shows higher noise among mixed zones.

The residential zone includes NL19 and NL20 namely Depot Site Location-1 and Depot Site Location-2. The noise level in residential zones has exceeded the standard limit of 55 and 45 dBA during day and night times, respectively. The lowest noise level in residential zone during day and night times are found 66.41 dBA and 55.45 dBA.

Overall, the findings imply that the noise level is inherently higher along the alignment of MRT Line-1 without even commencement of construction works. It is visually observed that traffic movement mostly contributed to the recorded noise level during monitoring.

Table 4-20: Leq Day and Leq Night of the Noise Level Data in MRT Line-1 area

Sl.	Location	ID No.	Date	Noise Level (dBA)		Standard (dBA)*		Zone*
				Leq Day	Leq Night	Day	Night	
1	Badda Station (In front of Gulshan Commerce College)	NL1	26/11/19	79.43	73.05	50	40	Silent
2	Malibagh Station (In front of Lab-Aid Diagnostic Center)	NL2	28/11/19	74.92	66.40	50	40	Silent
3	Kamlapur Station (Near AL Arabia Madrasa)	NL3	1/12/19	76.41	74.07	50	40	Silent
4	Hatirjheel East Station (Near East West University)	NL4	2/12/19	76.11	62.29	50	40	Silent
5	Rajarbagh Station (In front of Motijheel Government Boys' High School)	NL5	3/12/19	74.72	59.19	50	40	Silent
6	North Badda Station (In front of BIMS College)	NL6	4/12/19	77.68	73.18	50	40	Silent
7	Natun Bazar Station (In front of Jamia Madania Baridhara Mosque)	NL7	5/12/19	74.22	60.34	50	40	Silent
8	Nadda Station (In front of Faith International School)	NL8	8/12/19	82.01	71.47	50	40	Silent
9	Joar Sahara Station	NL9	9/12/19	61.62	60.81	60	50	Mixed
10	Khilkhet Station (In front of RPGCL Mosque)	NL10	10/12/19	77.79	70.57	50	40	Silent
11	Airport Terminal 3 Station (Beside the Dhaka Elevated Expressway Construction Yard Gate)	NL11	11/12/19	75.60	72.49	60	50	Mixed
12	Airport Station (In front Airport Railway Station)	NL12	12/12/19	73.58	72.06	60	50	Mixed
13	Mostul Station	NL13	15/12/19	68.16	67.47	60	50	Mixed
14	Boalia Station	NL14	17/12/19	68.65	64.65	60	50	Mixed
15	SHICS Station	NL15	18/12/19	68.92	50.26	60	50	Mixed
16	Purbachal Center Station	NL16	19/12/19	72.38	64.01	60	50	Mixed
17	Purbachal East Station	NL17	22/12/19	72.68	59.36	60	50	Mixed
18	Purbachal Terminal Station	NL18	23/12/19	71.65	56.10	60	50	Mixed

Sl.	Location	ID No.	Date	Noise Level (dBA)		Standard (dBA)*		Zone*
				Leq Day	Leq Night	Day	Night	
19	Depot Site Location 1 (North West Corner)	NL19	26/12/19	66.41	55.45	60	50	Mixed
20	Depot Site Location 2 (South East Corner)	NL20	29/12/19	66.83	55.91	60	50	Mixed
21	Transition section (Opposite to BICC gate)	NL21	30/12/19	73.37	68.13	60	50	Mixed
22	RSS (Hatirjheel - East Merul Badda Jame Mosque)	NL22	31/12/19	79.63	69.63	50	40	Silent
23	Rampura Station (In front of Delta Specialized Hospital)	NL23	1/1/20	77.71	72.45	50	40	Silent

*According to the ECR'1997 and subsequent amendment in 2006

Table 4-21 shows a comparison of the noise level in same locations during the initial baseline study 2017 and supplemental baseline study 2019-2020. During the initial baseline study in 2017, noise level was monitored in nine locations, while the noise level is monitored in 23 locations during the supplemental baseline study in 2019-2020. The table only presents a comparison for the common locations of two baseline studies. The findings show a mixed comparison between the results of two baseline studies. The noise level has been increased in some locations, whereas decreased in some locations. However, the noise values exceeded the standard values in most of the monitoring locations.

Table 4-21: Comparison of noise level in the same locations of initial baseline 2017 and supplemental baseline 2019-2020

Locations	Leq_{day}		Leq_{night}		Standard		Zone
	2017	2019-20	2017	2019-20	Day	Night	
Kamlapur Station	70.8	76.41	66.8	74.07	50	40	Silent
Rajarbagh Station	68.3	74.72	63.0	59.19	50	40	Silent
Rampura Station	70.5	77.71	65.2	72.45	50	40	Silent
Badda Station	71.7	79.43	65.9	73.05	50	40	Silent
Notun Bazar Station	70.8	74.22	63.5	60.34	50	40	Silent
Nadda Station	70.4	82.01	64.7	71.47	50	40	Silent
Airport Station	69.7	73.58	67.6	72.06	60	50	Mixed
Joar Sahara Station	65.7	61.62	56.4	60.81	60	50	Mixed
Depot Site of Line 1	52.6	66.41	45.0	55.45	60	50	Mixed

4.5 Geology, Soil and Drainage

4.5.1 Geology and Soil

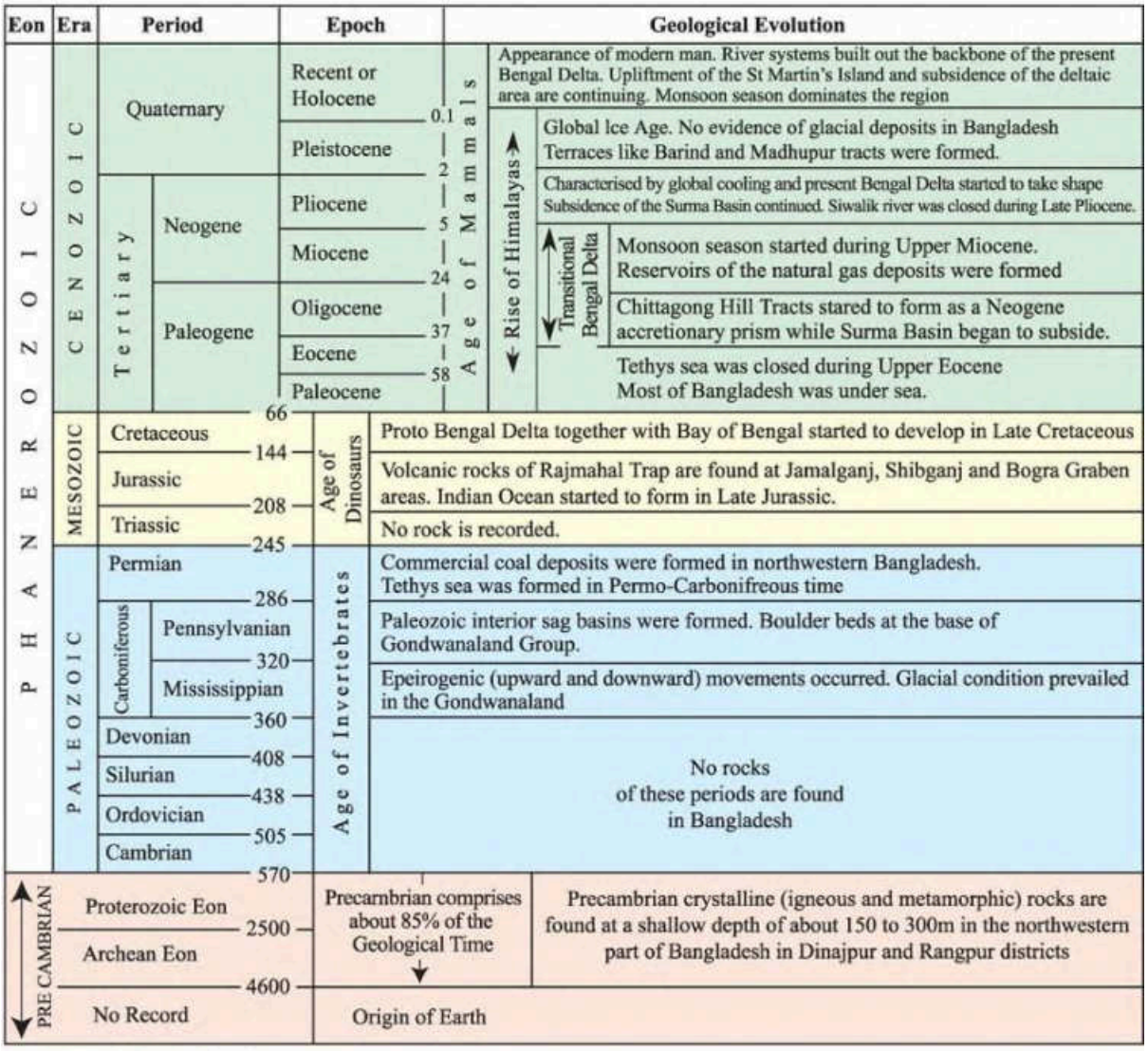
Geology

Figure 4-10 shows the geological time scale of Bangladesh showing the evolution of Bengal delta. The most ancient land formation evidence of Bangladesh is found in Dinajpur and Rangpur Districts. Precambrian crystalline (igneous and metamorphic) rocks are found at a shallow depth of about 150 to 300 m in the northwestern part of Bangladesh in Dinajpur and Rangpur Districts. The commercial coal formation of northwestern Bangladesh was formed during Permian period. During Jurassic period, volcanic activities took place in Jamalganj, Shibganj, and Bogra Graben area. Proto Bengal delta together with Bay of Bengal started to develop in Late Cretaceous. During the upper Eocene epoch most of the Bangladesh was under sea. During, Oligocene Epoch, Chittagong Hill Tracts started to form as a Neogene accretionary prism while Surma Basin began to subside. During Pleistocene Epoch, there was an ice age but no evidence of glacial deposits are found in Bangladesh. During this time, terraces like Banrind and Madhupur tracts were formed. Dhaka is the part of Madhupur tract.

Figure 4-11 shows the physiographic units covered by the project location. According to the map, the entire project is located in the Jamuna (Young Brahmaputra) Floodplain. A dual name is used for the mighty Brahmaputra, because the Jamuna channel is comparatively new and this course must be clearly distinguished from that of the older Brahmaputra. Before 1787, the Brahmaputra's course swung east to follow the course of the present Old Brahmaputra. In that year, apparently, a severe flood had the effect of turning the course southwards along the Jenai and Konai rivers to form the broad, braided Jamuna channel. The change in course seems to have been completed by 1830. Due to the upliftment of the two large Pleistocene blocks of Barind and Madhupur, the zone of subsidence between those turned to a rift valley and became the new course of the Brahmaputra and came to be known as the great Jamuna. Both the left and right banks of the river are included in this sub-region. The Brahmaputra-Jamuna floodplain can again be subdivided into the Bangali-Karatoya floodplain, Jamuna-Dhaleshwari floodplain, and diyaras and chars.

The right-bank of the Jamuna - once a part of the Tista floodplain is part of the bigger floodplain. Several distributaries of the Jamuna flow through the left-bank floodplain, of which the dhaleshwari is by far the largest and sub-classed, namely, the Jamuna-Dhaleshwari floodplain. The southern part of this sub-region was once a part of the Ganges floodplain. Along the Brahmaputra-Jamuna, as along the Ganges, there are many diyaras and chars. In fact, there are more of them along this channel than in any other river in Bangladesh. There is a continuous line of chars from where this river enters Bangladesh to the off-take Point of Dhaleshwari River. Both banks are punctuated by a profusion of diyaras.
The soil and topography of chars and diyaras vary considerably. Some of the largest ones have point bars and swales. The elevation between the lowest and highest points of these accretions may be as much as 5m. The difference between them and the higher levees on either bank can be up to 6m. Some of the ridges are shallowly flooded but most of the ridges and all the basins of this floodplain region are flooded more than 0.91 m deep for about four months (mid-June to mid-October) during the monsoon. Figure 4-12 and Figure 4-13 shows the tectonic fault framework and earthquake risk zone of containing the alignment of MRT-1.

Geological Evolution (numbers are in millions of years before the present)



Source Sifatul Quader Chowdhury.

Source: Banglapedia

Figure 4-10: Geological time scale showing the evolution of Bengal delta

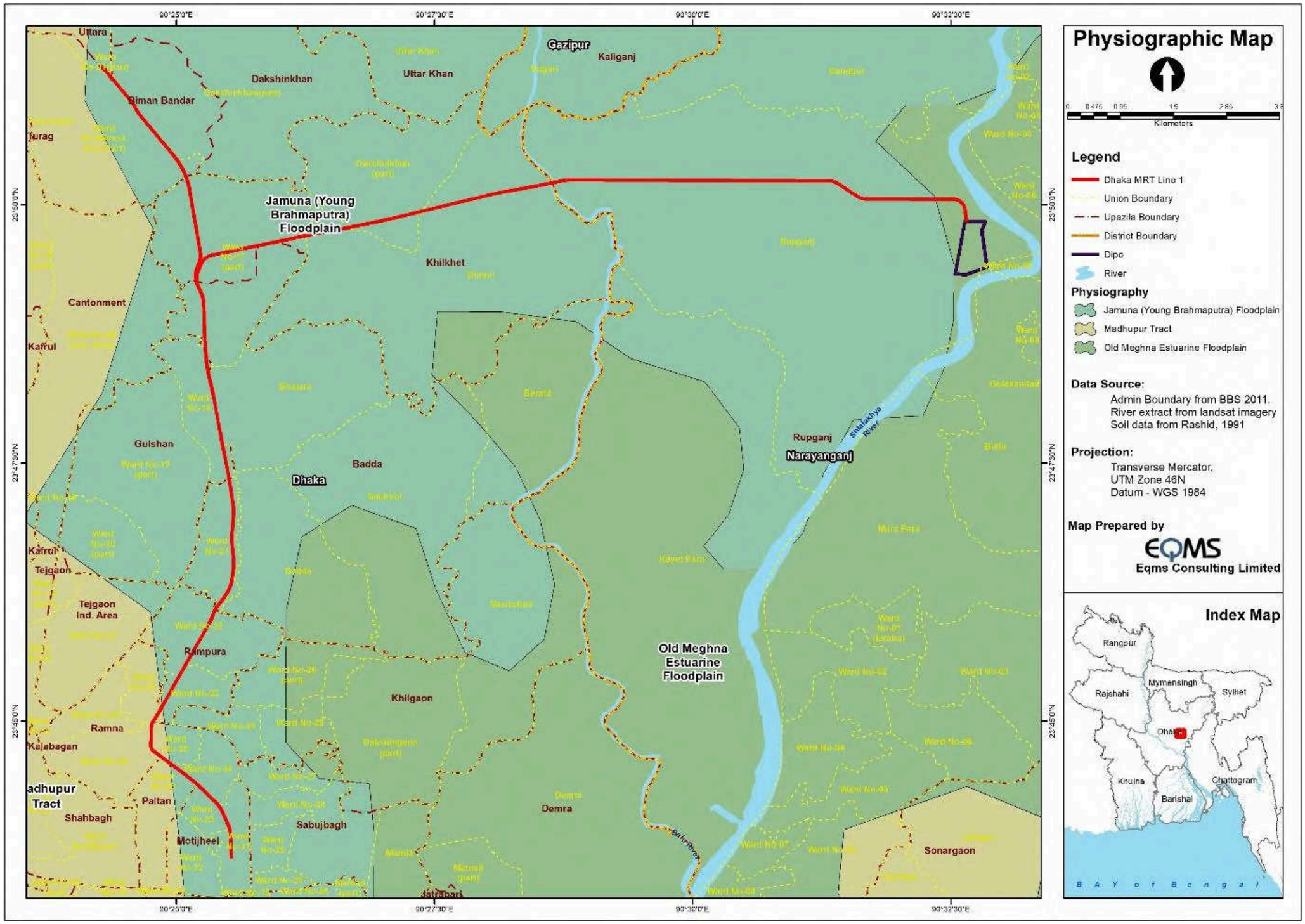


Figure 4-11: MRT Line-1 Alignment on Physiographic Map

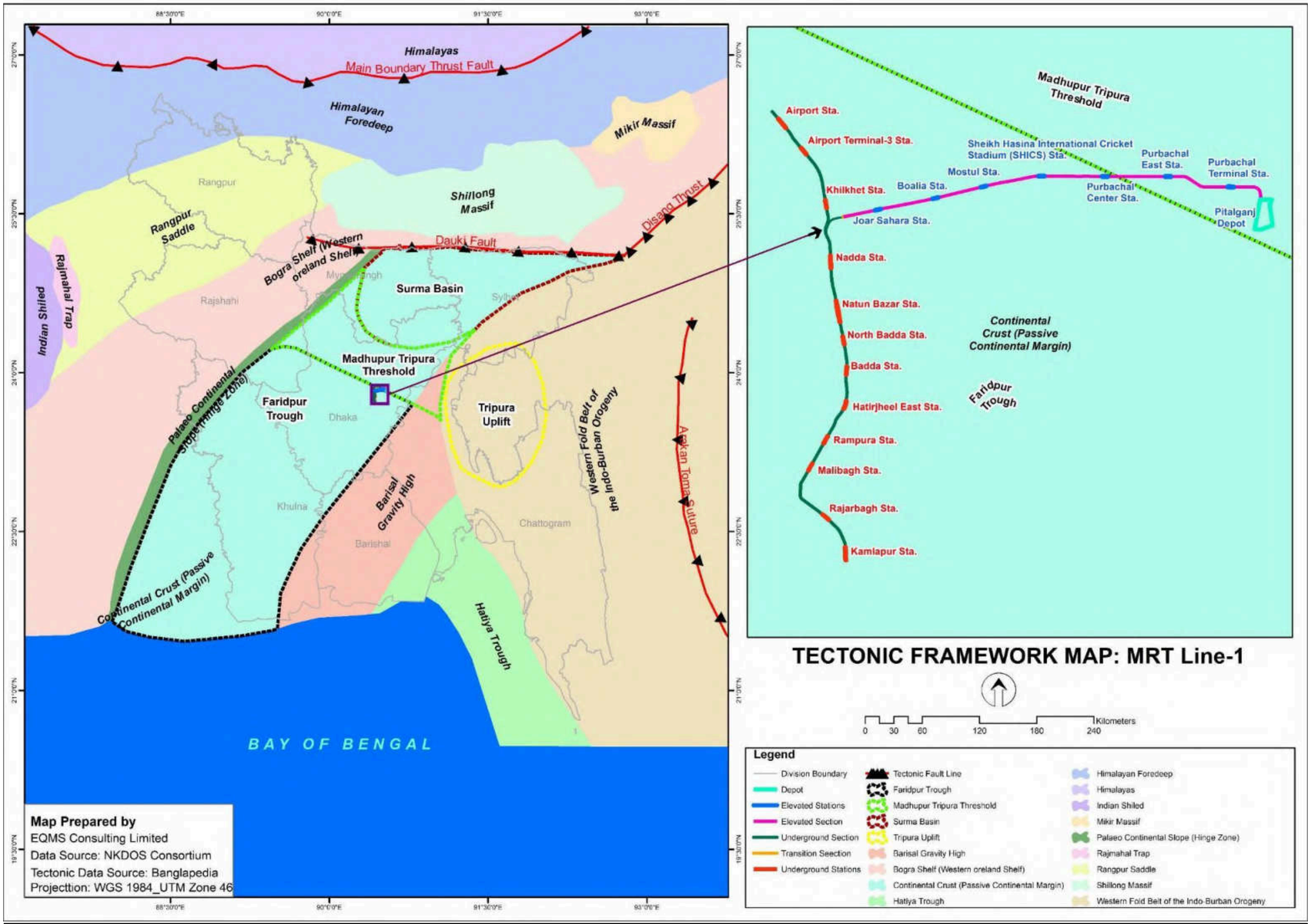


Figure 4-12: Map of Tectonic Framework with Alignment of MRT-1

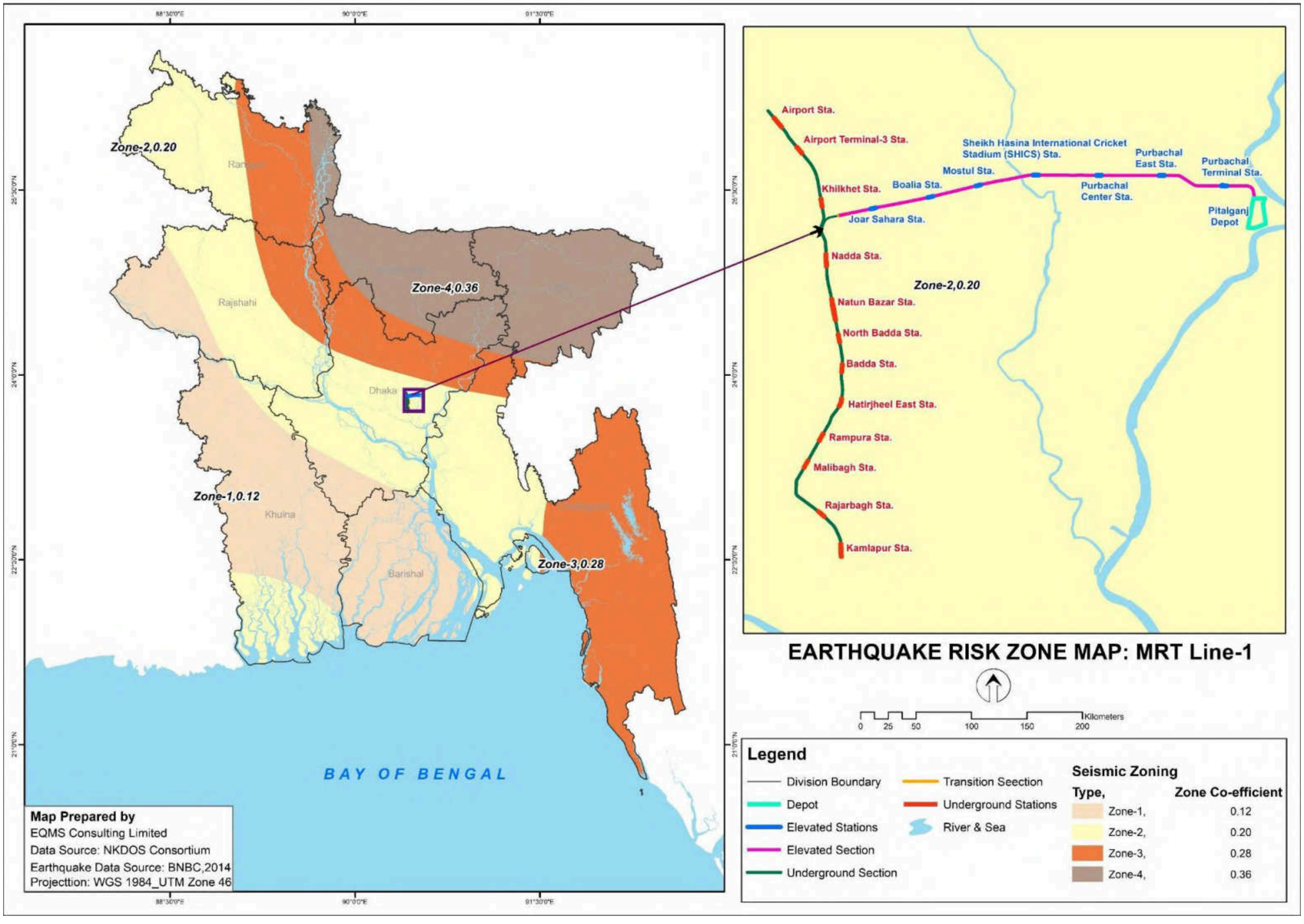


Figure 4-13: Earthquake Risk Zones of Bangladesh with MRT-1 Alignment

Soil

Dhaka lies in the extreme south of the Madhupur Tract, which is situated in the central-eastern part of Bangladesh. The planning area is covered mainly by the Pleistocene Madhupur Clay, a yellowish brown to the highly oxidized reddish brown silty clay; and by Non-calcareous Dark Grey Floodplain Soils, which is predominantly silt loam and silty clay loamy type of soil.

The moisture content and liquid limit results obtained for the Madhupur clay show that it is normally consolidated to slightly over-consolidated, perhaps due to groundwater pumping. The clay has intermediate to high plasticity, and is overlain by the Dupi Tila formation of medium to coarse sand. The incised channels and depressions within the city are floored by recent alluvial flood plain deposits. A map of soil classes showing the alignment of MRT Line-1 is given in **Figure 4-14**.

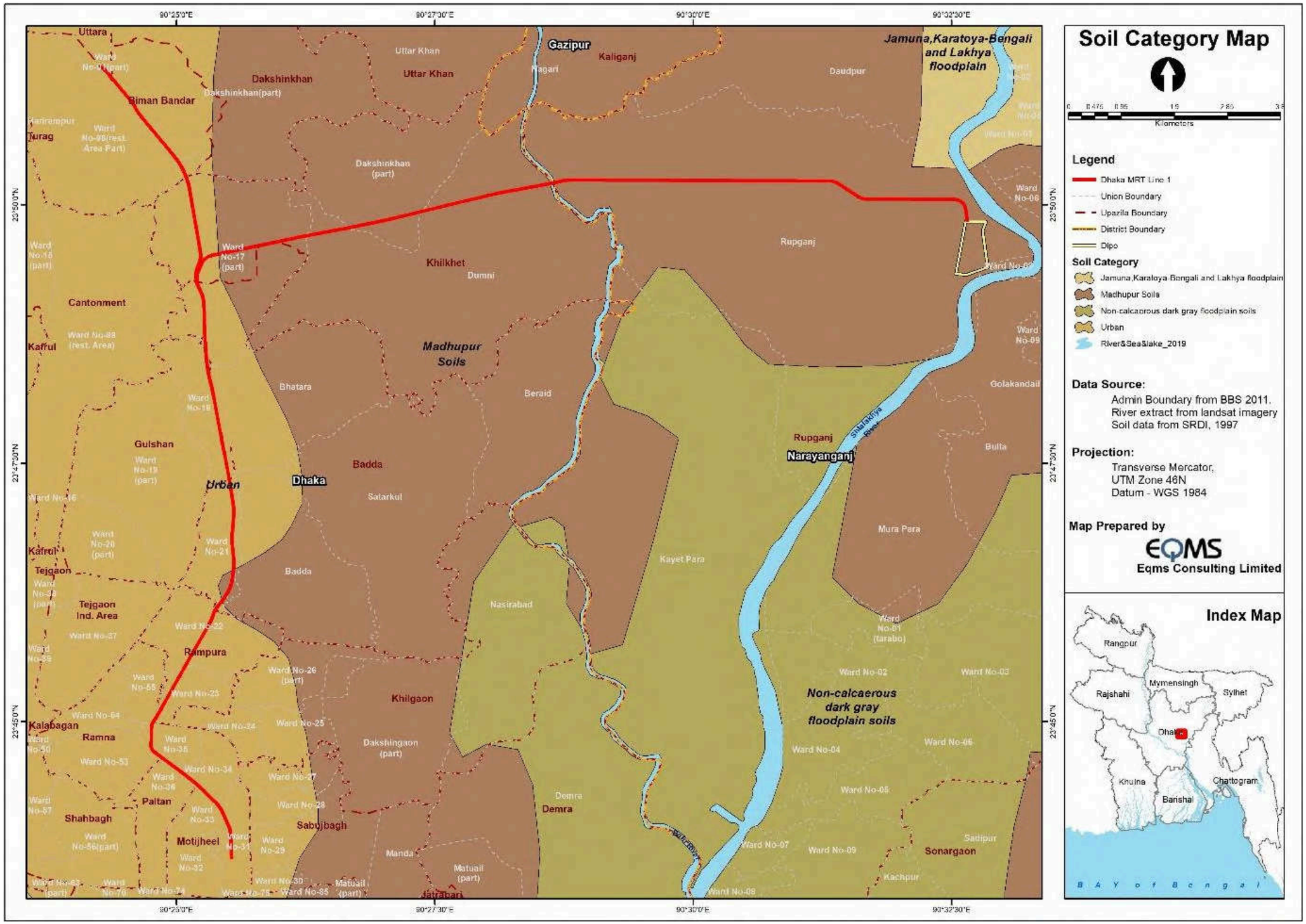
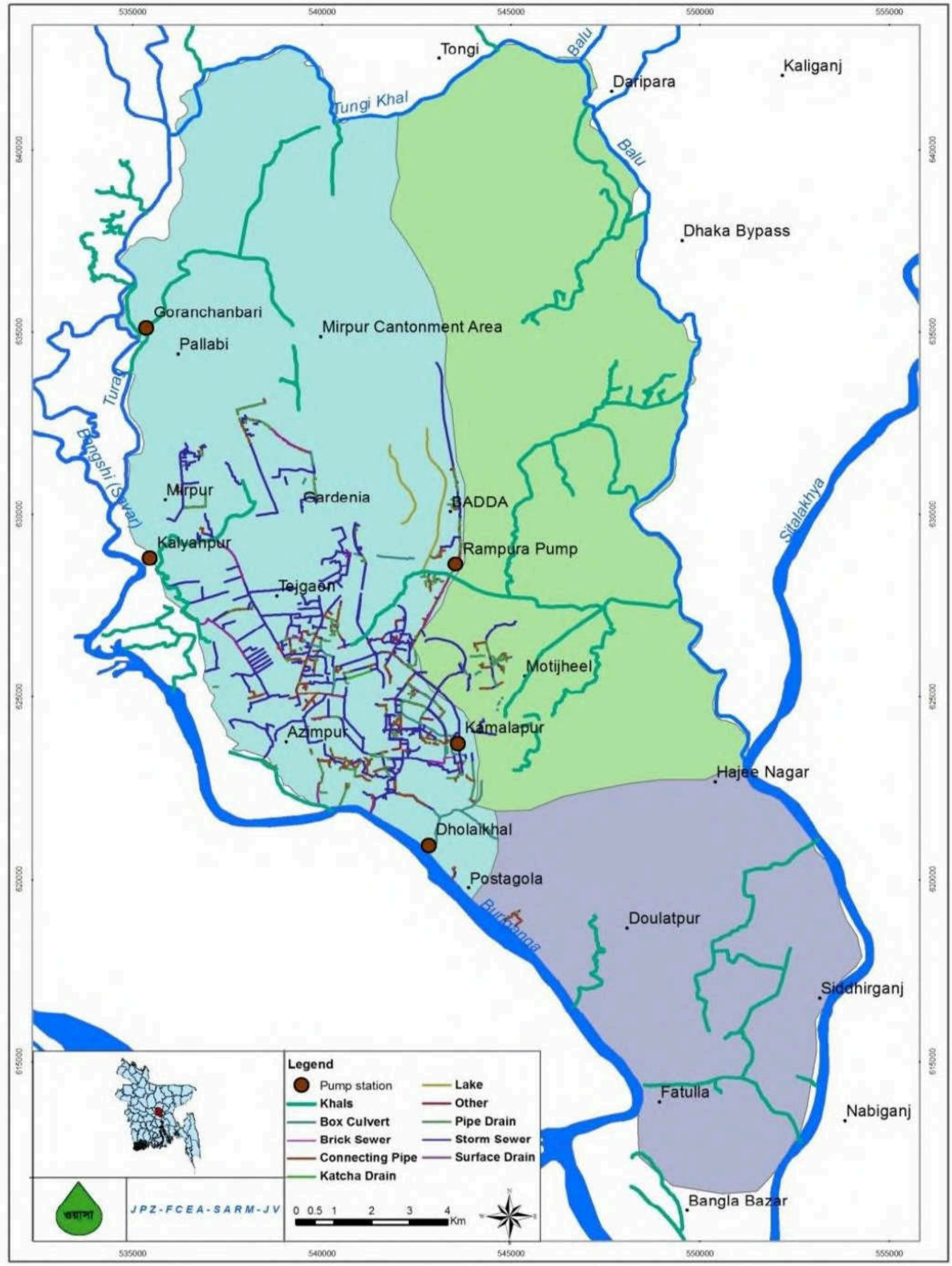


Figure 4-14: MRT Line-1 Alignment on Soil Map

4.5.2 Drainage

The existing internal drainage systems of Dhaka City consists of storm sewer lines, surface drains and open channels (locally known as Khals) that ideally carry the storm water as well as a part of waste water generated in the city to the surrounding rivers. It may be mentioned that there were a good number of open channels in the city areas which played a vital role to provide storm water drainage to the city. Also, there was sufficient low land around the city which acted as water retention area of the concerned command area to retain the excess water for time being. With rapid urbanization and unplanned development, most of these khals and water retention area have been filled up and the capacity of natural drainage has diminished dramatically. It is estimated that there are approximately 45 natural khals, totaling about 142 km that are part of the natural drainage system. In addition to the open channels and lakes, there are about 380 km of storm sewer lines that covers about 140 sq km of Dhaka and 8.75 km of box culverts under DWASA making up the storm water system of Dhaka. A storm sewer line varies in sizes ranging from 0.6 m to 3.0 m in diameter made of brick and concrete. **Figure 4-15** shows the drainage system map of Dhaka city.



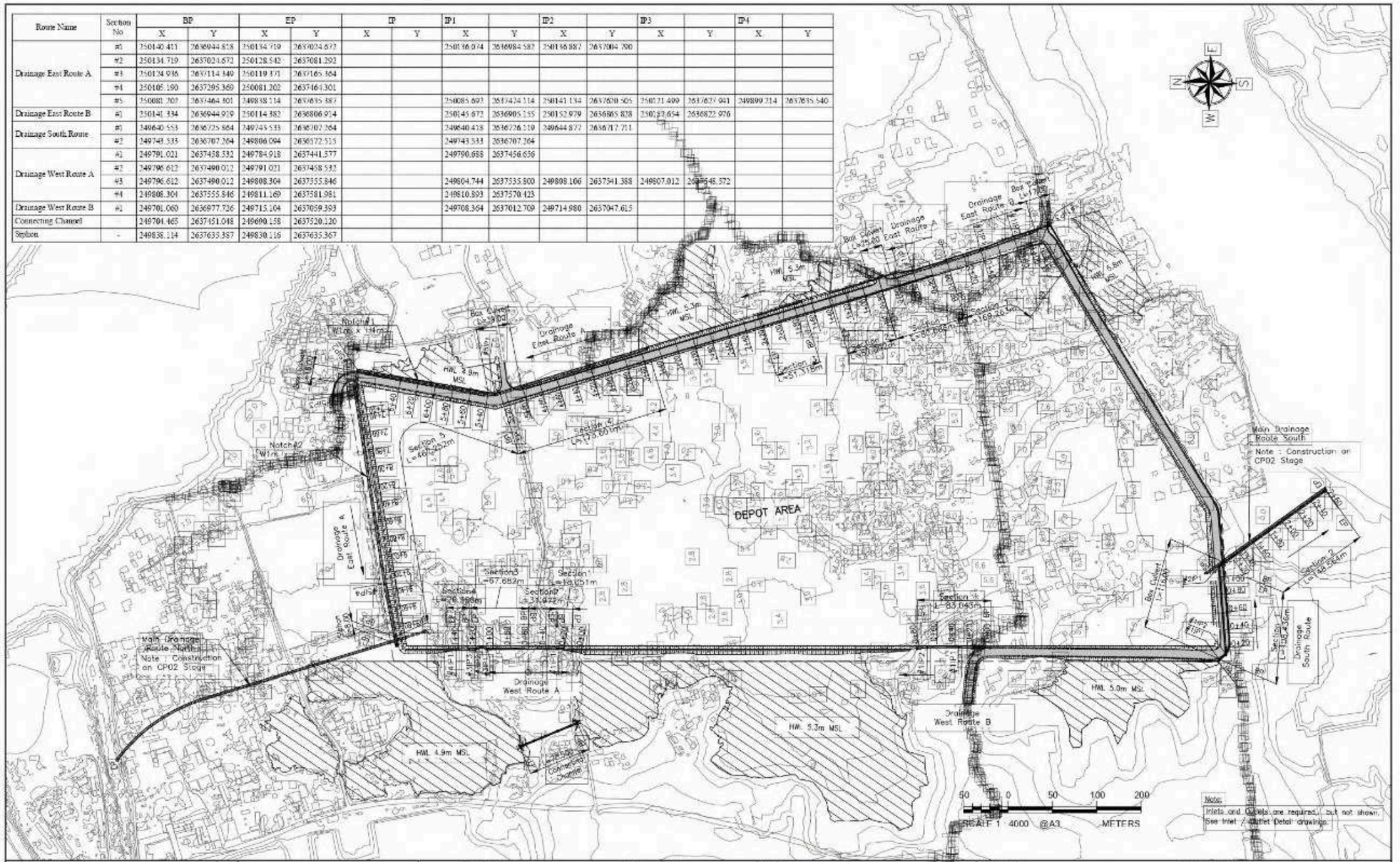
Source: DWASA, 2012

Figure 4-15: Drainage System of Dhaka City

It may be mentioned that the Progoti Sorani at the north leading to the Bishwa Road at the south of the city is treated as the central spine road and acts as the embankment for the central and eastern part of Dhaka City. It has been found that there are 13 outlets across this boundary, out of which 8 have flood-proofing structures (FS). These FS are normally remained closed during the peak monsoon following the flood water level at the river side. Amongst the eight (8) flood-proofing structures (FS), Rampura and Kamlapur (near Maniknagar) on Begunbari Khal and Segunbagicha Khal catchment area respectively, have permanent pumping arrangements for evacuating storm water from country side. The capacity of Rampura pump station is about 25 m^3/sec and Kamlapur pump station with capacity of about 15 m^3/sec.

The depot of MRT Line-1 is situated on the bank of Shitalakshya River. A drainage layout has been prepared showing the drains and outlets of storm water from the depot. **Figure 4-16** shows the drainage layout of depot area. The peripheral drainage will be constructed around the depot by the project so that no local drainage congestions occur. Bangladesh University of Engineering and Technology (BUET) carried out a flood assessment study during detail design stage. It was found that impact of flood on depot and impact of depot on flood are negligible.

Route Name	Section No	BP		EP		IP		IP1		IP2		IP3		IP4	
		X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
Drainage East Route A	#0	250140.411	2636944.878	250134.719	2637024.672			250136.074	2636984.587	250136.887	2637004.700				
	#2	250134.719	2637024.672	250128.542	2637081.292										
	#3	250124.936	2637114.349	250119.171	2637165.364										
	#4	250105.190	2637295.369	250081.202	2637461.301										
	#5	250081.202	2637464.301	249838.114	2637635.367			250085.693	2637474.114	250141.134	2637620.505	250231.499	2637637.981	249899.314	2637635.540
Drainage East Route B	#1	250141.334	2636944.919	250114.382	2636806.974			250145.673	2636905.155	250152.979	2636865.828	250237.654	2636822.976		
Drainage South Route	#0	249640.553	2636725.864	249743.533	2636707.264			249640.438	2636726.119	249644.877	2636717.711				
	#2	249743.533	2636707.264	249806.094	2636572.515			249743.533	2636707.264						
Drainage West Route A	#1	249791.021	2637458.532	249784.918	2637441.577			249790.688	2637456.636						
	#2	249796.612	2637490.012	249791.021	2637458.532										
	#3	249796.612	2637490.012	249808.304	2637555.846			249804.744	2637535.800	249808.106	2637541.388	249807.012	2637548.572		
	#4	249808.304	2637555.846	249811.169	2637581.981			249810.893	2637570.423						
Drainage West Route B	#1	249701.060	2636877.726	249715.104	2637059.393			249708.364	2637012.709	249714.980	2637047.615				
Connecting Channel	-	249704.465	2637451.048	249690.158	2637520.120										
Siphon	-	249838.114	2637635.367	249830.116	2637635.367										



Source: NKDOS

Figure 4-16: Drainage Layout of Depot Area

4.6 Meteorology

Climatic Sub-zones of Bangladesh

Climatic sub-regions of Bangladesh are presented in **Figure 4-17** and the alignment of MRT Line-1 falls under the South-Central Region. The Bangladesh Meteorological Department monitors different climate component in 35 weather stations in Bangladesh. The climatic data for the study area was obtained from the meteorological station located in Dhaka which is nearest to the project site.

South-central zone (G) in this zone rainfall is abundant, being above 1,900 mm. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in South-eastern zone. This is a transitory zone between the South-eastern, North-western and South-western zones and most of the severe hail storms, nor'westers and tornadoes are recorded in this area.

The climate of Bangladesh is heavily influenced by Asiatic monsoon. The monsoonal influence results in three distinct seasons:

- Pre-monsoon hot season (from March to May);
- Rainy monsoon season (from June to September); and
- Cool dry winter season (from October to February).

Bangladesh is located in the tropical monsoon region, and its climate is characterized by high temperature, heavy rainfall, often excessive humidity, and fairly marked seasonal variations. From a climatic point of view, three distinct seasons can be recognized in Bangladesh - the cool dry season from November through February, the pre-monsoon hot season from March through May, and the rainy monsoon season which lasts from June through September. January is the coolest month, with temperatures averaging near 26°C, and April the warmest, with temperatures from 33 to 36°C. Most places receive more than 1,525 mm of rain a year, and areas near the hills receive 5,080 mm per year. Most rains occur during the monsoon (June-September) and little occurs in winter (November-February). Moderate rains are also reported in the months of March, April and October (Rashid 1992)[12].

[12] Rashid HE (1991) Geography of Bangladesh. Dhaka: The University Press Limited

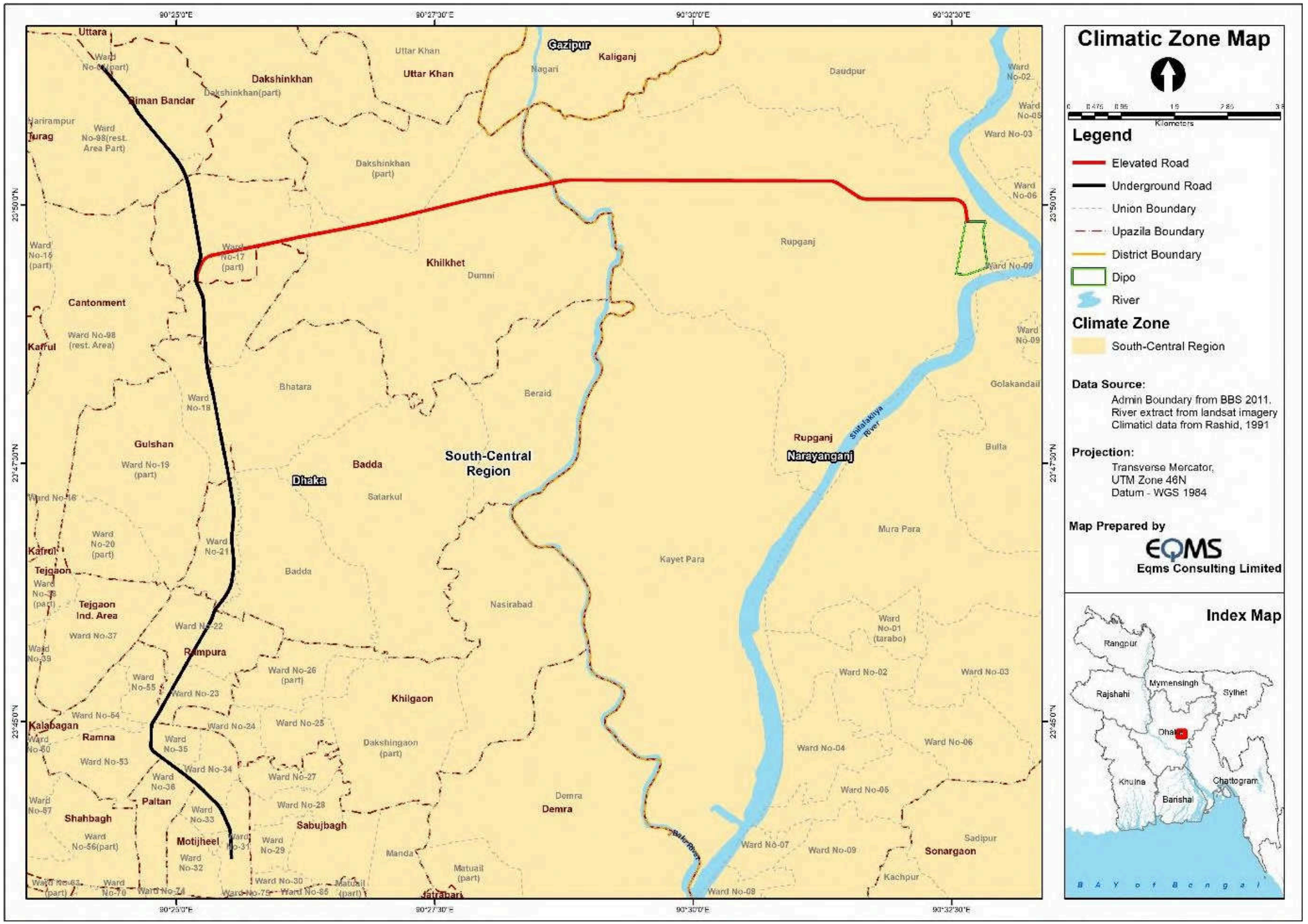
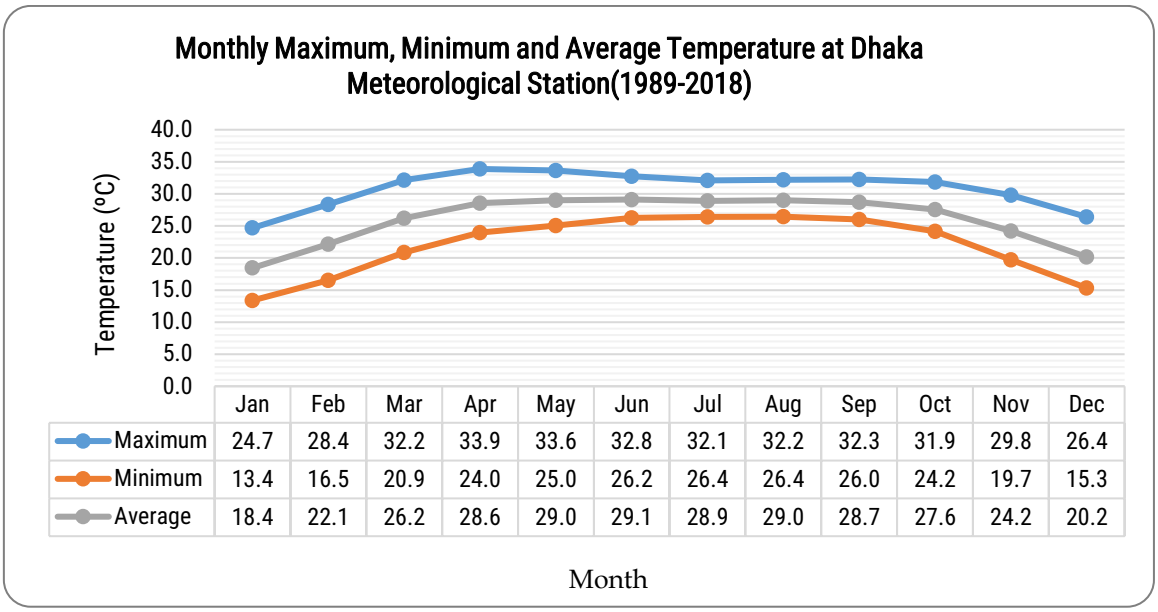


Figure 4-17: Location of Project Area in Climatic Zones of Bangladesh

Temperature

The monthly average minimum and maximum temperatures recorded at the Dhaka weather station are presented in Figure 4-18. The lowest monthly average temperature recorded in the past 30 years was in January 1989 (11.3°C). The highest monthly average temperature was 36.4 °C in April 2014. Throughout the year, the highest temperatures are generally in March through October, and the lowest temperatures are in December through February.



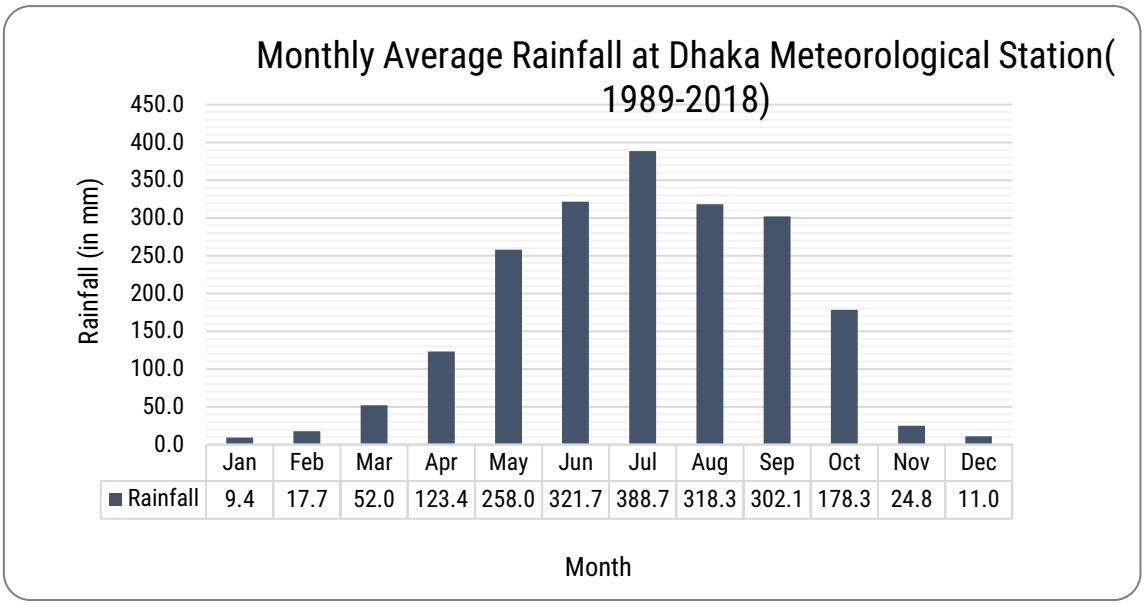
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum	24.7	28.4	32.2	33.9	33.6	32.8	32.1	32.2	32.3	31.9	29.8	26.4
Minimum	13.4	16.5	20.9	24.0	25.0	26.2	26.4	26.4	26.0	24.2	19.7	15.3
Average	18.4	22.1	26.2	28.6	29.0	29.1	28.9	29.0	28.7	27.6	24.2	20.2

Source: Bangladesh Meteorological Department (BMD)

Figure 4-18: Temperature variation at Dhaka Station (1989 to 2018)

Rainfall

During the monsoon (June to September), wind direction from the southwest brings moisture laden air from the Bay of Bengal, when the heaviest rainfall occurs. About 80% of the total rainfall occurs in this period. Average annual total rainfall at Dhaka station is about 1974 mm from 1989 to 2018. Highest annual rainfall is recorded 2892 mm in 2017. The peak one-day highest rainfall is 341 mm recorded in 14 September 2004. An insignificant amount of rainfall has also been recorded in winter (November to February). Monthly average rainfall recorded at the Dhaka station (1989 to 2018) is shown in **Figure 4-19**.

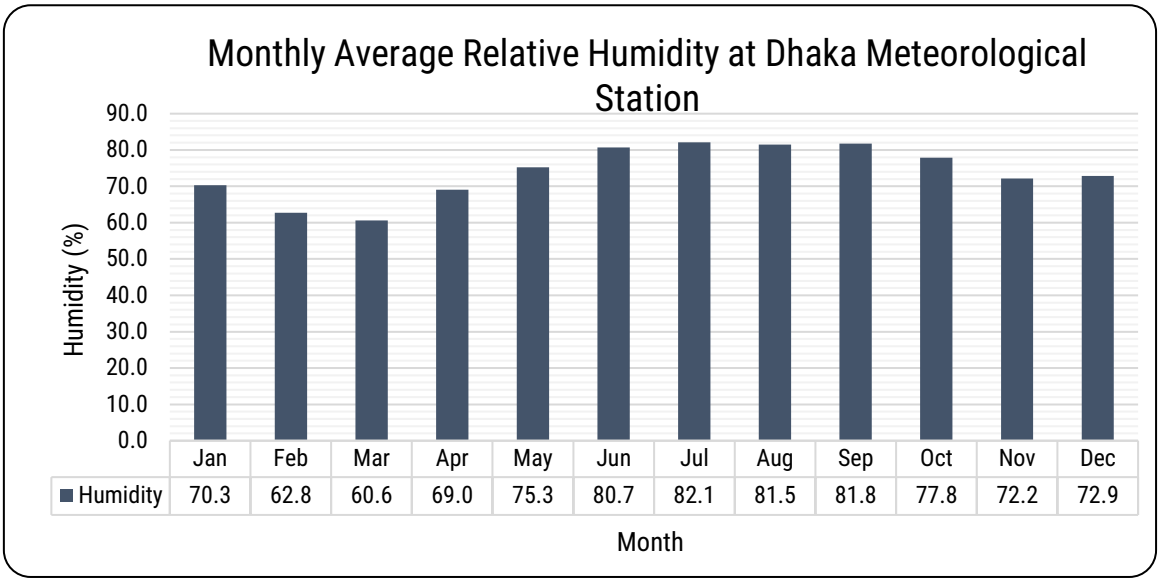


Source: Bangladesh Meteorological Department (BMD)

Figure 4-19: Average of Total Monthly Rainfall in mm (1989-2018) at Dhaka Station

Humidity

Monthly average relative humidity at the Dhaka Metrological station is shown in **Figure 4-20**. Humidity during the wet season is naturally the highest compared to those occurring at other times of the year. Humidity is also responsible for the fluctuation of temperature in the region. The monthly average relative humidity varies from 60.6% to 81.8%.

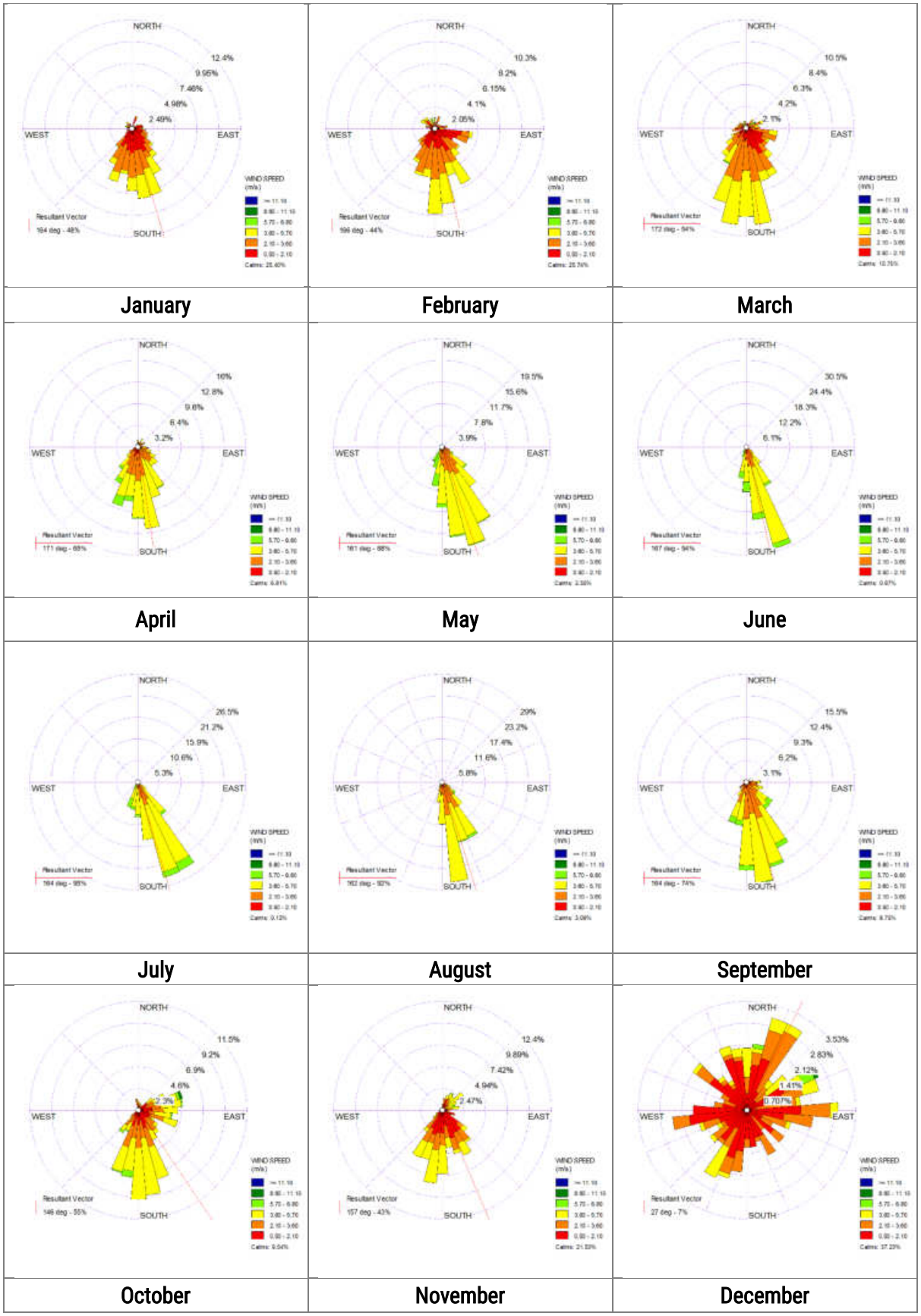


Source: Bangladesh Meteorological Department (BMD)

Figure 4-20: Average Monthly Relative Humidity in % (1989-2018) at Dhaka Station

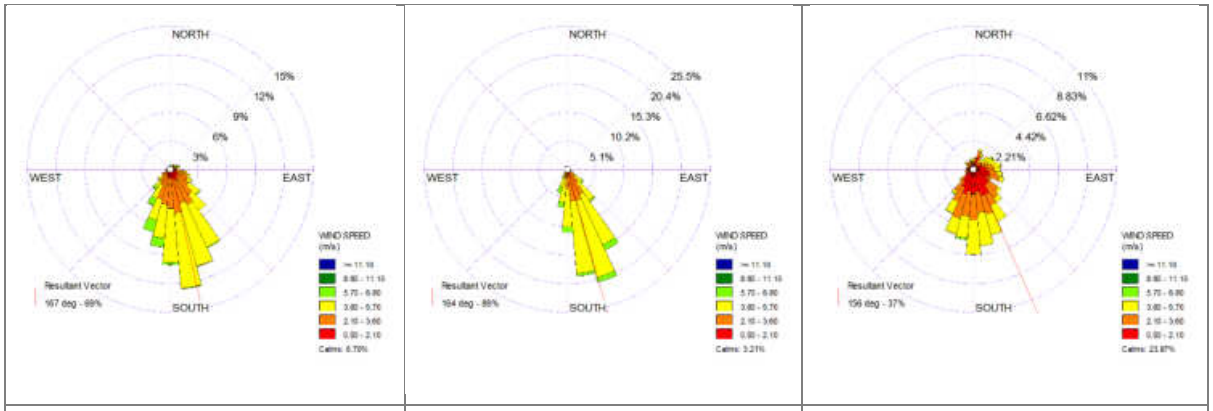
Wind speed and direction

The wind direction in Dhaka meteorological station is generally from South-South East (SSE) to North-North West (NNW) direction. Maximum wind speed was recorded 9.8 m/s during October. Wind blows from south to north during monsoon. Monthly wind rose diagram at Dhaka is shown in **Figure 4-21**. Seasonal and Annual wind roses are shown in **Figure 4-22** and **Figure 4-23** respectively.



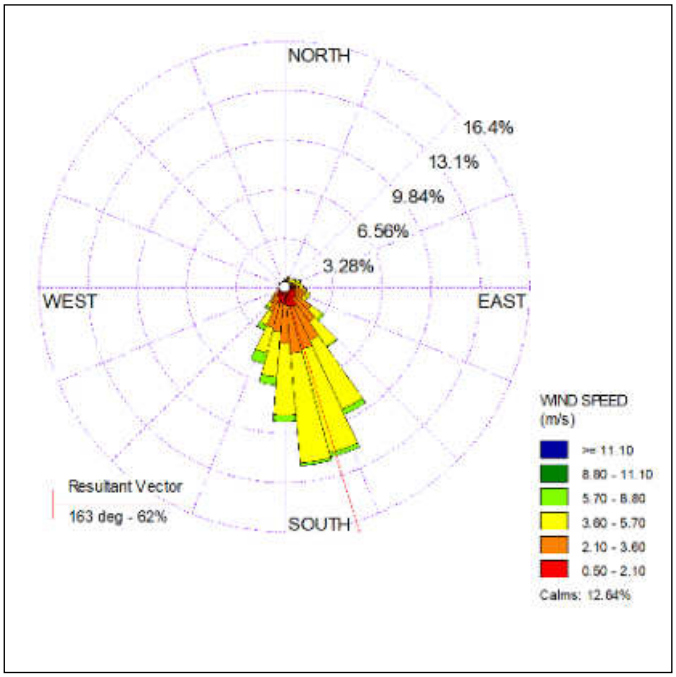
Source: Purchased met data from https://www.weblakes.com/services/met_order.html

Figure 4-21: Monthly Wind Speed and Direction at Dhaka in 2018



Source: Purchased met data from https://www.weblakes.com/services/met_order.html

Figure 4-22: Seasonal Wind Rose Diagram, 2018



Source: https://www.weblakes.com/services/met_order.html

Figure 4-23: Annual Wind Rose diagram at Dhaka, 2018

4.7 Biological Resource

An Ecological Survey was conducted during preparation of initial EIA report in 2018. In that survey a detail investigation was carried out to find out the biodiversity in project area following proper methodology. The detail findings of that survey, including the list of plant and animal species can be found in initial EIA report of 2018 (see section 4.9 of 2018 EIA report). During this supplemental study, no ecological survey is carried out.

4.8 Socioeconomic Characteristics

The present socio-economic conditions of the people of the project or study area will provide sound reference and assess probable socio-economic impact of the proposed interventions. This will enable us to compare the changes and impacts of the project interventions in future.

The socio-economic baseline scenario describes the socio-economic characteristics of project area on the basis of primary and secondary data. The socio-economic characteristics include administrative area, demographic, household size, education, occupation, housing, employment opportunity, health, housing, access to water and sanitation status, etc. The data provided in this section are mostly based on the Population and Housing Census 2011. Although these data are very old, but these are the latest available data that may differ from current situation. Next census is scheduled to take place in 2021 and it will take further one or two years to get the result. Therefore, these data are given to show just a crude outline.

4.8.1 Administrative Divisions and Location

Most of the project sites, including whole underground and a part of elevated alignment are located in Dhaka District. On the other hand, the depot site and a part of elevated section are located in Narayanganj District. Dhaka is the most populous city in Bangladesh, one of the most populous cities in the world, and the political, economic and cultural heart of Bangladesh. It lies between 23º53` and 24º06` north latitudes and between 90º01' and 90º37' east longitudes. Dhaka city consists of 2 City Corporations - Dhaka North City Corporation and Dhaka South City Corporation for ensuring better civic facilities. These two corporations are headed by City Mayor. Area within city corporations divided into several wards, which each have a ward commissioner and wards are further subdivided into mouza. In the greater Dhaka Metropolitan Area, the prominent division is Thana, used also within DCC, but subdivided further outside the DCC into unions and these unions are headed by Union Parishad Chairman.

These two city corporations have different administrative boundaries with overall 10 zones and 92 wards, where Dhaka South City Corporation has 56 wards and Dhaka North City Corporation has 36 wards. **Table 4-22** shows the list of wards adjacent to the alignment in North and South Dhaka.

Table 4-22: Study Area/Wards of the MRT Line-1 Alignment

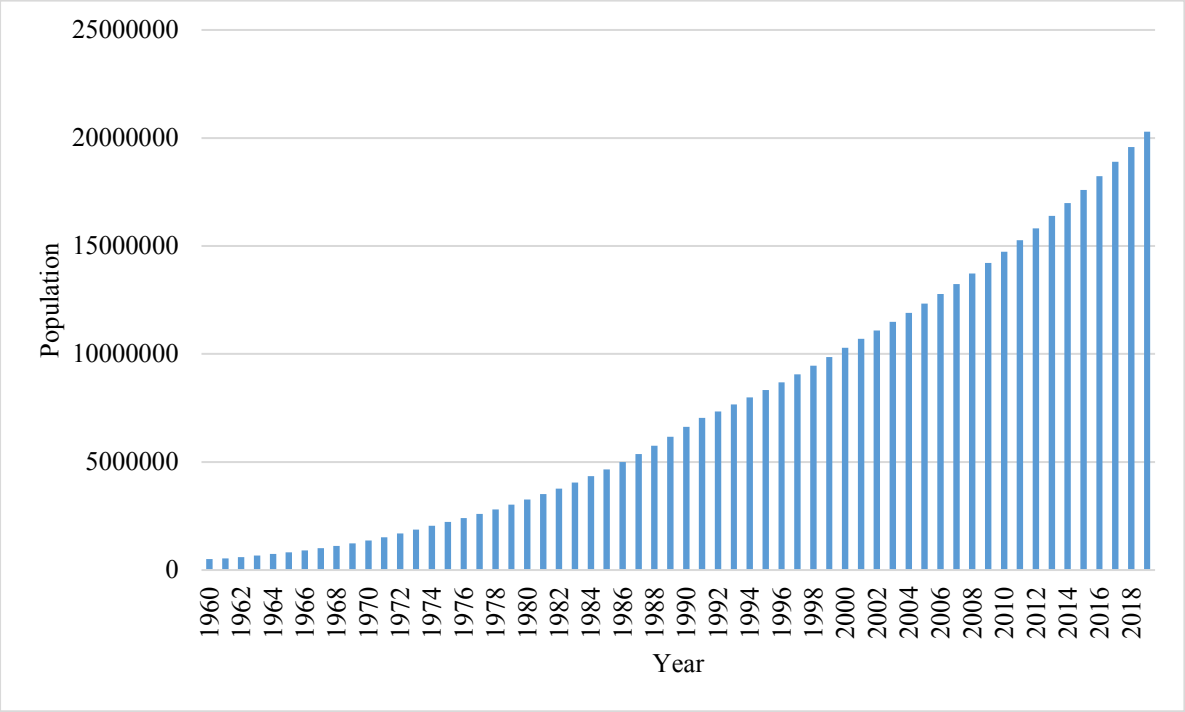
Ward No.	Area/Thana Covered
Dhaka South City Corporation	
Ward 19	Bara Maghbazar Eskaton, Kakrail (Part), Paschim Malibagh,Ramna (Part), Siddeswary(Part), Baily Square,
Ward 08	Dakshin Kamlapur, Gupibagh, Kamlapur Railway Stn., Kamlapur Railway Hospital, Uttar Kamlapur.
Ward 10	Bank Colony, Motijheel Colony, T & T Colony
Ward 11	Dakshin Shahjahanpur, Khilgaon Bagicha, Mominbagh, Shahidbagh, Uttar Shahjahanpur
Ward 12	Dakshin Shantibagh, Gulbagh, Malibagh, Uttar Shantibagh.
Dhaka North City Corporation	
Ward-01	Uttara Model Town
Ward-17	Kuril, Khilkhat, Kuratori, Joar shahara (Olipara), Jogonnathpur.
Ward-18	Baridhara residential area (block K and I), Shahjadpur, Kalachandpur, Nodda.
Ward-19	Gulshan 1 and 2, Banani, Gulshan Suipar Colony, Korail.
Ward-21	North Badda, Daskhin Badda, Maddha Badda, Purba Merul Badda, Pashchim Merul Badda, Gopipara.
Ward-22	East rampura, Ulon, Bagichar tek, Nachirer tek, Omar ali lane, West Haji Para.

Ward No.	Area/Thana Covered
Ward-35	Boro Moghbazar,New Eskaton road, Dilu road, Pashchim Malibagh, Maddha peyarabagh and Greenway, Uttar noyatola (First part)
Ward-36	Uttar Neyatola (second part), Daskhin noyatola, Purbo Noyatola, Mirer tek, Mirbagh, Modhubagh, Moghbazar wireless colony.
Narayanganj District	
Rupganj Upazila	Rupganj Union

(http://www.dncc.gov.bd/, 2017)

4.8.2 Population and Demography

Dhaka is the most populated city in Bangladesh, and it is also one of the most populated cities in the world. According to Population and Housing Census, 2011 the city itself has a population estimated at about 8 million. According to a recent estimate of World Bank, total population of Dhaka City stands more than 20 million in 2019. **Figure 4-24** shows an illustration of population growth in Dhaka City from 1960 to 2019.



Source: World Bank 2020

Figure 4-24: Population Growth of Dhaka City from 1960 to 2019

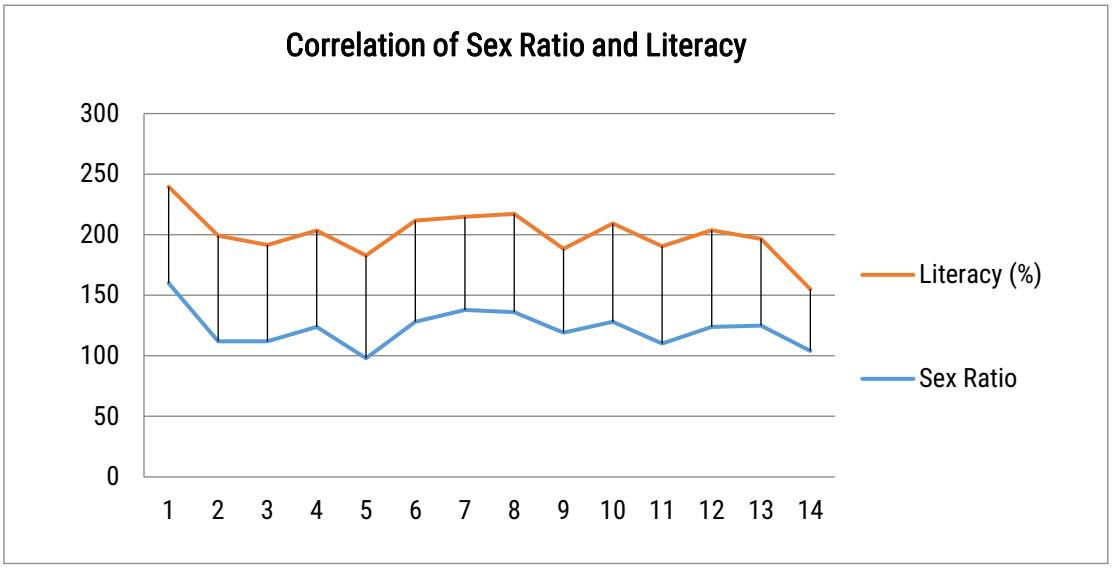
In the study area, there are 274468 households (HHs) including squatters with a total population of 1212231 with an average household size is 4.5. **Table 4-23** shows the ward and union wise Demography of the study area as per the findings of Population and Housing Census 2011.

Table 4-23: Demography of the Study Area Crossed by the Project

City Corporation/ Upazila	Ward No./ Union	Total Population	Total HHs	Avg. HH size	Sex Ratio	Literacy (%)
South City	Ward No-08	34867	8680	4.0	160	80
	Ward No-10	21968	4521	4.9	112	87
	Ward No-11	59999	13330	4.5	112	79
	Ward No-12	51067	11194	4.6	124	80
	Ward No-19	55920	10590	5.3	98	85
North City	Ward No-01	183298	39922	4.6	128	84
	Ward No-17	196479	47268	4.2	138	77
	Ward No-18	63616	14365	4.4	136	81
	Ward No-19	96291	22646	4.3	119	69
	Ward No-21	96111	23777	4.0	128	81
	Ward No-22	160316	36571	4.4	110	81
	Ward No-35	74069	16074	4.6	124	80
	Ward No-36	70984	15312	4.6	125	72
Rupganj Upazila	Rupganj Union	47246	10218	4.6	104	51
Project Study Area		**1212231**	**274468**	**4.5**	**123**	**78**

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Literacy rates are available by ward as shown in **Figure 4-25** alongside sex ratio. The correlation coefficient between these variables is 0.18, inferring there is little relationship. The Correlation of Sex Ratio and Literacy is shown in **Figure 4-25**. The literacy rate in the study area is 78% which is higher than the national average 42.1% and the average sex ratio (number of males per 100 females) is 123.

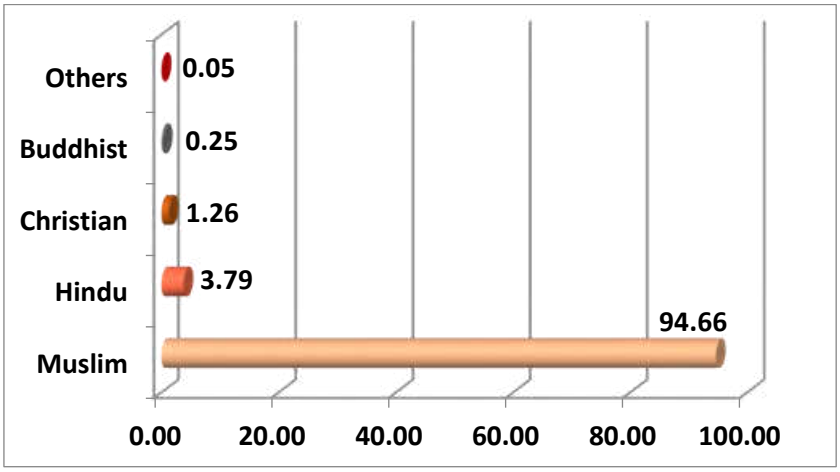


Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Figure 4-25: Correlation of Sex Ratio and Literacy

4.8.3 Religion

As per the 2011 census, the population of the study area dominated by The Muslim community (94.66%) in terms of faith. The second group goes to Hindu who is only 3.79% and other groups (Christian and Buddhist) are very negligible in percentage. The following **Figure 4-26** indicates the various religious profile of the study area.

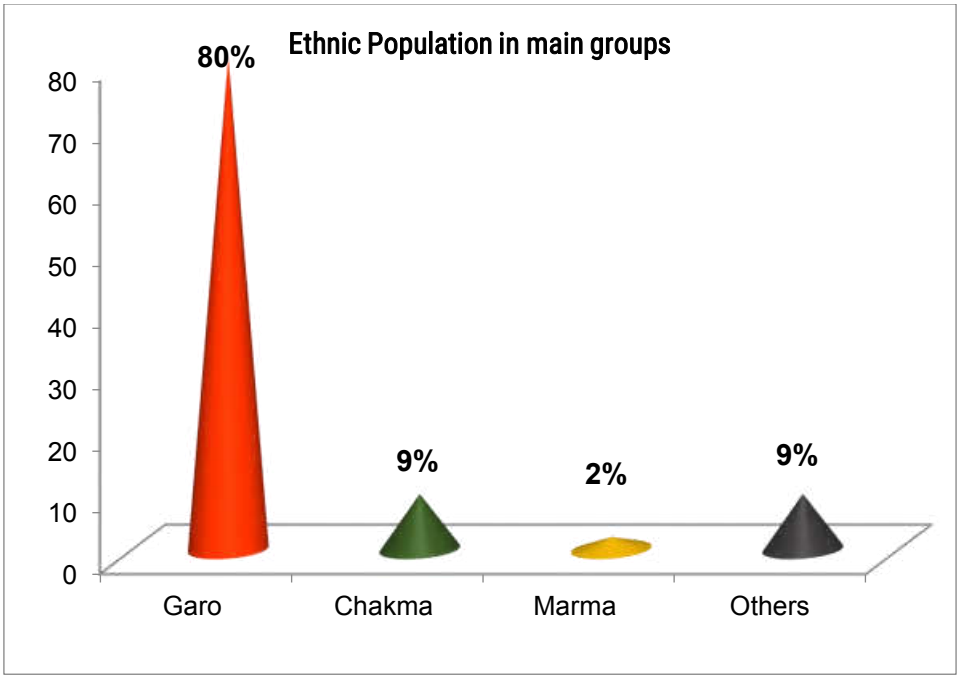


Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Figure 4-26: Religious Profile of the Study Area

4.8.4 Ethnic Composition

According to population census (2011), among the selected Unions 5803 ethnic households are found in the study area. Garo, Chakma, Marma and some other ethnic communities are over there. Ethnic composition of the Study area is dominated by the Garo community**. Figure 4-27** shows the distribution of ethnic community of the study area.

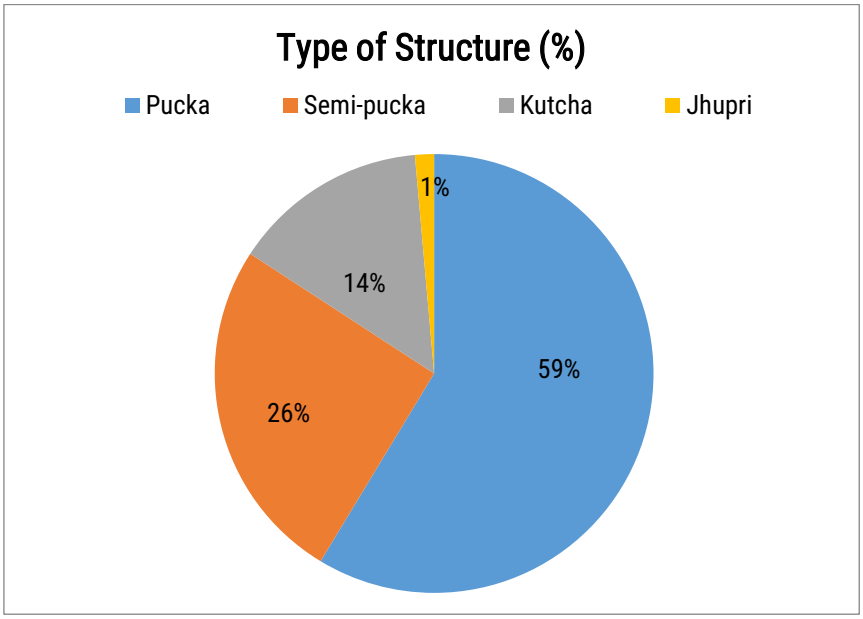


Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Figure 4-27: Distribution of Ethnic Community

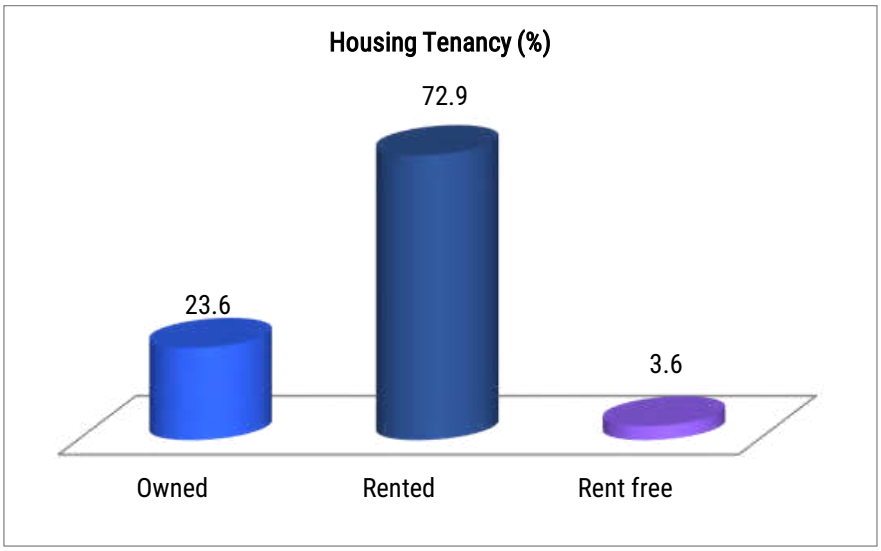
4.8.5 Human Settlement and Housing

According to population census (2011), total household of the study area is 225350. Predominant structure of this study area is Pucka (58.6%) followed by Semi-pucka (25.5%), Kutcha (14.4%) and Jhupri (1.4%). Housing tenancy of the study area is owned by (23.6%), rented (72.9%) and Rent free (3.6%). **Figure 4-28** and **Figure 4-29** show the Type of structure and Housing tenancy in the project study area.



Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Figure 4-28: Type of Housing Structure in the Study Area



Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

Figure 4-29: Housing Tenancy in the Project Area

4.8.6 Economic Activities

In accordance to the Census of Bangladesh (2011), service is the dominant source of employment in the study area. Approximately, 40513 and 26486 male and female involved in service-related activities. Moreover, significant numbers of the population; 8240 male and 5917 females, of the study area are involved in industrial activities. According to census in the study area, agriculture (including livestock and

farming) is another source of income. Though 3686 male and 284 females are involved in agricultural activities in the study area but 2587 male and 87 females are from only the Rupganj union. Agricultural activities are very few in Dhaka metropolitan area. **Table 4-24** shows employment status of the Study area.

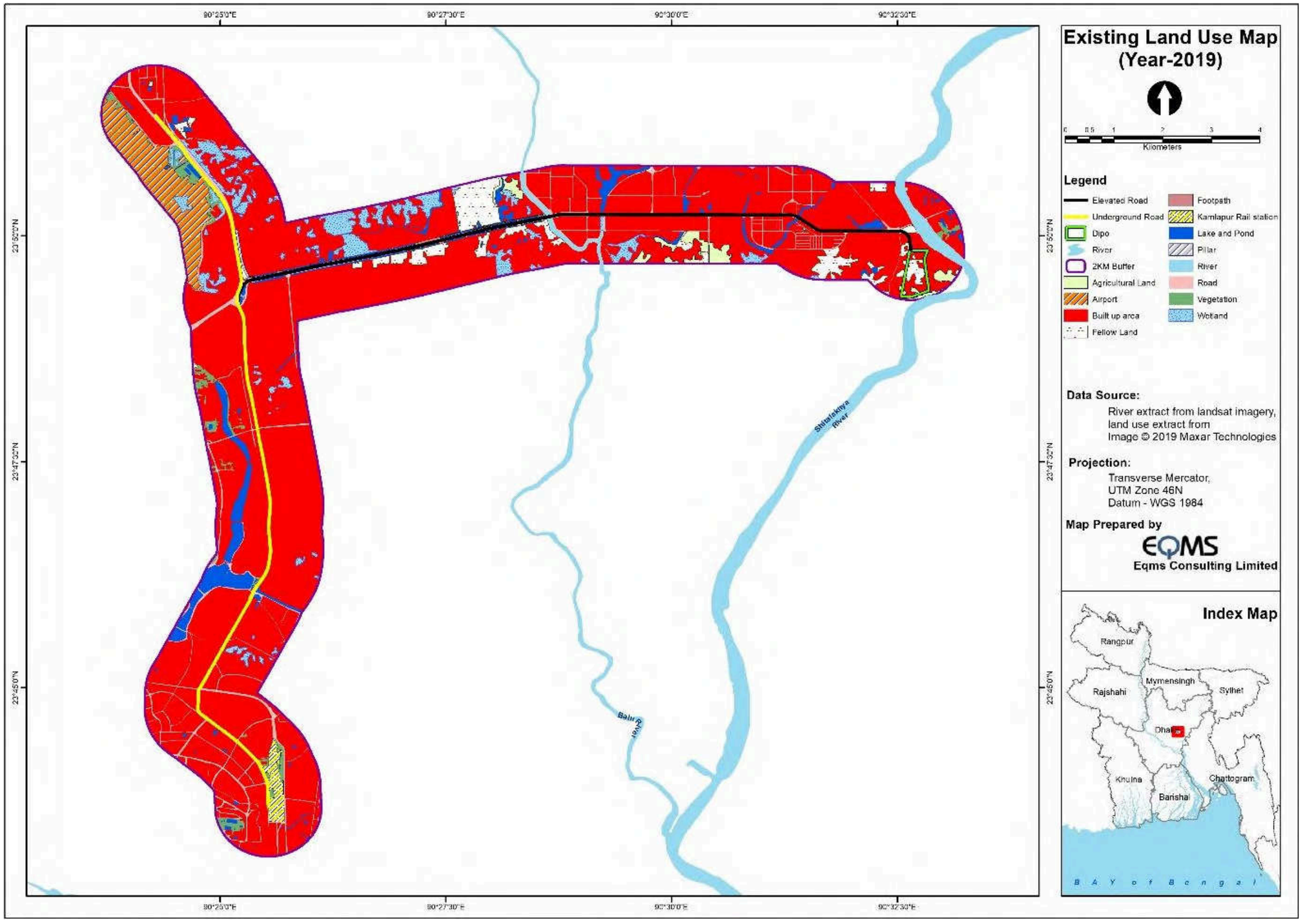
Table 4-24: Employment Status of the Study Area

City Corporation/Upazila	New Ward No./ Union	Population Aged 7+, not attending school but employed			Field of Activity					
					Agriculture		Industry		Service	
		Total	Male	Female	Male	Female	Male	Female	Male	Female
South City	Ward No-8	2813	1730	1083	17	4	317	78	1396	1001
	Ward No-10	1146	572	574	6	3	25	17	541	554
	Ward No-11	4927	2611	2316	21	2	175	96	2415	2218
	Ward No-12	3592	2211	1381	29	10	267	162	1915	1209
	Ward No-19	3816	1249	2567	10	6	284	92	955	2469
North City	Ward No-1	4292	2947	1345	295	53	784	759	1868	533
	Ward No-17	16033	10629	5404	271	36	2285	1777	8073	3591
	Ward No-18	4233	2564	1669	12	0	180	59	2372	1610
	Ward No-19	12536	6316	6220	221	69	947	826	5148	5325
	Ward No-21	5441	3644	1797	26	4	331	145	3287	1648
	Ward No-22	9812	5658	4154	87	9	918	860	4653	3285
	Ward No-35	4700	2722	1978	60	1	486	401	2176	1576
	Ward No-36	7060	5115	1945	44	0	724	581	4347	1364
Rupganj Upazila	Rupganj Union	4725	4471	254	2587	87	517	64	1367	103
Project Study Area		**85126**	**52439**	**32687**	**3686**	**284**	**8240**	**5917**	**40513**	**26486**

Source: Population and Housing Census, 2011, Bangladesh Bureau of Statistics (BBS)

4.8.7 Land Use Land Cover

Figure 4-30 shows the land use map around project locations in 2019. To detect the land use and land cover, a 2 km-buffer was drawn to specify the area of interest. The map shows that the dominant land cover type is built-up area followed by water body, wetland, and fallow land. There is a considerable portion of land is occupied by Hazrat Shahjalal Airport and Kamlapur Railway Station. There is also a small amount of agricultural land in Purbachal Area and beside Depot.



Source: Image © 2019 Maxar Technologies

Figure 4-30: Land Use Map around Project Area in 2019

4.9 Archaeological Monuments and Sites

4.9.1 Screening of Relevant Monuments

A Historical Importance and Archaeological (HIA) survey have been carried out in 2020 under this Line-1 E/S consultancy to identify the monuments and sites which have heritage value and located around the alignment and depot. The main objective of the survey was to identify and assess the heritage and historical importance of the monuments, places, or any other cultural establishments which lie along MRT Line-1 and in and around the depot area, within the direct visual contact of the MRT structures and within the indirect area of influence of the MRT Line-1. The information in this section is based on draft report. The information may be updated once the HIA report is finalized. On the basis of the draft report of the survey, the HIA study (2020) identified 27 important historical/ archaeological/cultural important sites around the project area. After screening, 6 sites were found more relevant to the Project which are presented in **Table 4-25**. The **Table 4-25** presents importance of selected monuments/sites from the perspective of their period of establishment, uses, locations, etc.

Table 4-25: Importance of Selected Monuments/sites along MRT Line-1 Alignment

SL	Name of the Site	Importance of Selected Monuments/Sites along MRT Line 1
1	Harzrat Sheikh Farid (RM) Astana Mubarak (Pagol Shah) Mazar	The monument is said to be colonial. It is very close to MRT Line-1 and is a religious place. Mass gathering happens during *Urash Mubarak* every year.
2	Kamlapur Railway Station	It is very close to MRT Line-1 and has national interest. It is also enlisted as a heritage site by RAJUK
3	Sultanul Awlia Mahbub-E-Subhani Noor-E-Rabbani Hazrat Shah Sufi Peer Jangi (RH) Babar Mazar Sharif	The monument is said to be colonial. It is close to MRT Line-1. It is a religious place where mass gathering happens during *Urash Mubarak* every year
4	Rajarbagh Police Line	It is very close to MRT Line-1. It has historic value from the time of the Liberation war, so it has national interest
5	Rampura BTV Building	These BTV Buildings are very close to MRT Line-1. It has group value. It has national interest as well
6	Purbachal 300 Feet Road-side Monuments	There are a few lucrative and aesthetic houses along the 300 Feet Road. It is assumed that near future many 7attractive houses will be built on both the sides of the 300 Feet Road. These monuments have group value

Source: Draft Archaeological Survey Report, 2020

4.9.2 Impact Assessment and Remedial Measures of Finally Selected Monuments/Sites

The positive and negative impacts on the identified monuments/sites that have been marked as “considered” in **Table 4-26**. The remedial measures to mitigate negative impacts on the monuments and sites are also given in the **Table 4-26**.

Table 4-26: Positive and Negative Impacts of Identified Monuments/Sites and their Remedial Measures

SL	Name of Identified Monuments/Sites	Negative Impact	Positive Impact	Remedial Measures
1	Hazrat Sheikh Farid (R) Astana Mubarak (Pagol Shah) *Mazar*	During construction the followers may feel disturbed attending ritual activities	Improved connectivity between different parts of the city	Need to create alternative temporary passage (s) for easy movement of the *mazar* followers
2	Kamlapur Railway Station	During construction, care should be taken to avoid any impact.	Improved city connectivity and different parts of the country	High level civil engineering technique will be needed to prevent any damage to the complex
3	Sultanul Awlia Mahbub-E-Subhani Noor-E-Rabbani Hazrat Shah Sufi Peer Jangi (R) Babar *Mazar Sharif*	During construction the followers may feel disturbed attending ritual activities	Improved connectivity between different parts of the city	Create alternative temporary passage (s) for easy movement of the *mazar* followers
4	Rajarbagh Police Line	During construction, special care should be taken in the police line complex to prevent the impact, if any	Improved connectivity between different parts of the city.	High level civil engineering technique will be needed to prevent any damage to the complex.
5	Rampura BTV Buildings	During construction the building complex should be taken care to avoid any impact.	Improved connectivity between different parts of the city.	High level civil engineering technique will be needed to prevent any damage to the complex.
6	Purbachal 300 Feet Road-Side Monuments	Sound/noise pollution	Improved connectivity between different parts of the city.	Construction dust and vibration need to be controlled. Employment of advanced shock absorbent construction technology may be needed. High quality sound/noise protector is needed to be set on both the sides of the elevated 13.4 km MRT Line 1

Source: Draft Archaeological Survey Report, 2020

CHAPTER 5

5 SCREENING AND SCOPING

5.1 Screening

Screening is the step to categorize projects/activities based on degree of environmental impacts caused by the project.

The Project was classified as" Red" under regulation of Bangladesh and "A" according to the JICA Environmental Guidelines, and thus EIA is necessary to be conducted.

5.2 Procedure of Scoping for Environmental Impact Assessment

In order to assess the likely significant environmental and social impacts, potential environmental and social impacts of the Project were preliminarily identified based on the project description and overall environmental and social conditions in and around MRT Line-1 project. The impacts of pollution, natural and social environments, health and safety, emergency risk, and others were classified as A to D in accordance with the following criteria, assuming no specific measures toward the impacts are taken:

5) A-/A+: Significant negative/positive impact
6) B-/B+: Some negative/positive impact
7) C-/C+: Impacts are not clear, require more investigation
8) D: Impacts are negligible, no further study required

As the MRT Line-1 will go through the underground from Kamlpur to Airport (which is already urbanized) and elevated from Kuril to Purbachal (under plan for the urbanization), so there might be some significant environmental impact due to the construction and operation period of the MRT Line-1. To find out the significant environmental impact of the environmental components, four environmental standpoints have been considered for finding out the significant impact. These are:

- Physical Environment
- Biological Environment
- Social Environment and
- Others

5.3 Results of Scoping for Environmental Impact Assessment

Results of the scoping for environmental impact assessment are shown in **Table 5-1**. Scoping was conducted toward the development project of MRT line-1. These impacts were evaluated in each of the three phases namely pre-construction, construction and operation.

Table 5-1: Scoping Matrix of the Proposed MRT Line- 1 Project

No.	Items of Impact	Predicted Impact		Description of Rating
		Before/During Construction Stage	Operation Stage	
Physical Environment				
1.	Noise	A-	B-	**During Construction:** Operations of the heavy equipment at the construction sites, movement of heavy machineries and transportation of vehicles may cause noise. **During Operation:** Running of railway may cause noise around viaduct section.
2.	Vibration	A-	B-	**During Construction:** Construction activities and operation of equipment may cause vibration. **During Operation:** Running of railway may cause vibration around viaduct section.
3.	Air pollution	A-	B+	**During Construction:** Transport of construction materials, heavy equipment operation and earthworks will generate dust and exhaust gas, temporarily. **During Operation:** The project will decrease road congestion, air pollution will be reduced.
4.	Surface Water Pollution	B-	B-	**During Construction:** Turbid water by construction work may deteriorate water quality of water bodies. **During Operation:** untreated water maintenance facilities of depot may deteriorate water bodies.
5.	Ground Water pollution	D	D	**During Construction:** Construction activity may not impact on ground water quality **During Operation:** Operation of metro rail will not impact on ground water quality

No.	Items of Impact	Predicted Impact		Description of Rating
		Before/During Construction Stage	Operation Stage	
6.	Soil pollution	A-	B-	**During Construction:** The construction will require hazardous material like lubricant for the light and heavy vehicles, maintenance of the equipment etc. and bentonite/polymer slurry for the piling activities. Such use of hazardous material will increase the possibility of soil pollution at the project site if proper steps will not be taken. Also mishandling of the bentonite slurry may pollute the surrounding soil of the construction sites. **During Operation:** Oil leak from maintenance facilities of depot may cause soil pollution.
7.	Waste	A-	B-	**During construction:** The construction work will generate several hundred metric ton surplus spoil as well as fragments of construction materials and garbage. It is assumed that the impact will be significant because the surplus spoil maintenance will be difficult task. **During Operation:** Illegal dumping of trash from stations and depot may affect the environment.
8.	Ground subsidence	C	C	**During Construction:** Construction on soft ground appropriate methods should be selected to avoid ground subsidence. **During Operation:** Ditto
9.	Offensive odors	D	D	**During construction:** Construction work with odors is not estimated. **During Operation:** Railway project will not occur odor.
10.	Topography and geology	D	D	**During Construction:** Elevated structure construction may not change the current topography significantly. **During Operation:** Elevated structure will not bring any major change in the topography.

No.	Items of Impact	Predicted Impact		Description of Rating
		Before/During Construction Stage	Operation Stage	
11.	Landscape	B-	B-	**During Construction:** Some extents of impacts are assumed; however, the magnitude might be not significant and affected duration will be short. **During Operation:** Impacts are assumed when the height of viaduct is so high to over other structures.
12.	Urban Drainage	B-	D	**During Construction:** The drainage system could be hampered due to construction activities like as infilling, construction of the depot, construction yards and haul routes. **During Operation:** No impact during operation
Natural Environment				
13.	Protected area	D	D	**During Construction:** There is no projected area in/around the project site. **During Operation:** Ditto
14.	Biota and ecosystem	B-	D	**During Construction:** Construction work may decrease water land and clear trees. **During Operation:** Operation of the depot may affect ecosystem around the depot.
Social Environment				
15.	Involuntary resettlement	A-	D	**During Construction:** PAPs will be displaced for MRT Line-1, therefore, significant impact will be assumed. **During Operation:** All PAPs will be resettled prior to start the construction activity, therefore, impact will be almost nil.
16.	Local economies such as employment, livelihood, etc.	B-/B+	A+	**During Construction:** Livelihood are assumed to be affected due to their displacement, however, the job opportunity will be increased at the same time. **During Operation:** local economics and employment will be increased.
17.	Social service facilities	C	C	**Before/During Construction:** Magnitude of impact is not clear at this stage. **During Operation:** Ditto

No.	Items of Impact	Predicted Impact		Description of Rating
		Before/During Construction Stage	Operation Stage	
18.	Cultural Heritages	C	C	**During Construction:** Cultural heritages concerned are not clear at this moment. **During Operation:** Ditto
19.	Local conflicts of interest	B-	C	**During Construction:** The gaps between those who shall be displaced and non-displaced are assumed. **During Operation:** It is not clear at this stage.
20.	Infectious disease such as HIV/AIDS	B-	D	**During Construction:** Influx of workers may increase the risk of infectious diseases. **During Operation:** No impact expected.
21.	Working conditions	B-	D	**During Construction:** Insufficient management by the contractor may worsen the workers' working condition. **During Operation:** No impact expected.
22.	Gender	B-	B+	**During Construction:** Some female headed household might be affected. **During Operation:** Women will be empowered by creating employment opportunity
23.	Children's rights	B-	C	**During Construction:** many children might be displaced along with their families; **During Operation:** It is not clear at this stage
24.	Misdistribution of benefits and damages	D	D	**During Construction:** The MRT Line-1 will be mostly underground structure and the elevated section will pass through the median of the road which is wide enough to construct the line. The number of damages due to the project activities is negligible. Therefore, the people will not be deprived from their benefit. **During Operation:** No impact expected.
25.	Indigenous or ethnic minority people	D	D	**During Construction:** Dhaka is not a natural habitat for indigenous people. **During Operation:** Ditto.

No.	Items of Impact	Predicted Impact		Description of Rating
		Before/During Construction Stage	Operation Stage	
26.	Land use and utilization of local resources	B-	B+	**During Construction:** It is assumed that impact due to the acquisition of depot will change the present aspect from negative points of view. **During Operation:** Vacant lots in suburbs will be improved properly by providing new structures related to MRT.
Others				
27.	Global warming/Climate change	B-	B+	**During construction:** The operation of construction machine and vehicle will produce greenhouse gas (CO_2). **During Operation:** Power consumption increases greenhouse gas; however, fuel efficiency of railway is much higher than vehicle. Therefore, modal shift from vehicles to railway will decrease the emission of greenhouse gas.
28.	Accident	B-	B-	**During Construction:** Since many heavy machineries and vehicles will be used for construction purpose, accidents may happen if employees ignore the safety rules. Inappropriate traffic control or increase of traffic may induce the accident. **During Operation:** Minor collision with viaduct and accident at depot are assumed.

Evaluation: A-/A+: Significant negative/positive impact
B-/B+: Some negative/positive impact
C-/C+: Impacts are not clear, require more investigation
D: Impacts are negligible, no further study required

CHAPTER 6

6 ANTICIPATED ENVIRONMENTAL IMPACTS AND THEIR MITIGATION MEASURES

This chapter describes the potential impacts of project implementation works on different variables of natural and human environment. The following sections incorporated the probable impacts due to construction and operation of the MRT line-1. In most of the case, environmental impacts will remain same as identified in initial EIA of 2017.

6.1 Noise

Noise impact due to the MRT Line-1 project construction and operation which will be more or less same to the receptor level as the existing ambient noise level. The major activities under the MRT Line-1 project during the construction phase are construction of foundations and piers erection of precast viaduct section, construction of station, tunnel boring etc. In the city area there are residential and commercial buildings beside the MRT Line-1 alignment. But as the line will go through underground so the impact of noise level will be minimum. Only impact will be in the station area which will be open cut method. Rest of the source of the noise level at both construction and operation stage is the elevated section (mainly from Kuril to the Purbachal area) which may have significant level of noise impact during construction and operation of the project. In Bangladesh (as per Noise Pollution Control Rules 2006), there is no applicable standard for the train operation. So, this project will voluntarily abide by the 2006 standards. Though the standard has been set up after the output from the noise modeling and comparing with different international laws.

6.1.1 Construction Noise Analysis

This section addresses noise levels expected from various combinations of equipment required to perform construction tasks. The main sources of noise level during the construction phase are:

- Different types of equipment used for the sand compaction piles and vibratory compaction used to stabilize the Depot area.
- Operation of the heavy equipment during infilling and construction
- Foundation, pier and viaduct construction and station construction at the Purbachal Line.

For the underground section from Airport to Kamlapur, less impact is anticipated except in the station area compared to the viaduct section. Underground section will introduce some source of noise as the construction of such station will be followed open cut system. This section addresses noise levels expected due to construction of MRT Line-1 project.

6.1.1.1 Approach

The prediction of construction noise on receptor points has been carried out based on sound power levels of equipment required to perform the work. Point of impact on the receptors are taken to be 30 - 95m based on the nearest settlement. The nearest receptor from the track center of the viaduct is situated at the Purbachal Center area which is around 25m. Receptors near the transition station point is about 90m far from the track center which is the highest in terms of distance from the track center to the receptor. In the city area, the distance from the receptor level to the station construction area is even closer (ranging from 6.5m to 30m). Predicted values are compared with ambient noise levels. Ambient and predicted noise levels are superimposed; comparisons are made with the DOE's ambient noise standards.

6.1.1.2 Applicable Standards

The ambient noise levels along the alignment of the Purbachal route line already exceeded the standard. Construction noise is not regulated by a standard in Bangladesh; target noise limits for construction depend on ambient noise conditions and standards used in other countries, which are reviewed and stipulated in **Table 6-1**. Based on the other countries standard following table has been summarized the standards proposed for construction noise control for the project.

Table 6-1: Noise Criteria and Standards Considered in Setting Limits for Metro Line-1

Countries	Standard or Criteria	Day Time Leq	Night Time Leq
New Zealand	Residential (less than 14 hr. per weekday)	65 dB (6.30 -7.30 am) 80 dB (7.30 am-6 pm)	75 dB (6-8 pm) 45 dB (8 pm-6.30 am)
	Residential (less than 20 hr. per weekday)	60 dB (6.30 -7.30 am) 75 dB (7.30 am-6 pm)	70 dB (6-8 pm) 45 dB (8 pm-6.30 am)
	Residential (more than 20 hr. per weekday)	55 dB (6.30 -7.30 am) 70 dB (7.30 am-6 pm)	65 dB (6-8 pm) 45 dB (8 pm-6.30 am)
	Commercial/industrial area (less than 14 days)	80 dB (7.30 am – 6pm)	85 dB (6 pm-7.30 am)
	Commercial/industrial area (less than 20 weeks)	75 dB (7.30 am -6pm)	80 dB (6 pm-7.30 am)
	Commercial/industrial area (more than 20 weeks)	70 dB	75 dB
Japan	Using heavy equipment with high noise level (piling, excavating etc.)	85 dB (Maximum)	
Singapore	Hospitals, schools, institutions of higher learning, homes for the aged sick, etc.	60dB (7 am-7pm, 12 hrs)	50 dB (7 pm-7am, 12 hrs)
	Residential buildings located less than 150m from the construction site where the noise is being emitted	75 dB (7 am-7 pm, 12 hrs)	60dB (7- 10 pm, 55dB)
	Other Buildings	75 dB (7 am-7 pm, 12 hrs)	
UK	In rural, suburban and urban areas away from main road traffic and industrial noise	70 dB (8.00-18:00)	
	Urban Areas near main roads	72 dB (8.00-18:00)	
USA America	Residential	80 dB (8 hrs)	70 dB (8 hrs)
	Commercial	85 dB (8 hrs)	85 dB (8 hrs)

Countries	Standard or Criteria	Day Time Leq	Night Time Leq
	Urban Area with high ambient noise level (>65 dB)	Ambient Noise Level +10 dB	

New Zealand Standard NZS 6803:1999* Acoustics-Construction Noise"
Noise Regulation Act, Japan (law no 98, 1968, Amended No 33, 2006)
Environmental Protection and management Act in Singapore (Chap. 94 A, Section 77, revised in 2008)
British standard 5228:1997 "Noise and vibration control on open and construction sites"
Transit Noise and Vibration Impact Assessment, U.S. Department of Transportation in USA, 1995

From the **Table 6-1**, it is observed that USA criteria allowed maximum of ambient + 10 db in urban areas with existing high ambient noise levels. Also, their target noise level in the commercial area at both day and night time is 85 dBA. Japan also set 85 dBA as a standard for the construction area where piling or excavation activity is normally going on by the heavy equipment.

The USA criteria states that "noise levels from construction should not exceed the existing ambient level +10 db in urban areas with existing high ambient noise levels". Target criteria for noise limits during construction in commercial areas and areas with high background noise is set at 85 dB. Japanese criteria also refer to the value of 85 dB. But as per ECR, 1997, there is no standard for the construction activity except schedule 5 where there is standard for the mechanized vehicles and which is 85 dBA at 7.5m distance from the construction site. So, considering all the references, target noise limits are therefore set for construction as follows:

- If the ambient noise level is less than the national standard, then the noise standard for the project will be the national standard + 10 decibels;
- If the existing noise level is higher than the national standard, then the noise level for the project will be the ambient noise level + 10 decibels for both day and night time, but it cannot be more than 85 decibels. The daytime will be considered from 6.00 – 22.00 and night time will be considered from 22.00 – 6.00.

So, considering the current ambient noise level at the elevated section and underground station area, the project standard noise for each point is given in **Table 6-2**.

Table 6-2: Proposed Project Construction Noise Standard at the Elevated and Underground Sections

		Baseline Noise Level		Project Standard (Either Existing Noise Level + 10 dBA or 85 dB, whichever is lower)	
Sl.	Elevated Section Area	Leq_{day}	Leq_{night}	Day	Night
1.	Transition section (Opposite to BICC gate)	73.37	68.13	83.37	78.13
2.	Joar Sahara Station	61.62	60.81	71.62	70.81
3.	Boalia Station	68.65	64.65	78.65	74.65
4.	Mostul Station	68.16	67.47	78.16	77.47
5.	SHICS	68.92	50.26	78.92	60.26
6.	Purbachal Center Station	72.38	64.01	82.38	74.01
7.	Purbachal East Station	72.68	59.36	82.68	69.36

		Baseline Noise Level		Project Standard (Either Existing Noise Level + 10 dBA or 85 dB, whichever is lower)	
Sl.	**Elevated Section Area**	**Leq_{day}**	**Leq_{night}**	**Day**	**Night**
8.	Purbachal Terminal Station	71.65	56.10	81.65	66.10
9.	Kamlapur	77.2	74.1	85.0	84.1
10.	Rajarbagh	74.7	59.2	84.7	69.2
11.	Malibagh	74.9	66.4	84.9	76.4
12.	Rampura	77.7	72.4	85.0	82.4
13.	Hatirjheel East	76.1	62.3	85.0	72.3
14.	Badda	79.4	73.1	85.0	83.1
15.	North Badda	77.7	73.2	85.0	83.2
16.	Natun Bazar	74.2	60.3	84.2	70.3
17.	Nadda	82.0	71.5	85.0	81.5
18.	Khilkhet	77.8	70.6	85.0	80.6
19.	Airport Terminal 3	75.6	72.5	85.0	82.5
20.	Airport	73.6	72.1	83.6	82.1

6.1.1.3 Heavy Equipment and at-Source Noise Levels

Noise impact predictions from construction activities are based on heavy equipment clusters for each type of construction site. Noise levels at source are calculated based on ambient noise levels, operating times and the combination of equipment types in use, as shown in the following formula.

L_{source}= 10 $\log_{10}$(a*$10^{Lp/10}$+ (1-a) *$10^{Lambient/10}$)

$L_{source\_combined}$=10 $\log_{10}(\sum_{i=1}^{n} 10^{Leqi/10})$, where

L_p : Sound Power Level [dB]
$L_{ambient}$: Ambient noise level [dB]
L_{source}: Noise level at source [dB]
$L_{source\text{-}combined}$: combined noise level at source [dB]
a: Ratio of operating hours with noisy work (0-1)

Source: EIA report of MRT Line 6 projects

6.1.1.4 Impact Prediction

Methods used by the Institute of Noise Control Engineering in Japan are used to predict noise levels from construction activities, the following formula is used. This formula can also be used to predict the effect of soundproof barriers erected around noisy pieces of equipment.

Lc=L source-8-20 log 10 (r/r0) +ΔL, where

ΔL=

$$\begin{cases} -10\,log\delta - 18.4 & \delta \geq 1 \\ -5 - 15.2\ sinh^{-1}(|\delta|^{0.42}\ ) & 0 \leq \delta < 1 \\ -5 + 15.2\ sinh^{-1}(|\delta|^{0.42}\ ) & -0.069 \leq \delta < 0 \\ 0 & \delta < -0.069 \end{cases}$$

Where,

Lc: noise level at evaluation point [dB]
r0: Distance from source to measurement point [m]
r: Distance from source to evaluation point [m]
ΔL: Effect of soundproof barrier (panel or sheet) [dB]

δ: Difference in sound propagation routes [m]

Table 6-3 shows heavy equipment sound power levels for various types of construction work along the alignment using typical equipment; and combined noise levels produced by equipment working in tandem. Equipment sound power levels are taken from the literature.

Combined noise levels of construction equipment are then determined at a specified distance from the activity (7.5 m) and further combined with ambient noise levels that were measured at the locations.

Table 6-4 shows results for construction work along the alignment of the Purbachal. The combined noise level at monitoring locations varies from 73 - 87 dB whereas the ambient noise levels are 67-76 dB. The ambient noise level at all monitoring locations exceeds 65 dB. Therefore, combined noise levels are lower than the established standard (areas with ambient noise level (>65 dB), standard is ambient noise level +10 dB) for all receptor locations. In the underground portion, the construction activities will be continued under the earth surface. So, as like as in the elevated portion, noise level in the underground portion is not expected. But as the construction activities of the station will be open cut method, so noise level is expecting little bit high at that point. However, the existing ambient noise level at both day and night time also exceeds the standard noise level. So, during the construction period expecting noise level from the construction activities in the station area will be the ambient noise level + 10 dBA. Target noise level in the underground station area is presented in the **Table 6-5**

Table 6-3: Heavy Equipment Noise Power Level and Combined Leq

Section	Kind of Construction	Heavy Equipment Used	Power Level Noise	Comb.L_{eq}
Elevated Track	Girder Installation & Track Preparation	Crawler Crane	100	106.2
		Concrete Mixer Truck	105	
Elev Track & Station	Preparation	Hand Breaker	109	110.0
		Excavator (0.4) Dump Truck	103	
	Ground Work	Hydraulic Vibratory Hammer	106	109.6
		Excavator (0.4) Dump Truck	103	
		Rough Terrain Crane	105	
	Girder Inst.& Frame-	Rough Terrain Crane	105	108.6
	Work Construction	Concrete Mixer Truck	105	
		Crawler Crane	100	

Table 6-4: Expected Noise Levels at Receptor Points during Construction Period in the Elevated Portion

Section	Types of Construction		Transition	Joar Sahara	Boalia	Mostul	SHICS	Purbachal Center	Purbachal East	Purbachal Terminal
		Ambient noise (Leq day)	73.37	61.62	78.65	78.16	78.91	72.37	72.68	71.65
		Ambient noise (Leq night)	68.12	60.80	64.65	67.47	50.25	64.01	59.35	56.09
		Distance from Source	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
	Target Noise Level (Leq)	Day	83.37	71.62	78.65	78.16	78.91	82.37	82.68	81.65
		Night	78.12	70.8	74.65	77.47	60.25	74.01	69.35	66.09
	Compacting Ground	Leq10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Ground Work	Leq10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depot & Track Prep.	Concrete Casting	Leq10	82.43	82.11	82.21	82.30	82.11	82.26	82.21	82.16
	Framework Construction.	Leq10	80.98	80.54	80.68	80.81	80.53	80.74	80.67	80.61
Elevated Track	Girder Installation	Leq10	79.43	78.78	78.99	79.18	78.77	79.08	78.97	78.89
Elevated Track & Station	Preparation	Leq10	82.80	82.51	82.60	82.68	82.51	82.64	82.59	82.56
	Ground Work	Leq10	82.43	82.11	82.21	82.30	82.11	82.26	82.21	82.16
	Girder Inst.& Frame-	Leq10	81.52	81.13	81.25	81.37	81.12	81.31	81.24	81.19

Table 6-5: Expected Noise Levels at Receptor Points during Construction Period in the Underground Station

Section	Types of Construction		Kamlapur	Rajarbagh	Malibagh	Rampura	Hatirjheel East	Badda	North Badda	Natun Bazar	Nodda	Khilkhet	Airport Terminal 3	Airport
		Ambient noise (Leq day)	77.2	74.7	74.9	77.7	76.1	79.4	77.7	74.2	82.0	77.8	75.6	73.6
		Ambient noise (Leq night)	74.1	59.2	66.4	72.4	62.3	73.1	73.2	60.3	71.5	70.6	72.5	72.1
		Distance from Source	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
	Target Noise Level (Leq)	Day	85.0	84.7	84.9	85.0	85.0	85	85.0	84.2	85.0	85.0	85.0	83.6
		Night	84.1	69.2	76.4	82.4	72.3	83.1	83.2	70.3	81.5	80.6	82.5	82.1
	Compacting Ground	Leq10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Ground Work	Leq10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Track Prep.	Concrete Casting	Leq10	83.4	83.3	83.3	83.6	83.2	83.9	83.6	83.1	83.9	83.7	83.0	83.1
Station	Preparation	Leq10	84.8	84.3	84.4	84.9	84.2	85.2	84.9	84.2	85.3	84.9	84.1	83.9
	Ground Work	Leq10	83.2	83.1	83.1	83.5	83.0	83.7	83.4	82.8	84.1	83.6	82.9	82.7

The target noise level will be 85 dB or ambient noise + 10 dB, whichever is lower. The above **Table 6-4** shows that some target noise levels (as per ambient + 10) should be higher than 85 dB. As the noise level considering upto 85 dBA, so the target noise level will be 85 dB.

For the Depot area, separate noise level analysis has been done (**Figure 6-1**) and a contour map has been prepared (presented in **Figure 6-2**). From the noise level analysis of **Figure 6-1**, it has been found that for the static SCP machine for the compaction work in Depot area, the noise level is 71.51 dBA at 15m distance. But for vibrating SCP, the noise level is around 88.51 dBA at same distance. So, for avoiding the impact on the nearest receptor during the compaction activity of the depot area, the static SCP will be used at the boundary. But for inside depot area, the vibrating SCP will be used as it will not affect the existing receptors.

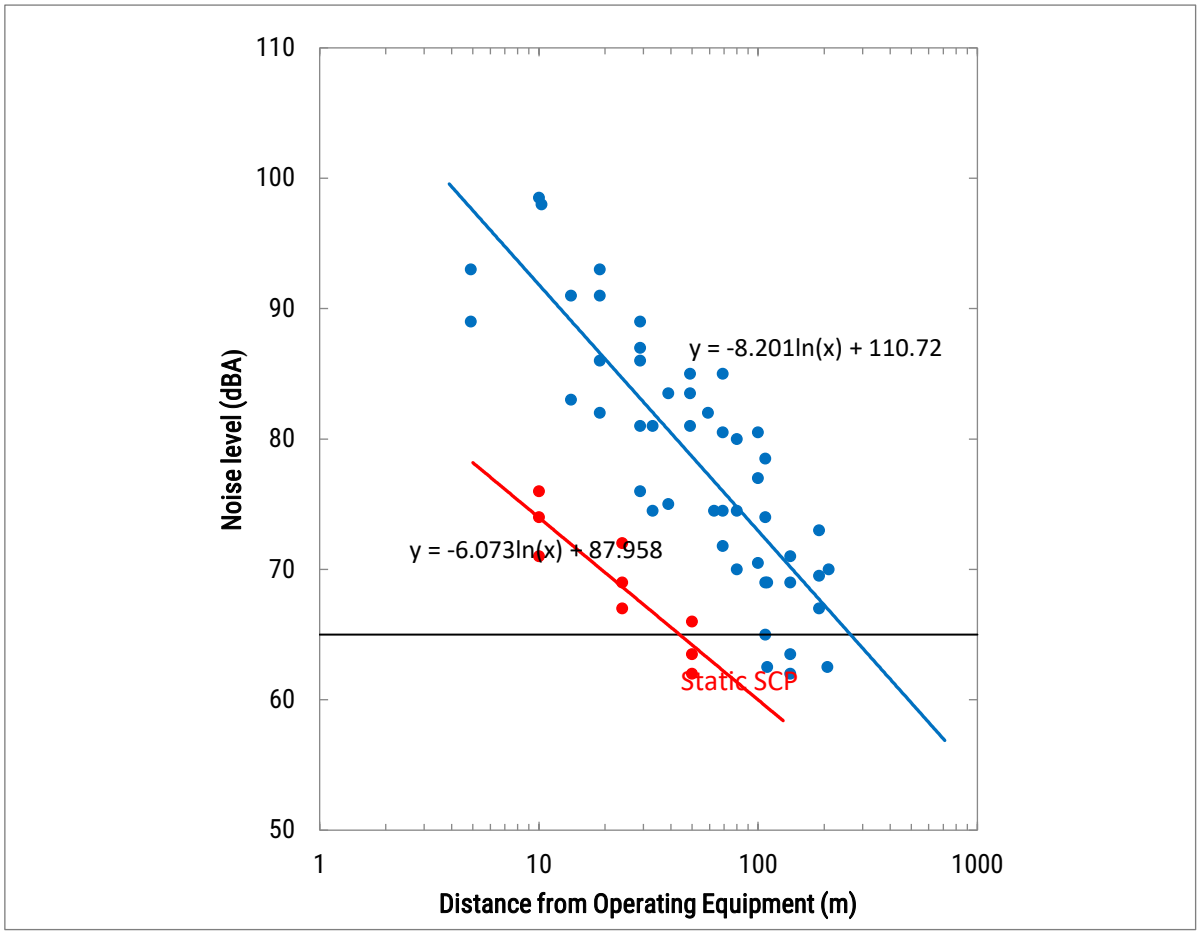


Figure 6-1: Noise Level Analysis for Depot Area

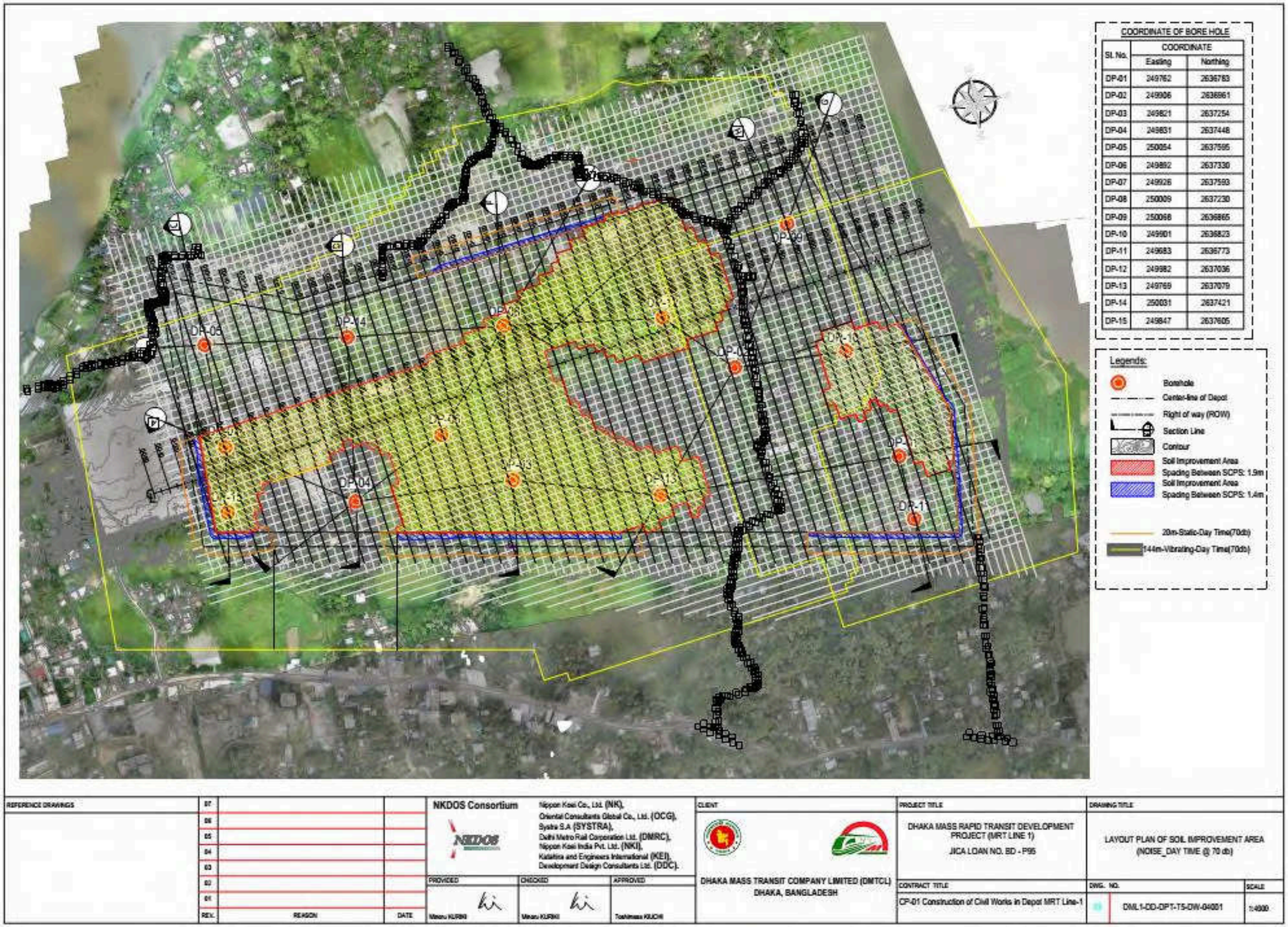


Figure 6-2: Noise Contour Map for the Depot Area

6.1.1.5 Mitigation Measures

Noise levels during construction along the alignment are not expected to exceed the standard adopted through a review of international practice. All mitigation measures stated in the initial EIA report and under this report will be applicable for the MRT Line-1 project. The following additional mitigation measures are proposed to reduce noise impacts from construction:

- Use low noise generating equipment as much as possible;
- Use heavy equipment with built in noise abatement, especially pavement breakers, crawler cranes, excavators, and concrete cutters
- Construct temporary noise barriers between noisy activities and noise-sensitive receivers
- Site equipment on construction and casting yards as far away from noise-sensitive sites as possible
- Construct walled enclosures around especially noisy activities or clusters of noisy equipment
- Combine noisy operations to occur in the same time period if possible
- Avoid nighttime activities where there is sensitivity to noise, such as hospitals
- Provide noise-dampened equipment, such as quieted and enclosed air compressors and properly working mufflers on all engines
- In the Depot area, the boundary fence should be high, and should have some sound absorption material. Though noise is less than target, but this is an extra measure due to nearby high-rise residential buildings.

Residual Impacts

The proposed mitigation measures will be able to mitigate noise pollution in a significant extent. Despite these measures, the occurrence of over standard noise can be happened during construction stage, especially during rigging, rebar cutting, etc. However, these noises will not be occurred frequently and the public nuisance created from this occurrence will not be significant. No additional measures are required.

6.1.1.6 Conclusion

Construction activities used to develop sites and to construct the project include land preparation, soil stabilization, installation of piling, and construction of viaduct foundations and piers, erection of precast viaduct sections, and construction of stations and overpass structures. These activities will contribute to noise levels along the project corridor. The combination of equipment and ambient noise levels are not likely to exceed the target noise level. Still, mitigation measures can be employed that involve scheduling times of operation, shielding pieces of equipment and/or sensitive receptors, and altering construction approaches. Construction noise impacts will need to be closely monitored during the construction cycle to identify specific problem locations.

In the event of excessive noise, Noise Control Ordinance 2006 provides a mechanism for bringing noise complaints before local authorities for adjudication of injury. Complaints will trigger the use of increased measures for limiting noise impacts in any given situation. This is seen as the most effective way to regulate construction noise given the need to implement the project, the temporary nature of activities generating noise during construction, and the special situations in which noise control issues arise.

The contractor should be required to carry out mitigation measures as necessary to limit noise in the vicinity of worksites, and should prepare a Noise Abatement Strategy at the outset of construction work under any of the civil work packages. Citizens should be made aware of their right to complain and seek redress, either through the grievance mechanism set up under the project, or under the Noise Control Ordinance 2006.

6.1.2 Train Operation

Noise due to train operation of MRT Line-1 has been predicted in this report which was absent in the initial EIA report of 2017. The method is similar, used for the calculation of MRT Line 6.

6.1.2.1 Procedure

The noise level due to the train operation has been predicted considering the speed of train, curvature of the rail and structural configuration of the viaduct (height, parapet walls and other features). Procedure of noise impact analysis during operation has followed some process which includes:

- Selection of target level
- Set condition for noise impact levels
- Prediction of noise level
- Combine with ambient noise monitoring results
- Combine with target noise level and
- Taking mitigation action

6.1.2.2 Target Level

As per the Noise Pollution Control Rules 2006, train operation is exempted from the rules. Even then the MRT line 1 project will follow the current standard in Bangladesh. The standard noise level for specific zone under the Noise Pollution Control Rules 2006 is given in **Table 6-6**.

Table 6-6: Noise level standard in different categories

	Category	Day	Night
A	Silent zone	50	40
B	Residential zone	55	45
C	Mixed area	60	50
D	Commercial area	70	60
E	Industrial area	75	70

The standards specified in the Noise Pollution Control Rules 2006 are only for specific areas and applicable for the ambient noise level. But neither sound receiving point nor receptor height is specified in the DoE regulation. Japanese Noise criteria “Noise Reduction for Newly – established or Massive Improvement of regular Railway Lines” published by MoE, Japan provided the following guidance:

a) Sound receiving point shall be 12.5m distance from center of track and the height shall be 1.2m above ground.
b) Leq will be less than 60dB during day time (7:00-22:00) and less than 55dB during night time (22:00-7:00)

Japanese guideline also requires that “necessary noise reductions shall be put into place in case of existing facilities in proximity to track such as school, hospital or other facility, which requires silence.” This analysis assumes Leq (A rated equivalent noise level) standard to be 60 (daytime) and 55 (night time), with attention to sensitive receptors along the alignment that could be affected by excessive noise. For the MRT Line-1, Kamlapur to Airport route will be undergrounded where all the schools, colleges, medical centers, mosques, temples are located. The elevated part is located only from the Transition point (i.e. is from Kuril point) to Depot area. In this part, the road is wide and currently there is no

settlement. In future, most of the settlement will be around 25 to 90m far from the track center. So, considering that Japanese standard and also considering the prediction noise level, the target could be fixed.

6.1.2.3 Condition

The general input conditions for the analysis of noise impacts during operations are shown in **Table 6-7**. These vary in special cases as described in the following sections.

Table 6-7: Conditions for Predicting Operation Noise Levels

Item	Condition
Rail Type	>400m radius of curvature, or curve radius
Track Structure	Ballast-less track with or without MSS bearing
Height of Bridge Railing	1.0m (increased as necessary with sound barrier, 0.5m)
Prediction Point	12.5m (Japanese standard) and at sensitive receptors
Operating Speed	Per CBTC system
Train length	160m
Number of trains per day	Based on 2026 and 2051 operating scenarios

6.1.2.4 Method for Predicting Transit Noise

The approach follows generally that prescribed in "Draft Proposal of the Prediction of Noise from Elevated Railway" written by Ishii et al.[13], and has been used on numerous elevated metro rail projects. Three types of noise are categorized for moving train e.g. rolling noise, structural noise and vehicle device noise. This method calculates Leq-10 (equivalent 10-minute A- weighted sound pressure level, in busy hour) using a conversion formula and predicts ambient peak noise level. Combined noise levels and ambient noise measurements are calculated for the receptors.

Rolling Noise Power Level (L_{W1})

Rolling Noise Power Level (L_{W1}) is determined by applying the following formulas that are dependent on the velocity of the moving train, radius of curvature of the track and use of ballast-less versus vibration-proof, or mass spring system supported (MSS) track. Steep curves in the alignment produce a condition under which excessive noise is generated. Curvature is a key variable in determining noise levels, as is velocity of the moving train.

a) Ballast-less track: straight section and relaxed curve (R>=400m) section
   L_{W1} = 13.7 log10V+75.7, where V = velocity of the moving train

b) Ballast-less track: sharp curve (R<400m) section
   L_{W1} = 13.7 log10V+75.7+4.6

c) Vibration-proof: straight section and relaxed curve (R>=400m) section

[13] K. Ishii (Institute of Industrial Science, University of Tokyo), M. Koyasu (Kobayashi Institute of Physical Research), Y. Cho and H. Koba (Bureau of Construction, Tokyo Metropolitan Government), Journal of the Institute of Noise Control, Japan 1980.

L_{W1} = 13.7 log10V+72.7

d) Vibration-proof: sharp curve (R<400m) section

L_{W1} = 13.7 log10V+72.7+4.6

Lw1 is converted to LA1 (Rolling Noise (dB)) using the following formula:

$$L_{A1} = L_{W1} - 8 - 10\log_{10} r_1 + 10\log_{10}\left[\frac{(l/2r_1)}{1+(l/2r_1)^2} + \tan^{-1}(l/2r_1)\right] + \alpha_d \quad \text{dB,}$$

Where

R1: Distance between track center and sound receiving point (m)

l: Train length (m)

αd: Effect of straight rail versus curving section.

Distances and relationships are shown on the following Figure 6-3.

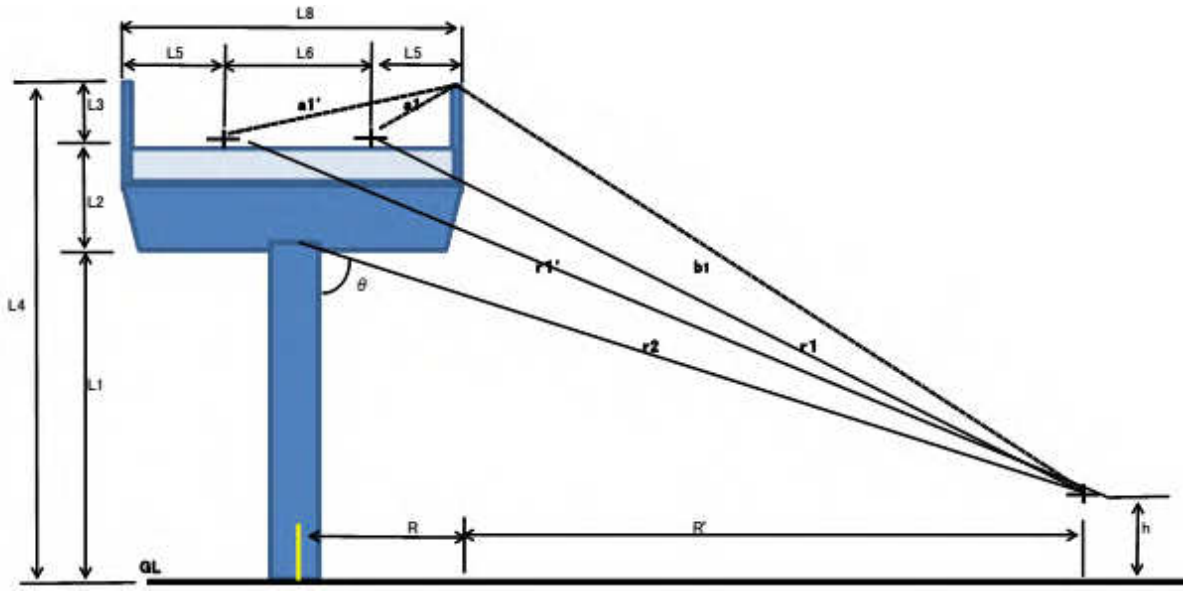


Figure 6-3: Sound Pathways

The longer path for deflected sound introduces a differential that reduces the overall sound level according to the graph in **Figure 6-4**.

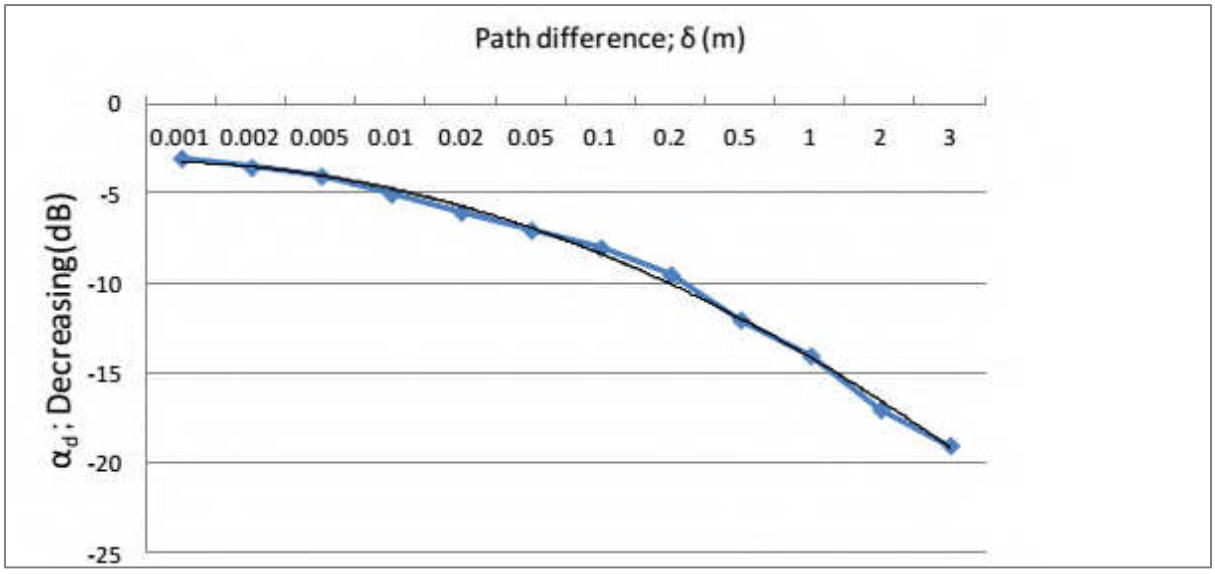


Figure 6-4: Path Difference and Sound Reduction

Structural dimensions of the viaduct configuration (e.g. dimensions in **Figure 6-4**) are shown in **Table 6-8**. A 1.5 m high parapet wall (L3) will be installed as noise barrier at locations along the route. Structural dimensions are used to calculate coefficients.

Table 6-8: Input Factors Related to Structural Dimensions of the Viaduct

Receptor Height, m		R'								
h	R'	r1	r2	L3	a1	b1	δ=a1+b1-r1	α1	l/2r1	l/2r2
1.2	7.5	14.13	10.27	1.00	3.21	14.22	3.30	-19.89	5.66	7.79
1.2	7.5	14.13	10.27	1.50	3.40	14.71	3.98	-20.65	5.66	7.79
1.2	7.5	14.13	10.27	2.00	3.65	15.21	4.72	-21.36	5.66	7.79

Structure Noise Power Level (LW2)

Structure Noise Power Level (LW2) are determined as follows:

e) Ballast-less Track: Straight section and relaxed curve (R>=400m) section
L_{W2} = 92.5

f) Ballast-less track: sharp curve (R<400m) section
L_{W2} = 94.6

g) Vibration-proof: straight section and relaxed curve (R>=400m) section
L_{W2} = 85.0

h) Vibration-proof: sharp curve (R<400m) section
L_{W2} = 86.4

For g) and h), it is assumed that the rail support coefficient is less than 10MN/m/rail fastening (MSS track)

L_{W2} is converted to Structure Noise (LA2) using the following formula:

$$L_{A2} = L_{w2} - 8 - 10\log_{10} r_2 + 10\log_{10}\left[(\cos\theta)\left(\tan\frac{l}{2r_2}\right)\right]$$ dB,

Where,

L_{A2}: Structure Noise (dB)

L_{W2}: Structure Noise Power Level (dB)

r2: Distance between center of floor slab and sound receiving point (m)

ɵ: The angle of center of floor slab to ground and center of floor slab to sound receiving point (^{0})

Vehicle Device Noise Power Level (L_{W3})

For inner fan-type motive unit:

$L_{W3} = 60\log_{10}(nV/100) + 10\log_{10}(l_m/l) + B$, where

Ballast-less track: B = 57

N: Gear ration = 6.06

V: Train speed (km/s)

L: Train length (m)

Lm: Length of motor car (m)

L_{W3} is covered to Vehicle Device Noise (dB) (L_{A3}) using the following formula:

$$L_{A3} = L_{w3} - 5 - 10\log_{10} r_1 + 10\log_{10}\left\{\frac{(l/2r_1)}{1+(l/2r_1)^2} + \tan^{-1}\left(\frac{l}{2r_1}\right)\right\} + \alpha_1$$ dB, where

Other Factors

Soundproof Wall Effect (sound absorbing material): subtract 2 dB

6.1.2.5 Evaluation of Noise Impact

The evaluation of noise impact has been determined based on the equation presented in the previous part, different primary and secondary input variables in accordance with the curvature (greater or lesser than 400 m) and anticipated travel velocity based on the CBTA operation schedule. A spreadsheet was setup to place all equations and data for getting output. Predicted noise levels are shown in **Table 6-9**.

Table 6-9: Predicted Noise Levels

Prediction/Assumption	Radius of curvature, R<400m, Lw1=13.7log V +80.3		R>=400m, Lw1=13.7 log V+75.7		
SRC[1] of Radious in (m)	200	210	400	450	over 550
Max[m] controlled speed in (km/hr)	45	55	85	90	100
Ballastless track[2], (L_{w1})	102.9	104.1	102.1	102.5	103.1
Vibration Proof BLT, (L_{w1}')	99.9	101.1	99.1	99.5	100.1
Structure noise[3], (L_{w2})	94.6	94.6	92.5	92.5	92.5

Prediction/Assumption	Radius of curvature, R<400m, Lw1=13.7log V +80.3		R>=400m, Lw1=13.7 log V+75.7		
Vibration Proof Str. noise, (L_{w2}')	86.4	86.4	85	85	85
Vehicle Device Power L. noise[4], (L_{w3})	80.1	85.4	96.7	98.2	100.9
BLT Rolling noise[5], $L_{A1}=L_{w1}$- 37.4 (Parapet ht 1 m)	65.5	66.7	64.7	65.0	65.7
VP BLT Rolling noise, $L_{A1'}=L_{w1'}$ -37.4 (Para Ht 1 m)	62.5	63.7	61.7	62.0	62.7
BLT Structure noise[6], $L_{A2}=L_{w2}$-18.1	76.5	76.5	74.4	74.4	74.4
VP BLT Structure noise, $L_{A2'}=L_{w2}$' -18.1	68.3	68.3	66.9	66.9	66.9
Vehicle Device noise[7], $L_{A3}=L_{w3}$-34.4 (Para ht 1 m)	45.7	50.9	62.3	63.7	66.5
Peak Level noise, $L_{Amax}=10 \log [\sum^{n}_{i=1}10^{LAi/10}]$	76.8	77.0	75.1	75.2	75.5
Sound Exposure[8] Level, $L_{AE}=L_{Amax}$+10 log(576/V)	87.9	87.2	83.4	83.3	83.1
Predicted value[9], $Leq= 10\log[0.0074*10^{(LAE/10)}]$	66.6	65.8	62.1	62.0	61.8
Peak Lev VPT noise, $L'_{Amax}=10 \log [\sum^{n}_{i=1}10L^{Ai/10}]$	69.3	69.7	69.1	69.5	70.5
Sound Ex. of VPT Level, $L_{AE}=L'_{Amax}$ + log (576/V)	80.4	79.9	77.4	77.5	78.1
VPT Predicted value[9], $Leq= 10\log[0.0074*10^{(LAE/10)}]$	59.1	58.6	56.1	56.2	56.8
BLT Rolling noise[5], $L_{A1}=L_{w1}$- 38.2 (Parapet ht 1.5 m)	64.7	65.9	63.9	64.3	64.9
Vehicle Device noise[7], $L_{A3}=L_{w3}$-35.2 (Para ht 1.5 m)	44.9	50.2	61.5	63.0	65.7
Peak Level noise, $L_{Amax}=10 \log [\sum^{n}_{i=1}10^{LAi/10}]$	76.8	76.9	75.0	75.1	75.4
Sound Exposure[8] Level, $L_{AE}=L_{Amax}$+10 log(576/V)	87.9	87.1	83.3	83.2	83.0
Predicted value[9], $L_{eq}= 10\log[0.0074*10^{(LAE/10)}]$	66.6	65.8	62.0	61.8	61.7
BLT Rolling noise[5], $L_{A1}=L_{w1}$- 38.9 (Parapet ht 2 m)	64.0	65.2	63.2	63.6	64.2
Vehicle Device noise[7], $L_{A3}=L_{w3}$-35.9 (Para ht 2 m)	44.2	49.5	60.8	62.3	65.0
Peak Level noise, $L_{Amax}=10 \log [\sum^{n}_{i=1}10L^{Ai/10}]$	76.8	76.8	74.9	75.0	75.2
Sound Exposure 8 Level, $L_{AE}=L_{Amax}$+10 log(576/V)	87.8	87.0	83.2	83.1	82.8
Predicted value[9], $L_{eq}= 10 \log[0.0074*10^{(LAE/10)}]$	66.5	65.7	61.9	61.7	61.5
VP BLT Rolling noise, $L_{A1'}=L_{w1'}$ -38.2 (Para Ht 1.5 m)	61.7	62.9	60.9	61.3	61.9

Prediction/Assumption	Radius of curvature, R<400m, Lw1=13.7log V +80.3		R>=400m, Lw1=13.7 log V+75.7		
Vehicle Device noise[7], $L_{A3}=L_{w3}$-37.9 (Para ht 1.5 m)	44.9	50.2	61.5	63.0	65.7
Peak Lev VPT noise, $L'_{Amax}=10 \log [\sum^{n}{}_{i=1} 10L^{Ai/10}]$	69.2	69.5	68.8	69.2	70.1
Sound Ex.of VPT Level, $L_{AE} = L_{Amax} + \log (576/V)$	80.3	79.7	77.1	77.2	77.7
VPT Predicted value[9], $L'_{eq}= 10 \log [0.0074*10^{(LAE/10)}]$	59.0	58.4	55.8	55.9	56.4
VP BLT Rolling noise, $L_{A1'} = L_{w1'}$ -38.9 (Para Ht 2 m)	61.0	62.2	60.2	60.6	61.2
Vehicle Device noise[7], $L_{A3}=L_{w3}$-39.2 (Para ht 2 m)	44.2	49.5	60.8	62.3	65.0
Peak Lev VPT noise,$L'_{amax}=10 \log [\sum^{n}{}_{i=1} 10L^{Ai/10}]$	69.1	69.3	68.6	68.9	69.7
Sound Ex.of VPT Level, $L_{AE} = L_{Amax} + \log (576/V)$	80.1	79.5	76.9	77.0	77.3
VPT Predicted value[9], $L'_{eq}= 10 \log[0.0074*10^{(LAE/10)}]$	58.8	58.2	55.6	55.6	56.0

Notes:

(1) Speed restriction curves (SRC) have their max Speed (km/hr)

(2) Ballastless track (BLT); If Vibration Proof Track (VPT) is used, the value of L_{wi} decreases by 3.0 dB

(3) Use of vibration proof track (VPT) reduces Structure Noise 7.5 dB in straight section and relaxing curves, and 8.2 dB in sharp curves with radius of curvature less than 400 meter.

(4) Vehicle Device Noise is calculated by the Equation, $L_{w3}=60 \log (n V/100) + 10 \log (l m/l) + B = 60 \log (0.0606V) + 54$, with the values of constants, Gear Ratio n=6.06, Length of motor car l m=80, Train length l=160 and Correction value B = 57 (?? 52) for Ballast less track

(5) Rolling noise LA1= Lw1-8-10 log r1 + 10 log [(l/2r1)/(1+(l/2r1) 2 + tan -1(l/2r1)] + α d = Lwi1-19.17, with values of train length l=160, Dumping number αd = (-)17,7714, Distance between track center and sound receiving point, r1=17.1898 with horizontal 7.5m

(6) Structure Noise LA2 = Lw2 -8 - 10 log r1 + 10 log [(cos θ)(tan -1(l/2r2))] = Lw2 - 20.301 , with value r2=16.19 with horizontal 7.5 m

(7) Vehicle Device Noise LA3 = Lw3 -5 -10 log r1 + 10 log [(l/2r1)/(1+l/2r1) 2+tan -1(l/2r1)] + αd = Lw3 - 16.17, with the values as in (5)

(8) Sound Exposure Level LAE= LAmax + 10 log t = LAmax + 10 log (576/V), with t = train passing time (sec)=2.15 sec, V= velocity km/hr,

(9) Predicted Value (as per DOE) Leq.10=10 log (nx 10LAE/10 / T) = 10 log (0.0074 * 10(LAE/10)), with values, number of train n=4.444 in 10 minutes, T = 600 (ie,10 minutes)

From **Table 6-9** Conclusion reached from the data include the following:

a) **Ballast less Track (BLT) –**

- The predicted noise levels from transit operations on ballast less track is generally lower than the ambient noise levels at 12.5m distance. At the receptor level, the noise is even lower than the day standard level of the mixed area.
- Transit noise, when added to ambient noise levels, provides a combined noise level that is, on average, 0.02% greater than observed ambient peak noise levels and 10.55% greater

than observed day/night noise levels. Most increases also are about 0.01% and 10.55%, respectively (median values).

b) **Vibration Proof Track (VPT)**

- Transit noise is also lower for the VPT also at 12.5m distance. At the receptor level, it is even lower than the daytime national standard level of the mixed area. For Joar Sahara and Mostul, the transit noise will be even better than the other area and will be within the night time standard level of the mixed area.
- Transit noise, when added to ambient noise levels, provides a combined noise level that is, on average, 0.02% greater than observed ambient peak noise levels and 10.48% greater than observed day/night noise levels. Most increases are about 0.01% and 10.48%, respectively (median values).

It has been observed that the average transit noise is lower than the ambient peak and ambient day-night noise level. Also, the combined noise for both ballast less and vibration proof track varied slightly from each other. So, considering the predicted noise, ballast less track with 1.5m parapet wall is recommended for the elevated section part.

Table 6-10: Noise Levels at Elevated Sections with respect to 5.5 m distance

Name of Receptor	Transition	Joar Sahara	Boalia	Mostul	SHICS	P Cent.	P East	P Terminal		
Distance from Track Centre (m)	5.55	5.5	5.5	5.5	5.5	5.5	5.5	5.5		
Ambient Peak(7am-7pm), L_{eq}	87.3	73.5	80.2	85.1	77.3	83.5	83.1	85.1		
Ambient Noise Level, L_{dn}	75.8	67.34	71.9	74.0	67.2	73.1	71.7	70.3		
Train Speed (Km/h) at R>500m			100		100	100				
BLT Transit Noise at R>500, L_{eq}			61.0		61.7	61.5				
Train Speed at 500>R>300m		95		90						
BLT T.Noise at 500>R>300, L_{eq}		61.0		61.8						
Train Speed (Km/h) at R<=300m	45						45	45		
BLT Transit Noise at R<=300, L_{eq}	66.6						66.6	66.6		
Train Speed (Km/h) at R>500m			100		100	100				
VPT Transit Noise at R>500, L_{eq}			54.5		56.4	56.4				
Train Speed at 500>R>300m		95		90						
VPT T.Noise at 500>R>300, L_{eq}		53.9		55.9						
Train Speed (Km/h) at R<=300m	45						45	45		
VPT Transit Noise at R<=300, L_{eq}	59.0						59.0	59.0		
Combined Noise Impact Levels acting on Receptors (BLT)	87.3	73.7	80.3	85.1	77.4	83.5	83.2	85.1		
Combined Noise Impact Levels acting on Receptors (VPT)	87.3	73.5	80.3	85.1	77.3	83.5	83.1	85.1		
									Avr.	Median

Name of Receptor	Transition	Joar Sahara	Boalia	Mostul	SHICS	P Cent.	P East	P Terminal		
Pct Increase over Peak Ambient considering ballast less track	0.01%	0.05%	0.01%	0.01%	0.04%	0.01%	0.02%	0.01%	0.02%	0.01%
Pct Increase over D/Nt Ambient considering ballast less track	11.5%	6.4%	8.4%	11.1%	10.2%	10.5%	11.5%	14.9%	10.55%	10.55%
Pct Increase over Peak Ambient considering VPT	0.01%	0.05%	0.01%	0.01%	0.04%	0.01%	0.02%	0.01%	0.02%	0.01%
Pct Increase over D/Nt Ambient considering VPT	11.5%	6.2%	8.3%	11.1%	10.1%	10.5%	11.4%	14.8%	10.48%	10.48%
Diff between combined and peak (BLT)	0.0	0.2	0.05	0.02	0.12	0.03	0.1	0.06	0.08	0.06
Diff between combined and D/N (BLT)	11.52	6.36	8.39	11.11	10.17	10.47	11.48	14.86	10.55	10.55
Diff between combined and peak (VPT)	0.01	0.05	0.01	0.01	0.04	0.01	0.02	0.01	0.02	0.01
Diff between combined and D/N (VPT)	11.49	6.17	8.35	11.10	10.09	10.45	11.41	14.81	10.48	10.48

Table 6-11: Noise Levels at Elevated Sections with respect to Receptors

Name of Receptor	Transition	Joar Sahara	Boalia	Mostul	SHICS	P. Cent.	P. East	P. Terminal		
Distance from Track Centre (m)	91.05	78.05	78.05	79.05	48.05	36.05	38.05	76.05		
Ambient Peak(7am-7pm), L_{eq}	87.3	73.5	80.2	85.1	77.3	83.5	83.1	85.1		
Ambient Noise Level, L_{dn}	75.8	67.34	71.9	74.0	67.2	73.1	71.7	70.3		
Train Speed (Km/h) at R>500m			100		100	100				
BLT Transit Noise at R>500, L_{eq}			56.3		55.0	55.1				
Train Speed at 500>R>300m		95		90						

Name of Receptor	Transition	Joar Sahara	Boalia	Mostul	SHICS	P. Cent.	P. East	P. Terminal		
BLT T.Noise at 500>R>300, L_{eq}		52.0		52.0						
Train Speed (Km/h) at R<=300m	45						45	45		
BLT Transit Noise at R<=300, L_{eq}	53.2						54.7	54.2		
Train Speed (Km/h) at R>500m			100		100	100				
VPT Transit Noise at R>500, L_{eq}			55.1		53.3	54.0				
Train Speed at 500>R>300m		95		90						
VPT T.Noise at 500>R>300, L_{eq}		50.1		50.1						
Train Speed (Km/h) at R<=300m	45						45	45		
VPT Transit Noise at R<=300, L_{eq}	39.9						52.8	50.2		
Combined Noise Impact Levels acting on Receptors (BLT)	87.3	73.5	80.3	85.1	77.3	83.5	83.1	85.1		
Combined Noise Impact Levels acting on Receptors (VPT)	87.3	73.5	80.3	85.1	77.3	83.5	83.1	85.1		
									Avr.	Median
Pct Increase over Peak Ambient considering ballast less track	0.00%	0.02%	0.01%	0.00%	0.02%	0.00%	0.00%	0.00%	0.01%	0.00%
Pct Increase over D/Nt Ambient considering ballast less track	11.5%	6.2%	8.4%	11.1%	10.1%	10.5%	11.4%	14.8%	10.48%	10.48%
Pct Increase over Peak Ambient considering VPT	0.00%	0.02%	0.01%	0.00%	0.02%	0.00%	0.00%	0.00%	0.01%	0.00%
Pct Increase over D/Nt Ambient considering VPT	11.5%	6.1%	8.4%	11.1%	10.1%	10.4%	11.4%	14.8%	10.47%	10.77%

Name of Receptor	Transition	Joar Sahara	Boalia	Mostul	SHICS	P. Cent.	P. East	P. Terminal		
Diff between combined and peak (BLT)	0.0	0.0	0.02	0.00	0.03	0.01	0.0	0.00	0.01	0.01
Diff between combined and D/N (BLT)	11.48	6.15	8.35	11.09	10.08	10.45	11.39	14.80	10.48	10.48
Diff between combined and peak (VPT)	0.00	0.02	0.01	0.00	0.02	0.00	0.00	0.00	0.01	0.00
Diff between combined and D/N (VPT)	11.48	6.14	8.35	11.09	10.07	10.45	11.39	14.80	10.47	10.47

The predicted noise levels are almost same as the existing ambient peak noise level. The prediction was conducted considering a receptor's distance of 5.5 m (road side). Since, the predicted noise level is not much higher than current ambient noise even such close distance, the actual impact on receptor level will be very low.

6.1.2.6 Mitigation Measures

The roads are wide along the alignment, therefore, the settlements will remain far from the alignment. So as per the noise modeling it is observed that the impact will be very minimum. So, BLT will be enough with 1.5m height parapet wall to control the noise in the Purbachal area. In the city area, the line will go under the ground. So, no impact from the noise is anticipated. Only the possible impact from the underground section will be the standby generator and the Ventilation Shaft. The standby generator would be acoustically treated to reduce the noise level 65 – 55 dBA at generator loading 80 - 70 % in the absence of any substantial external interference, measured at a distance of 1m from the external wall. Also, the ventilation fans that are connected to the respective ventilation shaft would be provided with atmospheric side sound attenuator to meet the accepted noise criteria i.e. 55 dBA from 2 m of shaft opening. As a result, the impact of noise from the ventilation shaft of the underground section need not to be calculated as the target noise level also will be within the standard range.

Residual Impacts

The proposed mitigation measures will be able to reduce noise level generated from rail transit. However, despite these measures some noise will still be generated from elevated section and stations of underground sections. This noise will not create any significant public nuisance and no additional measures are required.

6.2 Vibration

Vibration is measured in Vibration decibels (VdB) and in Peak Particle Velocity (PPV, mm/sec). The vibration during transit operations at 12.5 distance from pier-head, and also vibration during construction of the viaduct is found insignificant. But vibration during compaction work in the Depot area is significant.

6.2.1 Vibration Impact during Construction

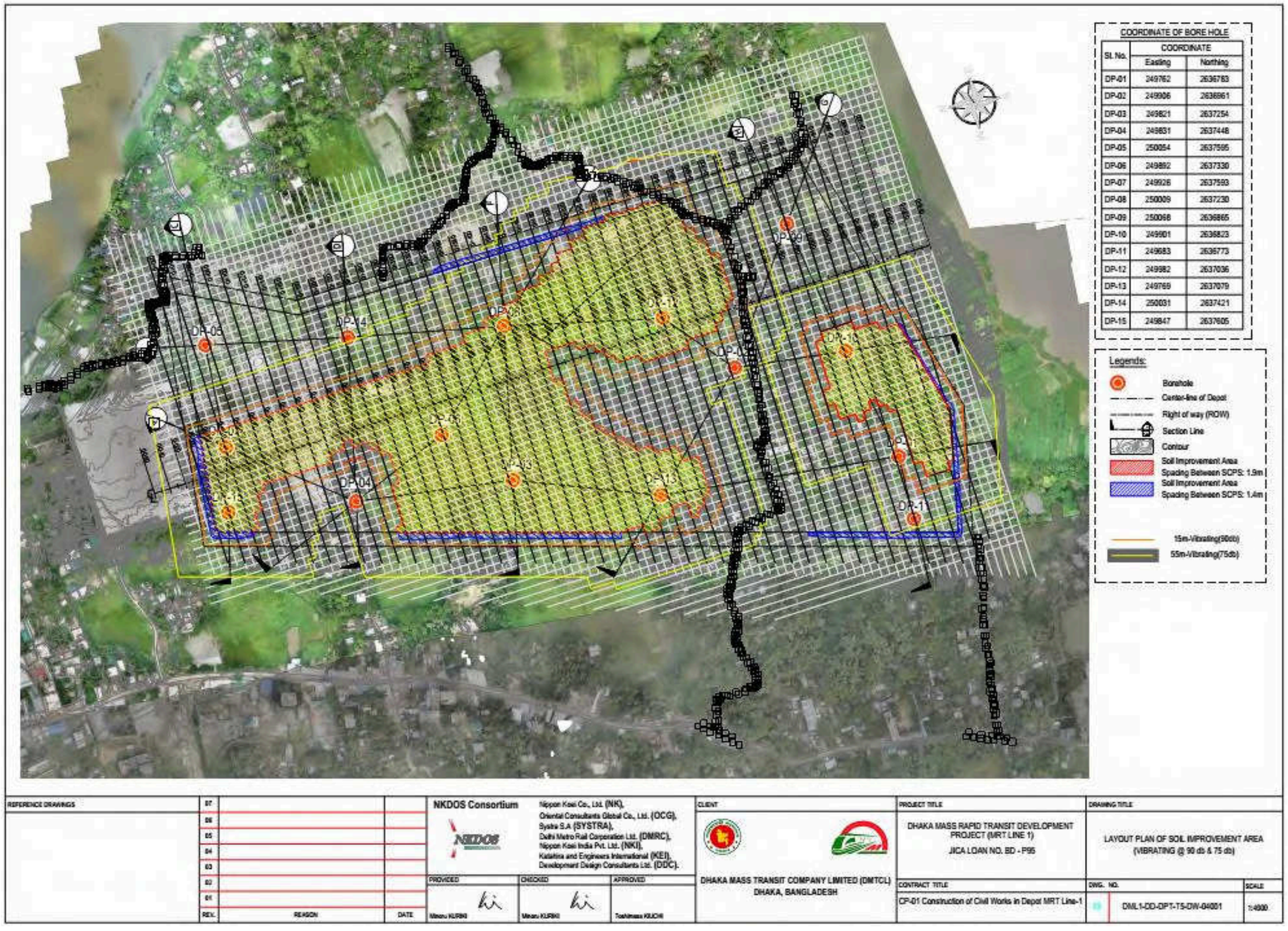
Depot Area Construction

Vibration induced by the construction activities in the main alignment (elevated section) is insignificant. But the Vibration induced by installation of sand compaction piles at the depot site during infilling and also during the construction activities in the station area is significant. Soil improvement area in the Depot has been shown in **Figure 6-5.** Some settlements are located surrounding the depot development area.

There is no vibration standard in Bangladesh. There are different international vibration standards. But, like the existing MRT Line 6, US FTA standard for “extremely susceptible to vibration” is recommended in this project as 90 VdB, approximately corresponding to 3 mm/s PPV, which is proposed as the project standard for the Depot area.

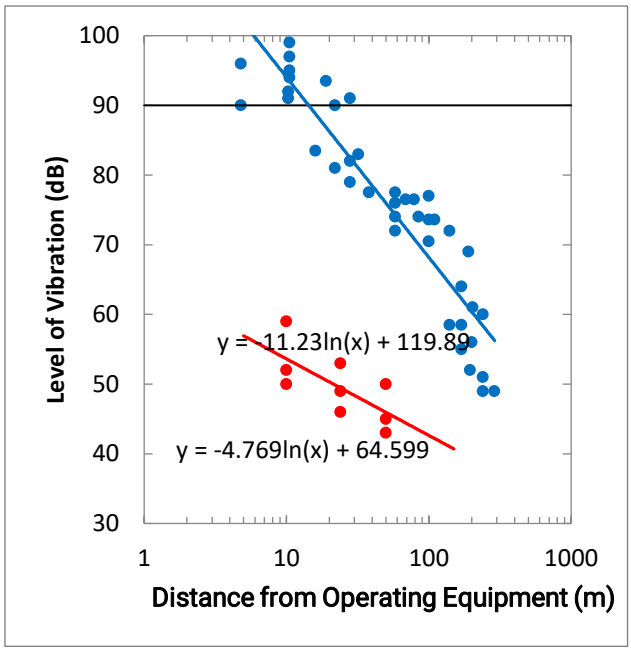
Construction activity can result in various degrees of ground vibration, depending on the equipment and methods employed. Buildings founded on the soil near the construction site respond to these vibrations with varying results, ranging from no perceptible effects at the lowest levels, low rumbling sounds and perceptible vibrations at moderate levels, and slight damage at the highest levels.

During the construction period, major sources of vibration are sand compaction pile, operation of Hoe Ram, Caisson drilling. Normally Sand Compaction Pile (SCP) is used for sand compaction. Both vibrating SCP and static SCP will be used during MRT line-1 depot development. Comparison of vibration level of vibrating SCP and static SCP is presented in **Figure 6-6**. For vibrating SCP, 90VdB will reach almost 15m distance whereas static SCP 90 VdB vibration will reach only 0.005m distance. Therefore, static SCP would be used near boundary areas of Depot.



Source: NKDOS

Figure 6-5: Soil Improving Area at the Depot



Source: NKDOS

Figure 6-6: Comparative Analysis of Vibratory and Static SCP for the Vibration Level

Alignment and Station Area

Construction activity can result in various degrees of ground vibration, depending on the equipment and methods employed. During the underground station construction period, major sources of vibration are steel sheet pile driving, operation of Hoe Ram, Caisson drilling. Vibration source levels for construction equipment is presented in **Table 6-12**.

Table 6-12: Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft, in/sec	Approximate Lv* at 25 ft
Pile Driver (sonic)	Typical	0.17	93
Hoe Ram		0.089	87
Caisson drilling		0.089	87

* RMS velocity in decibels, VdB re 1 micro-in/sec

Source: transit noise and vibration impact assessment manual, U.S Department of Transportation, Federal Transit Administration, September 2018

The following equitation is used to apply the propagation adjustment to the source reference level to account for the distance from the equipment to the receiver.

$$PPV_{equip} = PPV_{ref} X (25/D)^{1.5}$$

Total 19 stations will be constructed under the project of which 12 stations is underground and 7 is elevated. The underground station will be constructed in the city area following the open cut method where commercial and residential building are present along the road. On the other hand, elevated stations will be construction in the purbachal are where no industrial and residential buildings are present within 300 meters from the alignment. The residential and commercial building are located 20-50 meters from the proposed underground stations area. Different construction equipment will be used during the underground station construction which will generate vibration. There is no vibration standard in Bangladesh. Vibration standards for different countries are shown in **Table 6-13**. The Japanese standard

is the strictest (as it gives more importance to human perception). Like existing MRT line 6 project, US FTA standard for "extremely susceptible to vibration" is recommended in this project as 90 VdB, approximately corresponding to 3 mm/s PPV, which is adopted as the project standard. Vibration level generated from different equipment and level at the receiver points due to the construction activity is shown in **Table 6-14**.

Table 6-13: Vibration Standards for Construction in Different Countries

Country	Standard
India (CMRI) Historical buildings Domestic site development Industrial site development	 2 mm/sec PPV 5 mm/sec PPV 12.5 mm/sec PPV
Australia Historical buildings Residential development Commercial development	 2 mm/sec PPV 10 mm/sec PPV 25 mm/sec PPV
USA (Construction Vibration Damage Criteria, FTA) RCC CC Timber/ Mason Extremely susceptible to vibration	 0.5 in/sec (12.7 mm/s, 102 VdB) 0.3 in/sec (7.6 mm/s, 98 VdB) 0.2 in/sec (5 mm/s, 94 VdB) 0.12 in/sec (3 mm/s, 90 VdB)
Jakarta Metro During Construction	 85 VdB
Japan During Construction	 75 VdB

Table 6-14: Vibration Level at the Receiver Point during Construction Period

Equipment		PPV at 25 ft, in/sec	Vibration level at Receiver Point					Standard (VdB)
			10.0 m (65.6 ft)	20.0 m (65.6 ft)	30 m (98.4 ft)	50 m (164 ft)	100 m (328 ft)	
Pile Driver (Sonic)	Typical	0.04 in/sec PPV (80 VdB)	0.113 in/sec PPV (89 VdB)	0.04 in/sec PPV (80 VdB)	0.022 in/sec PPV (75 VdB)	0.022 in/sec PPV (55 VdB)	0.0005 in/sec PPV (41 VdB)	90
Hoe Ram		0.089 (87 VdB)	0.059 in/sec PPV (83 VdB)	0.021 in/sec PPV (74 VdB)	0.011 in/sec PPV (69 VdB)	0.011 in/sec PPV (50 VdB)	0.0002 in/sec PPV (36 VdB)	
Caisson drilling		0.089 (87 VdB)	0.059 in/sec PPV (83 VdB)	0.021 in/sec PPV (74 VdB)	0.011 in/sec PPV (69 VdB)	0.011 in/sec PPV (50 VdB)	0.0002 in/sec PPV (36 VdB)	

The **Table 6-14** shows that the vibration generated during the construction of underground and elevated section as well as elevated section's pier construction will not affect the structure located at a distance

of 10 meters and more. So, no major vibration impact is expected during the underground and elevated station construction.

6.2.1.1 Conclusion

According to the USA FTA standard, the target building vibration at 7.5 m distance from the construction activity particularly during vibratory sand compaction piling is not met. For this reason, at the boundary area of the Depot, static sand compaction piling method will be used. The vibration during the construction activity will also create annoyance to the occupants, even though there will be no damage. However, some measures or compensation are required for the residents resided along the 15 m RoW of the Depot Boundary and underground station area to mitigate vibration impact during construction.

6.2.1.2 Mitigation Measures

- Compensation will be provided to the vibration susceptible households located near to the boundary. The level of compensation will be determined by the Resettlement Action Consultant (RAC) and those amounts will be set out in the Resettlement Action Plan (RAP). If necessary, the affected people will be relocated for temporary period from the area of influence.
- Contractors will be required to use low-vibration generating equipment and machineries whenever it is necessary.
- To identify impact on the surrounding buildings, the vibration level and condition of the buildings should be monitored.
- The explanation and consultation to the affected persons prior to the construction should be conducted to obtain the understanding about the potential impacts including information of the positive impacts such as promotion of the local socio-economic activity. If the local people complain about noise and vibration, the consultant of the supervision and the contractors should reconsider the construction technique.
- Considering the extent of the work, routine vibration monitoring is required and necessary precautions should be taken to reduce the potential for vibration impacts. Monitoring will also be conducted if any grievance comes from the adjacent residents/receptors.
- Concurrent workload should be reduced if high vibration readings are found in monitoring. Instead, frequency of vibration generating works will be reorganized to reduce the impacts.

Residual Impacts

After implementing the mitigation measures, no significant impact related to vibration will remain. Therefore, no additional measures are required.

6.2.2 Train Operations

6.2.2.1 Method

The Japanese method established by Toei and used for analyzing the Tsukuba Express Line is used to calculate expected vibration levels along the alignment. The formula for vibration at-source (Lv) is based on ballast-less track: Lv = 10logV + 47 + 7.5.

If R<=400m, the following equation should be used: Lv = 10logV + 47 + 7.5+2.1 where,

a) Lv; Vibration level at source (VdB)
b) V; Train speed (km/h)

In the case of vibration-proof track: Lv = 10logV + 47

If R<=400m, following equation shall be used: Lv = 10logV + 47 + 2.1

In these formulas, an additional 2.1 VdB is added to account for vibrations generated when the train passes through curves of radius <= 400 m. Further, use of vibration-proof track (MSS bearing) reduces the vibration level by 7.5 VdB.

Prediction equation for vibration:

LP = Lv– 10log (r / r0) – 10logexp(α (r - r0)), where,

a. LP; Vibration level at target point (VdB)
b. Lv; Vibration level at reference point (VdB)
c. r; Distance from center of structure to target point (m)
d. r0; Distance from center of structure to reference point(m)

- α; Correction factor for internal dampening assumed α=0.04）

6.2.2.2 Applicable Criteria

Bangladesh has not established a regulation for vibration; therefore, Japanese criteria are adopted, of which there are two: 70 VdB for Shinkansen and 60 VdB for railways (Act No 1049, Vibration Regulation Act of 1977, Article 16, Section 1). The stricter value of 60 VdB will be applied for this Project. The value of 60 VdB approximately corresponds to 1.4 mm/sec of peak particle velocity (PPV). The proposed standard is strict compared to many international standards. For example, the USA regulation mentions that "vibration damage threshold criteria are 0.20 in (5 mm)/sec (approx. 100 VdB) for fragile buildings or 0.12 in (3 mm)/sec (appro. 95 VdB) for extremely fragile historic buildings" (Transit Noise and Vibration Impact Assessment, FTA 2006). The Australian Standard A-2183 mentions that for "historical building and monuments and buildings of special value", the allowable limit is 2 mm/sec PPV. The Indian CMRI Standard mentions that the applicable vibration limit is 2 mm/sec PPV for "objects of historical importance, very sensitive structures, more than 50 years old construction and structures in poor state condition". The adopted value for MRT Line 6 of 60 VdB (1.4 mm/sec PPV) is stricter than many international standards. The vibration level should be calculated at 12.5 m from the piers along the alignment.

6.2.2.3 Analysis

The formulas were applied for three curves radii and related train speeds. **Table 6-15** shows results for ballast-less track; for sections of curvature <200 m, between 200 - 400 m, and straight sections; for locations at the base of the pier and at 12.5 m distance.

Table 6-15: Expected Vibration Levels for Track Radii (VdB)

Track	R=200m	R=400	Straight(R>=500m)
At Pier Face			
Ballast-less track	64.9	68.2	66.8
At 12.5 m from Pier			
Ballast-less track	57.4	60.6	59.2

Table 6-16: Expected Vibration Levels for Track Radii (VdB) at Minimum Distance of the Receptor

Track	R=200m	R=400	Straight(R>=500m)
At Pier Face			

Track	R=200m	R=400	Straight(R>=500m)
Ballast-less track	64.9	68.2	66.8
At 25m from Pier			
Ballast-less track	52.8	56.1	54.7

The curvatures of proposed MRT Line-1 elevated portion alignment varies from 200 - 485 meter. Due to the sharp curvature, locations in the proximity of piers near <=200 m radius curves at all sections of proposed alignment will exceed the standard when ballast-less track is used. But the vibration level will be well within the standard for the ballast-less track at 12.5 m from pier. Currently, there is no settlement near the alignment of the elevated section. In future, the settlement also will be around 25 – 90m far from the track center. The vibration frequency will be below the normal level for all the curvature at the minimum distance for the receptor level (25m from the track center). Therefore, vibration proof track is not required at all in the elevated section. So, for the elevated section, ballast less track is recommended throughout the alignment.

For the underground section, even if the vibration is minimal, but to eliminate the risk of natural resonance, Mass Spring System (MSS) type Floating Slab Track (FST) will be placed for the entire UG section, which will also reduce the vibration. Low speed will be maintained in curved sections during train operation.

6.3 Air Pollution

6.3.1 Before/During Construction Stage

Effects on the air quality by the MRT Line-1 project is one of the major concerns especially during the construction phase. Dhaka air is inherently bad in winter season, due to northern wind with dust, high pressure at sea, and suspension of particle in land. So, without any construction, it will be very bad. Scientific explanations of such phenomenon are explained in section 4.3.3. The project target is to prevent construction activities not to add any further pollution. In the operation phase there will be no direct impact of MRT Line-1. As it is already described in the project area that there will be two sections. One is underground and another is elevated section. The train will operate based on the electricity. So, there will be no use of fossil fuel which is normally a big source of the gaseous pollutants. So, the total set up for the MRT Line-1 will be environment friendly. However, there will be some indirect impact also. The major sources of the pollution during the construction works are:

- Dust from earth works during site preparation, excavation, and tunnel boring activities
- Emissions from the operation of construction equipment and machines,
- Fugitive emissions from vehicles plying on the road
- Fugitive emissions during the transport of construction materials
- Loading and unloading construction materials, and
- Localized increased traffic congestion in construction areas
- Construction site generate dust from construction materials, waste, loose earth, and moving excavated material and transporting wastes on vehicles
- Emission of gases from the heavy equipment also will be the good source of the air pollution
- All the stationary heavy equipment or machineries like the batching plant, generators etc. will be the good source for the air pollution
- Stockpiling of soil in the construction area will be another source of dust in the construction site if not disposed in time.

6.3.1.1 Mitigation Measures

Following mitigation measures should be taken to reduce air pollution during construction work:

- Fit machinery with appropriate exhaust systems and emission control devices. Maintain these devices in good working condition in accordance with the specifications defined by their manufacturers to maximize combustion efficiency and minimize the contaminant emissions. Proof or maintenance register shall be required by the equipment suppliers and contractors / subcontractors.
- Equipped all the machineries with the exhaust system to control the black smoke.
- Operate the vehicles in a fuel-efficient manner.
- Cover haul vehicles carrying dusty materials moving outside the construction site (if the materials are dry).
- Impose speed limits on all vehicle movement at the worksite to reduce dust emissions.
- Removal of mud from the wheel at entry and exit point
- Install signage at the construction area roadside for the speed limit
- Control the movement of construction traffic.
- Service all vehicles regularly to minimize emissions.
- Machinery causing excess pollution (e.g. visible smoke) will be temporarily banned from the construction sites.
- Service all the equipment regularly to minimize emissions.
- Provide filtering systems, dust collectors or humidification or other techniques (as applicable) to the concrete batching and mixing plant to control the particle emissions in all its stages, including unloading, collection, aggregate handling, cement dumping, circulation of trucks and machinery inside the installations
- Water the material stockpiles, access roads and bare soils on an as required basis to minimize the potential for environmental nuisance due to dust. Increase the watering frequency during periods of high risk (e.g. high winds). Stored materials such as gravel and sand shall be covered and confined to avoid their being wind-drifted.
- Minimize the extent and period of exposure of the bare surfaces.
- Reschedule earthwork activities or vegetation clearing activities, where practical, if necessary, to avoid during periods of high wind and if visible dust is blowing off-site.
- Restore disturbed areas as soon as practicable by vegetation/grass-turfing.
- Store the cement in silos and minimize the emissions from silos by equipping them with filters.
- Establish adequate locations for storage, mixing and loading of construction materials, in a way that dust dispersion is prevented because of such operations

<u>Residual Impact</u>

With the implementation of air pollution mitigation measures stipulated in this EIA report during construction stage, no significant residual impact on air quality is expected.

6.3.2 Operation Stage

Vehicle exhaust emissions and entrained dust could increase in the vicinity of stations due to increased movements of people.

However, the proposed MRT Line-1 will be electrical operation and not use diesel fuel. Moreover, the operation will improve congestion of roads along the MRT Line and efficiency of the vehicle mobility. Consequently, increase in air pollution in Dhaka city may be mitigated as a positive impact.

6.3.2.1 Mitigation Measures

The trains will be operated by electricity. Although the production of electricity required for operation of metro rail will cause emission of air pollutants, but it will be insignificant than the amount of reduced emission due to decreasing of other vehicles. No additional measures are required.

Residual Impacts

No residual impact on ambient air quality is anticipated during operation stage.

6.4 Surface Water Pollution

6.4.1 Before/During Construction Stage

The potential sources of impact to surface water resource are:

- At the project site due to excavation activities may increase erosion during rainfall, that may increase the suspended sediment concentration in the adjacent water body (especially in the Rampura canal, adjacent canal at Purbachal, Balu River and Shitalakshya River);
- The mismanagement of wastes that may cause surface water pollution in the project area although the waste should be very small amount except the spoil materials;
- Washing of construction materials will generate liquid effluents which causes surface water pollution in the project area;
- Vehicle operating at the construction areas
- All kind of blackish and grey water from the accommodation area and office area will pollute the surrounding environment.
- Washing of the batching plant and ready mixture truck will increase the sedimentation in the storm water drainage line if not properly cleaned and high pH level may pollute the adjacent water body of the construction yard and depot area.

6.4.1.1 Mitigation Measures

Following mitigation measures should be taken to control surface water pollution during construction work:

- Install temporary drainage line (drains and bunds) around the storage areas for construction materials.
- Install temporary sediment basins, where appropriate, to capture sediment-laden run-off from site.
- Divert runoff from undisturbed areas around the construction site.
- Stockpile materials away from drainage lines.
- Prevent all solid and liquid wastes entering waterways by collecting solid waste, oils, chemicals, and wastewaters from brick, concrete and asphalt cutting where possible and transport to an approved waste disposal site or recycling depot.
- Wash out ready-mix concrete agitators and concrete handling equipment at washing facilities off site or into approved bounded areas on site. Ensure that tires of construction vehicles are cleaned in the washing bay (constructed at the entrance of the construction site) to remove the mud from

the wheels. This should be done in every exit of each construction vehicle to ensure the local roads are kept clean.

- Stabilize the cleared areas which will not be used for construction activities with vegetation or appropriate surface water treatments as soon as practicable following earthwork to minimize erosion.
- Ensure that roads used by construction vehicles are swept regularly to remove sediment.
- Water the material stockpiles, access roads and bare soils on an as required basis to minimize dust. Increase the watering frequency during periods of high risk (e.g. high winds).
- Monitor the water quality in the runoff from the site or areas affected by dredge plumes, and improve work practices as necessary.
- Protect water bodies from sediment loads by silt screen or bubble curtains or other barriers.
- Minimize the generation of sediment, oil and grease, excess nutrients, organic matter, litter, debris, and any form of waste (particularly petroleum and chemical wastes). These substances must not enter waterways, storm water systems or underground water tables.
- Use environment friendly and nontoxic slurry during construction of piles to discharge into the Channel.
- Reduce infiltration of contaminated drainage through storm water management design.
- Do not discharge cement and water curing used for cement concrete directly into water courses and drainage inlets.
- Pumping of groundwater should be from aquifers free from arsenic and other contaminants. Safe and sustainable discharges are to be ascertained prior to selection of pumps.
- Tube wells will be installed with due regard for the surface environment, protection of groundwater from surface contaminants, and protection of aquifer cross contamination.
- Protect groundwater supplies to adjacent lands.
- Take legal permission as per applicable local law.

Residual Impacts

With the implementation of proposed mitigation measures for surface water pollution, most of the anticipated pollution will be prevented. However, a little number of residual impacts, such as sedimentation of surface water, especially the river nearby depot can be occurred. This impact is not significant and will occur for short period (during construction phase). No additional measures are required.

6.4.2 Operation Stage

The surface water pollution due to the operation of metro rail is negligible as there is no significant source of pollution to water. In depot area, there will be Waste Water Treatment Plant. The waste water will go through an oil-water separator before coming to the treatment plant. In stations, the sewage will be discharged to the existing sewage line of DWASA wherever it is available. Otherwise, aerator or septic tank will be installed in the stations if any sewage line is not available. There will be no residual impact during operation period.

6.5 Ground Water

6.5.1 Construction Stage

Potential impacts on groundwater due to construction activities of the MRT Line-1 are insignificant. In Dhaka City, Ground Water extraction started from a depth of 100m and in some extreme condition the well goes up to 300 meters to reach the main aquifer and is unlikely to be affected by surface and tunnel

activity related to construction of the Metro. Only impact will be the extraction of groundwater for the construction purpose. So, this will create a little bit pressure on the groundwater table. But the impact is not so significant as the borehole will be in the specific area only. However, the mitigation measures for hazardous waste, mentioned in this report, should be implemented to prevent any contamination of ground water by hazardous waste, which is very unlikely.

Residual Impacts

Residual impacts on ground water are very rare. No additional measures are required.

6.5.2 Operation Stage

As the tunnel construction will be on the alignment (under the existing road) so there will be no possibility of interruption of ground water percolation.

In depot area, oil and lubricants can be released during train maintenance and repairing. Since there will be drainage with concrete floor and waste water will be undergo treatment. So, after taking the mitigation measures there will be practically no chance that these wastes would reach aquifer.

6.5.2.1 Mitigation Measures

Operations procedures related to the handling of hazardous chemicals and drainage from contaminated areas should be reviewed to highlight their safety and environmental aspects. Also, for avoiding such oil spillage, separate treatment plant will be installed at the depot area to avoid groundwater contamination.

Residual Impacts

No residual impact is expected.

6.6 Soil Pollution

6.6.1 Before/During Construction Stage

The project may not have significant impact on soil pollution because most of the alignment of the project will be done in the underground. Also, there is no activity in or near the agricultural field. The alignment will go through the city alignment from Airport to Kamlapur and Kuril to Purbachal. There have minor chance to soil pollution due to construct the project include soil stabilization, installation of pilling, construct of viaduct sections, construction of station. Problems could arise from dumping of debris i.e. construction soils (concrete, bricks), waste materials (from contractors' camp) etc. Improper management of these sources may contaminate the adjacent soil quality. Oil leakage from the unfitted machine and vehicle may also cause soil pollution. Waste from construction yard and camp will lead to the soil pollution. Also, during refueling of any vehicle and also from the stationary sources, oil leakage could happen which will pollute the soil.

6.6.1.1 Mitigation Measures

Following mitigation measures should be taken to control soil pollution during construction work:

- Before site works commence, a Spill Management Plan need to be prepared by the contractor and shall be approved by project supervision consultant (PSC). The plan shall provide details of procedures, responsibilities, resources, documentation and reporting requirements, training provisions for relevant staff, etc. to avoid spills of hazardous substances and to effectively respond to such incidents, in case these occur.
- Store fuel and hazardous substances in paved areas with embankment. If spills or leaks do occur, undertake immediate clean up.

- Ensure availability of spill clean-up materials (e.g., absorbent pads, etc.) specifically designed for petroleum products and other hazardous substances where such materials are being stored.
- Ensure all storage containers are in good condition with proper labeling.
- Regularly check containers for leakage and undertake necessary repair or replacement.
- Store hazardous materials above flood level.
- Equipment maintenance areas shall be provided with drainage leading to an oil water separator that will be regularly skimmed of oil and maintained to ensure.

Residual Impacts

It is expected that the possibilities of soil contamination can be mitigated by implementing the recommended measures in this EIA report. It is very unlikely that any residual impact on soil will occur during construction phase. However, if such impacts happen, that will be very minor and insignificant, any agricultural land will not be affected. No additional measures are required.

6.6.2 Operation Stage

Oil leakage from the maintenance work at depot site may contaminate soil quality of the surrounding.

6.6.2.1 Mitigation Measures

Following mitigation measures should be taken to control soil pollution during operation period:

- In the vehicle washing, maintenance area and wheel washing pits, drains shall be linked to the water treatment plant.
- Drainage from the depot workshops will be equipped with oil interceptors.
- Office buildings shall be provided with toilets and septic tanks to handle domestic sewage.
- The sewer system will be designed to prevent leakage or overflow of waste water that could contaminate the surrounding areas.
- All hazardous and potentially contaminating materials (chemicals, fuels, oils, etc.) shall be stored in facilities with weatherproof flooring and roofing, security fencing and access control and drainage/wastewater collection systems.

Residual Impacts

No residual impact during operation period is expected.

6.7 Waste

6.7.1 Before/During Construction Stage

During the construction stage several metric ton waste soils will be generated from tunnel boring as well as station construction by cut and covers method. The management of waste soil is the major challenge during the construction period. It is already estimated that approximately 17 million m^3 of spoil will be generated during the construction phase and this need to be disposed in a suitable location. Different types of fragments of construction materials and garbage also generate during the construction period. Solid and liquid waste also be generated from the depot area construction site, construction yard and construction camp. Solid waste generated from different area during construction site may impact on the surrounding soil as well as water quality. Improper management of waste during the construction stage might cause soil as well as water pollution so the impact of waste has been assessed as significant.

6.7.1.1 Mitigation Measures

Following mitigation measures should be taken to manage waste during construction period:

- Need to ensure proper segregation of solid wastes and put it in specified areas.
- Organize disposal of all solid wastes generated during construction in an environmentally acceptable manner.
- Minimize the production of solid waste materials by 3R (Reduce, Recycle and Reuse) approach.
- Segregate and reuse or recycle all the solid wastes, wherever practical.
- Prohibit burning of solid waste
- Collect and transport non-hazardous solid wastes to all the approved disposal sites. Vehicles transporting solid waste need to be covered with tarps or nets to prevent spilling waste along the route.
- Clinical wastes need to be bagged separately and then disposed of with the wastes by marking.
- Provide refuse containers at each worksite.
- Maintain all construction sites in a cleaner, tidy and safe condition and provide and maintain appropriate facilities as temporary storage of all the solid wastes before transportation and final disposal.
- For collection and disposal of solid wastes in an environmentally acceptable manner, the contractor needs to appoint a third party who is experienced in this issue and will be responsible for taking care of it.
- Separate spoil soil management plan needs to be prepared at before construction stage and those spoil materials will be disposed at the RAJUK approved land following the RAJUK standard and without any pollution.

Residual Impacts

There is very little scope of occurring any residual impact after implementing the mitigation measures, especially in the case of hazardous waste. There would also be a chance of sedimentation of water bodies nearby spoil soil disposal site due to runoff induced erosion. However, these impacts are insignificant and very unlikely to happen. No additional measures are required.

6.7.2 Operation Stage

At the operation phase, no hazardous waste is expected to be generated except maintaining works, car depot and operations of stations, miscellaneous municipal wastes, refreshments and ticketing booths, empty cans and bottles, food residues and other similar waste that will be thrown out of rail. The putrefaction of the organic component of the uncollected wastes will give rise to foul smells. Uncollected waste also will act as breeding grounds for the disease producing vectors and will affect the aesthetics of the project area.

6.7.2.1 Mitigation Measures

Following mitigation measures should be taken to manage waste during operation period:

- Offices, workshops, and other areas within the depot shall be provided with waste collection bins or receptacles;
- Solid wastes shall be segregated into hazardous, non-hazardous and reusable waste streams and stored temporarily on site in secure facilities with weatherproof flooring and roofing, security fencing and access control and drainage/wastewater collection systems;
- Garbage shall be regularly collected and shall be disposed consistent with local regulations;
- Wastes shall only be disposed to approved sites by local authorities.

Residual Impacts

No residual impacts are expected during operation period.

6.8 Ground Subsidence

6.8.1 Before/During Construction Stage

There will be no ground subsidence due to tunnel boring activities if there is no accident during the construction process of the metro rail. Only possibilities will be during the open cut method of the station work. But to avoid such accident, diaphragm wall method will be used. Therefore, if there is no disaster, there would be no possibility of land subsidence after taking the appropriate technology.

Buildings would be less likely to collapse due to ground subsidence because the planned metro rail alignment will be constructed under the existing road network.

6.8.1.1 Mitigation Measures

Following mitigation measures should be taken to control ground subsidence during construction period:

- Diaphragm wall method will be used to avoid any land slide during the construction of the underground station in open cut method;
- Detail methodology need to be prepared and submitted to the supervision engineer for their approval before starting any activities related to ground subsidence.

Residual Impacts

No residual impact is expected.

6.8.2 Operation Stage

During the operation phase of the metro rail, the possibility of the ground subsidence is less as the tunnel will be shielded. Also, from the subsoil investigation, it has been assured that there will be no ground subsidence during the operation phase. Moreover, the design of MRT-1 is prepared based on the guidelines of Bangladesh National Building Codes (BNBC) to protect the underground structures from the impacts of earthquake.

6.9 Offensive Odors

6.9.1 Before/During Construction Stage

Exhaust emission from heavy equipment causes odor problem. Though the construction camp site not yet finalized but there is a possibility of odor problem due to the open burning of construction waste, improper treatment of human liquid waste.

6.9.1.1 Mitigation Measures

Following mitigation measures should be taken to control offensive odors during construction period:

- Prohibit burning of solid wastes in the construction yard
- Need to install sewage treatment plant in the construction yard and in the depot area
- Need to seal the food wastes and dispose in a designated ground within a shortest period
- Storm water drainage line need to be cleaned at regular interval to avoid any bad odor from the stagnant water.

Residual Impacts

No residual impact is expected.

6.9.2 Operation Stage

Improper solid waste management in the station area might cause offensive odor but the possibility of this impact is negligible as regularly the solid waste will be collected from the station and depot area.

6.9.2.1 Mitigation Measures

Following mitigation measures should be taken to control offensive odors during operation period:

- Need to install sewage treatment plant in the depot area
- All kind of biodegradable wastes need to be separated, sealed in a plastic bag and then disposed in a designated place.

Residual Impacts

There will be no residual impact.

6.10 Topography and Geology

6.10.1 Before/ During Construction Stage

The MRT line-1 will be constructed mostly underground and some part is elevated. The MRT line-1 is located on the plain topography. The construction activities during the construction phase will not modify or alter the geologic formation and topography. So, no mitigation measures are required.

6.10.2 Operation Stage

In the operation stage, only the elevated section with station will be visible which will not change topography significantly. So additional mitigation measures are not required.

6.11 Landscape

6.11.1 Before/ During Construction Stage

Approximately 39 ha land will be acquired primarily for the Purbachal depot construction, which is currently privately owned. The majority of the land is used for agriculture, followed by vita/homesteading, and the remainder is used for water body. During construction, the present landscape will be changed. MRT Line-1 will follow the city's current road alignment. The attractive station structure would enhance the scenery in the depot area and on the elevated section.

The station, ventilation shafts, and sections of the metro line that will be designed using the cut and cover method are the key components of MRT Line-1 that could influence the surrounding landscape and aesthetics. Construction sites may have a detrimental effect on visual facilities and the appearance of the local area if they are not well maintained.

6.11.1.1 Mitigation Measures

Following mitigation measures should be taken during construction period:

- For the construction of the station at the underground route line area and in the elevated section area, barricade at minimum height needs to be provided to cover the construction activities from the City dwellers.
- Implementation of the mitigation measures stated in the Air pollution part to avoid any spoil or mud outside of the construction sites or to keep open while transporting from the generating sources to the disposal sites.

Residual Impact

After taking the mitigation measures, still there will be chances of negative landscaping at the entry and exit point. Also Spoil or mud may come to the road due to the washout from heavy rain. So, at the entry and exit point, security guard or signal men need to be posted to avoid entry or standing of the general people during the construction activities. Also, the barricade needs to be sealed to avoid washout of water to the road.

6.11.2 Operation Stage

In the operation phase, present landscape of the project area will be changed with the architectural and structural beauty at the route line from Kuril to the Purbachal Depot area. In the city area (from Kamlapur to Airport route line), ventilation shaft will be constructed in a nice way so that they merge with the surroundings.

6.12 Urban Drainage

6.12.1 Construction Stage

The drainage system could be hampered due to construction activities like as infilling, construction of the depot, construction yards and haul routes. A major impact during construction stage is due to entrain of suspended solids into the internal drainage line that can clog drainage system. Due to filling of low-lying areas for the construction of depots the surface drainage pattern may change at the depot site and surrounding.

6.12.1.1 Mitigation Measures

Following mitigation measures should be taken to maintain urban drainage during construction period:

- Placement of construction materials, excavated spoils, equipment shall not block flow of rainwater into canals/drainage structures.
- Prohibit disposal of waste materials to drainage channels.
- Regularly inspect and maintain all drainage channels in the vicinity of construction sites to keep these free from obstructions.

Residual Impacts

There will be change in surface runoff characteristics in depot and alignment area. However, these changes will not make any adverse impacts as proper drainage facilities will be developed for drainage. No additional measures are required.

6.12.2 Operation Stage

Dhaka city is flood prone area. Flooding may impact the operation of the metro rail especially underground tunnel. A hydrological study and modelling were conducted by BUET analyzing the historic flooding data during the detail design stage. Based on the information of the final hydrological report, the 100-year flood level was varied from 7.90 m PWD at station 1 to 8.33 m PWD at station 8 without considering the effect of climate change. The Depot Area is located near the Shitalakshya River. A coupled one- and two-dimensional hydrodynamic model was used to simulate the effects of land filling in and around the depot area on flood level. It was found that the land filling could increase the local flood level by about 8 cm. A comparison study by the NKDOS consortium indicated that the discharge in the Shitalakshya River could increase by 30% due to the potential impact of climate change. The hydrodynamic model simulation of the hydrological report shows that the flood level near the Depot Area could increase by 41 cm due to such increase in discharge. Overall, the impact of flood on depot and the impact of depot construction on

flood are negligible. Already the study has been considered in the design phase. So, there will be no impact and no additional mitigation measures will be required.

6.13 Protected Area

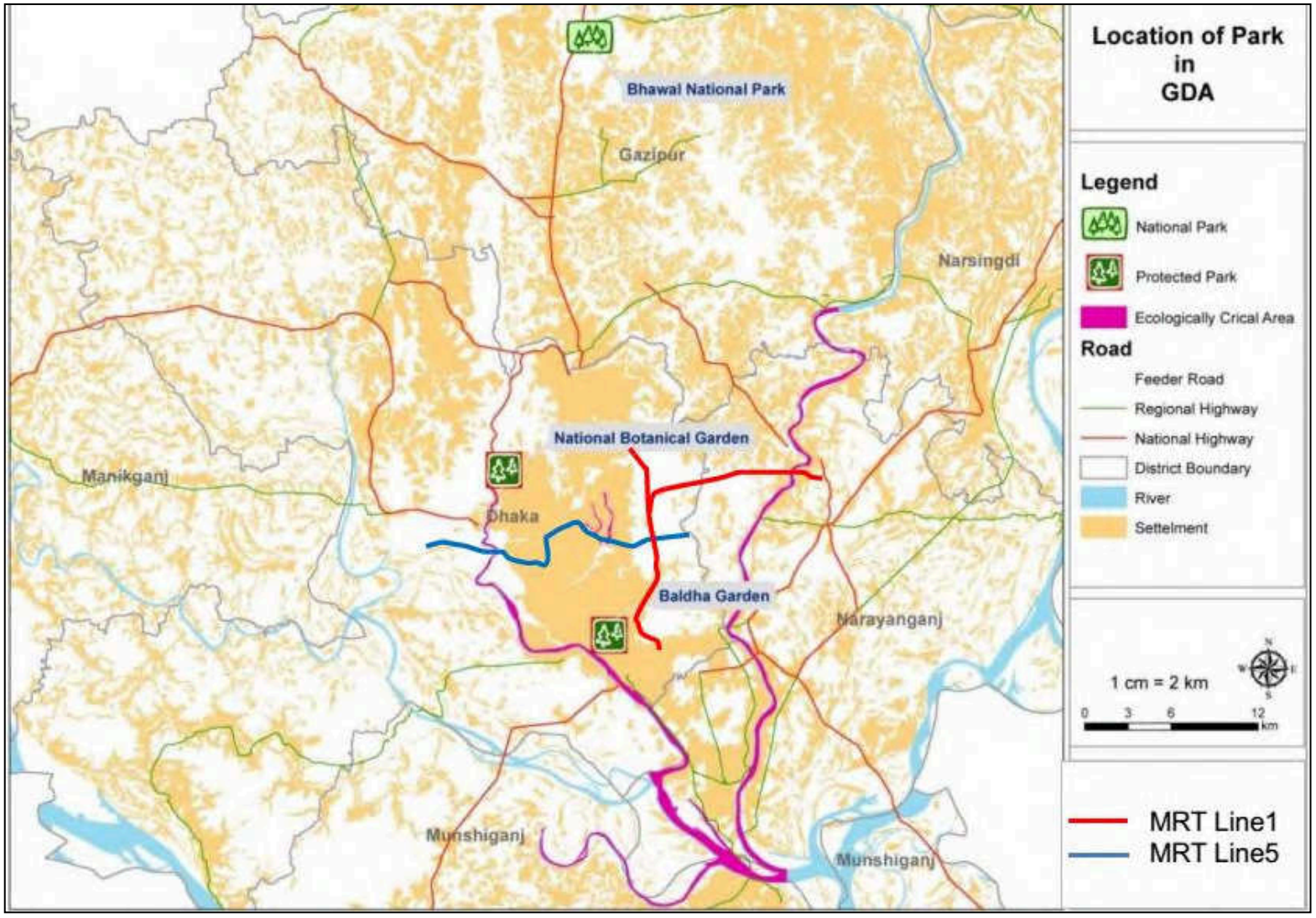
6.13.1 Construction Stage

Based on Bangladesh Wildlife Preservation Order 1973, Protected Areas (PAs) is classified into national parks, wildlife sanctuaries, game reserves and private game reserves. The protected areas in and around the project site are shown on **Figure 6-7**.

There is no protected area such as natural park, sanctuary, and conservation site in the project alignment. National Botanical Garden and Baldha Garden are located on over 5km from the project site. So, no impact is assumed.

The 1995 Bangladesh Environment Conservation Act includes provision for Ecologically Critical Area (ECA) declarations by the director general of the Department of the Environment in certain cases where the ecosystem is considered to be in danger of reaching a critical state. In ECA, GOB restricts activities and process of manufacture in the view of preventing deterioration of the environment. There are five ECA including one lake (Gulshan Banani-Baridhara Lake) and four rivers (Buriganga, Turag, Balu and Shitalakshya) (**Figure 6-7**). In line with the project, the elevated structure of MRT Line-1 crosses Balu River which is designated ECA in 2009. Existing Balu River Bridge consists of simple girders with 3 spans each 40m long.

As per the plan, more than 100 m span at the centre with a steel arch bridge will be constructed, so no pilling is required in the Balu River. Therefore, the impact on River is negligible.



Source: JICA Study Team

Figure 6-7: Protected Area in and Around the Project Site

6.13.2 Operation Stage

As there is no protected area near MRT Line therefore no impact is expected.

6.14 Biota and Ecosystem

6.14.1 Construction Stage

There is less impact on ecology as the most of the section is underground. In the depot area, there are some tree species which need to be cut down. A new study is going on to update the RAP, which will provide the exact number. Proper compensation will be provided for the loss of trees under RAP and a tree plantation program will be carried out in depot and under the viaducts once the construction is completed. It is the responsibility of the contractors to replant trees according to the quantities specified in the bid documents. A list of recommended tree species for planting in the median strip beneath the viaduct is provided in **Table 6-17**. Apart from these trees, median should also have grass cover. These species were selected on the basis of their common use in urban environments throughout tropical Asia, and their availability and prior use for roadway beautification in Dhaka. The tree species has been recommended based on Line 6 EIA Report. Depot landscape planner will determine the tree plantation provision for the depot area.

Table 6-17: Tree Species Recommended for planting under Viaduct

Scientific Name	Common Name	Local Name	Family
Casuarina equisetifolia Forst.	Australian Pine	Jhau	Casuarinaceae
Bougainvillea spectabilies Willd.	Bougainvillea	Bagan Bilash	Nyctaginaceae
Mimsops elengi L.	Bullet Wood	Bakul	Sapotaceae
Delonix regia Rafin.	Flame of Forest	Krishnachura	Caesalpiniaceae
Cassia fistula L.	Golden Shower Tree	Sonalu	Caesalpiniaceae
Syzygium cumini (L.) Skeels	Jambolan	Kala-jam.	Myrtaceae
Azadirachta indica A. Juss.	Neem	Neem	Meliaceae
Nyctanthes arbor-tristis L.	Night Flowering Jasmine	Sheuli	Verbenaceae
Michelia champaca L.	Joy Perfume Tree	Swarnachapa	Magnoliaceae
Caesalpinia pulcherrima (L.) Swartz	Peacock Flower	Radhachura	Caesalpiniaceae
Lagerstroemia speciosa (L.) Pers.	Pride of India	Jarul	Lythraceae
Polyalthia longifolia Thw. cv. Wipping	Telegraph Pole Tree	Debdaru	Annonaceae
Gardenia jasminoide	Gardenia Jasmine	Gandharaj	Rubiaceae
Diospyros peregrina	Malabar ebony	Gaub	Ebenaceae
Spondias pinnata	Hog-plum	Amra	Anacardiaceae

Few birds, reptile, mammals were found during the field survey in the depot area. Bengal Monitor is only near threatened according to the IUCN Red list 2015 whereas all species are least concern. As there are lots of homestead plantations near to the depot area, they can migrate to nearby area during the construction period of depot.

Residual Impacts

No residual impact is expected after implementing the mitigation measures, such as compensation and tree plantation.

6.14.2 Operation Phase

No impact has been predicted on ecosystem due to the rail operation in the underground tunnel. In the elevated portion (from the transition point to the Purbachal Terminal), there are no big trees. Currently the construction of Purbachal Express Way is already going on. Already the area is impacted by the current construction activities. So, there will be no additional impact anticipated on the ecosystem due to the operational activities of the MRT Line-1.

6.15 Involuntary Resettlement

6.15.1 Before/During Construction

In the design phase, detail RAP study is under preparation. The exact information and amount related to impact and loss of property will be known once the RAP study is completed. Proper compensation will be paid to all the project affected people as per the RAP study.

6.15.2 Operation Phase

There will be no impact during operation stage.

6.16 Local Economics

6.16.1 Before/During Construction Stage

During construction stage of the MRT Line-1, limited number of businessmen will be affected in the station area and in the Depot area. Final number will be confirmed after the completion of the detailed RAP study. There will be proper compensation for the affected businessmen as per the final RAP study. So, the impact will be very minimal after taking the compensation package. There will be no residual impact after compensation and other mitigation measures will be implemented as per the recommendation of the RAP report.

6.16.2 Operation Stage

It is expected that the new employment will be increased all along the route at every station. New manpower will be required to operate the metro rail as well as many new businesses will be created around the station areas. So, during the operation phase, the impact will be positive.

6.17 Social Service Facilities

6.17.1 Before/During Construction Stage

No social service facilities exist in the viaduct section. There may be some social service facilities in the depot area but not yet confirmed as the detail RAP study is underway. It would be known once the RAP study is completed. Proper compensation will be provided for the impacted social service facilities as per the national law and JICA guideline. Major route of the MRT Line will pass through the underground as a result the impact on social service facilities is negligible.

6.17.2 Operation Stage

MRT Line-1 is a major social service facility that will reduce the travel time and enhance the economic growth of the people.

6.18 Cultural heritages

6.18.1 Before/ During Construction Stage

The RoW of the project mainly followed the city road network. From draft final report of archaeological survey, it is observed that in the project area there are few infrastructures related to cultural heritage. Detail list of the cultural heritage and their impact due to the MRT line-1 construction is presented in **Table 6-18**.

Table 6-18: Construction Phase Impacts on the Cultural Heritage

Sl.	Name of the Cultural Heritage	Impacts during the Construction Phase
1.	Hazrat Sheikh Farid (R) Astana Mubarak (Pagol Shah) Mazar	During construction phase, the followers may feel disturbed during the ritual activities
2.	Kamlapur Railway Station	During Construction Phase, the structure might be impacted due to any unplanned construction activities of the underground Kamlapur station
3.	Sultanul Awlia Mahbub-E-Rabbani Hazrat Shah Sufi Peer Jangi (R) Babar Mazar Sharif	During construction phase, the followers may feel disturbed during the ritual activities
4.	Razarbag Police Line	No impact is suspected during the construction phase as there will be underground construction activities only. Rajarbag Station area will end at the intersection area.
5.	Rampura BTV Buildings	No impact is suspected during the construction phase as there will be underground construction activities only. There will be no station in this area
6.	Purbachal 300 feet road-side monuments	It is already calculated the expected noise and vibration level for the elevated section part (given in section 5.1 and 5.2). From the calculation, it is found that there will be no impact on these monuments due to noise and vibration during the construction stage

Source: Archaeological Survey Report, 2020

6.18.2 Operation Stage

There will be negative impact in the operation period also if proper mitigation measures will not be taken. The mitigation measures indicated under the subsection 6.1, 6.2 and 6.3 are enough to avoid such negative impact in the operation phase. Due to the operation of this MRT Line-1, the connectivity will be improved for all these cultural heritages. So, there will be positive impact also.

6.19 Local Conflict of Interest

6.19.1 Before/ During Construction Stage

In the construction phase, near the construction yard, accommodation camp, depot area, there will be good opportunity of employment and business for local population. Also, many people will come from different district of Bangladesh for the construction work. There will be migrant workers also from different countries. As a result, establishment of new business will take place at the construction sites. A positive impact on local economy will be occurred. But there might be chaos and conflict between the residents and migrant labour. But this is very rare considering others project examples in Bangladesh. Separate security plan needs to be prepared and assured before the starting of the construction phase.

Residual Impacts

There will be no residual impact after taking the mitigation measures.

6.19.2 Operation Stage

MRT Line-1 operation will enhance the development of concerned area. The underground section will go through a developed area, while the elevated section will be in developing area. Although it is expected that the benefits of this MRT will be enjoyed by people in catchment area without any discrimination.

6.20 Infection Disease

6.20.1 Before/ During Construction Stage

During the construction period, there will be accommodation camp for both the local staff, workers and the migrant staff and workers. So, there is a risk of increasing and spreading of infectious diseases in the accommodation camp and other sites also. However, this risk is not significant.

6.20.1.1 Mitigation Measures

- The accommodation camp needs to be separated for the local and migrant workers;
- Security needs to be posted at the entry gate to avoid direct entry of the workers in other camp;
- Infectious disease related banner needs to be posted at the accommodation sites to create awareness among the workers;
- Training needs to be provided at regular interval to create awareness among the workers;
- All the staff need to go for the medical test and infectious disease related test to prove them fit before joining to the sites;
- Checkup of the workers and staff at the regular interval.

Residual Impacts

After implementation of mitigation measures, the chance of spreading infectious disease will be rare. If such spread-out occur, then proper treatment and other benefits will be provided to the victims.

6.20.2 Operation Stage

In the operation period, the official staff will be limited and located at the station area and main depot area. So, there will be no possibility of the infectious disease as like as it is in the construction stage.

6.21 Working Condition

6.21.1 Before/ During Construction Stage

During the construction phase, there will be risk related to occupational health and safety in work sites due to the movement of heavy vehicles, work at height, depth and underground, handing of construction material etc. So, the impact will be significant if no mitigation measures are taken.

6.21.1.1 Mitigation Measures

To keep the work site safe, the following mitigation measures need to be provided

- Induction training needs to be available at sites containing the basic safety requirement, safety policy of the Contractor and related environmental issue. All the staff and members need to enter the site after taking induction training. The record of the induction training needs to be stored at site for further checking by the supervision consultant
- Safety related mitigation measures need to be taken at sites. Detail safety management plan needs to be submitted to the supervision consultant for approval prior to starting of the construction work.

- Daily toolbox talking needs to be conducted at sites to discuss about the safety issue of that day working activities
- Regular workforce training needs to be provided at site.
- Safety related signboard need to be posted at the required place to avoid any accidents
- All the equipment should take permit to work before starting of any construction activities. The Safety department of both the Supervision Consultant and the Contractor will fix the item which needs to cover under the permit to work process.
- Daily inspection checklists need to be followed for the specific safety items (like first aid, fitness of the heavy equipment, fire extinguisher etc.)
- Maintenance record of the heavy equipment need to be recorded at site.

Residual Impacts

After implementation of mitigation measures, the chance of accidents will be minimized. If such accidents happen, proper treatment and compensation will be provided to the victims.

6.21.2 Operation Stage

During the operation phase, there will be possibility of accidents in the station area and office premises. So, the work site also needs to be safe. But the impact is not significant. For avoiding such accidents, health safety plan will be adopted to ensure safety at the work sites.

6.22 Gender

6.22.1 Before/ During Construction Stage

An updated RAP study is being carried out for depot area. There might be some women headed household among the affected household which are going to adversely affected. The number will be known once the report is completed. This project will contribute to women empowerment by creating opportunity of employment for women. The project implementation agency will not do any discrimination between male and female employees.

6.22.2 Operation Stage

This project will contribute to women empowerment by creating opportunity of employment for women in the operation phase also.

6.23 Children Rights

6.23.1 Before/ During Construction Stage

During the construction phase of the MRT Line-1 project no under aged labor as per the condition of the local law will be employed. But if there is any employment by the Contractor and the sub-contractor then he/she need to be closed from the site after giving proper compensation by the Contractor (like replacement of job to his family senior or compensate him in a way to encourage his study or compensate his family to start a local business etc.). Due to resettle for depot construction, many children will be displaced along with their families. The vulnerable family will be taken care during RAP implementation. So, the project will not violate children rights. No additional mitigation measures are required in this part.

6.23.2 Operation Stage

During the operation phase, the children will be benefitted as they can move easily from one place to another for their education. So, the project will bring positive impact to the children.

6.24 Misdistribution of Benefits and Damages

6.24.1 Before/ During Construction Stage

The MRT Line-1 will be mostly underground structure and the elevated section will pass through the median of the road which is wide enough to construct the line. The number of damages due to the project activities is negligible. Therefore, the people will not be deprived from their benefit. The RAP study is under preparation. The affected people will get the benefit as per Land Acquisition and Requisition act 2017 and JICA guideline.

6.24.2 Operation Stage

The MRT Line 1 will be mostly underground structure and the elevated section will pass through the median of the road. During operation phase, there will be no damages. No impact has been expected. So, no mitigation measures are required.

6.25 Indigenous and Ethnic Minority People

6.25.1 Before/ During Construction Stage

From the previous RAP study, there were no existence of the indigenous people or the ethnic minority people along the MRT alignment and the Depot area. So, no impact is assumed in the construction stage.

6.25.2 Operation Stage

There are no indigenous people in or around the project site. So, there will be no impact during operation phase therefore, no mitigation measures are required.

6.26 Land Use and Utilization of Land Resources

6.26.1 Before/ During Construction Stage

Approximately 39 ha land will be required for depot development which will be permanently changed from homestead and agricultural land to developed area. As the depot will be within the confined area and additional land will not be required therefore, impact on land use and land resources will be minimum. However, for avoiding such impact, proper compensation needs to provide to the affected people who are directly or indirectly depend on that land resources.

6.26.2 Operation Stage

New transportation system will enhance the development of Purbachal area which will enable them to get more benefit.

6.27 Global Warming

6.27.1 Before/ During Construction Stage

GHG will be released from vehicles and machineries during construction phase. But the impact is not so significant considering the overall traffic numbers in the city area. Regular maintenance of the heavy vehicles, implementation of the mitigation measures under the Air pollution part will reduce the GHG emission as much as possible during the construction phase.

6.27.2 Operation Stage

The operation of metro rail will decrease the emission of greenhouse gas by reducing the numbers of conventional vehicles, e.g. bus, car, CNG rickshaw, etc. The reduction of GHG was calculated in FS Report (2018) using the demand forecast model as shown in **Table 6-19**.

Table 6-19: Reduction of GHG by the project

		Value	Unit
Emission reduction		63421	tCO_2/year
Baseline Emission		141648	tCO_2/year
Number of passenger of the project activity in year y		371,205,000	passenger/year
Average trip distance of the passenger of the project activity in year y		9.8	km
CO2 emission factor per passenger kilometer for transport mode i	Auto tempo	0.000034195	tCO_2/passenger-km
	Microbus	0.000117188	tCO_2/passenger-km
	Standard bus	0.000023565	tCO_2/passenger-km
	Other1	0	tCO_2/passenger-km
	Other1	0	tCO_2/passenger-km
	Other1	0	tCO_2/passenger-km
Share of passengers by transport mode in in the baseline scenario in year y	Auto tempo	7.289	%
	Microbus	15.729	%
	Standard bus	76.982	%
	Other1	0	%
	Other1	0	%
	Other1	0	%
Project Emission		78227	tCO_2/y
Annual electricity consumption associated with the operation of the project activity in year y		171550	MWh/year
CO2 emission factor of the grid electricity		0.456	tCO_2/MWh
Annual consumption of fuel I associated with the operation of the project activity in year y		0	t/year
CO2 emission factor of fuel i		0	tCO_2/TJ
Net calorific value of fuel i		0	TJ/t

Source: Feasibility Study Report 2018

The reduced GHG emission is the difference between the emissions produced by the project and baseline emissions in the case of without project. As seen in **Table 6-20** emission reduction was calculated by subtracting 78227 tCO2/year from 141648 tCO2/year, resulting to 63421 tCO2/year.

Table 6-20: Reduction in GHG emission

		Value	Unit
ER_y	Emission reduction	63421	tCO_2/year
BE_y	Baseline emission	141648	tCO_2/year

		Value	Unit
PE_y	Project emission	78227	tCO_2/year

Though CO_2 was actively traded in major global emission markets and the CO_2 price reached nearly as high as EUR 30 per ton in 2008, markets shrank after the Lehman Shock. Currently, it is mainly traded through negotiated transaction. In consequence, traded prices were affected by supply and demand at the time of the trade with little influence by the market itself[14]. In that F/S study, referring to the prices in EU Carbon Market and individual rates[15], UU$15 per ton is applied. Therefore, the benefit of emission reduction upon implementation of the project is calculated as 63421 tCO_2/year × US$25/ton = US$1585525/year.

6.28 Accident

6.28.1 Before/ During Construction Stage

There can be some sorts of accidents during construction as below:

- MRT construction requires works in elevated place such as work on the top of pier, girders and other height works;
- Traffic accident during the carrying construction material using the existing road;
- Heavy equipment's can bring on various significant accidents.

6.28.2 Mitigation Measures\

The following mitigation measures should be taken to avoid accident during construction period

- Detail safety procedure needs to be prepared and maintained for avoiding any kind of accidents during the construction stage;
- Proper training needs to be provided to the contractor and the sub-contractor;
- Continuous inspection needs to be ensured by the Employer and the Supervision Consultant to avoid any accidents;
- Before site works commence, a Traffic Management Plan for the construction phase needs to be prepared by the contractor and need to be approved by the Supervision Consultant. The plan shall be designed to ensure that traffic congestion due to construction activities and movement of construction vehicles, haulage trucks, and equipment is minimized. The plan needs to be prepared in consultation with local traffic officials and people's committees at the administrative and community levels. The plan shall identify traffic diversion and management, traffic schedules, traffic arrangements showing all detours, necessary barricades, warning/advisory signs, road signs, lighting, and other provisions to ensure that adequate and safe access is provided to motorists in the affected areas;
- Post traffic advisory signs (to minimize traffic build-up) in coordination with local authorities;
- As much as possible, schedule delivery of construction materials and equipment during non-peak hours;
- Regularly monitor traffic conditions along access roads to ensure that project vehicles are not causing congestion.

[14] JICA Capacity Development Training 2017. Climate Change through Forest Preservation (REDD+), 01 Aug 2017
[15] CO2 price in EU Carbon Market (EU-ETS) on 24 September 2018 was EUR22.39/ton

Residual Impacts

After implementation of mitigation measures, the chance of accidents will be minimum. If such accidents happen, proper treatment and compensation will be provided to the victims.

6.28.3 Operation Stage

The metro rail accident is rare case in the worldwide but it might happen. Fire is one of the risks, especially in stations. There will be automated sprinkler system to extinguish the fire in stations. On the other hand, all materials in the trains will be fireproof. Traffic accident will decrease because of the modal shift which will enhance the change from automobile to MRT.

CHAPTER 7

7 EVALUATION OF IMPACT

All positive and negative impacts on environmental and social components due to the MRT line-1 construction and operation have been discussed in section 6. Also, the proposed mitigation measures and residual impact have been discussed elaborately. The evaluation of impact has been made in this chapter considering without mitigation measures and with mitigation measures. As like as the scoring matrix, each impact was evaluated based on a rating instead of numeric scale. Impacts are rated in A, B, C and D. The definition of the rating is same as depicted in section 5.2.

Some impact ratings of construction and operation period during the scoping stage have been changed after detail assessment in the EIA study. The evaluation of environmental impacts is expressed in the context of physical, natural and social environment and other points of view as assessed during the scoping stage. The evaluation matrix after detail assessment considering without mitigation and with mitigation along with scoping rating is presented in **Table 7-1.**

Table 7-1: Evaluation Metrix of Environmental Impact under MRT Line-1

	Items of Impact		Impact Rating during Scoping Stage		Impact Rating after detail Study			
			Before/During Construction Stage	Operation Stage	Before/During Construction Stage		Operation Stage	
					Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Physical Environment	1.	Noise	A-	B-	A-	D	A-	D
	2.	Vibration	A-	B-	A-	D	A-	D
	3.	Air Pollution	A-	B+	A-	D	A+	-
	4.	Surface Water Pollution	B-	B-	A-	D	A-	D
	5.	Ground Water	D	D	B-	D	B-	D
	6.	Soil Pollution	A-	B-	A-	D	B-	D
	7.	Waste	A-	B-	A-	D	A-	D
	8.	Ground Subsidence	C	C	A-	D	D	-
	9.	Offensive Odors	D	D	B-	D	B-	D
	10.	Topography and Geology	D	D	D	-	D	-
	11.	Landscape	B-	B-	B-	D	A+	-
	12.	Urban Drainage	B-	D	B-	D	D	-
Biological Environment	13.	Protected Area	D	D	D	-	D	-
	14.	Biota and Ecosystem	B-	D	B-	D	B-	D

	Items of Impact		Impact Rating during Scoping Stage		Impact Rating after detail Study			
			Before/During Construction Stage	Operation Stage	Before/During Construction Stage		Operation Stage	
					Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Social Environment	15.	Involuntary Resettlement	A-	D	A-	D	D	-
	16.	Local Economics	B-/B+	A+	A-	D	A+	-
	17.	Social Service facilities	C	C	D	-	A+	-
	18.	Cultural Heritage	C	C	B-	D	B- and B+	D and B+
	19.	Local Conflicts of Interest	B-	C	B-	D	B-	D
	20.	Infectious Diseases such as HIV/AIDS	B-	D	B-	D	D	-
	21.	Working Conditions	B-	D	A-	D	B-	D
	22.	Gender	B-	B+	B-	D	B+	-
	23.	Children Rights	B-	C	B-	D	B+	-
	24.	Misdistribution of Benefits and Damages	D	D	B-	D	D	-
	25.	Indigenous and Ethnic Minority People	D	D	D	-	D	-
	26.	Land use and utilization of local resources	B-	B+	B-	D	A+	-
Others	27.	Global Warming	B-	B+	B-	D	B+	-
	28.	Accidents	B-	B-	A-	D	B+	-

Note:

- A = Significant impact is assumed, B = Impact is assumed but less than A, C = Impact is not clear because the design is not finished and further survey is needed to confirm, D = No impact is little
- The scoping items are referred from JICA guidelines

  '+' and '-'signs indicate positive and negative impacts, respectively

An extensive mitigation measures will be taken during construction and operation stage for the MRT line 1 project as stipulated in section 6 of this report. As a result, during construction stage 11 significant environmental and social impacts will be reduced as no impact whereas 13 moderate impacts or less than significant impact will come as no impact. During operation stage, all significant or moderate impacts will not have any impact due to adoption of proper mitigation measures.

7.1 Evaluation of Positive Environmental Impacts

7.1.1 Impacts on Local Economies

New employment will be generated due to construction and operation of the project. The project would provide substantial direct employment; more people would be indirectly employed in allied activities and trades. New business opportunity will be developed near the depot site that has positive impact to the local economy and livelihoods.

Introduction of the metro rail project at Dhaka city will result in the reduction in number of buses and private vehicles. This, in turn will result in significant social and economic benefits due to reduction of fuel consumption, vehicle operating cost and travel time of passengers. With the development of the metro rail, it is likely that more people will be involved in trade, commerce and allied services.

7.1.2 Land use and Utilization of Local Resources

Most of the alignment of the project will be constructed at underground so there will be very few losses of the public land and other natural resources. So, the land will be used for other development activities.

7.1.3 Global Warming and Climate Change

It is assumed that the increase of traffic and residents will cause the exhausted gas. However, it is expected that the modal shift and increase of travel speed will reduce the greenhouse gas emission. A carbon reduction calculation will be done in the final report.

7.1.4 Air pollution

The maximum alignment of the proposed Metro Rail Line 1 project will be underground and train will be operated by electricity. No diesel or other fuel will be used. On the other hand, a large number of passengers will be used the metro rail instead of other vehicle for movement. So, another vehicle will be reduced from the road that is run by diesel engine. So, the air pollution will be mitigated after construction of the MRT Line-1.

7.1.5 Traffic Congestion Reduction

There will be reduction in road traffic due to operation of the metro rail project. The numbers of vehicles are increasing day by day at Dhaka city. Traffic jam also increases with the increase of vehicles. People have great interest in the metro rail project. After the completion of the project a large number of people shift from road vehicle to proposed metro rail project. So, traffic congestion will be reduced at the operation phase of the project.

7.1.6 Mobility and Safety

The Proposed development project will reduce the journey time of the passenger. The project will also provide improved safety and lower number of accidental deaths and injuries of the passenger.

7.1.7 Gender

This project will contribute to women empowerment by creating opportunity of employment for women in the operation phase also. The project implementation agency will not do any discrimination between male and female employees. It is expected that some seats will be reserved for women passengers during operations of the metro. But this is still under the planning stage.

CHAPTER 8

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

The Environmental Management Plan (EMP) is prepared for all the identified environmental impacts as specified in Chapter 6 during pre-construction, construction and operation stages. The EMP outlines mitigation and monitoring requirements that will ensure compliance with the GOB environmental laws and regulations and comply with the JICA Guidelines for Environmental and Social Considerations. This section documents the EMP for the project and contains the overall institutional framework, project level institutional framework, environmental mitigation plan, environmental monitoring and management plan, compliance and grievances and EMP reporting.

8.2 Overall Institutional Framework

As per the MRT Line-1 project organogram, there is a position of Additional Project Director (EHS, LA and Resettlement). Under him, there are positions of Project Manager, Deputy Project Manager, and Assistant Project Manager. This section will monitor and coordinate all Environmental related activities.

8.3 Environmental Management Plan

Environmental management is essential to ensure that impacts identified are prevented and mitigated by the Environmental Management Plan (EMP). The EMP includes measures to address the potential impacts listed above that will be implemented during the construction stage of the project. More specifically, contracts for the respective rehabilitation works will include in the Technical Specifications, environmental guidelines for contractor.

The implementation of the EMP shall be monitored to ensure overall potential environmental and safety impacts that are readily avoidable and can be easily mitigated by adopting good engineering practices. Environmental monitoring and supervision shall be integrated into the project management and reporting system.

DMTCL and other relevant authorities will be involved in auditing project performance and will receive copies of monitoring reports. The Department of Environment will also be involved in monitoring sctivities. These agencies/institutions may also request an increase in frequency of monitoring and those appropriate actions are taken for environmental mitigation as they deem necessary. **Table 8-1** summarizes the proposed mitigation measures and budget and responsible agencies of management.

Table 8-1: Environmental Management Plan

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
PRE-CONSTRUCTION STAGE					
A. Environmental Management Plan for tunnel/elevated track/depot					
1. Project information	Disclosure of project information	• Prior to start site works, local residents and establishments, local authorities and other stakeholders who are likely to be affected by the project shall be informed about the construction schedule and activities, potential environmental impacts and mitigation measures through public consultation in each affected area.	Included in consultant's scope	DMTCL, General Consultant	DMTCL
2. Land acquisition and resettlement	Loss of land and homestead	• Provide compensation in accordance with Resettlement Action Plan (RAP) • Engage NGOs for implementation of RAP • Establish Monitoring Unit	Estimated by RAP	DC, DMTCL	DMTCL
3. Cutting trees at depot site and station area	Loss of vegetation	• Creating green ground cover by planting of ornamental shrubs below the elevated track/viaduct. A list of recommended tree species for planting in the median strip beneath the viaduct can be found in Table 6-17 under section 6.14.1. • Tree plantation should be conducted in depot area.	Estimated by RAP	Compensation by the RAP implementation agency and Plantation by the Contractor	General Consultant, DMTCL
4. Specific management plan shall be prepared by the	Hazard at work places and ambient	Prior to start of site works, Construction Environment Management Plan (CEMP) in the form of the following specific management plans shall be prepared by the	Included in contractor's scope	Contractors	General Consultant, DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
Contractor and shall be submitted Supervision Consultant prior to stat works		contractor and shall be submitted to the project supervision consultant for approval: **Dust Control Plan:** The plan will include details information of mitigation measures about the specific location, mitigation measures that helps to minimize the adverse impacts of sensitive receptors (residential areas, Mosque, Graveyards, Educational Institutions, Hospitals etc.) due to construction works, sourcing and transport of construction materials and other project related activities; **Noise Control Plan:** The plan will include details information about the specific location, mitigation measures that helps to minimize the adverse impacts of sensitive receptors (residential areas, Mosque, Graveyards, Educational Institutions, Hospitals etc.) due to construction works, sourcing and transport of construction materials and other project related activities; **Spill Management Plan:** The plan shall include details of procedures, responsibilities, resources, documentation and reporting requirement, training provision for relevant staff etc. to avoid spills of hazardous substances and to effectively respond to such incidents, in case these occur. **Spoil Management Plan**: The plan shall include details of procedures, responsibilities, resources, documentation and reporting requirement, training provision for relevant staff etc. to manage the Spoil **Traffic Management Plan:** The plan shall be designed to ensure that traffic congestion due to construction activities and movement of construction vehicles,			

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
		haulage trucks and equipment is minimized. The plan will be developed after completion of consultation with local community in the project area. **Occupational Health and Safety Plan**: In the occupational health and safety plan will include all construction activities (e.g. excavations, working at heights etc.), establishment and operation of construction/workers camps, use of heavy equipment, transport of materials and other hazards associated with various construction activities. **Emergency Response Plan:** An emergency response plan will be developed to prevent, mitigate, response and recover from emergency situation that could occur due to project activities such as accidents, spills of hazardous substances, fire, extreme weather events and other crisis			
5. Start of site works	Lack of mechanism to resolve environmental complaints due to project implementation	Prior to start site works, DMTCL shall undertake the following: • Establish a Grievance Redress Mechanism (GRM); • A 24-hour hotline will be established and publicized for complaints; • Ensure the contractor and DMTCL representatives name and contact numbers are placed on the notice board outside of the construction sites.	During pre-construction period, it will be included in contractor's scope.	Contractor (construction stage)	General Consultant, DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
CONSTRUCTION STAGE					
A. **Environmental Management Plan for underground Tunnel/Elevated Track/Viaduct/Depot**					
1. Tunnel Construction	Spoil disposal, material stockpiles, and dust	• Strictly implement approved Spoils Disposal plan; • The disposal sites will be cleaned and then treated so that leached water does not contaminate the ground water; • Material will be stabilized each day by watering or other accepted dust suppression techniques; • The height from which soil will be dropped shall be minimum practical height to limit the dust generation; • The stockpiling of earth in the designated locations with suitable slopes; • During dry weather, dust control methods such as water sprinkling will be used daily especially on windy, dry day to prevent any dust from blowing; • Sufficient equipment, water and personnel shall be available on dumping sites at all times for dust suppression; • Dust control activities shall continue even during work stoppages; • The Spoil shall be filled in the dumping site in layers and compacted mechanically. Dumping sites on sloping ground shall be protected adequately against any possible slide/slope failure through engineering measures; • If possible, use the spoil soil for development work	Included in contractor's scope	Contractor	General Consultant, DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
		surrounding the Dhaka city as well as brick kiln as there are lots of brick field near to the Dhaka city.			
2. Pier excavation works	Spoils generation from pier excavation works	• Strictly implement approved Spoils Disposal plan; • Spoil disposal only at the approved areas; • Trucks transporting spoils shall be tightly covered with suitable materials to minimize dust emission and spills; • Wheel washing shall be undertaken to remove mud so as to ensure that access road is kept clean; • Road surfaces shall be regularly cleaned of spilled spoils.	Included in contractor's scope	Contractor	General Consultant, DMTCL
3. Air quality at the time of construction	Air quality impacts due to gaseous and dust emissions	• Strictly implement approved dust control plan; • Wherever possible, use electrically-powered equipment; • Construction equipment and vehicles shall be well-maintained and shall meet national DOE emission standards; • Store excavated materials outside road reserve, but where there is no area, spoils shall be loaded and transported immediately; • Clean road surfaces of debris/spoils from construction equipment and vehicles; • Undertake daily cleaning of paved routes around the pier construction sites; • Impose speed limits on construction vehicles to	Included in contractor's scope	Contractor	General Consultant, DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
		minimize road dust in areas where sensitive receptors are located; • Provide prior notification to the community on schedule of construction activities; • Suppress of dust by spraying water at required interval.			
4. Noise and vibration at the time of construction	Noise and vibration impact due to operation of construction equipment and other activities	• Strictly implement approved Noise Control Plan; • Erection of temporary walls around the underground and elevated station construction sites and other construction sites; • All construction equipment and vehicles shall be well maintained; • No noisy construction –related activities will be carried out during the night; • As much as possible, use quiet equipment and working method; • Provide prior notification to the community on schedule of construction activities; • Monitor on the noise and vibration level shall be conducted periodically; • The surveillance and monitor on local residents shall be carried out periodically. When a complaint is arisen from them, additional conservation measures shall be taken; • Noisy work should be avoided during prayer time; • Night time noisy works should be avoided.	Included in contractor's scope	Contractor	General Consultant, DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
5. Surface water pollution at the time of construction	Surface water pollution due to the construction activities	• Adequate sanitary facilities and drainage in the temporary colonies of the construction workers; • Maximum rainwater harvesting and minimum use of existing water sources for construction will be ensured to minimize impacts; • Sediment trap will be provided to reduce sediment load in construction wastewater; • Water quality parameters will be monitored at the construction period within regular basis.	Included in contractor's scope	Contractors	General Consultant, DMTCL
6. Placement of materials	Drainage obstruction	• Placement of construction materials, excavated spoils, equipment shall not block flow of rain water into drainage structures • Regular inspect and maintain all drainage channels • Prohibit disposal of waste materials to drainage channels; • In case existing drainage ditch is filled up as required for the construction works, provide alternative drainage for rainwater;	Included in contractor's scope	Contractors	General Consultant, DMTCL
7. Solid waste	Generation of solid wastes	• Separate solid waste into hazardous, non-hazardous and reusable waste streams and store temporary on site • Undertake regular collection and disposal of wastes to sites approved by authority • Disposal site and method of treatment must be inspected and confirmed to prevent the secondary environmental pollution	Included in contractor's scope	Contractors	General Consultant, DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
8. Closure of median lanes for traffic	Traffic congestion and access problems	• Prepare a traffic management plan and strictly implement the approved Traffic Management Plan; • Provide signs advising road users that construction is in progress and that the road narrows to one lane using cones; • Employ flag persons to control traffic; • As much as possible, lifting and placing of the pre-cast pier and viaduct sections will be done at night to minimize traffic congestions; • Use traffic cones to direct traffic to move to the open lane.	Included in contractor's scope	Contractors	General Consultant, DMTCL
9. Working Environment	Hazards to health and safety of workers and the public due to operation of viaduct and tunnel facilities	• Implementation of Occupational health and safety plan; • Implantation of emergency response plan; • Appoint of Environment, Health and Safety Manager; • Conduct orientation of construction workers on safety; • Provide firefighting equipment at the working site; • Provide fencing of all areas of excavation and construction sites	Included in contractor's scope	Contractor	General Consultant, DMTCL
10. Land Subsidence/ Landslides	Tunnel construction as well as underground station construction work may lead to landslides or	• According to the feasibility study, RC segment will be used in the underground section. The D-wall method will be used for construction of the underground station. Closed type machines like Earth Pressure Balanced (EPB) shield machine and Slurry Shield machine are to be considered during construction of	Included in contractor's scope	Contractor	General Consultant, DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
	ground subsidence if any accident happens.	tunnel section to reduce the risk of landslides.			
OPERATION STAGE					
A. Environmental Management Plan for Train Operation					
1. Train operation and maintenance of rolling stock	Noise emission and vibration from rolling stock and operation of elevated and underground station	• Noise barrier will be placed in the curve section; • Parapet wall will be installed along the track to reduce the noise level at the receptor point; • Vibration proof track will be installed throughout the underground section; • Optimal maintenance of rolling stocks; • At the station platform, paging and bell signaling volume shall be adjusted to the lowest level where it will not detract from their function; • Monitor on the noise and vibration level shall be conducted periodically as long as the operation continues • The surveillance and monitor on local residents shall be carried out periodically. When a complaint is raised from them, additional mitigation measures shall be taken • Grinding and other maintenance activities that will generate high noise level will be undertaken inside the maintenance sheds	Included in contractor's scope during construction period and DMTCL's budget during operation period	DMTCL	DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
2. Cleaning of stations and depot activities	Solid waste and Wastewater generation	• Waste collection bins shall be provided • Garbage shall be collected regularly and disposed in designated places • station shall be provided toilet and other facilities • Wastewater shall be treated at the depot's industrial treatment plant. The treatment facility shall be properly maintained • Drainage emanating from the depot workshops will be equipped with oil interceptors • Office building shall be provided with toilets and septic tanks to handle domestic sewage	Included in DMTCL's budget	DMTCL	DMTCL
3. Working condition	Hazards to health and safety of workers and the public due to operation of viaduct facilities	• Implementation of Occupational Health and Safety Plan • Implementation of Emergency Response Plan	Included in DMTCL's budget	DMTCL	DMTCL
4. Emergency Situation	Health and safety of the passenger	• Occupational Health and Safety Plan for viaduct and tunnel operation and train staff in the implementation of such plan; • Emergency response plan (e.g. in case of fire, extreme weather events, power outage, equipment breakdown, accidents etc.) covering operation of viaduct and above-ground stations; • Ventilation system will be provided in the underground system; • Air compressors with fans will be used to cool air, before injecting it into the stations;	DMTCL's budget	DMTCL	DMTCL

Project Activities	Environmental Impacts	Proposed Mitigation Measures	Budget	Institutional Responsibilities	
				Implementation	Supervision
		• Air will be filtered prior to exhaust to the external environment; • Pumps will be installed into the tunnel and underground stations to pump storm water and waste water. Waste water treatment system will be installed at stations to treat sewage prior to discharge to the city system; • There will be provisions for sufficient emergency exits; • Backup electricity and ventilation systems will be installed in the tunnel sections; • Safety and evacuation measures in case of fire and other accidents (e.g., derailment, collision etc.) shall be developed prior to operation.			
5. Water Supply	Water supply liability	• Train wash water and rain water shall be collected in underground storage tanks for recycling • Considering installation of back-up well in addition to the existing well	Included in DMTCL's budget	DMTCL	DMTCL

8.4 Environmental Monitoring Plan

Table 8-2 shows Environmental Monitoring Plan (EMP) for construction and operation stage. During construction stage, the monitoring will be conducted as in-house monitoring to be implemented by contractors and supervised by DMTCL and Consultant. The location of in-house monitoring will be selected based on ongoing construction works and consultant's requirements. The suggested parameters and locations can also be changed as per the requirements of consultant's requirements. In addition to in-house monitoring, contractor will also employ an Independent Monitoring Group (IMG) for monitoring on a quarterly basis. The number of monitoring locations and parameters for IMG monitoring will be in the line of EIA baseline study. And during operation period, the number of monitoring locations are suggested based on the locations of EIA baseline study. The frequency of operation period monitoring will be once in a quarter.

Table 8-2: Environmental Monitoring Plan

Parameters	Locations	Means of Monitoring	Frequency	Budget BTD	Responsible Agency	
					Implemented by	Supervised by
DURING CONSTRUCTION						
A. Environmental Monitoring Plan for Tunnel/Elevated Track/Viaduct/Depot						
Air quality (PM_{10}, $PM_{2.5}$, SO_x, NO_x, CO, O_3)	As per construction activity and consultant's requirement	• Sample collection and laboratory analysis	Monthly or as per consultant's requirements	Included in contractor's scope	Contractor	DMTCL, General Consultant
Noise Level	As per construction activity and consultant's requirement	• Noise level collection and analysis	Monthly or as per consultant's requirements	Included in contractor's scope	Contractor	DMTCL, General Consultant
Water quality (DO, BOD_5, COD, pH, TDS, TSS, EC, oil and grease for both surface and ground water and As, Fe, Nitrate, Chloride, Coliform for ground water.	As per construction activity and consultant's requirement	• Sample collection and laboratory analysis	Monthly or as per consultant's requirements	Included in contractor's scope	Contractor	DMTCL, General Consultant
DURING OPERATION						
A. Environmental Monitoring Plan during Operation of Train						
Air quality (PM_{10}, $PM_{2.5}$, SO_x, NO_x, CO, O_3)	23 locations/as per EIA baseline locations	• Sample collection and laboratory analysis	Quarterly	Included in DMTCL's budget	DMTCL	DOE
Noise Level	23 locations/as per EIA baseline locations	• Noise level collection and analysis	Quarterly	Included in DMTCL's budget	DMTCL	DOE

Parameters	Locations	Means of Monitoring	Frequency	Budget BTD	Responsible Agency	
					Implemented by	Supervised by
Vibration	10 locations	• Sample collection and analysis	Quarterly	Included in DMTCL's budget	DMTCL	DOE
Water quality (DO, BOD_5, COD, pH, TDS, TSS, EC, oil and grease for both surface and ground water and As, Fe, Nitrate, Chloride, Coliform for ground water.	5 locations (depot and mainline)	• Sample collection and laboratory analysis	Quarterly	Included in DMTCL's budget	DMTCL	DOE
Waste Water	Depot area	• Sample collection and laboratory analysis	Quarterly	Included in DMTCL's budget	DMTCL	DOE

8.5 Reporting

The Environmental Construction Specifications (ECS) will be prepared based on this EIA and EMP, which will have necessary instructions and provisions to implement environmental compliance measures by contractors and it will be incorporated into contract document. Supervision Consultant will check the work of contractor through inspection based on ECS. A system of monitoring compliance with environmental mitigation measures will be set out prior to mobilization of construction, which will conform to the general arrangement shown in **Figure 8-1**. The system provides periodic inspection (at least quarterly), data compilation, and reporting of results. Consultant will prepare a quarterly monitoring report for DMTCL, JICA and DOE.

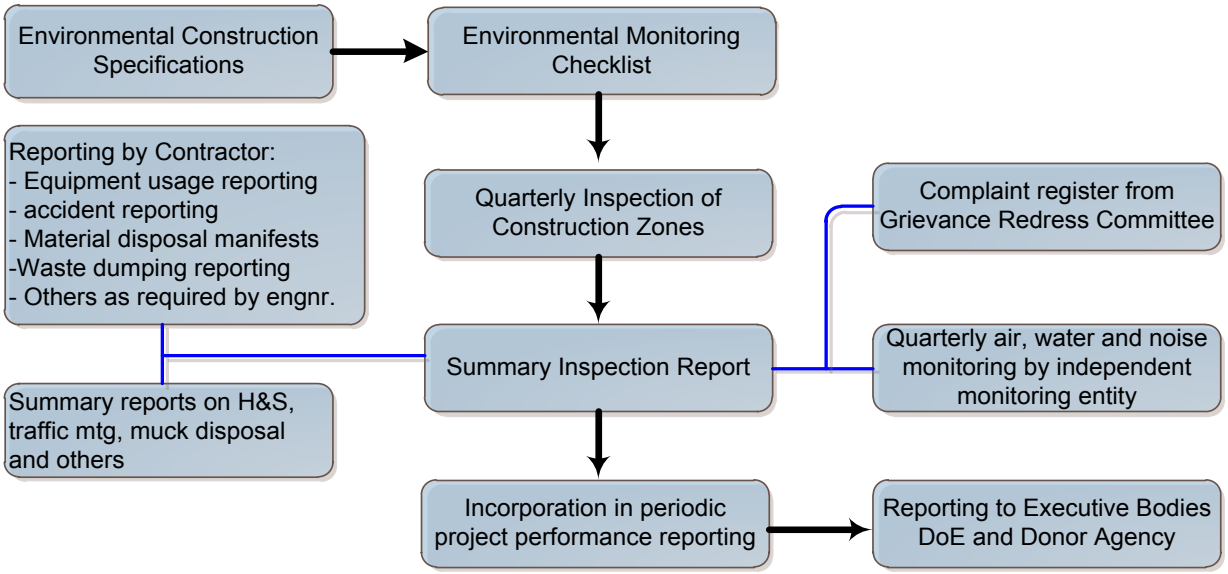


Figure 8-1: Flowchart for Environmental Monitoring and Reporting during Construction

Appropriate checklists will be used in inspecting compliance with mitigation measures (Sample checklist of JICA is attached in Appendix C). The main purpose of using checklists is to draw attention to requirements for pre-start up and the Contractor's Construction Environmental Management Plan (CEMP), the contract period, and completion stages. The checklists serve primarily as guides for reviewing performance to determine general compliance with broad indicators. The officials from ENV section of DMTCL, Consultant's Environment field staff, and the Contractor's Environmental Management Officer (EMO) will review performance against selected indicators. Indicators may include:

a) General conduct of work
b) Labor Provisions
c) Noise and Vibration Control
d) Air Quality
e) Drainage and wastewater
f) Traffic management
g) Solid and hazardous Waste Generation and Disposal
h) Spoil disposal
i) Use of land for Construction Purposes
j) Protection of Community Values and other indicators selected for the work at hand.

The EHS, LA and Resettlement section of DMTCL supported by the GC will prepare periodic reports that reflect performance of construction. Reports will be submitted to DoE and lender agency as part of the periodic project performance reporting requirement. Monitoring reports will summarize the results of air, water and noise monitoring conducted by the Independent monitoring group.

CHAPTER 9

9 STAKEHOLDER CONSULTATION

The Guidelines for Environmental and Social Considerations of JICA requires public consultation prior to starting the work in participations of project implementation authorities, beneficiaries, and project affected people. The main purpose of this consultation meeting is to inform people about the project and their potential environmental and social impacts and mitigation measures. Another purpose is to obtain their opinions regarding the implementation of the project.

9.1 Public Consultation Meeting

Two Public Consultation Meetings were held for two routes of MRT Line-1, e.g. Airport Route and Purbachal Route. Table 9-1 shows the detail information of the meetings. A total of 67 person (male) participated in the first consultation meeting, including local residents (2), businessmen (40), teacher (5), religious leader (3), community leader (1), service holder (4) and sector specialist (12). Whereas a total of 95 person (among them 77 were male and 18 were female) participated in the second consultation meeting, including land owner (2), farmer (1), businessmen (37), teacher (10), community leader (13), service holder (14), sector specialist (10), Housewife (4) and student (4). Mr. Md Abdul Wadud, (Additional Secretary), Additional Project Director (Environment, Health Safety and Resettlement & Land Acquisition, DMRTDP (Line-1) [E/S]; Mr. Md. Shaiful Islam, Project Manager (Environment Health Safety), DMRTDP (Line-1) [E/S]; and Mr. Md. Rakib Hasan Sarker, Assistant Project Manager (Environment), DMRTD Project (Line-1) [E/S] were present in the meeting from DMTCL. Mr. Md. Mozammel Hoque, Deputy Team Leader; Dr. Ashadul Alam, Environment Specialist; and Ms. Tanzia Sharmin, Jr. Safeguard Expert were present in the meeting from NKDOS Consortium. Besides, Dr. A.K.M. Nurul Islam, Safeguard Expert (Resettlement) from NKDOS Consortium joined the meeting online. The list of participants and minutes of two consultation meetings can be found in **Appendix-D**.

Table 9-1: Details of public consultation meetings

PCM No.	Date and Time	Location	Catchment Area	Type of Participants
01	10.01.2021 11:00 AM	Water Front Convention Hall, Rampura, Dhaka	Airport Route	Project Implementation Authority, Consultants, Beneficiaries and Project Affected People, including teacher, businessman, shop owner, representative from market association, representative from local government, hospital manager, senior citizen, local resident, etc.
02	11.02.2021 11:00 AM	Sea Shell Park and Restaurant, Gutiaba, Purbachal, Dhaka	Purbachal Route and Depot	Project Implementation Authority, Consultants, Beneficiaries and Project Affected People, including teacher, businessman, shop owner, representative from market association, representative from local government, hospital manager, senior citizen, local resident, farmer, govt. and non-govt. employee, etc.

9.2 Presentation in the PCMs

At first, an animated documentary film was showed in the meeting which displayed the route alignment of MRT Line-1, viaduct and tunnel design, elevated and underground station design, train design, entrance and exit design, etc. to give a clear idea about the project. Then, a presentation was delivered containing the findings of the supplemental environmental baseline survey of MRT Line-1. The presentation was divided into three parts. In first part, some key information about the project were presented. The second part was about the findings of supplemental baseline survey, including the summary results of ambient air quality, water quality, and noise level monitoring. Finally, the potential environmental impacts and their mitigation measures were discussed in the third part of the presentation.

9.3 Questions and Opinions of Participants

After presentation, a question-and-answer session was held in both public consultation meetings where public raised their questions or opinions and the project implementation authority and consultants gave responses. **Table 9-2** shows a summary of questions and opinions of participants in the meetings as well as responses provided by the authorities.

Table 9-2: Summary of Questions and Opinions of Stakeholders

No.	Name	Question/Opinion	Responder's Name	Response
First Public Consultation Meeting				
1	Niaz Makhdum Shibli Manager (Admin), Ibn Sina Diagnostic & Consultation Ltd.	Have you considered the earthquake risk during planning and designing of the project? What is the earthquake tolerance level of this project?	Md. Abdul Wadud, Kazi Farhed Iqubal	The possibility of earthquake has been considered during the design stage following the BNBC Earthquake requirement.
		The project was started in 2018, so what is the progress so far? Will you be able to finish the construction in due time?	Md. Abdul Wadud	Currently, detail design is ongoing. Hopefully the construction will be commenced in mid-2022 and will be completed in due time.
2	Md Golam Khawaja Director, Royal Furniture	Will the shops on both sides of the alignment be affected?	Md. Abdul Wadud	Since the alignment of this route will be underground, no shops will be affected. However, some small areas will be acquired to construct entrance and exit of stations. However, no significant impact will be occurred.
		To whom we contact if we get affected by the project activities? It would be better to assign area wise representatives.	Md. Abdul Wadud	A Grievance Redress Mechanism will be established to resolve the disputes. The procedure will be publicized.
		Please provide detail information about stations.	Kazi Farhed Iqubal	Detail information about stations were provided.
3	Dr. Anowar Hossain Molla Principal, North Badda Kamil Madrasah	In many cases, a decent plan was taken, but the implementation was not up to the mark. There was public suffering due to open stockpile of construction materials in other projects. What measures	Kazi Farhed Iqubal	This project will not create such types of problems. The construction materials will be handled properly so that they do not create environmental pollution. They will be covered during storing and transportation. This project will follow international standard.

No.	Name	Question/Opinion	Responder's Name	Response
		will be taken in this regard for this project?		
		Will the project be completed within current budget?	Md. Abdul Wadud	By the grace of Almighty Allah, we will complete the project within current budget without delay.
4	Mufti Zakir Hossain Mufti, Jamiah Madania, Baridhara	In other countries, metro stations are built in spacious places, which are not available in our country. How this will be addressed?	Md. Abdul Wadud	Although it seems that the space of station is small, but it will be enough once the construction is completed, especially in case of underground stations.
		Why not the design of train is not like other countries?	Md. Abdul Wadud	The design of trains has been selected based on the socio-economic and political condition of Bangladesh.
5	Shafiqul Islam Khan, Deputy Manager, Ibn Sina Diagnostic & Consultation Center	What compensation will be provided in case of loss of business due to this project?	Md. Abdul Wadud	A small amount of land will be acquired for construction of entrance and exit of underground stations. If any business gets affected for this reason, they will be compensated according to the Land Acquisition and Requisition act 2017 and JICA guideline 2010.
		How much fare will be charged for metro riding?	Md. Abdul Wadud	A committee is working to set fare of the metro rail, but not finalized yet. The economic affordability of people will be considered during fare determination.
6	Asaduzzaman Masum Local Businessmen, M/S Mamun Trading Corporation	How much land will be acquired for construction of entrance and exit of underground stations? In which locations?	Md. Abdul Wadud	Detail survey and design is still ongoing. There will be impact due to these structures, but not very much. Final estimation can be provided after completing the design.
7	Md. Azizul Haque Local Businessman, Babus-Salam Pharmacy, Airport	We are worried that the construction of metro rail will affect our business.	Md. Abdul Wadud	It is expected that this project will not affect local business rather create some new businesses.

No.	Name	Question/Opinion	Responder's Name	Response
8	Monowar Hossain Senior Teacher, Motijheel Colony High School	The spoil soil generated from the construction of underground stations using open-cut method will cause dust prevalence. Besides, it will decrease the width of road, which will create public hassle.	Kazi Farhed Iqubal	The station area will be excavated at one side of the road at a time, while the other side will remain open for vehicle movement. The spoil soil will be removed quickly after excavation and the stockpile will be covered. These measures will reduce dust generation. Alternative routes for traffic will be opened (if possible) in consultation with traffic police.
9	Saiful Islam, Madrasha Teacher, Karim Madrasha	What is luggage limit in metro rail?	Md. Abdul Wadud	Since metro rail is for urban commuting purpose, it is not expected to carry heavy luggage by passengers. However, small luggage like laptop, side bag can be carried with.
		Many drivers of conventional vehicles will be unemployed when metro rail starts due to modal shift. Will there be any rehabilitation program for them?	Md. Abdul Wadud	Metro rail will increase the mobility efficiency that will boost the economy. Although conventional vehicle will be reduced in metro route, they can shift in other areas. Moreover, metro rail will create opportunity of new jobs also.
10	Golam Mawla, Teacher, North Badda Kamil Madrashah	What factors were considered to select the location of the stations?	Md. Abdul Wadud	Mainly, the location of present bus stoppages, people's mobility, population density, vital places, available parking, traffic intersection, and land use factors were considered for selecting station locations.
Second Public Consultation Meeting				
1	Md. Mostafa Hossen Head Master H.R. Model High School	We know that there is a gap in-between rail tracks in conventional railway to accommodate expansion and contraction due to weather change. In MRT, continuous welded track will be used. How will it function in terms of weather induced expansion and contraction?	Md. Mozammel Hoque	In old days, small fragmented rail tracks were used keeping a gap to accommodate expansion and contraction due to weather change. And for the ease of conveyance up to 42 feet long rails were used. It was used almost 40 years ago. This used to make high noise and vibration as well as restricts speed of the train. Since it is our intention to make the metro rail speedier and less noisy than conventional rail, continuous welded track will be used. Switch Expansion Joint will be used to permit expansion contraction of the adjoining breathing lengths due to temperature variations. This will prevent the rail from buckling and occurring accident. And in conventional railway track, for increasing the speed, the joints were eliminated by welding. At first, three rails used to be welded and that was called short welded rail. Later, up to 0.5 miles the welding used to be conducted. Now

No.	Name	Question/Opinion	Responder's Name	Response
				even up to, 10 to 15 km continuous welding is happening. And for that, noise is also reduced in conventional railway.
2	Mokhles Bhuiyan Project Affected Person, Pitalganj	Why this meeting is not arranged in Pitalganj, near the depot location?	Dr. Ashadul Alam	First of all, from this location, depot area is not very far away. Secondly, today's meeting is arranged for entire Purbachal route that extents from Natun Bazar to Pitalganj Depot. Also, there is no suitable venue like this in Pitalganj area. Therefore, we have selected this location so that stakeholders from both ends can attend the meeting. Moreover, we have consulted with local people of Pitalganj and they have told us that they will be able to join the meeting easily at this location.
		The depot area is comparatively low land than adjacent areas. Therefore, the construction of depot may create water logging by preventing water drainage. What measures will be taken to mitigate this issue?	Md. Abdul Wadud	Necessary mitigation measures will be included to prevent water logging. A network of drains will be constructed inside and outside (periphery) of Depot to enhance the surface drainage system.
		The land acquisition for Depot construction will permanently close existing roads that will affect local mobility. What will be the alternative way?	Md. Abdul Wadud	A new road around the Depot on acquired land will be built, which will create the local mobility facility.
		It is seen in the case of conventional railway that many antisocial activities take place beside rail track. Will there be any similar situation in the case of metro rail?	Dr. Ashadul Alam	The anti-social activities are not only happening in railway stations, but also a worldwide social issue. The Government of Bangladesh is taking this issue very seriously now. If there is any activity like this in the metro stations, our Government will take necessary steps to prevent that.

No.	Name	Question/Opinion	Responder's Name	Response
			Md. Abdul Wadud	The metro rail system is totally different from the conventional ground level railway. Conventional trains are slower than metro rail. As a result, there is a scope for people to wait or stay in the station in the interval time of two trains arriving or leaving. Metro rail will arrive at the station within 1.5 to 2.5 minutes interval. So, people won't be needing to wait in the station. A dedicated security force for MRT lines will be formed. Furthermore, the metro rail is comparatively speedier and totally dedicated for urban commuting. Hence, there is no chance of such occurrence. The metro rail line partly elevated and partly underground. Therefore, no unauthorized access to the resources of the metro rail will occur as the security system will be highly sophisticated.
			Md. Shaiful Islam	Metro rail is being constructed for improving the communication system as well as the economic condition. During these huge economic activities, there will not be any scope of antisocial activities at the stations. As per our experience from abroad metro rails, there will be huge pressure in the metro rail during office hours. So, at that time any antisocial activity would be very difficult to occur. Also, it will be under close surveillance, and there won't be any scope of any crime happening.
3	Raju Ahmed Project Affected Person, Pitalganj	In addition to monetary compensation, will there be any resettlement program (housing/plot allocation) for project affected persons?	Md. Abdul Wadud	Necessary actions will be taken according to Resettlement Action Plan (RAP), existing laws of Bangladesh, and JICA Guidelines 2010.
		What measures will be taken to mitigate/compensate the impacts of noise and vibration of depot construction on nearby residents?	Md. Abdul Wadud	During Line-6 works, a measurement was conducted to determine the distance up to which the noise and vibration could be reached. Then the residents were offered a rental compensation for temporarily vacant their houses. And it was their wish to live in that place having that compensation. Or, leave that place for the certain working period. For Line-1, as per international rule, similar policy will be applied.
			Dr. Ashadul Alam	A prediction or modelling was undertaken to identify potential affected zone and structures. As per the analysis, Vibrating SCP will cause some harm at the nearby houses. For that, Static SCP is suggested to use around the boundary lines of the depot area.

No.	Name	Question/Opinion	Responder's Name	Response
4	Salauddin Bhuiyan Chairman, Rupganj Union Parishad	The mouza rate of land is very lower than current market price. Therefore, the project affected people will not be benefitted if the compensation is estimated based on mouza rate.	Md. Abdul Wadud	The advice was accepted with thanks. And the compensation will be done according to the Land Acquisition and Requisition act 2017 and JICA guideline 2010.
		The affected people are worried whether they will get compensation on time.		The project implementation authority will distribute the compensation among affected people as per the laws of Bangladesh. The project affected people should not get worried. Fair compensation will be provided without any kind of discrimination.
5	Mr. Jewel Master Local Resident	There will be environmental impacts due to depot area. Therefore, a separate meeting in depot area need to be conducted to inform the stakeholders of that area about potential impacts and mitigation measures.	Md. Abdul Wadud, Dr. Ashadul Alam	Actually, this meeting is for the stakeholders from both Alignment of Purbachal Route and Depot Area. Most of the participants here are from Pitalganj (depot area). Therefore, the purpose of informing the people of depot area about environmental impacts and mitigation measures is perfectly fulfilled by today's meeting. And for environmental impacts, proper mitigation measures will be implemented to reduce the adverse outcomes. In the Depot area, the trains will arrive and will be washed. As a result, lubricants, grease and other pollutants may be mixed with the water. The waste water will be collected in a sump. In order to refine that waste water, an Effluent Treatment Plant (ETP) would be established. After treating the waste water in the ETP, the water would be stored for sometimes. Then the water quality will be tested. If the water quality is standard to release in the environment, it will then be released. Also, in order to check the current water quality and potential deterioration of water quality during construction works, the water of Shitalakshya River was tested in 2017 and 2019. And will be tested regularly during construction to monitor and compare the quality. So, we can assure you that, there will be proper mitigation measures for all the potential environmental impacts in the depot area and route alignment as well.

9.4 Key Informant Interview (KII)

Details of the key informant interview with major stakeholders is given in **Table 9-3**. Photographs related to KII meeting have shown in **Appendix E**.

9.5 Information Disclosure

As per JICA guidelines, information disclosure is required. JICA guidelines stated it could be disclosure meeting, public display of EIA document, web posting, etc. This Updated EIA is available at DMTCL website as part of information disclosure measures.

Table 9-3: Details of Key Informant Interview

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
07/01/2021	Maruf Ahmed Monsur Ward Councilor, Ward No. 10, DSCC. Mobile: 01972569166	Perception and viewpoint of the people about the project	Government has taken a great initiative to construct a separate route line under the ground level. Hopefully people of this area will be benefitted and can move easily from this area to Uttara.	
		Current status of traffic jam in your area.	In this area, now-a-days traffic jam is a common scenario. Though after the COVID situation, now it's quite lower than as usual. But during the office cycle, traffic jam is very common.	
		How would the activities of the project affect the local community?	There will be good impact of the project on the local community. People can easily move from Kamlapur to the northern part of the Dhaka within a shortest period. This will save time, ensure more working scope, and contribute to local economy.	
		Expectations from the project	Hopefully after operation, all kind of people can travel through MRT Line-1. Ticket fare should be fixed considering all types of people of the Dhaka city as well as outside of Dhaka City.	The ticket price is not finalized yet. This will be finalized before starting the operation of MRT Line-1.
		Do you have any suggestions or comments or opinion that needs to be considered during the implementation of this project?	As the line will be under the ground level so hopefully, there will be no displacement of any private property. If there is any resettlement issue in this area then proper compensation and enough time needs to be provided to the public to minimize their losses.	As the station will be open cut method so there might be displacement in the station area only. But appropriate measures will be taken according to the laws of Bangladesh and JICA guidelines.
		Any concern of the local Community that needs to	Not yet. But if there is any response from the local community then it will be forwarded to the DMTCL.	

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
		be communicated to DMTCL?		
07/01/2021	Md. Sultan Mia Ward Councilor, Ward No. 8, DSCC Mobile: 01716181603	• Perception and viewpoint of the people about the project	As part of the development work of the current government, MRT Line-1 will be another milestone for the Dhaka City People and for the residents of the Kamlapur Area.	
		• Current status of traffic jam in your area.	Traffic Jam is common issue in the Kamlapur station area due to the movement of intercity and national route bus service at all the time.	
		• How would the activities of the project could affect the local community?	By this project, mostly there will be positive impact. During the construction period, there might be some negative impact which needs to be addressed during the design phase. Good positive impact will be the ease transportation of the local people, economic development of the areaetc.	Proper mitigation measures will be taken to reduce negative impact during the construction phase.
		• Expectations from the project	• Proper mitigation measures during the construction period • Availability to all level of people	Proper mitigation measures for environmental pollution will be taken and implemented during the construction and operation phase.
		• Do you have any suggestions or comments or opinion that needs to be considered during the implementation of this project?	• No additional comments	
		• Any concern of the	• No concern yet received from the local community	

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
		local Community that needs to be communicated to DMTCL?		
		• What are the CSR expectations from the project owner?	• Beautification of the area • Lighting in the street	The new structures will add aesthetic beauty to this area. Affected drainage line will be improved in coordination with DSCC.
07/01/2021	Mirza Aslam Ward Councilor, Ward No. 11, DSCC Mobile: 01775 488919	• Perception and viewpoint of the people about the project	Good initiative by the government. But before starting of the such mega project other construction activities in Dhaka should be finished. Otherwise, traffic condition may collapse if all the construction activities start at a time	This line will be underground from Kamlapur to Airport and there will be no construction activities at the surface level except the station work. So, we are hoping that traffic condition will not be collapsed in this area.
		• Current status of traffic jam in your area.	As one portion of the Mogbajar-Malibag-Mouchak flyover ends in this area and also there is an intersection, so traffic jam is common issue	
		• How would the activities of the project affect the local community?	• If the government can complete the project within the timeline, then people will be greatly benefitted. Their time will be saved, transportation will be easier than now. But if it delays like other projects then the sufferings of the people will be long lasting.	
		• Expectations from the project	Proper mitigation measures during the construction period	Proper mitigation measures will be taken.

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
07/01/2021	K. M. Mamunur Rashid Ward Councilor, Ward No. 12, DSCC Mobile: 01715 001222	• Perception and viewpoint of the people about the project	The development work in Bangladesh is continuing and MRT Line-1 is part of those development works. Hopefully, this MRT Line-1 will reduce the sufferings of the people as like as the flyovers during the construction period. Also, people will be benefitted during the operation period.	
		• Current status of traffic jam in your area.	Previously traffic jam was common issue in the Malibagh-Mouchak area. But after completion of the flyover, traffic jam is rare in this area. But it's common at Malibag Choudhury Para area where the flyover has ended	
		• How would the activities of the project affect the local community?	Hopefully there will be no negative impact of this project as it will be undergrounded.	
		• Expectations from the project	• This will be communicated at the later stage	
08/01/2021	Anamul Haque Ward Councilor, Ward No. 13, DSCC Mobile: 01711 355326	• Perception and viewpoint of the people about the project	Good initiative by the government to go for underground MRT Line-1 as like as the developed countries. Though people of this area don't know in details about this project. They only know that one MRT Line will go through the area.	Now the MRT Line-1 is in design phase. TO let the people know, DMTCL arrange a public consultation meeting in Rampura Waterfront Convention Hall on 10th January to inform people about the project.
		• Current status of traffic jam in your area.	Traffic jam is a common issue throughout the route from Mailbag to Nadda	

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
		• How would the activities of the project affect the local community?	• There will be both positive and negative impact of the project on the local Community. The most common negative impact will be the resettlement of the local people and construction period environmental pollution. Good positive impact will be the ease transportation of the local people, economic development of the areaetc.	As the line will be undergrounded, so the construction activities also will be undergrounded except the station works. So, the displacement of people will be less than the other project. Separate team is doing the study to find out the affected persons.
		• Expectations from the project	• Enough compensation to the project affected people • Proper mitigation measures during the construction period	Compensation will be fixed by the separate team and will be fixed as per law. Proper mitigation measures will be taken
06/01/2021	Jakir Hosen Ward Councilor, Ward No. 18, DNCC Mobile: 01711 531949	• Perception and viewpoint of the people about the project	It's a great initiative by the government to construct a the MRT Line from the Kamlapur to Airport. Though the local people don't have brief idea about the line	
		• Current status of traffic jam in your area.	Currently traffic jam in this area (Nontubajar intersection) is not a big issue in this area except some days. But for going to Kamlapur from here, at least 2 hours will be needed due to traffic jam in Badda, Rampura and Mailbag area.	After completion of the project, hopefully this time will be reduced and people can easily move from Natunbajar to Kamlapur.
		• How would the activities of the project affect the local community?	• There will be both positive and negative impact of the project on the local Community. The most common negative impact will be the resettlement of the local people and construction period environmental pollution. Good positive impact will	Proper compensation will be provided for resettlement to those who will lose lands and houses. And for environmental pollution, different mitigation

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
			be the ease transportation of the local people, economic development of the area etc.	measures will be taken to reduce the pollution.
		• Expectations from the project	• Proper mitigation measures during the construction and operation period	Though the project is in design phase, but proper mitigation measures will be proposed for the both construction and operation period.
06/01/2021	Mofijur Rahman Ward Councilor, Ward No. 19, DNCC Mobile: 01819 218462	• Perception and viewpoint of the people about the project	People of this area has no detail idea about the MRT Line-1. They just know that MRT Line-1 will be constructed which will be undergrounded.	To inform the people in details there will be a public consultation meeting in Rampura. In that meeting brief information will be given by the DMTCL authority.
		• Current status of traffic jam in your area.	Traffic jam is common issue from the Badda link road to the Gulshan area.	
		• How would the activities of the project affect the local community?	• Hopefully there will be good positive impact due to this MRT Line-1. Easy transportation of the local people, economic development of the area etc.	
		• Expectations from the project	• People always expect less suffer from any project.	
06/01/2021	Md. Anisur Rahman Nayem	• Perception and viewpoint of the people about the project	Good initiative by the current government to go for the underground MRT Line.	

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
	Ward Councilor, Ward No. 49, DNCC Mobile: 01713 517006	• Current status of traffic jam in your area.	Traffic jam is common issue in the airport area. Recent BRT construction activities in this area, make the status more negative for traffic jam.	
		• How would the activities of the project affect the local community?	• There will be both positive and negative impact of the project on the people. The most common negative impact will be the resettlement of the local people and also construction period environmental pollution. • Good positive impact will be easy movement of people from airport to Kamlpaur.	
		• Expectations from the project	• Enough compensation to the project affected people • Proper mitigation measures during the construction period	Compensation for project affected people as well as mitigation measures for environmental pollution will be included and then will be implemented during the construction and operation stage.
08/01/2021	Md. Fajlul Haque Head Master, Alatunnecha Higher Secondary School Mobile: 01965491329	• Do you know about the project and its location?	Not in detail. But there was signboard nowadays in the roads where written something about MRT Line-1. So, from that banner, it was the assumption that MRT Line-1 might go through this area.	Assumption is correct and MRT Line-1 will go through underground from Kamlapur to Airport and elevated from Kuril to Purbachal.
		• What about your perception about the project? (positive and negative)	As the construction activities will go through the city's heart so there will be initial trouble to the city dwellers. But after finishing the construction phase, city's people will be mostly benefitted from this project.	In the city's heart, the construction will be undergrounded. Only the station will be built following the open cut method. Proper steps will be

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
				taken to avoid such trouble to the city dwellers.
		• What is your expectation during the construction and operation period?	• Traffic jam should be controlled at the barricaded area • There should be cross section for the city people to cross the road from one side to another • Dust needs to be controlled	
		• Any suggestion from your side	Hopefully government is planning for utilizing the route line in best way. But fare should be fixed considering all kind of people. Also, there should be separate facilities for the city's students.	DMTCL always respects such comments and will take them into account during the fare's finalization process.
05/02/2021	Md. Md. Ishak Mia Ward Councilor, Ward No. 17, DNCC. Mobile: 0171301422	• Perception and viewpoint of the people about the project	This is the great initiative of Bangladesh government to construct another MRT Line which will be undergrounded. But the local people currently have no any detail idea about the MRT Line-1. Most of them are worried whether they will be affected by it or not.	In the public consultation meeting, this will be discussed in details.
		• Current status of traffic jam in your area.	Khilkhet area is always busy area. But as the road is quite wider than the other part of Dhaka, so the traffic jam is very rare except during the VIP movement.	
		• How would the activities of the project affect the local community?	During Construction Period: • During the construction period, noisy activity should be stopped at night time. • Drainage line shouldn't be disrupted. • Need to take steps to avoid traffic congestion • Dust also needs to be controlled During operation period:	Proper mitigation plan is taken to reduce dust and noise pollution as well as traffic congestion. The design of the metro rail has considered less noise and vibration production. So,

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
			• Surrounding people shouldn't be disturbed during the operation period of metro rail.	surrounding people will not be affected.
		Expectations from the project	Hopefully the MRT Line-1 will be affordable to all kind of people and reduce the traveling time from northern part to southern part.	
09/01/2021	Dr. Md. Arifur Rahman Principal, Kalachandpur High School and College. Mobile: 01670251470	Do you know about the project and its location?	There is no detail information about MRT Line-1 to this area people. 2-3 years back there was a team who came to meet for such some information. At that time, it's known that there will be MRT Line-1 and MRT Line 5 in this area. Exact location and route line is not yet confirmed.	MRT Line-1 is in design phase and in the upcoming PCM, detail information will be provided. Also, information is available at the DMTCL websites.
		What about your perception about the project? (positive and negative)	Hopefully the project will improve the existing traffic system of the Dhaka City and also contribute to the country's economy	
		What is your expectation during the construction and operation period?	• During the construction period dust need to be controlled. • Noisy activity needs to be avoided during night time and also during the prayer time • There should be proper traffic plan to avoid any traffic congestion • Drainage line shouldn't be affected by the construction activity. During the operation period, it should be accessible to all types of people during operation period.	Proper mitigation plan is taken to reduce dust and noise pollution as well as traffic congestion. The design of the metro rail has considered less noise and vibration production. So, surrounding people will not be affected.
08/01/2021	Ajit Kumar,	Do you know about the project and its location?	People of this area do not have any detail idea about this project.	

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
	Proprietor, J.C. Enterprise, Nadda Station Area Mobile: 01819-299646	What about your perception about the project? (positive and negative)	Any kind of project activity creates huge dust, high noise and also inundation due to damage of the existing drainage line. Existing road becomes muddy or slippery by the bore soil. Also, local traffic could be disrupted due to the movement of the construction vehicles. Also, the businessmen faced a good amount of loss due to blockage of the road. So, these problems could happen during the construction of the project. From the positive concern, obviously the route line will contribute to the country's prosperity, ensure easy movement from northern part of Dhaka to Kamlapur and also from Kamlapur to the Northern part.	Proper mitigation measures will be taken during construction phase to reduce the pollution and other impacts mentioned here.
		What is your expectation during the construction and operation period?	During the construction period, hopefully the mitigation measures will be taken place to reduce noise and control the dust. Also, proper compensation will be paid to the affected businessmen. Though it is assumed that there will be sound during operation period of the train, but hopefully the government will take steps to dampen the noise during the operation period also.	A detail RAP study is under process where all the affected people will be considered and compensated as per local law. The design of the metro rail is prepared considering less noise production during operation phase.
07/02/2021	Mr. Junu Mia, Ex Chairman, Rupganj Union Parishad	Do you know about the project and its location?	All the People of the Depot area know about the project as there will be good number of displacements in this area.	
		What about your perception about the project? (positive and negative)	Depot area people will lose their land and business also in some cases. So, this is the main concern of the Depot area people how to compensate that impact and what will be the amount, which local laws will be followed etc.	Detail RAP study is under preparation and proper compensation will be given as per the local law of Bangladesh.

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations	Response
			Rest of the environmental impacts are not considered by the Depot area people. But in the operation phase there will be positive impacts including ease movement of people from the Depot area to the city area and there will be boost up of economy after being urbanized the Purbachal area.	
		What is your expectation during the construction and operation period?	During the construction phase, local people will be compensated and get the opportunity to work in the project area. In the operation phase, the MRT Line-1 will be accessible to all people.	This is already under plan and will be considered during the implementation.

9.6 Conclusion

Overall, the participants were in favor of this project as it is going to ease the existing difficulties of public transport in Dhaka city that will improve the standard of living and economic well-being. However, there were some concerns regarding the environmental and social impacts of the project, especially related to land acquisition, resettlement, damage of business, etc. among project affected people. The project implementation authority responded by explaining the mitigation and management plan that have been prepared following the laws of Bangladesh and JICA rules.

CHAPTER 10

10 EMERGENCY RESPONSE PLAN AND DISASTER IMPACT ASSESSEMENT

An outline of Emergency Response Plan (ERP) is given here in the EIA. During the implementation, Contractor and Consultant will also prepare a more detail version. A general plan is follows.

10.1 Disaster Management

Disaster is an unexpected event due to sudden failure of the system, external threats, internal disturbances, earthquakes, fire, and accidents. The first step is to identify the causes which develop/ pose unexpected danger to the structural integrity of Metro tunnel or overhead rail. The potential causes are excessive load, cracks, failure and malfunctioning of sensing instruments, accident, etc. These need to be investigated with care. A hydrological study has been conducted by BUET under the E/S service to assess the flood impacts on the project. Necessary measures will be taken as per the study. There will be periphery drainage network in depot area to prevent water logging. In station entrance and exit points, there will be elevated staircase (sample picture is added in **Figure 10-1** and **Figure 10-2**) to prevent rain or flood water entering into the underground stations. Moreover, there will be provisions of water pump at underground stations to withdraw water from tunnel.

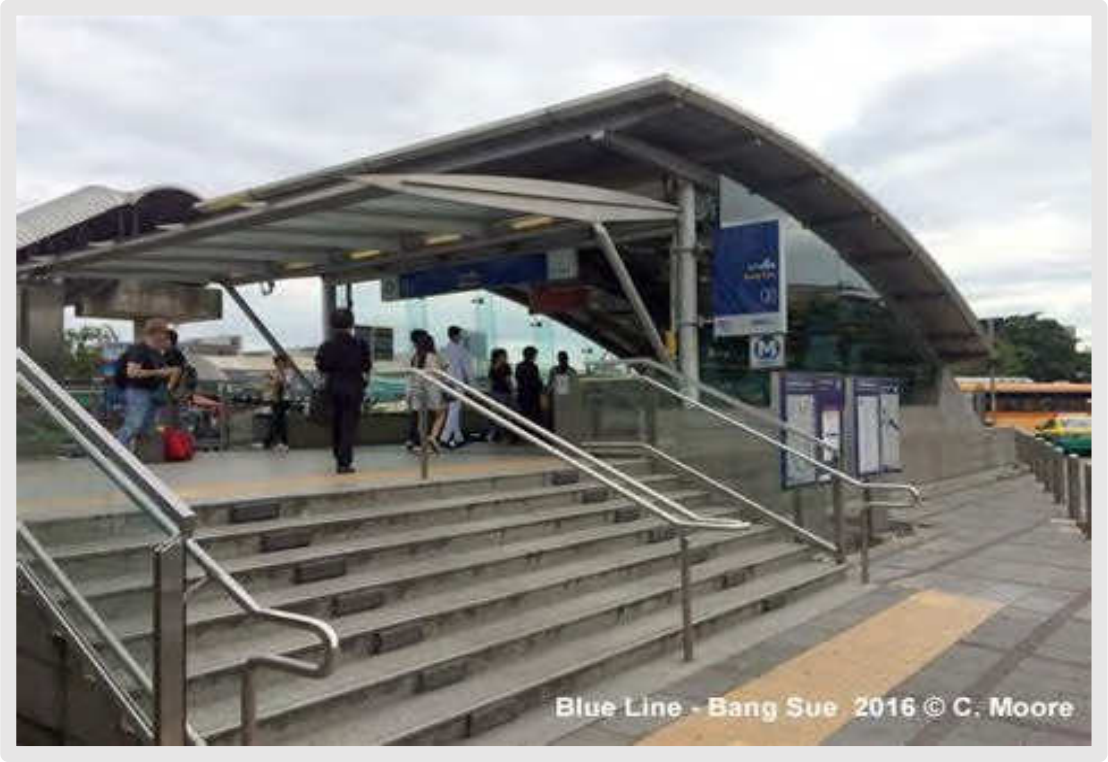


Figure 10-1: All UG station entrance has elevated start point to prevent flood water entrance.

Figure 10-2: In extreme case (like cyclone), there will be flood gate.

10.1.1 Preventive Action

Once the likelihood of a disaster is suspected, action must be initiated to prevent a failure. Engineers responsible for preventive action should identify sources of repair equipment's, materials, labor, and expertise for use during emergency.

10.1.2 Reporting Procedures

The level at which a situation will be termed a disaster shall be specified. This shall include the stage at which the surveillance requirements should be increased both in frequency and details.

The Engineer-in-Chief should notify the officer for the following information:

- Exit points for the public,
- Safety areas in the tunnel/overhead rail, and
- Nearest medical facilities.

10.1.3 Communication System

An efficient communication system is essential for the success of any disaster management plan. This must be worked out in consultation with local authorities. More often, the entire communication system gets disrupted when a disaster occurs. The damage areas need to be clearly identified and provided with temporary and full proof communication system.

10.1.4 Emergency Action Committee

<u>Mainline and Station</u>

To ensure coordinates action, an Emergency Action Committee should be constituted. The civic administrator may be the Chairman of this Committee. The committee may comprise of:

- Station Master concerned,
- Police Officer of the area,

- Dhaka Transport Coordination Authority Representative
- Dhaka Mass Transit Company Limited Representative
- Home Guard representative,
- Fire Brigade representative,
- Health Department representative,
- Department of Information and Publicity, and
- Non-Governmental Organization of the area.

Emergency Action Committee will prepare the evacuation plan and procedures for implementation based on local needs and facilities available. The plan should include:

- Demarcation of the areas to be evacuated with priorities,
- Safe route to be used, adequacy of transport for evacuation, and traffic control,
- Safe area and shelters,
- Security of property left behind in the evacuated areas,
- Functions and responsibilities of various members of evacuation teams, and
- Setting up of joint control room.

Depot

An Emergency Action Committee will also be constituted in depot having the similar members mentioned for mainline and stations. This committee will also be assigned with similar works. Since the nature of works is different in depot than mainline and stations, a separate evacuation plan will be prepared considering the possible hazards that can occur in depot.

All personnel involved in the Emergency Action Plan should be thoroughly familiar with all the elements of the plan and their responsibilities. They should be trained through drills for the Emergency Action Plan. The staff at the site should be trained for problem detection, evaluation and emergency remedial measures. Individual responsibility to handle the segments in emergency plan must be allotted.

Success of an emergency plan depends on public participation, their response to warning notifications and timely action. Public has to be educated on the hazards and key role in disaster mitigation by helping in the planned evacuation and rescue operations.

It is essential to communicate by whom and how a declared emergency will be terminated. There should be proper notification to the public on de-alert signals regarding termination of the emergency. The notification should be clear so that the evacuees know precisely what to do when re-entering or approaching the affected areas.

10.2 Emergency Measures

The depot is located very close to Jet fuel storage area. There is a risk of blast damage. So, it is recommended to carry out a blast risk assessment for depot area. If found risky, then blast barrier wall should be properly designed and constructed. The emergency measures are adopted to avoid any failure in the system such as lights, fire, means of escape, ventilation shafts etc. The aim of Emergency Action Plan is to identify areas, population and structures likely to be affected due to a catastrophic event of accident. The action plan should also include preventive action, notification, warning procedures and co-ordination among various relief authorities. These are discussed in following sections.

10.2.1 Emergency Lighting

The emergency lights operated on battery power should be provided at each station. The battery system should supply power to at least 25% of the lights at the station, platforms, and tunnels/viaducts for a period of 2 hours. The underground station should have transformer at each end of the platform. Both the transformers need to be kept energized and should feed independently alternate rows of lights so that in case of failure of one transformer, there will not be complete darkness. The tunnels need to be provided with fluorescent incandescent lamps at a spacing of 20 m.

10.2.2 Fire Protection

The building materials should be of appropriate fire resistance standard. For underground structures the fire resistance period should be at least 4 hours, and 2 hours for surface or overhead structures. Wood shall not be used for any purpose, excluding artificial wood products, which are flame resistant. The materials which have zero surface burning characteristics need to be used. The electrical systems shall be provided with automatic circuit breakers activated by the rise of current as well as activated by over current. The design of a station will include provision for the following:

- Fire prevention measures,
- Fire control measures,
- Fire detection systems,
- Means of escape,
- Access for fireman, and
- Means of firefighting.

Accumulations of refuse of any inflammable material like paper, plastic cartons constitute a major fire hazards and should not be permitted. Smoking should be strictly prohibited at all locations of MRT.

All aspects of fire prevention and control will be dealt in close collaboration with the city fire fighting authority. Smoke control will be achieved by the following means:

- Down stand bulkheads of a minimum depth of 600 mm to provide smoke containment. These will be provided around openings for escalators, lifts and stairs in underground stations,
- In underground stations the ventilation system will be designed to extract smoke in the event of fire, and
- In enclosed public areas of above ground stations (e.g. a concourse located below a platform) arrangement for smoke extraction will be provided.

A minimum of 30 minutes supply of water is to be assured in the case of fire. The pumps/overhead tanks shall have the capacity to discharge the water at the rate of 1100 liters per minute at a head of 21 m at nozzle mouth.

The storage capacity in an underground or overhead tank may be divided into two parts i.e. dead storage and running storage. Firefighting pumps shall be provided with a diesel pump as a standby arrangement, in case of power failure.

Fire of electrical origin, water cannot be used until the electric system has been made dead and earthened. For electrical fires, non-aqueous agents like ABC Power Chloro Bromo Methane or CO_2 gas are utilized for firefighting. Fire extinguishers with these agents shall be liberally provided at static installations and on the rolling stock.

Generally, there are often more casualties from smoke inhalation than from burning. Smoke needs to be transported away from the site of the fire. In order to achieve this, each fresh air has to be introduced into the underground section and exhaust gases should be sucked out from other section.

Openings, including ducts and passages, between MRTS property and any adjoining structures which allow free access into the MRTS property will be protected by fire doors, fire shutters, fire dampers, etc. as appropriate. Fire detection and alarm systems will be provided as per the prevailing state of technology.

A. Fire Prevention and Safety Measures

Fire prevention measures will be designed and implemented to minimize the risk of outbreak of fire by appropriate choice, location and installation of various materials and equipment. In stations planning, potential sources of fire can be reduced by:

I. Fire Prevention
- Use of non-combustible or smoke retardant materials where possible,
- Rolling stock is provided with fire retarding materials, low smoke zero halogen type electric cable is also provided,
- Provision of layout which permits ease of maintenance for equipment and cleaning of the station premises,
- Provision of special storage spaces for combustible materials such as paint and oil,
- Prohibition of smoking in fire prone areas,
- Provision of cigarette and litter bins, and
- Good housekeeping.

II. Safety

Following provisions will be required from fire safety point of view:

- Automatic sprinkler/detection system to be provided if floor area exceeds 750 sq.m.
- One wet riser-cum-down comer per 1000 sq. m floor area with static underground storage tank, overhead tanks and pumps of suitable capacity with hydrants, first-aid reel, etc.
- Portable fire non-aqueous extinguishers of Carbon di Oxide, chemical dry powder etc. at suitable places.
- Automatic smokes venting facilities.
- Two separate means of exit shall be provided, if more than 10 persons are working and the area exceeds 1400 sq. m
- Fire resisting doors shall be provided at appropriate places along the escape routes to prevent spread of fire and smoke.
- The travel distance for fire escape shall not exceed 20 m where escape is available in more than one direction; the distance could be up to 40 m.

B. Fire Alarm and Detection System

A complete fire detection system with equipment complying with the requirements of Bangladesh Fire service and Civil Defense shall be provided through out each station and ancillary buildings including entrance passageways, subways and exits etc. to give visual and audible indication of alarm conditions actuated by the operation of break glass contact or fire sensors e.g. detector heads, linear heat detecting cables etc. The system shall be operated from 24 V DC Power sources. Manually operated call points shall be provided at every hydrant and nose reel points, station head wall, tail wall and other locations.

Alarm bells shall be installed in each plant room complex at both platform and concourse level and shall be clearly audible at all points in the room/area.

Beam detector or heat detector shall be installed at roof level, ceiling and floor cavity, whilst linear detecting cables shall be installed in under platform cable ducts and cable shafts.

Smoke probe units shall be installed in rooms/compartments. When an alarm point is operated, the fire pump shall start to operate automatically. A station fire control and indicating panel shall be provided an installed in the station controller's room, for the control indication and monitoring of the whole detection and firefighting systems. While designing the firefighting system, the zone of Bangladesh Fire Services and Civil Defense shall be taken into account for linking with the same.

C. Fire Control Measures

Control of the spread of fire and smoke will be achieved by partition of fire risk areas, planning for smoke extraction, and arrangement for smoke containment. Partition is aimed at limiting the extent of a fire. The openings must be capable of being sealed in the event of fire. With the exception of station public areas, a fire compartment will not exceed 1500 m^2. Partition of the public areas in stations is not practicable for operational reasons. The fire resistance period of this separated area should be about 3 hours.

D. Access for Fireman

A secondary access to the station, not used by passengers for evacuation, shall be available to fireman should the need arise. The entry point shall be easily accessible from the road. Access shall be available to all levels of the station. The minimum width of the stairs is 1.0 m and maximum height should not exceed 60 cm.

E. Explosion Risk Assessment

There is an Aviation Fuel Depot situated very close to the depot of MRT Line-1. Therefore, an explosion risk assessment should be conducted by DMTCL. The assessment should evaluate present security measures of the fuel depot as well as formulate modelling to assess the degree of vulnerability of the MRT depot in case any explosion happens. Necessary mitigation measures and response plan after explosion will also be suggested by this assessment.

10.2.3 Ventilation Shafts

The Environmental Control system for underground stations requires ventilation openings between various plants, plant rooms and the atmosphere. Five independent shafts are required for exhaust air, fresh air intake and draft relief. The minimum cross-sectional area of each shaft will be 12 m^2. Total length of each ventilation shaft from the station box to the atmosphere should not exceed 60m.

10.2.4 Emergency Door

The rolling stock is provided with emergency doors at both ends of the cab to ensure directed evacuation of passengers in case of any emergency including fire in the train.

CHAPTER 11

11 CONCLUSION AND RECOMMENDATIONS

This main objective of the present study is to update the initial EIA report prepared in 2017 for MRT Line-1 following the JICA's Environmental and Social Consideration Guidelines and the guidelines of Department of Environment. Different data collection techniques have been used to conduct the baseline study which include literature review, observation, and environmental baseline survey. The EIA is prepared through identifying the potential impacts, assessing them and recommending possible mitigation measure for adverse impacts. The potential adverse environmental impacts of the Projects include air pollution, land acquisition, involuntary resettlement, loss of livelihood, noise and vibration pollution, loss of vegetation, water pollution, etc. On the other hand, there would be some positive impacts of the project that include enhancement of land and utilization of local resources, social infrastructure and services, development of local economy, reduction in GHG emission, etc. The project also has a positive impact in terms of employment opportunities during both construction and operational phase. In addition, there will be enhancement of economic activities around the stations of the MRT Line-1.

Proper mitigation measures have been suggested to reduce the impacts during construction phase and operation phase. Moreover, the residual impacts after implementation of mitigation measures have also been discussed. In case of social impacts like land acquisition, resettlement, loss of trees and property, loss of business and livelihood, proper compensation package will be suggested in updated RAP report, which is now in process.

Besides, a monitoring plan, including both in-house monitoring and IMG monitoring has been prepared mentioning the monitoring parameters, frequency, implementing and supervision agency, and budget information.

Appendix A : Environmental Clearance Certificates

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পরিচ্ছন্ন পরিবেশ ।

Government of the People's Republic of Bangladesh
Department of Environment
www.doe.gov.bd
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207

Memo No: DOE/Clearance/5726/2017/555 Date: 05 /11 /2017

Subject: Environmental Clearance for Mass Rapid Transit Development Project (Line 1 from Airport to Notun Bazar to Kamalapur).

Ref: Your application dated 10/10/2017.

Please refer to your letter of 10/10/2017 on the captioned subject, I have the pleasure to award the Environmental Clearance as well as approval of Environmental Impact Assessment (EIA) report for Mass Rapid Transit Development Project (Line 1 from Airport to Notun Bazar to Kamalapur).

A copy of the said Environmental Clearance Certificate is attached herewith for your kind information and necessary action at your end.

05.11.2017

(Syed Nazmul Ahsan)
Director (Environmental Clearance)
Phone # 8181673

Executive Director
Dhaka Transport Coordination Authority (DTCA)
Road Transport and Highways Division
Ministry of Road Transport and Bridges
13-14th Floor, Nagar Bhaban, Fulbaria, Dhaka-1000.

Copy Forwarded to :

1) PS to the Secretary, Ministry of Environment and Forests, Bangladesh Secretariat, Dhaka.
2) Director, Department of Environment, Dhaka Regional/Dhaka Metropolitan Office, Dhaka.
3) Deputy Director, Department of Environment, Dhaka District Office, Dhaka.
4) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

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পরিচ্ছন্ন পরিবেশ।

Government of the People's Republic of Bangladesh
Department of Environment
www.doe.gov.bd
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207

Environmental Clearance Certificate

Section 12 (1), of the Bangladesh Environment Conservation Act, 1995 (Amended 2010)

Clearance Certificate Number: 555

File number: DOE/Clearance/5726/2017

Clearance Certificate Issue Date: 05, November 2017

Renewal date not later than: 04, November 2018

A. Clearance Certificate Type
Environmental Clearance Certificate

B. Clearance Certificate Holder
Executive Director Dhaka Transport Coordination Authority (DTCA) Road Transport and Highways Division Ministry of Road Transport and Bridges 13-14th Floor, Nagar Bhaban, Fulbaria, Dhaka-1000.

C. Premises to which this Clearance Certificate Applies
Mass Rapid Transit (MRT) line-1 will be 28.2 km long which is located in the RAJUK area and will start from west side of the Kamlapur Railway Station. DMRT line-1 consists of two line: one named Airport Line being the route that connects Kamlapur in central Dhaka with the Dhaka International Airport, other named Purbachal Line being the route that branches off from the Airport Line at Notun Bazar station to the Purbachal area.

D. Activities for which this Clearance Certificate Authorizes and Regulates
The following activities will be implemented under Mass Rapid Transit Development Project (Line-1): ***Pre-construction Phase*** • Selection of final route alignment. • Planning and Utility Diversion specially in the open cut area and viaduct section if there any utility line • Land acquisition for the depot area as well as road side area where underground station will be constructed by open cut method • Preparation of construction site ***Construction Phase*** • 28.2 km MRT line construction (13.4 km underground line , 14.8 km viaduct line).

- 1 Depot (24 ha) construction.
- Tunneling (range from 20m to 50m underground) from Kamalapur station to Future Park Station .
- Elevated line construction from Bashundhara to Purbachal Terminal Station
- 19 Station Construction (12 underground stations construction by open cut method and 7 elevated viaduct station construction.)
- Manufacturing of girder for elevated section and RC segment for underground tunnel in the construction yard.

Operation Phase

- Test run of the MRT line 1.
- Commercial operation.
- Maintenance of the station.
- Washing and repairing of the train in the depot.
- Automatic ticketing system maintenance.
- Maintenance the continuous power supply system.
- Implement the environmental management plan.

E. Terms and Conditions for Environmental Clearance Certificate

1. **Limit Condition for Discharges to Air and Water**: The Environmental Clearance Certificate must comply with schedule 2 and 10, rule 12 of the Environment Conservation Rules, 1997.

2. **Noise Limit**: The Environmental Clearance Certificate must comply with the Noise Pollution (Control) Rules, 2006.

In case of non-coverage of ECR 1997, the Asian Development Bank & World Bank Environment, Health and Safety Guideline shall be adhered to.

3. **Operating conditions:**

3.1 Activities must be carried out in a competent manner. This includes:
(a) the processing, handling, movement and storage of materials and substances used to carry out the activity; and
(b) the treatment, storage, processing, reprocessing, transport and disposal of waste generated by the activity.

3.2 All plant and equipment installed at the premises or used in connection with the Environmental Clearance activity:
(a) must be maintained in a proper and efficient condition; and
(b) must be operated in a proper and efficient manner.

3.3 Construction works shall be restricted to day time hours so as to avoid/mitigate the disturbance of local lives as well as implementation schedules of the works shall be notified in advance to nearby residents.

3.4 Storage area for chemicals and other construction materials shall be carefully selected to avoid disturbance of the natural drainage. To avoid soil contamination at labour camp and work site chemical, cement and petroleum derivatives shall be handled cautiously.

3.5 Sufficient number of culverts, bridges and other drainage facilities shall be installed properly to ensure sufficient cross drainage capacity.

3.6 This shall be ensured that soil is obtained from nearby areas, which are free of invasive plants. Re-vegetation and replanting shall be undertaken if rehabilitation works involve extensive vegetation clearance.

3.7 Vegetation Clearance shall be minimizing at the construction phase as to minimize soil erosion. Soils for embankments shall be properly tested and compacted to ensure stability.
3.8 Proper construction practices shall be followed that minimize loss of habitats and fish breeding, feeding & nursery sites.
3.9 Proper and adequate sanitation facilities shall be ensured in labor camps throughout the proposed project period.
3.10 In order to control noise pollution, vehicles & equipment shall be maintained regularly; working during sensitive hours and locating machinery close to sensitive receptor shall be avoided.
3.11 No solid waste can be burnt in the project area. An environment friendly solid waste management should be in place during whole the period of the project in the field.
3.12 Proper and adequate on-site precautionary measures and safety measures shall be ensured so that no habitat of any flora and fauna would be demolished or destructed.
3.13 Any heritage sight, ecological critical area, and other environmentally and / or religious sensitive places shall be avoided during project construction phase.
3.14 Resettlement plan should be properly implemented and people should be adequately compensated, where necessary.
3.15 Appropriate permission would be required to obtain from the forest department in favor of cutting/felling of any plant/tree/sapling forested by any individual or government before doing such type of activity.
3.16 Construction material should be properly disposed off after the construction work is over.
3.17 All the required mitigation measures suggested in the Environmental Management Plan (EMP) included in the EIA report along with the emergency response plan are to be strictly implemented and kept operative/functioning on a continuous basis.

4. Monitoring and Recording conditions:

4.1.1 The results of any monitoring required to be conducted by this Clearance Certificate must be recorded.

4.1.2 The following records must be kept in respect of any samples required to be collected for the purposes of this Clearance Certificate:
(a) the date(s) on which the sample was taken;
(b) the time(s) at which the sample was collected;
(c) the point at which the sample was taken; and
(d) the name of the person who collected the sample.

4.2. Requirement to monitor concentration of pollutants discharged
For each monitoring, the Clearance Certificate holder must monitor (by sampling and obtaining results by analysis) the following parameter: air quality, water quality and Noise.

5. Reporting Conditions: Environmental Monitoring Reports shall be made available simultaneously to Head quarters and Dhaka Regional/ Dhaka Metropolitan office of the Department of Environment on a quarterly basis during the whole period of the project.

6 Notification of environmental harm: The Clearance Certificate holder or its employees must notify the Department of Environment of incidents causing or threatening material harm to the environment as soon as practicable after the person becomes aware of the incident.

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F. Recording of pollution complaints

The certificate holder must keep a legible record of all complaints made to the certificate holder or any employee or agent of the certificate holder in relation to pollution arising from any activity to which this Environmental certificate applies. The record must include details of the following:

(a) the date and time of the complaint;
(b) the method by which the complaint was made;
(c) any personal details of the complainant which were provided by the complainant or, if no such details were provided, a note to that effect;
(d) the nature of the complaint;
(e) the action taken by the certificate holder in relation to the complaint, including any follow-up contact with the complainant; and
(f) if no action was taken by the certificate holder, the reasons why no action was taken.

The record of a complaint must be kept for at least 4 years after the complaint was made. The record must be produced to any authorized officer of the DOE who asks to see them.

G. Validity of the Clearance Certificate: This Environmental Clearance is valid for one year from the date of issuance and Project Director shall apply for renewal to Head Office of DOE at Dhaka with a copy to Dhaka Regional/ Dhaka Metropolitan office of DOE at least 30 days ahead of expiry.

Violation of any of the above conditions shall render this clearance void.

This Environmental Clearance Certificate has been issued with the approval of the appropriate authority.

05.11.2017

(Syed Nazmul Ahsan)
Director (Environmental Clearance)

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe.gov.bd

Memo No: DoE/Clearance/5726/2017/1082 Date: 20/11/2018

Subject: **Renewal of Environmental Clearance for Dhaka Mass Rapid Transit Development Project (MRT line-1).**

Ref : Your Application dated 30.10.2018.

With reference to the above, the Department of Environment (DOE) is pleased to award the Renewal of Environmental Clearance in favor of Renewal of Environmental Clearance for Dhaka Mass Rapid Transit Development Project (MRT line-1) subject to fulfilling the following terms and conditions.

I. This renewal is valid until 04.11.2019. Application for further renewal along with the renewal fee and Vat on renewal fee in separate Treasury Chalan shall be submitted to the Director General, Department of Environment, Head Office, Dhaka with a copy to the Dhaka Regional and Dhaka Metropolitan Office of DOE in Dhaka at least 30 days ahead of expiry.

II. The Project shall require a new environmental clearance for any sorts of expansion or modifications of the project activities.

III. The terms and conditions as stated in Environmental Clearance issued on 05.11.2017 vide DoE/Clearance/5726/2017/555 shall also be effective for the renewed period.

20.11.2018
(Syed Nazmul Ahsan)
Director (Environmental Clearance)
Phone # 02-8181673

Project Director
Dhaka Mass Rapid Transit Development Project (MRT line-1).
Probasi Kollan Bhavan (Level 13-14)
71-72 Old Elephant Road,
Eskaton Garden, Dhaka-1000

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment, Forest and Climate Change, Bangladesh Secretariat, Dhaka.
2) PS to Secretary, Road Transport and Highways Division, Bangladesh Secretariat, Dhaka.
3) Managing Director, Dhaka Mass Transit Co. Ltd. Probasi Kollan Bhavan (Level 13-14) 71-72 Old Elephant Road, Eskaton Garden, Dhaka-1000
4) Director, Department of Environment, Dhaka Regional/Metropolitan Office, Dhaka.
5) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe.gov.bd

Memo No: DoE/Clearance/5726/2017/ 512 Date: 04/11/2019

Subject: Renewal of Environmental Clearance for Dhaka Mass Rapid Transit Development Project (MRT Line-1).

Ref : Your Application received on 06.10.2019

With reference to the above, the Department of Environment (DOE) is pleased to award the Renewal of Environmental Clearance in favor of Renewal of Environmental Clearance for Dhaka Mass Rapid Transit Development Project (MRT Line-1) subject to fulfilling the following terms and conditions.

I. This renewal is valid until 04.11.2020. Application for further renewal along with the renewal fee and Vat on renewal fee in separate Treasury Chalan shall be submitted to the Director General, Department of Environment, Head Office, Dhaka with a copy to the Dhaka Regional and Dhaka Metropolitan Office of DOE in Dhaka at least 30 days ahead of expiry.
II. The Project shall require a new environmental clearance for any sorts of expansion or modifications of the project activities.
III. The terms and conditions as stated in Environmental Clearance issued on 05.11.2017 vide DoE/Clearance/5726/2017/555 shall also be effective for the renewed period.

04.11.19

(Syed Nazmul Ahsan)
Director (Environmental Clearance)
Phone # 02-8181673

Project Director
Dhaka Mass Rapid Transit Development Project (MRT Line-1).
Probasi Kollan Bhaban (Level 13-14)
71-72 Old Elephant Road,
Eskaton Garden, Dhaka-1000

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment, Forest and Climate Change, Bangladesh Secretariat, Dhaka.
2) PS to Secretary, Road Transport and Highways Division, Bangladesh Secretariat, Dhaka.
3) Managing Director, Dhaka Mass Transit Co. Ltd. Probasi Kollan Bhavan (Level 13-14) 71-72 Old Elephant Road, Eskaton Garden, Dhaka-1000
4) Director, Department of Environment, Dhaka Regional/Metropolitan Office, Dhaka.
5) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

Government of the People's Republic of Bangladesh
Department of Environment
Head Office, Paribesh Bhaban
E-16 Agargaon, Dhaka-1207
www.doe.gov.bd

Memo No: DoE/Clearance/5726/2017/ 291 Date: 15/11/2020

Subject: Renewal of Environmental Clearance for Dhaka Mass Rapid Transit Development Project (MRT Line-1).

Ref : Your Application dated 05.10.2020

With reference to the above, the Department of Environment (DOE) is pleased to award the Renewal of Environmental Clearance in favor of Renewal of Environmental Clearance for Dhaka Mass Rapid Transit Development Project (MRT Line-1) subject to fulfilling the following terms and conditions.

I. This renewal is valid until 04.11.2021. Application for further renewal along with the renewal fee and Vat on renewal fee in separate Treasury Chalan shall be submitted to the Director General, Department of Environment, Head Office, Dhaka with a copy to the Dhaka Regional and Dhaka Metropolitan Office of DOE in Dhaka at least 30 days ahead of expiry.
II. The Project shall require a new environmental clearance for any sorts of expansion or modifications of the project activities.
III. The terms and conditions as stated in Environmental Clearance issued on 05.11.2017 vide DoE/Clearance/5726/2017/555 shall also be effective for the renewed period.

15.11.2020
(Syed Nazmul Ahsan)
Director (Environmental Clearance)
Phone # 02-8181673

Project Director
Dhaka Mass Rapid Transit Development Project (MRT Line-1).
Probasi Kollan Bhaban (Level 11)
71-72 Old Elephant Road,
Eskaton Garden, Dhaka-1000

Copy Forwarded to :

1) PS to Secretary, Ministry of Environment, Forest and Climate Change, Bangladesh Secretariat, Dhaka.
2) PS to Secretary, Road Transport and Highways Division, Bangladesh Secretariat, Dhaka.
3) Managing Director, Dhaka Mass Transit Co. Ltd. Probasi Kollan Bhavan (Level 11), 71-72 Old Elephant Road, Eskaton Garden, Dhaka-1000
4) Director, Department of Environment, Dhaka Regional/Metropolitan Office, Dhaka.
5) Assistant Director, Office of the Director General, Department of Environment, Head Office, Dhaka.

Appendix B : Lab Sheets of Surface Water Test Result

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/ CC, DPHE, CL, Dhaka. Date: 11-12-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019120044	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: Suface Water
Sent by:Kazi Forhad Iqbal ,Executive Director , EQMS Consulting Ltd., Banani, Dhaka-1213.	Dist:Dhaka, Upa:
Care Taker: EQMS Consulting Ltd.(SW-01)	Union:, Vill.:MRT-1 Project area
Sample Collection date: 02-12-2019	Date of Testing: 03/12/2019-11/12/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Biochemical Oxygen Demand (BOD)	0.2	24	mg/L	5 days Incubation	0.1
2	Chemical Oxygen Demand (COD)	4.0	88	mg/L	CRM	-
3	Coliform (Faecal)	0	12	N/100ml	MFM	-
4	Coliform (Total)	0	48	N/100ml	MFM	-
5	Colour	15	37.5	Hazen	UVS	-
6	Total Suspended Solid (TSS)	10	15	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, MFM-Membrane Filtration Method, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	11.12.19	1.) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2.) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/ CC, DPHE, CL, Dhaka. Date: 11-12-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019120045	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: Suface Water
Sent by:Kazi Forhad Iqbal ,Executive Director , EQMS Consulting Ltd., Banani, Dhaka-1213.	Dist:Dhaka, Upa:
Care Taker: EQMS Consulting Ltd.(SW-02)	Union:, Vill.:MRT-1 Project area
Sample Collection date: 02-12-2019	Date of Testing: 03/12/2019-11/12/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Biochemical Oxygen Demand (BOD)	0.2	2	mg/L	5 days Incubation	0.1
2	Chemical Oxygen Demand (COD)	4.0	8	mg/L	CRM	-
3	Coliform (Faecal)	0	96	N/100ml	MFM	-
4	Coliform (Total)	0	192	N/100ml	MFM	-
5	Colour	15	24	Hazen	UVS	-
6	Total Suspended Solid (TSS)	10	18	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, MFM-Membrane Filtration Method, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	11.12.19	1.) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2.) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/ CC, DPHE, CL, Dhaka. Date: 11-12-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019120046	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: Suface Water
Sent by:Kazi Forhad Iqbal ,Executive Director , EQMS Consulting Ltd., Banani, Dhaka-1213.	Dist:Dhaka, Upa:
Care Taker: EQMS Consulting Ltd.(SW-03)	Union:, Vill.:MRT-1 Project area
Sample Collection date: 02-12-2019	Date of Testing: 03/12/2019-11/12/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Biochemical Oxygen Demand (BOD)	0.2	3	mg/L	5 days Incubation	0.1
2	Chemical Oxygen Demand (COD)	4.0	12	mg/L	CRM	-
3	Coliform (Faecal)	0	24	N/100ml	MFM	-
4	Coliform (Total)	0	46	N/100ml	MFM	-
5	Colour	15	17.1	Hazen	UVS	-
6	Total Suspended Solid (TSS)	10	12	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, MFM-Membrane Filtration Method, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	11.12.19	1.) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2.) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/ CC, DPHE, CL, Dhaka. Date: 11-12-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019120047	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: Suface Water
Sent by:Kazi Forhad Iqbal ,Executive Director , EQMS Consulting Ltd., Banani, Dhaka-1213.	Dist:Dhaka, Upa:
Care Taker: EQMS Consulting Ltd.(SW-04)	Union:, Vill.:MRT-1 Project area
Sample Collection date: 02-12-2019	Date of Testing: 03/12/2019-11/12/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Biochemical Oxygen Demand (BOD)	0.2	1	mg/L	5 days Incubation	0.1
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Coliform (Faecal)	0	16	N/100ml	MFM	-
4	Coliform (Total)	0	28	N/100ml	MFM	-
5	Colour	15	4.2	Hazen	UVS	-
6	Total Suspended Solid (TSS)	10	3	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, MFM-Membrane Filtration Method, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	11.12.19	1.) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2.) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019

Md. Biplab Hossain
Chief Chemist
Department of Public Health Engineering
Central Laboratory Mohakhali, Dhaka.

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Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
Phone: 88-02-9881927, Fax: 88-02-9882003 , Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/ CC, DPHE, CL, Dhaka.

Date: 11-12-2019

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2019120048	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: Suface Water
Sent by:Kazi Forhad Iqbal ,Executive Director , EQMS Consulting Ltd., Banani, Dhaka-1213.	Dist:Dhaka, Upa:
Care Taker: EQMS Consulting Ltd.(SW-05)	Union:, Vill.:MRT-1 Project area
Sample Collection date: 02-12-2019	Date of Testing: 03/12/2019-11/12/2019

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Biochemical Oxygen Demand (BOD)	0.2	1	mg/L	5 days Incubation	0.1
2	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
3	Coliform (Faecal)	0	8	N/100ml	MFM	-
4	Coliform (Total)	0	16	N/100ml	MFM	-
5	Colour	15	5.1	Hazen	UVS	-
6	Total Suspended Solid (TSS)	10	5	mg/L	Gravimetric Method	-

Comments: Sample was collected & Supplied by client.
N.B: UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, MFM-Membrane Filtration Method, LOQ - Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	11.12.19	1.) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2.) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Appendix C : JICA Environmental Checklist

Category	Items	Check points	Yes: Y No: N	Measures of Environmental and Social Considerations (Reasons for Yes or No, Bases, Mitigation measures)
1. permits and explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been officially completed? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) Y (b) Y (c) N (d) Y	(a) The EIA report has been prepared during the F/S stage, in accordance with laws and regulations of Government of Bangladesh, as well as JICA Guidelines for Environmental and Social Considerations (April 2010). A design stage Updated EIA is now under preparation. (b) The EIA report has been approved by Department of Environment (DOE) on 5 November, 2017, and Environmental Clearance Certificate (ECC) has been issued to DTCA/DMTCL. It has been regularly renewed in 2018, 2019 and 2020. The latest ECC renewal was on 15th Nov 2020, and is valid till 4th Nov 2021. (c) ECC includes conditions for operating, monitoring, reporting, etc., mostly for construction and operation stage. DMTCL assures to satisfy the conditions in appropriate way. (d) The project does not need to obtain any other permits on environmental issues, other than ECC. However, DMTCL will obtain other relevant permits, for example, ground water abstraction, fire protection, etc. as required.
	(2) Explanation to the Public	(a) Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? (b) Are proper responses made to comments from the public and regulatory authorities?	(a) Y (b) Y	(a) During the F/S stage EIA preparation process of the project, stakeholder meetings (2 times x 4 venues) were held. The outlines and expected impacts of the project were shared with the stakeholders. The EIA document is currently available at DMTCL website. For design stage updated EIA preparation, public consultation and information disclosure meetings are planned. The Updated EIA will also be posted on DMTCL website. (b) The opinions and comments received were incorporated into F/S stage EIA. Further public response/ comments will be included in the Updated EIA, if required.
	(3) Alternatives	(a) Are the alternatives of the project examined in terms of the environmental and social matters?	(a) Y	(a) On the planning of structure types, alignment, station locations, underground/ elevated sections, and depot locations, alternatives have been examined in terms of environmental and social considerations.

Category	Items	Check points	Yes: Y No: N	Measures of Environmental and Social Considerations (Reasons for Yes or No, Bases, Mitigation measures)
2. Mitigation Measures	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from various sources, such as construction machinery will affect ambient air quality? Does ambient air quality comply with the country's ambient air quality standards? (b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	(a) Y (b) Y	(a) Inherent ambient air quality of Dhaka is poor, particularly in winter season and exceeds the standards of air quality of Bangladesh. Baseline air quality sampling during Updated EIA preparation also confirms this. Air pollution by construction machinery and construction activities may make the situation worse. Proper measures has been proposed in EIA to prevent further worsening. (b) Since the project is a electric powered railway, the Project will not cause any impacts on air quality during its operational stage; rather it will contribute towards air quality improvement as it will reduce small vehicle operation. The Project will take necessary measures not to deteriorate the air pollution during construction.
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b)Do effluents from various facilities, such as stations and depot areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas that do not comply with the country's ambient water quality standards?	(a) N (b) Y	(a) Entire alignment is either elevated viaduct or underground tunnel, so no scope of cutting and filling except depot. Only landfill activity is depot land development. Proper measures are proposed to prevent soil runoff. (b) Effluent water from the stations and depot will be treated to meet the standards of water quality of Bangladesh before discharge. Proper measures are proposed to prevent water pollution during construction.
	(3) Waste	(a) Are wastes derived from stations and depot facilities legally disposed?	(a) Y	(a) The wastes derived from the stations and depot facility will be disposed legally, based on Waste Management Plan to be developed by the Contractor, supervised by DMTCL during the operation phase. Proper measures are proposed for waste management during construction period also. Contractors are oblized to make legal dispose, which will be supervised by DMTCL and supervision consultant.
	(4) Noise and Vibration	(a) Do noise and vibrations from railway comply with the country's standards?	(a) Y	(a) The host country does not have any noise and vibration standards for railway operation. Nonetheless, proper designing measures are considered to meet the guidelines of railway vibration of Japan and ambient noise standard of Bangladesh.
	(5) Ground Subsidence	(a) Does vast extraction of groundwater cause ground subsidence?	(a) N	(a) There is no scope of vast groundwater extraction in the Project. Only depot facility has a plan to use limited ground water taking approval from proper authority. Further, the groundwater level is lower than the underground structures of the project, thus there is a low possibility of ground subsidence.

Category	Items	Check points	Yes: Y No: N	Measures of Environmental and Social Considerations (Reasons for Yes or No, Bases, Mitigation measures)
3. Biological Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's law or international treaties and conventions? Is there a possibility that the project will affect the protected area?	(a) N	(a) There are water bodies which are designated as Environmental Critical Area (ECA) near the project. However, there is no direct impact of the Project on those water bodies. Furthermore, the Project doesn't have any activities declared unauthorized in the DOE Gazettes for those ECA. DOE, the competent authority for ECA, has already issued ECC for the Project.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats? (b)Does the project site encompass the protected habitats of endangered species designated by the country's law or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measure taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of railway will cause impacts, such as destruction of forest, poaching, etc.? (f) In case where the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of nature environments?	(a)N (b)N (c) N (d)Y (e)N (f)N	(a) There are no primeval forests, tropical rain forests, and ecologically valuable habitats near the Project site. (b) The survey conducted during EIA preparation confirmed that there is no habitat of rare species in the Project site. (c) Significant ecological impacts are not anticipated. Monitoring of ecosystem will be conducted during implementation. If needed, appropriate measures will be adopted. (d) Because the Project site is located in a built-up urban setting, there are no impacts to disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock. (e) Because the project is an urban railway within the Dhaka city, there is a no possibility of negative impacts regarding forest destruction and poaching. (f) Because the project is a railway in developed areas, there are low possibility that the project deteriorates the Biological Environment.
3. Biological Environment	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?(b) Does structures affect the flows of surface and underground water?	(a)N(b) N	(a) Because the project will not have any structures on surface water, so there are no direct impacts on surface water. Also as the groundwater level is lower than the underground structures of the project, there is a very low possibility of negative impacts on groundwater flow.(b) As explained above, no such possibility is anticipated.
	(4) Topography and Geology	(a) Is there a soft ground on the route that may cause slope failures or landslides? Are adequate measure considered to prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting and filing will cause slope failure or landslides? Are adequate measure considered to prevent slope failure or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measure taken to prevent soil runoff?	(a) N (b) N (c) N	(a) Because the project is located on a developed plain land, there is very low possibility of slope failures or landslides. To prevent slope failures at the depot, proper design measures are taken for slope protection. (b) Because the land filling at depot may cause slope failures, appropriate measures on slope protection will be adopted. (c) Regarding the soil runoff from depot area and sites for spoil soil from underground stations and tunnel excavation, appropriate measures will be examined through detail design.
4. Socia — Envir	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the	(a)Y (b)Y	(a) Yes, implementation of the Project will cause the involuntary resettlement. Alternatives have been examined to minimize negative

Category	Items	Check points	Yes: Y No: N	Measures of Environmental and Social Considerations (Reasons for Yes or No, Bases, Mitigation measures)
		resettlement? (b) Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? (c) Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Are compensations paid prior to the resettlement? (e) Are compensation policies issued written instructions? (f) Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected persons obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are monitoring on the resettlement planned? (j) Is a plan developed to monitor the impacts of resettlement?	(c)Y (d)Y (e)Y (f)Y (g)Y (h)Y (i)Y (j)Y	impacts of resettlement. RAP has been prepared, and updating of which is ongoing. Implementation of RAP will minimize the negative impacts of resettlement. (b) During preparation of F/S stage RAP, compensation policy was shared with PAPs through stakeholder meetings. The policy will be again shared during updating of RAP. (c) Yes, the Entitlement Matrix, and Livelihood and Income Restoration Program, are based on the socioeconomic survey conducted during F/S stage. For upgrading of RAP, another round of socioeconomic survey will be conducted. (d) Compensations will be paid prior to resettlement. (e) During RAP implementation, written compensation policies will be distributed. (f) Yes, entitlement matrix of F/S stage RAP includes particular attention to vulnerable groups or persons. (g) During consultations, no concrete objections from affected persons were identified during F/S stage RAP preparation. (h) DMTCL already established a safeguard unit for Line 1 project implementation headed by an additional project director. DMTCL also assures to establish other organizational framework like JVC, PVAC, and GRC during the implementation of RAP. Budget has been secured in Project's DPP. (i) Yes, LAP/ RAP monitoring is conducted as part of E/S consulting service. Quarterly monitoring reports are issued from August 2019 and shared with JICA. (j) Yes. An External Monitoring Agency (EMA) will be appointed during RAP implementation to monitor impacts of resettlement.
	(2) Living and Livelihood	(a) Where railway is newly installed, is there a possibility that the project will affect the existing means of transportation and associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Is adequate measure considered for preventing these impacts? (b) Is there a possibility that the project will adversely affect the living condition of inhabitants other than the affected inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there a possibility that diseases, including communicable diseases, such as HIV will be introduced due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	(a)N (b)N (c)N (d)N (e)N	(a) Existing traffic such as CNG and Rickshaw will convert into feeder traffic. Since the project location is in a developed urban settings, the project will not cause significant conversion of land use and livelihood and unemployment. On the contrary, the project will open up scope of extensive economic activities. (b) There is a low possibility of negative impacts on other residents. Rather, the project will improve the living conditions of the city dwellers. (c) Since the project is urban railway, it is not expected that vast population will flow from other areas. Regarding construction phase, appropriate education and awareness program on public health will be conducted for construction workers. An HIV/AIDS awareness policy has

Category	Items	Check points	Yes: Y No: N	Measures of Environmental and Social Considerations (Reasons for Yes or No, Bases, Mitigation measures)
		(d) Is there a possibility that railway will cause impede the movement of inhabitants? (e) Is there a possibility that structures associated with railway such as bridges will cause a sun shading and radio interference?		been developed and such provisions are included in the Contractor's bid documents. (d) Since the project is a railway which takes mainly underground or elevated structures, the Project will not obstruct movement of inhabitants at grade. (e) Tunnel and underground stations will be located underground, so no issue of sun shade and radio interference. Since the elevated structures of the project will be installed in wide road, sun shading and radio interference will not be a major issue.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)N	(a) There are no archeological, historical, cultural, and religious heritage sites around the project site. Nonetheless, a dedicated study is now ongoing for Historical and Archeological site under the E/S consulting service. Adequate measures will be proposed through that specialized study, if required.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a) There is no possibility of landscape change due to the project.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Where ethnic minorities and indigenous peoples are living in the rights-of-way, are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples? (b) Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples?	(a)N (b) Y	(a) The project site is located within metropolitan capital area, which is not natural habitat of ethnic minorities and indigenous peoples. (b) Not applicable as there is no ethnic minorities and indigenous peoples.
4. Social Environment	(6) Working conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?(c)Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public sanitation) for workers etc.?(d)Are appropriate measures being taken to ensure that security guards involved in the project do not violate safety of other individuals involved, or local residents?	(a)Y(b)Y(c)Y(d)Y	(a) The Project will abide by relevant laws and regulations on working conditions, labor and occupational health of GoB.(b) Health and safety requirements are included in the Contractor's bid documents. DMTCL and supervision consultant will strictly inspect the safety compliance. (c) Yes. Same as (b)(d) Yes. Same as (b)

Category	Items	Check points	Yes: Y No: N	Measures of Environmental and Social Considerations (Reasons for Yes or No, Bases, Mitigation measures)
5. Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the Biological Environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a)Y (b)Y (c) Y	(a) Yes. Environmental Contract Specifications (ECS) has been prepared to mitigate adverse impacts during construction. ECS has been included in the Contractor's bid documents. DMTCL and supervision consultant will strictly inspect the environmental compliance. ECS also requires continuous monitoring. Supervision consultant will prepare quarterly monitoring report, which will be shared with DOE and JICA. (b) Same as (a) (c) F/S RAP already considered adequate measures to reduce negative impacts. Updating of RAP is underway. DMTCL will assure complete implementation of RAP to reduce adverse impact on social environment.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) Are the items, methods and frequencies included in the monitoring program judged to be appropriate? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)Y (c)Y (d)Y	(a) According to the monitoring plan stated in the EIA report and the ECS, the monitoring will be conducted by contractor as well as supervision consultant. (b) Yes, the items, methods and frequencies included in the monitoring program provided in the EIA and ECS are judged as appropriate. Further review will be made during preparation of Contractor's Environmental Management Program (CEMP). (c) DMTCL already established a dedicated safeguard section. DMTCL will ensure proper budget for sustain monitoring framework. (d) DOE and JICA requires quarterly environmental monitoring reporting. DMTCL assures that such reports will be prepared by the supervision consultant and will be shared with JICA and DOE.
6. Note	Other Environmental Checklist	(a) If necessary, the impact factors on forestry shall be added. (b) If necessary, the impact factors on power transmission shall be added.	(a)N (b)N	(a) The project is far from any forest. (b) Power transmission facilities are currently studied in detail design phase. In case any negative impacts are expected, appropriate mitigation measures will be examined.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No negative impact on transboundary or global environmental issues. Rather, the Project will decrease carbon emission and NOX/SOX by decreasing vehicles on the roads.

Appendix D : Minutes and Participants of PCMs

Minutes of the First Public Consultation Meeting for the Supplemental Environmental Baseline Study for MRT Line-1

Date: January 10, 2021
Location: Waterfront Convention Hall, Rampura, Dhaka
Starting Time: 11:00 AM
End Time: 01:45 PM
Participants: See appendix section for participant list

Objective of the Meeting

The objective of the meeting was to inform and obtain opinions of the public about the proposed MRT Line-1, its potential environmental impacts and mitigation measures. The stakeholders and public were invited by sending invitation letters by hand. Appendix 3 is the list of stakeholders and the representatives of project implementation authority who were present at the meeting. A total of 67 person (male) participated in the meeting, including including local residents (2), businessmen (40), teacher (5), religious leader (3), community leader (1), service holder (4) and sector specialist (12). The Project Director of DMRTDP (Line-1) [E/S] Md. Saidul Haque, was virtually present in the meeting as chief guest. Dr. A.K.M. Nurul Islam, Safeguard Expert (Resettlement) from NKDOS Consortium joined the meeting online. Mr. Md Abdul Wadud, (Additional Secretary), Additional Project Director (Environment, Health Safety and Resettlement & Land Acquisition, DMRTDP (Line-1) [E/S], Mr. Ashrafur Rahman, Project Manager (Land Acquisition & Resettlement), DMRTDP (Line-1) [E/S], Mr. Md. Shaiful Islam, Project Manager (Environment Health Safety), DMRTDP (Line-1) [E/S] and Mr. Md. Rakib Hasan Sarker, Assistant Project Manager (Environment), DMRTD Project (Line-1) [E/S] were present in the meeting from DMTCL. Dr. Ashadul Alam, Environment Specialist was present in the meeting from NKDOS Consortium.

Opening of the Meeting

The meeting was opened by reciting from the Holy Quran by a local Qari. Then Mr. Md. Saiful Islam, Project Manager (Environment Health Safety), DMRTDP (Line-1) [E/S] welcomed all participants and briefly explained the objectives and agenda of the meeting. After that, Mr. Md. Saidul Haque, Project Director, DMRTDP (Line-1) [E/S] delivered the welcome speech.

Presentation

Firstly, an animated documentary film was showed in the meeting which displayed the route alignment of MRT Line-1, viaduct and tunnel design, elevated and underground station design, train design, entrance and exit design, etc. to give a clear idea about the project. Secondly, Mr. Kazi Farhed Iqubal from EQMS Consulting Ltd. presented the findings of the supplemental environmental baseline survey of MRT Line-1. The presentation was divided into three parts. In first part, some key information about the project were presented. The second part was about the findings of supplemental baseline survey, including the summary results of ambient air quality, water quality, and noise level monitoring. Finally, the potential environmental impacts and their mitigation measures were discussed in the third part of the presentation.

Question and Answer Session

After the presentation, a question and answer session was held, which is summarized in Table 1 below. While many questions and opinions were raised by the participants, once their concerns were answered, nobody expressed any objection towards the Project. Mr. Kazi Farhed Iqubal, Executive Director, EQMS Consulting Ltd. answered the questions related to environmental impacts and Mr. Md Abdul Wadud, (Additional Secretary), Additional Project Director (Environment, Health Safety and Resettlement & Land Acquisition, DMRTDP (Line-1) [E/S] answered other questions mostly related to land acquisition and social impacts.

Table: Summary of question-and-answer session of first PCM

No.	Name	Question/Opinion	Responded By	Answer
1	Niaz Makhdum Shibli Manager (Admin), Ibn Sina Diagnostic & Consultation Ltd.	Have you considered the earthquake risk during planning and designing of the project? What is the earthquake tolerance level of this project?	Md. Abdul Wadud and Kazi Farhed Iqubal	The possibility of earthquake has been considered during design stage. The structure of the project will be able to tolerate an earthquake with 7.5 Richter scale magnitude.
		The project was started in 2018, so what is the progress so far? Will you be able to finish the construction in due time?	Md. Abdul Wadud	Currently, detail design is ongoing. Hopefully the construction will be commenced in mid-2022 and will be completed by 2026.
2	Md Golam Khawaja Director, Royal Furniture	Will the shops on both sides of the alignment be affected?	Md. Abdul Wadud	Since the alignment of this route will be underground, no shops will be affected. However, some small areas will be acquired to construct entrance and exit of stations. However, Not so significant impact will be occurred.
		To whom we contact if we get affected by the project activities? It would be better to assign area wise representatives.	Md. Abdul Wadud	A Grievance Redress Mechanism will be established to resolve the disputes. The procedure will be publicized.
		Please provide detail information about stations.	Kazi Farhed Iqubal	Detail information about stations were provided.
3	Dr. Anowar Hossain Molla Principal, North Badda Kamil Madrasah	In many cases, a decent plan was taken, but the implementation was not up to the mark. There was public suffering due to open stockpile of construction materials in other projects. What measures will be taken in this regard for this project?	Kazi Farhed Iqubal	This project will not create such types of problems. The construction materials will be handled properly so that they do not create environmental pollution. They will be covered during storing and transportation. This project will follow international standard.
		Will the project be completed within current budget?	Md. Abdul Wadud	By the grace of Almighty Allah, we will complete the project within current budget without delay.
4	Mufti Zakir Hossain Mufti, Jamiah Madania, Baridhara	In other countries, metro stations are built in spacious places, which are not available in our country. How this will be addressed?	Md. Abdul Wadud	Although it seems that the space of station is small, but it will be enough once the construction is completed, especially in case of underground stations.
		Why not the design of train is not like other countries?	Md. Abdul Wadud	The design of trains has been selected based on the socio-

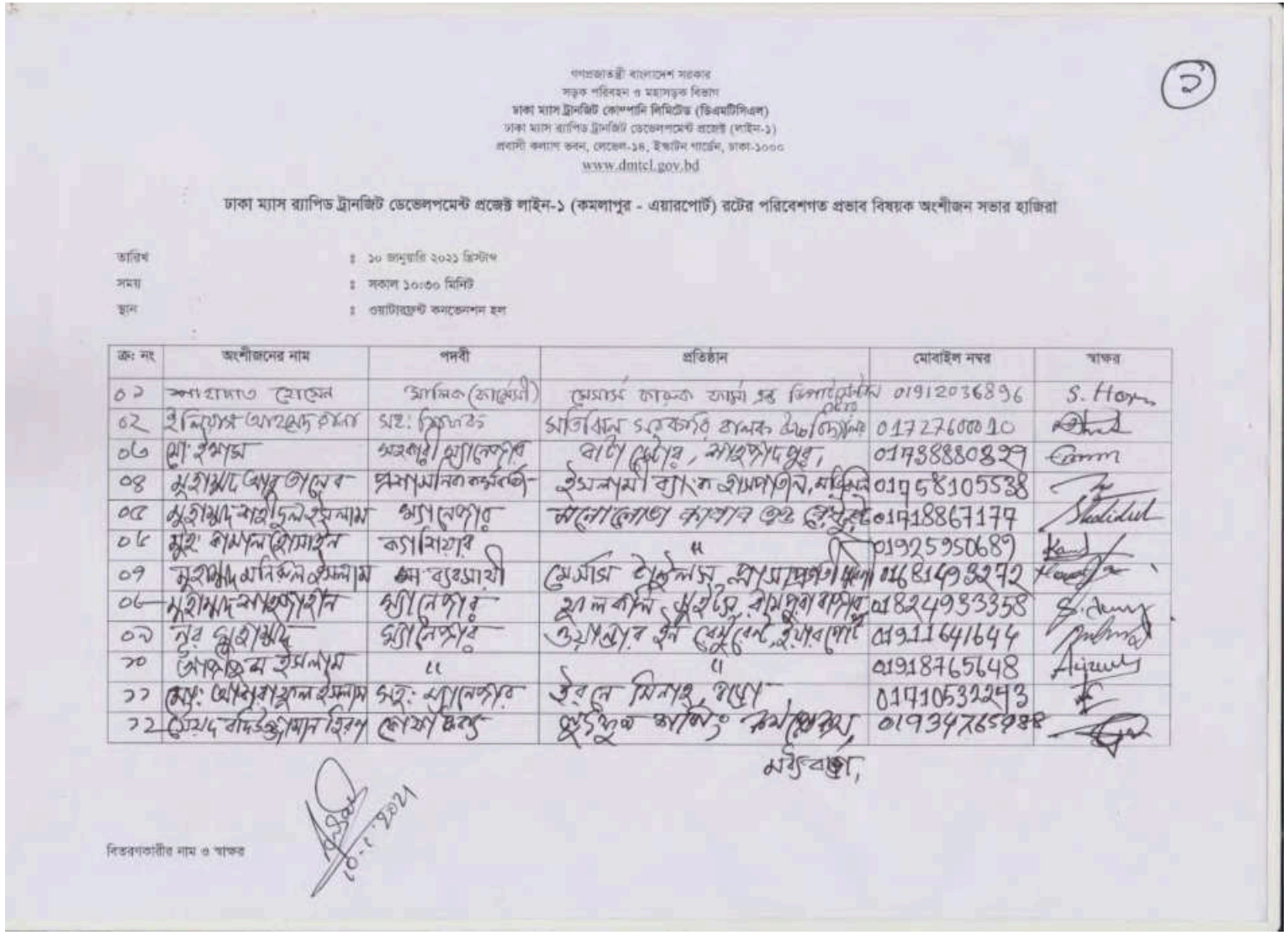
No.	Name	Question/Opinion	Responded By	Answer
				economic and political condition of Bangladesh.
5	Shafiqul Islam Khan, Deputy Manager, Ibn Sina Diagnostic & Consultation Center	What compensation will be provided in case of loss of business due to this project?	Md. Abdul Wadud	A small amount of land will be acquired for construction of entrance and exit of underground stations. If any business get affected for this reason, they will be compensated according to the Land Acquisition and Requisition act 2017.
		How much fare will be charged for metro riding?	Md. Abdul Wadud	A committee is working to set fare of the metro rail, but not finalized yet. The economic affordability of people will be considered during fare determination.
6	Asaduzzaman Masum Local Businessmen, M/S Mamun Trading Corporation	How much land will be acquired for construction of entrance and exit of underground stations? In which locations?	Md. Abdul Wadud	Detail survey and design is still ongoing. There will be impact due to these structures, but not very much. Final estimation can be provided after completing the design.
7	Md. Azizul Haque Local Businessman, Babus-Salam Pharmacy, Airport	We are worried that the construction of metro rail will affect our business.	Md. Abdul Wadud	It is expected that this project will not affect local business rather create some new businesses.
8	Monowar Hossain Senior Teacher, Motijheel Colony High School	The spoil soil generated from the construction of underground stations using open-cut method will cause dust prevalence. Besides, it will decrease the width of road, which will create public hassle.	Kazi Farhed Iqubal	The station area will be excavated at one side of the road at a time, while the other side will remain open for vehicle movement. The spoil soil will be removed quickly after excavation and the stockpile will be covered. These measures will reduce dust generation. Alternative routes for traffic will be opened (if possible) in consultation with traffic police.
9	Saiful Islam, Madrasha Teacher, Karim Madrasha	What is luggage limit in metro rail?	Md. Abdul Wadud	Since metro rail is for urban commuting purpose, it is not expected to carry heavy luggage by passengers. However, small luggage like laptop, side bag can be carried with.
		Many drivers of conventional vehicles will be unemployed when metro rail starts due to modal shift. Will there be	Md. Abdul Wadud	Metro rail will increase the mobility efficiency that will boost the economy. Although conventional vehicle will be reduced in metro route, they can shift in other areas.

No.	Name	Question/Opinion	Responded By	Answer
		any rehabilitation program for them?		Moreover, metro rail will create opportunity of new jobs also.
10	Golam Mawla, Teacher, North Badda Kamil Madrashah	What factors were considered to select the location of the stations?	Md. Abdul Wadud	Mainly, the location of present bus stoppages, people's mobility, population density, vital places, available parking, traffic intersection, and land use factors were considered for selecting station locations.

Closing of the Meeting

The Project Director of DMRTDP (Line-1) [E/S] Md. Saidul Haque made a short speech after question and answer session. Then, Mr. Ashrafur Rahman, Project Manager (Land Acquisition & Resettlement), DMRTDP (Line-1) [E/S] gave a short speech thanking the participants for attending the meeting from different places. After that, the Additional Project Director Mr. Md. Abdul Wadud made the conclusive speech declared the closing of the meeting. At the end, the participants were entertained with some refreshment snacks.

Participants of First Public Consultation Meeting



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ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১)
প্রবাসী কল্যাণ ভবন, লেভেল-১৪, ইস্কাটন গার্ডেন, ঢাকা-১০০০
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তারিখ : ১০ জানুয়ারি ২০২১ খ্রিস্টাব্দ
সময় : সকাল ১০:৩০ মিনিট
স্থান : ওয়াটারফ্রন্ট কনভেনশন হল

ক্রঃ নং	অংশীজনের নাম	পদবী	প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
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০৩	[illegible]	[illegible]	[illegible]	01738880827	
০৪	[illegible]	[illegible]	[illegible]	01958105538	
০৫	[illegible]	[illegible]	[illegible]	01718867177	
০৬	[illegible]	[illegible]	[illegible]	01925950689	
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০৮	[illegible]	[illegible]	[illegible]	01824933358	
০৯	[illegible]	[illegible]	[illegible]	01911641644	
১০	[illegible]	[illegible]	[illegible]	01918765648	
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সময় : সকাল ১০:৩০ মিনিট
স্থান : ওয়াটারফ্রন্ট কনভেনশন হল

ক্র: নং	অংশীজনের নাম	পদবী	প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
১২	মঞ্জুরে এলাহী	ম্যানেজার	ট্রপিক্যাল মোল্লা টাওয়ার ওনার্স এসোসিয়েশন	01627870312	
১৩	গোলাম মাওলা	ডিরেক্টর	বাড্ডা জেনারেল, হাসপাতাল	01611743560	
১৪	গোলাম খাজা	ডিরেক্টর	রয়েল ফার্নিচার	01994833445	
১৫	মোকাদ্দেস মোল্লা	মওলানা	মধ্য বাড্ডা	~~0171113~~ 01711197165	
১৬	মুন্সী দেলোয়ার হোসেন	সভাপতি	শ্রমিক লীগ, রামপুরা থানা ৩৩ নং ওয়ার্ড	01712064973	
১৭	আব্দুল রহিম তালুকদার	ম্যানেজার	প্যান ফার্মাসিউটিক্যাল হসপিটাল লি:	01711220536	
১৮	~~মো: অ~~ ড. মো: মাহফুজুর রহমান	MD	"	0175295821	
১৯	তুষার ভূঁইয়া	ব্যবসায়ী	লেডিস ওয়ার্ড	01712135597	
২০	নূর নবী	ড্রাইভার	DMTCL	01314666011	
২১	মো: মাহতাব হোসেন	"	"	01755713507	Mehotab
২২	আব্দুল জলিল	"	"	01815250832	জলিল
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ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট লাইন-১ (কমলাপুর - এয়ারপোর্ট) রুটের পরিবেশগত প্রভাব বিষয়ক অংশীজন সভার হাজিরা

তারিখ : ১০ জানুয়ারি ২০২১ খ্রিস্টাব্দ
সময় : সকাল ১০:৩০ মিনিট
স্থান : ওয়াটারফ্রন্ট কনভেনশন হল

ক্র: নং	অংশীজনের নাম	পদবী	প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
২৪	হাজী মো: কামাল হোসেন	ব্যবসায়ী, সভাপতি	মদিনা রেস্তোরাঁ, ইয়ার পোর্ট	01415004859	[signature]
২৫	মো: আজিজুল হক	ব্যবসায়ী	বাবুল সালাম ফার্মেসী, ইয়ার পোর্ট	01775994080	[signature]
২৬	মো: বেলাল হোসেন	ম্যানেজার	মদিনা রেস্তোরাঁ, ইয়ার পোর্ট.	01974934371	[signature]
২৭	মুফতি জাকির হোসেন	মুফতি	জামিয়া আমানিয়া, বারিধারা	~~০৬~~ 01712139822	[signature]
২৮	আতাউর রহমান	সিনিয়র এক্সিকিউটিভ	পপুলার বাড্ডা ব্রাঞ্চ	01711286989	[signature]
২৯	সাইফুল ইসলাম	আদর্শ শিক্ষক	কাসিম মাদ্রাসা	01824341196	[signature]
৩০	শফিকুল ইসলাম খান	ডেপুটি ম্যানেজার	ইবনে সিনা ডায়াগনস্টিক এন্ড কনসালটেশন সেন্টার	01707144603	[signature]
৩১	কামাল হোসেন মজুমদার	মার্কেট ইনচার্জ	বাড্ডা ট্রেড সেন্টার	01712564306	[signature]
৩২	শফিকুল ইসলাম	ম্যানেজার	"	01749770893	[signature]
৩৩	মোহাম্মদ মোস্তফা	সভাপতি	উত্তর বাড্ডা রহিম খাবার	~~০১৫৬০~~ 01611549987	[signature]
৩৪	মোহাম্মদ মজিবর রহমান	সেক্রেটারি	উত্তর বাড্ডা সিদ্দিকিয়া জামে মসজিদ	01818815536	[signature]
৩৫	ড: আনোয়ার হোসেন মোল্লা	প্রিন্সিপাল	উত্তর বাড্ডা কামিল মাদ্রাসা	01910201556	[signature]

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বিতরণকারীর নাম ও স্বাক্ষর [signature]

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তারিখ ঃ ১০ জানুয়ারি ২০২১ খ্রিস্টাব্দ
সময় ঃ সকাল ১০:৩০ মিনিট
স্থান ঃ ওয়াটারফ্রন্ট কনভেনশন হল

ক্র: নং	অংশীজনের নাম	পদবী	প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৩৬	মজিবর রহমান	ম্যানেজার	মোজাফেদি হোটেল এন্ড রেস্টুরেন্ট	01791683566	মো: মজিবর
৩৭	আনোয়ার হাবীব	HR	ডেল্টা স্পেশালাইজড হসপিটাল	01916447307	[signature]
৩৮	মো: মোয়াজ্জেম হোসেন	Head of Marketing	"	01718365622	[signature]
৩৯	মো: উজ্জ্বল হোসেন খান	~~ইউনিটি ল্যাব~~ GM	ইউনিটি ল্যাব	01716141650	উজ্জ্বল
৪০	নিয়াজ মাখদুম শিবলী	ম্যানেজার (এডমিন	ইবনে সিনা ফার্মাসিউটিক্যাল এন্ড কসমেটিক্স লি	01619158080	[signature]
৪১	মো: নাজমুল হাসান	সহকারী ম্যানেজার	ইউনিটি ল্যাব	01714027955	[signature]
৪২	মিজানুর রহমান মজুমদার	সভাপতি	[illegible] ই সোনালী টাওয়ার	01720522590	[signature]
৪৩	রেজাউল করিম	ম্যানেজার	"	01713396107	[signature]
৪৪	মো: আহসান হাবীব	চেয়ারম্যান	ডাসা ইন্ডাস্ট্রিজ লিমিটেড	01959536704	[signature]
৪৫	মো: নুরুল রহমান	ম্যানেজিং ডিরেক্টর	"	01713037952	[signature]
৪৬	মনোয়ার হোসেন	সিনিয়র শিক্ষক	মতিঝিল কলোনী উচ্চ বিদ্যালয়	01911718578	[signature]
৪৭	মো: আনোয়ার হোসেন	ব্যবসায়ী	মুসলিম ~~[illegible]~~ সুইটস	01788787877	Sohel

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স্থান : ওয়াটারফ্রন্ট কনভেনশন হল

ক্রঃ নং	অংশীজনের নাম	পদবী	প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৪৮	আসাদুজ্জামান মাসুম	ব্যবসায়ী	মেসার্স আমিন ট্রেডিং [illegible]	01677184442	[signature]
৪৯	এম. এম. আনোয়ার জাহিদ	ব্যবসায়ী	[illegible], কমলাপুর	01671071023	[signature]
৫০	আনোয়ার নুর	[illegible]	[illegible] হোটেল, [illegible]	01713332504	[signature]
৫১	আবুল কবীর	[illegible]	[illegible]	01914889894	[signature]
৫২	মু: আমান-আজীম	ম্যানেজার	[illegible] হোটেল কমলাপুর	01738060761	[signature]
৫৩	জাহিদ হাসান	ম্যানেজার	হোটেল সেন্ট্রাল [illegible] : কমলাপুর	01882131297	[signature]
৫৪	মাসুম বিল্লাহ	ম্যানেজার	আমিন হোটেল / কমলাপুর	01743071911	[signature]
৫৫	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	[signature]
৫৬	মু: জাহাঙ্গীর আলম	ম্যানেজার	[illegible] [illegible]	01913138120	[signature]

[signature] 10.1.2021

বিতরণকারীর নাম ও স্বাক্ষর

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সময় : সকাল ১০:৩০ মিনিট
স্থান : ওয়াটারফ্রন্ট কনভেনশন হল

ক্রঃ নং	অংশীজনের নাম	পদবী	প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৫৪	[illegible]	APD(ESH RLA)	DMTCL	01553302716	
৫৬	[illegible]	PM(LABR)	DMTCL	01972212136	10.01.2021
৫৭	[illegible]	PM(EHS)	~~DMTCL~~ DMTCL	01710834443	10/01/21
৫৯	Dr. Ashadul Alam	Environment Spec. NKDOS	NKDOS	01747215770	
৬০	Rakib Hasan	APM(Environment)	DMTCL	01521238592	
৬২	KAZI FARHED IQUBAL	ED	EQMS.	01911702074	
৬৬	Tauhidul Hasan	Senior Consultant	EQMS	01721346853	
৬৪	Rafiul Kanion	Senior Consultant	EQMS	01965491329	
৬৫	Md. Saiful Islam	Asst. Consultant	EQMS	01928803065	
৬৬	Md. Feroz Alom	Consultant	EQMS	01724082640	
৬৭	Oliver Tintho Sarkar	Assistant Consultant	EQMS	0168-9965398	
৬৬	Jubayer Ahmed	Asst. Consultant	EQMS	01742-556466	

বিতরণকারীর নাম ও স্বাক্ষর
Md. Saiful Islam

Minutes of the Second Public Consultation Meeting for the Supplemental Environmental Baseline Study for MRT Line-1

Date: February 11, 2021
Location: Sea Shell Park and Restaurant, Gutiaba, Purbachal, Dhaka
Starting Time: 11:00 AM
End Time: 01:15 PM
Participants: See Appendix-1 for participants.

Background of the Meeting

The objective of the meeting was to inform and obtain opinions of the public about the proposed MRT Line-1 (Purbachal Route) and its potential environmental impacts and mitigation measures. The stakeholders and public were invited by sending invitation letters by hand. Total 96 people (among them 78 were male and 18 were female) participated in the meeting, including land owner (2), farmer (1), businessmen (37), teacher (10), community leader (13), service holder (14), sector specialist (10), Housewife (4) and student (4). Mr. Md Abdul Wadud, (Additional Secretary), Additional Project Director (Environment, Health Safety and Resettlement & Land Acquisition), DMRTDP (Line-1) [E/S]; Mr. Md. Shaiful Islam, Project Manager (Environment Health Safety), DMRTDP (Line-1) [E/S]; and Mr. Md. Rakib Hasan Sarker, Assistant Project Manager (Environment), DMRTD Project (Line-1) [E/S] were present in the meeting from DMTCL. Mr. Md. Mozammel Hoque, Deputy Team Leader; Dr. Ashadul Alam, Environment Specialist; and Ms. Tanzia Sharmin, Jr. Safeguard Expert were present in the meeting from NKDOS Consortium. Besides, Dr. A.K.M. Nurul Islam, Safeguard Expert (Resettlement) from NKDOS Consortium joined the meeting online. Mr. Tauhidul Hasan, Sr. Consultant; Mr. Rafiul Karim, Sr. Consultant; Mr. Md. Feroz Alam, Consultant; Mr. Md. Saiful Islam, Asst. Consultant; and Mr. Md. Shahparan, Asst. Consultant were present from EQMS Consulting Limited. The photographs of the meeting are attached in Appendix-2.

Opening of the Meeting

The meeting was opened by reciting from the Holy Quran by Hafez Mohammad Iqbal. Then Mr. Md. Shaiful Islam, Project Manager (Environment Health Safety), DMRTDP (Line-1) [E/S] welcomed all participants and briefly explained the objectives and agenda of the meeting.

Presentation

At first, an animated documentary film was showed in the meeting which displayed the route alignment of MRT Line-1, viaduct and tunnel design, elevated and underground station design, train design, entrance and exit design, etc. to give a clear idea about the project. Then, Mr. Tauhidul Hasan from EQMS Consulting Ltd. delivered a presentation containing the findings of the supplemental environmental baseline survey of MRT Line-1. The presentation was divided into three parts. In first part, some key information about the project were presented. The second part was about the findings of supplemental baseline survey, including the summary results of ambient air quality, water quality, and noise level monitoring. Finally, the potential environmental impacts and their mitigation measures were discussed in the third part of the presentation.

Question and Answer Session

After the presentation, a question-and-answer session was held, which is summarized in **Table A2** below. While many questions and opinions were raised by the participants, once their concerns were answered, nobody expressed any objection towards the Project. Mr. Md Abdul Wadud, (Additional Secretary), Additional Project Director (Environment, Health Safety and Resettlement & Land Acquisition, DMRTDP (Line-1) [E/S] responded to the questions mostly related to land acquisition and social impacts. Dr. Ashadul Alam, Environment Specialist, NKDOS Consortium answered the questions related to environmental impacts. Mr. Md. Mozammel Hoque, Deputy Team Leader, NKDOS Consortium replied to the question related to technical aspect.

Table A2: Summary of Question and Answer Session in PCM

No.	Name	Question/Opinion	Responded By	Response
1	Md. Mostafa Hossen Head Master, H.R. Model High School	We know that there is a gap in-between rail tracks in conventional railway to accommodate expansion and contraction due to weather change. In MRT, continuous welded track will be used. How will it function in terms of weather induced expansion and contraction?	Md. Mozammel Hoque	He started with giving a short introduction of himself and then explained the answer. In old days, small fragmented rail tracks were used keeping a gap to accommodate expansion and contraction due to weather change. And for the ease of conveyance upto 42 feet long rails were used. It was used almost 40 years ago. This used to make high noise and vibration as well as restricts speed of the train. Since it is our intention to make the metro rail speedier and less noisy than conventional rail, continuous welded track will be used. Switch Expansion Joint will be used to permit expansion contraction of the adjoining breathing lengths due to temperature variations. This will prevent the rail from buckling and occurring accident. And in conventional railway track, for increasing the speed, the joints were eliminated by welding. At first, three rails used to be welded and that was called short welded rail. Later, upto 0.5 miles the welding used to be conducted. Now even upto, 10 to 15km continuous welding is happening. And for that, noise is also reduced in conventional railway.
2	Mokhles Bhuiyan Project Affected Person, Pitalganj	Why this meeting is not arranged in Pitalganj, near the depot location? As the venue is not inside the depot, many people couldn't attend.	Dr. Ashadul Alam	First of all, from this location, depot area is not very far away. Secondly, today's meeting is arranged for entire Purbachal route that extents from Natun Bazar to Pitalganj Depot. Also, there is no suitable venue like this in Pitalganj area. Therefore, we have selected this location so that stakeholders from both ends can attend the meeting. Moreover, we have consulted with local people of Pitalganj and they have told us that they will be able to join the meeting easily at this location.
		The depot area is comparatively low land than adjacent areas. Therefore, the construction of depot may create water logging by preventing water drainage. What	Md. Abdul Wadud	Necessary mitigation measures will be included to prevent water logging. A network of drains will be constructed inside and outside (periphery) of Depot to enhance the surface drainage system.

No.	Name	Question/Opinion	Responded By	Response
		measures will be taken to mitigate this issue?		
		The land acquisition for Depot construction will permanently close existing roads that will affect local mobility. What will be the alternative way?	Md. Abdul Wadud	A new road around the Depot on acquired land will be built, which will create the local mobility facility.
		It is seen in the case of conventional railway that many antisocial activities take place beside rail track. Will there be any similar situation in the case of metro rail?	Dr. Ashadul Alam	The anti-social activities are not only happening in railway stations, but also a worldwide social issue. The Government of Bangladesh is taking this issue very seriously now. If there is any activity like this in the metro stations, our Government will take necessary steps to prevent that.
			Md. Abdul Wadud	The metro rail system is totally different from the conventional ground level railway. Conventional trains are slower than metro rail. As a result, there is a scope for people to wait or stay in the station in the interval time of two trains arriving or leaving. Metro rail will arrive at the station within 1.5 to 2.5 minutes interval. So, people won't be needing to wait in the station. A dedicated security force for MRT lines will be formed. Furthermore, the metro rail is comparatively speedier and totally dedicated for urban commuting. Hence, there is no chance of such occurrence. The metro rail line partly elevated and partly underground. Therefore, no unauthorized access to the resources of the metro rail will occur as the security system will be highly sophisticated.
			Md. Shaiful Islam	Metro rail is being constructed for improving the communication system as well as the economic condition. During these huge economic activities, there will not be any scope of antisocial activities at the stations. As per our experience from abroad metro rails, there will be huge pressure in the metro rail during office hours. So, at that time any antisocial activity would be very difficult to occur. Also, there will be card punching system to enter the stations which will show all the biometric information of the card holder. So, it will be under close

No.	Name	Question/Opinion	Responded By	Response
				surveillance, and there won't be any scope of any crime happening.
3	Raju Ahmed Project Affected Person, Pitalganj	In addition to monetary compensation, will there be any resettlement program (housing/plot allocation) for project affected persons?	Md. Abdul Wadud	Necessary actions will be taken according to Resettlement Action Plan (RAP), existing laws of Bangladesh, and JICA rules.
		What measures will be taken to mitigate/compensate the impacts of noise and vibration of depot construction on nearby residents?	Md. Abdul Wadud	During Line-6 works, a measurement was conducted to determine the distance up to which the noise and vibration could be reached. Then the residents were offered a rental compensation for temporarily vacant their houses. And it was their wish to live in that place having that compensation. Or, leave that place for the certain working period. For Line-1, as per international rule, similar policy will be applied.
			Dr. Ashadul Alam	A prediction or modelling was undertaken to identify potential affected zone and structures. As per the analysis, Vibrating SCP will cause some harm at the nearby houses. For that, Static SCP is suggested to use around the boundary lines of the depot area.
4	Salauddin Bhuiyan Chairman, Rupganj Union Parishad	The mouza rate of land is very lower than current market price. Therefore, the project affected people will not be benefitted if the compensation is estimated based on mouza rate.	Md. Abdul Wadud	The advice was accepted with thanks. And the compensation will be done according to the Land Acquisition and Requisition act 2017.
		The affected people are worried whether they will get compensation on time.		The project implementation authority will distribute the compensation among affected people as per the laws of Bangladesh. The project affected people should not get worried. Fair compensation will be provided without any kind of discrimination.

No.	Name	Question/Opinion	Responded By	Response
5	Juyel Miah, Teacher, Progoti High School	We do not expect any environmental impacts along the route alignment. But, there will be environmental impacts because of the depot around Pitalganj. Therefore, a separate meeting in depot area need to be conducted to inform the stakeholders of that area about potential impacts and mitigation measures.	Md. Abdul Wadud	Actually, this meeting is for the stakeholders from both Alignment of Purbachal Route and Depot Area. Most of the participants here are from Pitalganj (depot area). Therefore, the purpose of informing the people of depot area about environmental impacts and mitigation measures is perfectly fulfilled by today's meeting. And for environmental impacts, proper mitigation measures will be implemented to reduce the adverse outcomes.
			Dr. Ashadul Alam	In the Depot area, the trains will arrive and will be washed. As a result, lubricants, grease and other pollutants may be mixed with the water. The waste water will be collected in a sump. In order to refine that waste water, an Effluent Treatment Plant (ETP) would be established. After treating the waste water in the ETP, the water would be stored for sometimes. Then the water quality will be tested. If the water quality is standard to release in the environment, it will then be released. Also, in order to check the current water quality and potential deterioration of water quality during construction works, the water of Shitalakkhya River was tested in 2017 and 2019. And will be tested regularly during construction to monitor and compare the quality. So, we can assure you that, there will be proper mitigation measures for all the potential environmental impacts in the depot area and route alignment as well.

Closing of the Meeting

The Chairman of Rupganj Union Parishad, Mr. Salauddin Bhuiyan, made a short speech after question and answer session. He thanked the Government of Bangladesh and JICA for initiating this project and expected a smooth implementation of the project, provided that the concerns of project affected people regarding compensation of land acquisition are duly addressed. Then, the Additional Project Director Mr. Md. Abdul Wadud made the conclusive speech declaring the closing of the meeting.

Participants of Second Public Consultation Meeting

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ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
১	মোঃ কামরুজ্জামান মোল্লাহ	ব্যবসায়ী	পিতলগঞ্জ	01715516725	[illegible]
২	পিয়ারা	গৃহিনী	[illegible], পিতলগঞ্জ	01759123538	পিয়ারা
৩	সেলিনা	ব্যবসায়ী	,, পিতলগঞ্জ	-	[illegible]
৪	সাইফুল্লাহ সরকার	,,	পিতলগঞ্জ	01758642252	সাইফুল্লাহ সরকার
৫	মোঃ মনির হোসেন মেম্বার	ব্যবসায়ী	[illegible] ২নং ওয়ার্ড	01400077[illegible]	[illegible]
৬	ইকবাল হাসান	চাকুরী ব্যাংক	এন.আর.বি. [illegible] লি., শান্তিনগর	01717087884	[illegible]
৭	জাকিয়া সুলতানা	ইউ.পি. মেম্বার	রূপগঞ্জ	01766538510	[illegible]
৮	[illegible]	শিক্ষক/ছাত্র	[illegible]	01959774791	[illegible]
৯	মোছাঃ রিপা	গৃহিনী	,,	01778086747	রিপা
১০	মোঃ হাসান	গাড়িচালক	রূপগঞ্জ	01732225275	[illegible]
১১	ইমন-আহমেদ	চাকুরী	EQMS	01766-025729	[illegible]
১২	মোঃ জাকির	ব্যবসায়ী	[illegible]	01746856370	[illegible]

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ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
১৬	[illegible]	শিক্ষক	[illegible]	01832-922815	
১৪	মো: আবুল হোসেন	ব্যবসায়	[illegible]	01721-881525	
১৫	মো: আউলাদ হোসেন	মেম্বার	৯২ ওয়ার্ড, [illegible]	01711-512389	
১৬	লিটন সরকার	মেম্বার	৪১ ওয়ার্ড "	01711-510938	
১৭	[illegible]	চেয়ারম্যান	[illegible]	01711-353308	
১৮	খোরশেদ আলম	মেম্বার	৯২ ওয়ার্ড, "	01711-487674	
১৯	নাসরিন আক্তার	গৃহিনী	পূর্বাচল	01712298373	
২০	[illegible]	শিক্ষক	"	01405045328	
২১	বাপ্পী আহমেদ	ব্যবসায়	"	01711201222	
২২	[illegible]	ব্যবসা	[illegible]	01712581953	
২৩	[illegible]	[illegible]	[illegible]	01712678594	

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ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
২৪	মোঃ হাসান	চাকরি	পূর্বাচল	01731-948055	হাসান
২৫	মোঃ কুদ্দুস	ব্যবসায়	,,	01764-949720	কুদ্দুস
২৬	মো: আবাউর রহমান মোল্লা	ব্যবসায়	আক্কা ডেভেলপ	01687070798	[illegible]
২৭	শহীদ	চাকরি	পূর্বাচল	-	-
২৮	মো: আবাউর রহমান	শিক্ষক	প্রগতি উচ্চ বিদ্যালয়	0173-6037605	[illegible]
২৯	মোঃ সিরাজুল ইসলাম	Consultant	EGMS Consulting Ltd.	01724082690	[illegible]
৬০	অনিন্দ্য দীপ সরকার	Asst Consultant	,,	0168-9965398	[illegible]
৬১	মো: মোস্তফা হোসেন	প্রধান শিক্ষক	H.R. Model High School	0199-7410132	[illegible]
৬২	মো: আবুল আলীম	ব্যবসায়	আলফাফা ফার্নিচার, হরিণমারা	0187-0028455	[illegible]
৬৩	মো: মিজানুর রহমান	শিক্ষক	প্রগতি উচ্চ বিদ্যালয়	01768-630584	[illegible]
৬৪	তুহিন মিয়া	,,	,,	017222-45846	[illegible]
৬৫	মো: আমান মিয়া	চাকরী	,,	~~017~~ 01765-187889	[illegible]

বিতরণকারী/নিবন্ধকের নাম :

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ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৩৬	জিন্নাত [illegible]	মহিলা সভাপতি	রূপগঞ্জ সদর ইউনিয়ন	০১৯১৫-৮৮২৯৮৭৫	[illegible]
৩৭	সোমা রানী	"	৪ নং ওয়ার্ড, রূপগঞ্জ	০১৭২-৬৮৭৮৩৯৯	সোমা রানী
৩৮	সাবিনা আক্তার	"	৫ নং ওয়ার্ড, "	০১৯৬-৫৬১২৯৪৮	সাবিনা
৩৯	রোজিনা	"	৬ নং ওয়ার্ড "	০১৪০-৬৯৭৫৯০৪	রোজিনা
৪০	মিতা	রাজনীতি	৪ নং ওয়ার্ড, "	০১৮৭-৫১৮৬০৬	মিতা রানী
৪১	অর্চনা রানী	"	৪ নং ওয়ার্ড "	০১৯৬+৪১৭৭০২	অর্চনা রানী
৪২	মো: আমিন	ব্যবসায়	[illegible] গ্রাম	০১৯৪-৫৯২২৬৮৬	আমিন
৪৩	মাসুদ রহমান	শিক্ষক	আল-আকসা মাদ্রাসা	01911-962213	[illegible]
৪৪	মো: মমিনুল ইসলাম মোল্লা	ব্যবসায়ী	[illegible]	0193-49362313	[illegible]
৪৫	মো: সালিম উল্লাহ	শিক্ষক	আল-আকসা মাদ্রাসা	01719-586006	[illegible]
৪৬	মো: আকবর হোসেন	ব্যবসায়ী	পূর্বাচল	01725-029257	[illegible]
৪৭	মো: রুবেল	"	"	01911-905665	[illegible]

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৪৮	আব্দুল হালিম	—	পিতলগঞ্জ	01759-123586	[signature]
৪৯	মিনা	গৃহিনী	,,	01880-289913	[signature]
৫০	মাসুদা আক্তার	,,	ব্রাহ্মণখালী	01855-044336	[signature]
৫১	রাকিব	ব্যবসায়	সাই গ্রাম	01940-086117	[signature]
৫২	মো: আক্তার হোসেন	,,	মুদি ব্যবসায়	01732-482919	[signature]
৫৩	মজিবর রহমান	,,	[illegible]	01985644354	[signature]
৫৪	মো: মাহবুব আলম	,,	M.H.R Brick field	01715-112877	[signature]
৫৫	হারুন	প্রবাসী	সিটি মার্কেট	01837613565	[signature]
৫৬	Dewan Mehedi	Job	Purbachal Shitalakhya Resort	01922500190	[signature]
৫৭	আমানুল্লাহ	শিক্ষক	পিতলগঞ্জ	01720016115	[signature]
৫৮	মোতার	[illegible]	,,	01710323179	[signature]
৫৯	সুমন	ব্যবসায়ী	[illegible]	01963433261	[signature]

বিতরণকারী/নিবন্ধকের নাম :

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সড়ক পরিবহন ও মহাসড়ক বিভাগ
ঢাকা ম্যাস ট্রানজিট কোম্পানি লিমিটেড (ডিএমটিসিএল)
ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১)
প্রবাসী কল্যাণ ভবন, লেভেল-১৪, ইস্কাটন গার্ডেন, ঢাকা-১০০০
www.dmtcl.gov.bd

ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১) পূর্বাচল রুটের পরিবেশগত প্রভাব বিষয়ক অংশীজন সভার হাজিরা

তারিখ ও বার : ১১ ফেব্রুয়ারি ২০২১ খ্রিস্টাব্দ, রোজ বৃহস্পতি বার
সময় : সকাল ১০:০০ ঘটিকা
স্থান : সী শেল পার্ক, পূর্বাচল, ঢাকা

ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৬০	শেঃ জোবায়দুল মজিদ	[illegible]	পিতলগঞ্জ-রূপগঞ্জ	01711674378	[illegible]
৬১	মোঃ জনি	"	পূর্বাচল	01871-545941	জনি
৬২	আরিফুল ইসলাম	"	"	01828-620170	আরিফুল
৬৩	মো: আনওয়ার মোল্লা	"	মোল্লা মার্কেট (পূর্বাচল)	01923-164460	[illegible]
৬৪	মো: শফিকুল ইসলাম	ছাত্র	পিতলগঞ্জ, [illegible]	01937-361523	[illegible]
৬৫	সহিদুল্লাহ	কৃষি	পিতলগঞ্জ	0172-1753471	[illegible]
৬৬	মো: ফিরোজ	ব্যবসায়	"	0171-9629611	[illegible]
৬৭	আল-আমিন	দলিল লেখক	মধুখালী	0181-8979036	[illegible]
৬৮	মো: আমান মিয়া	গাড়ি চালক	পিতলগঞ্জ	0194-3405808	আমান মিয়া
৬৯	নুরুল ইসলাম	সেক্রেটারী	[illegible]	01921-468733	[illegible]
৭০	মো: মোমেন ভূঁইয়া	ব্যবসায়ী	পিতলগঞ্জ	0171-2170247	[illegible]
৭১	রাসেল	ছাত্র	"	01977-118353	Rasel

বিতরণকারী/নিবন্ধকের নাম :

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সড়ক পরিবহন ও মহাসড়ক বিভাগ
ঢাকা ম্যাস ট্রানজিট কোম্পানি লিমিটেড (ডিএমটিসিএল)
ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১)
প্রবাসী কল্যাণ ভবন, লেভেল-১৪, ইস্কাটন গার্ডেন, ঢাকা-১০০০
www.dmtcl.gov.bd

ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১) পূর্বাচল রুটের পরিবেশগত প্রভাব বিষয়ক অংশীজন সভার হাজিরা

তারিখ ও বার : ১১ ফেব্রুয়ারি ২০২১ খ্রিস্টাব্দ, রোজ বৃহস্পতি বার
সময় : সকাল ১০:০০ ঘটিকা
স্থান : সী শেল পার্ক, পূর্বাচল, ঢাকা

ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৭২	আলমগীর হোসেন	সাধারণ সম্পাদক [illegible]	বাড়িয়াছনী	0181[illegible]96313	[illegible]
৭৩	টিপু সুলতান	ছাত্র	"	01931629854	[illegible]
৭৪	মোঃ আনোয়ার হোসেন	ব্যবসায়ী	বাগানবাড়ী	01729784812	[illegible]
৭৫	মোঃ চান মিয়া	ব্যবসায়ী		01727408605	মোঃ চান মিয়া
৭৬	মো: দেলোয়ার হোসেন	ব্যবসা		01720635953	দেলোয়ার
৭৭	সাইফুল ইসলাম (শাহীন)	ব্যবসা	[illegible]	01758737556	[illegible]
৭৮	Jannatul. Abedin.	Business	Golakandail [illegible]	01708862558	[illegible]
৭৯	মো: আলিম মিয়া	ব্যবসায়	পিতলগঞ্জ	01720395320	Alim
৮০	মো: আনোয়ার	"	"	01822-558586	আনোয়ার
৮১	রুজিনা	সভাপতি	[illegible] বাজার	01724410357	রুজিনা
৮২	সাদিকা	চাকুরী	রূপগঞ্জ	0177-8644560	সাদিকা
৮৩					

বিতরণকারী/নিবন্ধকের নাম :

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সড়ক পরিবহন ও মহাসড়ক বিভাগ
ঢাকা মাস ট্রানজিট কোম্পানি লিমিটেড (ডিএমটিসিএল)
ঢাকা মাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১)
প্রবাসী কল্যাণ ভবন, লেভেল-১৪, ইস্কাটন গার্ডেন, ঢাকা-১০০০
www.dmtcl.gov.bd

ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১) পূর্বাচল রুটের পরিবেশগত প্রভাব বিষয়ক অংশীজন সভার হাজিরা

তারিখ ও বার : ১১ ফেব্রুয়ারি ২০২১ খ্রিস্টাব্দ, রোজ বৃহস্পতি বার
সময় : সকাল ১০:০০ ঘটিকা
স্থান : সী শেল পার্ক, পূর্বাচল, ঢাকা

ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৬৪	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৬৫	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
৬৬	[illegible]	[illegible]	[illegible]	01999201853	[illegible]

বিতরণকারী/নিবন্ধকের নাম :

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সড়ক পরিবহন ও মহাসড়ক বিভাগ
ঢাকা মাস ট্রানজিট কোম্পানি লিমিটেড (ডিএমটিসিএল)
ঢাকা মাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১)
প্রকাশী কলাপ ভবন, লেভেল-১৪, ইস্কাটন গার্ডেন, ঢাকা-১০০০
www.dmtcl.gov.bd

ঢাকা ম্যাস র‍্যাপিড ট্রানজিট ডেভেলপমেন্ট প্রজেক্ট (লাইন-১) পূর্বাচল রুটের পরিবেশগত প্রভাব বিষয়ক অংশীজন সভার হাজিরা

তারিখ ও বার : ১১ ফেব্রুয়ারি ২০২১ খ্রিস্টাব্দ, রোজ বৃহস্পতি বার
সময় : সকাল ১০:০০ ঘটিকা
স্থান : সী শেল পার্ক, পূর্বাচল, ঢাকা

ক্রম	নাম	পেশা/পদবী	ঠিকানা/প্রতিষ্ঠান	মোবাইল নম্বর	স্বাক্ষর
৬৭	Md. Abdul Wadud	চাকরি	DMTCL	01558302916	
৬৬	[illegible]	চাকরিজীবী	[illegible]	01718533308	
৬৯	Dr. Md. Ashadul Alam	Consultant	NKDOS	01747215770	
৭০	Md. Mozammel Hoque	Deputy Team Leader	NKDOS consortium	01713047157	
৭১	M. Shariful Islam	PM (EHS)	MRT Line-01 DMTCL		
৭২	Fuad Karim	Service	EQMS	01711383496	
৭৩	Md. Saiful Islam	Asst. Consultant	EQMS	01928803065	
৭৪	Tauhidul Hasan	Sr. Consultant	EQMS	01721346853	
৭৫	Md. Shilpaan	Asst. Consultant	EQMS	01822456477	
৭৬	Tanzia Sharmin	Jr. Safeguard Exp	NKDOS	01787911097	

বিতরণকারী/নিবন্ধকের নাম :

Appendix E : Photographic Evident of the Key Informant Interviewee

Stakeholder Details	Photographic Evident
Md. Sultan Mia Ward Councilor, Ward No. 8, DSCC Mobile: 01716181603	
Mirza Aslam Ward Councilor, Ward No. 11, DSCC Mobile: 01775 488919	

K. M. Mamunur Rashid Ward Councilor, Ward No. 12, DSCC Mobile: 01715 001222	
Anamul Haque Ward Councilor, Ward No. 13, DSCC Mobile: 01711 355326	

Jakir Hosen Ward Councilor, Ward No. 18, DNCC Mobile: 01711 531949	
Mofijur Rahman Ward Councilor, Ward No. 19, DNCC Mobile: 01819 218462	

Md. Anisur Rahman Nayem Ward Councilor, Ward No. 49, DNCC Mobile: 01713 517006	
Md. Fajlul Haque Head Master, Alatunnecha Higher Secondary School Mobile: 01965491329	

Md. Md. Ishak Mia Ward Councilor, Ward No. 17, DNCC. Mobile: 0171301422	
Dr. Md. Arifur Rahman Principal, Kalachandpur High School and College. Mobile: 01670251470	

Ajit Kumar, Proprietor, J.C. Enterprise Mobile: 01819-299646	
Md. Zunu Mia Ex Chairman of Rupganj Union Parishad, Mobile:	

Appendix F : Lab Sheets of Lead Test of Air Quality

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212.
Phone: 88-02-98881927, Fax : 88-02-9882003, Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/CC, DPHE, CL, Dhaka

Date: 11/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120049	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-1)	Union: Vill.: MRT-1
Sample collection date: 02-12-2019	Date of Testing: 03/12/2019– 11/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	11.12.19	1) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019 Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka

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Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212.
Phone: 88-02-98881927, Fax : 88-02-9882003, Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/CC, DPHE, CL, Dhaka

Date: 11/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120049	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-2)	Union: Vill.: MRT-1
Sample collection date: 02-12-2019	Date of Testing: 03/12/2019– 11/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	11.12.19	1) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

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Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212.
Phone: 88-02-98881927, Fax : 88-02-9882003, Email: wqmsc_central_lab@yahoo.com

Lab Memo: 530/CC, DPHE, CL, Dhaka

Date: 11/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120049	Sample Receiving date: 03-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 03-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-3)	Union: Vill.: MRT-1
Sample collection date: 02-12-2019	Date of Testing: 03/12/2019– 11/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	11.12.19	1) Name: Mita Sarker Designation: Senior Chemist	11-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	11.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	11/12/2019 Md. Biplab Hossain Chief Chemist Department of Public Health Engineering Central Laboratory Mohakhali, Dhaka.

Page 1 of 1

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212.
Phone: 88-02-98881927, Fax : 88-02-9882003, Email: wqmsc_central_lab@yahoo.com

Lab Memo: 576/CC, DPHE, CL, Dhaka

Date: 16/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120088	Sample Receiving date: 09-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 09-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-4)	Union: Vill.: MRT-1
Sample collection date: 08-12-2019	Date of Testing: 09/12/2019– 16/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	16.12.19	1) Name: Mita Sarker Designation: Senior Chemist	16-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	16.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	16/12/19

Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212.
Phone: 88-02-98881927, Fax : 88-02-9882003, Email: wqmsc_central_lab@yahoo.com

Lab Memo: 576/CC, DPHE, CL, Dhaka

Date: 16/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120088	Sample Receiving date: 09-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 09-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-5)	Union: Vill.: MRT-1
Sample collection date: 08-12-2019	Date of Testing: 09/12/2019– 16/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	16.12.19	1) Name: Mita Sarker Designation: Senior Chemist	16-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	16.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	16/12/19

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Lab Memo: 576/CC, DPHE, CL, Dhaka

Date: 16/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120088	Sample Receiving date: 09-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 09-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-6)	Union: Vill.: MRT-1
Sample collection date: 08-12-2019	Date of Testing: 09/12/2019– 16/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	16.12.19	1) Name: Mita Sarker Designation: Senior Chemist	16-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	16.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	16/12/19

মোঃ বিপ্লব হোসেন
চীফ কেমিস্ট
জনস্বাস্থ্য প্রকৌশল অধিদপ্তর
কেন্দ্রীয় পরীক্ষাগার মহাখালী, ঢাকা।

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Lab Memo: 576/CC, DPHE, CL, Dhaka

Date: 16/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120088	Sample Receiving date: 09-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 09-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-7)	Union: Vill.: MRT-1
Sample collection date: 08-12-2019	Date of Testing: 09/12/2019– 16/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	16.12.19	1) Name: Mita Sarker Designation: Senior Chemist	16-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	16.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	16/12/19

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Lab Memo: 607/CC, DPHE, CL, Dhaka

Date: 24/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120109	Sample Receiving date: 16-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 16-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-8)	Union: Vill.: MRT-1
Sample collection date: 15-12-2019	Date of Testing: 16/12/2019– 24/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	24.12.19	1) Name: Mita Sarker Designation: Senior Chemist	24-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	24.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	24/12/19

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Lab Memo: 607/CC, DPHE, CL, Dhaka

Date: 24/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120109	Sample Receiving date: 16-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 16-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-9)	Union: Vill.: MRT-1
Sample collection date: 15-12-2019	Date of Testing: 16/12/2019– 24/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	24.12.19	1) Name: Mita Sarker Designation: Senior Chemist	24-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	24.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	24/12/19

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Lab Memo: 607/CC, DPHE, CL, Dhaka

Date: 24/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120109	Sample Receiving date: 16-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 16-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-10)	Union: Vill.: MRT-1
Sample collection date: 15-12-2019	Date of Testing: 16/12/2019– 24/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	24.12.19	1) Name: Mita Sarker Designation: Senior Chemist	24.12.19
2) Name: Taslima Akhter Designation: Sample Analyzer	24.12.19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	24/12/19

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Lab Memo: 607/CC, DPHE, CL, Dhaka

Date: 24/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120109	Sample Receiving date: 16-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 16-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-11)	Union: Vill.: MRT-1
Sample collection date: 15-12-2019	Date of Testing: 16/12/2019– 24/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.002	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	24-12-19	1) Name: Mita Sarker Designation: Senior Chemist	24-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	24-12-19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	24/12/19

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Lab Memo: 607/CC, DPHE, CL, Dhaka

Date: 24/12/2019

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120109	Sample Receiving date: 16-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 16-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-12)	Union: Vill.: MRT-1
Sample collection date: 15-12-2019	Date of Testing: 16/12/2019– 24/12/2019

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	24-12-19	1) Name: Mita Sarker Designation: Senior Chemist	24-12-19
2) Name: Taslima Akhter Designation: Sample Analyzer	24-12-19	2) Name: Md. Biplab Hossain Designation: Chief Chemist	24/12/19

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Lab Memo: 653/CC, DPHE, CL, Dhaka

Date: 04/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120168	Sample Receiving date: 22-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 22-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-13)	Union: Vill.: MRT-1
Sample collection date: 21-12-2019	Date of Testing: 22/12/2019– 4/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	04.01.20	1) Name: Mita Sarker Designation: Senior Chemist	04-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	04.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	4/01/20

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Lab Memo: 653/CC, DPHE, CL, Dhaka

Date: 04/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120168	Sample Receiving date: 22-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 22-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-14)	Union: Vill.: MRT-1
Sample collection date: 21-12-2019	Date of Testing: 22/12/2019– 04/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	04.01.20	1) Name: Mita Sarker Designation: Senior Chemist	04-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	04.0120	2) Name: Md. Biplab Hossain Designation: Chief Chemist	4/01/20

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Lab Memo: 653/CC, DPHE, CL, Dhaka

Date: 04/12/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120168	Sample Receiving date: 22-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 22-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-15)	Union: Vill.: MRT-1
Sample collection date: 21-12-2019	Date of Testing: 22/12/2019-- 4/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	04.01.20	1) Name: Mita Sarker Designation: Senior Chemist	04-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	04.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	4/01/20

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Date: 04/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120168	Sample Receiving date: 22-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 22-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-16)	Union: Vill.: MRT-1
Sample collection date: 21-12-2019	Date of Testing: 22/12/2019– 4/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	04.01.20	1) Name: Mita Sarker Designation: Senior Chemist	04.01.20
2) Name: Taslima Akhter Designation: Sample Analyzer	04.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	4/01/20

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Lab Memo: 702/CC, DPHE, CL, Dhaka

Date: 07/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120209	Sample Receiving date: 25-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 25-12-2019	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-17)	Union: Vill.: MRT-1
Sample collection date: 24-12-2019	Date of Testing: 25/12/2019– 07/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	7.01.20	1) Name: Mita Sarker Designation: Senior Chemist	7-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	7.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	07/01/20

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Lab Memo: 720/CC, DPHE, CL, Dhaka

Date: 07/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120209	Sample Receiving date: 25-12-2019
Ref. Memo No: EQMS/2019/Nill & Dated: 25-12-2019	Sample Source: Water
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-18)	Union: Vill.: MRT-1
Sample collection date: 24-12-2019	Date of Testing: 25/12/2019– 07/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	7.01.20	1) Name: Mita Sarker Designation: Senior Chemist	7.01.20
2) Name: Taslima Akhter Designation: Sample Analyzer	7.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	07/01/20

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চীফ কেমিস্ট
জনস্বাস্থ্য প্রকৌশল অধিদপ্তর
কেন্দ্রীয় পরীক্ষাগার মহাখালী, ঢাকা।

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Lab Memo: 782/CC, DPHE, CL, Dhaka

Date: 15/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120276	Sample Receiving date: 06-01-2020
Ref. Memo No: EQMS/2019/Nill & Dated: 06-01-2020	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-19)	Union: Vill.: MRT-1
Sample collection date: 05-01-2020	Date of Testing: 06/01/2020– 15/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	15.01.20	1) Name: Mita Sarker Designation: Senior Chemist	15-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	15.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	15/01/20

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কেন্দ্রীয় পরীক্ষাগার মহাখালী, ঢাকা।

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Lab Memo: 782/CC, DPHE, CL, Dhaka

Date: 15/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120276	Sample Receiving date: 06-01-2020
Ref. Memo No: EQMS/2019/Nill & Dated: 06-01-2020	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-20)	Union: Vill.: MRT-1
Sample collection date: 05-01-2020	Date of Testing: 06/01/2020– 15/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrcphotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	15.01.20	1) Name: Mita Sarker Designation: Senior Chemist	15-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	15.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	15/01/20

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Lab Memo: 782/CC, DPHE, CL, Dhaka

Date: 15/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120276	Sample Receiving date: 06-01-2020
Ref. Memo No: EQMS/2019/Nill & Dated: 06-01-2020	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-21)	Union: Vill.: MRT-1
Sample collection date: 05-01-2020	Date of Testing: 06/01/2020– 15/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	15.01.20	1) Name: Mita Sarker Designation: Senior Chemist	15-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	15.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	15/01/20

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Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212.
Phone: 88-02-98881927, Fax : 88-02-9882003, Email: wqmsc_central_lab@yahoo.com

Lab Memo: 782/CC, DPHE, CL, Dhaka

Date: 15/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120276	Sample Receiving date: 06-01-2020
Ref. Memo No: EQMS/2019/Nill & Dated: 06-01-2020	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-22)	Union: Vill.: MRT-1
Sample collection date: 05-01-2020	Date of Testing: 06/01/2020 – 15/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	15.01.20	1) Name: Mita Sarker Designation: Senior Chemist	15-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	15.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	15/01/20

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Lab Memo: 811/CC, DPHE, CL, Dhaka

Date: 22/01/2020

Physical / Chemical/ Biological Analysis of Water Sample

Sample ID: CEN2019120312	Sample Receiving date: 08-01-2020
Ref. Memo No: EQMS/2019/Nill & Dated: 08-01-2020	Sample Source: AQW
Sent By: Kazi Forhed Iqbal, Executive Director, EQMS Consulting Ltd., Banani, Dhaka-1213	Dist: Dhaka, Upa:
Care taker: EQMS Consulting Ltd. (AQW-23)	Union: Vill.: MRT-1
Sample collection date: 07-01-2019	Date of Testing: 08/01/2020– 22/01/2020

LABORATORY TEST RESULTS

SL#	Water Quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Lead (Pb)	0.05	0.001	mg/L	AAS	0.001

Comments: Sample was collected & supplied by client.
N.B: AAS-Atomic Absorption Spectrophotometer, LOQ- Limit of Quantification

Test performed by	Signature	Countersigned/Approved by:	Signature
1) Name: Md. Saiful Alom Khoshru Designation: Sample Analyzer	20.01.20	1) Name: Mita Sarker Designation: Senior Chemist	20-01-20
2) Name: Taslima Akhter Designation: Sample Analyzer	20.01.20	2) Name: Md. Biplab Hossain Designation: Chief Chemist	20/01/20

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