Supplementary EIA Report for Motijheel to Kamalapur Extension of MRT Line-6

Final Report

Prepared for:

NKDM Association

January 2021

Prepared by:

EQMS Consulting Ltd.

Dhaka Mass Transit Company Limited (DMTCL)

Final Report

NKDM Association

Supplementary Environmental Impact Assessment for MRT Line 6 Extension (Motijheel to Kamalapur extension)

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Preface

NKDM Association, a consortium working as general consultant for Dhaka Mass Rapid Transit Developing Project (MRT Line-6), has appointed EQMS Consulting Ltd. to conduct Supplementary Safeguard Survey for MRT Line-6 Extension Part (Motijheel to Kamalapur). Among other deliverables of this assignment, one is this EIA update report. This report presents the findings of baseline study, especially conducted for extension part as well as the potential impacts of the project on environments and their mitigation measures. A Public Consultation Meeting (PCM) has also been conducted to disclose the findings of EIA study and the proceedings of meeting are included in this report. This report has been prepared as Addendum No. 04 of updated EIA report of 2016 to be submitted to Department of Environment (DOE) for approval. Previously, a total number of 03 Addendums were prepared and submitted to DOE.

Addendum No. 4 to the

Environmental Impact Assessment of MRT Line 6

of January 2016 and its First (July, 2016), Second (April 2018), and Third Addendum (May 2019)

For the

Dhaka Mass Rapid Transit Development Project

Prepared for

Dhaka Mass Transit Company Limited

By

NKDM Association

January 2021

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Abbreviations and Acronyms

ACC : Anti-Corruption Commission
AIDS : Acquired Immune Deficiency Syndrome
BDT : Bangladeshi Taka
BR : Bangladesh Railway
BRT : Bangladesh Road Transport
BRTA : Bangladesh Road Transport Authority
CCTV : Closed Circuit Television
CEMP : Construction Environmental Management Plan
CO : Carbon Monoxide
CP : Contract Package
CWR : Continuous Welded Rail
DC : Deputy Commissioner
DCC : Dhaka City Corporation
DEE : Dhaka Elevated Express Way
DMRTDP : Dhaka Mass Rapid Transit Development Project
DMTCL : Dhaka Mass Transit Company Limited
DNCC : Dhaka North City Corporation
DOE : Department of Environment
DPP : Development Project Proposal
DSCC : Dhaka South City Corporation
ECA : Environmental Conservation Act
ECC : Environmental Clearance Certificate
ECS : Environmental Construction Specification
EIA : Environmental Impact Assessment
EMP : Environmental Management Plan
FDEE : First Dhaka Elevated Express Way
FST : Floating Slab Track
GHG : Green House Gas
HIV : Human Immunodeficiency Virus
HT : Heavy Transit
ICD : Inland Container Depot
IMG : Independent Monitoring Group
IOL : Inventory of Losses
JICA : Japan International Cooperation Agency
KMME : Kamalapur-Motijheel MRT Extension
KRS : Kamalapur Railway Station

KS : Kamalapur Station
LAP : Land Acquisition Plan
LWR : Long Welded Rail
MLD : Million Liter per Day
MRT : Mass Rapid Transit
MSL : Mean Sea Level
MSS : Mass Spring System
NOx : Oxides of Nitrogen
OL : Over Loaded
OW : Over Weight
PAP : Project Affected Person
PAU : Project Affected Unit
PCL : Project Construction Level
PM10 : Particulate Matter (Less than 10 micro)
PPE : Personal Protective Equipment
PWD : Public Works Department
RAJUK : Rajdhani Unnayan Kartripokkhyo
RHD : Road and Highway Department
RMG : Ready Made Garments
ROW : Right of Way
RSS : Receiving Sub-Stations
RSTP : Road Strategic Transport Plan
SO_2 : Sulphur-di-oxide
SPM : Suspended Particulate Matter
UK : United Kingdom
USD : US Dollar
VIP : Very Important Person
WASA : Water Supply and Sewage Authority

1 INTRODUCTION

1.1 Purpose of the Report

According to initial plan, the under-construction route of MRT Line-6 extents from Uttara to Motijheel through Pallabi, Mirpur, Agargaon, Farmgate, Shahbag, and Paltan area, which is now under construction. However, to avail a greater benefit by connecting MRT Line-6 with Kamalapur Railway Station (KRS) and the proposed Kamalapur Station of MRT Line-1, government has now planned to extend the Line-6 from Motijheel to Kamalapur, referred to herein as the Kamalapur-Motijheel MRT Extension (KMME). Since this extended portion of the Line-6 will go through new areas that was not studied before to explore the possible environmental impacts, this report has been prepared as an addendum of updated EIA report of 2016 to fill up that gap. In short, this report contains a brief description of the project, findings of the environmental baseline survey, potential risks and impacts, mitigation measures and environmental management plan, the findings of public consultation meeting, etc. Figure 1.1 shows the revised route alignment, including the extension of Line-6.

1.2 Project Environmental and Social Objectives

The main purpose of constructing the MRT is to reduce traffic congestion and to reduce environmental degradation by providing an easy and sustainable means of public mobility. Keeping it in mind, this project aims to facilitate people in accessing full benefits through connecting MRT Line-6 with other mass transit facilities, i.e. Bangladesh Railways and MRT Line-1, which also terminates at Kamalapur Railway Station (KRS). Moreover, the upcoming MRT Line-2 and MRT Line-4 will touch Kamalapur. Furthermore, the Dhaka-Chittagong high speed train will also start from Kamalapur. In short, Kamalapur will be the biggest hub of transportation with other infrastructures like hotels, commercial offices, expo, etc. This extension is just not a connection between Motijheel and Kamalapur, rather between Uttara, Mirpur, Farmgate etc. to Rampura, Purbachal, Kuril, and so on. It will reduce the public hassle by saving working hour that will ultimately increase the economic potentiality and outcome of workforce. All socioeconomic groups, despite their age, sex, income and occupation, will be able to avail the benefits from this project without marginalizing any group of people or community.

The project will create reduction of congestion along roadways and lessened air pollution exposure for roadway users and people living and working along roadways. On the other hand, from the perspective of national and global level, the project expects to reduce the consumption of fossil fuel in order to reduce the national greenhouse gas emission. In brief, the project aims to accelerate the achievement of the objectives of lessening traffic congestion and improving air quality of Dhaka by improving connectivity and public mobility—that will contribute to the development of regional economy and urban environment, as set out by JICA.

1.3 Zone of Influence

The zone of influence does not change except in the area of the extension. A viaduct within a 15 m wide right-of-way over a length of (approx.) 1.16 km will connect the originally proposed

Line 6 southernmost terminus at Motijheel to the KRS. The width of viaduct top is usually 10 m for construction and maintenance, which requires a 20 m wide road underneath the viaduct. However, the design team reduced the width of road to 15 m in order to reduce the impact. It is an example of impact reduction in design stage. The ROW passes through the Kamalapur neighborhood, an area of low-profile mixed-use (commercial and residential) buildings. A transit easement access for pedestrians, non-motorized and motorized vehicles will be opened at ground level below the Line 6 viaduct, which has no existence at present. Construction of the viaduct involves displacing existing structures located on private property over most of this distance and demolition of buildings in the ROW. Construction activity will introduce workers, and result in air and noise pollution along the alignment that will penetrate in added distance back from the ROW, exerting a zone of influence wider than the 15 m ROW.

Direct environmental impacts will be confined within a corridor of approximately 200 m width along the project's alignment as per the estimation of updated EIA report of 2016. The key aspects of the zone of influence estimated in updated EIA report of 2016 study, such as traffic congestion, noise and air pollution, drainage congestion etc. also will remain same during construction and operation for this extension project. Furthermore, the cumulative and indirect impacts and benefits resulted from the project will affect land use, economic development and physical aspects of the urban environment. In addition, some changes in traffic flow might be observed during construction and operation phase of the project.

The new Environmental Base Map for the Project (with the extension route line) is shown in **Figure 1-1**. It shows the principal features of the Project and surrounding environment, including urbanized area, green space, water bodies, and administrative boundaries. **Figure 1-2** shows the extension part to understand the surroundings of the route line which could be affected during construction and operation period.

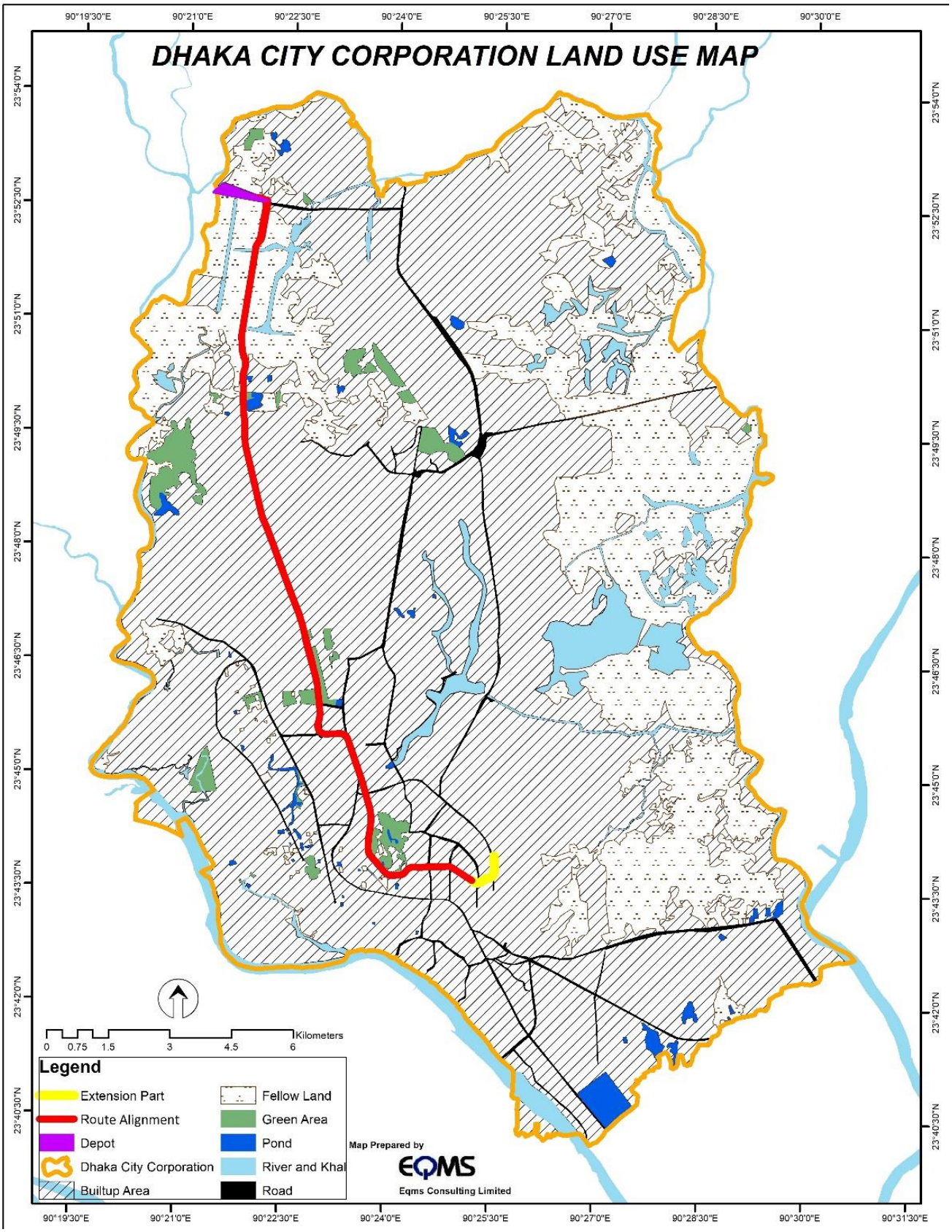


Figure 1-1: Dhaka City Land Use Map with the Alignment of MRT Line 6

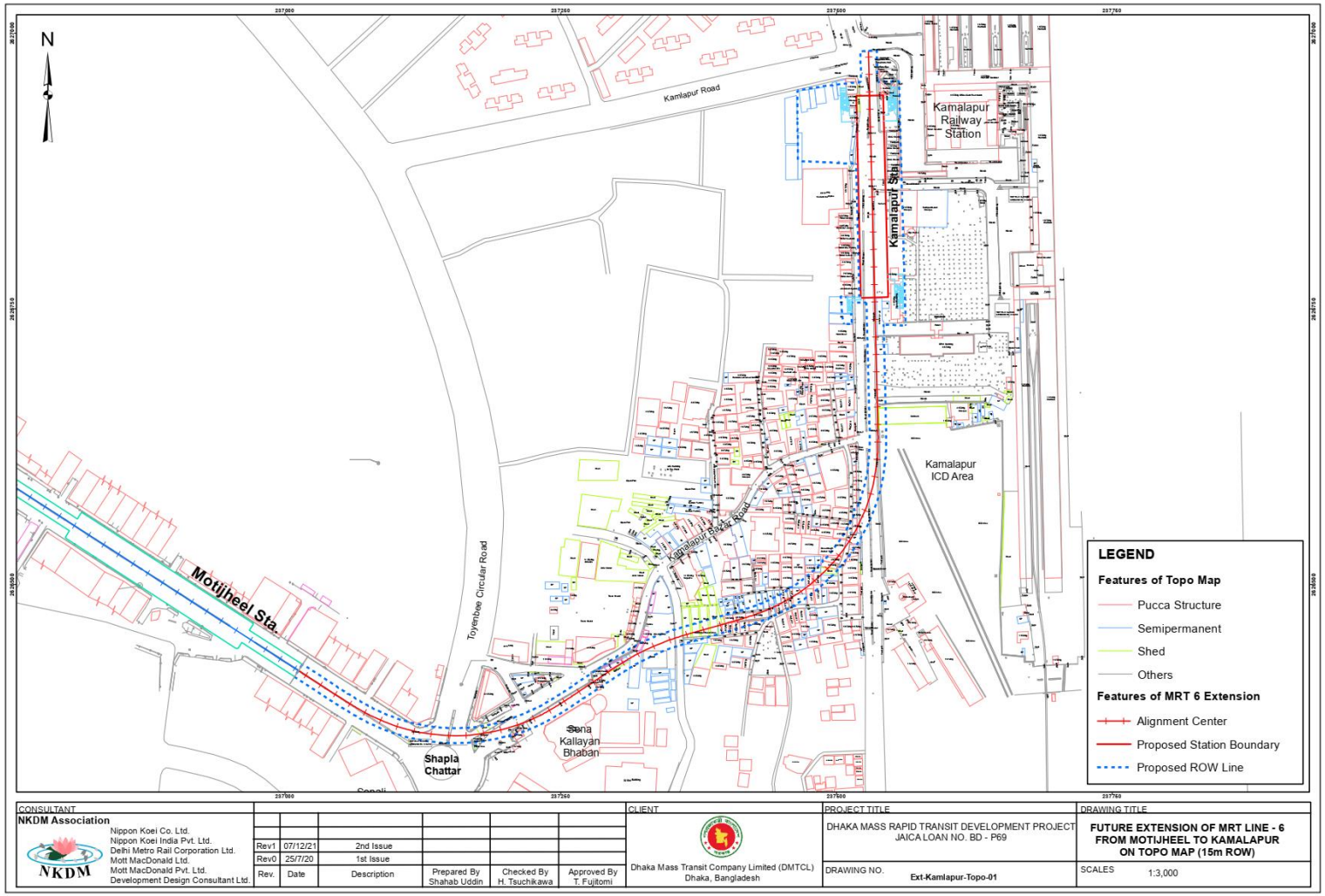


Figure 1-2: Map of the Alignment of MRT-6 Extension

1.4 Financing and Implementation

The financing and implementation of the extension project will be carried out as per the existing framework and arrangement for Line-6. Necessary finance to implement the project will be facilitated by the Japan International Cooperation Agency (JICA). It may be possible to complete the extension from the savings of the existing construction work of MRT Line 6 (from Uttara Diabari up to Motijheel). Dhaka Mass Transit Company Limited – a state owned company under the Ministry of Road Transport and Bridges – will implement the project, while the NKDM Association will act as General Consultant for design, construction supervision, and operation management.

1.5 Organization of the Report

Chapter 2 introduces the Acquisition and Requisition of Immovable Property Act, 2017 which was not discussed in updated EIA report of 2016. Other policy, laws, rules, and regulations described in the updated EIA of 2016 will remain same for this report also.
Chapter 3 describes changes and/or new addition to the project description that have been brought by the extension project.
Chapter 4 describes about the alternative route for extension project and their background factors for decision making. This chapter also describes a feasibility argument between MRT extension and skywalk options.
Chapter 5 includes the findings of new baseline survey, i.e. air quality and noise level as well as the physical, biological, and socioeconomic resources. Only the information that covers the extension project has been included in this chapter.
Chapter 6 describes the newly identified impacts due to Kamalapur Extension Project that especially includes demolition works, which was not explored during updated EIA of 2016. Besides, mitigation measures have also been written in this chapter. This chapter also presents a summary of IOL study.
Chapter 7 presents the findings of public consultation meetings, including the disclosed information and the opinion of stakeholders. It also contains the response of the owners as well as lessons learned.
Chapter 8 deals with Environmental Management Plan (EMP) with especial consideration to the management of the impacts of demolition works. However, many aspects of the EMP will remain same as updated EIA report of 2016. That is why this chapter did not cover them in details.
Chapter 9 summarizes the report with a conclusion.

1.6 Status of EIA and Further Additions

The original EIA of MRT Line-6 was prepared in 2011 and it has been updated in January 2016. Subsequently, three addendum were prepared in July 2016, April 2018, and May 2019 to accommodate the changes occurred from the updated EIA of 2016. The current report is the fourth addendum to the updated EIA report of 2016, which is prepared to assess the potential environmental impacts of proposed Kamalapur Extension Project in order to facilitate JICA program review for funding approval of the extension project.

The Department of Environment (DOE) issued an Environmental Clearance Certificate (ECC) for the Project on the basis of its review of the 2011 EIA. At that time, the Project was classified

as Category A by JICA, and similarly as a Red Category Project under GOB's 1997 Environmental Conservation Rules, categories requiring preparation of an EIA and related measures. As a condition of the JICA loan agreement, preparation of an updated EIA (design stage) began in 2014 under GC services. An updated EIA was completed in January 2016 prior to start of construction. DOE renewed the ECC in January 2016 upon taking into account the recommended mitigation measures in the updated EIA. The first addendum to the EIA was submitted to DOE in July 2016 and the ECC was renewed on 8 Sept. DMTCL applied for a further renewal on 15 June 2017, which secured the ECC up to 10 July 2018. A further renewal application was submitted to DOE in late June 2018 along with a second EIA addendum. Approval was granted on 14 Aug 2018, which secured the ECC up to 10 July 2019. A third EIA addendum was prepared and submitted to DOE alongside the most recent renewal application in June 2019. Approval was granted on 19 Aug, which secures the ECC up to 10 July 2020. Finally, the ECC has been renewed for last time in August 2020. Hence, the ECC has been renewed seven times since 2011 in 2014, 2015, 2016 (two times), 2017, 2018, 2019, and 2020. ECC renewal history can be found in **Table 1-1**.

Table 1-1: Authorization notices (environment)

Authorizing Agency	Issuing Document	Date
DOE	Environmental Clearance Certificate	11 Jul 2011
JICA	Comments on EIA included in loan agreement	2011
DOE	ECC Renewal 01 valid until 10 Jul 2015	20 Nov 2014
JICA	Notice of No Objection for updated EIA	11 Nov 2015
DOE	ECC Renewal 02 valid until 10 Jul 2016	13 Jan 2016
DOE	ECC Renewal 03 valid until 10 Jul 2017	08 Sep 2016
DOE	ECC Renewal 04 valid until 10 Jul 2018	07 Jul 2017
DOE	ECC Renewal 05 valid until 10 Jul 2019	14 Aug 2018
DOE	ECC Renewal 06 valid until 10 Jul 2020	19 Aug 2019
DOE	ECC Renewal 07 valid until 10 Jul 2021	26 Jul 2020

2 POLICY AND LEGAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT

2.1 Government of Bangladesh

2.1.1 Environment

A description of relevant environmental policy, laws, rules, and regulations – prepared and enacted by Bangladesh Government – are given in updated EIA report of 2016 under same section heading. All of those policies, acts, and rules will be applicable for this extension project also. However, apart from those rules and regulations in updated EIA report of 2016, some new rules and regulations applicable for this extension project are described in this section.

2.1.2 Resettlement and Land Acquisition

The government of Bangladesh has repealed the Acquisition and Requisition of Immovable Property Ordinance, 1982 and enacted a new law called 'The Acquisition and Requisition of Immovable Property Act, 2017' in 2017. Previously, land acquisition activities of MRT Line-6 have been carried out as per the procedures of 1982 Ordinance. As for this extension project, land acquisition activities will be carried out as per the procedures of new law, *viz.* 2017 Act.

As per the 2017 Act, the compensation for acquired land shall be the amount that adds 200% premium to the average market price of land in the past years for the purpose of government projects. Compensation for the loss of property on the land (i.e. trees, crops), transfer of residence and business, loss of occupation, shall be the amount that adds 100% premium to their market price. The land price set by the Deputy Commissioner Office will be applied to determine the market price for calculating land compensation. As for the loss of buildings, the compensation will be calculated as per the market price set by Public Works Department (PWD).

The 2017 Act retains the provision that land of religious institutions like mosques, temples and graveyards cannot be acquired generally. However, it also incorporates a provision that would allow the government to acquire land of any religious institutions if inevitable for public interest.

The 2017 Act also permits to facilitate rehabilitation of affected parties in addition of providing appropriate compensation. The detail assessment of the types of acquired land, ownership status, associated properties, compensation, etc. will be carried out through preparation of a separate Land Acquisition Plan (LAP) based on which the Deputy Commissioner (DC) will be responsible to execute the land acquisition activity under the jurisdiction of The Act. The Ministry of Land is authorized to deal with land acquisition through the DC.

Involuntary Resettlement

The resettlement activities of this extension project will be carried out in accordance with the legal procedures as described in updated Resettlement Action Plan (RAP) of Line-6.

2.2 JICA Guidelines

The necessary guidelines and policies provided by JICA for environmental and social considerations as well as land acquisition and compensation have been described in updated EIA report of 2016, which will remain same for this extension project also.

2.3 Administrative Framework for the Dhaka Metro

The Dhaka Mass Rapid Transit Development Project (DMRTDP) is being implemented under the administration of Dhaka Mass Transit Company Limited (DMTCL), which is a state-owned company constituted in 2013. A detail project management setup showing the relationship of the Environmental and Rehabilitation Section within the organization have been illustrated and described in updated EIA report of 2016 (see Figure 2-1 in updated EIA report of 2016). The same administrative setup will implement this extension project also.

3 PROJECT DESCRIPTION

In 2015, the Revised Strategic Transport Plan (RSTP) recommended to connect the MRT Line 6 with the Kamalapur railway station and turn the Kamalapur station as multimodal transport hub. DMTCL decided to extend MRT Line-6 from Motijheel to the Kamalapur Railway station in 2019. The government approved the proposal for Extension Kamalapur on 15th Sep, 2019. The alignment was approved by the government on 3rd September, 2020.

The KMME has no effect on the following components of the project: depot configuration and operations; viaduct structural design and construction approach; track type, placement (curvature, spacing), and method of assembling/fixation; rolling stock; electro-mechanical systems (except in respect to installed quantity); and temporary construction facilities.

The KMME causes change in the geometry of the viaduct and track (by changing the installed lengths of viaduct and track, by introducing additional considerations into the curvature of viaduct and track); and stations (by altering numbers, types, locations and architecture in specific ways); and by the numbers of PAPs and degree of compensation. Other interface issues of a detailed nature may be influenced that are outside the scope of environmental review.

The modified Project Description (this section) does not refer to, describe or discuss any further those elements mentioned above on which the KMME has no effect. This section only describes elements of the Project for which the KMME introduces a change, alteration or effect.

3.1 Transport Planning Context

Motijheel is a commercial hub of the Dhaka City and very nearer to the Kamalapur Railway Station—the largest and central railway station of the country. Besides, a station of MRT Line-1 will also be in this area. Moreover, upcoming MRT Line-2 and MRT Line-4 will touch Kamalapur. Furthermore, high speed train between Dhaka and Chittagong will also start from Kamalapur. In short, Kamalapur will be the biggest transport hub of the country. Therefore, the passengers from railway and other MRTs at Kamalapur station who want to commute by Line-6 will face a great trouble to reach Motijheel Station and vice versa. Also, it will increase traffic congestion in-between Motijheel and Kamalapur and the anticipated benefits of these MRT Lines will be achieved partially. A revised map of the MRT network in Dhaka city is shown in **Figure 3-1**for better understanding. In this circumstance, the Line-6 has been planned to be extended up to Kamalapur from Motijheel adding another station at Kamalapur. The extension will develop overall transport network by enhancing connectivity, especially for those who want to interchange between MRTs and Railways. Eventually, it will improve the urban mobility of Dhaka City.

3.2 Cost, Magnitude and Extent

According to the Government's Development Project Proposal (DPP), total cost of whole MRT Line-6 is about BDT 220 billion (USD 2.82 billion), of which approximately 75% is financed through Japanese ODA (BDT 166 billion, USD 2.13 billion) and rest of the amount will be contributed by Bangladesh Government. Some additional financing are provided by JICA in the form of grants for preparatory studies and training. However, necessary cost for current

extension project may be managed from the savings of Line-6 budget without allocating any extra money. The footprint for the Project is as follows:

- The length of alignment between depot (on north end) and terminus at Kamalapur will be around 21.2 km, including the length of proposed extension. A portion of the extended viaduct will consume some acquired of pre-occupied built-up land as well as railway-owned land.
- The proposed new extension part will be 1.16 km. The previous route line up to Motijheel was 20.1 km.
- There will be one new station at Kamalapur—the terminus of Line-6 as per proposed plan. The regular distance in-between two piers will be 30 m, unless the necessity of any long span arises due to physical obstacles, i.e. road crossing.
- If this extension project is given to CP-06, it may be completed quickly, because they can use the existing construction facilities. Otherwise, it may take long time to complete total process and start the construction. However, it is not finalized yet.

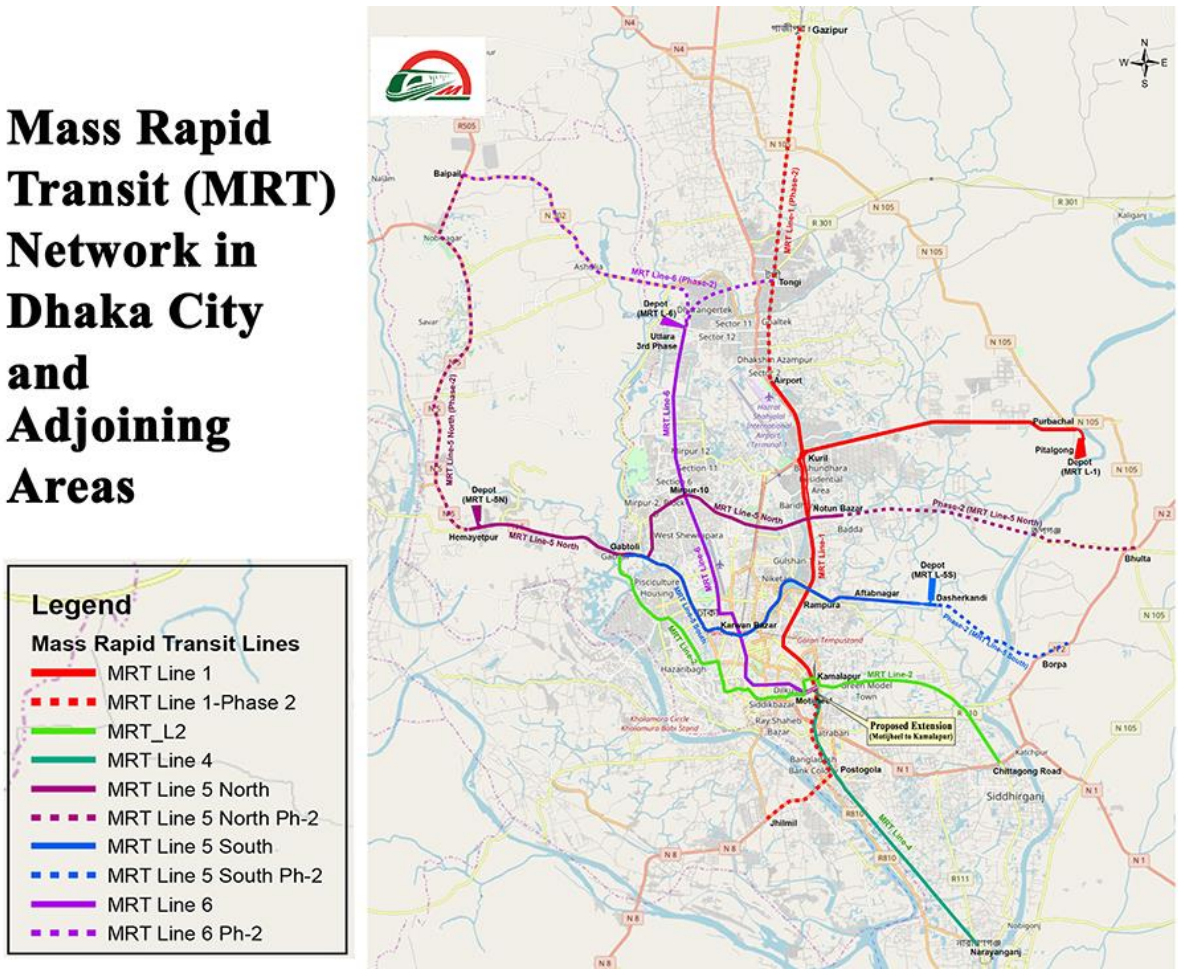


Figure 3-1: Dhaka Metro Rail Network

3.3 Main Features

3.3.1 Depot

A detail description of depot, including site development; buildings and architectural features; equipment, tools and vehicles; water demand in depot; wastewater treatment discharged from depot; byproducts and chemical recycling; and health and safety aspects of operations are provided in updated EIA report of 2016under this very same sub-paragraph. No features of that description will be changed or updated after adding this extension of the line.

3.3.2 Viaduct and Rail

3.3.2.1 Structural Aspects

This extension project increases the length of viaduct and track. The extended portion of viaduct and track will go through double reverse curve over the distance. That is why speed restrictions will be in play due to the curve and also the approach to KS (or MS). The switchback will be repositioned by the KMME. The distance of a span between two piers is normally 30 m, unless any necessity of long span arises. Generally, long span or bridge span (more than 30 m in length) is considered to overpass any water body, road crossing or pedestrian bridge along the alignment. The length of spans in-between the piers of this extension part will be determined once the detail design is completed.

This extension is the continuation of previously planned and approved project of Line-6, which is now under construction, rather than to be a separate line. Therefore, the structural characteristics of civil construction of this extended line will be same as rest of the part of the line, unless any location-specific requirements arise. More detail information with diagram are provided in updated EIA report of 2016.

3.3.2.2 Track

The characteristics of rail track will be same as determined for MRT-6 and described in updated EIA report of 2016. The rail track on viaduct will be ballast less plinth-type track and joint-less Long Welded Rails (LWR)/Continuously Welded Rails (CWR) in order to improve maintainability and rider comfort as well as to reduce vibration and noise. Some geometric design standards for track are as follows:

- Maximum gradient: 35/1,000
- Vertical curve radius: 2,000 m
- Min. horizontal curve radius: 400 m (normal case), 200 m (extreme case in transit viaduct), 160 m

In the KMME part, there are three proposed curvatures, i.e. 170 m curvature at Shapla Chattar to Sena Kallyan Building area, 200m curvature in South Kamalapur area and 163m curvature at the turn point to Kamalapur Station area.

The rails consist of 60E1, R350 HT Head hardened on main line, which are continuously joined with welding without fishplate joints for providing a smooth track. In this extension part also, there will be some sensitive receptors where mitigation measures are necessary. The CWR

Track and MSS system will act as noise and vibration barrier to ensure that prescribed limits are not exceeded.

More detail description and information with cross sectional diagram of ballast less track are available in section 3.3.2.2 of the updated EIA report of 2016.

3.3.3 Station

The total number of stations will be 17 as one new station will be constructed in Kamalapur, which will also be terminus of Line-6. The characteristics of Kamalapur Station will be determined once the detail design is completed. However, the numerical characteristics of the station like length, width, height, platform type, platform height, platform width, etc. will be very same to the other stations of MRT Line-6. A detail description of the characteristics of other stations of Line-6 can be found in section 3.3.3 of the updated EIA report of 2016.

3.3.4 Rolling Stock

The characteristics of rolling stock will remain same as described in the updated EIA report of 2016.

3.3.5 Electro-mechanical Systems

The characteristics and features of electro-mechanical system will remain same as described in updated EIA report of 2016.

3.3.6 Temporary Construction Facilities

There will not be built any separate or new construction yard and batching plant for this extension project. Initially it is under plan to deploy the contractor of Contract Package 06 to continue the work from Motijheel to Kamalapur to use their existing facilities. It is not finalized yet.

3.4 Implementation Schedule

The implementation works of this extension project will take place in several time span. The land acquisition process will probably be started from January 2021 and it will take about 18 months to complete. Thus, the construction works would be started from July 2022. It will take about 02 years (till June 2024) to complete the construction of extension part. Therefore, it is expected that the operation of the extension part can be started at the end of 2024. It is noted that this tentative implementation schedule can be changed and adjusted in future.

3.5 Summary of Resettlement Action Plan

A separate Resettlement Action Plan (RAP) report will be prepared for this extension project. In addition, a separate Inventory of Loss (IOL) report has also been prepared. The key findings from IOL study are included in Section 6.16 of this report.

4 DESCRIPTION OF ALTERNATIVES

The necessity and feasibility of MRT Line-6 has been widely explored through a series of previous studies, e.g. DHUTS 1, DHUTS 2 and found very effective to reduce the traffic congestion of Dhaka City. The DHUTS 2 Study has also estimated the anticipated outcome of this line is the improvement of travel speed i.e. 7.6 km/hr once the project is completed. On the other hand, the travel speed will decrease to 2.8 km/hr. in 2025 without implementing the MRT-6 project. According to this study, the line was planned to build with its alignment from Uttara to Motijheel. Later, JICA Study Team prepared RSTP master plan in 2015, which proposed to build a metro rail network with six interconnected lines. This plan recommends to establish a confluence of four MRT Lines, i.e. Line-1, 2, 4, and 6 by building their terminuses at Kamalapur that got approval from government in August 2016. In following year, the JICA Feasibility Study Team for MRT Line-1 conducts a study to examine the issue of extending Line-6 from Motijheel to Kamalapur. This study incorporates the selection of options regarding appropriate way to connect Line-6 from Motijheel to Kamalapur into the Scope of Works of Line-1 consultant; however, this work has not been carried out yet. Then, following a discussion between JICA and DMTCL held on 08th July 2019, JICA and DMTCL agreed to conduct a topographic survey and social survey to estimate the extent of affected parties, resettlement and difficulties due to this extension project of MRT-6 before finalizing the fourth installment of loan. A primary feasibility study of the extension, including the alternative analysis between skyway and metro rail extension, resettlement and land acquisition, route selection, etc. was conducted in September 2019. The government approved the extension proposal for MRT Line-6 from Motijheel to Kamalapur station on 15th September 2019, while the final alignment was approved on 3rd September 2020.

4.1 No Build Alternative

An extensive analysis has been carried out through a series of studies and discussion to undertake to select the route of the alignment to get maximum benefits from least amount of loss. Without implementation of this project, the passengers of Line-6 will face difficulties to access other MRT Lines at Kamalapur. Traffic congestion will be increased in-between Motijheel and Kamalapur, the target of building MRT will be hindered. Passengers who arrive at Kamalapur having heavy luggage will also face difficulties to access Line-6 for inner city travel. Given the anticipated benefits (after completing the project) and troubles (if not implemented), it is firmly established that an extension of Line-6 from Motijheel to Kamalapur is necessary and inevitable.

4.1.1 Skywalk vs. MRT-6 Extension

An alternative option, Skywalk, was examined in spite of MRT-6 extension in the primary feasibility study (September 2019) for facilitating passengers to commute in-between Motijheel Station and Kamalapur. **Figure 4-1** shows the appearance of a typical skywalk. However, the existing data about passenger's satisfaction regarding the length of skywalk in other countries suggest that their dissatisfaction rises with the increase of length. The estimated length of skywalk between Motijheel and Kamalapur is 800-900 m, which would cause dissatisfaction to more than 50% transit passengers as per the experience of Tokyo (244

m), Nagoya (198 m), and Osaka (261 m) (MTCS 2002). Furthermore, skywalk also needs land acquisition, building demolition and makes the road underneath useless or less useful. Two skywalk routes were examined; among them, one route will be passing in front of Notre Dame College covering a length of 1.5 km, which is completely inappropriate for a skywalk. Another one will be crossing through a built-up area, which has substantial social impacts, such as land acquisition, resettlement, and closing of existing road below. As for MRT-6 expansion, it will also need land acquisition and resettlement, however, the net benefits suppress the loss in this case. The estimated number of passengers from Motijheel to Kamalapur will be about 19511, 26339, and 42207 per day in 2026, 2036, and 2056, respectively. In addition, more than 11,000 and 18,000 passengers in-between Motijheel and Kamalapur will be added from Bangladesh Railway on a daily basis in 2036 and 2056 after completing the proposed Bullet Train. A skywalk is not sufficient to accommodate this huge number of transit passengers. That is why the expansion of MRT-6 from Motijheel to Kamalapur with another station in Kamalapur is the most feasible alternative.

Figure 4-1: A typical skywalk (inner and outer view)

4.2 Grade and Alignment Alternatives

4.2.1 Selection of MRT Line-6 Extension Route

NKDM prepared alternate route selection using digitized mouza map and topo technology. Primarily NKDM proposed 3 alternative routes with 15 meters ROW for MRT Line-6 Extension project. All three routes passed through the residential area in south Kamalapur and the stations will be on the land of Bangladesh Railway. Finishing points/stations of proposed alternative routes 1&2 are located in the south of Kamalapur railway station, while route-3 finishes at west side of the existing stations. Initially, DMTCL choose and selected alternative route-3 (Option-3) for MRT Line-6 extension from Motijheel to Kamalapur and started discussion with Bangladesh Railway. The length of the alternative route-3 is 1.16 km. **Figure 4-2** shows a map of the alignment of three proposed routes.

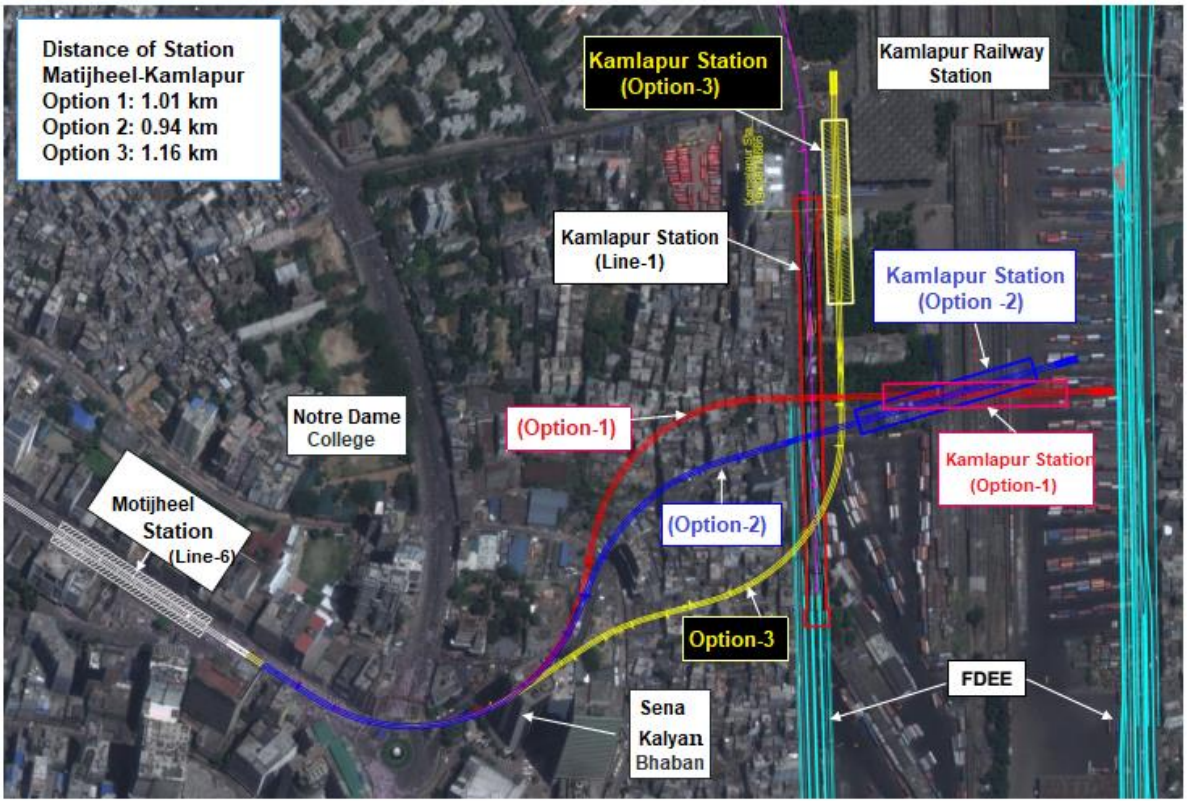


Figure 4-2: Three Alternative Alignments from Motijheel to Kamalapur

4.2.2 Re-Alignment of Option-3

After crossing central road, the alternative route (option-3) will impact Bangladesh railway's main administrative building, signaling facilities, mosque, one office building and some semi-pucca structures on BR land. Moreover, station of alternative route (option-3) will be very close to the existing terminal building of Kamalapur station. This terminal building has a historic and architectural value due to its exclusive and superb architectural design. Furthermore, Bangladesh Railway has its own master plan for future development. Considering above mentioned factors, BR requested not to place MRT Line 6 station in front of Kamalapur BR station. NKDM re-designed the alignment of the Option-3. Four new alignment based on modification of the Option-3 has been proposed; the technical specifications are as follows:

Name of Alignment	Technical Consideration
Option-3a	Line-1: Locate on the existing road edge Line-6: In BR land, conflict with the existing facilities
Option-3b-1	Line-1: In BR land Line-6: Locate on the existing road edge (scissor before station)
Option-3b-2	Line-1: In BR land Line-6: Locate on the existing road edge (scissor after station)
Option-3c	Line-1: Locate on the existing road edge (same as Option 3a) Line-6: On top of Line 1 station (2 stations at same location)

The main difference between Alignment of Option-3b-1 and Option 3b-2 is the station location; in Option-3b-1, the station Kamalapur will be located just in front of the Kamalapur BR station, while station of Option-3b-2 will be little far from the existing Kamalapur BR station.

4.2.3 Finalization of MRT Line-6 Extension Route

Considering various factors like minimum use of BR land, use of the existing ROW for alignment, no impact on BR signaling facilities and structures, and impact on BR Kamalapur Station, DMTCL finalized Option-3b-1 for the extension from Motijheel to Kamalapur. This alignment also obtained approval from the government. Selected alignment for MRT Line-6 Extension project is presented in **Figure 4-3**.

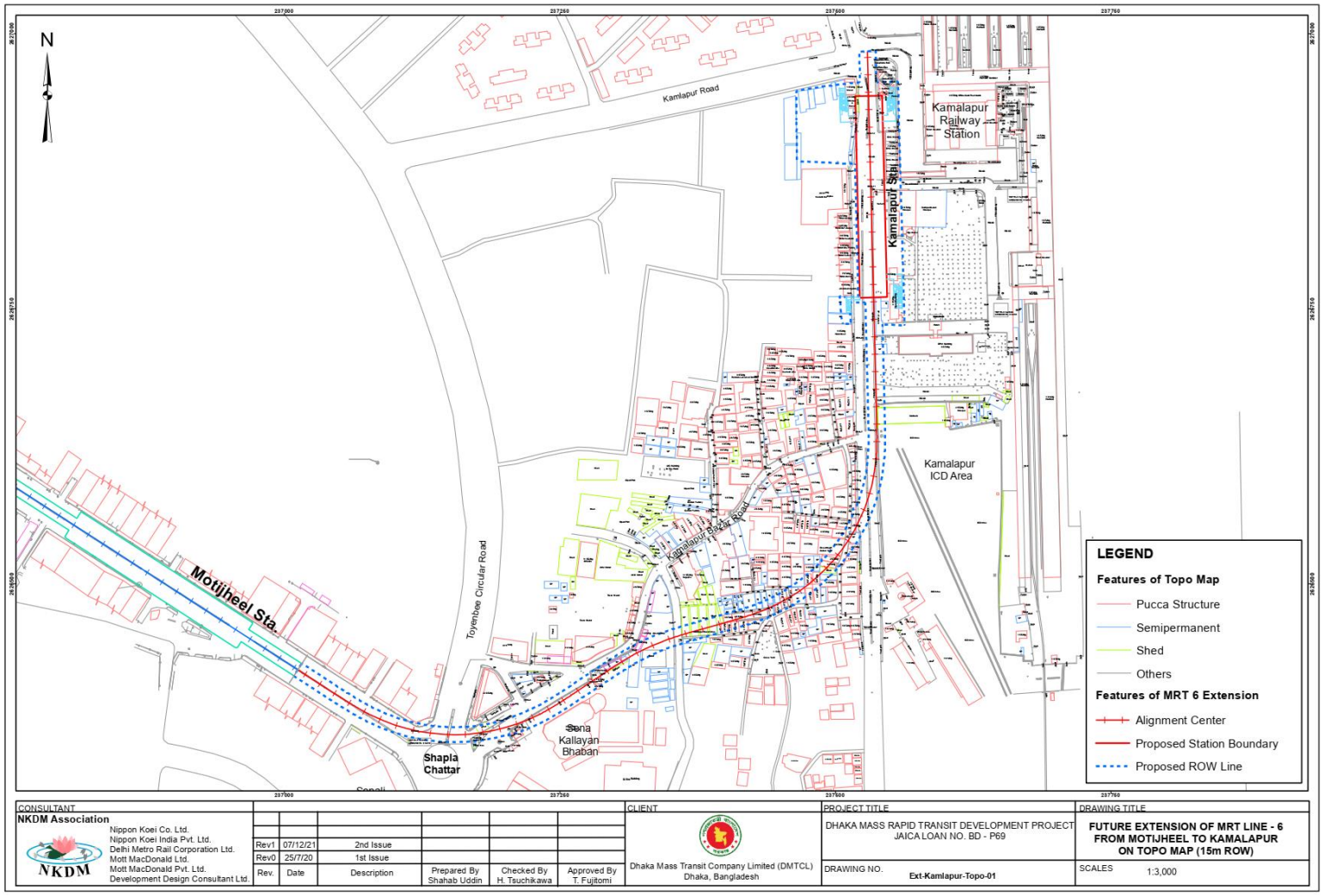


Figure 4-3: Final Alignment of MRT Line-6 Extension from Motijheel to Kamalapur

5 DESCRIPTION OF THE ENVIRONMENT (BASELINE DATA)

5.1 Physical Resources

5.1.1 Geology, Soils and Groundwater

The description of geological and soil characteristics provided in updated EIA report of 2016 covers the location of present extension project also. The physical geographical features described in the updated EIA report of 2016 under this section covers the whole Dhaka City, therefore, no separate discussion for this extension project is not necessary. On the other hand, no groundwater sample was tested during baseline survey of this extension project as no impact on groundwater was anticipated due to implementation of this project.

5.1.2 Surface Hydrology and Water Quality

The project location is a built-up area with mostly impervious surface. Segunbagicha Khal intercepts a series of storm culverts that drain the area around Motijheel. There is a box culvert road named Kamalapur Box Culvert Road in the project location. The box culvert road mainly is built on a khal by covering up the khal with concrete-made wall. There is no open water body in and around the project site. Surface runoff is mainly discharges through drain. The existing drains may not be adequate when the storm water discharge from viaduct will be added. The storm water from viaduct will mainly discharge through pre-installed pipeline inside pier and drain water into a pit at pier-bottom. Finally, water will be discharged to sewage line from the pits. The reconnaissance survey suggests that the entire drainage channel needs to be rebuilt along the alignment after completion of the project. No surface water sample collected and tested during baseline survey for this extension project, as there is no existence of surface water body.

5.1.3 Meteorology and Air Quality

This extension project covers a very small area and is situated in the same climatic region as Dhaka. There is only one weather station in Dhaka that covers the whole region. Consequently, the meteorological description provided in updated EIA report of 2016 is viable for this extension project also. Thus, no new discussion on meteorology for this extension project is required.

5.1.3.1 Air Quality

A baseline survey was conducted to assess ambient air quality of project location. Air quality was monitored in three locations i.e. Sena Kallyan Bhaban, Kamalapur Railway Station, and South Kamalapur (Kabarsthan) for 08 hours. Air quality parameters were selected based on the baseline survey of updated EIA report of 2016 in 2016. **Table 5-1**shows the summary findings of air quality monitoring, including both 08 hours average and standard period converted data. After calculating arithmetic average from observed data of every parameters that include one reading per minute, standard period average has been calculated by converting from observed average using appropriate formula. However, the standard average period will be considered as baseline data for air quality monitoring.

The findings show that the concentration of SPM is exceeded in every monitoring locations by more than two times of standard. In case of PM_{10}, the highest concentration is found in Kamalapur Railway Station followed by Sena Kallyan Bhaban having the values of 272 and 152 µg/m³, respectively. Among the hazardous gaseous variables, NOx, CO and SO_2 are found within the limit of the DOE standard in all monitoring locations.

The findings imply that the air of Dhaka city is inherently polluted, especially from the perspective of Particulate Matter (PM). In US Embassy Dhaka, there is air quality monitoring station, which provides real time concentration of value of $PM_{2.5}$ as well as Air Quality Index (AQI) values. According to US Embassy findings, the maximum concentrations of $PM_{2.5}$ on test days were 195, 215, and 194 µg/m³, respectively. On the other hand, minimum concentration of $PM_{2.5}$ were 131, 184, and 133 µg/m³, respectively. Besides, the average values were 93, 153, and 77 µg/m³. The results show that the concentration of $PM_{2.5}$ in Dhaka on test days was higher than Bangladesh standard 65 µg/m³. Another source of higher concentration of particles in the air Dhaka is trans-boundary pollution. The air flow from north carry many particles over Dhaka city. Due to high pressure at bay, all dirty air suspends over Dhaka. Therefore, it will be difficult to limit the concentration of particular matter within standard limit during construction phase of the extension project. Despite the pre-existing pollution condition in Dhaka city, the contractor should try hard as per the guideline of this report to suppress particular matter as much as possible during construction phase.

Table 5-1: Findings of air quality monitoring during baseline survey 2020

Location	Date	Parameter	PM_{10}	SPM	CO	NOx	SO_2
		Unit	µg/m³	µg/m³	ppm	µg/m³	µg/m³
Sena Kallyan Bhaban	06 Jan 2020	8 Hr. Average	207.36	446.45	0.29	55.48	31.34
		Converted data	152.45	446.45	0.29	7.82	23.04
Kamalapur Railway Station	07 Jan 2020	8 Hr. Average	370.34	559.61	0.71	235.34	52.73
		Converted data	272.28	559.61	0.71	33.16	38.77
South Kamalapur (Kabarsthan)	08 Jan 2020	8 Hr. Average	190.54	429.69	0.13	27.44	19.14
		Converted data	140.08	429.69	0.13	3.87	14.07
ECR 1997 (Amendment 2005)			150	200	9	100	365
		Duration	24 hr.	08 hr.	08 hr.	Annual	24 hr.

5.1.4 Noise

In the updated EIA report of 2016, number of sources report high noise levels at urban locations throughout the Dhaka city. Baseline noise level for MRT line 6 was conducted at 40 locations. Ambient noise levels of MRT line 6 generally exceed the standards for residential, mixed and commercial uses. Considering these findings of the updated EIA report of 2016, ambient noise level has been conducted for the MRT Line 6 extension at three points near the alignment. Equivalent noise of both day and night is presented in **Table 5-2**. Day–night equivalent noise level is also calculated for these areas. The data are represented in **Table 5-3**.

Table 5-2: Day and Night Equivalent Noise Level of MRT 6 Extension Part

Location	Code	Noise Level		Zone	Standard	
		Leq (day)	Leq (Night)		Day	Night
Sena Kallayan Bhaban, Motijheel	NL1	68.5	61.3	Commercial	70	60
Al Masjidu Assalam Jame Masjid, South Kamalapur	Nl2	61.5	57.9	Residential	55	45
Faridia Jame Mosque, Kamalapur	Nl3	71.5	62.9	Mixed	60	50

Source: Noise Pollution (Control) Rules 2006

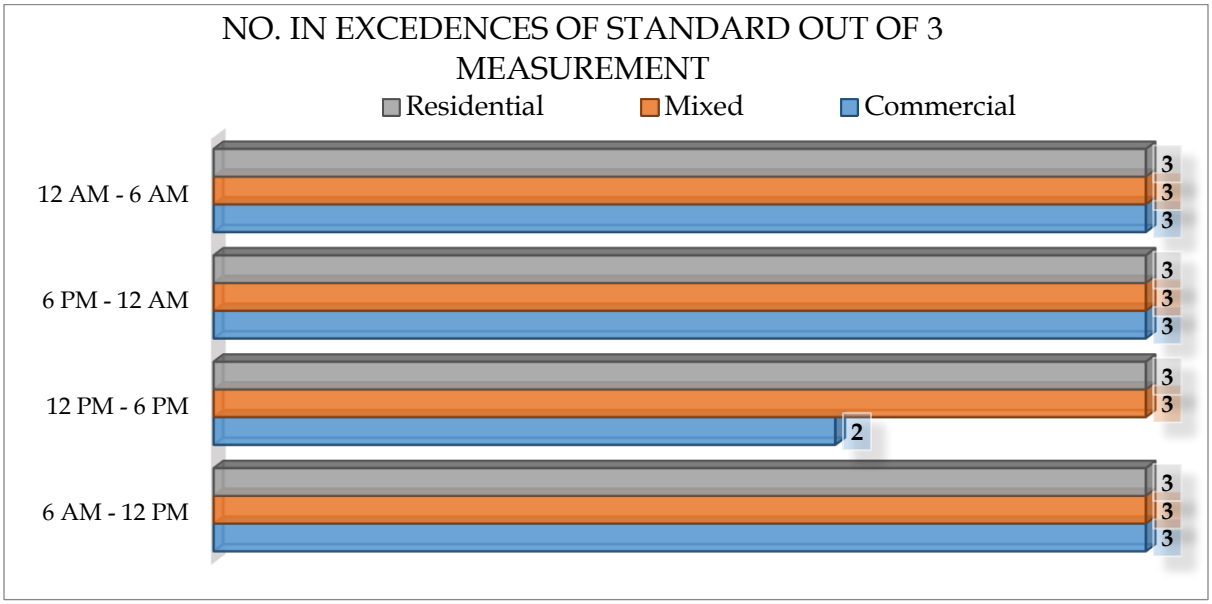


Figure 5-1: No. in Exceed of Standard out of Three Measurements in Extension Part

Table 5-3: Ambient Noise Levels at Various Receptors in dBA of Kamalapur Extension Part

Location of Receptor	Date	1st Quarter (6.00 am to 12.00 pm)				2nd Quarter (12.00 pm to 6.00 pm)				3rd Quarter (6.00 pm to 12.00 am)				4th Quarter (12.00 am to 6.00 am)				Ldn
		1 hr Recording Time		Leq_{10} of 1st Quarter	Period	1 hr Recording Time		Leq_{10} of 2nd Quarter	Period	1 hr Recording Time		Leq_{10} of 3rd Quarter	Period	1 hr Recording Time		Leq_{10} of 4th quarter	Period	
		from	to			from	to			from	to			from	to			
Sena Kallyan Bhaban, Motijheel	6/1/2020 - 7/1/2020	9:41:43	10:40:43	**73.57**	10:27:43	15:41:43	16:40:43	**74.63**	16:40:43	18:00:43	18:59:43	**71.75**	18:09:43	0:00:43	0:59:43	**62.58**	0:10:43	**69.75**
Al Mosjidu Assalam Jame Mosque, South Kamalapur	8/1/2020 - 9/1/2020	7:41:23	8:40:23	**68.49**	8:15:23	12:00:23	12:59:23	**66.06**	12:47:23	18:00:23	19:59:23	**70.09**	18:33:23	2:41:23	3:40:23	**60.39**	3:09:23	**65.03**
Faridia Jame Mosque, Kamalapur	7/1/2020 - 8/1/2020	8:41:34	9:40:34	**76.78**	9:36:34	13:41:34	14:40:34	**75.61**	14:15:34	19:41:34	20:40:34	**70.81**	20:22:34	1:41:34	2:40:34	**70.81**	1:20:34	**72.12**

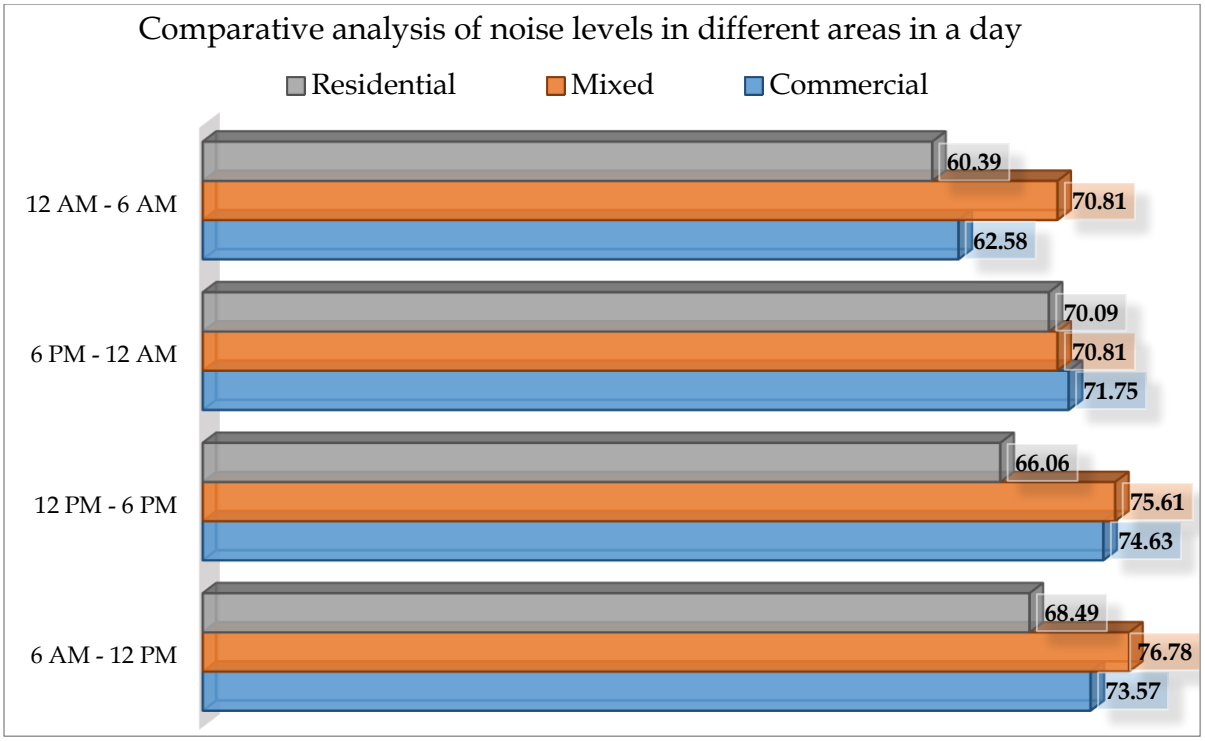


Figure 5-2: Peak Level of Noise in Different Areas

Three points have been considered as three different area. As the major business and commercial hub are located at Motijheel area, so the area considered as commercial[1]. The Kamalapur railway station considered as a mixed area because there are both commercial and residential activities around the station and some sensitive receptors are found near the station. South Kamalapur (Al Masjidu Assalam jame Mosque) area has considered as residential area as the predominant land use of the area is the residential dwelling. **Table 5-2** and **Table 5-3**show that the equivalent noise level at these three areas have exceeded the standard level except day in Motijheel area. Out of three measurements, in all quarter of a day have exceeded the standard of commercial, mixed and residential standard (**Figure 5-1: No. in Exceed of Standard out of *Three Measurements in Extension Part***). Peak level noise in 4 quarters of a day has been presented in **Table 5-3** and **Figure 5-2.** The peak level noise in a day is maximum from 6PM – 12 AM in residential area, 6AM – 12 PM in mixed area and 12PM – 6PM in commercial area. In the mixed area, peak level is quite higher than the commercial area. It is due to the movement of heavy vehicles (buses and trucks) through the Kamalapur area. Day-night average noise level is presented in the **Table 5-3.** Predicted noise of both construction and operation period is presented in Chapter 6 (section 6.1). Don't understand.

5.2 Biological Resources

5.2.1 Protected Areas

As like as the updated EIA report of 2016, in the KMME part there is no existence of protected areas or ECA area near or within the project boundary.

[1]https://en.wikipedia.org/wiki/Motijheel_Thana

5.2.2 Land Cover, Tress and Valued Flora

From the IOL study, it is found that about 454.12 decimal of land will be required for the extension part. From the inventory, it has been identified also that 358Nos.of trees need to be cut down for the KMME part. Detailed of the IOL study is represented in section 6.16.

5.2.3 Mammal, Reptile and Bird Life

5.2.3.1 Mammals

In the updated EIA report of 2016, it is already mentioned about the common mammals in or around the route line. It included domesticated cats, dogs and farm animals, rats, house shrews and fruit bats. In addition, in the KMME area bared land is currently exist behind the Ansar Camp area and a graveyard at South Kamalapur area. In these areas, any kind of mammals might be available. Considering the issues, consultation with local people has been conducted in 1st week of March and it has been found that Mongooses available in this area. However, this area is not the natural habitat of these Mongooses.

5.2.3.2 Reptiles

Normally in the bushes and graveyard area reptiles are common in rural settings. But in such urban settings, reptiles are very rare due to the anthropogenic activities at or around such area. Considering least possibility of finding reptiles, consultation with local people was conducted to find out their presence. They confirmed that there is no presence of reptile.

5.2.3.3 Birds

In the updated EIA report of 2016, birds of Dhaka area were identified. From the discussion with local people around the KMME part, it has been found that several types of birds exist in this area. House Crow (*Corvus splendens*) is a very common species in this area. Besides House Sparrow (*Passer domesticus*) and Common Myna (*Acridotheres Tristis*) also found in the KMME part. These birds can also be found in other parts of the city and this area is not the natural habitat of these birds.

5.3 Socioeconomic Resources

5.3.1 Administrative Divisions and Population

5.3.1.1 Administrative Divisions

For population statistics, social services and social infrastructure, administrative zones will serve as an important role. Details about administrative zone is already mentioned in the final EIA report of 2016. But the term DCC will be expressed as DNCC and DSCC which has been dissolved by the Local Government (City Corporation) Amendment Bill 2011 on November, 2011[2]. In addition, RAJUK Uttara Model Town area (Depot, Uttara North Station, Uttara Central Station and Uttara South Station) is now under Zone No. 6 of DNCC[3]. Rest of the information (such as Ward) will be kept same as it is in the EIA report of 2016.

[2]https://web.archive.org/web/20111130233931/http://www.bdnews24.com/details.php?id=212488&cid=3

[3]http://www.dncc.gov.bd/site/page/c0b6953f-16d3-405b-85e9-dece13bb98de/-

The KMME part of MRT Line 6 is under the Ward No. 8 and 9. Area of Ward no. 9 is already identified in **Table 5-12** of the updated EIA report of 2016. Area of Ward no. 8 is identified in the **Table 5-4**

Table 5-4: Ward no. 8 adjacent to MRT Line 6 Extension Alignment

Ward	Thana Area / Road No.	Nearest Station
Ward No. 8	Bangladesh Bank Colony, Sonali Bank Colony, R.K Mission Road, Gopibag, Kamalapur, Motijheel, B Railway Barak	Motijheel and Kamalapur

Source: http://dscc.gov.bd/site/page/489c2445-4a6e-4917-9580-0dadd8057dec/-

5.3.1.2 Populations

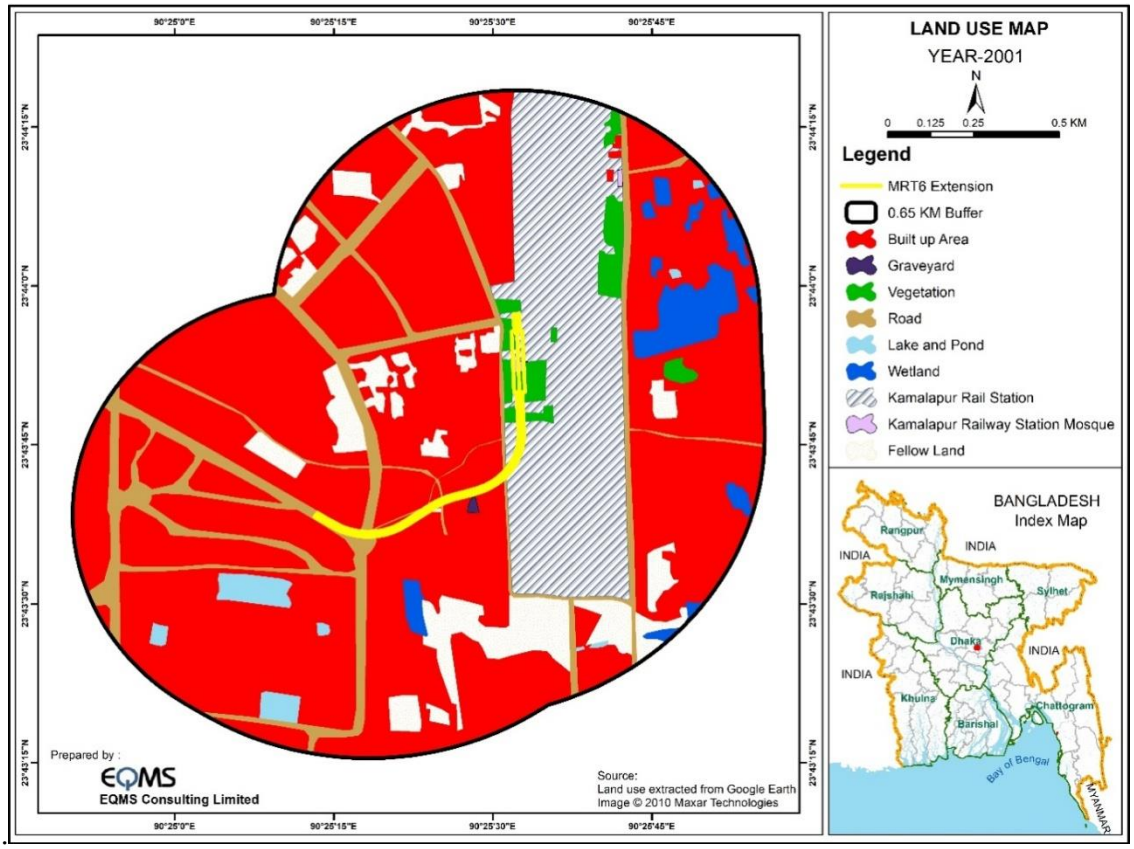
As per the last population and housing census 2011 the information, regarding population statistics have already mentioned in the updated EIA report of 2016. After the 2011 census, the next census will be in 2021. But as per the world population review record in 2016 the population of Dhaka crossed 18 million and in 2020 the population is more than 21 million. Currently the growth rate in Dhaka city is 4.2%.[4]

5.3.2 Land Use along Rail Alignment

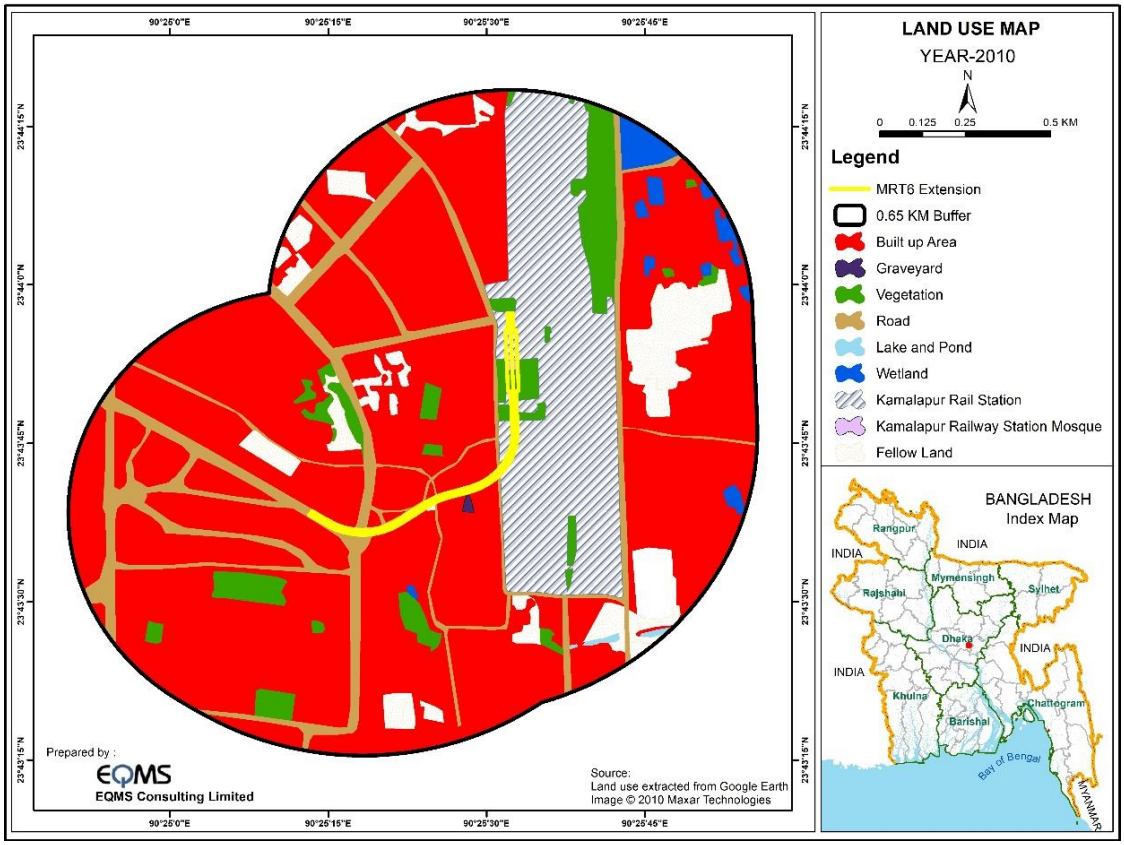
The MRT line 6 extension covers a small part of Dhaka. The land use pattern of Dhaka in 1990, 2000 and 2010 is already discussed in the updated EIA report of 2016. In this section, 0.65 km buffer land use of route alignment has been discussed. As it was identified from the previous land-zoning pattern of Dhaka from the updated EIA report of 2016 about the built up area that was in increasing trend, same trend has been observed in the KMME part also. From the 2001 scenario, it has been identified that most of the adjacent area of the KMME part was built area, very small part was green and fellow land. In 2010 and 2019, the ratio has increased for the built up area, fellow land has been diminished periodically especially in the southern part of the Kamalapur. Wetland in the eastern part of the Kamalapur area was turned into fellow land by 2010 and then transformed to build up area and a small portion as a vegetative area.

Rest of the information will be kept same as it is identified in section 5.3.2 of the updated EIA report of 2016. Comparative analysis of land use around the MRT line 6 extension area is given in **Figure 5-3.**

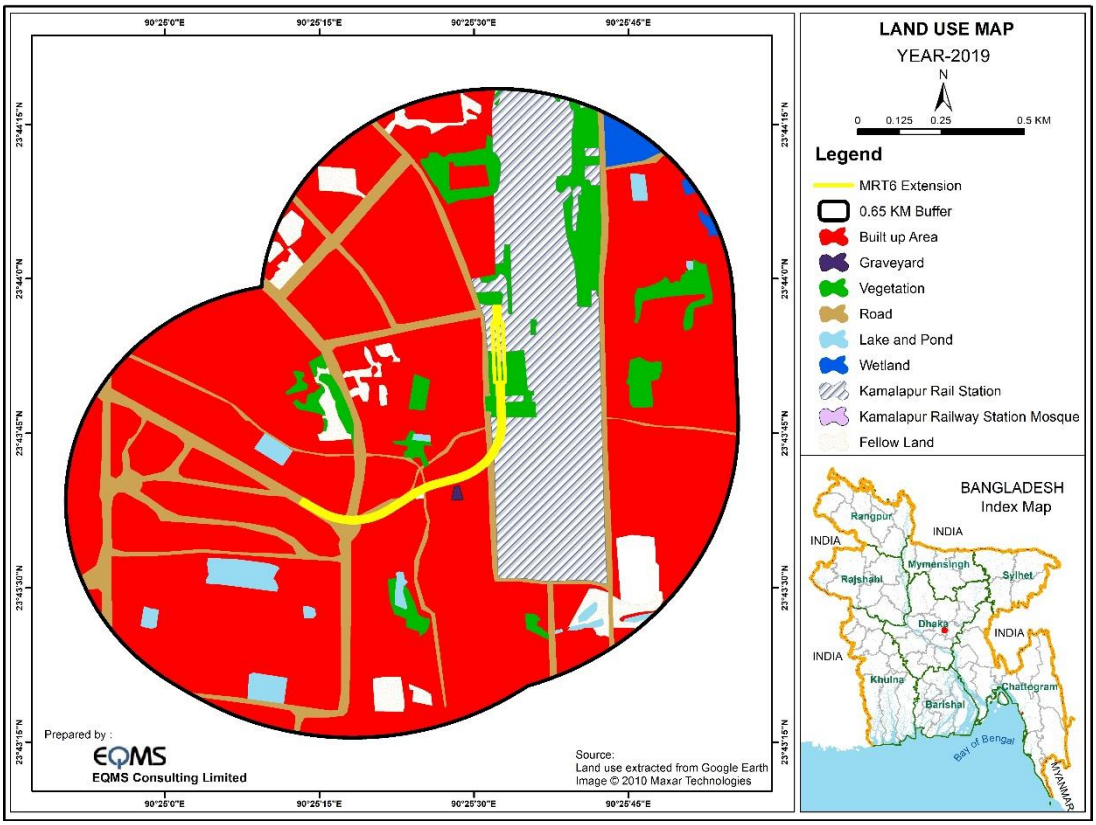
[4] *https://worldpopulationreview.com/world-cities/dhaka-population/*


LAND USE MAP
YEAR-2001
N
0 0.125 0.25 0.5 KM
Legend
MRT6 Extension
0.65 KM Buffer
Built up Area
Graveyard
Vegetation
Road
Lake and Pond
Wetland
Kamalapur Rail Station
Kamalapur Railway Station Mosque
Fellow Land
BANGLADESH
Index Map
Rangpur
INDIA
Rajshahi
Mymensingh
Sylhet
Dhaka
Khulna
Chattogram
Barishal
Bay of Bengal
MYANMAR
Prepared by :
EQMS
EQMS Consulting Limited
Source:
Land use extracted from Google Earth
Image © 2010 Maxar Technologies

a. 2001


LAND USE MAP
YEAR-2010
N
0 0.125 0.25 0.5 KM
Legend
MRT6 Extension
0.65 KM Buffer
Built up Area
Graveyard
Vegetation
Road
Lake and Pond
Wetland
Kamalapur Rail Station
Kamalapur Railway Station Mosque
Fellow Land
BANGLADESH
Index Map
Rangpur
INDIA
Rajshahi
Mymensingh
Sylhet
Dhaka
Khulna
Chattogram
Barishal
Bay of Bengal
MYANMAR
Prepared by :
EQMS
EQMS Consulting Limited
Source:
Land use extracted from Google Earth
Image © 2010 Maxar Technologies

b. 2010



c. 2019

Figure 5-3: Land Zoning Pattern around MRT Line 6 Extension Part from 2001 (a) to 2019 (c)

5.3.3 Nearby Community Infrastructure

At the nearby area of extension project, major community infrastructures are commercial buildings, school madrasah and mosques. List of the community infrastructures are given in the **Table 5-5**. These infrastructures will not be affected during construction or operation phase.

Table 5-5: List of Community Infrastructures in the KMME Part

Institute Name	Category	Location
Bangladesh Bank	Commercial	Motijheel
Sena Kallyan Bhaban	Commercial	Motijheel
Al Masjidul Asalam Jamia Mosque	Religious Institution	South Kamalapur
Al-Arabiyah Madrasah	Educational Institution	Kamalapur
Kamalapur Railway Jame Mosque	Religious Institution	Kamalapur
Kamalapur Railway Station	Commercial	Kamalapur
Shekh Faridiya jame Mosque	Religious Institution	Kamalapur

5.3.4 Housing

The housing of Dhaka residents described in the updated EIA report (2016). No updated population and housing census has been conducted after 2011. Therefore, information about housing will be same as mentioned in the updated EIA report of 2016.

5.3.5 Water and Sanitation Services

Currently WASA is covering total Dhaka Metropolitan area for supplying water serving about 20 million people. For supplying water, 78 per cent water comes from underground sources and the rest 22 percent comes from the surface water. Ground water is abstracted by using 887 Nos. deep tube wells. Surface water is supplying from the four water treatment plants. To reduce pressure on groundwater, government has taken initiative to rely on surface water treatment from 22 percent to 70 percent. As per annual report of 2018-2019 by Dhaka WASA, summary of water supply system is given in **Table 5-6**.

Table 5-6: Summary of Water Supply System in Dhaka metropolitan Area

Item	Unit	2018-2019
Deep Tube Well	Nos	887
Water Treatment Plant	Nos	4
Water Productivity/day	MLD	2550
Water Line	Km	3750
Water Connection	Nos	390642
Overhead Tank	Nos	38
Street Hydrant	Nos	1643

Currently, WASA is covering 934 km sewer line in all around the Dhaka. 26 Nos. of Sewer lift station is currently available in Dhaka City. There is one sewerage treatment plant in the Dhaka City area for the treatment of the sewage water. Storm sewer line is about 380 km and box culverts are about 10.5 km in length in or around the Dhaka City. In addition, WASA installed four permanent pumping stations in Kalyanpur, Dholaikhal, Rampura and Kamalapur that the capacity of 20 m^3/s, 22 m^3/s, 25 m^3/s and 15 m^3/s, respectively[5].

5.3.6 Transport Assets

In last five years (2015-2020), traffic of Dhaka City is growing quite faster than the last five years (reported in updated EIA report, 2016). In last five years, traffic has been increased about 64% than it was in 2015. In the updated EIA report of 2016, the growth rate of previous five years was 49%. So, from the statistics, it can understand that how fast traffic of Dhaka city is

[5]http://dwasa.org.bd/wp-content/uploads/2020/03/Annual-Report-Corrected-2018-19S.pdf

increasing. In **Figure 5-4**, percentage of the different types of vehicle in Dhaka City is shown.

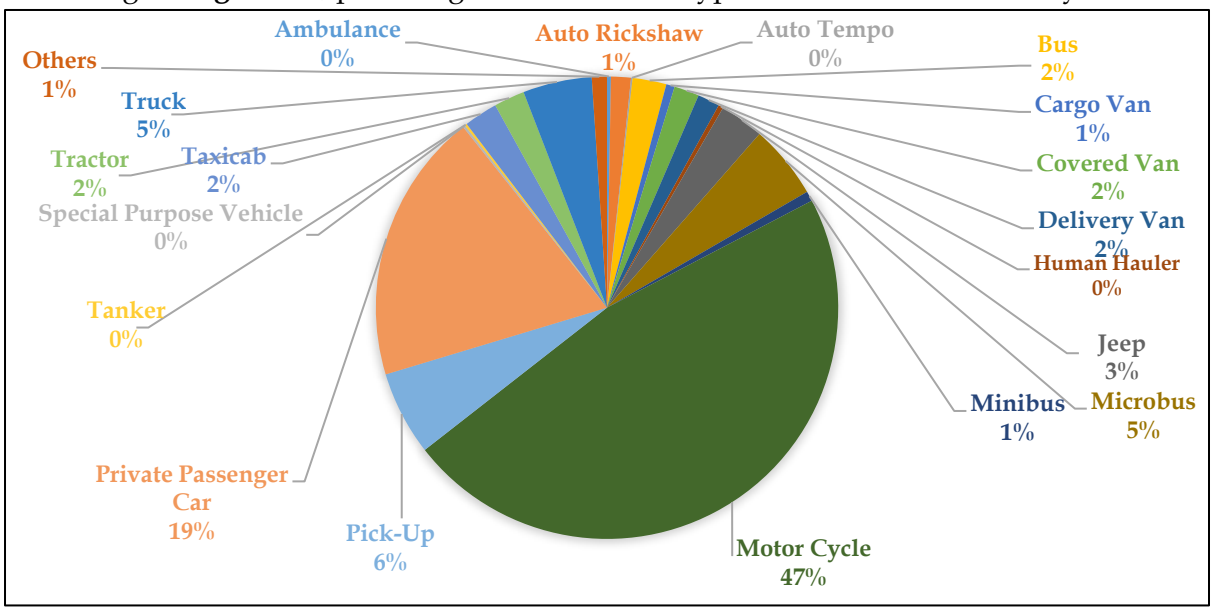


Figure 5-4: Type of Vehicle Percentage in Dhaka City (Source: BRTA, 2020[6])

From the figure, it is seen that Motor Cycle takes the highest percentage which is 47% of all the vehicles in Dhaka City. The second highest percentage is of the Private Passenger Car which is about 19% of all the vehicles. Public transport like Bus and Mini Bus Covered only 3% of all the vehicles. In February 2020, the total number of vehicles in Dhaka City are 1554051 Nos. while in whole country total number of vehicles are 4394365 Nos. So, out of total vehicles, Dhaka is representing about 35.4% of total traffic. From the numbers, it can understand how much pressure on city road to take the commuters to different destination. In last five years, Motorcycle has increased 91%, Pick-up 72%, Covered Van 103%, Auto Rickshaw 156%, Ambulance 74%, Bus 53%, Cargo van 62%, Delivery van 45%, Jeep 70%, Private Passenger Car 32%, Tanker 66%, Truck 57% and others (vehicle except the identified vehicles) 429% (BRTA, 2020).

5.3.7 Religion

Regarding religion, the information will be same as it is mentioned in the updated EIA report of 2016.

5.3.8 Crime and Criminal activities

There is detailed information about the types of crime and criminal activities in the updated EIA report of 2016. Currently, the steps that have been identified in the updated EIA report of 2016 are acting more fruitfully to combat the crimes. Additionally, the law enforcement unit has taken a few more steps. The ACC has become stronger than they were to reduce corruption. The DoE enforcement team is more vigilant in the field to reduce environmental pollution. High court also become more pro-active to stop any kind of crime in Bangladesh. Also, the law enforcement team is more pro-active and digitized than they were before. Now people can take service in online. There is a hotline number to inform any kind of complaint

[6]http://www.brta.gov.bd

in every day for 24 hours. Also, people can submit any general diary in online about any crime. For special cases, the information of such an informer has been kept secret. CCTV cameras are installed in the main point of the road and almost in all the VIP zones.

5.3.9 Gender Based Violence

Gender-related issues are almost same as it is reported in the updated EIA report of 2016. But, currently, few actions have been taken by the government, national and international organizations and also by gender activists to reduce gender violence. Hopefully, in the near future this type of violence will be reduced. Though, the job market related fields are open for both male and female in the country. In the RMG sector, female (about 61%) are working more than the male (39%)[7]. Males have to come forward to reduce discrimination and give equal opportunity to both male and female[8].

5.3.10 In and Out Migration

The section 5.3.10 of updated EIA report of 2016 will remain same. Updated data of in and out migration has been added under this section. The overall in-migration rate in the sample area in 2018 was estimated to be 72.8 per thousand population[9]. This compares with an out-migration rate of 72.4 per thousand population resulting in a gain of 0.4 persons per thousand population. These rates were 73.8 and 74.3 in 2017 resulting in a loss of 0.5 persons per 1000 population. Migratory movement of the females was more pronounced than their male counterparts. For example, while 65.0 per thousand males moved into the sample area in 2018, the corresponding rate for females was 80.6 per thousand. A similar feature of movement was also noted in the case of out-migration: 65.4 for males and over 79.4 for females.

The incidence of in-migration in urban areas was about three times of the incidence with respect to the same event in rural area (38.6 vs 115.2). The tendency to out-migrate of the urban people was also very high compared to their rural counterparts; the rural-urban ratio being 1: 3.4. The flow of in-migration to rural areas exceeds the out-migration resulting in a net gain of 3.6 persons per thousand population. On the contrary, a net loss of 3.4 persons per thousand populations in urban area due to out-migration.

Migratory movement was the highest in Dhaka division with an in-migration rate of 122.3 and an outmigration rate of 125.1 resulting in a loss of 2.7 persons per 1000 population.

5.3.11 Employment

Similar statistics has been found for Dhaka city as it is reported in the updated EIA report of 2016. In fact, the labor force are quite same as it was reported during preparation of the updated EIA report of 2016. In recent statistics, it has been noted that the unemployment figure in 2016 and 2019 is same which is 4.2 percent of the total population.. From 1991 to 2019, the average mean is 4.3 percent of the total population. Highest unemployment rate was in 1997. From 2016 to 2019, highest unemployment rate was in 2018 (4.3 percent)[10]. Labor force

[7]https://cpd.org.bd/declining-female-participation-in-rmg-sector-cpd-study/
[8]https://www.daily-sun.com/post/448887/Bangladesh%E2%80%99s-Progress-in-Gender-Equality
[9] Report on Bangladesh Sample Vital Statistics 2018, Bangladesh Bureau of Statistics (2019)
[10]https://tradingeconomics.com/bangladesh/unemployment-rate

has increased about 6.18 million from 2016 to 2019[11].But in recent time, many people have been engaged with business entrepreneurship. Due to the digital development in every sector of the country, the people are also contributing into the national economy by involving themselves in various sector. In last five years, significant change has been observed. Lots of online services (like ride sharing, online shopping etc.) has started up where many people are working. A large number of people also doing freelancing work at their home[12]. Construction work of development projects (Metro Rail Line 6, Metro Rail Line 1, BRT, Elevated Express Way, Express Way etc.) are going on in or around the city of Dhaka. As a result, many people also move to Dhaka from villages for working in such development project. RMG sector is improving day by day and contributing in our national economy. Therefore, this has also created lots of employment opportunity for the general people especially the women.

5.4 Historical, Cultural and Archaeological Resources

In this extension part, a baseline survey has been conducted to find out the archaeological and historical sites. But in this 1.16 km area, no such archaeological or historical places of such interest exists except the Kamalapur Railway Station which is one of the structural beauty in Bangladesh and largest station in the country built during East Pakistan period. There is a mosque at south edge of the railway station. So, from the religious point of view this is the only establishment.

5.5 Current and Proposed Development Activities in Project Area

Current and proposed development project is already mentioned in the updated EIA report of 2016. Except these two, some of other development work is under process in the adjacent KMME part which has described in details below.

5.5.1 MRT Line 1

The Government of Bangladesh with financial loan from Japan International Cooperation Agency (JICA) is implementing the Mass Rapid Transit System Project aimed at alleviating traffic congestion and improving air quality in Dhaka City, thereby contributing to the economic and social development of Greater Dhaka Region. Considering these factors, MRT Line 1 is a high priority project for Dhaka. MRT line 1 has a total length of 29.8 km with 19 stations and 1 depot in the Purbachal area. The alignment of MRT Line 1 consists of two lines; one line connects Kamalapur with the Hazrat Shahajalal International Airport (hereafter the "Airport Line"). This runs through an underground tunnel that starts from the Kamalapur 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 Dhaka 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 Jamuna Future Park Station and heads towards the Purbachal area (hereafter the "Purbachal Line"). It has an underground

[11]https://data.worldbank.org/indicator/SL.TLF.TOTL.IN?locations=BD&view=chart
[12]https://www.weforum.org/agenda/2019/06/how-the-digital-economy-is-shaping-a-new-bangladesh/

section from Pragati Sarani to Kuril followed by the elevated section from East side of Kuril Flyover to Purbachal. From Kuril Transition, this line will proceed eastward directly above the median strip of the Purbachal Highway to the Purbachal Terminal Station. The Purbachal line has a total of 15.3 km length connecting 7 elevated stations. This project is currently under detailed design phase.

5.5.2 Multimodal Hub at Dhaka Railway Station

About 120,000 passengers use Dhaka Railway Station (Kamalapur) daily to avail 117 nos. trains. According to the Revised Strategic Transport Plan (RSTP) of Dhaka city, MRT Line 6: (Uttara to Motijheel) will be extended to Kamalapur. Dhaka Elevated Expressway will be connected with Kamalapur area through loops, MRT Line 1 (Airport to Kamalapur) will also end up at Kamalapur. At present, there are different existing and proposed mode of transport around Kamalapur Railway Station. Along with conventional road and railways, MRT Line and high-speed railway are proposed. Therefore, an integrated hub to provide maximum comfort and convenience to the users is required. The proposed project will allow a private partner to develop a modern multi modal transport hub, which will:

- Reduce traffic congestion.
- Integrate different mode of transport.
- Provide convenience to the passenger.

Besides these projects, few housing projects are also proposed for construction near Kamalapur area.

5.6 Conclusion

Current extension of MRT Line 6 from Motijheel up to Kamalapur is mostly important in consideration of the commuter who usually commute from Kamalapur to Motijheel or from Motijheel to Kamalapur. This extension part will ease the passing on of those who usually travel to different parts of the country from the country's biggest railway station and also for the travelers coming from Airport to Kamalapur via MRT Line 1 or DEE and want to visit Motijheel. Currently the route line is the best possible route in consideration of the social impact. Design team should consider the presence of old building in the south Kamalapur area during the detail design stage. Since there are residential buildings along the proposed alignment therefore, nighttime work should be restricted.

6 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential impacts of project implementation works on different variables of natural and human environment. This extension project introduces a new scope of works, *viz.* demolition works, which was not applicable for the updated EIA (2016). Since the extended alignment will go through a built-up area, several number of infrastructures need to be demolished essentially. The following sections incorporated the probable impacts of demolition works and other newly introduced impacts, if any. In most of the case, environmental impacts will remain same as identified in the updated EIA report of 2016.

6.1 Noise

Noise impact due the MRT line 6-extension project construction and operation which will be more or less same as the existing under construction MRT line 6 project. The major activities under the MRT line 6-extension project during the construction phase are construction of foundations and piers erection of precast viaduct section and construction of Kamalapur station. Noted that there are residential and commercial buildings along the MRT line 6-extension alignment which may have significant level of noise impact during construction and operation of the project.

6.1.1 Train Operation

Noise due to train operation of MRT 6 has been predicted in the updated EIA report of 2016 (2016) under section 6.1.1. Train operation noise of MRT line 6-extension project also predicted based on the same method statement of the MRT line 6 project.

6.1.1.1 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 been presented in **Figure 6-1** of the existing MRT line 6 EIA report.

6.1.1.2 Target Level

A detail discussion regarding target level of noise has been provided in updated EIA report of 2016, which will remain same for this extension project.

6.1.1.3 Condition

The general input conditions for the analysis of noise impacts during operations are shown in Table 6-2 of the updated EIA report of 2016 of MRT line 6.

6.1.1.4 Method for Predicting Transit Noise

The transit noise prediction has been done following the same approach used in the existing MRT Line 6 EIA study. 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. Detail method for predicting transit noise is presented in section 6.1.1.4 of MRT line 6 EIA report.

6.1.1.5 Evaluation of Noise Impact

The evaluation of noise impact has been determined based on the equation presented in section 6.1.1.4 of MRT line 6 EIA report, different primary and secondary input variables in accordance with the curvature (greater or lesser than 400 m) and anticipated travel velocity based on the Communication Based Train Control (CBTC) operation schedule. A spreadsheet was setup to place all equations and data for getting output. Predicted noise levels are shown in **Table 6-1**.

Table 6-1: 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)	160	200	230	250	350	400	500	over 550
Max[m] controlled speed in (km/hr)	45	50	60	70	80	85	95	100
Ballastless track[2], (L_{w1})	102.9	103.6	104.7	105.6	106.4	102.1	102.8	103.1
Vibration Proof BLT, (L_{w1}')	99.9	100.6	101.7	102.6	103.4	99.1	99.8	100.1
Structure noise[3], (L_{w2})	94.6	94.6	94.6	94.6	94.6	92.5	92.5	92.5
Vibration Proof Str. noise, (L_{w2}')	86.4	86.4	86.4	86.4	86.4	85	85	85
Vehicle Device Power L. noise[4], (L_{w3})	80.1	82.9	87.6	91.6	95.1	96.7	99.6	100.9
BLT Rolling noise[5], $LA_1=L_{w1}$- 36.2 (Parapet ht 1 m)	66.8	67.5	68.6	69.5	70.3	66.0	66.7	67.0
VP BLT Rolling noise, $LA_{1'}=L_{w1'}$ - 36.2 (Para Ht 1 m)	63.8	64.5	65.6	66.5	67.3	63.0	63.7	64.0
BLT Structure noise[6], $LA_2=L_{w2}$- 21.5	72.2	72.2	72.2	72.2	72.2	70.1	70.1	70.1
VP BLT Structure noise, $LA_{2'}$ =Lw2' -21.5	64.0	64.0	64.0	64.0	64.0	62.6	62.6	62.6
Vehicle Device noise[7], $L_{A3}=L_{w3}$- 33.2 (Para ht 1 m)	47.0	49.8	54.5	58.5	62.0	63.6	66.5	67.8
Peak Level noise,L_{Amax}=10 log $[\sum^{n}_{i=1}10^{LAi/10}]$	73.3	73.5	73.8	74.2	74.6	72.2	72.9	73.3
Sound Exposure[8] Level, L_{AE} =L_{Amax}+10 log(576/V)	84.4	84.1	83.6	83.3	83.2	80.5	80.7	80.9
Predicted value[9], Leq= 10 log $[0.0074*10^{(LAE/10)}]$	63.1	62.8	62.3	62.0	61.9	59.2	59.4	59.6
Peak Lev VPT noise,L'_{Amax}=10 log $[\sum^{n}_{i=1}10L^{Ai/10}]$	67.0	67.3	68.1	68.8	69.7	67.9	69.4	70.2
Sound Ex.of VPT Level, L_{AE} =L'_{Amax} + log (576/V)	78.0	77.9	77.9	78.0	78.3	76.2	77.2	77.8
VPT Predicted value[9], Leq= 10 log $[0.0074*10^{(LAE/10)}]$	56.7	56.6	56.6	56.7	57.0	54.9	55.9	56.5
BLT Rolling noise[5], $LA_1=L_{w1}$- 37.2 (Parapet ht 1.5 m)	65.8	66.4	67.5	68.4	69.2	65.0	65.6	65.9

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], $L_{A3}=L_{w3}$-34.2 (Para ht 1.5 m)	46.0	48.7	53.5	57.5	61.0	62.5	65.4	66.8
Peak Level noise,L_{Amax}=10 log $[\sum^{n}_{i=1}10^{LAi/10}]$	73.1	73.2	73.5	73.8	74.2	71.8	72.4	72.8
Sound Exposure[8] Level, L_{AE} =L_{Amax}+10 log(576/V)	84.2	83.8	83.3	83.0	82.7	80.1	80.2	80.4
Predicted value[9], Leq= 10 log $[0.0074*10^{(LAE/10)}]$	62.9	62.5	62.0	61.7	61.4	58.8	58.9	59.1
BLT Rolling noise[5], $LA_1=L_{w1}$- 37.2 (Parapet ht 2 m)	64.8	65.5	66.5	67.5	68.3	64.0	64.7	65.0
Vehicle Device noise[7], $L_{A3}=L_{w3}$-34.2 (Para ht 2 m)	45.0	47.8	52.5	56.5	60.0	61.6	64.5	65.8
Peak Level noise,L_{Amax}=10 log $[\sum^{n}_{i=1}10L^{Ai/10}]$	72.9	73.0	73.3	73.5	73.8	71.5	72.0	72.4
Sound Exposure 8 Level, L_{AE} =L_{Amax}+10 log(576/V)	84.0	83.7	83.1	82.7	82.4	79.8	79.9	80.0
Predicted value[9], Leq= 10 log $[0.0074*10^{(LAE/10)}]$	62.7	62.3	61.8	61.4	61.1	58.5	58.6	58.6
VP BLT Rolling noise, $LA_{1'}=L_{w1'}$ - 37.3 (Para Ht 1.5 m)	62.8	63.4	64.5	65.4	66.2	62.0	62.6	62.9
Vehicle Device noise[7], $L_{A3}=L_{w3}$-34.3 (Para ht 1.5 m)	46.0	48.7	53.5	57.5	61.0	62.5	65.4	66.8
Peak Lev VPT noise,L'_{Amax}=10 log $[\sum^{n}_{i=1}10L^{Ai/10}]$	66.5	66.8	67.4	68.2	69.0	67.1	68.5	69.3
Sound Ex.of VPT Level, L_{AE} =L_{Amax} + log (576/V)	77.5	77.4	77.3	77.3	77.6	75.5	76.4	76.9
VPT Predicted value[9], L'eq= 10 log $[0.0074*10^{(LAE/10)}]$	56.2	56.1	56.0	56.0	56.3	54.1	55.1	55.6
VP BLT Rolling noise, $LA_{1'}=L_{w1'}$ - 37.2 (Para Ht 2 m)	61.8	62.5	63.5	64.5	65.3	61.0	61.7	62.0
Vehicle Device noise[7], $L_{A3}=L_{w3}$-34.2 (Para ht 2 m)	45.0	47.8	52.5	56.5	60.0	61.6	64.5	65.8
Peak Lev VPT noise,L'_{amax}=10 log $[\sum^{n}_{i=1}10L^{Ai/10}]$	66.1	66.4	66.9	67.6	68.4	66.6	67.9	68.6
Sound Ex.of VPT Level, L_{AE} =L_{Amax} + log (576/V)	77.2	77.0	76.8	76.8	76.9	74.9	75.7	76.2
VPT Predicted value[9], L'eq= 10 log $[0.0074*10^{(LAE/10)}]$	55.9	55.7	55.5	55.4	55.6	53.6	54.4	54.9

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} decreased by 3.0 dB.

[3]Use of VPT reduces surface noise 7.5 dB in straight section and relaxing curves, and 8.2 dB in sharp curves with radius of curvature less than 400 m.

[4]Vehicle Device Noise is calculated by the Equation, $L_{W3}=60\log(nV/100)+10\log(l_m/l)+B=60\log(0.0606V)+54$, 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 for Ballast less track.

[5]Rolling noise $L_{A1}=L_{W1}$-8-10logr1+10log$[(l/2r1)/(1+(l/2r1)^2+\tan^{-1}(l/2r1)]+\alpha_d=L_{Wi1}$-19.17, with values of train length l=160, Dumping number α_d=(-)17,7714, Distance between track centre and sound receiving point, r1=17.1898 with horizontal 7.5 m.

[6]Structure Noise $L_{A2}=L_{W2}-8-10\log r1+10\log[(\cos\theta)(\tan^{-1}(l/2r2))]=L_{W2}-20.301$, with value r2=16.19 with horizontal 7.5 m.

[7]Vehicle Device Noise $L_{A3}=L_{W2}-5-10\log r_1+10\log[(l/2r1)/(1+l/2r1)^2+\tan^{-1}(l/2r1)]+\alpha_d=L_{W3}-16.17$, with the values as in (5).

[8]Sound Exposure Level $L_{AE}=L_{Amax}+10\log t=L_{Amax}+10\log(576/V)$, with t=train passing time (sec)=2.15sec, V=velocity km/hr.

[9]Predicted value (as per DOE) $L_{eq10}=10\log(nx10^{LAE/10}/T)=10\log(0.0074*10^{(LAE/10)})$, with values, number of train n=4.444 in 10 minutes, T=600(i.e., 10 minutes).

Three locations were selected for noise level monitoring along the MRT line 6-extension alignment and predictive analysis is applied to those locations. Ambient noise results (**Table 5-3**) and predicted result (**Table 6-1**) are combined to get the combined noise impact level at receptor points. Ballast Less Tract (BLT) and Vibration Proof Track (VPT) including 1.5-meter parapet wall have been considered for evaluating noise impact at the receptor points to determine a feasible option. The combined sound level predictions are shown in **Table 6-2**. Conclusion reached from the data include the following:

a) **Ballast less Track (BLT) –**
   - The predicted noise levels from transit operations on ballastless track is generally in the range of ambient noise levels. Transit noise is on average 0.19 dB greater than peak ambient noise levels and 5.09 dB greater than observed LD/N levels. Median values are 0.17 and 5.13 dB respectively.
   - Transit noise, when added to ambient noise levels, provides a combined noise level that is, on average, 0.25% greater than observed ambient peak noise levels and 7.40% greater than observed day/night noise levels. Most increases are about 0.23% and 7.41%, respectively (median values).

b) **Vibration Proof Track (VPT)**
   - Transit noise is on average 0.05 dB greater than peak ambient noise levels, and 4.95 dB greater than observed LD/N levels. Median values are 0.05 and 4.96 dB respectively.
   - Transit noise, when added to ambient noise levels, provides a combined noise level that is, on average, 0.07% greater than observed ambient peak noise levels and 7.21% greater than observed day/night noise levels. Most increases are about 0.08% and 7.12%, respectively (median values).

It has been found that the average transit noise and combined noise at the receptor points will be 0.14 dB above peak ambient noise for ballast less tract than vibration proof track.

Table 6-2: Noise Levels at Elevated Sections with respect to Receptors

Name of Receptor	Sena Kallayan	Al Masjidu Assalam Jame Masjid	Faridia Jame Mosque, Kamalapur	Average	Median
Aprx. Chainage of the Receptor					
Distance from Track Centre (m)	11	60	12		
Ambient Peak(7am-7pm), Leq	74.6	70.1	76.8		
Ambient Noise Level, L_{dn}	69.7	65.0	72.1		

Name of Receptor	Sena Kallayan	Al Masjidu Assalam Jame Masjid	Faridia Jame Mosque, Kamalapur	Average	Median
Train Speed (Km/h) at R>500m					
BLT Transit Noise at R>500, Leq					
Train Speed at 500>R>300m					
BLT T.Noise at 500>R>300, L_{eq}					
Train Speed (Km/h) at R<=300m	45	45	45		
BLT Transit Noise at R<=300, Leq	62.7	54.9	62.5		
Train Speed (Km/h) at R<=300m	45	45	45		
VPT Transit Noise at R<=300, Leq	56.2	51.2	56.0		
Combined Noise Impact Levels acting on Receptors (BLT)	74.9	70.2	77.0		
Combined Noise Impact Levels acting on Receptors (VPT)	74.7	70.2	76.8		
Pct Increase over Peak Ambient considering ballast less track	0.36%	0.19%	0.21%	0.25%	0.23%
Pct Increase over D/Nt Ambient considering ballast less track	7.4%	8.0%	6.7%	7.40%	7.41%
Pct Increase over Peak Ambient considering VPT	0.08%	0.08%	0.05%	0.07%	0.08%
Pct Increase over D/Nt Ambient considering VPT	7.1%	7.9%	6.6%	7.21%	7.12%
Diff between combined and peak (BLT)	0.27	0.13	0.16	0.19	0.17
Diff between combined and D/N (BLT)	5.17	5.23	4.86	5.09	5.13
Diff between combined and peak (VPT)	0.06	0.06	0.04	0.05	0.05
Diff between combined and D/N (VPT)	4.96	5.16	4.74	4.95	4.96

6.1.1.6 Mitigation Measures

There are some commercials and residential buildings close to the MRT line 6-extension alignment. The principle mitigation measures for noise impact due to operations are use of vibration-proof track (MSS cushion) and 1.5-meter noise barriers. The vibration proof MSS track and noise barrier will be installed for entire track.

6.1.2 Construction Noise Analysis

The main sources of noise level during the construction phase are different types of equipment used for foundation, pier and viaduct construction and station construction. This section addresses noise levels expected due to construction of MRT line 6-extension project.

6.1.2.1 Approach

The prediction of construction noise on receptor points has been carried out based on same approach and method used for the MRT line 6 project. Point of impact on the receptors are taken to be 11-60 m from the sound source as the Sena Kallayan Bhaban is located at a distance of 11 meters, Al Majidu Assalam Jame Mosque is 60 meters and Faridia Jame Mosque is about 12 meters from the track center. 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.

6.1.2.2 Applicable Standards

The ambient noise levels along the alignment already exceeded the standard. There is no standard in Bangladesh for construction noise; target noise limits for construction depend on ambient noise conditions and standards used in other countries, which are reviewed and stipulated in **Table 6-9** of updated EIA report (2016) of MRT line 6 project. Based on the other countries standard following table has been summarized the standards proposed for construction noise control for the project.

Table 6-3: Target Noise Level at Construction Phase

Category	Day Time (Leq)	Night Time (Leq)
Sensitive Areas and Hotel	75 dB	65 dB
Office and Commercial	85 dB	85 dB
Commercial and Service	85 dB	85 dB
Areas with ambient noise level (>65 dB)	Ambient Noise Level +10 dB	-

Notes: Evaluation point is at boundary of buildings
Daytime: 6:00-22:00, Night time: 22:00-6:00
Sensitive areas: residential areas, hospitals, schools, places of religious worship

Source: Table 6-10 of updated EIA report (2016) of MRT line 6 project

6.1.2.3 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, as described in contract tender documents of MRT line 6 project, and sound power levels for equipment available in the literature. 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]* $L_{source-combined}$: *combined noise level at source [dB]* *a: Ratio of operating hours with noisy work (0-1)*

Source: Updated EIA report (2016) of MRT line 6 project

6.1.2.4 Impact Prediction

Same method has been used for impact prediction as shown in section 6.1.2.4 of updated EIA report (2016) of MRT line 6 project. 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**]

dB) for all receptor locations.

Table *6-4* 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 (11-60 m) and further combined with ambient noise levels that were measured at the locations.

Table *6-5* shows results for construction work along the alignment. The combined noise level at monitoring locations varies from 67.0-79.7 dB whereas the ambient noise levels are 70.1-76.8 dB. The ambient noise level at all monitoring locations exceed 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.

Table 6-4: 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 Vibatory 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 6-5: Expected Noise Levels at Receptor Points during Construction

Section	Kind of Construction		Sena Kallayan Bhaban	Al Masjidu Assalam Jame Masjid, South Kamalapur	Faridia Jame Mosque, Kamalapur
		Ambient noise (Leq_{10})	74.6	70.1	76.8
		Distance from Source	11	60	12
Target Noise Level (Leq)		Day	84.6	85	80
		Night	84.6	85	80.1
Depot & Track Preparation	Concrete Casting	Leq_{10}	79.3	68.0	79.1
	Framework Construction	Leq_{10}	78.0	67.5	77.9
Elevated Track	Girder Installation & Track Preparation	Leq_{10}	76.5	67.0	76.7
Elevated Track & Station	Preparation	Leq_{10}	79.7	68.2	79.4
	Ground Work	Leq_{10}	79.3	68.0	79.1
	Girder Inst.& Framework Construction	Leq_{10}	78.5	67.7	78.3

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 updated EIA report of 2016 under section 6.1.2.4 are also applicable for the extension project. The following additional mitigation measures are proposed to reduce noise impacts from construction:

- Steel Sheet pile driving activities should be restricted during day time;

- Use low noise generating equipment as much as possible since there are residential buildings close to the alignment;
- 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.

6.1.2.5 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 standard. 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, the 2006 DOE Sound Control Ordinance 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 works 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 2006 Sound Control Ordinance.

6.1.3 Noise due to Demolition

Noise generated from demolition works depends on the process of demolition and associated equipment. The process of demolition should be adopted carefully because there are many infrastructures which are located very close to the affected infrastructure and due to their close proximity, there is a huge chance of these infrastructures to get affected while demolition work will take place. In this case, use of explosives is not suitable because there is a chance of collateral damage to the immediate surrounding structures. Rather traditional demolition method using both hand-operated and mechanical equipment, such as hammer, jackhammer, concrete chipper, scrabbles, steel rod cutting saw, excavator, lifting crane, etc. is recommended. Concrete chipping and breaking as well as rod cutting using hand and electricity-operated equipment will generate high noise, which will potentially exceed the project standard of 85 dBA. Unless high-explosive detonation, impact pile driving, or a rock drill is used, heavy equipment used during demolition activities (e.g., jackhammers and bulldozers) could generate maximum combined noise level of around 95 dBA at a distance of

15 m (50 ft) from noise sources[13]. Since the neighborhood of affected structures are mainly residential and commercial area, the impact of noise generated from demolition works will be significant. Receptors of noise are mainly the adjacent city dwellers and workers involved in demolition works. There are few religious institutions, i.e. mosque, *dorgah* and madrasa located in neighboring area of demolition site. On the other hand, there is no hospital within impact zone of the work. The intensity of noise will depend on the frequency and continuity of noise generating tasks. Generally, high noise will be generated during hammering, drilling and breaking of concrete using concrete chipper. Another source of noise would be lifting and transportation activities of concrete spoil from demolition site to dumping area. However, this noise is predicted to be insignificant compare to the noise from demolition works.

6.1.3.1 Mitigation Measures

Following mitigation measures are suggested to reduce noise generated from demolition works:

a) **Working Hour:** Working hour for demolition work should be restricted to reduce public disturbance from high noise. According to Noise Control Rules 2006, the operation of construction machineries must be restricted in-between 07pm and 07am. And according to UK Rules, demolition working hours are as follows:
   - Monday – Friday: Start 7:30am and finish at 6pm. Please note that works and activities likely to be audible outside of the site boundary should not commence until 8:00am.
   - Saturday: Start 9am and Finish at 1pm.
   - Sunday and Bank Holidays: No work permitted.

   Since Friday is the weekly holiday in Bangladesh for both government and private offices, following work schedule is suggested for demolition works:
   - Saturday – Thursday: Start 7:30am and finish at 6pm. Please note that works and activities likely to be audible outside of the site boundary should not commence until 8:00am. Also, no works are permitted during prayer time.
   - Friday and Public Holidays: No work permitted

b) **Noise Barrier:** An effective way of reducing noise is to install a purpose-built barrier around the buildings to be demolished. This measure would reduce the noise by 5-10 dBA.
c) All pneumatic tools will be fitted with silencers/mufflers.
d) Vehicles and mechanical plant will be maintained in a good and effective working order and operated in a manner to minimize noise emissions.
e) Reduce the speed of vehicle movements.
f) During prayer time working activities need to be stopped
g) Drop heights will be minimized when loading vehicles with rubble/debris.
h) Residents of the adjacent properties will be informed by the Contractor minimum 2 weeks prior to start noisy demolition works.
i) Regular in-house monitoring of noise level during demolition activity.

[13] U.S. Department of Energy (2009). *Environmental assessment for the proposed demolition of building 330 at Argonne national laboratory*. U.S. Department of Energy, Argonne Site Office, Illinois.

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 is found insignificant. While, Vibration during construction of the viaduct is significant, especially during pile driver operation.

6.2.1 Train Operations

6.2.1.1 Method

Same method presented in the existing EIA report of MRT line 6 has been used to analyze the vibration for the MRT line 6-extension project. More detail refers to the section 6.2.1.1 of existing EIA report of MRT line 6.

6.2.1.2 Applicable Criteria

Applicable criteria for MRT line 6 extension project follows the same used for the existing MRT line 6 project. Since Bangladesh does not have any regulation for vibration, therefore Japanese criteria are adopted for this project, which is 60 VdB. The vibration level shall be calculated at 12.5 m from the piers along the alignment.

6.2.1.3 Analysis

The formulas were applied for three curves radii and related train speeds. **Table 6-6** shows results for ballast-less and vibration proof (with Mass Spring System, MSS) 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 6-6: Expected Vibration Levels for Track Radii (VdB)

Track	R=200m	R=400	Straight(R>=600m)
At Pier Face			
Ballast-less track	65.0	68.3	66.9
Vibration proof track	57.4	60.7	59.3
At 12.5 m from Pier			
Ballast-less track	57.5	60.8	59.4
Vibration proof track	49.9	53.2	51.8

The curvatures of proposed MRT line 6 extension alignment varies from 162-300 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. Conversely, the vibration level will be within the standard at pier face when vibration proof track is used. The vibration level will be well within the standard for both ballast-less and vibration proof track at 12.5 m from pier. The Sena kallayan Bhaban in Motijheel and residential buildings in South Kamalapur area are located 11.0 m and 7.5 m distance from the centerline of the alignment. Therefore, vibration proof track is recommended throughout the alignment.

6.2.2 Vibration Impact during Construction

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 steel sheet pile driving, Operation of Hoe Ram, Caisson drilling. Vibration source levels for construction equipment is presented in **Table 6-7**.

Table 6-7: 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.

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

There are some residential buildings adjacent to the proposed alignment in the south Kamalapur area. These buildings are old structure and seems they have no proper foundation. The Sena kallayan Bhaban in Motijheel and residential buildings in South Kamalapur area are located 11m (36.08 ft) and 7.5 m (24.6 ft) distance from the centerline of the alignment. Vibration level at the receiver points due to the construction activity is shown in **Table 6-8**. There is no vibration standard in Bangladesh. There are different international vibration standards presented in **Table 6-16** of existing MRT Line 6 EIA report. The Japanese standard is the strictest. Like 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 adopted as the project standard.

Table 6-8: Vibration Level at the Receiver Point during Construction Period

Equipment		PPV at 25 ft, in/sec	Vibration level at Receiver Point	
			11.0 m (36.08 ft)	7.5 m (24.6 ft)
Pile Driver (Sonic)	Typical	0.17 (93 VdB)	0.098 in/sec PPV (88 VdB)	0.174 in/sec PPV (93 VdB)
Hoe Ram		0.089 (87 VdB)	0.050 in/sec PPV (82 VdB)	0.091 in/sec PPV (87 VdB)
Caisson drilling		0.089 (87 VdB)	0.050 in/sec PPV (82 VdB)	0.091 in/sec PPV (87 VdB)

Conclusion

According to the USA FTA standard, the target building vibration at 7.5 m distance from the construction activity particularly during sheet pile driving is not met. 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 15m RoW of the alignment in the south Kamalapur area to mitigate vibration impact during construction.

Recommendation

Structural survey by NKDM and Contractor is required for the existing residential buildings along the ROW of the proposed alignment to determine the susceptibility to vibration. If any structure is found vulnerable to vibration, it should be demolished and compensated (like Milestone School & College in depot area). If necessary, the residents of demolished buildings should be provided with rental assistance. Temporary closure of living in adjacent buildings could be required during the construction period. A structural inventory and socio-economic survey are required of these building to compensate if required. 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).

6.2.3 Vibration due to Demolition

Major demolition equipment such as bulldozers, graders, compactors, and wrecking balls could cause vibration effect to the nearby weak structures, if any. The vibration velocity level at a receptor beyond 70 meters (230 feet) from any demolition activities (except high-explosive detonation or impact pile driving) would diminish below the 65-VdB threshold of perception by humans and interference with vibration-sensitive activities[14]. However, it is unlikely that such types of heavy equipment capable of causing great ground vibration would be used in this project. Therefore, there would be very little vibration impacts from the proposed activity on surrounding areas.

The vibration standard has been followed as same mentioned in the updated EIA report of 2016 which is 90 VdB (Section 8.5 of the updated EIA report of 2016) during the construction period.

6.2.3.1 Mitigation Measures

Following mitigation measures are suggested to reduce vibration generated from demolition works:

a) DMTCL should employ NKDM to prepare a Technical Guideline of Demolition which will cover the technical methods of demolition considering the least noise and vibration generation, prevention of structural collapse, safety of adjacent structures, employees' safety, etc. Contractor shall also prepare a Method Statement of Demolition Works maintaining the guideline of the consultant, which will be followed after getting approval from consultant.

[14]Hanson, C.E., D.A. Towers and L.D. Meister(2006). *Transit Noise and Vibration ImpactAssessment*, FTA-VA-90-1003-06. Prepared by Harris Miller Miller & Hanson Inc. for U.S.Department of Transportation, Washington, D.C., May. Available at*http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf* (Accessed May 2009).

b) 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.
c) 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.
d) Impacted area needs to be vacant during construction work that will need to be considered in the RAP study.

6.3 Air Quality

Demolition work, a new attribute of air pollution in Kamalapur Extension Project which was not discussed in the updated EIA report of 2016. Thus, this section incorporated a new sub-section for describing the impacts of demolition works in order to address this issue.

6.3.1 Effects on Air Quality due to Demolition

Demolition work is a potential source of air quality degradation, especially in neighborhood area. Demolition activities would be essentially the reverse of construction activities, but typically on a more limited scale and duration. Operations typically involved in demolishing and removing structures include mechanical dismemberment, drilling and breakup of foundations, debris loading, pushing (dozing) operations, and traffic. Explosives should not be used for the proposed action. For the above activities, fugitive dust particulate emission is a primary concern and also minor emissions of criteria pollutants (CO, Pb, NO_2, O_3, PM, SO_2) and hazardous air pollutants from engine exhaust would be generated. Fugitive Dust refers very small particles suspended in the air, the source of which is primarily the building material and Earth's soil. It does not include particulate matter from other common sources, such as vehicle exhaust. Demolition activities would generate criteria and toxic air pollutants from heavy equipment engine exhaust, soil disturbances, and unpaved road traffic.

Considering the small numbers of heavy equipment and crew required for the proposed action, the potential impacts of engine exhaust emissions from heavy equipment on ambient air quality are anticipated to be minimal. However, fugitive dust emissions are of concern for most construction activities because they are released near the ground without any plume rise induced by buoyancy and/or vertical momentum. The contribution of fugitive dust emissions from demolition activities would not likely result in expedience of the ambient air quality standard of entire Kamalapur neighborhood. Instead, dust generated from demolition works would be concentrated in surroundings of work site. Therefore, the primary receptor of dust pollution from demolition works are workers involved in demolition and transportation of debris. Furthermore, residents of nearby neighborhood within the proximity of work site are also receptors of dust pollution. In particular, child and elderly people with respiratory problem would be affected significantly.

6.3.1.1 Mitigation Measures

Following mitigation measures should be taken to reduce air pollution during demolition works:

a) The whole building should be enclosed with jute-made sack to prevent spreading of dust during demolition operation.
b) Water misting/fogging should be applied to suppress indoor dust during demolition inside the building.
c) Hard barrier should be erected around the building to prevent the spreading or rolling down of debris into road.
d) Water spray (by water truck or hose pipe) should be applied on hauling roads during concrete debris transportation.
e) Debris stockpile should be water down and covered.
f) Remove construction debris through approved route, covered, netted, or otherwise contained to prevent dust generation.
g) Electric and mechanical equipment and vehicle involved in demolition work should be maintained well to prevent emissions of SOx, NOx, CO, and PM.

6.3.2 During Construction and Operation Phase

The impact of metro rail construction and operation on ambient air quality and their potential mitigation measures have been described thoroughly in the updated EIA report of 2016 [for details: see section 6.3.3, 6.3.4, 6.3.6 and 6.3.7in updated EIA report of 2016]. The nature of previously identified impacts and mitigation measures will remain same for this extension project also.

6.3.3 Air Quality Monitoring and Standards/Criteria

The necessity of in-house air quality monitoring by contractor during construction phase has been established in the updated EIA report of 2016. This provision will remain same for current extension project also. The updated EIA report of 2016 also discussed the applicable air quality standards in order to compare the findings of in-house monitoring, which will also remain same. More details can be found in section 6.3.1 and 6.3.5 in updated EIA report of 2016.

6.4 Impacts due to Traffic Congestion

About 230m viaduct will go through a built-up area of Kamalapur Neighborhood where there is no existing road with enough width along the ROW. As a result, a number of buildings will be demolished to make space for the viaduct. The residents of affected area usually move through a narrow road that will be slightly affected during construction work, especially during demolition work. Kamalapur Bazar Road and Kamalapur Graveyard Road as well as part of Front Road will be blocked during construction. Therefore, public mobility through these roads will be restricted. Another issue might be the movement of hauling vehicles transporting spoil soil, concrete, and construction materials. For this purpose, Outer Circular Road and Toyenbee Circular Road can be used. The movement of such vehicles should be restricted within night times. The Kamalapur Box Culvert Road plays an important role to access Motijheel and Kamalapur Railway Station through Outer Circular Road. Once the demolition is completed and high fence is erected, all equipment and vehicle will move through the newly created passage. After commencement of construction works, residents of the southern part can use Graveyard Road to access Box Culvert Road, while residents of northern part can use Front Road and Kamalapur Bazar Road for accessing Motijheel and

Kamalapur Railway Station. It is inevitable that construction works will cause hassle and problem for the adjacent residents. By taking appropriate measures, the problem can be manageable and impact can be rated as moderate.

Mitigation Measures:

a) The contractor should prepare a traffic management plan with clear delineation of routes through urban areas for movement of materials and equipment. This plan shall be effective after getting approval from the consultant.
b) Truck traffic will be routed away from residential streets to through routes with the least residential land use.
c) Flagmen will be stationed at main intersections along haul routes during periods of intense transport activity, at points of vehicle access into the worksite, at obstructions in the line of traffic, and at the start and end of construction. Traffic detours will be set up if necessary and clearly marked.
d) The contractor will provide front and rear escort vehicles, equipped with flashing light, for movement of vehicles carrying over-weight/over-length (OW/OL) loads of heavy equipment, and provide auxiliary flagmen along the route and onboard to assure clearance.
e) Movement of OW/OL loads preferably will be done at night.

6.5 Drainage and Water Quality

The potential impacts of viaduct and station construction works on drainage and surface runoff have been thoroughly discussed in the updated EIA report of 2016. There is no water body within the proximity of Kamalapur Extension Project. Therefore, there are no specific locational impacts of water quality identified for this extension project. Drainage of the South Kamalapur area is the major concern which needs to be considered during the construction period. The drainage line currently exists under the narrow road. Therefore, special concern is needed to keep existing drainage line functional during construction work. Else, people of this area may suffer from drainage congestion problem and create hassle during construction work. In this case, before occupying the area for the construction separate drainage line needs to be established first to keep active the current drainage line.

6.6 Groundwater

Potential impacts of viaduct and station construction on groundwater was identified as "insignificant" in the updated EIA report of 2016. However, potential impacts on groundwater at depot area were identified in the updated EIA report of 2016, which are not applicable to this extension project. Therefore, the discussion regarding impacts on groundwater in the updated EIA report of 2016 will remain same for this extension project (see details in section 6.6.1 and 6.6.2 of the updated EIA report of 2016).

6.7 Solid Waste and Hazardous Materials

The nature and types of solid waste and hazardous waste – likely to be generated during construction and operation phase – have been identified in updated EIA report of 2016. Same types of waste will be generated in current project also. Thus, the maintenance guideline for

solid and hazardous waste will be same as previous guidelines described in section 6.7.1 and 6.7.2 of updated EIA (2016).

6.8 Vegetation, Wildlife and Aquatic Habitat

Removal of trees that will degrade habitat for birds. However, this impacts are temporary and of very limited extent; thus, the impact is likely to be less significant. The loss of tree species will be mitigated by further tree plantation as per the instructions provided in the updated EIA report of 2016. Table 6-26 in updated EIA report of 2016 shows a list of tree species recommended for planting on median strip under viaduct. This mitigation plan will remain same for this extension project also. Loss related to trees, mammals, reptiles and birds have already been discussed in section 5.2.2, 5.2.3.1, 5.2.3.2 and 5.2.3.3 respectively. There are no possibility of damaging any other wildlife and aquatic habitat due to implementation of the project. Additionally, impacts of train operation have already been discussed in the updated EIA report of 2016. This extension project will not bring any new impacts on biological habitat. Detail description of this issue can be found in the section of 6.8.1 and 6.8.2 of updated EIA report of 2016.

6.9 Public Infrastructure and Utilities

Installation of pier foundations and other sub-grade work can damage existing utilities. A comprehensive utility survey and relocation plan for utilities was undertaken by NKDM at the beginning of the project. A similar survey needs be conducted to identify, maintain and relocate the utilities for this extension project. A list of agencies having utilities that could be affected by construction of the Metro were listed in Table 6-27 of the updated EIA report of 2016. Some of the agencies listed in that table, such as Cantonment Board and Dhaka North City Corporation, will not be affected by the current project. Whereas, some new agencies related to optical fiber line provider might be affected due to the locational change. A revised list of agencies will be prepared by NKDM after conducting utility survey. Necessary mitigation and compensation plan have been described in the updated EIA report of 2016 which will remain same for this extension project also. The maintenance plan of utilities during operation phase has also be described in section 6.9.1, 6.9.2, and 6.9.3 of the updated EIA report of 2016.

6.10 Earthquake, Fire and Other Forms of Risk

These types of risks are mainly associated with operation of the Metro. These risks are considered in design, pre-planning, planning and operational phase of the project. A detail description of potential risks and their management plan have been written in section 6.10 of updated EIA report of 2016 that will remain same for this extension project.

6.11 Community/Occupational Health and Safety

Kamalapur extension project introduces some new aspects of occupational and community health and safety that has been described in this section. While other aspects of the section will remain same as the updated EIA report of 2016.

6.11.1 Occupational Health and Safety

6.11.1.1 Demolition

Current project requires demolition of a number of single or multi-storied buildings. This activity is associated with several health and safety related risks especially for those employees who will carried out the hazardous work. Because different types of heavy equipment both manual and mechanical will be involved in this job. It's difficult to predict what will happen as there are many contingencies bearing on the job like fall down of broken concrete and debris accidentally, electric hazard from live electric line during deconstruction or hazard from pre-installed pipeline in the buildings. In case of health hazard, dust and high noise from jackhammer and rod-cutting saw will be a major issue for workers. Using of gas cutter and wielding will create some risks for workers' eyes, if unprotected. Bad odor can be released by septic tank demolition.

Demolition works also impose risks for community exposures. This work will take place in such a residential area where people are residing close proximity. As a result, noise and dust may cause public disturbance, poor maintenance of debris and concrete spoil can make the situation even worse, accidental falling of broken concrete block from high-rise building can cause injury of the pedestrians, hauling vehicles for concrete debris removal can cause disruption of community mobility. However, these anticipated risks especially injury is very unlikely to occur.

Mitigation Measures

Following measures are required to adopt for ensuring occupational health and safety during demolition works:

a) Workers should be ensured to wear necessary PPE, i.e. high visibility vest, hard helmet, safety shoe, hand gloves, safety goggles, mask, earmuff, safety harness, etc. during demolition work.
b) Workers engaged with rod cutting by cutting saw and gas cutter as well as wielding shall be equipped with apron, face shield, fire-resistant skull cap, ear plug, etc.
c) Water misting should be installed to suppress indoor dust during demolition.
d) Electric live line and gas pipeline need to be removed and/or relocated prior to beginning of demolition.
e) Signalman need to be employed during lifting of concrete debris in order to prevent accident of workers.
f) Necessary number of resting place with drinking water supply need to be established for workers.
g) To prevent injury of common people and workers from falling down of broken concrete, safety net and canopy should be installed during demolition.
h) Dust suppression activities like water spray on road, watering down of materials stockpile, covering of debris and construction materials, etc. should implemented.
i) Contractor should prepare a Debris and Spoil Concrete Dumping Plan, including removing and dumping schedule considering the community health and safety issues.
j) Moreover, hauling vehicles should be covered during operations.

6.11.1.2 Construction and Operation Phase

Potential health and safety related issues during construction and operation phases have been described in the updated EIA report of 2016 very thoroughly, including applicable rules and regulation, contractor's duties for risk management, mitigation approaches, etc. This description also includes the accommodation of labors and HIV/AIDS protection issue during construction phase. The description in section 6.11 of updated EIA report of 2016 will be applicable to current extension project.

Another issue has become a major concern in recent times, especially during monsoon season. The construction site of MRT has become a potential place for Aedes mosquito breeding that cause Dengue disease.

Mitigation Measures regarding Dengue Prevention

i. To mitigate this issue, contractor should remove stagnant water from construction site.
ii. Contractor should spray larvicide after rainfall, especially at water logging area.
iii. Unused formworks should be removed or covered to prevent stagnant water.
iv. Workers residing in labor camp should use mosquito net.
v. Fogging should be conducted on daily basis to prevent the prevalence of adult mosquito.

Moreover, necessary preventive measures should be implemented, as per the guidelines of the consultant, to prevent any infectious disease like COVID-19.

6.12 Construction and Installation of Electric Substations

Two Receiving Substations (RSS) are being constructed as per previous plan for MRT-6. No new RSS will need to be built for current extension project. Environmental issues related to the site and the routing of the high voltage cables between the site and the rail line were addressed under section 6.12 in the updated EIA report of 2016 that will remain same for this extension project. Installation of the cable trench could temporarily interfere with traffic and pedestrian movements, and block access to adjacent buildings. Mitigation measures related to traffic management and occupational health and safety apply.

6.13 Temporary Construction Facilities

There is no need to build any temporary construction facilities, like casting yard, batching plant for this extension project. Instead, additional demand generated by this project will be fulfilled from existing castings yards and batching plants. However, the number of site office for NKDM, DMTCL, and Contractor; on-site storage of construction materials; and temporary accommodation for workers will be changed/increased due to implementation of the current project. Nevertheless, the potential impacts and mitigation measures will remain same as described under section 6.13 in the updated EIA report of 2016.

6.14 Cumulative Effects

The cumulative effects have been discussed in the updated EIA report of 2016. Current extension project will not alter these effects that have been described in section 6.15 of the EIA report.

6.15 Greenhouse Gases (GHG) and Climate Change Adaptation

An estimate of potential GHG emission reduction in comparing to baseline scenario was calculated and presented in Table 6-28 of the updated EIA report of 2016. Although current extension project adds about 1.16 km of viaducts and another station, total number of rail car will not be changed. However, total number of ridership will be increased which is fairly significant in comparing to previous estimates for whole MRT-6. Therefore, the reduction amount of potential greenhouse gas emission will increase than the previous estimate. However, the discussion regarding climate change adaptation written under section 6.15.1 and 6.15.2 in the updated EIA report of 2016 will remain more or less same.

6.16 Social Impacts and Land Acquisition

6.16.1 Potential Impact on Land

The Kamalapur Extension Project will require land acquisition. It will also cause loss of occupation as there is a Bazar (local market) which will be completely demolished. The Inventory of Loss (IOL) report estimated the number of Project Affected Households (PAH) and Project Affected Persons (PAP) for public and private land category, shown in **Table 6-9** below.

Table 6-9: Category wise Impacts of the MRT Line-6 (Extension) Project on Affected Population

Kind of Impacts	Type of Ownership	Numbers of Plot	Number of PAH/ Entity	Number of PAP	Affected Area (Decimal)
Impacts on Land	Public	27	5		356.23
	Private	39	110	485	97.89
Total		**66**	**115**	**485**	**454.12**
Impacts on Structures	Public	14	3		24,267
	Private	54	517	2280	160,292
Total		**68**	**520**	**2280**	**184,559**

Source: IOL Report 2020

Quantum of mouza-wise land

The IOL study estimated that total 454.12 decimal land will be required to acquire for the implementation of the project.

Table 6-10 shows the quantum of affected land as per their mouza name.

Table 6-10: Quantum of mouza-wise land

Mouza Name	JL No.	Sheet No.	Number of plots	Affected Area (Decimal)
Motijheel	6	6	1	20.53
Motijheel	6	15	12	107.68

Sub Total	**13**	**128.21**		
Uttar Brahman Chiron	5	6	5	122.15
Uttar Brahman Chiron	5	7	41	96.21
Uttar Brahman Chiron	5	10	1	25.00
Uttar Brahman Chiron	5	3	4	36.80
		Sub Total	**51**	**280.16**
Pashchim Rajarbag	2	8	2	45.75
		Sub Total	**2**	**45.75**
		Total	**66**	**454.12**

Source: IOL Report 2020

Ownership Status of Required Land

Table 6-11 shows the distribution of affected land in three mouza according to their ownership status.

Table 6-11: Ownership status of land

SL.	Mouza	Owners of the acquired land (in decimal)						
		Private	DC	RHD	MHPW	BR	DCC	Total
1.	Motijheel	18.67	62.76	4.23	42.55	0	0	128.21
2.	Pashchim Rajarbag	0	0	0	45.75	0	0	45.75
2.	Uttar Brahmanchiran	79.22	0	0	0	195.95	4.99	280.16
	Total	97.89	62.76	4.23	88.3	195.95	4.99	454.12

Source: IOL Report 2020

Land Use Category

As per records (*khatian*), there are different types of land considering its usages and productivity.

Table 6-12 shows the areas of public and private land as per their land use category.

Table 6-12: Ownership status of land

Sl	Mouza	Area of different type of to be acquired land (decimal)										
		Homestead	Road	Viti	Commercial	Office	Null	Garden	Foot path	Fallow	Others	Majar
1	Public Land	0	211.91	0	0	50.73	0	65.34	0.55	2.7	25.0	
2	Private Land	64.42	0	19.62	6.06	0	4.72	0	2.71	0	0	0.36
	Total	64.42	211.91	19.62	6.06	50.73	4.72	65.34	3.26	2.7	25	0.36

Source: IOL Report 2020

6.16.2 Potential Impact on Infrastructure

Structures by Construction Materials

The IOL study has identified the infrastructures that need to be demolished to make space for viaduct construction. **Table 6-13** shows the types of affected structures with their floor number and floor space.

Table 6-13: Potential impacts on structures

Ownership Type	Structure Type	Floor	Count	Total Area (Sq. ft)
Public	Building	1	5	3,775
	Building	2	1	480
	Building	3	2	4,647
	Semi pucca building	1	2	2,896
	Tin shed	1	3	12,369
	Steel Structure	4	1	100
	Sub Total		**14**	**24,267**
Private	Building	1	5	3,067
	Building	2	10	25,550
	Building	3	5	14,850
	Building	4	8	39,600
	Building	5	3	25,500
	Building	6	2	18,000
	Semi pucca building	1	17	26,125
	Tin shed	1	4	7,600
	Sub Total		**54**	**160,292**
Grand Total			**68**	**184,559**

Source: IOL Report 2020

Uses of Affected Structures

Table 6-14 shows the user category of affected structures as per their ownership and current users.

Table 6-14: Usages of affected structures

Usage of Structures	Number of Structure	Sum of Area (Sq. Ft)
Bangladesh Railway	**7**	**14,421**
Building	**3**	**672**
Commercial	1	300
Generator room	1	225
Watch Tower	1	147

Usage of Structures	Number of Structure	Sum of Area (Sq. Ft)
Semi pucca building	**1**	**1,600**
Railway Office	1	1,600
Tin shed	**2**	**12,049**
Commercial	2	12,049
Steel Structure	**1**	**100**
Search Light Tower	1	100
Deputy Commissioner	**3**	**825**
Building	**2**	**505**
Guard Room	1	25
Police Fari	1	480
Shed	**1**	**320**
Open Shed	1	320
Islami Bank Bangladesh Limited (Private)	**5**	**6,517**
Building	**3**	**517**
Guard room	1	25
Islami Bank Sheba Kendra	1	192
Official	1	300
Semi building	**2**	**6,000**
Answer camp	2	6,000
Ministry of Housing & Public Works	**4**	**9,021**
Building	**3**	**7,725**
Bangladesh Railway Project Office	2	7,700
Police Box	1	25
Semi building	**1**	**1,296**
Bangladesh Railway Muktijuddha Shangshad	1	1,296
Private Owners	**49**	**153,775**
Building	**30**	**126,050**
Commercial	6	11,700
Residential	24	114,350
Semi building	**15**	**20,125**
Commercial	3	7,400
Majar	1	225
Residential	11	12,500
Shed	**4**	**7,600**
Residential	4	7,600
Grand Total	**68**	**184,559**

Source: IOL Report 2020

6.16.3 Potential Impact on Trees

A survey was conducted to count trees that need to be cut down during IOL study. The study found that a total number of 358 Nos. trees of different species need to be cut-down in order to implement the project. After completion of the project, a tree plantation program will be implemented along the alignment.

Table *6-15* shows the number of trees need to felled according their species, size, and types of occupied land.

Table 6-15: Impacts on Trees

Ownership	Tree Size	Total
Public	Big (DBH > 30 cm)	65
	Medium (15–30 cm)	87
	Small (DBH < 15 cm)	153
Private	Big (DBH > 30 cm)	7
	Medium (15–30 cm)	32
	Small (DBH < 15 cm)	14
	Total	**358**

Source: IOL Report 2020

7 STAKEHOLDER CONSULTATION

As part of the EIA study, Public Consultation Meeting was conducted in November 2020. In the public consultation meeting, major concern of the participants was the resettlement issue. Therefore, there was limited chance to discuss the environmental issues in details. For this reason, additional Key Informant Interview (KII) has been taken place with the local representatives and other elite member of that area. Details of Public Consultation Meeting and also outcomes from the Key Informant Interview is given in section 7.1 and 7.2.

7.1 Public Consultation Meeting

Public consultation and disclosure are very crucial for success of any development or infrastructures project. Through the consultation process, affected communities can raise their voices about project, its impact, compensation policy and participate in project design and impacts mitigation planning. Consultation ensures community participation and allows affected community to make suitable choices and preferences. Peoples or community participation through consultation process will establish transparency in project planning and implementation. Consultation is a two-way process where the executing agency, policy makers, beneficiaries and affected persons discuss and share their concerns in a project planning.

To obtain concerns and views of likely project affected persons about the proposed MRT Line-6 Extension project from Motijheel to Kamalapur Extension, its potential social impacts and mitigation measures, the Dhaka Mass Transit Company Limited (DMTCL) organized and conducted stakeholders meeting on November 10, 2020 at AGB Colony Community Center, Motijheel, Dhaka.

7.1.1 Participants of the Meeting

All concern and pertinent stakeholder participated in the stakeholders meeting. Participated stakeholders includes Managing Director of DMTCL, Project Director (PD), Additional Project Directors (APD), Deputy Project Director (DPD), Additional Deputy Commissioner (revenue), Deputy Police Commissioner of DMP, Ward Councilors of the affected and adjacent Ward of DSCC, likely direct and indirect affected persons by the proposed extension project of MRT Line-6 and representative of consultant team. Photographs related to public consultation meeting have shown in the Annex A.

7.2 Key Informant Interview (KII)

Details of the key informant interview with major stakeholders is given in **Table 7-1**. Photographs related to KII meeting have shown in Annex B.

Table 7-1: Details of Key Informant Interview

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations
21/11/2020	Md. Sultan Mia Ward Councilor, Ward No. 8, DSCC Mobile: 01716181603	• Perception and viewpoint of the people about the project	It's a great initiative by the government to extend the MRT line from the Motijheel to Kamalapur. But the affected people requested to avoid the current proposed line if possible and redesign it through the existing Kamalapur to Culvert road to ensure minimal loss.
		• Current status of traffic jam in your area.	Currently traffic jam in this area is not a big issue. But people has demanded to expand the culvert road from South Kamalapur to Motijheel for more ease movement.
		• 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 also construction period environmental pollution. Good positive impact will be the ease transportation of the local people, economic development of the area, widening of road etc.
		• Expectations from the project	• Enough compensation to the project affected people • Proper mitigation measures during the construction period

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations
		• Do you have any suggestions or comments or opinion that needs to be considered during the implementation ofthis project?	• No additional comments
		• Any concern of the local Community that needs to be communicated to DMTCL?	• No concern yet received from the local community
		• What are the CSR expectations from the project owner?	• Beautification of the area • Lighting in the street • Improvement of the existing drainage line
21/11/2020	Md. Abdul Jolil Patowari Permanent Residents, South Kamalapur. Mobile: 01711140195	• Do you know about the project and its location?	All the people of the South Kamalapur area are informed about the project. Most of them were present during the Public Consultation Meeting.
		• What about your perception about the project? (positive and negative)	Lots of people will lose their ancestral property. But hopefully the affected people will receive enough compensation to settle them in a new place. Also, hopefully the construction and operation activity of this extension line will ensure more economical development in this area.
		• What is your expectation during the construction and operation period?	• During the construction period dust need to be controlled.

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations
			• 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. • It should be accessible to all types of people during operation period.
		• Any suggestion from your side	Government needs to compensate the local people before starting of the project and also need to ensure enough time to vacant the land before displacement.
21/11/2020	Amir Hossain Khan Permanent Residents, South Kamalapur. Mobile: 01913055378	Do you know about the project and its location?	Exact location is not still confirmed. Hopefully the government will declare the section 4 notice in this area so that everyone gets informed about the exact location.
		What about your perception about the project? (positive and negative)	Hopefully the project will update 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 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 need to be controlled During operation period:

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations
			• Surrounding people shouldn't be disturbed during the operation period of metro rail.
25/11/2020	Md. Mojammel Haque Ward Councilor, Ward No. 9, DSCC. Mobile: 01712067363	Perception and viewpoint of the people about the project	Government has taken a great initiative to extend the route line. But it would be great if it will go through the Arambagh to Kamalpur.
		Current status of traffic jam in your area.	In the Kamalapur area, now-a-days traffic jam is a common scenario due to huge load of all kind of passengers including of both inter-district bus and also of Bangladesh Railway. During the office cycle and also at night time when the inter-district buses depart for their targeted route, traffic jam is very popular.
		How would the activities of the project affect the local community?	Definitely there will be good impact of the project on the local community. People can easily move from Kamalapur to the northern part of the Dhaka within a shortest period of time. 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 6. Ticket fare should be fixed considering all types of people of the Dhaka city as well as outside of Dhaka City.
		Do you have any suggestions or comments or opinion that needs to be considered during the implementation of this project?	Before starting of the construction, affected people should get enough time for the displacement. Also, compensation need to be paid off before the displacement so that people can move happily to another place.

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations
		Any concern of the local Community that needs to be communicated to DMTCL?	Local community would like to shift to any permanent residence (like flat or equivalent something) if possible. Also, they need enough time to get off from their ancestor properties.
		What are the CSR expectations from the authorities?	Extra compensation to the middle-class people and local market businessmen. Relocate the local market in a new place so that the affected businessmen can continue their livelihood.
25/11/2020	Md. Abdul Sattar President, South Kamalapur Market. Mobile: 01823866511	Do you know about the project and its location?	Unfortunately, the line will go through the south Kamalapur market though the market committee request several times to save the market and relocate the line in another way.
		What about your perception about the project? (positive and negative)	The market people are not aware about any environmental concern. They are day to day earner. Any environmental issue is not their concern. The businessmen only concern about their livelihood and future.
		What is your expectation during the construction and operation period?	Before starting of the construction activities, all the affected businessmen of the market will get enough compensation. Also, during the operation period, these people will get priority for any business activity or job related to MRT Line 6. If possible, the government is requested to shift the local market in a new place and save the livelihood of these people.

Date	Stakeholder Details	Issues Discussed	Stakeholder Observations
25/11/2020	Mawlana Md. Nurun Nabi, Imam, Al Mosjidu Asalam Jame Mosque, South Kamalapur Mobile: 01711140195	Do you know about the project and its location?	All the People of the South Kamalapur area know about the project. The project line will come from Motijheel, touch the adjacent corner of the graveyard, turn left from the ICD of Kamalapur and end in-front of the Kamalapur Railway Station
		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. So, these problems could happen during the construction of the project. From the positive concern, obviously the extension will contribute to the country's prosperity, ensure easy movement from northern part of Dhaka to Kamalapur and also from Kamalapur to the Northern part.
		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, existing drainage line will not be affected. During prayer time, construction activity needs to stop also for a short period of time. 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.

8 ENVIRONMENTAL MANAGEMENT PLAN

8.1 Purpose

The purpose of the Environmental Management Plan (EMP) is to describe institutional proposal and mitigation measures aimed at specific types of impacts. Since this extension project is a continuation of MRT-6 with similar nature of works, the EMP described in the updated EIA report of 2016 will be applicable for this project also. On the other hand, environmental management for demolition works have been addressed in this report, which was not included in updated EIA report of 2016.

8.2 Acquisition of Prior Clearances and No Objection Certificate

The Environmental Clearance Certificate (ECC) was renewed on July 26, 2020 and it will be expired on July 10, 2021. In addition, necessary No Objection Certificate (NOCs) will be sought from concerned authorities like Dhaka South City Corporation, Bangladesh Railway, etc. to implement the project.

8.3 Environmental Management Framework

The Environmental Management Framework section, provided in the updated EIA report of 2016, will not be changed for this extension project.

8.4 Mitigation Measures

8.4.1 Periods of Applicability

The mitigation measures described in this section shall be applied throughout the project period, including design and construction as well as during operation phase. Primarily, the responsible bodies to implement the measures will be (a) NKDM, (b) Construction contractors, and (c) DMTCL and other agencies following commissioning.

8.4.2 Mitigation Measures during Design

In the updated EIA report of 2016, mitigation measures have been considered during design works of MRT-6 that includes environmental concerns, health and safety, and energy conservation (see section 8.4.2 of updated EIA report of 2016). These measures will also be incorporated during the design works of this extension project.

8.4.3 Construction

Environmental measures are applied to contract by means of the Environmental Construction Specification (ECS). The ECS is typical of civil works construction contracts to be implemented under the Project, and is modified to fit the circumstances of individual bid packages. The mitigation measures provided with ECS were described in the updated EIA report of 2016. However, an amendment or addendum of ECS for CP-06 contract should be needed incorporating demolition works.

In addition, the Construction Environmental Management Plan (CEMP) provided by CP-06 contractor needs to be updated by preparing an addendum that will include the management of demolition work and will update their scope and area of works.

The contractor is also required to update their sites of IMG monitoring and in-house monitoring incorporating new monitoring locations as per the on-going works.

Following **Table 8-1**lists the mitigation measures to be undertaken by the contractor during construction.

Table 8-1: Environmental Mitigation Measures during Construction

	Impact Mitigation Measures
A.	**General Provisions**
General provisions of mitigation measures have been described in the updated EIA report of 2016 that will be same for current extension project (see Table 8-5 of updated EIA report of 2016).	
B.	**Labor Provisions**
Labor provisions of construction work that have been described in the updated EIA report of 2016 will remain same for this extension project (see Table 8-5 of updated EIA report of 2016).	
C.	**Noise and Vibration Control**
The mitigation measures for noise and vibration generated from construction of viaduct and station will be same as t described in the updated EIA report of 2016. However, demolition work will generate noise and vibration also. Following measures are required for mitigation of demolition noise and vibration:	
1.	DMTCL should employ the NKDM to prepare a Technical Guideline for demolition to ensure generation of least noise and vibration for demolition, prevention of structural collapse, prevention of accidental falling, safety of adjacent structures, etc. Contractor should follow this guideline to prepare method statement. The contractor is responsible for complying with the Department of Environment's Noise Control Regulation (2006). The allowable noise limit at the perimeter of the site has been set at 85 dB. In the event of noise levels exceed the threshold limit, the contractor shall mitigate noise by use of the following measures.
2.	Working hour shall be confined within Saturday to Thursday in-between 7:30am and 6:00pm without commencing noise generating works before 8:00am. Friday and public holiday, work shall be closed.
3.	Contractor shall install temporary noise barrier around the buildings to be demolished if suggested by the consultant. This measure would reduce the noise by 5-10 dBA.
4.	All pneumatic tools will be fitted with silencers/mufflers. The contractor will regularly maintain construction machinery and vehicles so that aggregate noise levels fall within the project standard.
5.	Generator and engine compartment doors will be kept closed and turned off when not in use.
6.	Vehicles and mechanical plant will be maintained in a good and effective working order and operated in a manner to minimize noise emissions.

7.	Reduce the speed of vehicle movements. Drop heights will be minimized when loading vehicles with rubble/debris.
8.	Residents of adjacent properties will be informed by the contractor minimum 2 weeks prior to start noisy demolition works taking place.
9.	Steel sheet pile driving activities should be restricted during day time and monitor the vibration level where and when necessary.
10.	Walled enclosures will be constructed around sensitive receptors like mosque if required.
11.	Regular in-house monitoring of noise level during operations.
Following measures are suggested for vibration mitigation:	
1.	Instead of concurrent demolition, buildings should be demolished one by one. Without engaging heavy machines that generate high vibration, conventional demolition method using hammer, concrete chipper should be adopted.
2.	During piling and shoreline protection installation, high vibration might be harmful for adjacent buildings. A survey can be conducted by the Engineer to identify the weak structures that have chance to be damaged by vibration. Necessary measures, i.e. cut-off trench can be applied to prevent such damage, if any.
3.	Routine vibration monitoring by the contractor is required.
4.	Impacted household/s due to vibration during construction work also need to be considered in the RAP.
D.	**Air Quality**
Building demolition works have been identified as potential source of dust generation. Following measures are required to implement to prevent or suppress demolition dust. On the other hand, mitigation measures for air pollution associated with construction works are described in the updated EIA report of 2016 that will remain same for this extension project.	
1.	The whole building should be enclosed with jute-made sack to prevent spreading of dust during demolition operation.
2.	Water misting/fogging should be applied to suppress indoor dust during demolition inside the building.
3.	Hard barrier should be erected around the building to prevent the spreading or rolling down of debris into road.
4.	Water spray should be applied on hauling roads during concrete debris transportation.
5.	Debris stockpile should be kept wet by watering down and covered.
6.	Remove construction debris through approved route by covered or netted, otherwise contained to prevent dust generation.
7.	Electric and mechanical equipment and vehicle involved in demolition work should be maintained well to prevent emissions of SOx, NOx, CO, and PM.
8.	Mud and windblown dust deposited on haul roads by the movement of transport vehicles will be removed by sweeping, scraping and washing, as appropriate.

9.	Ensure that construction equipment brought onsite complies with IN-BS-1 exhaust emissions standards, and assure proper maintenance of equipment.
E.	**Traffic Management**
1.	The contractor should use an approved traffic management plan which clearly delineates the routes through urban areas for movement of materials and equipment.
2.	Truck traffic will be routed away from residential streets to through routes with the least residential land use.
3.	Flagmen will be stationed at main intersections along haul routes during intense traffic, at points of vehicle access into the worksite, at obstructions in the line of traffic, and at the start and end of construction site. If necessary, traffic detours will be set up and clearly marked.
4.	The contractor will provide front and rear escort vehicles, equipped with flashing light, for movement of vehicles carrying over-weight/over-length (OW/OL) loads of heavy equipment, and provide auxiliary flagmen along the route and onboard to assure clearance.
5.	Movement of OW/OL loads preferably will be done at night.
F.	**Drainage and Water Quality**
1.	A survey need to be conducted by the utility team of the consultant to find out the utilities in MRT 6 extension part area.
2.	Alternative drainage need to be assured in the KMME part before construction work.
3.	Other mitigation measures for drainage and water quality will remain same as given in the updated EIA report of 2016.
G.	**Waste Generation and Disposal**
Waste management plan described in the updated EIA report of 2016 will remain same for current extension project.	
H.	**Protection of Communities Values**
Protection of community values related issues described in the updated EIA report of 2016 will remain same for current extension project.	
G.	**Occupational Health and Safety**
1.	Need to provide clear pathways for pedestrians around construction sites.
2.	Buffer areas need to be barricaded to exclude waiting vehicles and rickshaws.
3.	Accessible work areas also need to be barricaded clearly at ground elevation in order to ensure passage for pedestrians around the work area.
4.	Vendors should be relocated away from construction sites
5.	Clear, visible signage need to be provided to make aware of the local community regarding risks at points of contact.
6.	Other mitigation measures for health and safety remain same as described in the updated EIA report of 2016 under labor provisions.

7.	Registered doctor, paramedic, and nurse should be employed to provide primary medical care of employees.
8.	All project workers and staffs must use helmets and safety shoes. Other PPE (such as lifejackets, goggles, raincoats, belts for working at height, masks, gloves, reflective jackets, ear plugs, respirators etc.) also need to wear as and when required during working period
9.	To mitigate Dengue prevalence, contractor should remove stagnant water from construction site and spray larvicide after rainfall, especially at water logging area .
10.	Unused formworks should be removed or covered to prevent stagnant water.
11.	Workers residing in labor camp should use mosquito net.
12.	Fogging should be conducted on daily basis to prevent the prevalence of adult mosquito.

8.4.4 Operations

The updated EIA report of 2016 includes a management plan for noise and vibration during operation of metro rail. For this extension project, operation characteristics will not be changed. Therefore, environmental management for noise and vibration during operation phase will remain same as described in updated EIA report of 2016.

8.5 Environmental Monitoring during Construction

The updated EIA report of 2016 established the regulation of environmental monitoring, including ambient air, water and noise level by Independent Monitoring Group (IMG) for four times in a year (once in each quarter). This monitoring requirement will also be applicable for this extension project. If contract of this extension project extends with same contractor of CP-06, then current IMG of CP-06 can carry out this monitoring by amending contract. In this case, number and place of monitoring locations need to be reorganized. On the other hand, a new IMG needs to be assigned if new contractor are employed to implement the extension project. The rules and regulation regarding IMG monitoring will remain same as described in the updated EIA report of 2016.

9 CONCLUSION AND RECOMMENDATION

9.1 Compliance with Relevant Sector Guidelines of JICA and GoB

The MRT-6 Extension Project complies with GoB and JICA guidelines, including environmental and social impact, land acquisition and resettlement, compensation for loss as well as local administration as it was committed in updated EIA (2016) for whole MRT-6 Project. Sector wise guidelines related to the environment, public transit design and construction, traffic safety as well as public health have been compiled in the updated EIA report of 2016. However, some new rules, for instance, related to land acquisition have been discussed in this addendum report. In short, this addendum provides a means for environmental management through the implementation phase of the extension project.

9.2 Gains that Justify Project Implementation

This extension project will provide a more integrated public mobility system for city dwellers and commuters. According to the new plan, the terminus of Line-6 will be at Kamalapur Station, which is also terminus for Line-1 as well as Bangladesh Railway. Together they will create a junction that will facilitate more connectivity and easy access to intra-city movement. It will reduce traffic congestion between Motijheel and Kamalapur area by eliminating the needs of using other mode of transportation (such as rickshaw, CNG auto rickshaw, car, bus, etc.) for the passengers of Line-6 and Line-1 and eventually it will save working hours by providing a fast and safe transportation system. Moreover, this extension project will also contribute in reducing GHG emission, the reduction amount has not been estimated separately though. An estimation of GHG reduction for whole MRT-6 project is available in the updated EIA report of 2016.

9.3 Adverse Effects

According to previous plan, the Line-6 was planned to build a clear right of way in the public domain that allows the project to be built without any land acquisition. However, according to the new plan, few hundred meters of extended part of MRT-6 will go through previously occupied built-up areas. A considerable portion of these built-up areas are privately owned land with infrastructure that needs to be demolished to provide space for viaduct construction. Hence, the main adverse impact of this extension project will be generated from demolition works and relocation of people from their homestead. The impact of demolition includes excessive noise, dust, and vibration generation as well as traffic congestion due to movement of hauling vehicles transporting demolished debris. Other adverse impacts on natural environment will remain same as described in the updated EIA report of 2016, except the impacts related to noise generation during operation phase. A noise modeling has been performed to estimate the probable noise level during operation phase of this extension of Line-6. Furthermore, vibration during piling works may affect immediate adjacent vulnerable buildings. Vibration may also generate during operation phase, which is also predicted through vibration modeling. In addition, drainage congestion would be another big issue as the proposed route goes through the narrow streets, including drainage line of this area. On the other hand, this extension project will bring some social impacts, which were not

experienced previously. Several acres of land need to be acquired that will force hundreds of people to be relocated and several numbers of buildings both single and multi-storied need to be demolished. In addition, some trees also need to be cut down along the extended alignment. A separate RAP, LAP, and IOL have been prepared to manage these social impacts through facilitating adequate compensation to affected people as per the laws of the country.

A summary of impacts that will be applicable to Line-6 project due to the implementation of this extension project is given in **Table 9-1**.

Table 9-1: Summary of impacts due to this extension project

Area of Impact	Common Impacts
Air Quality	For the above activities, fugitive dust particulate emission is a primary concern and also minor emissions of criteria pollutants (CO, Pb, NO_2, O_3, PM, SO_2) and hazardous air pollutants from engine exhaust would be generated.
Noise Level	Operation of heavy equipment could generate maximum combined noise level of around 95 dBA at a distance of 15 m (50 ft.) from noise sources.
Vibration	Vibration may generate during pile driving activities.
Biological Resource	Some trees need to be felled to implement this extension project. Apart from this, no impact will be occurred on other biological resources.
Drainage	There will be impact on existing municipal drainage system in project area. The drainage channel needs to be redesigned and reconstructed after completion of the project.
Land use land cover (LULC)	The project is situated in mostly built-up area except a small vegetation cover in Kamalapur station area. Therefore, there will be no major change in LULC, however, a small vegetated area needs to be cleared. No water body will be affected. Overall, the impact is not significant.
Traffic Impact	There will be an impact on local mobility and traffic. However, this impact is not significant as alternative roads are available to use during construction period. Moreover, after completion of the project, the road underneath viaduct will be spacious which will bring positive impacts.
Public Infrastructure and Utilities	Installation of pier foundations and other sub-grade work can damage existing utilities.
Occupational Health and Safety (OHS)	Working activities in the build up area will create some sort of risk for the staff and workers as they have to work in a confined spaces
Community Health and Safety	There will be some risks related to community health and safety due to construction activities in the confined space and also due to building demolition works.
Social Impacts and Land Acquisition	There will be social impacts due to land acquisition, building demolition, property relocation, loss of business and property, etc. Moreover, local demographic characteristics will be changed due to resettlement of many affected people. Furthermore, temporary migration will be occurred during construction phase.

Table 9-2 shows a summary of additional mitigation measures that have been added to Line-6 project due to this extension project from Kamalapur to Motijheel.

Table 9-2: Summary of mitigation measures due to this extension project

Area of Impact	Mitigation Measures due to Line-6 Extension
Air Quality	a) Water misting/fogging should be applied to suppress. b) Hard barrier should be erected around the work side to prevent the spreading or rolling down of debris into road. c) Water spray (by water truck or hose pipe) should be applied on hauling roads using for concrete debris transportation. d) Debris stockpile should be water down and covered. e) Remove construction debris through approved route, covered, netted, or otherwise contained to prevent dust generation.
Noise Level	a) Working hours: • Saturday – Thursday: Start 7:30am and finish at 6pm. Please note that works and activities likely to be audible outside of the site boundary should not commence until 8:00am. Also, no work is permitted during prayer time. • Friday and Public Holidays: No work permitted b) All pneumatic tools will be fitted with silencers/mufflers. c) Vehicles and mechanical plant will be maintained in a good and effective working order and operated in a manner to minimize noise emissions. d) Reduce the speed of vehicle movements. e) During prayer time working activities need to be stopped f) Drop heights will be minimized when loading vehicles with rubble/debris. g) Residents of the adjacent properties will be informed by the Contractor minimum 2 weeks prior to start noisy demolition works. h) Regular in-house monitoring of noise level during demolition activity.
Vibration	a) 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. b) 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.

	c) Impacted area needs to be vacant during construction work that will need to be considered in the RAP study.
Biological Resource	Tree plantation will be implemented along the alignment of this extension and Kamalapur Station once the construction is completed.
Drainage	Special concern is needed to keep existing drainage line functional during construction work. Regular cleaning of drainage line is required to prevent drainage clogging and water logging during construction. Alternative drain needs to be arranged if needed.
Land use land cover (LULC)	Tree plantation will be implemented after completion of the project.
Traffic Impact	After demolition, a passage will be created for alignment and it will be used for transportation of construction materials. Until then, traffic management plan will be prepared by GC and Contractor for movement of machineries, vehicles, local vehicles, and public mobility.
Public Infrastructure and Utilities	Utilities lines, such as electricity line, telephone line, gas pipe line, cable TV line, optical fiber line, etc. will be removed and relocated. Alternative lines will be arranged for neighboring houses who will not be demolished.
Occupational Health and Safety (OHS)	a) Workers should be ensured to wear necessary PPE, i.e. high visibility vest, hard helmet, safety shoe, hand gloves, safety goggles, mask, earmuff, safety harness, etc. during demolition work. b) Workers engaged with rod cutting by cutting saw and gas cutter as well as wielding shall be equipped with apron, face shield, fire-resistant skull cap, ear plug, etc. c) Water misting should be installed to suppress indoor dust during demolition. d) Electric live line and gas pipeline need to be removed and/or relocated prior to beginning of demolition. e) Signalman need to be employed during lifting of concrete debris in order to prevent accident of workers. f) Necessary number of resting places with drinking water supply need to be established for workers. g) To prevent injury of common people and workers from falling of broken concrete, safety net and canopy should be installed during demolition.
Community Health and Safety	a) Dust suppression activities like water spray on road, watering down of materials stockpile, covering of debris and construction materials, etc. should implemented. b) Contractor should prepare a Debris and Spoil Concrete Dumping Plan, including removing and dumping schedule considering the community health and safety issues.

	c) Moreover, hauling vehicles should be covered during operations.
Social Impacts and Land Acquisition	The affected people will be compensated as per the laws of Bangladesh as well as JICA rules. Necessary compensation estimation related to land acquisition as well as resettlement plan will be provided in updated LAP and RAP report.

9.3.1 Adverse Effects Minimized

This addendum provides some detail mitigation measures for the demolition works which is completely new in terms of MRT-6 project implementation. Necessary mitigation measures have been suggested in this addendum report to reduce these adverse impacts of demolition works. Apart from demolition works, this extension project has also impacts on environment during construction and operation phase. However, these impacts are almost same as previously identified in updated EIA report of 2016. Therefore, mitigation measures for such kind of impacts will remain same as described in the updated EIA report of 2016. On the other hand, social impacts will be managed by providing adequate amount of compensation as well as rehabilitation assistance, wherever necessary. For this purpose, separate RAP and LAP have been prepared and will be implemented accordingly.

9.3.2 Adverse Effects Offset

No environmental impact was identified to be offset on the project.

9.3.3 Adverse Effects Compensated

Following the existing laws of the country as well as lender's guidelines, adequate compensation will be paid to directly affected parties who will lose their properties, such as land, home, and business. For this purpose, a RAP have been prepared that estimated the amount of compensation following the existing laws of the country as well as lender's guidelines. In addition, some relocation and rehabilitation assistance may be provided to the affected parties wherever laws required such kind of actions. There is a mosque and graveyard and the former might be affected due to implementation of the project. To compensate, a new mosque will be built nearby and the mitigation for graveyard, if affected, will be determined by RAP. No compensation has been identified related to environmental impacts from construction and operation of the project.

9.4 New Impacts Identified and their Mitigation

Possible impacts with its mitigation measures for the MRT Line 6 extension project have been summarized in ***Table 9-1: Summary of impacts due to this extension project*** and ***Table 9-2: Summary of mitigation measures due to this extension project***. Most of impacts are like ongoing project, and their mitigation measures are currently practiced successfully, based on 2016 EIA. But for this extension there are few new types of impacts. Those impacts and their mitigations are given in **Table 9-3**

Table 9-3: Additional Impacts for the MRT Line 6 Extension Part

Area of Impact	Additional Impacts	Mitigation Measures
Air Quality	**Impacts on Air Quality due to Building Demolition** For the above activities, fugitive dust particulate emission is a primary concern.	**Mitigation Measures during Building Demolition** a) The whole building should be enclosed with jute-made sack to prevent spreading of dust during demolition operation. b) Water misting/fogging should be applied to suppress indoor dust during demolition inside the building. c) Hard barrier should be erected around the building to prevent the spreading or rolling down of debris into road. d) Debris stockpile should be water down and covered. e) Remove construction debris through approved route, covered, netted, or otherwise contained to prevent dust generation. f) All other applicable mitigation measures mentioned in section 8.4.3 and also in ***Table 9-2***.
Noise Level	**Impacts on Noise Level due to Building Demolition** Heavy equipment used during demolition activities (e.g., jackhammers and bulldozers) could generate maximum combined noise level of around 95 dBA at a distance of 15 m (50 ft.) from noise sources.	**Mitigation Measures during Building Demolition** a) Noise Barrier: An effective way of reducing noise is to install a purpose-built barrier around the buildings to be demolished. This measure would reduce the noise by 5-10 dBA. b) All other applicable mitigation measures of section 8.4.3 and ***Table 9-2***.
Vibration	Vibration may generate during building demolition work.	a) DMTCL should employ NKDM to prepare a Technical Guideline of Demolition which will cover the technical methods of demolition considering the least noise and vibration generation, prevention of structural collapse, safety of adjacent structures, employees' safety, etc. Contractor shall also prepare a

Area of Impact	Additional Impacts	Mitigation Measures
		Method Statement of Demolition Works maintaining the guideline of the consultant, which will be followed after getting approval from consultant.
Occupational Health and Safety (OHS)	**Additional Risks of OHS due to Building Demolition** Building demolition will create some risks related to occupational health and safety of workers. The risks include multiple hazards like falling hazard, electric and gas pipeline (undetected) hazard, noise and dust hazard, etc.	a) All the applicable mitigation measures identified in Table 9-2 and in section 8.4.3.

9.5 Use of Irreplaceable Resource

There is a graveyard situated besides alignment of the extension of Line-6, which will not be affected during construction phase. Necessary pre-caution will be taken to avoid the impacts on the graveyard. However, since graveyard is considered as a symbol of religious belief and sacred, the implementing authority of the project will try its best to keep the graveyard intact.

9.6 Provisions of Follow-up Surveillance and Maintenance

The updated EIA report of 2016 established a requirement of periodic environmental and social monitoring during construction phase. Follow-up public consultation is also required to investigate if any issue raised. The in-house and IMG monitoring may be merged with current monitoring schedule of CP-06. The EMP, presented in this addendum will be incorporated into individual contract bidding documents in the form of Environmental Construction Specification (ECS), which form the basis for the contractor's environmental performance. Periodic monitoring will be undertaken by DMTCL supported by the GC, and quarterly reports will be submitted to the financing agency (JICA).

ANNEX A

Photographs of Public Consultation Meeting

Registration Booth

Opening Remarks

Invited Guests

Md. Sultan Mia
Councilor, Ward No. 08
Dhaka South City Corporation

Md. Mozzammel Haque
Councilor, Ward No. 09
Dhaka South City Corporation

Md. Abdul Baquee Miah
Additional Project Director (Civil)
Dhaka Mass Rapid Transit Development Project (Line-6)

Krishna Kanta Biswas
Additional Project Director (EHSLAR)
Dhaka Mass Rapid Transit Development Project (Line-6)

Zia Uddin Ahmed
Project Affected People

Md. Anwar Hossain
Project Affected People

Mrs. Rupa
Project Affected People

Md. Belayet Hossain Roni
Project Affected People

Golam Morshed
Project Affected People

Khalilur Rahman
Project Affected People

Mir Basona Begum
Project Affected People

Mohammad Mahmudul Haque
Additional Deputy Commissioner (LA)
Dhaka District

Md. Enamul Haque Mithu
Additional Deputy Police Commissioner
(Motijheel Division)

M. A. N. Siddique
Managing Director
Dhaka Mass Transit Company Limited

Md. Aftabuddin Talukder
Project Director
Dhaka Mass Rapid Transit Development Project (Line-6)

ANNEX B

Photographs of the Key Informant Interviewee

Stakeholder Details	
Md. Sultan Mia Ward Councilor, Ward No. 8, DSCC Mobile: 01716181603	
Md. Abdul Jolil Patowari Permanent Resident, South Kamalapur. Mobile: 01711140195	
Amir Hossain Khan Permanent Residents, South Kamalapur. Mobile: 01913055378	

Md. Mojammel Haque Ward Councilor, Ward No. 9, DSCC. Mobile: 01712067363	
Md. Abdul Sattar President, South Kamalapur Market. Mobile: 01823866511	
Mawlana Md. Nurun Nabi, Imam, Al Masjidu As-Salam Jame Mosque, South Kamalapur Mobile: 01711140195