DHAKA TRANSPORT COORDINATION BOARD (DTCB)
MINISTRY OF COMMUNICATIONS (MOC)
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

PREPARATORY SURVEY REPORT
ON
DHAKA URBAN TRANSPORT NETWORK DEVELOPMENT STUDY (DHUTS) IN BANGLADESH

FINAL REPORT

March 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

Katahira & Engineers International
Oriental Consultants Co., Ltd.
Mitsubishi Research Institute, Inc.

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Preface

Japan International Cooperation Agency (JICA) conducted the preparatory survey on Preparatory Survey for Dhaka City Urban Transport Network Development in People's Republic of Bangladesh, dispatching a preparatory survey team comprised of Katahira & Engineering International, Oriental Consultants Co., Ltd and Mitsubishi Research Institute, Inc., headed by Mr. Toshio Kimura, from March 2009 to March 2010.

The team held discussions and conducted field surveys with the officials concerned of the Government of Bangladesh. Having completed them, the team prepared this final report.

I hope that this report will greatly contribute to the development of urban transport networks in Dhaka, as well as to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Bangladesh for their close cooperation to the project.

March 2010

Kiyofumi Konishi,
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

Kiyofumi Konishi,
Director General
Economic Infrastructure Department
Japan International Cooperation Agency
Tokyo, Japan

March 2010

Letter of Transmittal

We are pleased to submit to you the basic design study report on Dhaka Urban Transport Network Development Study (DHUTS) in People's Republic of Bangladesh.

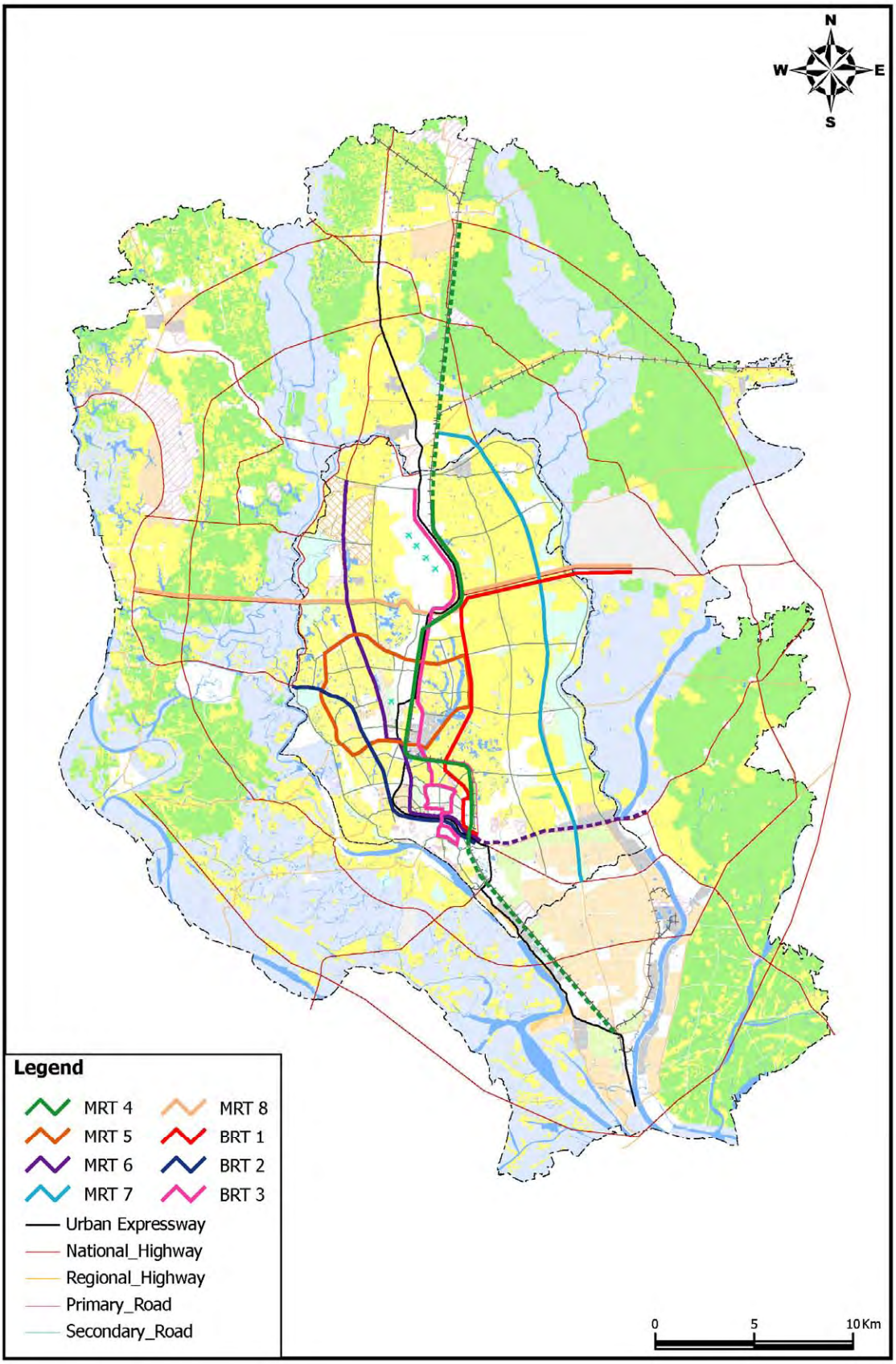
This study was conducted by the Consortium of Katahira & Engineers International, Oriental Consultants Co., Ltd. and Mitsubishi Research Institute, Inc., under contract to JICA, during the period from March 2009 to March 2010. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Bangladesh and formulated the most appropriate basic design for the project under Japan's Technical Cooperation Scheme.

Finally, we hope that this report will contribute to further promotion of the project.

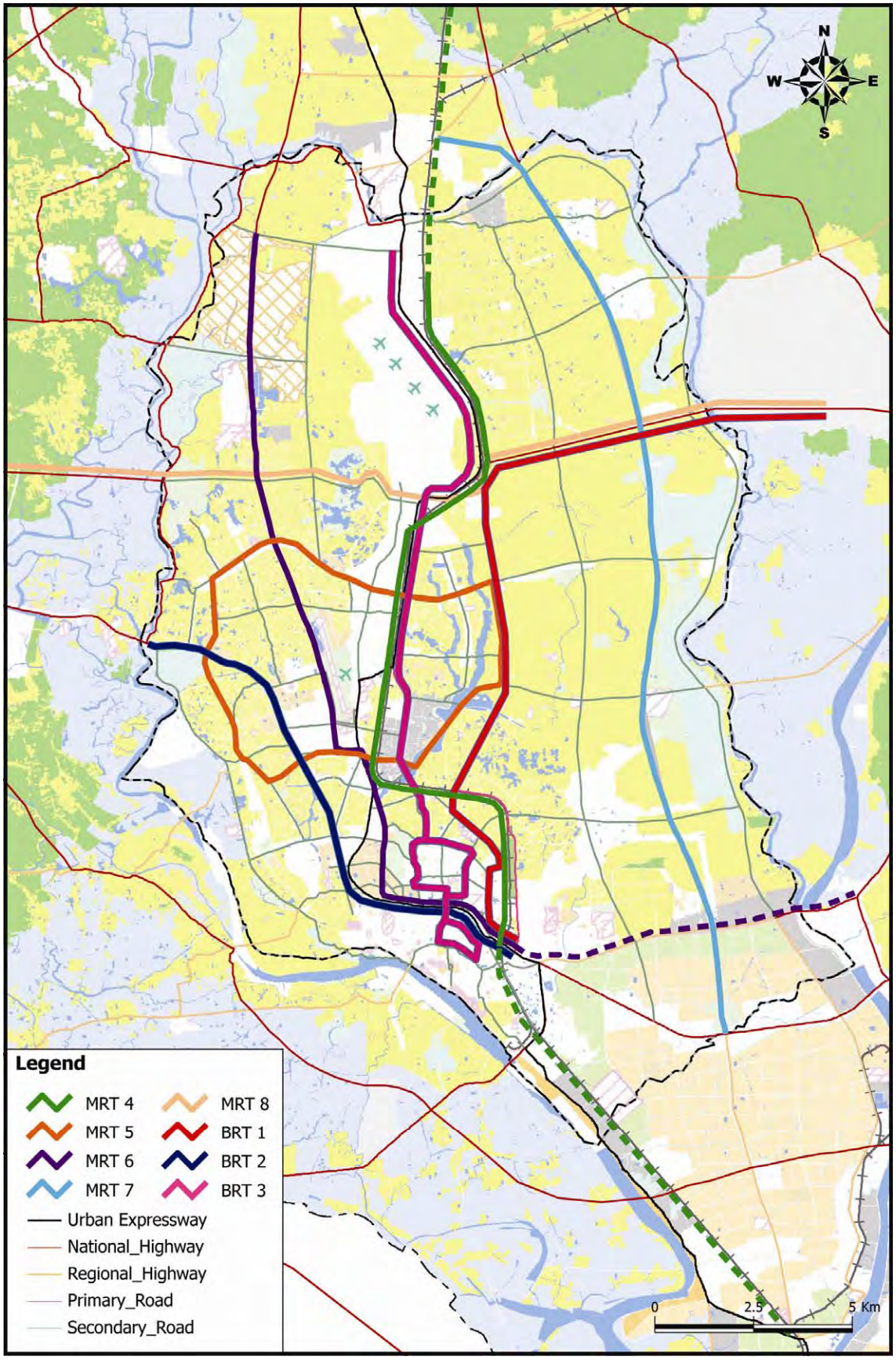
Very truly yours,

Toshio KIMURA
Team Leader
Preparatory Study Team on
Dhaka Urban Transport Network Development Study
The Consortium of
Katahira & Engineers International,
Oriental Consultants Co., Ltd, and
Mitsubishi Research Institute, Inc.

LOCATION MAP OF THE STUDY AREA



URBAN TRANSPORT NETWORK DEVELOPMENT PLAN IN RAJUK



URBAN TRANSPORT NETWORK DEVELOPMENT PLAN IN DMA

DHAKA URBAN TRANSPORT NETWORK DEVELOPMENT STUDY
FINAL REPORT
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LIST OF ABBRIVATIONS

AAGR	Annual Average Growth Rate
ADB	Asian Development Bank
ADP	Annual Development Program
AGT	Automatic Guide Transit
AIDS	Acquired Immune Deficiency Syndrome
BBS	Bangladesh Bureau of Statistics
BDT	Bangladesh Taka
BEPZA	Bangladesh Export Processing Zone Authority
BFY	Bangladesh Fiscal Year (July to June)
BIWTA	Bangladesh Inland Waterway Transport Authority
BIWTC	Bangladesh Inland Waterway Transport Corporation
BOD	Biochemical Oxygen Demand
BR	Bangladesh Railways
BRT	Bus Rapid Transit
BRTA	Bangladesh Road Transport Authority
BRTC	Bangladesh Road Transport Corporation
BTMS	Bangladesh Traverse Mercator System
BWDB	Bangladesh Water Development Board
CASE	Clean Air and Sustainable Environment
CBD	Central Business District
CO	Carbon Monooxide
CL	Cordon Line
C/P	Counterparts
DAP	Detail Area Plan
DCC	Dhaka City Corporation
DHUTS	Dhaka Urban Transport Network Development Study
DIFPP	Dhaka Integrated Flood Protection Project
DIT	Dhaka Improvement Trust
DITS	Dhaka Metropolitan Area Integrated Transport Study
DMA	Dhaka Metropolitan Area
DMAIUDP	Dhaka Metropolitan Area Integrated Urban Development Project
DMDP	Dhaka Metropolitan Development Plan
DMP	Dhaka Metropolitan Police
DMRTA	Dhaka Mass Rapid Transit Authority
DMTA	Dhaka Mass Transit Authority
DND	Dhaka Narayangangj Demra
DPZ	Detail Planning Zone
DTCB	Dhaka Transport Coordination Board
DUTP	Dhaka Urban Transport Project
EIRR	Economic Internal Rate of Return
E&M	Electric and Mechanical
EPZ	Export Processing Zone
FAP	Flood Action Plan
FIRR	Financial Internal Rate of Return

FOB	Foot Over Bridge
GDA	Greater Dhaka Area
GDP	Gross Domestic Product
GNI	Gross National Income
HIS	Household Interview Survey
HIV	Human Immunodeficiency Virus
JFY	Japanese Fiscal Year (April to March)
JICA	Japan International Cooperation Agency
LGED	Local Government and Engineering Department
LGI	Local Government Institution
LGRD	Local Government and Rural Development
LRT	Light Rail Transit
MOC	Ministry of Communications
MOE	Ministry of Environment
MOHPW	Ministry of Housing and Public Works
MRT	Mass Rapid Transit
MSL	Mean Seawater Level
MT	Motorized Transport
MTS	Nass Transport System
NHBB	Non Home Based Business
NMT	Non Motorized Traffic
NPV	Net Present Value
OD	Origin & Destination
O&M	Operation and Maintenance
PAX	Passengers
PCU	Passenger Car Unit
PhPD	Per Hour Per Direction
PIC	Project Implementation Committee
PPP	Public Private Partnership
PWD	Public Work Department
RAJUK	Rajdhani Unnayan Katripakkha (Dhaka Metropolitan Development Authority)
RHD	Road & Highway Department
RMMS	Road Maintenance and Management System
RTC	Regional Transportation Committee
SMA	Statistical Metropolitan Area
SO2	Sulphur Dioxide
SPV	Special Purpose Vehicle
SS	Secondary Sreenline
STP	Strategic Transport Plan
SVRS	Sample Vital Registration System
TAZ	Traffic Analysis Zone
TFR	Total Fertility Rate
TOD	Transit Oriented Development
TTC	Travel Time Cost
UAP	Urban Area Plan
UNDP	United Nation Development Program
VOC	Vehicle Operating Cost

EXECUTIVE SUMMARY

INTRODUCTION

1 Background of the Study

Dhaka city is the capital of People's Republic of Bangladesh. The Dhaka Metropolitan Area (DMA) has a population of 10.7 million (7.5% of the total population of the country in 2006). Currently the urban transportation in DMA mostly relies on road transport, where car, bus, auto-rickshaw, rickshaw, etc. are coexistent. This creates a serious traffic jam in addition to health hazard caused by the traffic pollution including air pollution. With the national economic growth the urban population will also increase, and at the same time the number of privately owned automobiles will also increase significantly. So, the improvement of urban public transportation system for DMA has become a pressing issue to improve its traffic situation and urban environment.

Considering this situation the government of Bangladesh formulated a 'Strategic Transportation Plan' (STP) in cooperation with the World Bank in 2005. The implementing agency is Dhaka Transport Coordination Board (DTCB) under the Ministry of Communications (MOC). The STP prepared 'Urban Transportation Policy' for 20 years (2004–2024), and identified priority issues such as improvement of mass transit system (buses and rail transportations) , development of urban expressway and establishment of organization in implementation and maintenance/operation of the projects.

Since the STP has already received the official approval of the government of Bangladesh, it is expected that each donor will hereafter provide the assistance based on this STP for the improvement of the situation of urban transportation.

The JICA Study Team will conduct the study with DTCB as our counterpart (C/P) agency with the aims of formulating the basic concept of urban development for DMA in 2025 as well as formulating the projects for the JICA assistance program required in the medium- to long-term.

2 Objectives of the Study

The objectives of the study are as follows;

a) To formulate the Urban Transport Network Development Plan integrated with urban development plan of DMA for the period up to 2025.
b) Based on this plan, to draw general outline of the urban transport projects to be implemented on priority basis.

c) To clarifying the roles of the project implementation agency and the operation/maintenance/management agency, and to propose the development of their implementation capability.

d) To draw an outline of the feasibility study plan for construction of the urban transport system.

3 Study Area

The study area is a Dhaka Metropolitan Area (DMA) within the area surrounded by Turag River, Balu River and Buriganga River, which is located on the east side of Dhaka District and encompasses Dhaka city, northern side and east district of outer edges of Dhaka city. It may include in the adjacent administrative areas relevant to the aforementioned area, if necessary for the study. (Refer to Location Map).

4 Target Year

The target year of the plan is set as the year of 2025. Which consists short term (2010 -2015), medium term(2016-2020) and long term (2021-2025).

5 Work Schedule of the Study

The entire work period of the study is thirteen (13) months, beginning with the domestic preparatory work in March 2009 and terminating with submission of the final report in March 2010. The follow up study for prioritized project selected in the Phase 1 study is expected to start from May 2010.

6 Organization of the Study

The Study Team works with the counterpart personnel assigned from DTCB and Bangladesh Government has established a Project Steering Committee (PSC) under chairmanship of the Secretary of Road and Bridge Division of Ministry of Communications and a Project Implementation Committee (PIC) under chairmanship of Additional Secretary and Executive Director of DTCB for smooth implementation of the Study.

PERSPECTIVES OF DHAKA METROPOLITAN AREA IN 2025

1 Urban Development Vision and Scenario

Dhaka is capital city of Bangladesh with the functions of administrative, commercial, industrial, educational and cultural centers. It is often called Mega City[1], which indicates a large population agglomeration with more than 10 million. More significantly, Dhaka has extremely high density of population. Some areas in the old city area have a population density of more than 1,000 persons per hectare, which causes serious traffic congestion and deterioration of living environment.

According to the previous master plans like DMDP, it is proposed that Dhaka should be decentralized in population and employment opportunities from the inner city to the surrounding areas with satellite communities. Following the recommendations of the DMDP, the Government has developed satellite communities outside of DCC, such as Tongi, Gazipur, Savar and Narayanganj. More recently, Purbachal new town has been development by RAJUK. The DHUTS Study follows the concept of decentralization in population and work place from inner city to surrounding satellite communities. We call the concept of agglomeration of dominant city and surrounding urban/peri-urban/rural settlements as Urban Region, which is a system of cities with surrounding settlements.

Dhaka Urban Region consists of dominant city of DCC and surrounding satellite communities and rural settlements and they are economically integrated. Thus, future urban development in Dhaka will emanates from a dominant urban center and envelopes adjacent cities and settlements, such as Tongi, Gazipur, Savar, Narayanganj and Purbachal. These cities and settlements will constitute a multi-core mega urban region centering DCC. There are at least four key issues in the development of multi-core urban region. They are: (1) strategic urban development of satellite communities, (2) effective transport network to connect existing urban cores with surrounding growth poles, (3) economic integration

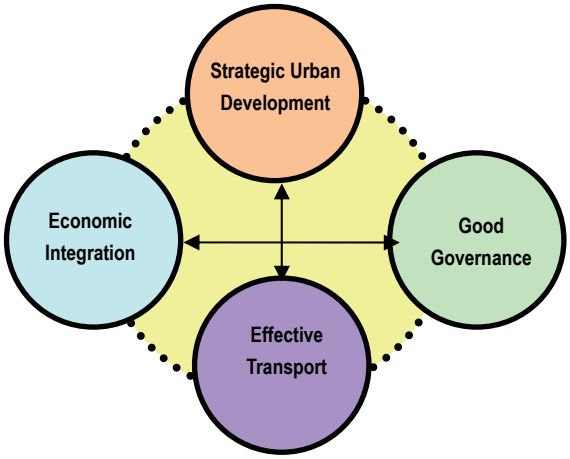


Figure 1 Concept of Urban Region

[1] *The United Nations defines agglomeration of population with 10 million or more as Mega City.*

between dominant urban center and surrounding urban/peri-urban/rural settlement, (4) good governance to manage the urban region in effective and efficient manners.

The development of multi-core urban region needs to encourage decentralization of over concentration of urban activities and population from the central area to the satellite communities. A large number of employment opportunities and new residential areas for medium and low income people should be developed in the satellite communities. In order to introduce private investment into the satellite communities, new transport system connecting between the central area and satellite centers will be necessary to alleviate traffic congestion.

The future urban structure making multi-core mega urban region in Greater Dhaka Area toward 2050 is illustrated in Figure 2-2. It is proposed that three development axes with mass transit corridors should be established: (1) Existing North-South Development Corridor, i.e., Tongi – Mirpur – City Center - Narayanganj, (2) East-West Development Corridor, i.e., Purbachal – Uttara – Savar, and (3) Eastern Fringe Development Corridor. Strategic urban development along these mass transit corridors should be encouraged. The mass transit includes Buss Rapid Transit (BRT) and rail oriented Mass Rapid Transit (MRT), which will become a trigger to change the urban structure of Dhaka to multi core mega urban region. Mass transit development will provide a significant impact on urban activities. Figure 2-3 shows the overall development scenario for Dhaka in a timeframe from 2009 to 2050.

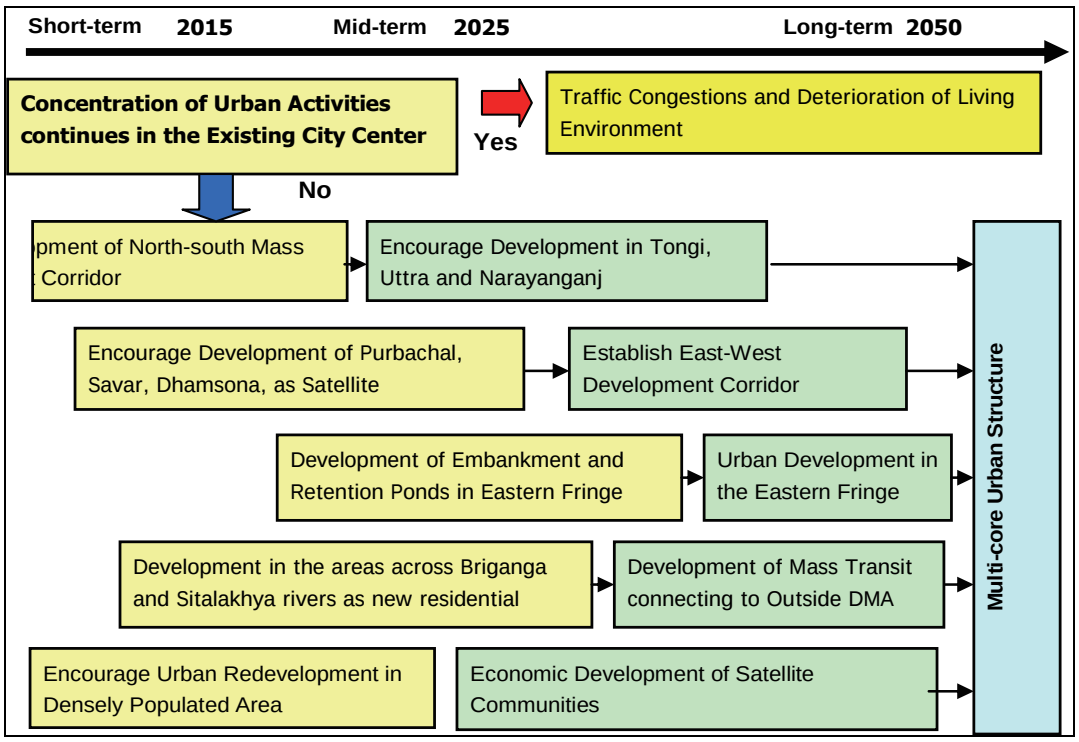


Figure 2 Urban Development Scenario for Dhaka toward 2050

Source: JICA Study Team

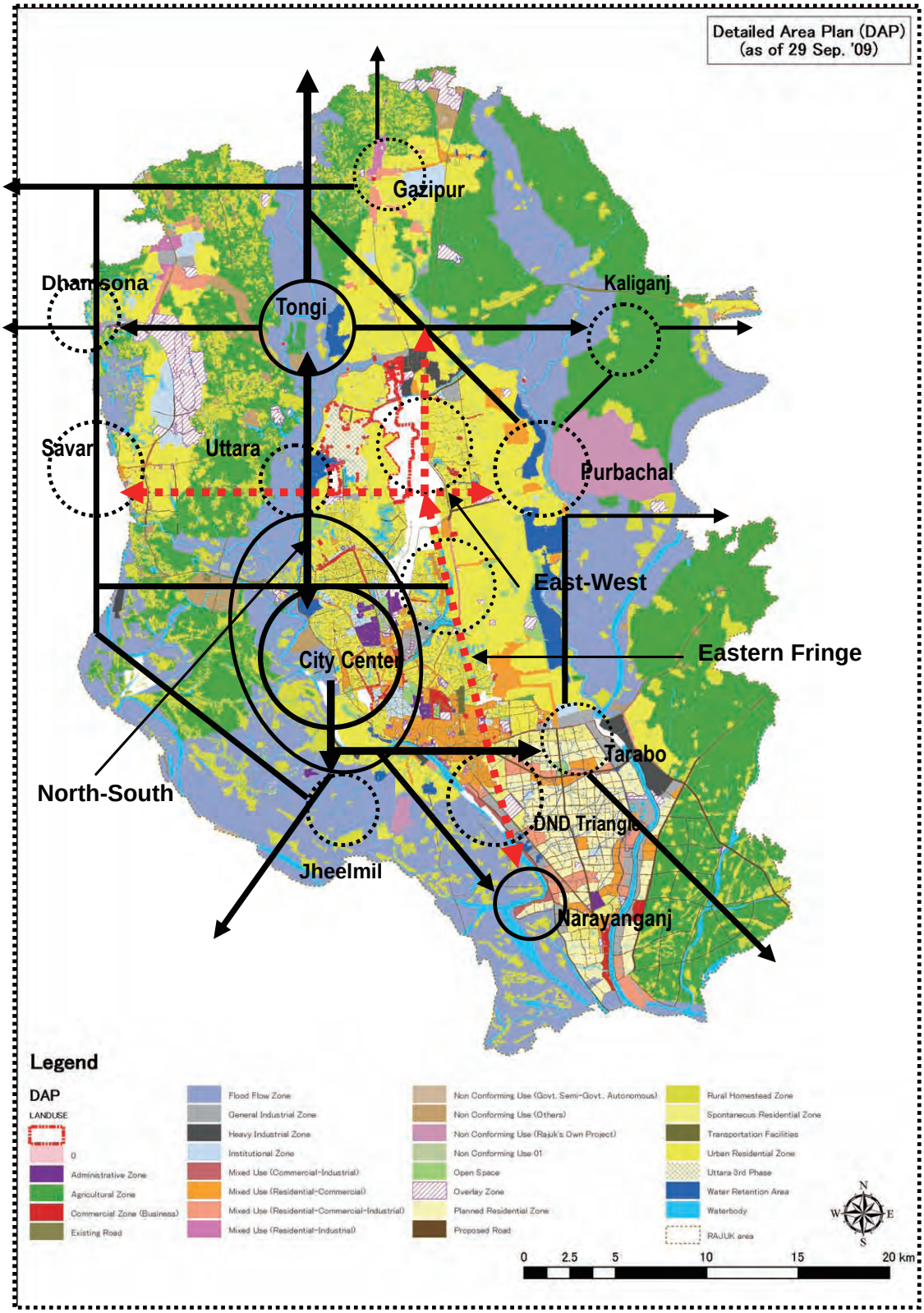


Figure 3 Proposed Future Urban Structure for Dhaka toward 2050

Source: JICA Study Team

OPENING NEW ERA OF INNOVATIVE TRANSPORT SYSTEM IN DHAKAM

1 Major Issues

Dhaka plays an important role to strengthen Bangladesh economy. Dhaka, however, faces number of serious urban transport problems and issues identified as follows:

- Heavy and chronic traffic congestion in the city
- Concentration of population into urban area
- Poor road transport system without fulfilling traffic demand
- No hierarchical road network in CBD and old Dhaka Area
- No proper traffic management and traffic awareness

2 Visions

Based on future perspectives of the urban development in RAJUK Area and DMA, DHUTS established three visions to achieve socio-economic goal, each of which is the vital factor to improve the people's quality of lives.

a) Vision 1: To achieve a sustainable social and economic growth

Dhaka should be a drive force to achieve the growth of Bangladesh economy and it will function as socio-economic growth center in the country.

b) Vision 2: To ensure social equity

Development of urban transport should provide equitable benefits to all the people, not only to the selected social and economic groups.

c) Vision 3: To ensure a healthy and secure urban environment

Urban transport should contribute to ensuring a healthy and secure environment for all the residents.

3 Mission of Urban Transport System

In order to materialize the above three socio-economic visions, Dhaka Urban Transport System delivers the following tree missions;

- **Mission 1: Efficient and Effective Transport Systems**
- **Mission 2: Equitable Mobility for People**
- **Mission 3: Safe and Environment-friendly Transport System**

4 Strategies

Great efforts should be made to build sustainable urban transport system to solve chronic transport problems and to cope with transport demands in Dhaka. Five (5) key strategies are proposed:

- **Strategy 1: Improvement of People's Mobility**
- **Strategy 2: Establishment of Optimum Transport Infrastructure**
- **Strategy 3: Safe and Secure Transport**
- **Strategy 4: Accessible Transport for All People**
- **Strategy 5; Establishment of Institution and Organization for Sustainable Transport Management**

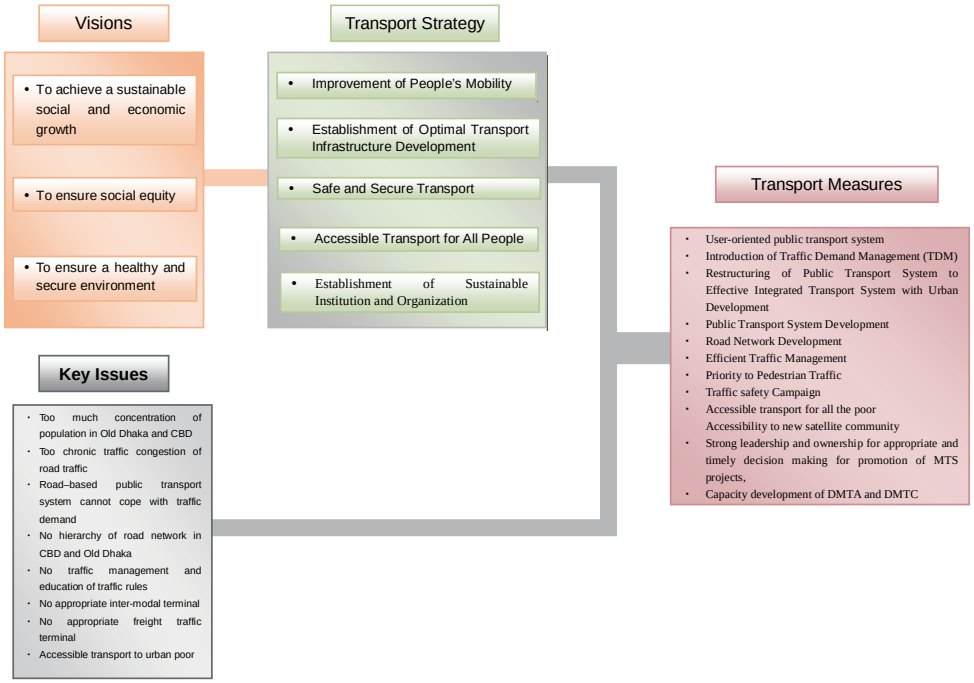


Figure 4 Visions, Transport Strategies and Measures

Source: JICA Study Team

5 Innovative Urban Transport System

DHUTS proposed an innovative transport system in Dhaka based on lessons learned from many cities in Asian Countries. The innovative transport system consists of Mass Rapid Transit (MRT) system as a backbone of the transport system integrated with conventional public transport system, road network and traffic management. The development of MRT system is essential and it will make a great impact on the behavior of people. The following changes can be expected in the development of MRT in Dhaka:

- Travel style and behavior of people
- Increasing mobility and accessibilities

- Punctual and shorten travel time

The Study Team expects that this innovative transport system will be opening a new era of the transport system in Dhaka.

OPTIMAL TRANSPORT SYSTEM

1 Perspectives of Socio-Economic Framework

It is estimated that the GDA (RAJUK administration area) has 14.5 million persons in 2009 and it increases to 25.4 million in 2025. The DMA area, on the other hand, has 9.2 million persons in 2009 and it increases to 15.7 million in 2025. The population growth rate in the RAJUK area is 3.98% p.a. during the period of 2001-2009 while 4.4% p.a. in the DMA during the same period.

The future GDP of Bangladesh has been projected by the Debt Sustainability Analysis (DSA) report prepared by World Bank[2] However, this growth rate might be slightly high taking into account the past trend. In this study, annual growth rate of GDP will be 6 % from 2013 to 2025 instead of 7%. Based on the future GDP figures, per capita GDP is estimated to be double increasing from US$591 in 2009 to US$1,204 in 2025.

2 Trip Generation

Person trips in GDA are expected to increase from 35.9 million trips in 2009 to 65.5 million trips in 2025 with an average annual growth rate of 3.8 % as shown in Figure

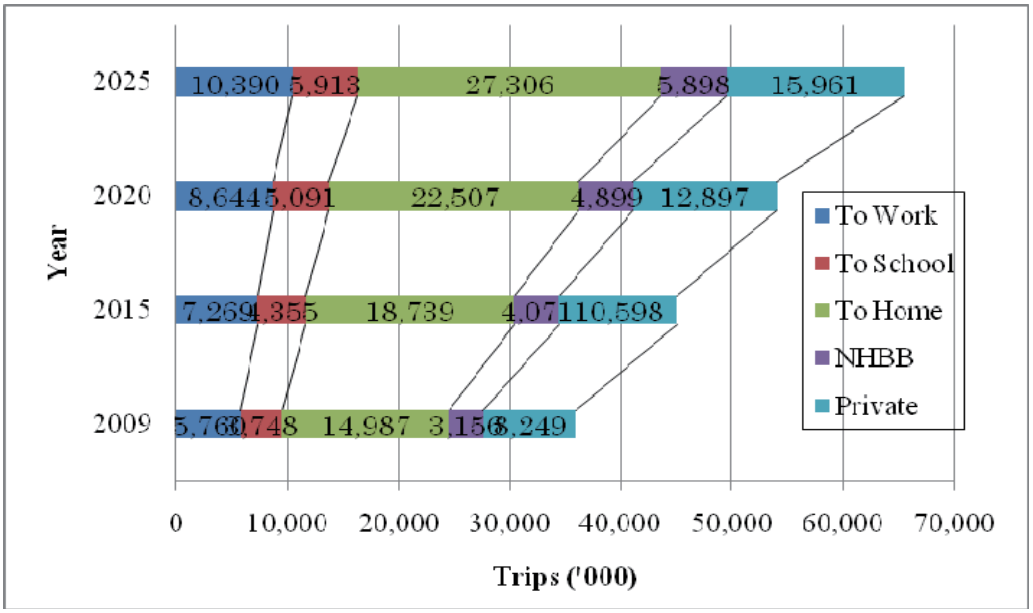


Figure 5 Number of Daily Person Trips in RAJUK Area

Source: JICA Study Team

[2] *World Bank Debt Sustainability Analysis (DSA), September 2008.*

3 What will happen Under "Do Nothing" Scenario

Given only currently on-going projects in the road network and public transport and given nothing more than the on-going improvements, the traffic situation of RAJUK area and DMA in 2025 will be chaotic according to the DHUTS transport model.

The DHUTS model reveals that under do-nothing condition only with the on-going projects, the average travel speed on road will be as low as 4.2 km/h in 2025 compared to the current travel speed of 15.1 km/h. This means that the major roads will be fully congested all day, that is the volume/capacity (V/C) rate will be reach 1.09 which means a saturated condition, compared to 0.51 at present.

Table 1 Vehicle /Capacity (V/C) Rate of Road Network under Do Nothing Scenario

Year	Item	Total (km)	Distance by VCR Rank in Alteranatives						Average V/C
			0.00~0.50	0.50~0.75	0.75~1.00	1.00~1.25	1.25~1.50	1.50~	
2009	Road Length	679.6	335.2	174.1	92.1	59.5	11.7	7.0	0.51
	%	100%	49.3%	25.6%	13.6%	8.8%	1.7%	1.0%	
2025	Road Length	747.1	143.1	46.5	130.0	134.7	115.0	177.8	1.09
	%	100%	19.2%	6.2%	17.4%	18.0%	15.4%	23.8%	

Source: JICA Study Team

4 Procedure for Selection of Optimal Transport Development Scenario

In order to select the optimal transport network scenarios, two (2)-step selection approach is employed in this study;

a) Selection of priority MRT Line proposed by STP
b) Selection of optimal transport network scenario

Figure 6 demonstrates the procedural flow of optimal transport scenario formulation.

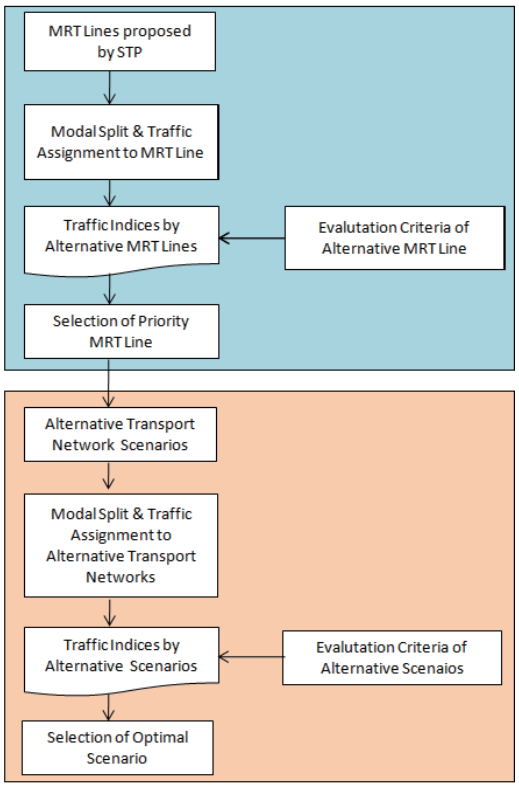


Figure 6 Procedure of Selection of Optimal Scenario

5 Selection of priority MRT Line proposed by STP

(1) Selection Criteria

The selection of three (3) lines proposed by STP here is done in terms of amount of potential users for MRT and impact on alleviation of road traffic congestion. The evaluation was done on the basis of the differentiation between the indices of the cases of "WITH" and "WITHOUT".

Table 2 Evaluation Indices of MRT Line

Specific Indices	Remarks
Index for MRT	
Number of potential users	Potential Passengers for each of three alternative MRTs.
Indices for impacts on Road Traffic	
Average degree of congestion	Degree of congestion averaged over whole DMA. The index stands for degree of alleviation of road traffic congestion.
Total vehicle kilometer	Total traffic volume summed up in whole DMA. The index stands for degree of reduction of road traffic volume and running distance.
Total time consuming	Total time consumed summed up in whole DMA. The index stands for degree of time savings due to introduction of MRTs.

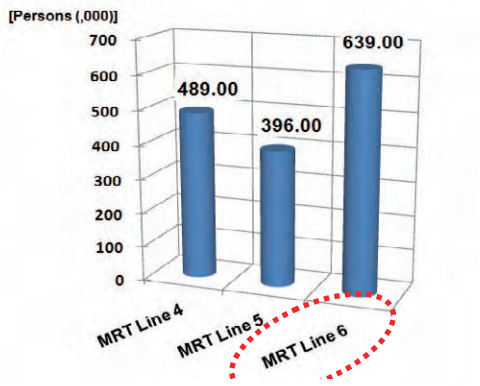
(2) Traffic Demand Forecast of each MRT Line

Traffic demand forecast using transport networks incorporated with MRT lines is made and the results are shown in Table 3.

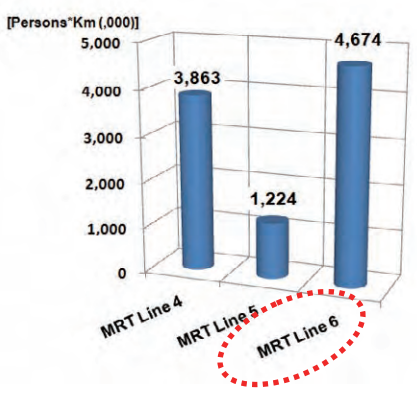
Table 3 Results of Traffic Demand Forecast of Each MRT Lines

	Passenger Demand for MRT('000)	Passenger-Km ('000)	Average Trip Length (km)	Reduction of Road Trffic Volume ('000 veh/km)	Congestion Ratio (Veh. Km/cap.)	Reduction of Passenget Hours ('000 Pass-km)
With MRT Line 4	489	3,863	7.9	1,345	0.66	790
With MRT Line 5	396	1,224	3.1	302	0.68	397
With MRT Line 6	639	4,674	7.3	1,788	0.65	785

Source: JICA Study Team



Number of daily Passengers

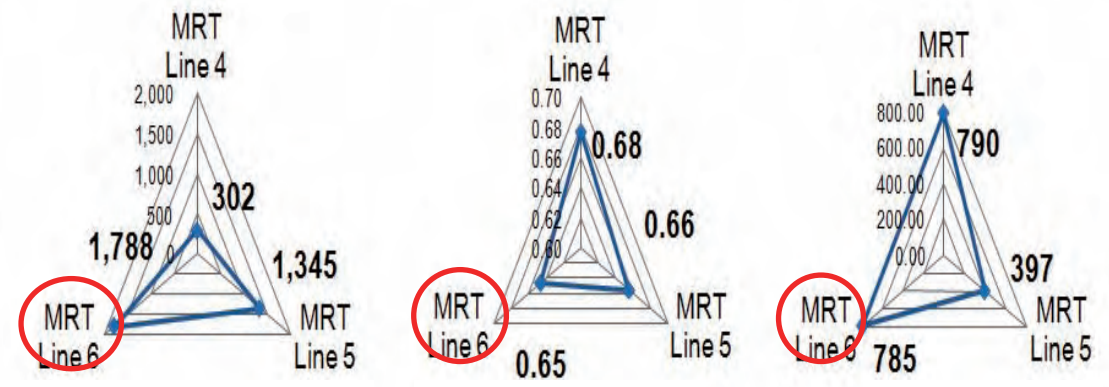


Passenger-Kilometer on daily basis

Figure 7 Demand Forecast for each MRT Line

Source: JICA Study Team

(3) Impacts of introduction of MRT on alleviation of road traffic congestion



Reduction of the road traffic volume [Veh.*km (,000)]

Degree of road traffic congestion

Travel Time savings

Figure 8 Impacts on Alleviation Traffic Congestion

Source: JICA Study Team

(4) Conclusion

As the results of the examinations, it is recommend that MRT Line 6 can be the most prioritized MRT system from the view point of the amount of expected demand and impact of alleviation of road traffic congestion.

6 Selection of Optimal Transport Network Scenario

Based on the results of the prioritization of STP proposal of MRT system, the optimal transport network plan in 2025 here is evaluated and selected from alternative transport scenarios in this section.

(1) Alternative Transport Network Development Scenario Setting

a) "Do Minimum Scenario"

Taking into limited government financial, "Do Minimum" Scenario contains three (3) BRT lines and one (1) MRT Line with expansion of commuter services of BR from among three lines being proposed by STP.

b) "Do Medium Scenario"

"Do Medium Scenario" is assumed principally based on the STP proposal although some minor amended proposals are made.

c) "Do Maximum DHUTS Scenario"

In this scenario, future urban development in RAJUK area is considered. This contains three (3) BRT lines and five (5) MRT lines as follows. This scenario corresponds to the long term (beyond

2025) development scenario.

Table 4 Summary of the Alternative Transport Development Scenarios

		Do Nothing Scenario	Do Minimum DHUTS Scenario	Do Medium DHUTS Scenario	Do Maximum DHUTS Scenario
Public Transport					
0.0	Without MRT & BRT	●			
MRT Plan					
1.0	MRT Line 4 (Minor Improvement of BR)				
1.1	MRT Line 4 (Minor Improvement BR w/ Extension)			●	
1.2	MRT Line 4 (Metro Level Development w/ Extension)		●		●
2.0	MRT Line 5 (Gulshan - Mirpur - Rampura)		●	●	●
3.0	MRT Line 6 (Pallabi - Saidabad)				
3.1	MRT Line 6 Extension (Uttara 3- Pallabi - Saidabad)		●	●	
3.2	MRT Line 6 Extension (Uttara 3 - Saidabad- Tarabo)				●
BRT Plan					
4.0	BRT Line 1 (Uttara - Saidabad)				
4.1	BRT Line 1 (Purbachar - Saidabad)		●	●	●
5.0	BRT Line 2 (Gabtori - Saidabad)		●	●	●
6.0	BRT Line 3 (Uttara - Airport Road - Ramna)		●	●	●
6.1	BRT Line 3 Extension (Uttara - Ramna - Jheelmel)				●
Road Network Plan					
0.0	Without Road Improvement	●			
1.0	Urban Expressway		●	●	●
2.0	Gulide Development		●	●	●
3.0	R/C Road Network in Rajuk				●

Source: JICA Study Team

(2) Comparative Analysis

The alternative scenarios are comparatively evaluated on the basis of the following three (3) factors;

Table 5 Evaluation Indices for Alternative Transport Scenarios

Index	Description
Traffic Aspects	Indices of traffic aspect consists of a) average travel speed, and b) average volume / capacity (V/C) ratio
System efficiency	Indices of system efficiency aspect consists of a) travel length, b) travel time and b) travel cost
Economic / Financial Aspect	Indices of system efficiency aspect consists of a) average fare revenue per km, and b) fare revenue per investment cost

The traffic assignment analysis of three (3) alternative scenarios is made on the proposed transport network scenarios in year 2025 using transport models developed in this study.

(3) Comparative Analysis of Traffic Indicators

Table 6 summarize the comparison of traffic indicators of each transport scenarios.

Table 6 Number of Trips by Modes and by Alternative Scenarios

	Walk	Rickshaw	Car	Bus	CNG	BRT or MRT	Total
2009	4,139,000	8,162,000	1,037,000	6,314,000	1,360,000	0	21,011,000
2025							
Do Nothing	9,887,000	20,376,000	8,589,000	19,094,000	6,624,000	0	64,570,000
Do Minimum	9,889,000	20,441,000	7,819,000	17,678,000	6,114,000	2,629,000	64,570,000
Do Medium	9,889,000	20,441,000	7,727,000	17,598,000	6,067,000	2,849,000	64,570,000
Do Maximum	9,889,000	20,441,000	7,716,000	17,570,000	6,056,000	2,898,000	64,570,000

Source; JICA Study Team

(4) Overall Evaluation

Table 7 presents the overall evaluation of four (4) alternative scenarios. Overall evaluation is made from the view of traffic aspect, system efficiency, and economic and financial points. As the results of the evaluation, the following findings can be made;

- Do nothing scenario is considered beyond acceptable due to the not solving any traffic congestion faced in Dhaka.
- Do maximum scenario shows a scarcely acceptable level. This is due that a huge amount of investment costs for mass transit system projects will be required.
- Do minimum scenario or Do medium scenario is superior to the other scenarios. However taking into consideration financial situation of the government, it is recommended to employ the Do Minimum Scenario as master plan for DMA in 2025.

Table 7 Comparison Analysis of Alternative Transport Scenario

Scenario	Traffic Efficiency	System Efficiency	Economic / Financial Aspects	Overall Evaluation
Do Nothing ・No Special Projects	・Average Travel Speed=4.2 km/h ・Average VCR = 1.09 ・Proposed network in 2025 is not acceptable [X]	・Passenger load = 0 pass/km ・Trip length = 16.5 km ・Travel Time =49 min [X]	・Due to no investment cost required, no financial burdon is necessary but bad affects to Dhaka economy [X]	As transport network in 2025, it is not recommended due to high traffic congestion [X]
Do Minimum ・MRT Line 6 ・Upgrading BR ・3 BRT Lines ・Urban Expressway	・Average Travel Speed = 14.1 km/h ・Average VCR = 0.65 ・Proposed transport network in 2025 is acceptable from view point of traffic aspect [○]	・Passenger load = 196,000 pass/km ・Trip length = 16.5 km ・Travel Time = 15 min [○]	・Average fare revenue = 552,000 Tk/km ・Efficiency of investment cost= 15,400 Tk [◎]	As transport network in 2025, it is recommended due to minimum investment while effects being more or less same [◎]
Do Medium ・MRT Line 4,5 and 6 ・3 BRT Lines ・Urban Expressway	・Average Travel Speed=14.5 km/h ・Average VCR=0.63 ・Proposed transport network in 2025 is acceptable from view point of traffic aspect [○]	・Passenger load = 183,000 pass/km ・Trip length = 14.9 km ・Travel Time = 14 min [○]	・Average fare revenue = 548,000 Tk/km ・Efficiency of investment cost= 11,300 Tk [△]	As transport network in 2025, it is recommended as second best plan [○]
Do Maximum ・MRT Line 4,5 and 6 ・MRT Line 7 & 8 ・3 BRT Lines ・Urban Expressway	・Average Travel Speed=14.9 km/h ・Average VCR =0.63 ・Proposed transport network in 2025 is acceptable from view point of traffic aspect [○]	・Passenger load = 139,000 pass/km ・Trip length = 15.4 km ・Travel Time = 14 min [△]	・Average fare revenue = 383,000 Tk/km ・Efficiency of investment cost= 7,750 Tk [X]	As transport network in 2025, it is not recommended due to high investment cost [X]

Source; JICA Study Team

(5) Optimal Transport Scenario in the year 2025

The 'Do Minimum' scenario is recommended based on the evaluation on traffic aspect, system efficiency, and economic and financial points.

The 'Do Minimum' Scenario is composed of as follows;

- Construction of Mass Rapid Transit Railway (MRT) Line.6
- Upgrading of existing Bangladesh Railway (BR)
- Bus Rapid Transit (BRT) Line 1 to 3

The recommended Transport Network Development Plan is illustrated in Figure 9.

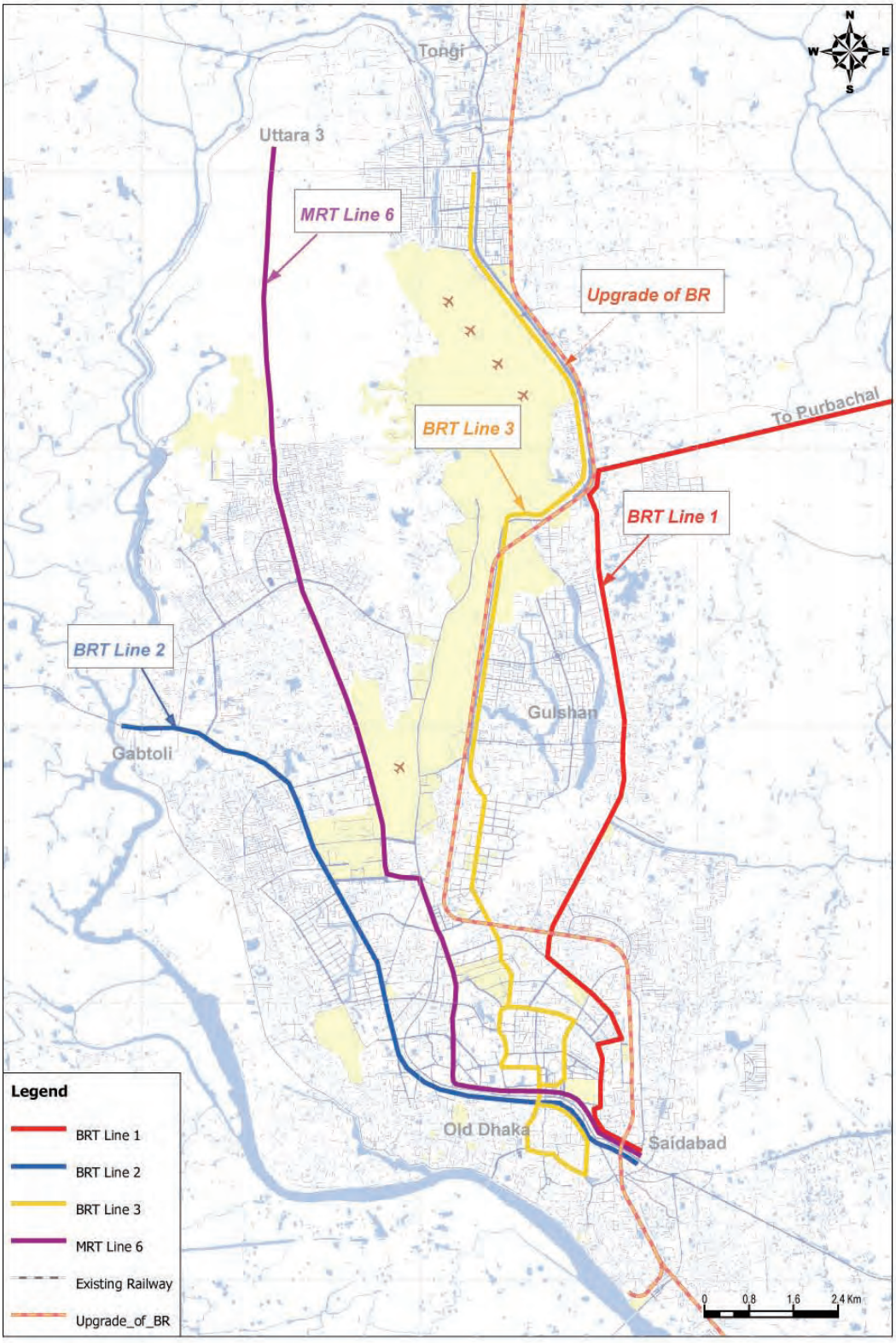


Figure 9 Proposed Mass Transit Network in 2025

Source: JICA Study Team

TRANSPORT INFRASTRUCTURE & MANAGEMENT

1 Optimal Urban Transport Network Plan

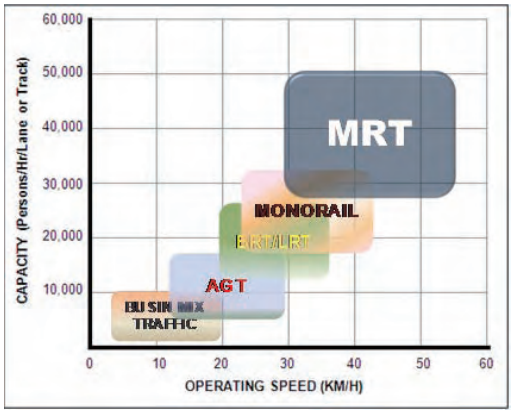
The evaluation here was done in terms of amount of potential users for MRT and impact on alleviation of road traffic congestion. Indices adopted in the evaluation are a) number of potential users, b) average degree of congestion, c) Total vehicle kilometer, and d) total time consuming.

As the results, it is recommend that 'Do Minimum Scenario' can be the most optimal plan from the view point of the amount of expected demand and impact of alleviation of road traffic congestion.

2 Public Development Plan

(1) Public Transport Development Policies

Based on the public transport planning concept, the following four (4) key policies for public transport development policies are recommended as follows;



a) Introduction of mass transit system based on hierarchy of public transport system
b) Building integrated public transport system
c) Public transport for low income group
d) Public transport system for promotion of urban development

(2) Recommendations for the Better Bus Transport System

The following recommendations are made to provide better bus transport system;

1) Restructuring the Bus Industries

The following components are recommended to restructure

- Establishing a management and monitoring (public) entity
- Regulating a requirement for bus operator (scale, fleet, driver's management etc.)
- Introduction of "Bus Route Franchising System"

2) Improving a Bus Operation System

- Bus Fleet Management
- Periodical Monitoring (for bus fleets and crews)
- Crew Management
- Roster of employees

- Introduction of electronic technology such as automatic fare collection machines

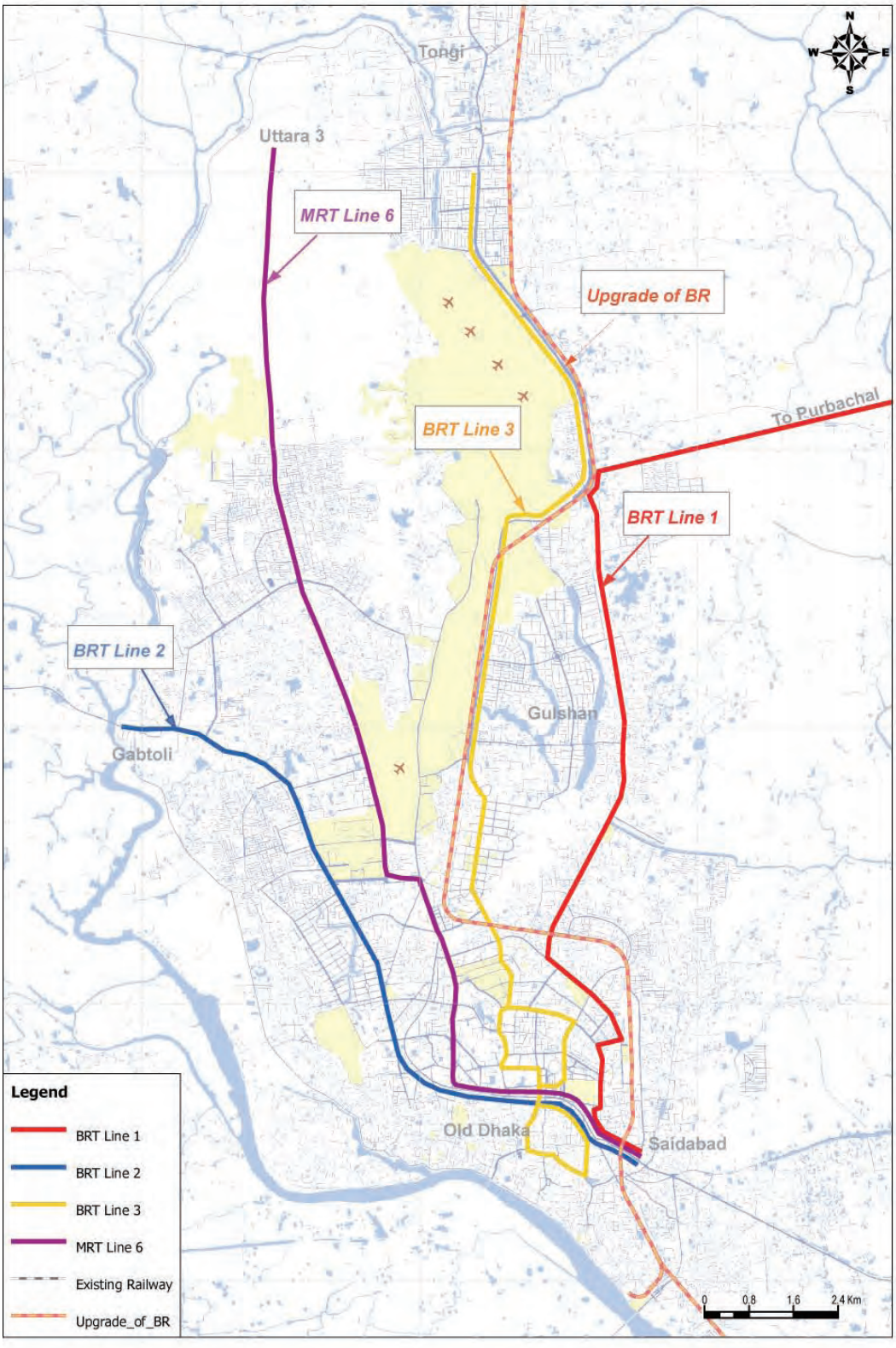


Figure 10 Proposed Mass Transit Network in 2025

3) Providing Proper Information regarding Bus Operation

- Developing the comprehensive bus route map
- Presenting bus fare system
- Running Interval

4) Fare Policy Reform (Ticketing)

- Reviewing current fare policy
- Formulating precise fare structure (zone base or distance base)
- Establishing the common ticketing system

5) Public Transport for the Urban Poor

- Campaigning for promoting urban public transportation use
- Establishing a subsidy system for the vulnerable transport users

6) Training Program for Bus Drivers

- Developing a driver training program
- Establishing a bus-specified driving licensing system
- Establishing a training centre for public transport drivers

7) Integration with Urban Development

8) Building an Integrated Network

- Systematic planning of route network
- Community involvement in the planning process
- Integrated and consistent actions between the planning process and the implementation
- Better monitoring and enforcement of bus operation
- Capacity building for local government's planning staff

(3) Mass Transit System Plan

The MTS network plan is recommended in order to accommodate future population increase. In the year 2050, it may be necessary to construct MTS network as shown in Table 8 Summary of MRT System Plan.

Table 8 Summary of MRT System Plan

	Section	Starting Point	Via	Terminating Point	System proposed by STP	Length (km)	Remarks
Line 1	Purbachar-Saidabad Line	Purbachar	DTI Road	Saidbad	BRT	23	
Line 2	Gastali - Saidabad Line	Gastali	New Market	Saidabad	BRT	14	
Line 3	UTTRA-Old Dhaka Line	UTTRA	Airport Road	Old Dhaka	BRT	26	
Line 4	UTTRA - Saidabad Line	UTTRA	Tajgaon	Saidabad	MRT	22	
Line 5	Circular Line	Badda	Mirpur	Badda	MRT	22	
Line 6	Pallabi -Saidabad Line	UTTRA Pahes 3	National Assembly	Saidabad	MRT	22	
Line 7	Purbachar-Savar Line	Purbachar	Zia Colony	Savar	-	22	Future line
Line 8	East Fringe Line	Tongi	Satarkul	Narayanganj	-	22	Future line

Source JICA Study Team

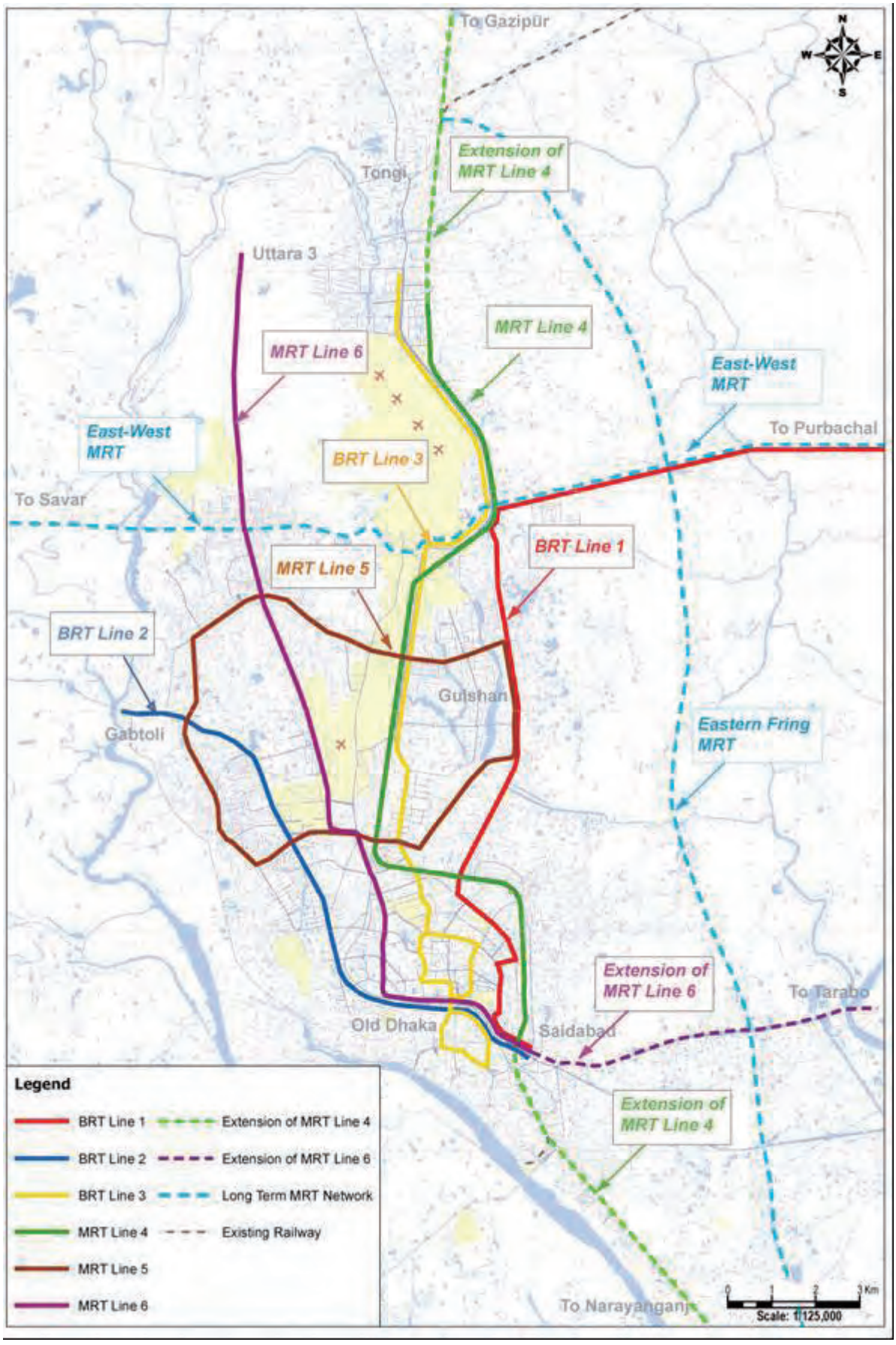


Figure 11 Proposed Mass Transit Network towards 2050

3 Road Network Plan

(1) Policies

Based on the road network development planning concept, the road network development policies are recommended as follows;

a) The road network plays a role as' a prime Mover of Economic Growth' and as arteries linking all parts of Dhaka to be a cohesive economic body and to integrate the Dhaka economy within Bangladesh and the Region.

e) The road network development in Dhaka shall be integrated with the Land use development plan of RAJUK.

f) The Government will continue to give high priority to the rehabilitation and reconstruction of road network connecting to all parts of the Dhaka Division and with neighboring Division.

g) The Government will continue to accord high priority to the maintenance of national Highway, Regional Highway and the reconstruction of feeder roads.

h) The Government will seek increasing private sector and road users to participate in road infrastructure development.

i) The Government will speed up the adoption of Law on Roads as well as supporting legal and regulatory framework for efficient management of transport infrastructure

j) The Government will place emphasis on traffic safety for road users

(2) Road Network Plan

The principals of the road network development plan for DCC and DMA are;

a) To improve based on hierarchical and functional road network

k) To improve the primary road network to link between CBD of Dhaka and urban cores, satellite communities and division centers.

l) To improve the missing link within the urbanized area in order to prepare efficient road network

m) To develop the grid type road network for newly development areas taking into consideration the geographic feature of the East Fringe Area,

n) To construct the Urban Expressway to make backbone road network in the center of Dhaka

o) To improve Inner Ring Road to serve traffic from Dhaka to regional centers in RAJUK area but also in Bangladesh.

The recommended road network development plan in DCC and DMA is shown in Figure 15.2-3.

While the principals of the road network development for RAJUK area are as follows;

a) To develop the road network taking into consideration hierarchy and road functions,

p) To development as concept of circumferential and radial road network,

q) To improve inter-regional roads such as Dhaka – Chittagong Road, Dhaka –Khruna Road, etc.

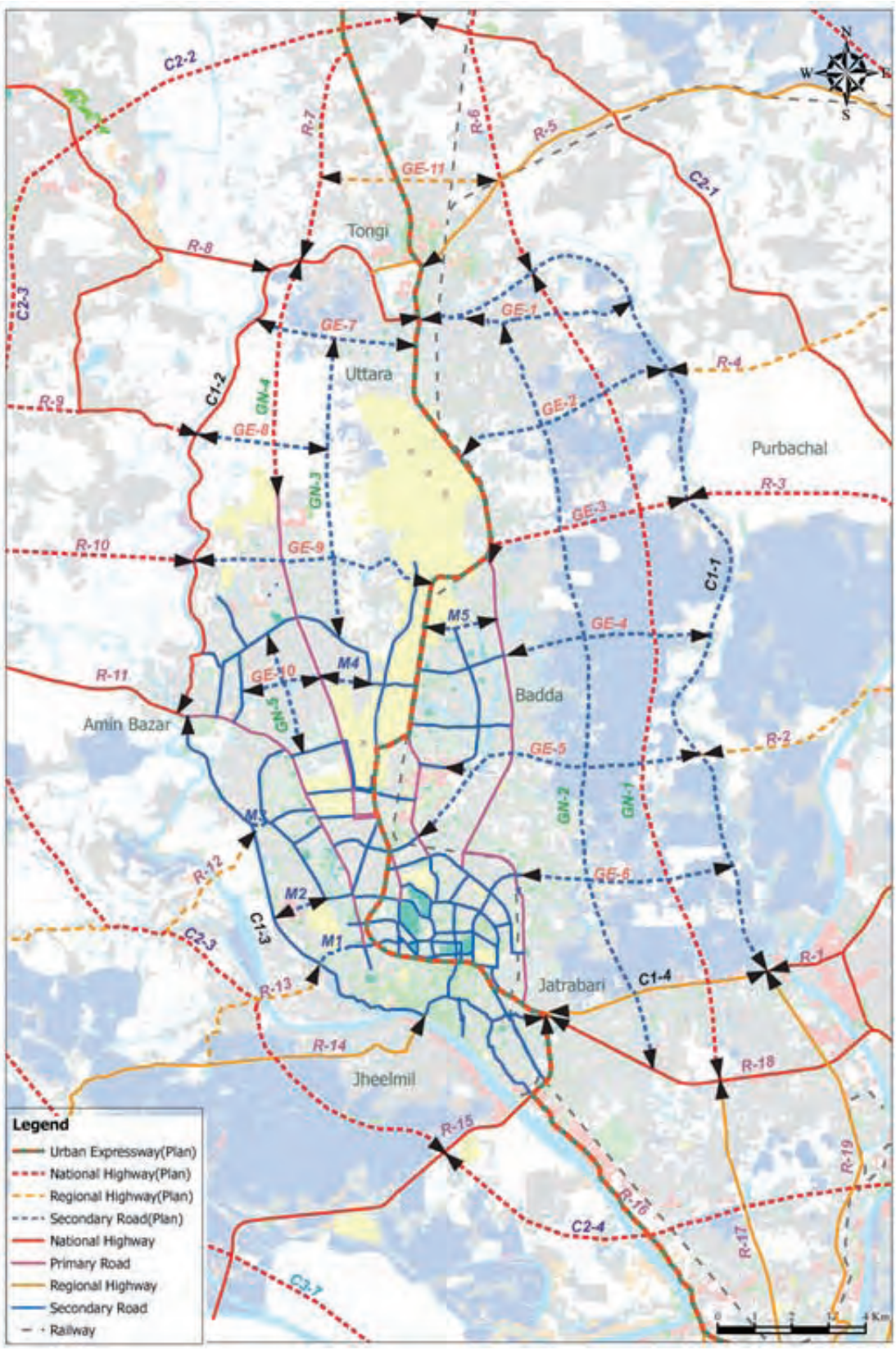


Figure 12 Proposed Road Network in DCC/DMA

4 Traffic Management Plan

(1) Traffic Management

The existing traffic congestion is largely caused by inadequate road usage due to a lack of traffic management. An appropriate systematic traffic management system is essential for safety and smooth traffic flows on roads, making a maximum usage of road facilities to enlarge the current road capacities.

- To achieve smooth traffic flow
- To reduce traffic accidents, and
- To create pedestrian –friendly facilities

To achieve the above-mentioned objectives, the traffic management plan composed of the following measures is recommended;

Table 9 Traffic Management Measures by Phase

Countermeasures	Short-Term	Medium-Term
● Improvement of bottleneck intersections	✓	
● Improvement of parking system	✓	✓
● Improvement of traffic safety facilities	✓	
● Improvement of traffic signal control	✓	✓
● Introduction of ITS system		✓
● Traffic safety education	✓	
● Institutional coordination	✓	

(2) Public Experiment

Public Experiment was carried out at designated two intersections, namely Gulshan-2 Circle and New Market between Monday 01 and Wednesday 03 March 2010 to monitor whether some traffic management counter measures are effective or not and to investigate whether such improvement measures are applicable into other intersections in near future in DCC and/or DMA.

Before Public Experiment

Based on the site observations and computer simulations, following items are authorized to be implemented as Public Experiment in the Traffic Management Committee represented by DMC, DCC, and BRTA/C which chaired by DTCB in late January 2010;

- ✓ Installation of Lane Markings, Traffic Sign
- ✓ Installation of Traffic Corns along Left Lane as Temporally Sidewalk Space
- ✓ Readjusting Signal Cycle & Green Light Distributions

During Public Experiment

Public Experiment was carried out between Monday 01 and Wednesday 03 March 2010 after some night works and preceding traffic campaign from Monday 22 to Sunday 28 February 2010, following results are achieved, however, due to breakdown of control boards of traffic signals, readjustment of signal cycle and green light distribution was not done as proposed;

- ✓ Lane demarcation was clarified and traffic became smooth
- ✓ By securing sidewalk space, pedestrian can cross road safely

Recommendations

Following recommendations are advised from the results of the Public Experiment;

- ✓ Lane markings and traffic signs should be installed in major intersections in DCC, especially within the influence area of each intersection
- ✓ Enough sidewalk spaces at intersections in consideration of peak hour pedestrian volume are necessary
- ✓ Repair and regular maintenance of control boards of traffic signal are highly recommended

Comparisons

Observed seen before and during the Public Experiment are shown in Figure 13.

Before

During

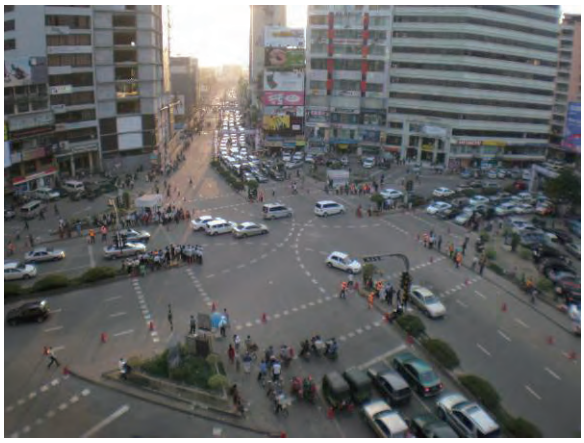


Figure 13 Before and During the Public Experiments

INITIAL ENVIRONMENTAL EXAMINATION (IEE)

1 EIA Legislation in Bangladesh

According to the Environment Conservation Rules, 1997, for the purpose of issuance of Environmental Clearance Certificate, the industrial units and development projects are classified into four categories: Green, Orange - A, Orange - B and Red. The Green categories are automatically granted the Clearance Certificate. The Orange categories must submit considerable further information and plans to Department of Environment and may be subject to field inspection. The Orange-B categories must conduct an Initial Environmental Examination and prepare environmental management plans satisfactory to the Department. The Red categories must conduct a detailed Environmental Impact Assessment and prepare environmental management plans.

Schedule 1 of the Rules provides classification of industrial units or development projects based on its location and impact on environment. Orange-B category projects include “engineering works (up to 10 hundred thousand Taka capital.)”, “construction, re-construction and extension of road (feeder road, local road)” and “construction, re-construction and extension of bridge (length below 100 meters)”. Red category projects include “engineering works (capital above 10 hundred thousand Taka)”, “construction, re-construction and expansion of road (regional, national and international)” and “construction, re-construction and expansion of bridge (length 100 meter and above)”. The classification of traffic management plan is not stated in the Rules. Most of construction projects proposed in the DHUTS will be classified as Red categories.

2 Scoping for IEE

Expected major environmental and social impacts of the DHUTS plans are as follows:

(1) Mass Rapid Transit Railway (MRT) Development Plan

a) Air and water pollution caused by construction works
b) Less total volume of air pollutants by MRT operation than without plan as positive impact
c) Generation of construction waste including surplus soil
d) Generation of noise and vibration from construction machines and MRT operation
e) Impact on groundwater, subsidence and surrounding underground structures of existing buildings
f) Loss of trees on roadside and center strip
g) Generation of greenhouse gas from construction works
h) Less total volume of greenhouse gas by MRT operation than without plan as positive impact
i) Impacts on hydrological situation of road drainage and flood pattern in low land

j) Impacts on sunshine right in sides of elevated structures

k) Construction workers' accidents

(2) Proposed Road Development Plan

a) Road Network Development

i. Air and water pollution caused by construction works

ii. Increase in air pollutants by increased vehicles

iii. Generation of construction waste

iv. Generation of noise and vibration from construction machines and increased vehicle

v. Loss of semi-natural vegetation and trees on roadside and center strip

vi. Irrigation canals may be affected

vii. Potential increase in greenhouse gas by increased vehicular traffic

viii. Impacts on hydrological situation of road drainage and flood pattern in low land

b) Intersection Improvement (Flyover projects)

i. Air and water pollution caused by construction works

ii. Increase in air pollutants by increased vehicles

iii. Generation of construction waste

iv. Generation of noise and vibration from construction machines and increased vehicle

v. Potential impact on subsidence

vi. Loss of trees on roadside and center strip

vii. Impacts on hydrological situation of road drainage

viii. Impacts on sunshine right in sides of elevated structures

ix. Construction workers' accidents

PRELIMINARY STUDY ON MRT LINE 6

1 Route

According to the STP proposal, the Line 6 connects between Pallabi in the north of the City and Saidabad in the south with the total length of 16 km. Taking into account future urbanization of Dhaka city, DHUTS is recommended its extension from Pallabi to Uttara-3 area, where RAJUK has undertaken large housing developments. Total length of proposed Line 6 is 22 km from Uttara-3 to Saidabad including 6 km of extension. Thus the Line 6 has two terminals and 16 intermediate stations.

2 Initial Operation Planning

Based on the future traffic demand forecast, the passenger of the MRT line 6 is estimated to be some 64,000 pph (passengers per hour) at peak hour in both directions in the year 2025. If around 70% of the passengers will go from the north to the south, i.e., from the areas of Uttara, Pallabi and Mirpur to downtown in the morning peak hour, it is estimated to be about 40,000 pphpd at peak hour in one direction in the year 2025. We use this figure for preliminary operational planning.

Basic assumptions made for the preparation of initial operation plan are summarized as follows:

a) Crash Load 250/m^2 (AW3)
b) Average Train Speed 35 km/hr Max. Speed 80 km/hr
c) Commercial Length 22 km
d) Turn round time at both terminals 4 minutes
e) Stop time at Stations 40 seconds
f) All train runs through between two terminals. (No Express Service)
g) Train composition 10 cars
h) Number of Stations 16 (Station) + 2 (Terminal)

3 Preliminary Cost Estimates

The following preliminary cost of the Project is estimated on the basis of the following option;

- Option 1; With underground case
- Option 2: Without underground case

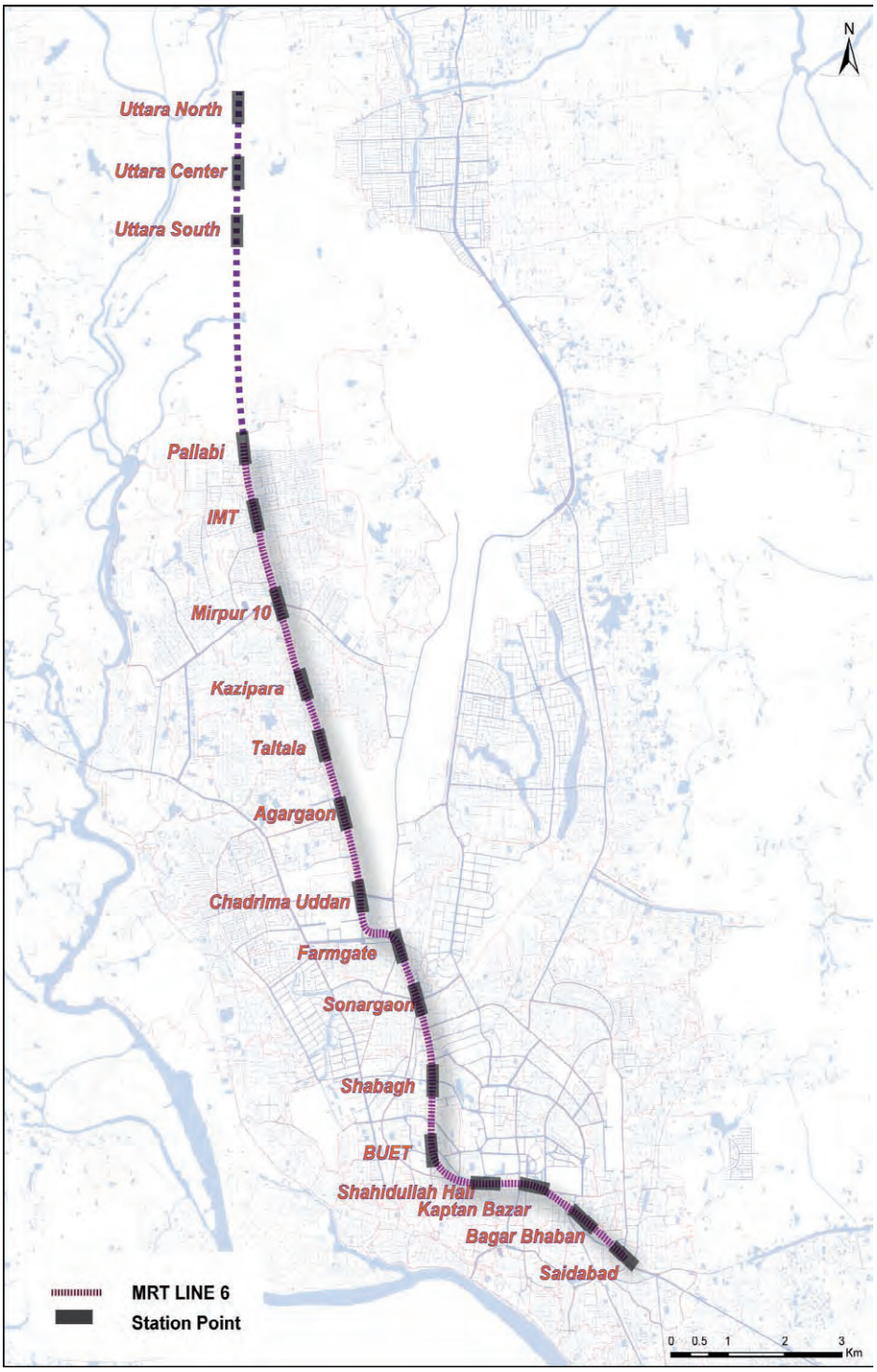


Figure 14 Proposed Route of MRT Line 6

Table 10 Project Cost Estimates

Unit: USD Million

	Option 1 (W/ Underground)		Option 2(W/O Underground)	
Origin	UTTRA3	Pallabi	UTTRA3	Pallabi
Destination	Saidabad		Saidabad	
Length (km)	22	16	22	16
Structure	With Underground		Without Underground	
Infrastructure	1,091	972	838	713
System	595	454	627	445
Engineering	207	171	176	139
Total	1,893	1,597	1,641	1,295

Source; JICA Study Team

4 Preliminary Financial Evaluation

Based on construction cost of the option 2 from UTTRA 3 to Saidabad section, the preliminary financial analysis is made the following cases:

a) Case 1; No subsidy to the capital cost
b) Case 2; 10 % of the capital cost is invested as share capital from Bangladesh Government
c) Case 3; In addition to case 2, RUJUK will contribute construction and system cost for additional costs from Pallabi to UTTRA Phase 3.
d) Case 4; Infrastructure cost among the project costs will be granted to the MRT company.

The results of the financial analysis are summarized as follows;

- Without any Government subsidy, FIRR of the project indicates to be 1.71%.
- When the Government and RAJUK invest some of the project cost, FIRR becomes to be 3.2 %. If the Government introduces the soft loan such as Yen Loan to the project, it is financially possible to implement the project.

Table 11 Financial Analysis of the Project

	Case 1	Case 2	Case 3	Case 4
Total Revenue (USD Million)	3,581.8			
Total Expenditure (USD Million)	2,803.2	2,639.2	2,358.4	1,790.3
Net Revenue (USD Million)	778.6	942.6	1223.4	1781.5
Revenue/Expenditure Rate	1.28	1.36	1.52	2.00
FIRR (%)	1.71%	2.20%	3.19%	6.71%
Year: Accumlated balance into plus	26	25	23	16

Note: Financial calculation period is assumed to be 30 years.

5 Preliminary Economic Evaluation

The results of the economic feasibility analysis are shown that the investment of USD 7,491 million will be produced annual economic benefits of USD 1,309 million in 2025, the BC ratio is computed to be 2.23. Another evaluation indicator, the EIRR is computed to be 25.7%.

These indicators are economically feasible.

Table 12 Summary of Economic Analysis

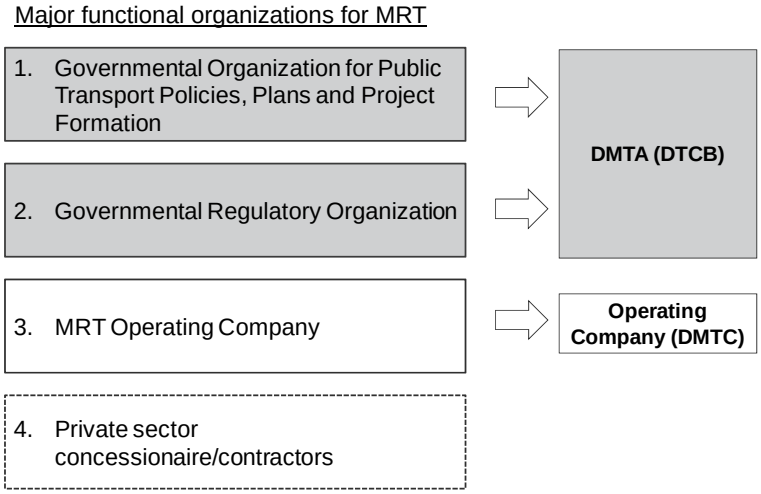
Economic Indicators	Net Present Value (USD Million)	5,055
	B/C Ratio	2.23
	EIRR (%)	25.7%

Notes; 1) A discount rate is assumed to be 12 % per annum for computation of Net Present Value and B/C ratio

2) Project life is assumed to be 30 years

INSTITUTIONAL PLAN FOR MRT LINE 6

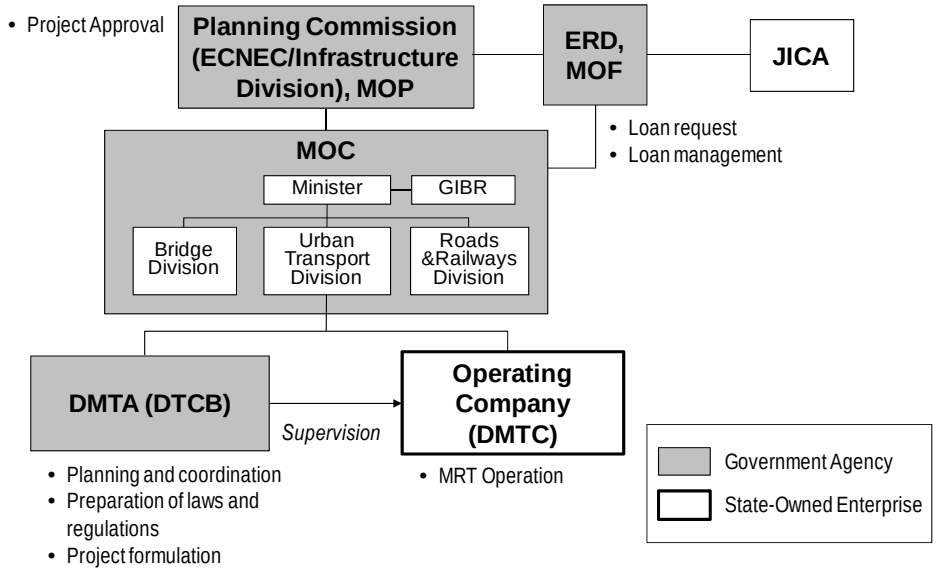
DMTA is scheduled to established by restructuring of DTCB, and an MRT operating company, DMTC should be newly established. DMTA should assume the functions that DTCB was mandated to fulfill, including the formulation of policies and plans and the coordination among the related organizations. Also, DMTA is expected to determine public transport related projects like MRT and BRT, and regulate public transport operating organizations. DMTA itself may implement part of the MRT project, e.g. only infrastructure part, in accordance with the appropriate financial sharing between DMTA and DMTC. DTMC is an independent organization in charge of MRT project implementation and operation.



Source: JICA Study Team

Figure 15 Basic Role Demarcation between DMTA and DMTC

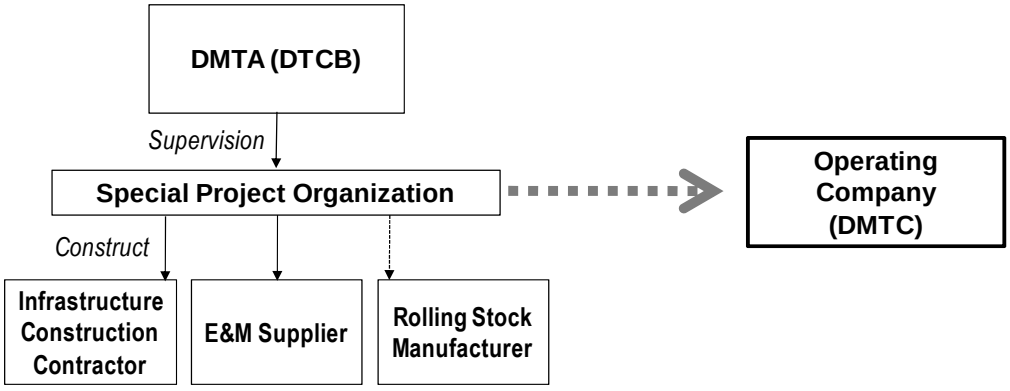
As the results of comparative analysis of the MRT project implementation and operation organization, DMTC is proposed to be set up at the same level as DMTA as shown in Figure 10. Even under this structure it is possible for DMTA to assume the responsibility of regulating and supervising MRT operations according to the DMTA Act which stipulates DMTA's functions clearly. For this option, establishment of the Urban Transportation Division in MOC is the key to make it work.



Source: JICA Study Team

Figure 16 Institutional Setup Options for MRT

The JICA Study Team proposed that DMTA should conduct all the works during preparation and implementation phase and DMTC will be responsible in operation phase. In this case, a Special Project Organization is proposaed to be established temporally under DMTA during the project implementation in order for a gradual development of DMTC, as shown Figure 17. It would ensure transparent financial flow for the project implementation. This scheme is practiced in many cases of project implementation in Bangladesh.



Source: JICA Study Team

Figure 17 Demarcation of Responsibilities for MRT Construction and O&M between DMTA and Operating Company (DMTC)

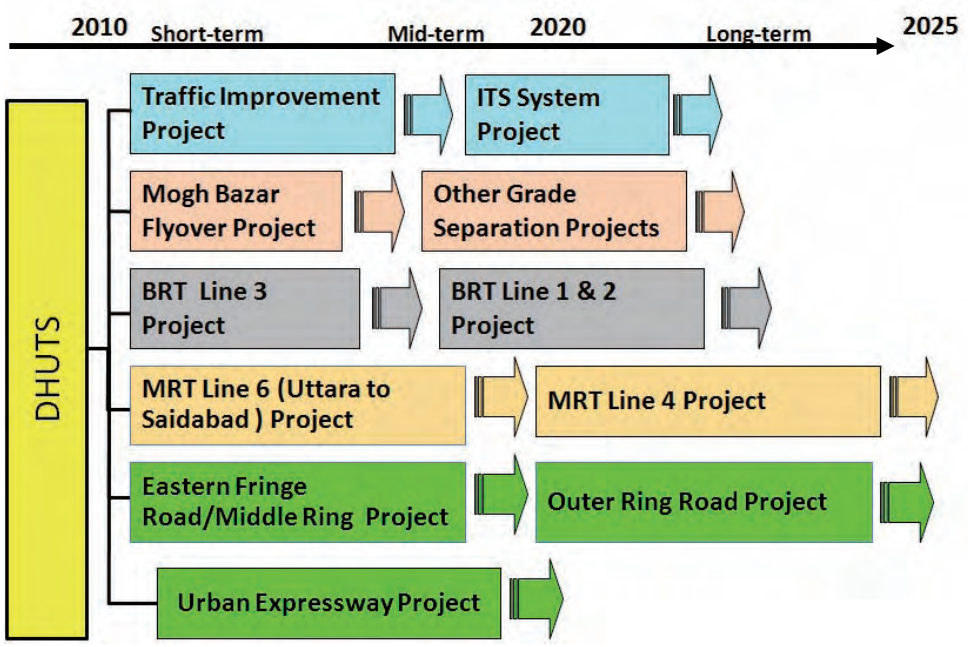
IMPLEMENTATION PROGRAM

1 Implementation Program

The total planning period is 16 years from 2010 to 2025, which is divided into the following three (3) phases:

a) Short Term Period: 2010 - 2015
b) Medium Term Period: 2016 – 2020
c) Long Term Period: 2021 – 2025

Figure 5 Implementation Program of Major Projects



2 Investment Requirement

Based on the proposed implementation schedule, the required investment costs are estimated, as shown in Table 13. According to this table, the following findings can be made;

a) The total investment costs are required for US$ 4.8 billion by 2025. Among those costs, US$ 1.6 billion is required for the project implementation in the short term, US$ 1.5 billion is required in the medium term, and US$ 1.7 billion is the long term.
b) Against the required costs, local fund may be available for US$ 1.7 million by 2025. The remaining balance of about US$ 3.1 billion shall be procured form private sector and/or foreign assistance.

c) It is assumed that the development of infrastructure in MRT system and BRT system are financed by foreign funding agencies. In addition, major arterial roads proposed by DHUTS, such as the east fringe road, middle ring road and outer ring road, are also expected to be financed by foreign funding agencies.

Table 13 Investment Requirements and Available Funds

USD: Million

Item		Total	Short Term (2010-2015)	Medium Term (2016-2020)	Long Term (2021-205)
Required Cost					
1	Public Transport Development	2,482.0	980.0	760.7	741.3
2	Roads and Highways	1,596.0	417.1	475.5	703.4
3	Traffic Management	732.1	161.4	275.7	295.0
4	Environmenatal & Management	32.0	12.0	10.0	10.0
5	Institutional Improvement	15.0	9.0	6.0	-
Total		4,857.1	1,579.5	1,527.9	1,749.7
Avaiable Fund					
1	Available Local Fund	0.0	0.0	0.0	0.0
2	Private Participation	1,193.0	388.0	375.3	429.8
3	Foreign Assistance	3,664.1	1,191.5	1,152.6	1,320.0
Total		4,857.1	1,579.5	1,527.9	1,749.7

Source: JICA Study Team

3 Recommendation of the High Priority Projects

Among the candidate projects, the following projects are selected for the following projects.

1. Public Transport Projects
   - MRT Line 6 Project
   - BRT Line 3 Project
2. Road Projects
   - Eastern fringe road project
   - Southern section of Middle Ring Road
   - Flyover projects
3. Traffic Management
   - Comprehensive traffic management project
4. Organizational development for DTCB(DMTA) and MRT Line6 Operating Company(DMTC)