Karachi Metropolitan Corporation
The Islamic Republic of Pakistan

THE STUDY
FOR
KARACHI TRANSPORTATION IMPROVEMENT PROJECT
IN
ISLAMIC REPUBLIC OF PAKISTAN

FINAL REPORT
VOLUME-2
(FEASIBILITY STUDY)

DECEMBER 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
YACHIYO ENGINEERING CO., LTD.
ORIENTAL CONSULTANTS CO., LTD.

EID
JR（先）
12-150

Karachi Metropolitan Corporation
The Islamic Republic of Pakistan

THE STUDY
FOR
KARACHI TRANSPORTATION IMPROVEMENT PROJECT
IN
ISLAMIC REPUBLIC OF PAKISTAN

FINAL REPORT
VOLUME-2
(FEASIBILITY STUDY)

DECEMBER 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
YACHIYO ENGINEERING CO., LTD.
ORIENTAL CONSULTANTS CO., LTD.

Exchange Rate

1 Pakistan Rupee (Rs.)	= 0.871 Japanese Yen (Yen)
1 Yen	= 1.148 Rs.
1 US dollar (US$)	= 77.82 Yen
1 US$	= 89.34 Rs.

Table of Contents

Appendix-1: Pre-Feasibility Study of Blue Line

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

Appendix-2: Stakeholder Meeting
Appendix-3: Business Plan (Draft)

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period (Chapter 4, 5, 7, and 8)

Appendix-4: PC-I (Draft)

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

Appendix-5: Karachi Metropolitan Transport Authority Act, 2012 (Draft)
Appendix-6: Comments on Draft Final Report by KMTC

List of Tables

List of Figures

Abbreviation

ADA	Americans with Disabilities Acts
ADB	Asian Development Bank
ATM	Active Traffic Management
BOD	Biochemical Oxygen Demand
BRT	Bus Rapid Transit
CBD	Central District Business
CBU	Complete Build-up
CDGK	City District Government of Karachi
CKD	Complete Knock-down
CNG	Compressed Natural Gas
DPF	Diesel Particulate Filter
DSCR	Debt Service Coverage Ratio
DTRA	District Regional Transport Authority
EDA	European Disability Acts
EIIR	Economic Internal Rate of Return
F/S	Feasibility Study
FC	Foreign Currency
FIIR	Financial Internal Rate of Return
GCP	Ground Control Point
GOS	Government of Sindh
GPS	Global Positioning System
GST	General Sales Tax
GVM	Gross Vehicle Mass
HIS	Household Interview Survey
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IEE	Initial Environmental Examination
ITS	Intelligent Transportation System
JICA	Japan International Cooperation Agency
JST	JICA Study Team
KBRTC	Karachi Bus Rapid Transit Corporation
KCR	Karachi Circular Railway
KDA	Karachi Development Authority
KMC	Karachi Metropolitan Corporation

KMC	Karachi Municipal Cooperation
KMTC	Karachi Mass Transit Cell
KTIP	Karachi Transportation Improvement Project
KTIP-EMS	Karachi Transportation Improvement Project's Environmental Management System
KUTC	Karachi Urban Transport Corporation
KUTMP	Karachi Urban Transportation Master Plan
LC	Local Currency
LRT	Light Rail Transit
LTC	Lahore Transport Company
M/P	Master Plan
MCI	Maintenance Cost for Insurance
MPGO	Master plan Group of offices
MRT	Mass Rapid Transit
NCS	National Conservation Strategy
NEQS	National Environmental Quality Standards
NOC	No-Objection Certificate
NPV	Net Present Value
O& M	Operation and Maintenance
O&D	Origin & Destination
OAC	Other Administrative Cost
PCUs	Passenger Car Units
PEPA	Pakistan Environmental Protection Agency, or Pakistan Environmental Protection Act
PEPO	Pakistan Environment Protection Ordinance
PHPDT	Passenger per hour per direction
PM	Particulate Matter
QCL	Quality Control Laboratory
ROW	Right of way
RTA	Road Traffic Accidents
SCOOT	Split Cycle Offset Optimization Technique
SOSE	Study on Social Environment
TCD	Transport & Communications Department
TFL	Transport for London
TSS	Total Solved Solid and Sulphide
UC	Union Council
ULSD	Ultra Low-Sulfur Diesel
V/C	Volume Capacity Ratio
VAT	Value Added Tax
VIC	Vehicle Insurance Cost
VMC	Vehicle Maintenance Cost
VOC	Vehicle Operating Cost
W& SD	Work & Services Department
WPI	Wholesale Price Index

The abbreviations, CDGK and KMC, used in this report are the name of the local governments of Karachi.
These two names were used in the reports because during the study period, the CDGK renamed to KMC, as per GOS Notification in this regard.

Chapter 1 Introduction

1.1 Karachi Transportation Improvement Project

1.1.1 Background

This report (Final Report, hereinafter referred as FR) describes the concept plan of Bus Rapid Transit System (BRTS) along Green Line and Red Line proposed in the master plan stage of the Study on Karachi Transportation Improvement Project (hereinafter referred as "the KTIP Study").

The KTIP Study aims to formulate the Karachi Urban Transportation Master Plan (KUTMP) 2030 and conduct a feasibility study for the priority project. The JICA Study Team organized by the Joint Venture of Nippon Koei Co., Ltd, Yachiyo Engineering Co., Ltd, and Oriental Consultants Co., Ltd commenced the Study in the middle of April 2010. Karachi Mass Transit Cell (KMTC) is the counterpart of the KTIP Study. The JICA Study Team conducted a Person Trip Survey including a Household Interview Survey whose sample size was as large as 40,000 households but the survey was delayed to a large extent due to worsening law and order situation. To avoid the critical influence on the entire schedule, the JICA Study Team started the demand analysis using 36,000 samples that was collected by the beginning of March, and submitted the Interim Report-1 (1) that include the results of the master plan study on 30th June, 2011.

City District Government of Karachi (CDGK) has been promoting the implementation of Light Rail Transit (LRT) for the Priority Corridor-I among the Karachi Mass Transit Corridors that was notified by the Government of Pakistan (GOP) in 1995. KMTC has been the main authority for the activity. The JICA Study Team organized the study members and work plan assuming that a railway system would be selected as the project for the feasibility study. The JICA Study Team proposed Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT). The cost-benefit performance of BRT is higher than that of LRT, while the capacity of MRT is higher than that of LRT. At the same time, it was concluded that MRT should be developed after the implementation of Karachi Circular Railway (KCR) which had shown the progress recently, taking into account of the amount of JICA loan and the budgetary condition of the local government of Pakistan.

As far as BRT concerns, Asian Development Bank (ADB) proposed three routes based on "Private-Public partnership based Environment Friendly Public Transport System for Karachi, 2006" and KMTC regards the implementation of the proposed BRT as one of the important projects. On the other hand, promotion of the BRT project became an issue of KMTC since ADB discontinued the BRT project.

The JICA Study Team consulted with KMTC about the plan to select BRT for the project of the feasibility study based on the result of the master plan and the intension of JICA at the time of the submission of Interim Report-1 (1). After that, JICA and KMTC had a talk on 5th July, 2011 about the feasibility study project and agreed that the JICA Study Team would conduct the feasibility study for the Green Line and Red Line that are proposed in the master plan.

On the other hand, KMTC raised a plan to extend the Green Line and Red Line in the Technical Committee on 23th July, 2011. Although a careful consideration is necessary for the proposal because the master plan did not evaluate the route, it would be better to consider the extension of these lines because it would be possible according to the type of BRT.

The JICA Study Team reviewed the work plan and reorganized the team members for efficient conduct of the feasibility study of BRT. Interim Report-1 (2), in which the updated work plan and staffing schedule are described, was submitted to KMTC in the end of August, 2011.

Interim Report -2 was submitted in the end of January, 2012.

1.1.2 Work Items

The followings are revised work items in the feasibility study stage.

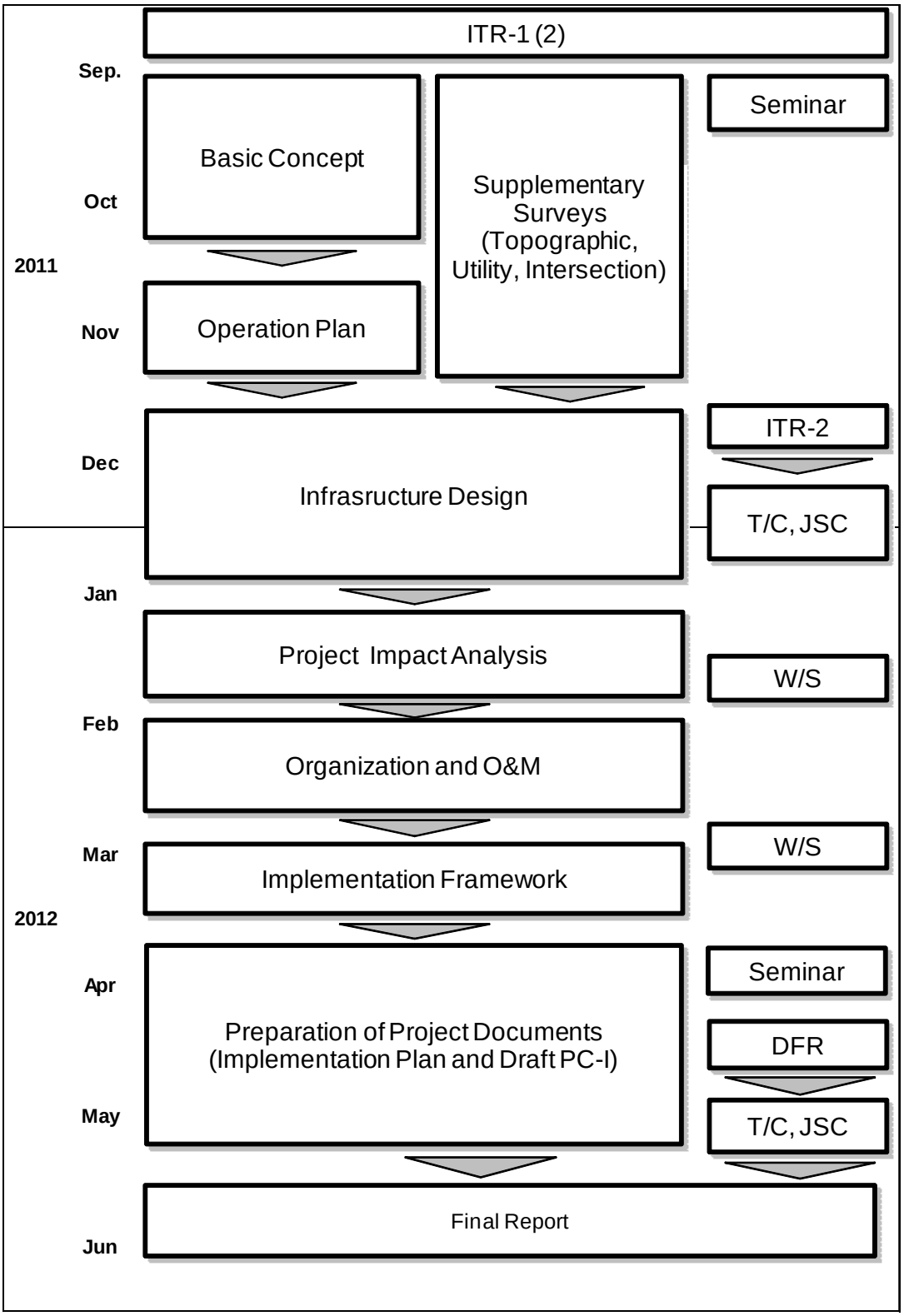
Table 1-1-1 Work Items in Feasibility Study Stage

Code-1	Work Item	Code-2	Sub Work Item
A	Master Plan Follow Up	A-1	HIS Analysis
		A-2	Demand Forecast Model Update
		A-3	Master Plan Update
B	Supplementary Surveys	B-1	Topographic Survey
		B-2	Utility Survey
		B-3	Turning Movement Traffic Count Survey
C	Conceptual Design	C-1	Bus Network and Route
		C-2	Station Locations
		C-3	Cross Section
		C-4	Vehicle Type
		C-5	Demand Forecast
		C-6	Selection of Depot
D	Operation Plan	D-1	Traffic Management
		D-2	Operation Plan
		D-3	Traffic Signal
		D-4	Fare Structure
E	Vehicle Plan	E-1	Vehicle Design
		E-2	Manufacturer Survey
		E-3	Procurement Cost Estimate
F	Infrastructure Design	F-1	Alignment Plan and Cross Section Plan
		F-2	Station
		F-3	Intersection
		F-4	Depot and Terminal
		F-5	Intermodal Facilities
		F-6	Cost Estimate
G	Environmental Consideration	G-1	Scoping
		G-2	Impact Forecast
		G-3	Impact Evaluation and Comparison of Alternatives
		G-4	Study of Mitigation Measures
		G-5	Monitoring Plan
		G-6	Stakeholder Meeting
H	Project Impact	H-1	Operation and Effect Indicator
		H-2	Environmental Improvement
		H-3	Qualitative and Quantitative Check
		H-4	Economic & Financial Analysis
J	Operation & Maintenance Plan	J-1	O& M Cost Estimate
		J-2	Cash Flow Analysis
K	Implementation Framework	K-1	Institutional Arrangement
		K-2	Project Cost Estimates
		K-3	Financing Plan
		K-4	Implementation Schedule
		K-5	Procurement
		K-6	Capacity Development Programme
L	Preparation of Project Documents	L-1	Implementation Plan
		L-2	PC-I
M	Technology Transfer	M-1	Workshop
		M-2	Seminar

Source: JICA Study Team

1.1.3 Work Schedule

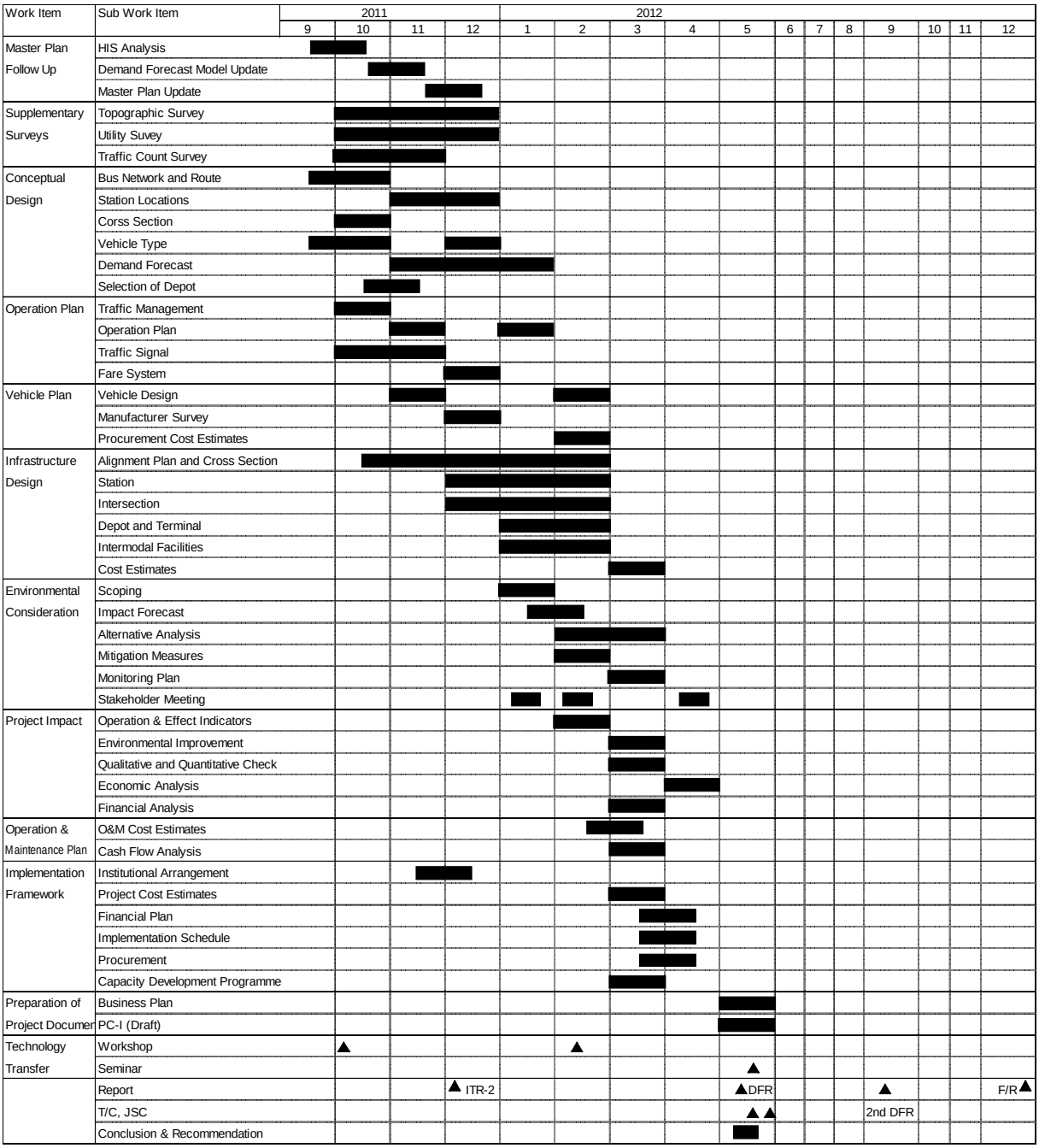
The figure below shows the work schedule of the feasibility study.



Source: Prepared by the JICA Study Team

Figure 1-1-1 Work Flow

The schedule was changed according to the progress of the study. For example, the Technical Committee and the Joint Steering Committee after the Interim Report-2 were not held. Although the work in Karachi finished in the end of May as the original schedule, the submission of the Final Report was delayed because there were JICA's comments on the Draft Final Report and the JICA Study Team revised the report and submitted it as 2nd Draft Final Report to KMTC. Figure below shows the actual schedule of the study.



Source: Prepared by the JICA Study Team

Figure 1-1-2 Actual Schedule of the Study

1.2 Progress of the Household Interview Survey (HIS)

There remained sample backlogs in Clifton Cantonment while the survey in other areas in Karachi was completed. Although the number of samples collected in the HIS has already reached 41,225 in total against the target sample of 40,000, the collected number of samples in Clifton Cantonment was still low.

The reason of the poor response in Clifton Cantonment was that residents hesitate to give detail information of their family in fear of security risk. From this, the JICA Study Team simplified the questionnaire and removed detail information, while question about trip information remained in the survey form. In addition, the survey method was changed from direct interview method to drop-off & pick-up method.

1.3 Seminar & Workshop

The 1st seminar for the master plan study was held on September 29th, 2011 at Avari Tower Hotel. There were 75 participants from various stakeholders. The chief guest was Minister for Local Government. The contents of the presentation were:

- Study Presentation by Director General, KMTC
- Introduction of KTIP Study by JICA Study Team
- Household Interview Survey by Exponent
- Analysis of Household Interview Survey by JICA Study Team
- Master Plan Summary by JICA Study Team
- Detail Analysis of Master Plan by JICA Study Team

A workshop was held on March 2nd, 2012, at Avari Tower Hotel, to discuss BRT system as a part of the capacity development. The key topics were 1) Infrastructure, 2) Alignment, and 3) Station. The basic concept of BRT system proposed for Karachi was presented by the JICA Study Team, and the content was discussed by participants.

The 2nd seminar was held on May 24th, 2012 at Avari Tower Hotel. There were 65 participants from various stakeholders. The contents of the presentation were:

- The Presentation on the Study Report and Master Plan
- The presentation of the Feasibility Study on BRT Corridors

Photo: JICA Study Team (Left: 1st seminar. Right: 2nd Seminar)

1.4 Supplementary Survey

1.4.1 Topographic and Utility Survey

(1) Field Works for the Topographic and Utility Survey

Field works for the topographic and utility survey has been implemented under a contract with a local subcontract.

(2) Outline of survey

The outline of digitization and survey for Satellite Image Processing is as follows.

- Field reconnaissance & identification of GCPs
- GPS survey for establishing – GCP
- Adjustment of Satellite Image
- Image digitization after image processing and adjustment
- Adjustment of Satellite Image using GCPs
- Vertical & horizontal control points for field survey
- Topographic & Cross-section survey
- Depot area and its approach survey
- Utility survey
- Preparation of survey drawings

(3) GCP Control Points

Reconnaissance survey was carried out to identify the Ground Control Points – GCP. Initially 15 GCP points were selected for short-listing. Out of these 15 GCP points, 6 points were finalized for GCP observation.

Location of six control points is shown in Figure 1-4-1 and observed GCP coordinates are shown in Table 1-4-1.

Source: JICA Study Team

Figure 1-4-1 Location of Six Ground Control Points

Table 1-4-1 GCP Coordinate Value

STATIONS	EASTING	NORTHING	ELEVATION
GCP1	301710.517	2752303.742	16.284
GCP2	301274.505	2758151.343	27.964
GCP3	304643.030	2762131.735	41.895
GCP4	304849.165	2766814.327	56.808
GCP5	309756.354	2758497.752	52.198
GCP6	305284.291	2755314.136	27.791

Source: JICA Study Team

1.4.2 Water Quality Survey

The water quality survey to obtain the data of the present status around the project area was conducted during two seasons. Description of water quality survey is shown in Table 1-4-2. Total 38 parameters of chemical and biological were measured and analyzed.

As a result, average character of stream during dry and wet season is not showing a viable difference with respect of its criteria parameters. Some figures are exceeding than National Environmental Quality Standard (NEQS) for Municipal and Liquid Industrial Effluent including Biochemical Oxygen Demand (BOD), Total Solved Solid (TSS) and Sulphide.

Table 1-4-2 Description of Water quality survey

Site No.	Sampling Site	Water body	Survey Period
St. 1	Shaharah-e-Pakistan road bridge (End of Lyari Express)	Lyari River	1st : July 07, 2011 (Wet Season) 2nd :October 10, 2011 (Dry season)
St. 2	Jahangir Sethna road bridge	Lyari River	
St. 3	Mauripur road bridge	Lyari River	

Source: The Study for Karachi Transportation Improvement Project

1.4.3 Turning Movement Traffic Count Survey

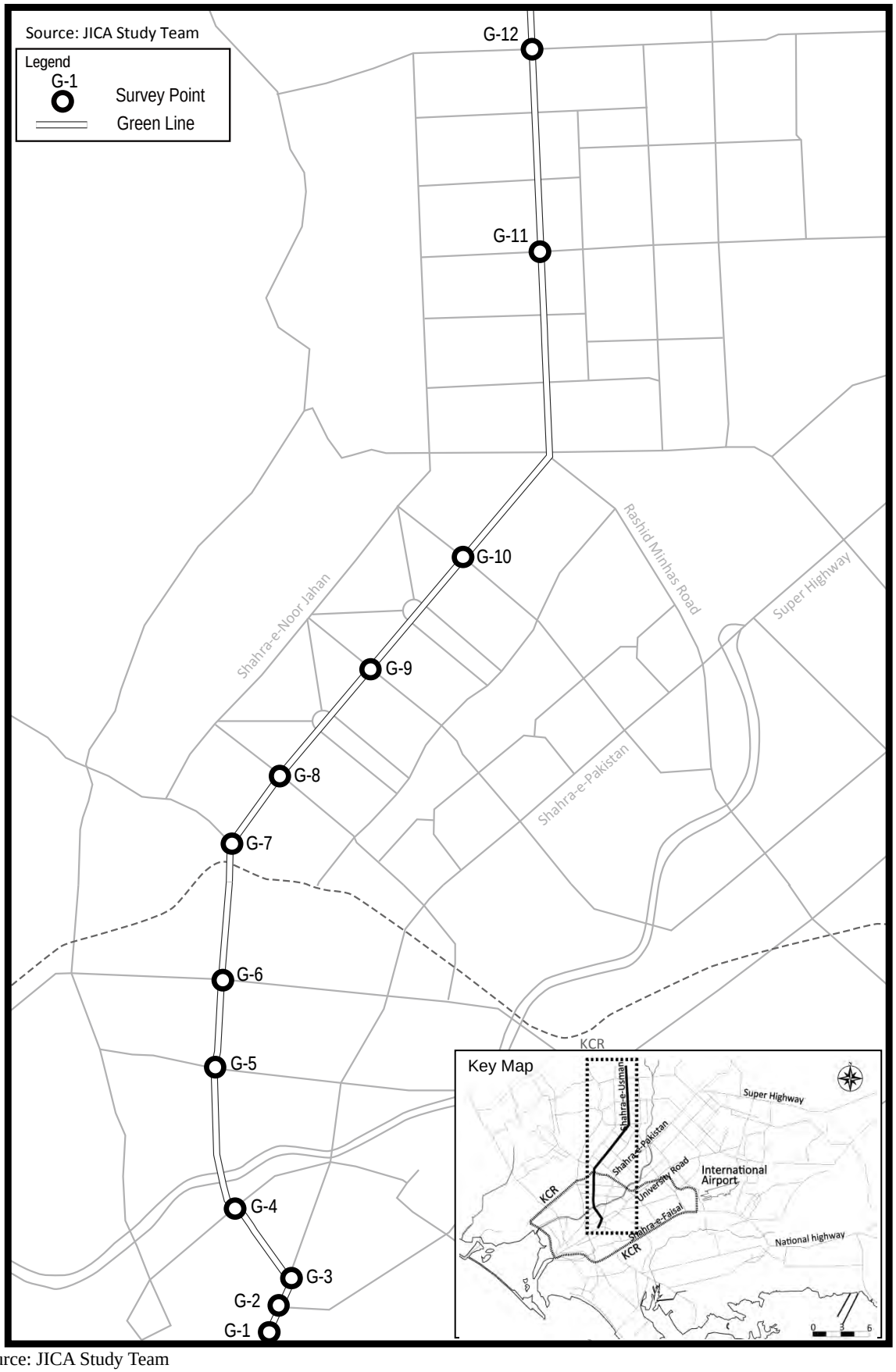
Introduction of BRT system requires signalization of BRT corridors. To analysis existing intersections, Turning Movement Traffic Count Survey was conducted at 20 major intersections along Green Line and Red Line. The contents of the survey are as follows.

- Traffic volume count by turning direction
- Surveys from 7:00 to 23:00 (16 hours)
- A weekday for each survey location
- 20 intersections including roundabouts (Figure 1-4-2, Figure 1-4-3)
- Vehicle classification is shown in Table 1-4-3.

Table 1-4-3 Vehicle Classification

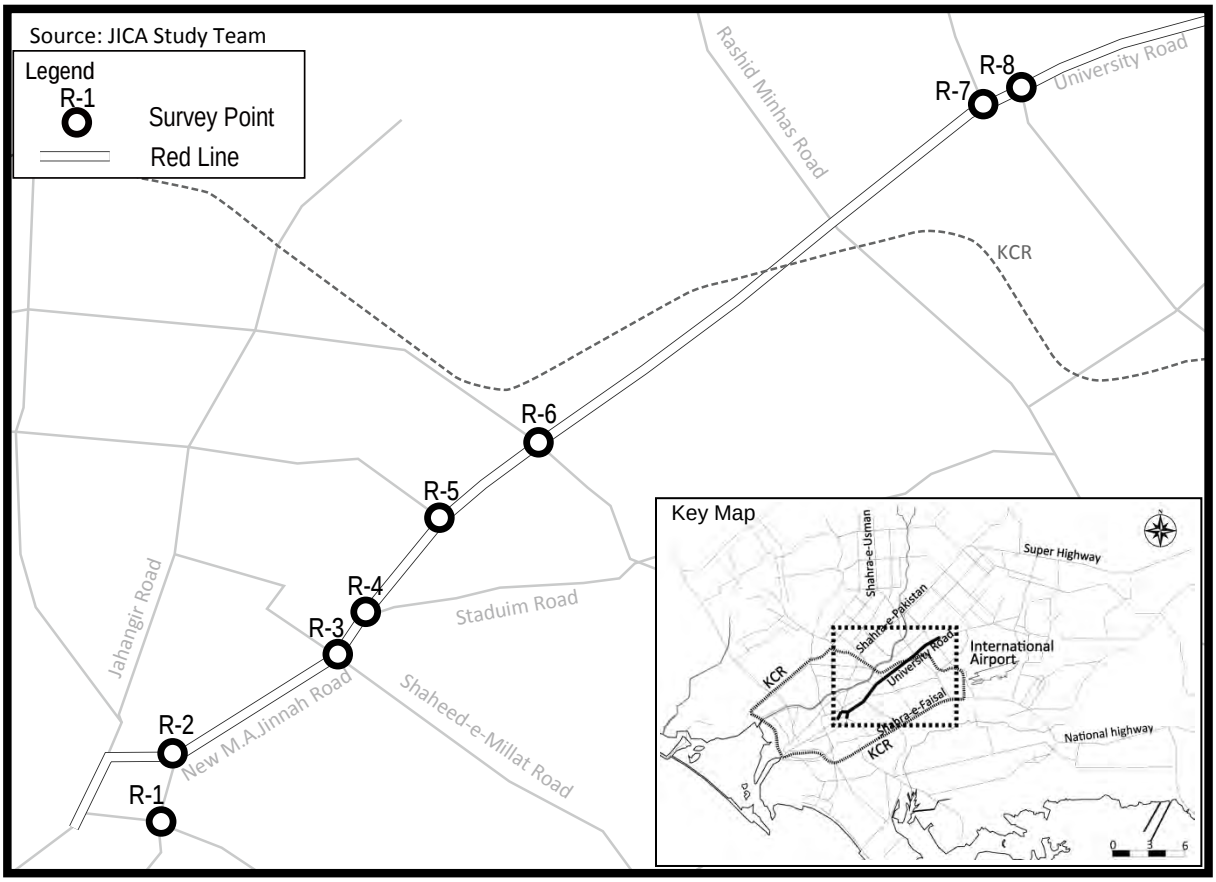
No.	Type	Description
1	Motorcycle	Motorcycles & Scooters
2	Auto Rickshaw	Old Style & CNG 4-Stroke
3	Car / Jeep / Taxi / Van	Cars, Jeeps & Station Wagons, Vans, Taxis
4	Pickup	Suzuki Pickups
5	Mini Bus	Mini Buses, Coaches
6	Large Bus	Intercity buses, UTS, KPTS
7	Truck / Trailer	Trucks, Trailers

Source: The Study for Karachi Transportation Improvement Project



Source: JICA Study Team

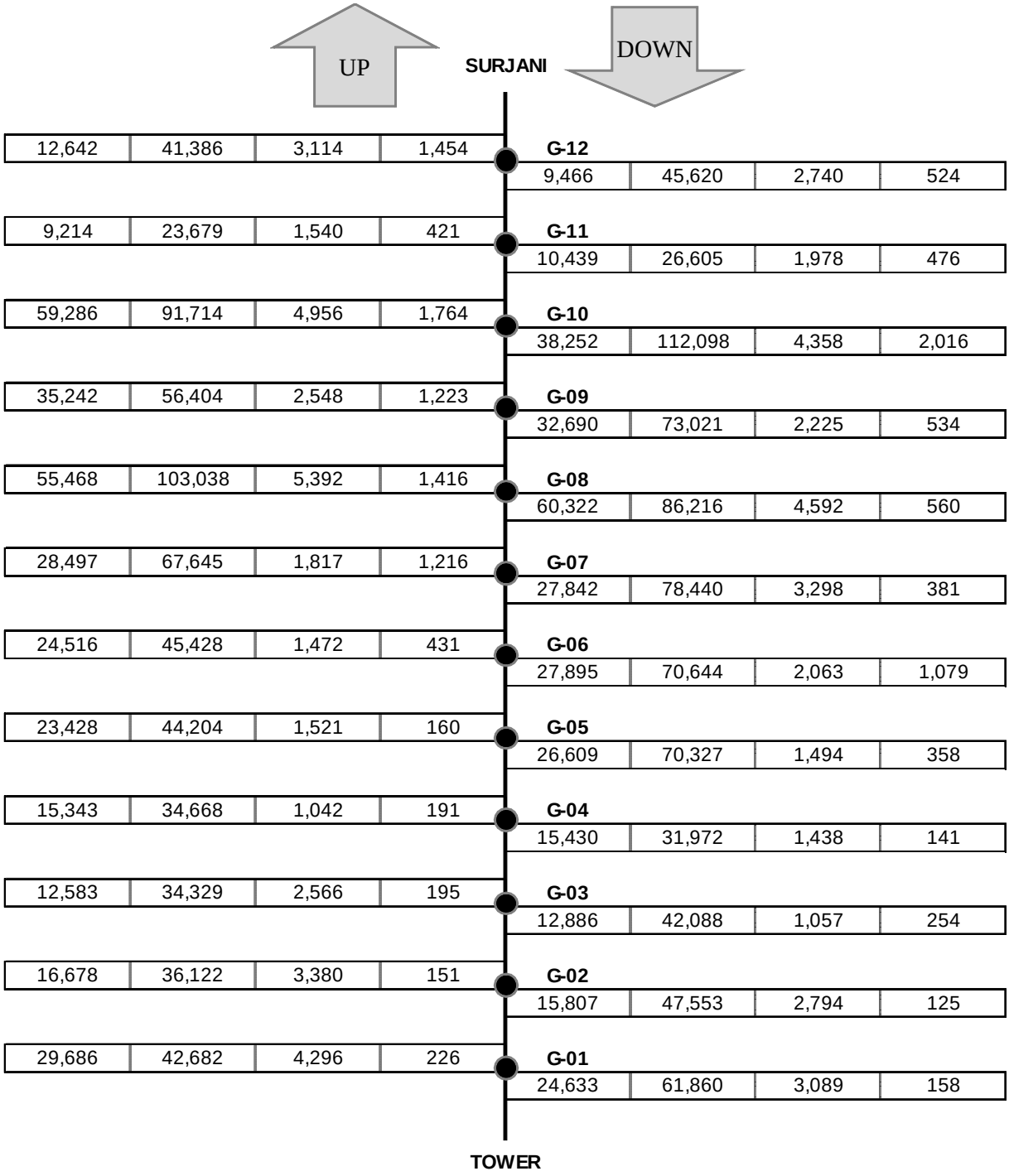
Figure 1-4-2 Location of Turning Movement Count Survey (Green Line) , 2011



Source: JICA Study Team

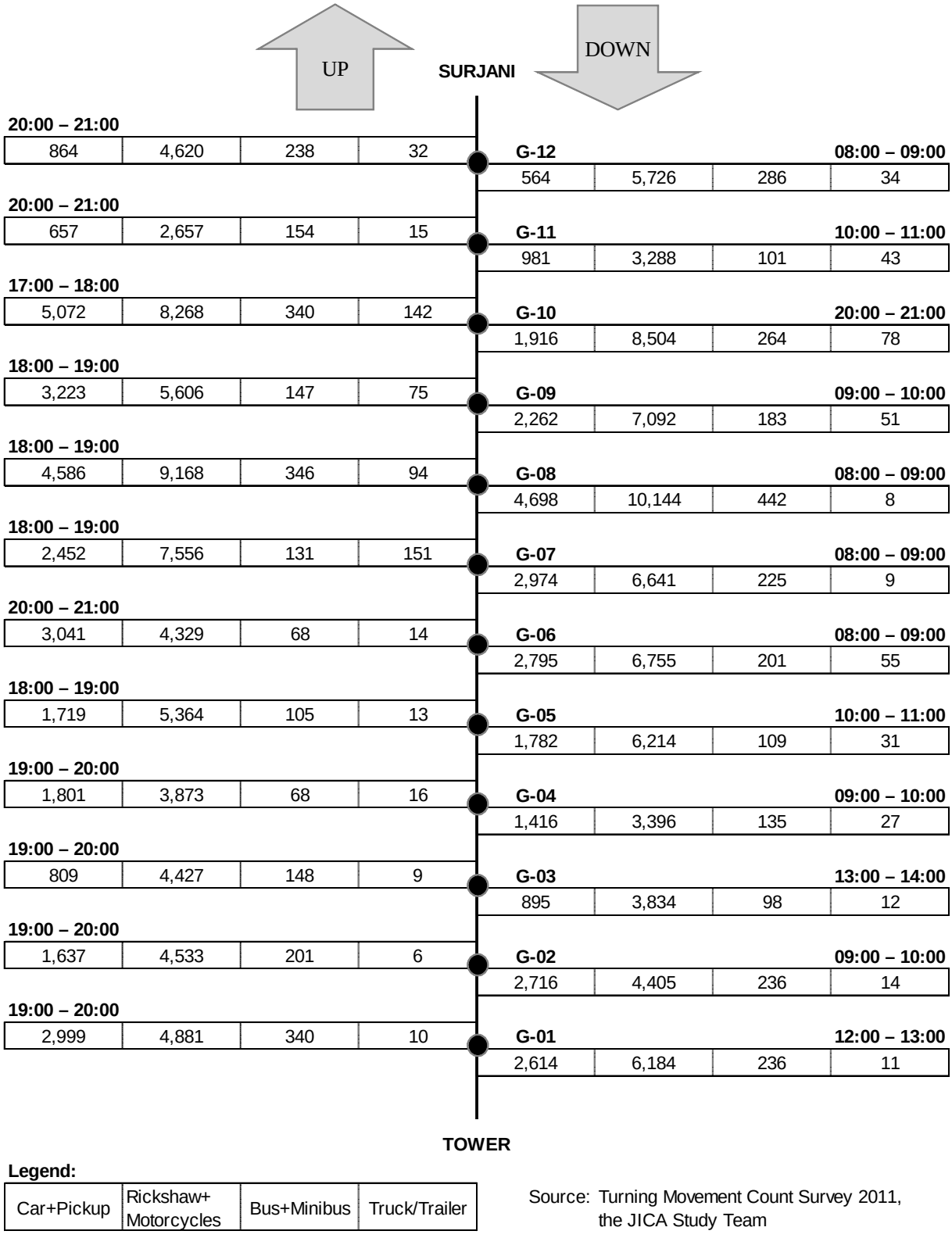
Figure 1-4-3 Location of Turning Movement Count Survey (Red Line), 2011

The results of Turning Movement Traffic Count Survey were recorded by survey location. Figure 1-4-4 and 1-4-5 show daily and peak traffic volume by direction (up and down) along Green Line, and 1-4-6 and 1-4-7 show one of Red Line.



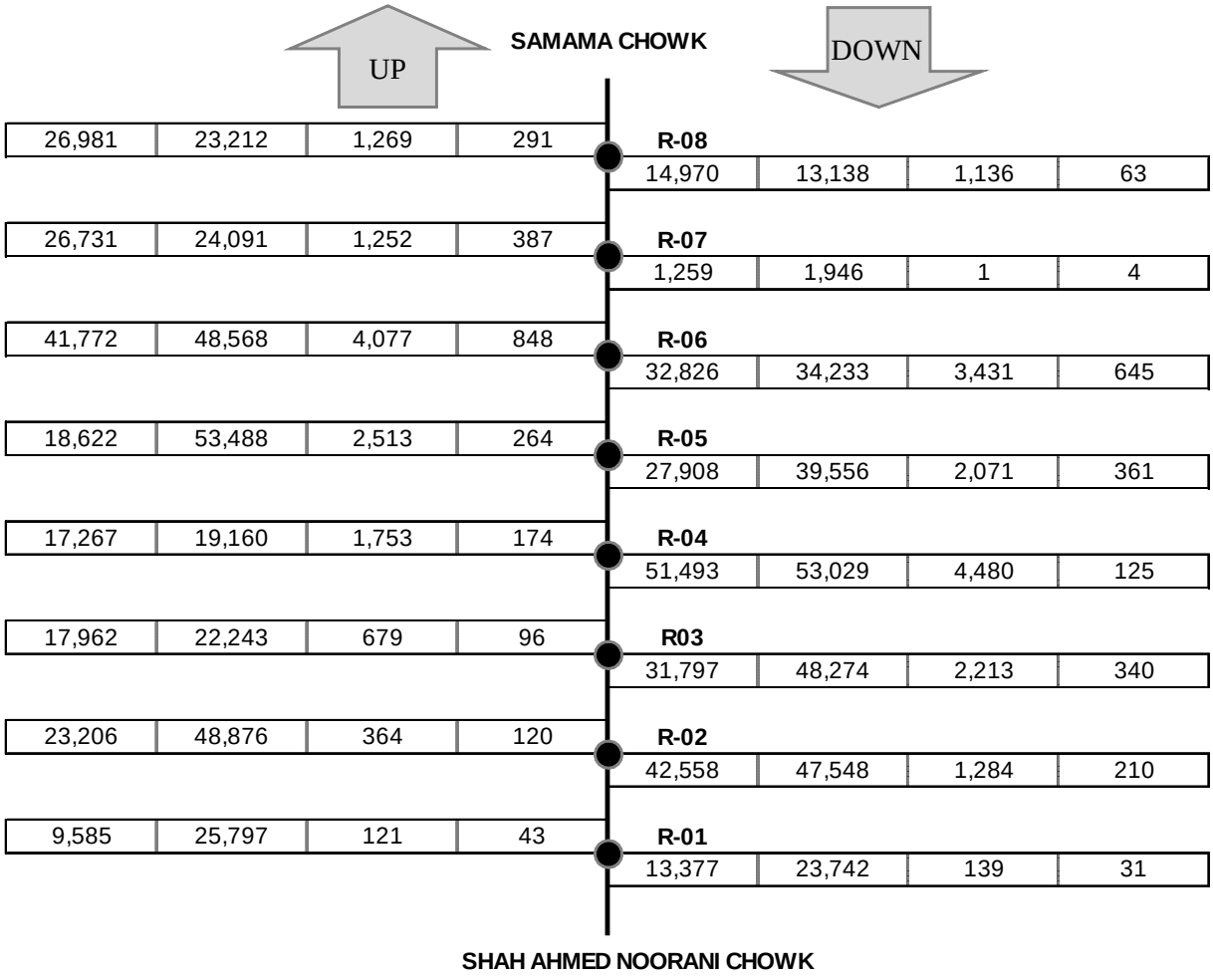
Source: JICA Study Team

Figure 1-4-4 Daily Traffic along Green Line



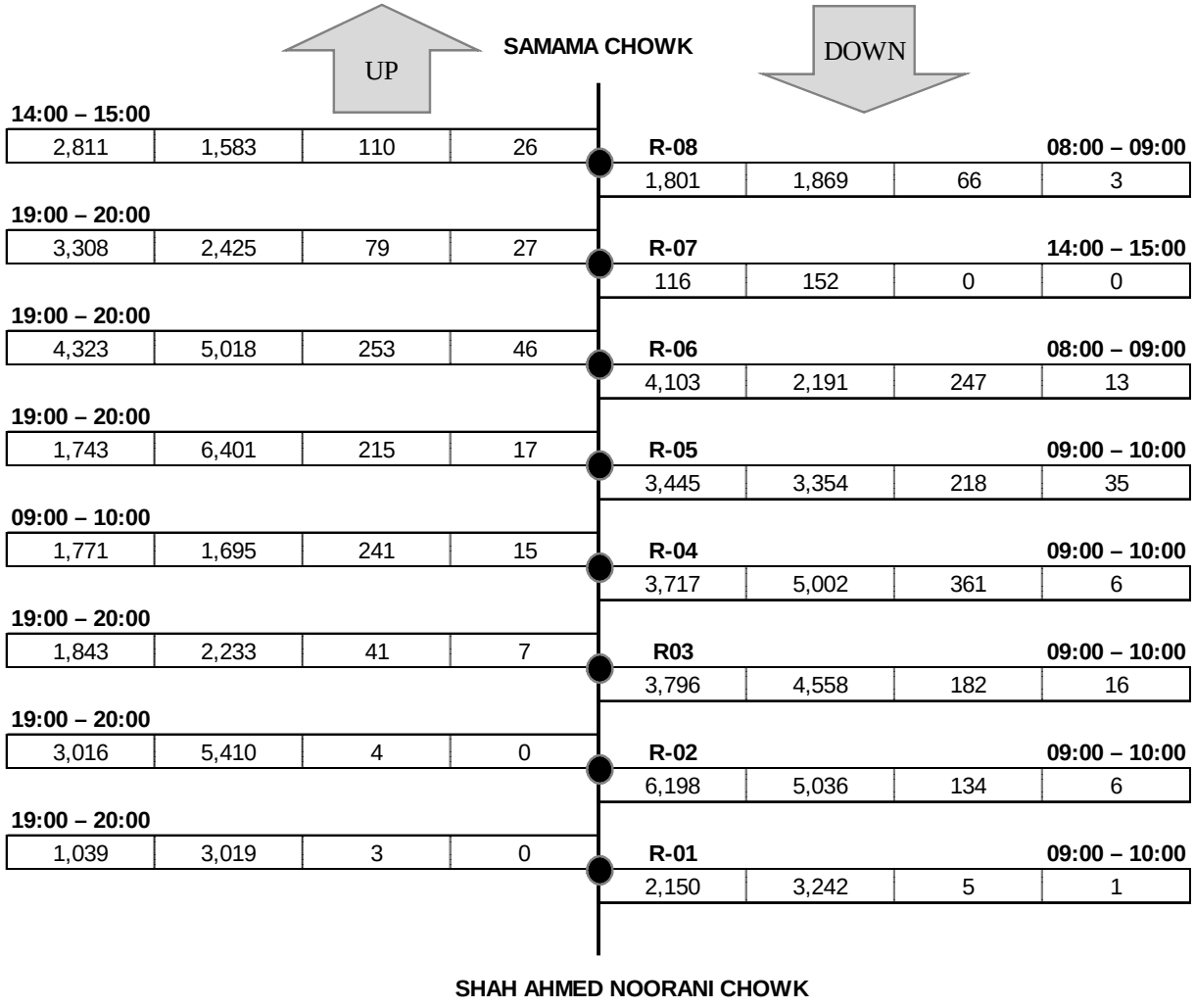
Source: JICA Study Team

Figure 1-4-5 Peak Traffic along Green Line



Source: JICA Study Team

Figure 1-4-6 Daily Traffic along Red Line



Source: JICA Study Team

Figure 1-4-7 Peak Traffic along Red Line

Chapter 2 Bus Rapid Transit (BRT) for Karachi

2.1 Feature of Bus Rapid Transit (BRT)

2.1.1 World Trend

Bus Rapid Transit (BRT) is a high quality bus system providing high speed, reliable, and comfortable services compared to traditional bus services. The concept of BRT is based on railway system, i.e. running along exclusive way, high speed, accurate travel time, and high capacity.

Curitiba (Brazil) introduced a high quality bus service system in 1974, which is now recognized as the first successful case of BRT in the world although some advanced bus transit services such as busway and bus exclusive lanes had been introduced in some cities. In 2000, Bogota (Columbia) opened innovative BRT system (TransMillenio) which made great impact on transit planners and decision makers in the world, showing that the BRT can achieve high capacity transport service similar to railway system.

Curitiba
Photo: Toshiyuki Okamura

Bogota
Photo: Toshiyuki Okamura

In the 2000s, a number of capital cities in the world introduced BRT such as Taipei (2001), Seoul (2004), Jakarta (2004), Beijing (2005), New Delhi (2008), Istanbul (2008), Lima (2010), and Bangkok (2010).

BRT has been recognized as a cost-efficient mass transit system which can solve urban transport problem in not only developing country but also developed country.

2.1.2 BRT Type

There are a number of variations for BRT, and the boundary between BRT and conventional bus services is not clear as far as the physical appearance concerned. A typical BRT is the bus transit service on exclusive lanes in road spaces.

As defined in “Private /Public Partnership based Environmentally- friendly Public Transport System For Karachi, 2006”, there are three levels of BRT system commonly used for the classification of BRT.

- Level 1 Bus Lane
- Level 2 Busway
- Level 3 BRT

Level-1 system usually provides a bus lane along kerb side. The bus lane is sometimes a priority lane which gives priority of using the lanes to buses but other vehicles can use the lanes when the bus traffic is not heavy, and other times an exclusive lane. In case that this system is

introduced in the urban street system where access demand along the road side exist and there are intersections with crossing streets, the bus lanes are easily interrupted by other vehicles.

To avoid interweave of buses and other traffic, bus lanes are located in the center of roads in Level-2 systems. The Busway system is usually a part of the network of general bus services. The improvement of bus services by introduction of this system would be insufficient in case that there are a number of operators (like Karachi) and it is allowed to use the busway by many operators. The BRT systems in Seoul and Taipei are the examples of this system.

Level-3 system is similar to railway system. In most cases, buses are only operated on the dedicated lanes controlled by a single operator along the lanes. Since the BRT buses need not run in general traffic roads, advanced vehicle technologies can be used to increase the capacity and speed. In addition, pre-board fare collection reduces dwell time at bus stations.

Seoul (Level 2)
Photo: Thoshiyuki Okamura

Lima (Level 2)
Photo: Nippon Koei Co., Ltd.

Metrobus (Istanbul) is the example of BRT of Level-3. Note that Level-3 does not necessarily mean high capacity system. For example, TransJakarta (Jakarta) is categorized to Level-3 system but the capacity is very small.

TransMillenio (Bogota) is quite different from other BRTs in terms of the capacity, speed, and quality. It is classified as “Full BRT”.

Jakarta (Level 3)
Photo: Nippon Koei Co., Ltd.

Istanbul (Level 3)
Photo: http://www.iett.gov.tr

2.1.3 BRT Capacity

The Bogota BRT (TransMillenio) shows that BRT system can provide transport capacity as high as railway system, by achieving the capacity of 43,000 passengers per hour per direction. From this, BRT has been proposed in many cities as an alternative of rail-base mass transit system.

However, TransMillenio is very special case and no other BRT has achieved such a high traffic throughput. The success of TransMillenio brought about misunderstanding of BRT capacity as if BRT can be an alternative of railway system in terms of capacity.

The maximum capacity of a standard BRT is approximately 13,000 passengers per hour per direction.

BRT capacity depends on the service frequency and vehicle capacity as same as railway system. The service frequency depends on dwell time and clearance time. In case that dwell time and clearance time is 20 and 20 seconds, respectively, the frequency is calculated at 1.5 buses per minutes (60/(20+20)), meaning 90 buses per hour (1.5*60). If articulated buses having the capacity of 150 passengers are used, the capacity is calculated at 13,500. This is the case when the stopping bay is fully used by vehicles all the times. The percentage of time that a stopping bay is used by vehicles (saturation level) affects the vehicle speed. It is recommend that saturation level is less than 0.4 to ensure the proper operating speed[1]. If the saturation level of 40% is applied, the above calculated capacity becomes 5,400 passengers per hour per direction.

Additional stopping bays can increase the capacity. The following is the formula to calculate the system capacity of BRT.

$$\mathrm{Ca[pax/hour]} = \sum_{i=1}^{Nsp} X_i \times \frac{3600[\mathrm{sec/hour}]}{\mathrm{Tsb[sec/bus]} \times (1 - \mathrm{Dir_i}) + \mathrm{To[sec/bus]}} \times \mathrm{Cp[Pax/bus]}$$

Where,

Ca [pax/hour]	System capacity (Passengers per hour per direction)
Nsp	Number of stopping bays
Tsb [sec/bus]	Passenger boarding and alighting time per bus (Dwell time)
To [sec/bus]	Minimum interval between buses (Clearance time)
Dir_i	Ratio of passing buses
Cp [pax/bus]	Bus capacity (passengers capacity per bus)
X_i	Saturation level

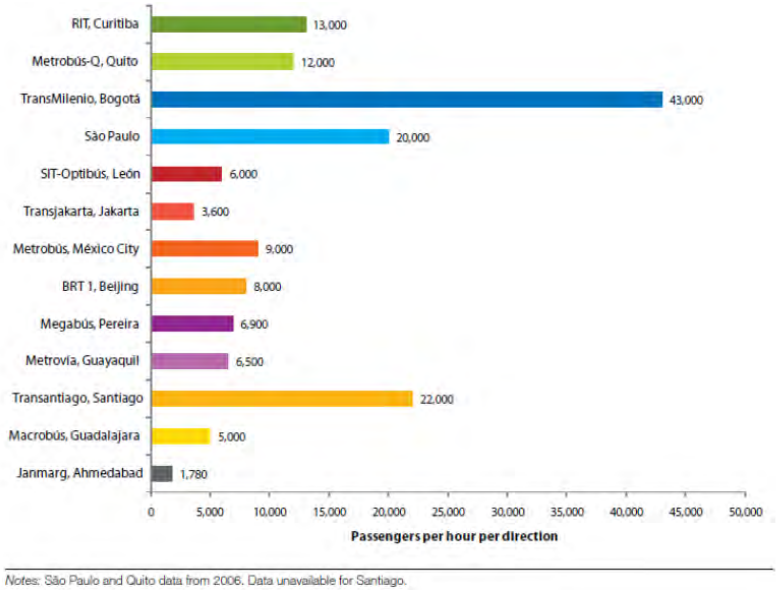
Source: EMBARQ (translated from the original in Spanish)

If a station has three stopping bays, the above calculated capacity (5,400) increases to 16,200. The ratio of passing buses (express operation) is also an important factor to increase the transport capacity.

Note that the addition of stopping bays requires passing lane at station.

Figure below shows examples of passenger volume per hour per direction in the world. Only Bogota's BRT achieves the capacity of 43,000, followed by Sao Paulo and Santiago at the capacity of approximately 20,000. The throughput of Curitiba and Quito is approximately 12,000 – 13,000. Other cities show the passenger volume of 3,600 – 9,000.

[1] Bus Rapid Transit Planning Guide, June 2007



Source: EMBARQ

Figure 2-1-1 Comparison of Hourly Passenger Volume per Direction

The capacity of BRT is similar to Light Rail Transit (LRT) of at-grade type.

As far as the capacity concerned, the present bus operation in mixed traffic lanes shows relatively high passenger volume. For example, M.A. Jinnha Road carries 21,000 bus passengers per hour per direction in a peak hour and Shahra-e-Faisal carries 14,000 bus passengers. Bus passenger volume reaches 22,000 per hour per direction along University Road near Jail Chowrangi.

2.1.4 Speed

The world experiences show that BRT is not necessarily high speed system. The average commercial speed of a standard BRT is approximately 20km/h ranging from 15 to 25km/h, while Transmillenio achieves approximately 30km/h. It is expected that a standard BRT can achieve a commercial speed of 25-30km/h. The commercial speed depends on the distance between stations, the density of intersections to be crossed, and necessary time at stations. Due to the delay at intersections, the maximum speed of a BRT without stopping at stations would be approximately 30-40km/h depending on the signal pashing given to BRT lanes. With the stopping at stations, the speed would reduce to 20-30km/h.

Since the average speed of existing minibuses in Karachi is approximately 17km/h, the speed of 20km/h will produce very small benefit from travel time saving. Therefore, it is necessary to achieve higher commercial speed.

2.1.5 Elevated BRT

Since low cost urban transport system is the basic concept of BRT, it is not popular to use elevated structure although elevated structure can segregate bus lanes completely from mixed traffic. The examples of elevated BRT are:

- Nagoya (Japan) introduced “guideway” bus in 2001, having 6.5km elevated section. Nagoya City subsidized 85 % of the cost of the infrastructure.
- Expresso Tiradentes is the elevated BRT system in Sao Paulo (Brazil), which was put into service in 2007 with length of 8.5km.
- Xiamen (China) BRT is an elevated BRT system with 3 lines in the total length of 67.4km. The system was put into service in 2008.

Stations of these systems are similar to that of elevated railway systems. The higher operational

speed can be achieved compared to at-grade BRT systems because intersection delay does not exist along the elevated section. However, capacity of these systems is not necessarily high because passing lanes are not provided.

2.1.6 Cost Performance

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

2.1.7 Institutional Structure

(1) Typical Structure

There are various institutional structures for BRT operation in the world depending on the local conditions. However, the following is the typical principal for the successful operation of BRT.

- Competition of private sectors for the concession of BRT operation by proper bidding to reduce the cost
- Independent concession of fare collection for transparent distribution of fare revenue
- Payment to the operator based on the service output such as vehicle-kilometers
- Infrastructure (bus lanes, stations, and terminal) is developed by public sector
- Vehicles are purchased by private sector
- Fare system is integrated with feeder buses

(2) Best Practice: URBS-Curitiba Urbanization

This is a public organization developed for management of BRT system.

- Created by Municipal Law in 1963
- Based on the Master Plan of1966
- Planning and development –Institute of Urban Research and Planning (IPPUC)
- Implementation and Management –URBS
- Similar to TransMilenio - report to the Mayor

(3) Best Practice: TransMilenio, Bogotá

This is a Public Company developed for the BRT system

- Created in 1974 as a public company
- Report to the Mayor through a Board of Directors
- Manage vehicle operations, fare collection system through private sector operators
- Plan the System
- Program the Operation
- Oversees Quality Control
- Contract Management

(4) Best Practice: Transport for London (TfL)

This is a PPP Company with wide range of coordinating activities across entire London metropolitan area Contracts private firms for infrastructure development and operations of London Bus System, London Underground System, Light Rail Lines, Traffic Management and Taxi Regulation.

- Created In March 1998 as a PPP company with the goals and objectives to provide a

sustained high-level of funding together with engineering skills required to rehabilitate and regenerate the London Underground (Tube).

- The PPP structure divides London Underground into four parts or the next 30 years-three private sector infrastructure companies. Public sector operating company, London Underground, is a part of TfL.
- In this PPP structure, three private sector infrastructure companies take control of London Underground assets - trains, tracks, tunnels, signals and stations – that are effectively privatized for 30 years. London Underground will manage the PPP contracts and provide train operation and station staff.
- It is the responsibility of private infrastructure companies to raise the money to invest in London Tube network and carry out maintenance and engineering work that should lead to its regeneration and improvement.

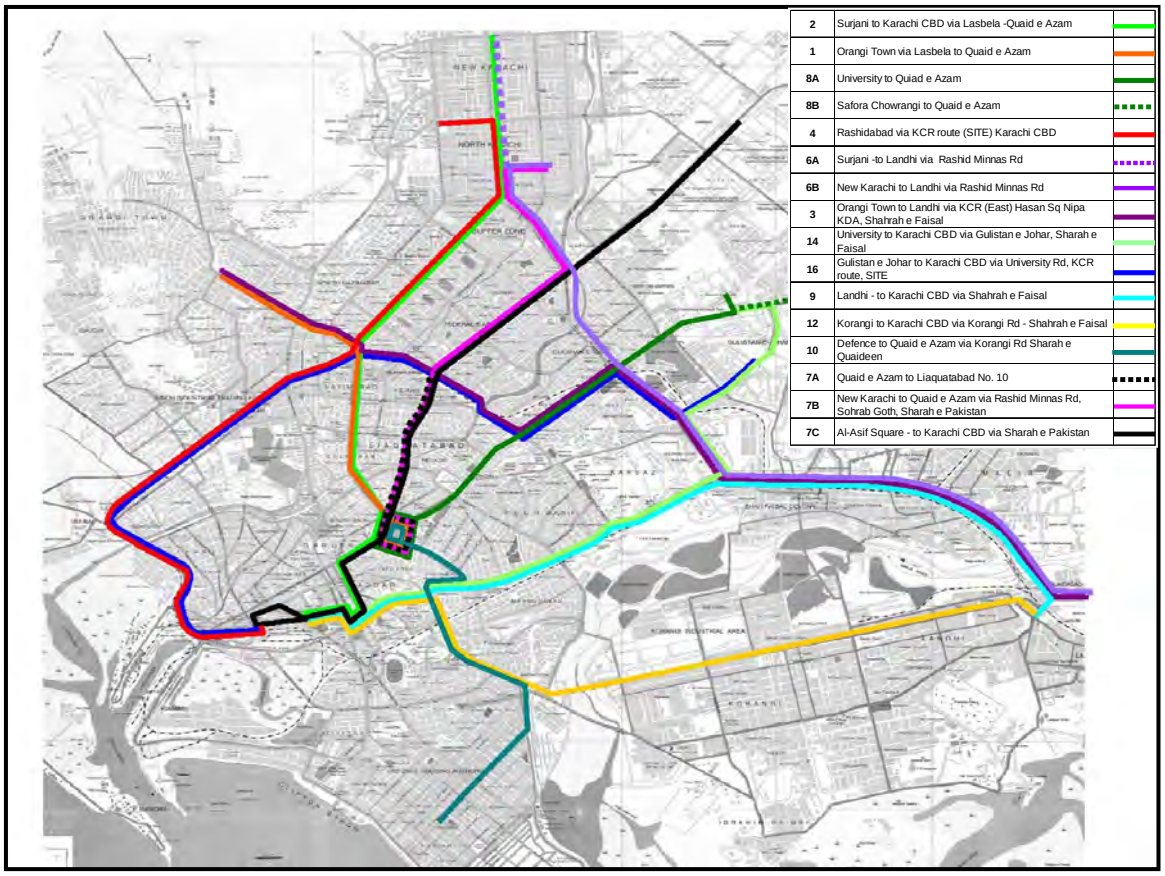
2.2 Review of BRT Studies in Karachi

2.2.1 PPP Environmental Friendly Public Transport System (2006)

BRT as mass transit system for Karachi was proposed in "Detailed Study on a Private /Public Partnership based Environmentally-friendly Public Transport System for Karachi". According to KMTC, this is one of the most important studies about mass transit system in Karachi.

(1) BRT Route

This study proposed 16 bus routes as shown in Figure 2-2-1. Out of 16 proposed BRT routes, 3 lines were proposed to use the KCR line Karachi Central Station and NIPA. From this figure, it is clear that the KCR route plays an important role to formulate BRT corridors in the study. The study emphasized the advantage of converting KCR to BRT. In this case CDGK must purchase the right-of-way of KCR from Pakistan Railways.



Source: Detailed Study on a Private /Public Partnership based Environmentally-friendly Public Transport System for Karachi

Figure 2-2-1 Proposed BRT Network

The BRT routes were grouped into 4 phases. Table 2-2-1 shows the route number of the proposed bus routes by phase and the corresponding routes in the KTIP Study. Most BRT routes in the study were incorporated in the KTIP master plan to some extent except for No. 9 and 14 along Shahrah-e-Faisal Road. Instead of No. 9 and 14, KCR was proposed in the KTIP.

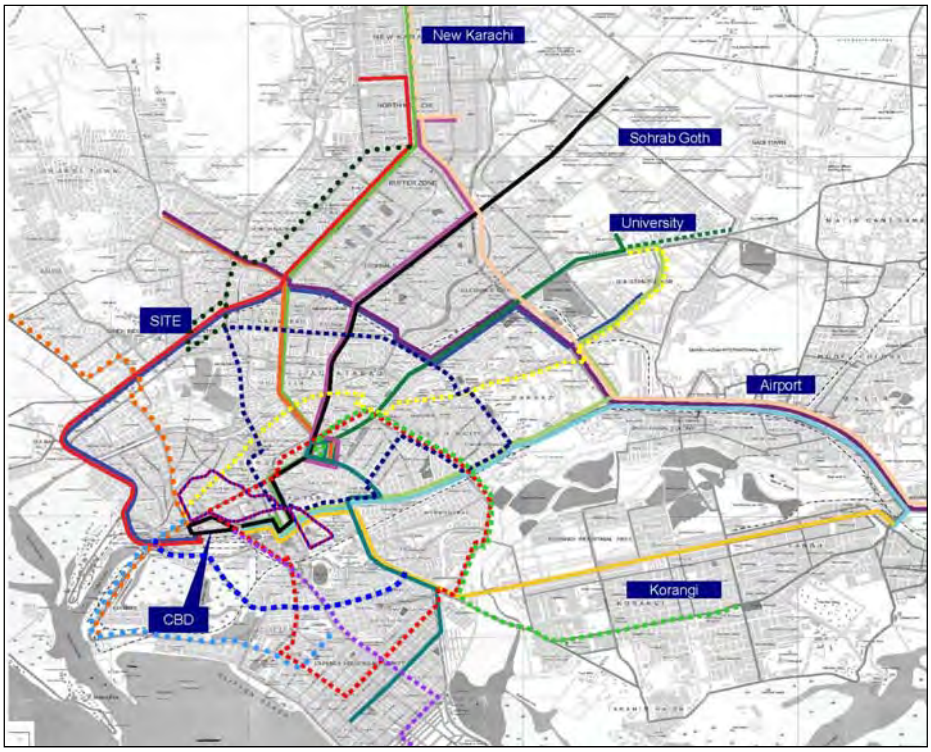
Table 2-2-1 Proposed BRT Routes

Phase	No.	Corresponding Routes in KTIP
1	2	Green Line
	1	Orange Line
	8A	Red Line
	8B	Red Line
2	4	**KCR** + Green Line
	6A	Brown Line
	6B	Brown Line
	3	Orange Line + **KCR** + Red Line
3	14	--
	16	**KCR** + Red Line + Brown Line
	9	--
	12	Yellow Line
	10	Red Line
4	7A	Blue Line
	7B	Blue Line + Brown Line
	7C	Blue Line

Source: Detailed Study on a Private /Public Partnership based Environmentally-friendly Public Transport System for Karachi

(2) Secondary Bus Network

Secondary routes (369km by 21 routes) were designed in this study to complement and support the BRT network as shown in the figure below. It was recommended that the gross cost contract model would be applied to the secondary routes as same as BRT routes.



Source: Detailed Study on a Private /Public Partnership based Environmentally-friendly Public Transport System for Karachi

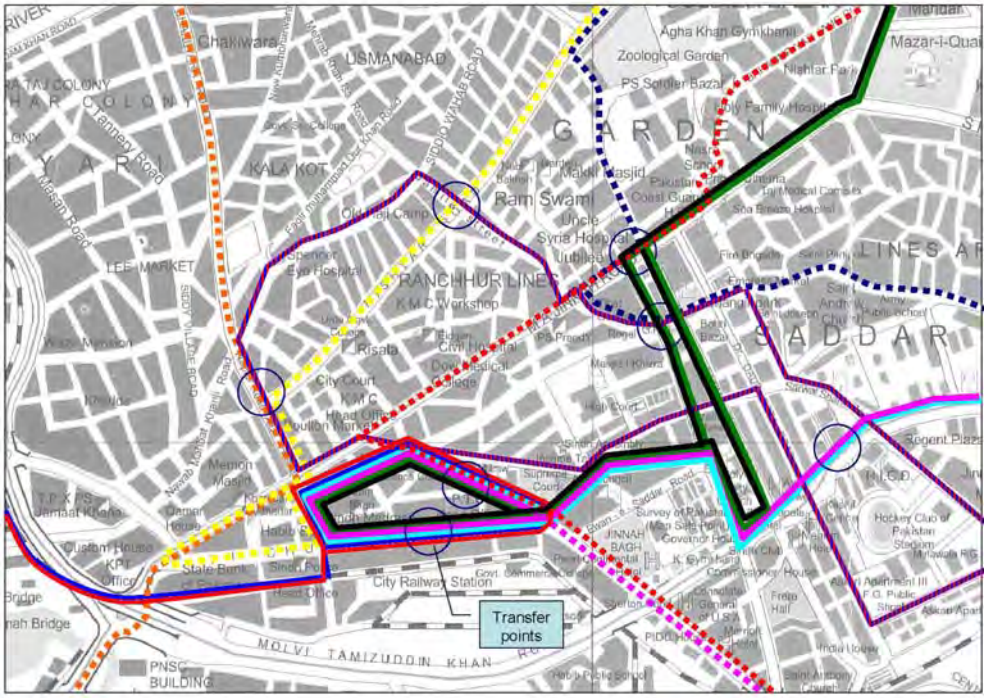
Figure 2-2-2 Proposed Secondary Routes

(3) Bus Routes in Saddar Area

BRT route between Tower and Garden Square was not proposed in the study. For the access to CBD, a one-way route was proposed from M.A. Jinnah Road turning left to Zaibunissa Street to Galaxy Chowk, and returning through Metropole Roundabout and Abdullah Haroon Road to M.A. Jinnah Road.

Although Fatima Jinnah Road (approximately 20m) can fiscally accommodate a single BRT lane between Garden Square and Metopole Roundabout, it would require difficult traffic management on stopping or parking traffic for roadside commercial buildings.

This route is congested so heavy that it would be difficult to accommodate dedicated BRT lanes. In peak hours, Metrople Roundabout is heavily congested due to private car traffic for all directions.



Source: Detailed Study on a Private /Public Partnership based Environmentally-friendly Public Transport System for Karachi

Figure 2-2-3 BRT in CBD

(4) Business Model

The study proposed a performance based contract for the BRT operation. In this case, the operator will receive the contact payment from the government based on vehicle kilometers of bus operation. Operators must pay operation and maintenance cost. The government will receive the fare revenue from passengers. The government needs to take revenue risk. Even if fare revenue is small due to low passenger demand, the government must pay the contract price to the operator based on the vehicle kilometers.

(5) Vehicle Type

The study proposed following types:

- Articulated bus
- More than 160 passengers capacity
- Doors on right side for boarding and alighting
- 0.9m floor height

(6) Infrastructure Design

After the study, infrastructure design for BRT was studied by Karachi Mass Transit Cell in 2007 employing Engineering Associates as the consultant. The characteristics of the drawings are:

- BRT lanes are proposed along KCR lines.
- BRT stations are proposed near intersections with pedestrian bridges which can be accessed from all corners of the intersections.
- BRT lanes are located along curb side along the narrow roads.
- Right door BRT is assumed but left door BRT is proposed at some sections.
- Solution of traffic conflict between U-turn and BRT lanes is not shown.

2.2.2 Karachi BRT Pre Feasibility Planning Study

(1) Status of the Study

Based on the above mentioned study, Asian Development Bank (ADB) identified 11 BRT Lines and selected Lines 1 and 3 as the initial pilot project. After that, ADB conducted a pre-feasibility study for the two BRT routes – Lines 1 and 3. Lines 1 and 3 correspond to Green Line and Orange Line in KTIP, respectively. On the other hand, Line 2 corresponds to Red Line. This study had not been completed because of the withdrawal of ABD from the BRT project as a part of Megacity Project in 2007. The results of the study are described in the draft final report.

Note that the plan of BRT Line-1, 2, and 3 is one of the official master plans in Karachi, according to KMTC.

(2) Vehicle Type

The proposed BRT system was center BRT lanes with median stations in the center for right door buses. This is as same as the proposal in "Private/ Public Partnership based Environmentally - friendly Public Transport Systems for Karachi.

(3) Traffic Management

The study pointed out the issues about traffic management at roundabouts and median breaks. For the median break, it is described as follows.

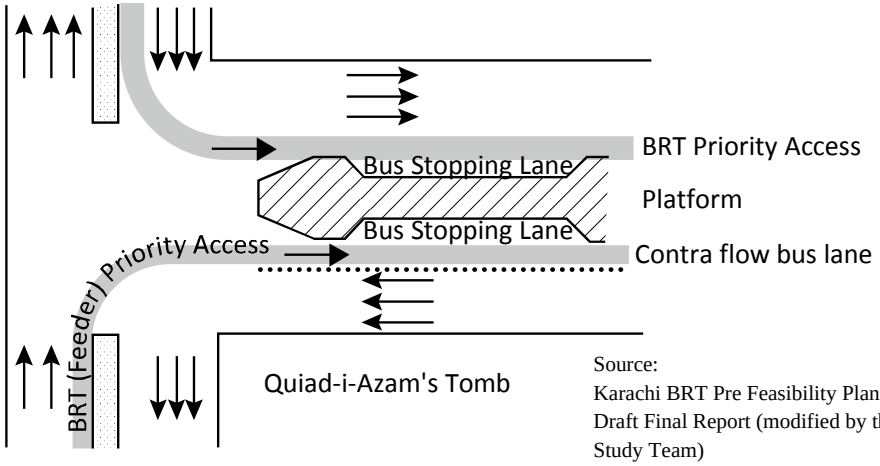
> *The general recommended treatment for the median breaks is to close them to maintain the integrity of the BRT alignment. Traffic will either be diverted to the next signalised intersection or roundabout along the alignment. Where feasible, the local service roads in the alignment should be refurbished and/or upgraded to enable this local traffic to circulate relatively easily. These measures will minimize the impact of the closure of the breaks and in the process, reduce the requirement for them. – Page 27*

> *The median break between Station 7 and 8 at the SSGC Gas Customer Centre will require closure to maintain the integrity of the BRT alignment. – Page 36*

(4) BRT in Saddar Area

This study concluded that it would not be feasible to provide BRT services in Saddar Area and proposed feeder system between Saddar Area and Mazar Terminal. The proposed route is similar to that in "Detailed Study on a Private/Public Partnership based Environmentally-friendly Public Transport System for Karachi".

Mazar Terminal was proposed along the part of M.A. Jinnah Road located in the north of Quaid-e-Azam Mausoleum. The conceptual layout plan in the BRT Pre Feasibility Study is shown in the figure below. A terminal station is proposed for the transfer between BRT (right door) and feeder buses (left door). It is not described how BRT buses return to the BRT lane in the north and how feeder buses return to CBD.



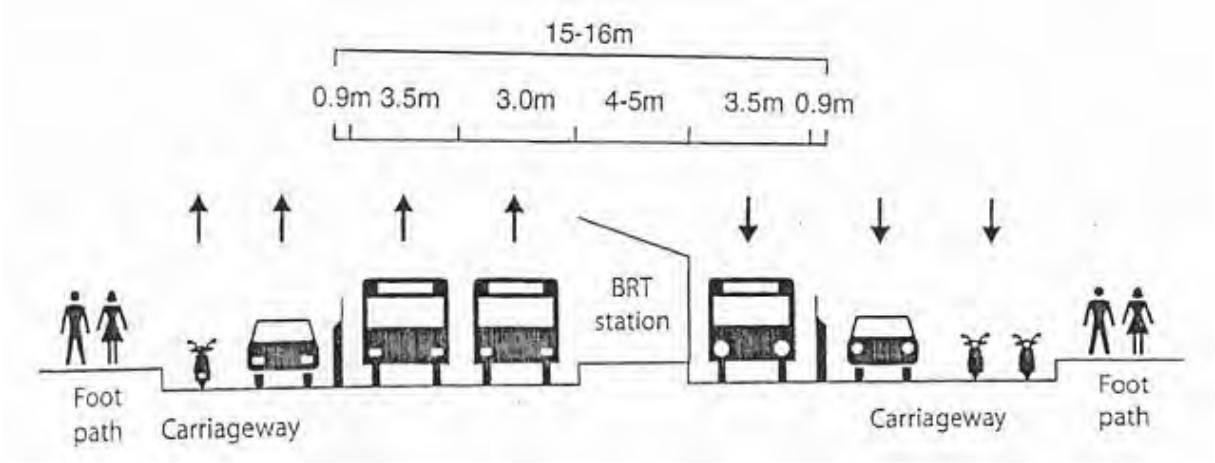
Source:
Karachi BRT Pre Feasibility Planning Study, Draft Final Report (modified by the JICA Study Team)

Figure 2-2-4 Concept Sketch of Mazar Terminal

(5) Cross Section

Typical cross section proposed in the study is illustrated as shown below. The width of BRT section at the station is 15-16m consisting of two passing lanes (3.5m×2), a bus stopping lane (3.0m), platform (4-5m), and two spaces for barrier structure (0.9×2). The total width excluding sidewalks becomes 30m in case of two-lane carriageway for both sides.

The ticket sale booth and the ticket gate are proposed to locate on the pedestrian bridge which connects sidewalks and the station platform.



Source: Karachi BRT Pre Feasibility Planning Study Draft Final Report

Figure 2-2-5 Typical Cross Section at BRT Station

(6) Elevated Section

The section between Nazimabad No.1 Chowrangi and Lyari River is heavily congested due to road side parking for market activity. Since the parking vehicles usually occupy two or three lanes, only a single lane is available for both directions in most time. The study evaluated that at-grade BRT along this section would not be feasible and elevated sections are proposed between Nazimabad No.1 Chowrangi and Gurumandir.

(7) Station Location

The study identified 18 BRT stations for Line-1 between Quaid-e-Azam and Surjani. The study report mentions that the locations were selected with KMTC staff.

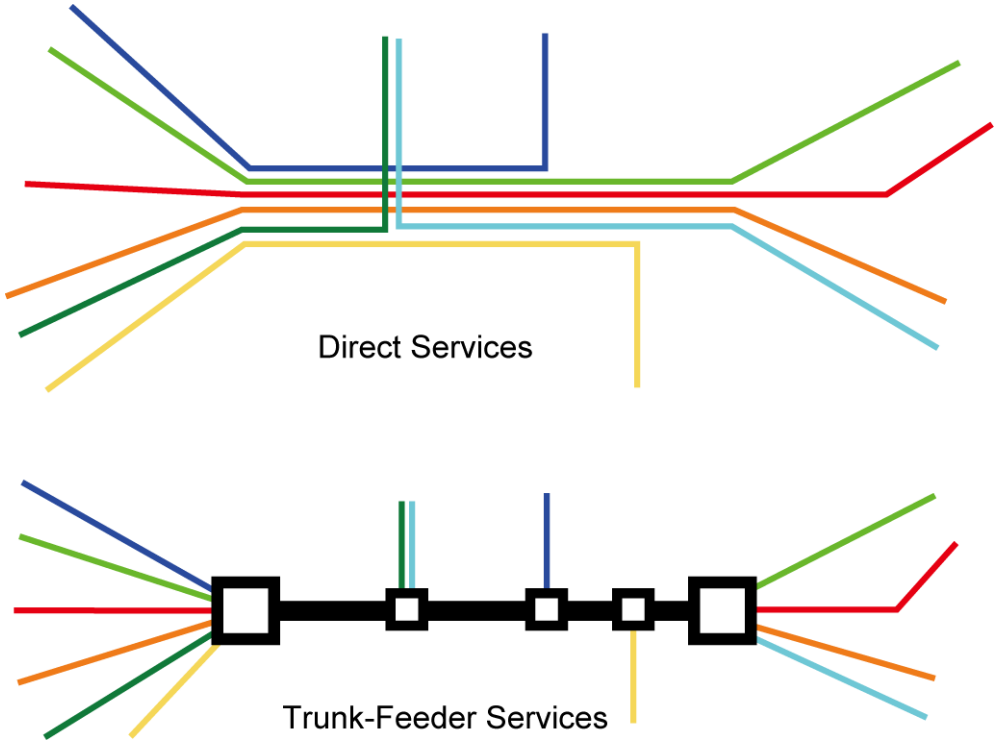
2.3 BRT Scenario in Karachi

2.3.1 Trunk–Feeder Services and Direct Services

(1) Characteristics of Trunk-Feeder Services and Direct Services

Development of a high capacity BRT system requires specialized types of vehicle which are usually different from normal buses presently running on mixed traffic lanes. For example, articulated (generally 18m) or bi-articulated (generally 24m) buses are used to increase passenger capacity. To decrease boarding and alighting time, floor height is adjusted for platform height and on-board fare collection is not considered in most systems. Due to these differences, BRT buses run along the BRT corridors only, and feeder routes provide services outside the service area of the corridors. This means that high capacity BRT system requires truck-feeder services in nature.

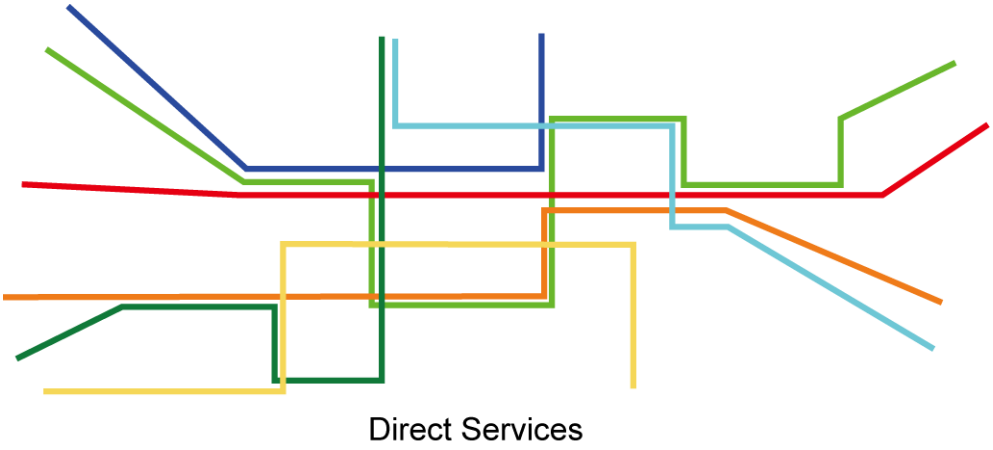
The figure below illustrates the concept of direct services and trunk-feeder services.



Source: illustrated by JICA Study Team

Figure 2-3-1 Conceptual Diagram of Trunk-Feeder Services

Restructuring of bus network from direct services to trunk-feeder services will improve operational efficiency if high demand corridors are properly transformed to trunk routes and the outside of the service area of trunk routes are covered by feeder services. The degree of the improvement by introducing trunk-feeder services depends on the present urban structure. If the passenger demand is almost the same along the major arterial roads all over the area, identification of trunk routes is difficult. If traffic demand concentrates on several corridors, trunk routes can be identified easily. There is a chance that restructuring bus network connecting various areas by direct service as shown in the figure will not improve operational efficiency.



Source: illustrated by JICA Study Team

Figure 2-3-2 Conceptual Diagram of Direct Services of Various Routes

(2) Present Bus Network

Reorganization of the present bus network from direct services to trunk-feeder services requires a large scale change in bus network in Karachi.

There are 29 bus routes for various destinations that go through M.A. Jinnah Road as shown in Figure 2-3-3. Introduction of trunk system along M.A. Jinnah Road requires a large scale of terminal for various directions. Otherwise trunk routes should be developed for all the major corridors at once to provide BRT services for various areas in Karachi. Since available corridors that can accommodate BRT lane are limited, this will be a difficult task.

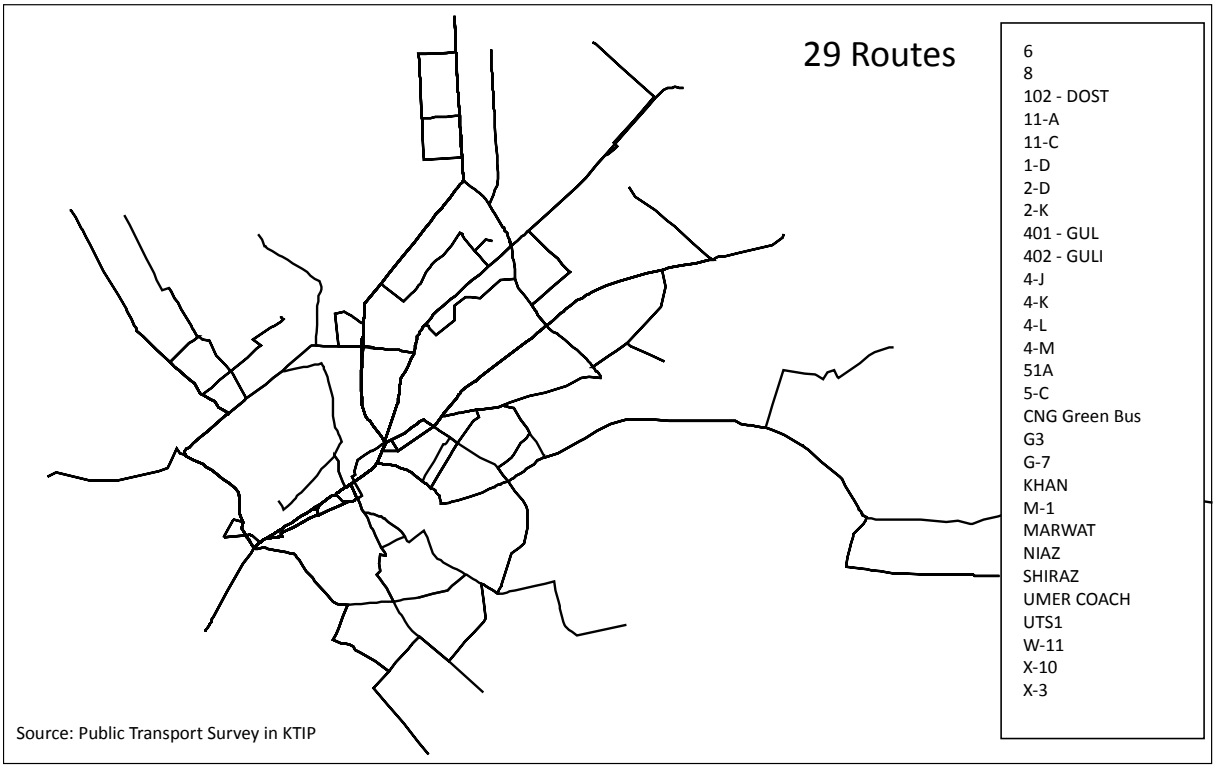


Figure 2-3-3 Bus Routes through M.A. Jinnah Road (Quaid-e-Azam – Dr Daud Pota Road)

Figure 2-3-4 and 2-3-5 show the present bus routes that go through a part of Green Line and Red Line, respectively. If a trunk route is developed for Green and Red Lines each, these bus routes

will be affected. In case that a trip consists of one trunk route and two feeder routes (origin and destination), passengers for the trip need two transfers. The complex bus network in Karachi means that some passengers need transfer between trunk lines.

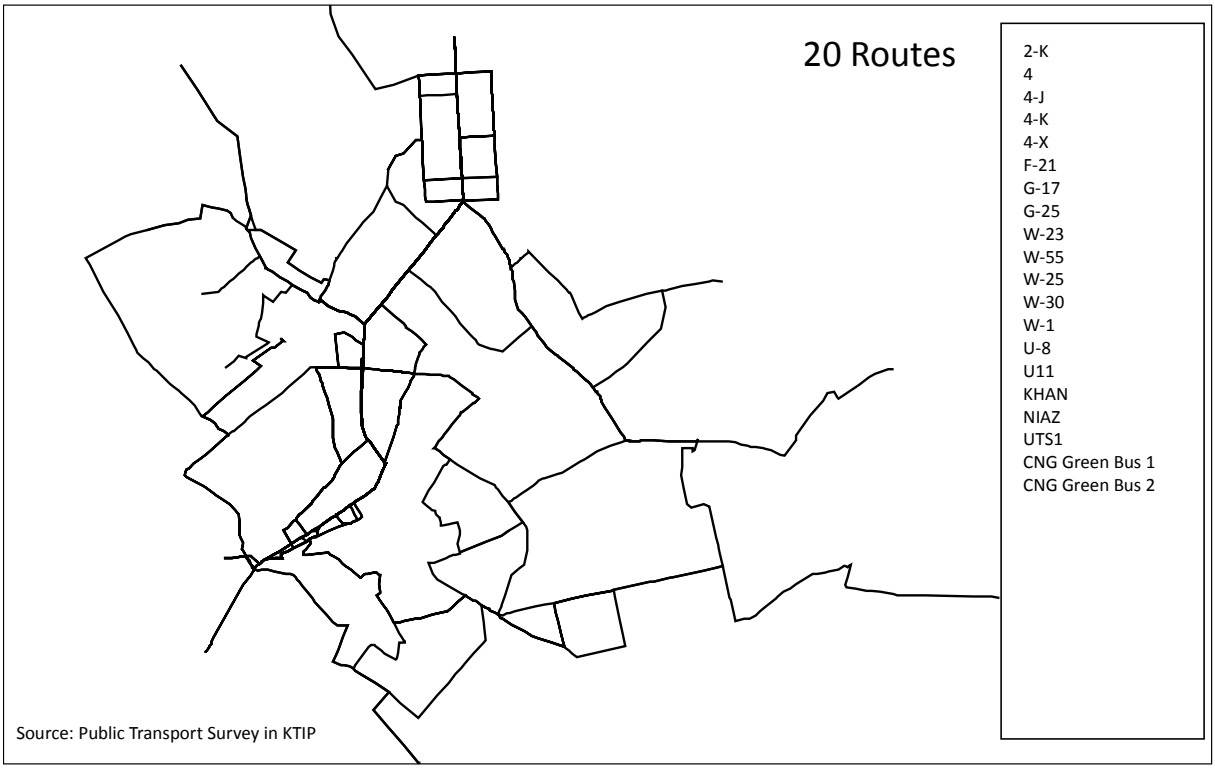


Figure 2-3-4 Bus Routes through Khayaban-e-Sher Shah Suri (Front of Hydri Market)

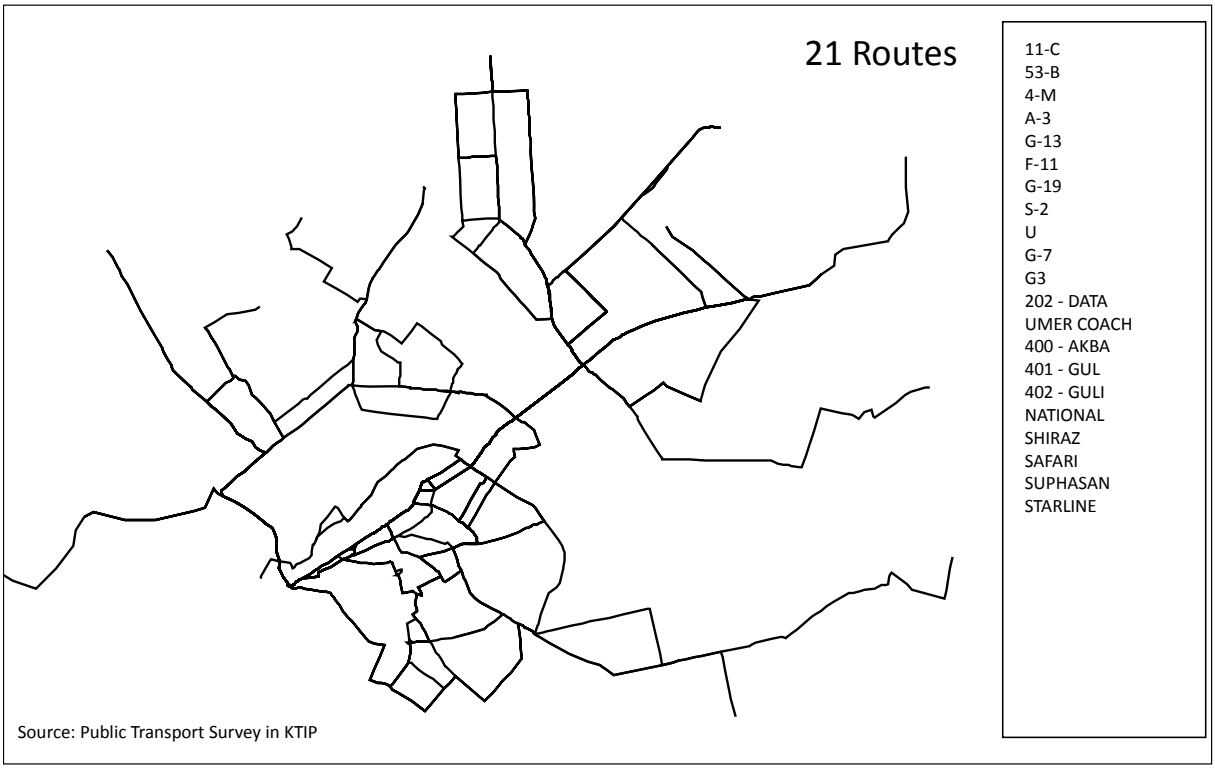


Figure 2-3-5 Bus Routes through University Road (Front of Urdu University)

(3) Issues of Trunk-Feeder System

To evaluate both systems (trunk-feeder vs. direct services), issues of them are studied from existing conditions. Issues of the trunk-feeder system in Karachi are:

- Need trunk routes for various corridors
- Need feeder services
- Need transfer terminals in CBD
- Need fare integration between trunk routes and feeder routes

Need trunk routes for various corridors

As shown in the present bus network, introduction of a trunk route along Green Line or Red Line will affect various bus routes in Karachi. To maintain the bus services for various directions, it is necessary to provide a number of transfer terminals along the corridor. Otherwise most present bus routes except for the same route as the new BRT lines should remain in mixed traffic lanes, which will bring about heavy congestion of roads where two lanes are given to BRT. To avoid this situation, trunk lines should be developed along major corridors at once. In addition to Green and Red Lines, other corridors such as Blue Line, Brown Line, Shahra-e-Faisal, Yellow Line, and inner ring road should be developed as BRT corridors.

Need feeder services

Since road space is not enough in Saddar Area for BRT lanes, any trunk routes cannot go through Saddar Area. It is necessary to provide feeder services to reach the center of the city for all trunk routes.

Need transfer terminals in CBD

For the transfer between feeder routes and trunk routes, large scale of transfer terminals should be provided. The empty land in Mazar Area can be a transfer terminal that covers trunk routes for north and east part of Karachi. Mazar Terminal proposed in the ADB study might be only possible for Green Line because the access from other routes such as Red Line to the proposed terminal is difficult.

Need fare integration between trunk routes and feeder routes

The trunk-feeder system increases the number of transfers. If the feeder services are as same as the present bus system, passengers who use two feeders and one trunk need to pay approximately three times the present fare. Although some passengers afford to pay this amount, most people need alternatives to avoid the extra payment. This means that the present bus network should remain even if BRT system is introduced and BRT services will suffer from competition with the present bus network. If BRT can go to Tower or other important points in Saddar Area directly, independent fare system would be possible. However, since feeder system to reach Saddar Area is inevitable in case of trunk-feeder system, the fare integration is one of the important requirements of the introduction of BRT system.

Need clearance of roadside encroachment

There are three major bottleneck roads along the corridors: Business Recorder Road (roadsides are occupied by rickshaw market.), Nawab Sadiq Ali Khan Road (roadsides are occupied by parking cars for sanitary market.), and New M.A. Jinnah Road near Jail Road (roadsides are occupied by car dealers.). For trunk-feeder system, the roadside encroachment of these roads should be cleared before the construction of BRT lanes. However, construction of bus exclusive lanes along these roads would cause political and social problems.

Parking by Car Dealers
Photo: The JICA Study Team

Rickshaw Market along Business Recorder Road
Photo: The JICA Study Team

(4) Issues of Direct Services

Issues of direct services for BRT system in Karachi are:

- Need discontinuance of existing bus routes that are related to BRT routes.
- Need more bus stations to disperse passenger boarding and alighting
- Need feeder services
- Need on-board fare collection

Need discontinuance of existing bus routes that are related to BRT routes

The present bus routes along the proposed BRT corridors will be converted to BRT routes. In addition, some routes that run a part of the BRT corridors should be terminated, and the route permission should be given to the BRT operator to reduce the number of existing bus routes in mixed traffic lanes. This is due to the existence of various routes along the proposed corridors. For example, two-thirds of buses running along Khayaban-eSher Sha Suri, which is the main part of Green Line, have different destinations from the proposed Green Line. This means that if BRT is provided only for the same route as Green Line, two-thirds of buses will remain in the mixed traffic lanes where the number of lanes is reduced due to bus lanes. The percentage is 60% in case of Red Line.

Need more bus stations to disperse passenger boarding and alighting

The problem of direct services is less capacity than trunk-feeder system because of constrained vehicle design for capacity increase. For example, articulated buses cannot run outside BRT lanes in most cases. Introduction of high floor vehicles is difficult because buses need to stop at bus stops in mixed traffic lanes where low step is necessary for boarding and alighting. This will increase boarding and alighting time compared to high floor vehicles that can provide flat access from station platform to buses.

In order to decrease boarding and alighting time, concentration of passenger demand at one station should be avoided, especially in the center of the city where providing passing lanes is difficult.

Need feeder services

Even if the system of direct services is employed as the BRT system, feeder services should be provided because some routes need be merged so that route numbers become simple enough for passengers to understand easily. In addition, routes should be reorganized in view of efficient operation. Some direct services currently provided by minibuses might not be proper routes for high capacity buses of BRT system.

Need on-board fare collection

Equipment of fare collection is necessary in vehicles because buses will use the present bus stops outside BRT routes in case of direct services. This will cause some problems in case of performance based contract because it is necessary to ensure the transparency of fare collection. The mixture of on-board fare collection in mixed traffic lanes and pre-board fare collection in BRT lane require careful arrangement of fare collection mechanism.

If ticket sale stands are provided at all bus stops, pre-board fare collection would be possible but the concern over transparency of fare collection still remain as the major issue.

(5) Selection of Service Type

In general, trunk-feeder system is the popular and advantageous public transport system using BRT system. However, local conditions should be carefully considered.

Initial Proposal – Direct Services

In the beginning of the F/S of KTIP, it was recommended by the JICA Study Team that direct services should be adapted to BRT system in Karachi. The major reason was that the difficulty to construct a trunk line that goes through CBD area. If truck routes are introduced, transfer to feeder routes will be inevitable for passengers. Since providing better services to bus passengers is one of the important objectives of BRT, transfer to feeder lines near CBD is not a good plan. The possibility of mixed traffic operation on bottleneck roads was another important reason to avoid the trunk-feeder system. On the other hand, the BRT system of direct services can absorb present bus routes into the BRT lanes while many routes will remain in mixed traffic in case of the truck-feeder system.

Second Proposal: Trunk-feeder System

Meanwhile, after the analysis of institutional and operational aspects of bus transport in Karachi, it was recommended that fare should be collected by different organization than the bus operators to ensure the transparency and financial stability. This means that fares should be collected outside buses at the stations where paid and unpaid areas are separated. Such operation will not be possible along mixed traffic roads. Therefore, direct services are not applicable for this case.

For the bottleneck sections, Karachi Mass Transit Cell (KMTC) ensured that the illegal parking and usage of road space would be cleared by the time of BRT project.

KMTC also insisted that BRT should be introduced along M.A. Jinnah Road up to Tower. Although the introduction of BRT to Tower is not realistic, it was assured from the strong opinion of KMTC for the BRT along M.A. Jinnah Road that the road space would be able to be used for BRT project as much as possible.

The table below shows the expected issues in case of trunk-feeder system in Karachi and its counter measures for the solution.

Table 2-3-1 Issues and Solutions of Trunk-Feeder System in Karachi

Issues of Trunk-Feeder in Karachi	Solution
Need trunk routes for various corridors	Maintain direct services along Green Line and Red Line that connect various corridors instead of construction of new corridors and transfer points
Need feeder services	Introduce BRT system to the center of the city as near the Tower as possible
Need transfer terminal in CBD	Construct transfer terminal near Quaid-e-Azam Mazar
Need fare integration between trunk routes and feeder routes	Maintain direct services along Green Line and Red Line for alternatives Enable direct access to CBD
Need clearance of roadside encroachment	Clear the encroachment by the initiative of KMTC

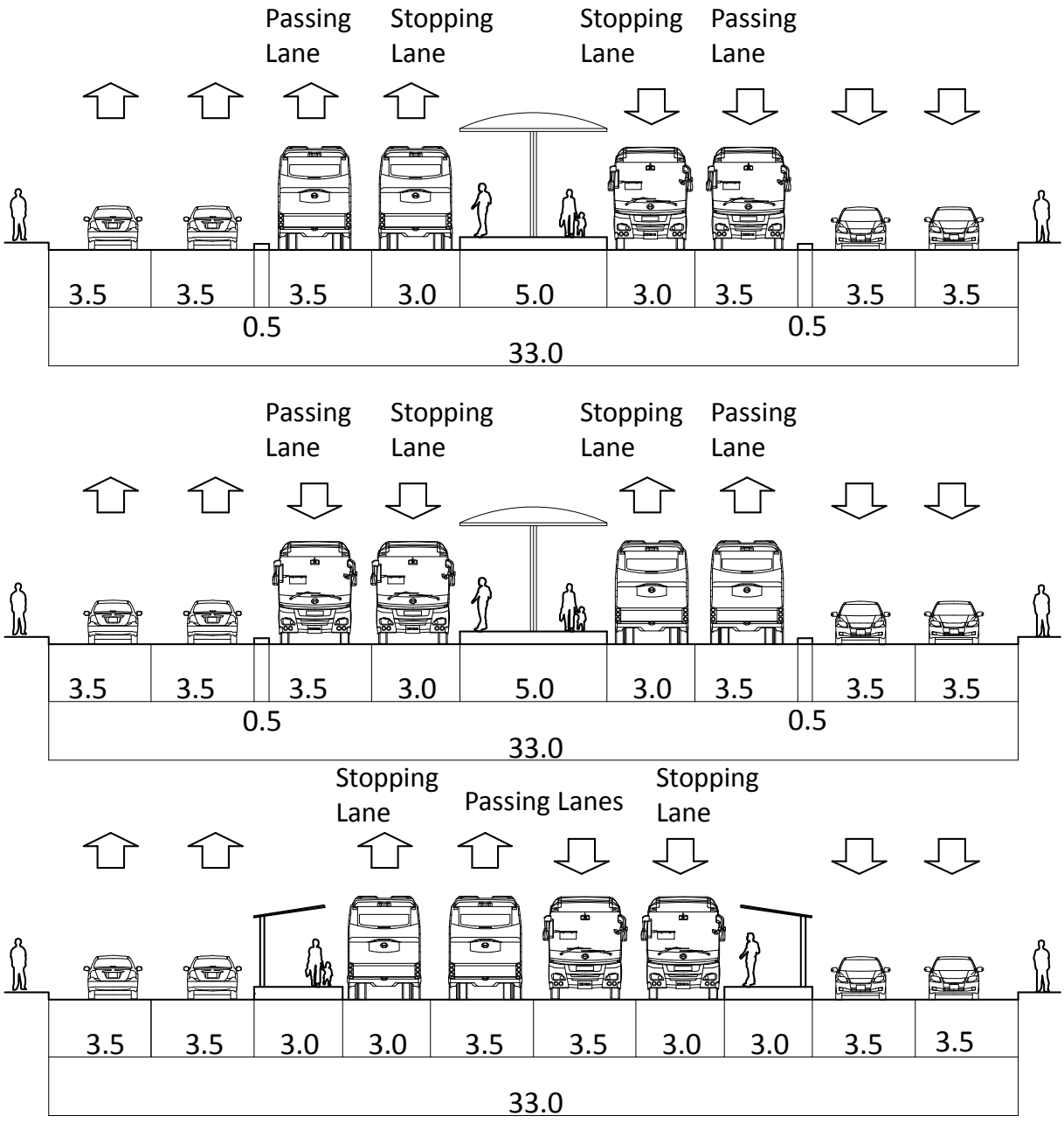
Source: JICA Study Team

2.3.2 Configuration of Lanes, Station, and Vehicle

(1) Alternatives

A typical BRT has stations between the exclusive lanes for both directions in the median of the road and buses run for the same directions of other lanes. In this case, doors of boarding and alighting should be equipped in the right side of vehicle and due to this existing buses cannot use BRT lanes. As an alternative, stations are provided at the both sides of bus exclusive lanes in the median but this requires wider width of road. Providing lanes for the opposite directions is also an alternative. Installing bus exclusive lanes along curb sides is also another alternative.

Figure 2-3-6 shows alternatives of cross section at a station in case of 33m width road (excluding sidewalk).



Source: The Study for KTIP

Figure 2-3-6 Cross Section Alternatives

(2) Road Space

M.A. Jinnah Road is very busy road but road width is so narrow that it is difficult to introduce BRT lanes. Figure 2-3-7 shows the road width along M.A. Jinnah Road between Tower and Gurumandir. The width of most parts of the road is less than 33m which is desirable for BRT. In the section between Tower and Cloth Market, the width of road is less than 22m, which is the minimum for BRT without bus stations.

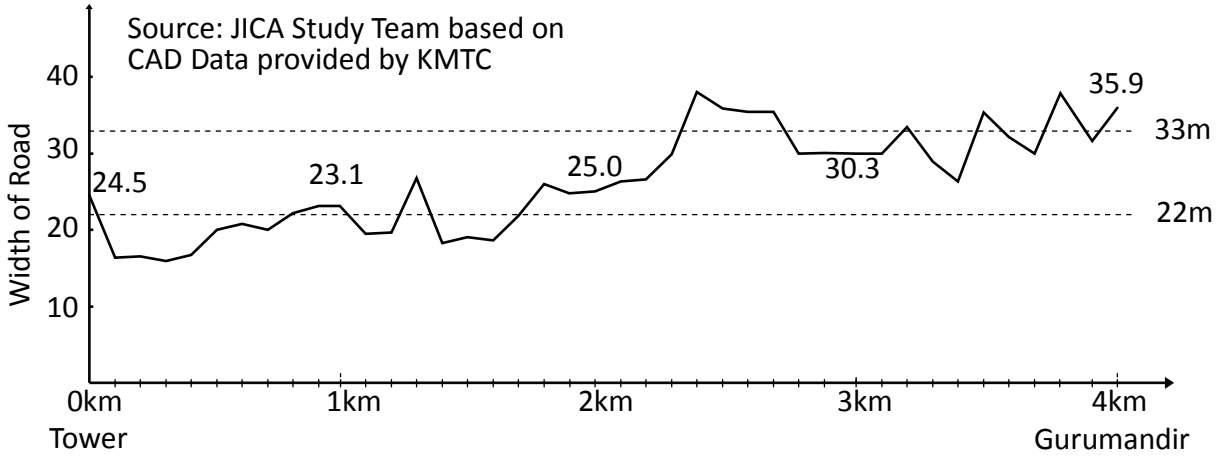


Figure 2-3-7 Road Width of M.A. Jinnah Road

2.3.3 Traffic Control

(1) Signal Free Corridor and BRT

The Signal Free Corridor project is implemented by CDGK. A signal free corridor is a highway corridor where traffic is not interrupted by traffic signal with flyovers, underpasses, U-turns, and pedestrian bridges. Signals are removed from Signal Free Corridors. In October 2009, CDGK approved 29 Corridors (Notification NO.DCO/CDGK/PS/373/09). So far, Signal Free Corridors 1, 2, and 3 have been completed. Corridor-3 corresponds to Red Line.

There is a collision between Signal Free Corridors and BRT corridors.

Median breaks for U-turn traffic is essential part of a signal free corridor to provide a way for right turn traffic without signals. Since BRT lanes will be provided in the center of roads, U-turn traffic will conflict with BRT traffic. To avoid the conflict, intersections along BRT corridors should be signalized, which is incompatible with the policy of Signal Free Corridor.

Transjakart – Bus lane is blocked by U-turn traffic
Photo: Nippon Koei Co., Ltd.

(2) U-Turn Traffic (Red Line)

Figure 2-3-8 shows the locations of U-turns along University Road. There are four median breaks for U-turn traffic between Shaheed-e-Millat Road and Rashid Minhas Road. And Table 2-3-2 shows traffic volume at U-turns along Red Line by vehicle types.

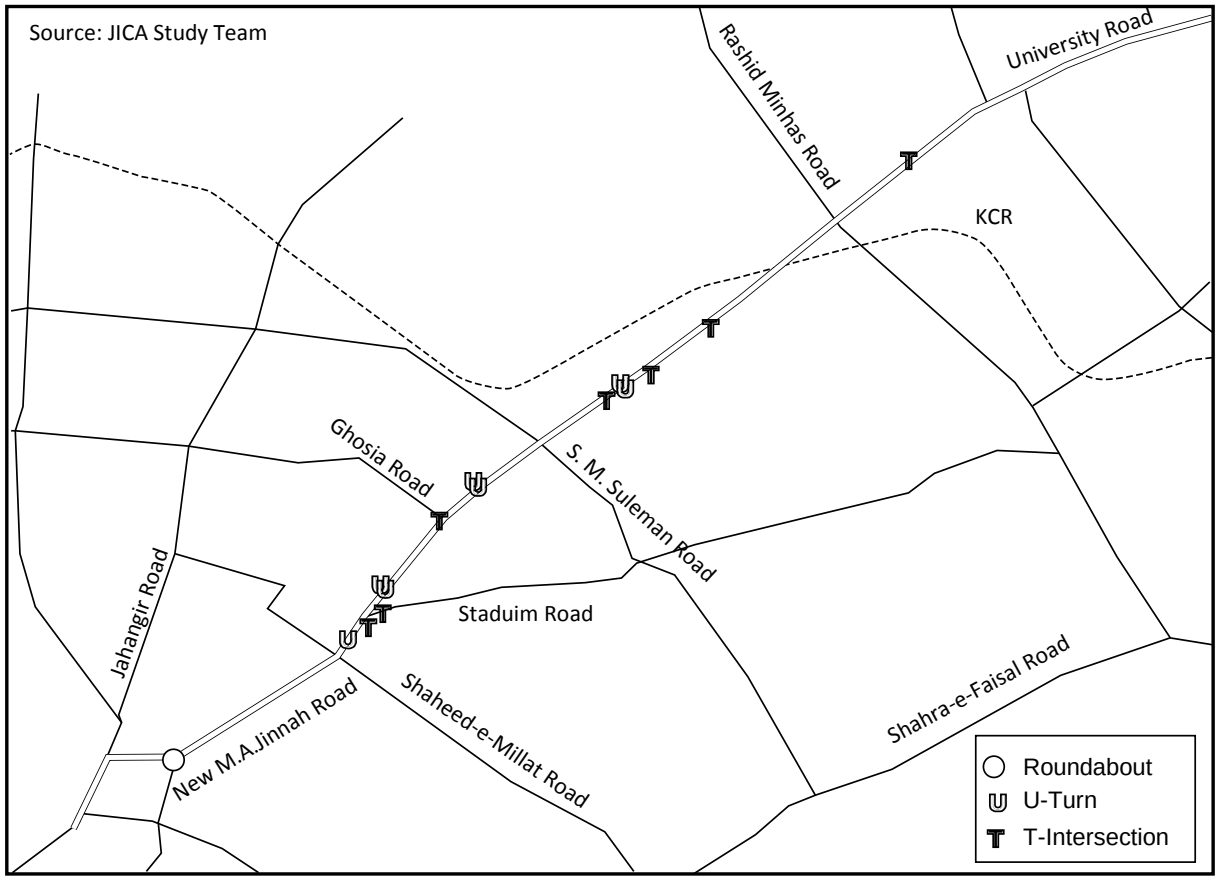
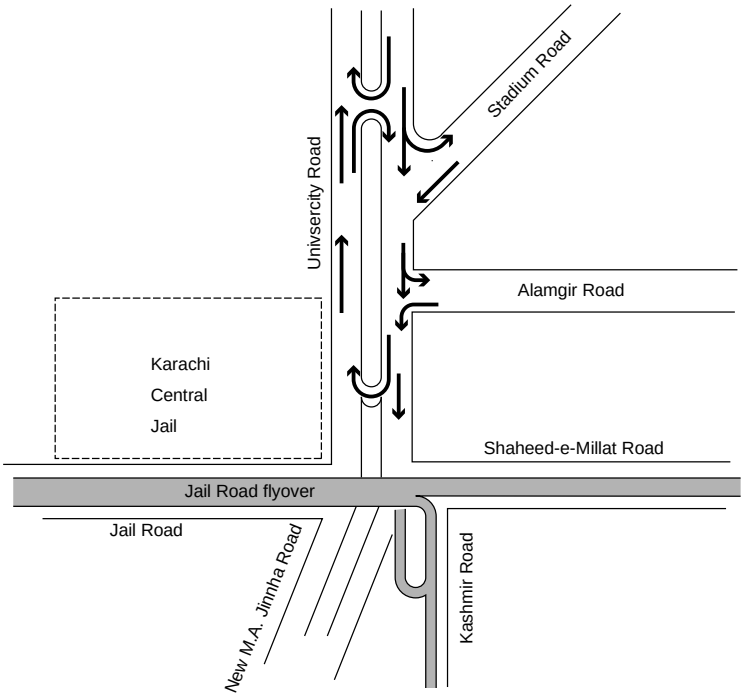


Figure 2-3-8 U-Turn Locations along Red Line

Signalization of intersections between University Road and Stadium Road will be an issue because two T-intersections are located very near as shown in Figure 2-3-3.



Source: JICA Study Team

Figure 2-3-9 Traffic Movement along University Road near Karachi Center Jail

Table 2-3-2 Traffic Volume at U-turns along Red Line

Location ID	Direction (from/to -)	14 hours (7:00 - 21:00) / 1 hour of peak hour	Cars & Jeeps & Taxis & Vans	Rick shaws	Motor cycles & Scooters	Pickups	Mini Buses & Coaches	Large Buses	Trucks & Trailers	Total
RU-1	Civic Center	7:00 - 21:00	5480	2380	5638	316	1517	8	15	15,354
		18:00 - 19:00	804	267	753	21	132	1	1	1,979
RU-2	Jail Chowrangi	7:00 - 21:00	6357	2614	7169	436	179	176	34	16,965
		19:00 - 20:00	471	221	878	61	11	14	2	1,658
RU-3	Civic Center	7:00 - 21:00	2416	1664	4451	738	27	5	104	9,405
		14:00 - 15:00	236	175	512	67	8	0	5	1,003
RU-4	Jail Chowrangi	7:00 - 21:00	3440	1698	5146	1354	94	25	89	11,846
		19:00 - 20:00	520	142	521	228	17	10	12	1,450
RU-5	NIPA Chowrangi	7:00 - 21:00	5714	2228	5432	556	632	41	175	14,778
		16:00 - 17:00	510	145	634	43	31	6	23	1,392
RU-6	Bait-ul-Mukkaram Masjid	7:00 - 21:00	11,491	1,799	6,502	448	40	0	54	20,334
		14:00 - 15:00	1,191	173	525	65	18	0	9	1,981
RU-7	PIA Garden	7:00 - 21:00	5,504	2,018	8,471	457	14	3	28	16,495
		13:00 - 14:00	486	170	739	38	0	0	4	1,437

Source: JICA Study Team

(3) U-Turn Traffic (Green Line)

Figure 2-3-10 shows U-turn locations along Green Line and Table 2-3-3 shows traffic volume at U-turns by vehicle types in North Nazimabad. There are six median breaks for U-turn traffic in North Nazimabad and seven U-turns in New Karachi. If intersections are signalized, U-turns can be closed in New Karachi because the U-turns are provided for right-turn traffic at intersections in New Karachi.

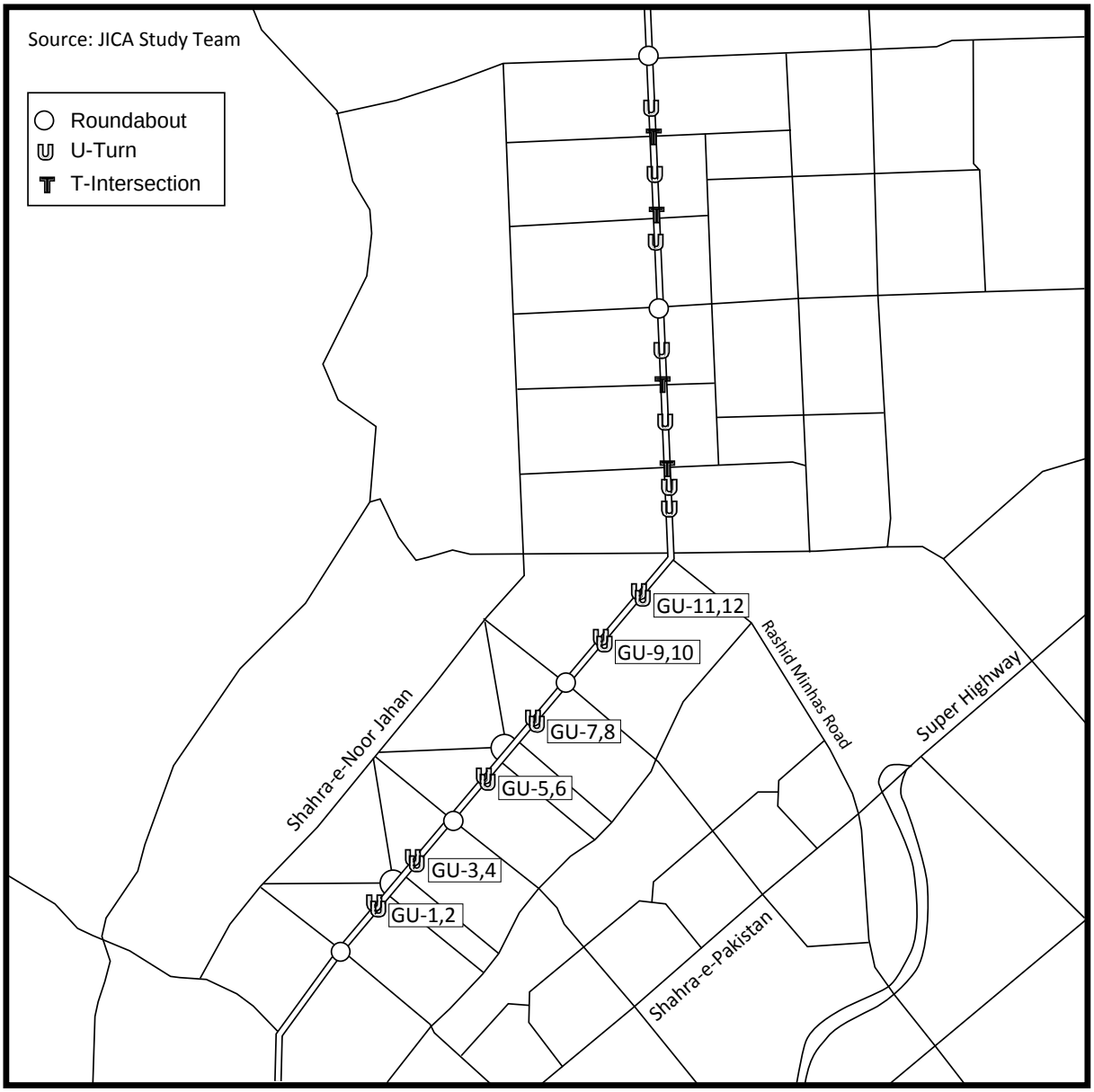
On the other hand, it will be difficult to close U-turns in North Nazimabad because signalization of intersection is not proper along the corridor in North Nazimabad. Figure 2-3-11 illustrate the location of U-turns and connecting roads between KDA Chowrangi and Five Star Chowrangi. Since the distance between the two interchanges is as long as 1.6km, it is desirable to provide additional intersections to access the opposite side. There are two T-intersections but they are close each other in the distance of 220m, which is too short to convert them to two signalized intersections.

Traffic along North Nazimabad
(U-turn traffic in red circles)
Photo: JICA Study Team

(4) U-turn Traffic (Blue Line)

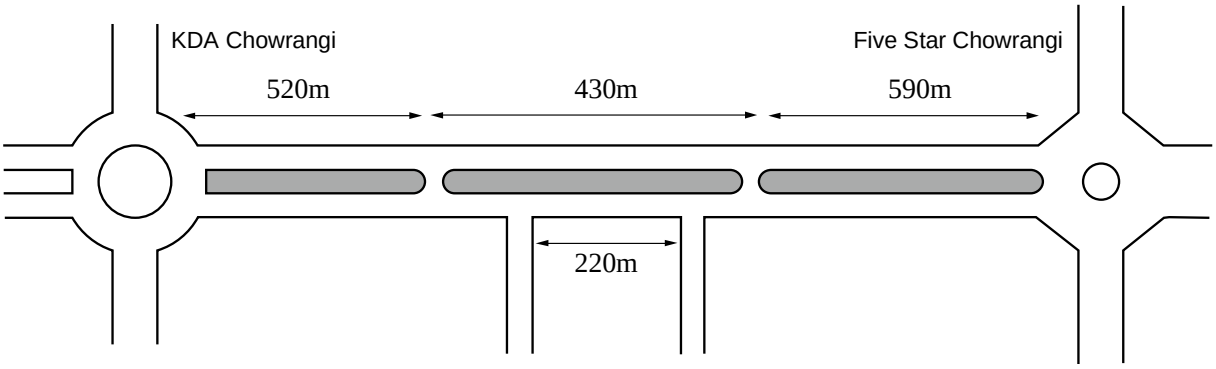
There are three U-turn locations along Blue Line between Gurumandir to Sohrab Goth at present. The U-turn under flyover of Sohrab Goth Intersection is important for traffic using Super Highway to access the opposite side of the road. The U-turn at the city side of Sohrab Goth is also important for traffic from the north side of the road to the south side. The U-turn at the north of Shah Abdul Aleem Melthi provides access to the west side of Shara-e-Pakistan Flyover.

There are no U-turn points between other major intersections: Karimabad Intersection, Aysha Manzil Intersection, and Water Pump Chowrangi. On the other hand, turning demand at these intersections is very high and making median breaks between them would be one of the solutions to cease the congestion.



Source: JICA Study Team

Figure 2-3-10 U-Turn Locations along Green Line



Source: JICA Study Team

Figure 2-3-11 U-turn Location between KDA Chowrangi and Five Star Chowrangi

Table 2-3-3 Traffic Volume at U-turns along Green Line

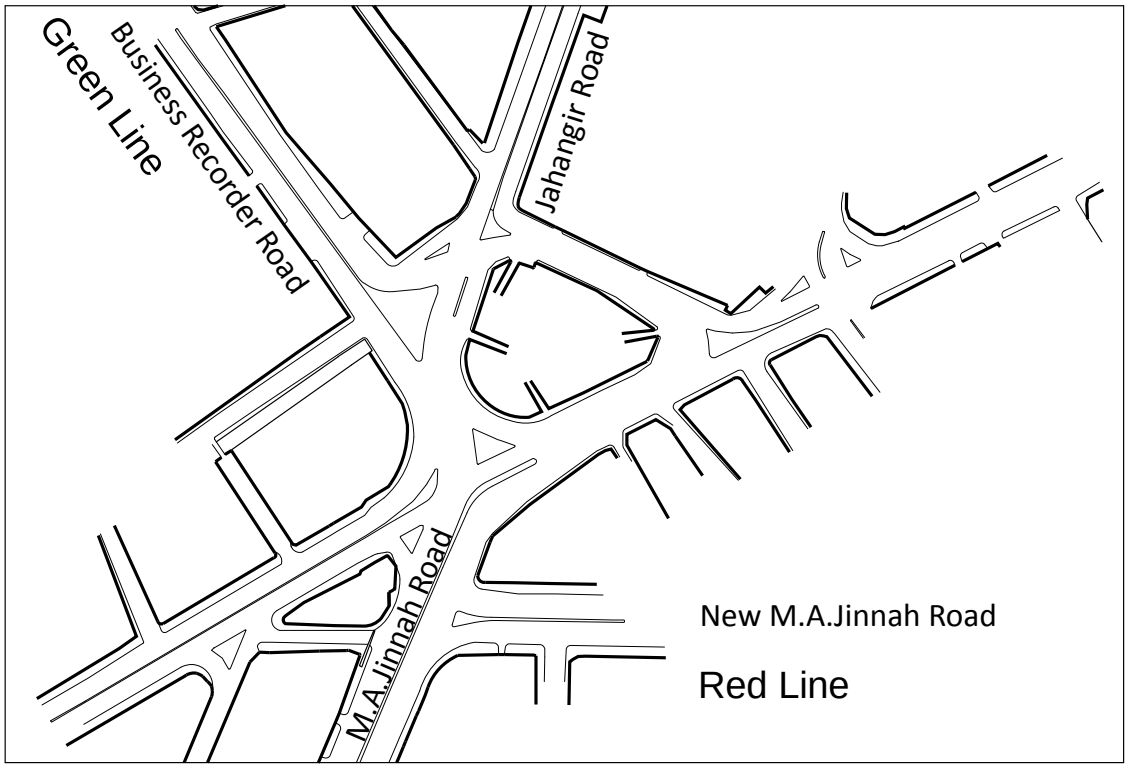
Location ID	Direction (from/to -)	14 hours (7:00 – 21:00) / 1 hour of peak hour	Cars & Jeeps & Taxis & Vans	Rick shaws	Motor cycles & Scooters	Pickups	Mini Buses & Coaches	Large Buses	Trucks & Trailers	Total
GU-1	KDA Chowrangi	7:00 – 21:00	122	61	494	9	10	1	0	697
		7:00 - 8:00	26	5	27	2	1	0	0	61
GU-2	Hyderi Market	7:00 – 21:00	3,918	1,483	3,824	300	31	9	32	9,597
		14:00 - 15:00	442	158	303	34	13	0	4	954
GU-3	Hyderi Market	7:00 – 21:00	4,320	1,646	3,888	174	45	1	54	10,128
		18:00 - 19:00	518	158	268	14	0	0	4	962
GU-4	Five Star Chowrangi	7:00 – 21:00	195	41	253	13	2	2	1	507
		12:00 - 13:00	18	5	19	5	0	1	0	48
GU-5	Five Star Chowrangi	7:00 – 21:00	50	22	231	3	0	0	0	306
		12:00 - 13:00	6	3	24	0	0	0	0	33
GU-6	New Hyderi Market	7:00 – 21:00	1,295	349	1,458	117	15	7	11	3,252
		13:00 - 14:00	146	40	130	15	3	1	2	337
GU-7	New Hyderi Market	7:00 – 21:00	1,537	497	1,672	128	26	38	15	3,913
		13:00 - 14:00	158	50	141	7	1	5	0	362
GU-8	Sakhi Hasan Chowrangi	7:00 – 21:00	41	26	135	7	0	0	0	209
		18:00 - 19:00	6	4	14	1	0	0	0	25
GU-9	SakhiHasan Chowrangi	7:00 – 21:00	170	25	234	8	2	0	1	440
		19:00 - 20:00	29	4	14	0	0	0	0	47
GU-10	Nagan Chowrangi	7:00 – 21:00	1,006	586	1,781	88	16	4	16	3,497
		17:00 - 18:00	116	87	175	5	1	0	1	385
GU-11	HaroonShoping Ceter	7:00 – 21:00	1,280	608	2,078	156	28	15	15	4,180
		19:00 - 20:00	157	53	163	9	2	2	0	386
GU-12	Nagan Chowrangi	7:00 – 21:00	1,086	766	2,322	223	129	2	19	4,547
		13:00 - 14:00	110	69	200	24	17	0	2	422

Source: JICA Study Team

(5) Roundabout Traffic

A roundabout is one of the difficult road elements for a BRT operation. There are roundabouts without traffic signals along Green Line. There are some examples of BRT systems in the world that are operated along roads having roundabouts. For example, there are roundabouts along the major route of TransJakarta (Jakarta). BRT systems in Quito (Ecuador) and Cali (Colombia) also have roundabout intersections. In case that a roundabout is heavily congested, it is better to signalize the roundabout so that BRT buses are not delayed by the congestion. So far, roundabouts in North Nazimabad and New Karachi are not so saturated that the delay of BRT buses at roundabouts would not be a problem.

Gurmandir is the bottleneck roundabout for Green Line. The roundabout has five legs and traffic congestion is very heavy. In peak hours, traffic of three major corridors (Business Recorder Road to Surjnai, Jahangir Road to Sohrab Goth, and New M.A. Jinnah Road to University Road) concentrates on the roundabout.



Source: JICA Study Team

Figure 2-3-12 Gurmandir Intersection

2.3.4 Business Model, Institution and Organization

(1) Experiences of Public Transport in Karachi

Currently, public transport services in Karachi are provided by small private operators. They provide public transport services based on the route permission given by District Regional Transport Authority (DRTA). Bus fare is regulated by the Government of Sindh. Only routes and fares are regulated and the level of services is not controlled by public sector. Transforming the existing system to a good system for BRT would be a very challenging issue.

In Pakistan, Punjab Province introduced franchise bus scheme in the early 2000s. Exclusive right to use a certain routes is given to those operators that satisfy the requirement of the level of services. The outline of the scheme is:

- The franchise for a route is awarded through a “transparent and competitive bidding process”.
- Franchise period is for 10 years.
- Franchise affords exclusivity of operations on the franchised route, provided the franchisee is able to cater to the entire load of passengers.
- Fares are flexible (more on this later).
- A subsidy of 4 percent for non-air-conditioned buses and 8 percent for air-conditioned buses is awarded to operators for the purchase of vehicles.
- Bids are advertised in the press. A bids evaluation committee, made up of senior officials from the province, evaluates all bids, with special attention given to the financial stability of the bidding operator. The recommended bids are sent to the provincial chief minister for approval, who issues the franchise for an initial 10-year period.

On the other hand, CDGK also introduced the similar scheme as Urban Transport Scheme (UTS)

in 2000 for 18 bus routes. However, the scheme was failed because the exclusive rights for routes were not sufficient and the contract companies faced competition with mini buses.

The good practice of successful BRT systems is that bus routes of BRT are operated by a private company and the public authority pays the contract fee to the private company based on the performance such as vehicle-kilometer. The public authority receives the fare revenue through a fare collection company and the contract fee of fare collection is given to the company. CDGK once introduced a well-designed business model, which is popular solution for the successful operation of BRT, for the CNG Green Bus Pilot Project. CDGK received fare revenue and paid contract fee to private operators for the route of Green Bus Pilot Project. However, the fare revenue was smaller than the contract fee and it was difficult for CDGK to burden the deficit. From this, CDGK changed the contract with the private company. In the new business structure, the private companies receive the fare revenue directly instead of receiving the fee from CDGK. For the compensation of using bus depot and other infrastructure and rolling stock, the private companies pay contract fee to CDGK.

The failure of the initial scheme of the pilot project shows that the following issues.

- The present fare level which is determined by the government is too low to maintain the high quality of service.
- The financial situation of CDGK is so bad that it is difficult for CDGK to take a risk of fare revenue.
- The network size of the pilot project is so small that the project buses can get only a limited number of passengers along the corridor.
- Bus operators in Karachi are so small and not sophisticated as a public transport company that it is difficult to formulate a competitive operator to participate in the bidding.

(2) Institutional Issues

Institutional issues in transport sector are discussed in the Interim Report-1 and establishment of a new organization is proposed.

The major points of the institutional problem in Karachi for BRT are follows:

- The successful BRT depends on the mechanism of the fare regulation. Currently, bus fare in Karachi is regulated by the Department of Transport of the Government of Sindh (GOS) based on Motor Vehicle Ordinance (45). The maximum and minimum fares are fixed by GOS based on Vehicle Ordinance. The fare decision is often affected by political pressure.
- There are some overlaps between DRTA under CDGK and Regional Transport Authority (RTA) under GOS.
- There is a risk of battles over the public transport responsibility between CDGK and GOS.
- Generally, the cost of BRT is low and it is affordable for a local municipality. However, the financial status of CDGK is bad and the support from GOS or the central government would be necessary. Otherwise CDGK need to ask for private investors.
- BRT system can be developed under the present legal scheme in Pakistan. However, there remain a risk that giving dedicated lane to a private company using existing roads will cause legal challenge from road users because there is no sentence about such exclusive use of lanes in Pakistan’s laws and regulations.

2.3.5 Recommendation

Considering the available space for BRT in the road network in Karachi and the difficulty of institutional reform, the following BRT scheme is proposed.

- Busways should be developed in the center of road to ensure the speed.
- Fare collection should be ensured for the stable operation of BRT. Therefore, the BRT system should employ pre-board fare collection system.
- Buses should be reasonable and the repair and spare parts should be available in local market in Pakistan.
- Major intersections should be signalized to avoid the conflict of BRT traffic with right turn and U-turn traffic.
- The fare should be set at a sustainable level. Existing buses providing reasonable fare for low income people should remain for some years.
- A new law about mass transit development should be enacted so that the transit authority can take necessary actions without legal challenges.

Chapter 3 Conceptual Design

3.1 BRT Network and Route

3.1.1 Green Line

The route of Green Line was originally proposed as the same route as the BRT line-1 proposed by ADB in 2007. The original line terminates at the north side of Quaid-e-Azam Mausoleum and transfer to feeder lines are proposed for the access to Saddar Area.

There are two options for Green Line, which was proposed by KMTC during the master plan stage. Option-1 is connecting Green Line to Shaheed-e-Millat Road, which is wide enough to accommodate bus lanes. Option-2 is connecting Green Line to Shahrah-e-Quaideen which is busy but relatively wide road.

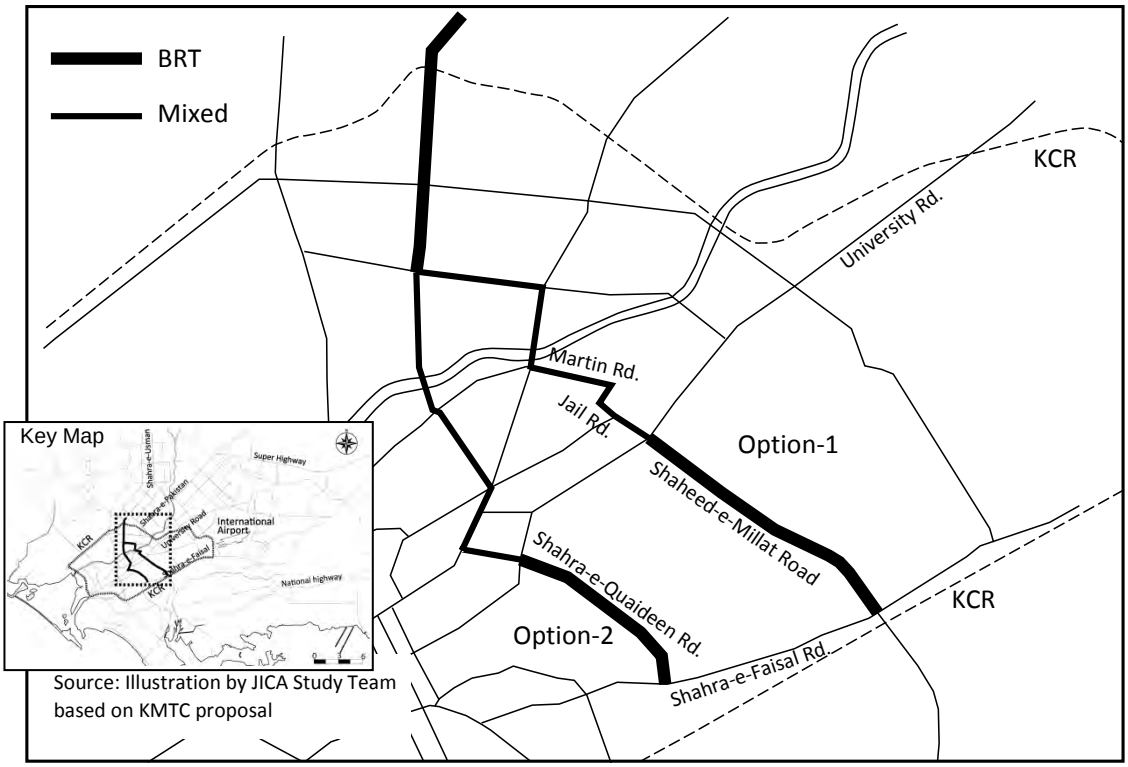


Figure 3-1-1 Option-1 and 2 for Green Line Proposed by KMTC

Option-1

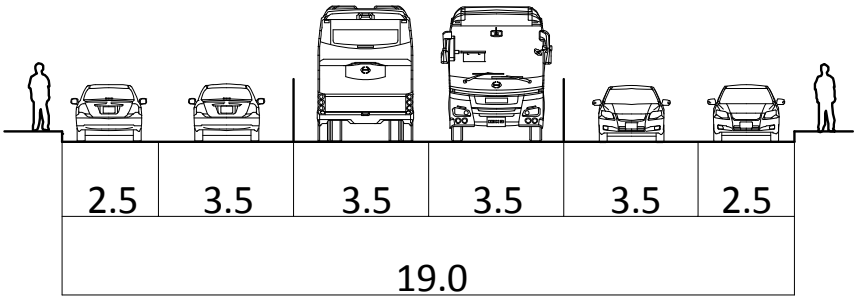
There is a bottleneck section in the route of Option-1. Martin Road is too narrow (15.5-19.5m) to accommodate BRT lanes and so is Jail Road. Mixed traffic operation of BRT along Martin Road and Jail Road will worsen the image of BRT because of congestion and slow speed in this section. U-turn operation at the terminal point of Shaheed-e-Millat Road will be also a problem because there is no U-turn place at present. There is an alternative to extend the route to Korangi. However, traffic demand of private cars along this road is very high, so it is difficult to provide bus lanes. From these points, Option-1 is not recommended.

Option-2

Shahrah-e-Quaideen Road can accommodate BRT lanes. However, BRT operation will be difficult at the trumpet interchange with Shahrah-e-Faisal Road. The road width is narrow for BRT lanes at the ramp of the flyover that crosses Shahrah-e-Faisal Road. U-turn under flyover will cause crossing of BRT and mixed traffic before the flyover. Instead of terminating the route at this point as the extension of Green Line, it is recommended that Yellow Line is extended to Shahrah-e-Faisal Road and go to Shahrah-e-Quaideen Road.

M.A. Jinnah Road

There is strong opinion that BRT should be provide up to Tower along M.A. Jinnah Road because it is high demand corridor. However, the section is narrow between Tower and Cloth Market. Since this is very busy commercial area, the road must have parking lanes or emergency shoulder for both sides. Considering the demand of commercial vehicle for loading and unloading, the width of parking lane should be 2.5m. This means that even if a bus stop is not provided along this section, a minimum of 19m plus sidewalk width is required for road width. The road width near Tower is approximately 15m for the length of 400m.



Source: JICA Study Team

Figure 3-1-2 BRT Cross Section in Urban Streets

The section of a bus station needs to have at least 22m plus side walk. The road width is 23.5 m in front of Karachi Municipal Cooperation (KMC) building but the width between Tower and KMC building is less than 22m. This means that bus stations cannot be provided between Tower and KMC building.

From this, the JICA Study Team does not recommend to extend Green Line to Tower. The previous studies about BRT in Karachi also did not recommend BRT along M.A. Jinnah Road.

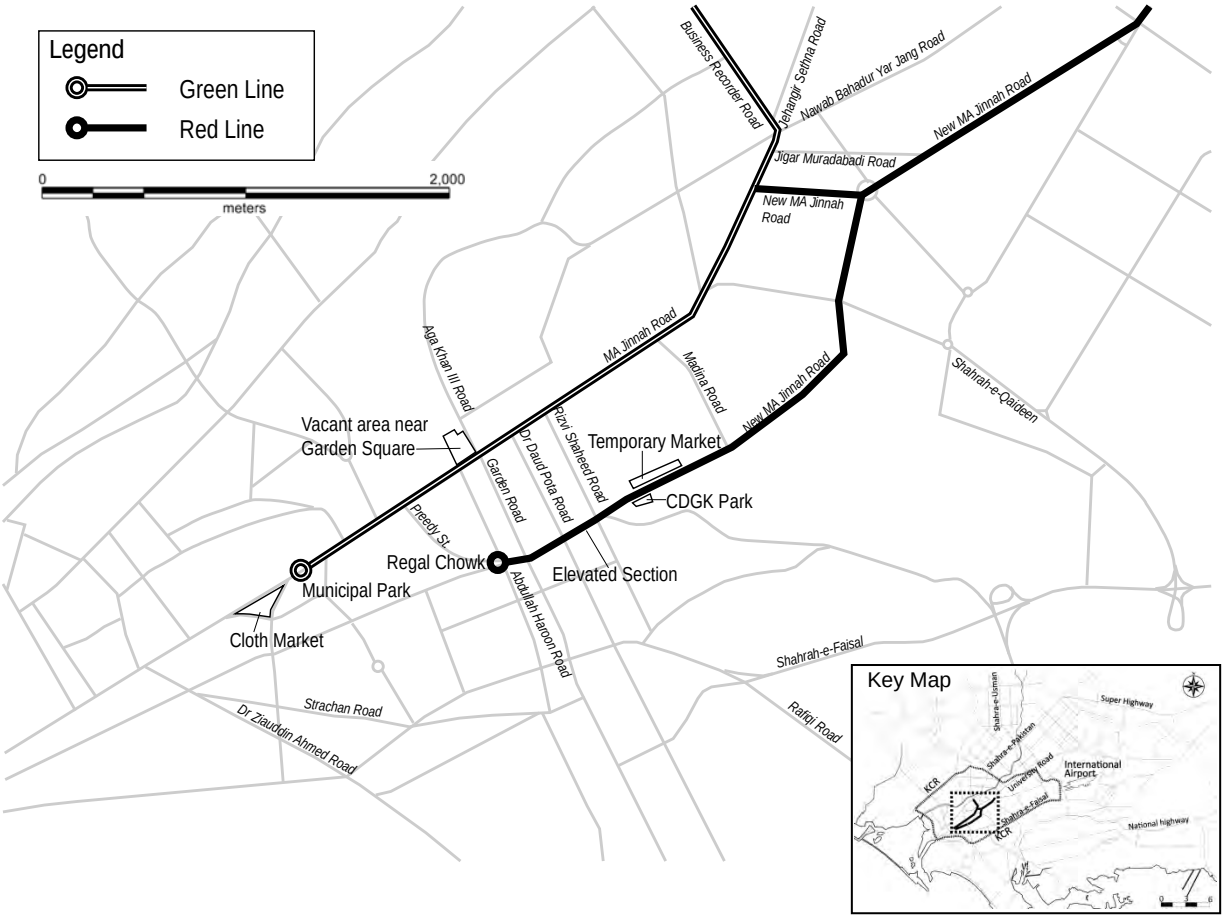
Instead of shuttle services proposed in the previous BRT studies, it is proposed to construct BRT lanes along M.A. Jinnah Road up to the point as close to Tower as possible. Since the one-way section of M.A. Jinnah Road is narrow and no U-turn point is available, Municipal Park near Cloth Market was selected as the end point (or start point) of BRT lanes along M.A. Jinnah Road. Figure 3-1-3 shows the location of Municipal Park.

3.1.2 Red Line

Red Line is proposed along University Road, and there is no alternative except for the terminal points of both sides. The terminal point is proposed to Model Colony of Malir Town. From Malir Town to the center of the city, Shahrah-e-Faisal Road is the best route while University Road becomes a detour. The advantage of the BRT route on University Road for Malir Town depends on the travel time along Shahrah-e-Faisal Road. The terminal point should be decided by the location of the depot.

The major issue of this route is that University Road was developed as a Signal Free Corridor in recent years despite the road was proposed as a BRT corridor by KMTC.

KMTC proposed the route along New M.A. Jinnah Road and Preedy Street up to Regal Chowk including elevated section between CDGK parking and Regal Chowk. Figure 3-1-3 shows the route along Preedy Street up to Regal Chowk. Since the road is narrow, elevated structure is proposed for this section.



Source: JICA Study Team

Figure 3-1-3 BRT Route along M.A. Jinnah Road

3.1.3 Blue Line

Blue Line is proposed as a railway system in the master plan, although the project is proposed after the completion of KCR. On the other hand, a rapid urban development along Super Highway is expected because of the rapid increase in population. To encourage the usage of public transport instead of private transport mode in new development area, public transport services along Blue Line should be developed.

There are three bottlenecks along Blue Line: M.A. Jinnah Road, Jahangir Road, and the bridge near Sohrab Goth. BRT along M.A. Jinnah Road is described in 2.1.1. Jahangir Road is as narrow as 17-18m in width and stations cannot be constructed along this road. There is no alternative route for Jahangir Road. It is recommended that the road should be widened to increase traffic capacity regardless of BRT project.

The bridge near Sohrab Goth is narrow especially the direction from the center of the city to Super Highway where the width of carriageway is only 10m. This is too narrow considering the heavy traffic along this road.

The analysis and the future plan of Blue Line are described in Appendix-1.

3.2 Station Location

3.2.1 Distance between Stations

Commercial speeds of BRT depend on the number of stations because buses need to spend a time at each station for boarding and alighting. The longer the distance between stations, the faster the commercial speed of BRT. On the other hand, walking distance becomes longer if the distance between stations is longer. For passengers, total travel time is the sum of walking time, waiting time for a bus, and on-board time. There will be an optimum distance that minimizes the total passenger-hours. In general, the optimum distance between stations is approximately 500m considering the standard BRT systems in the world.

Although a better transport system usually increases the acceptable walking distance, there will be a maximum limit. Considering the law and order situation in Karachi, walking distance should be as short as possible. Assuming the proper walking time along the major road is less than 5 minutes, and the walking speed is 4km/h, the maximum distance between stations is calculated as 667m.

3.2.2 Proposed Station Locations

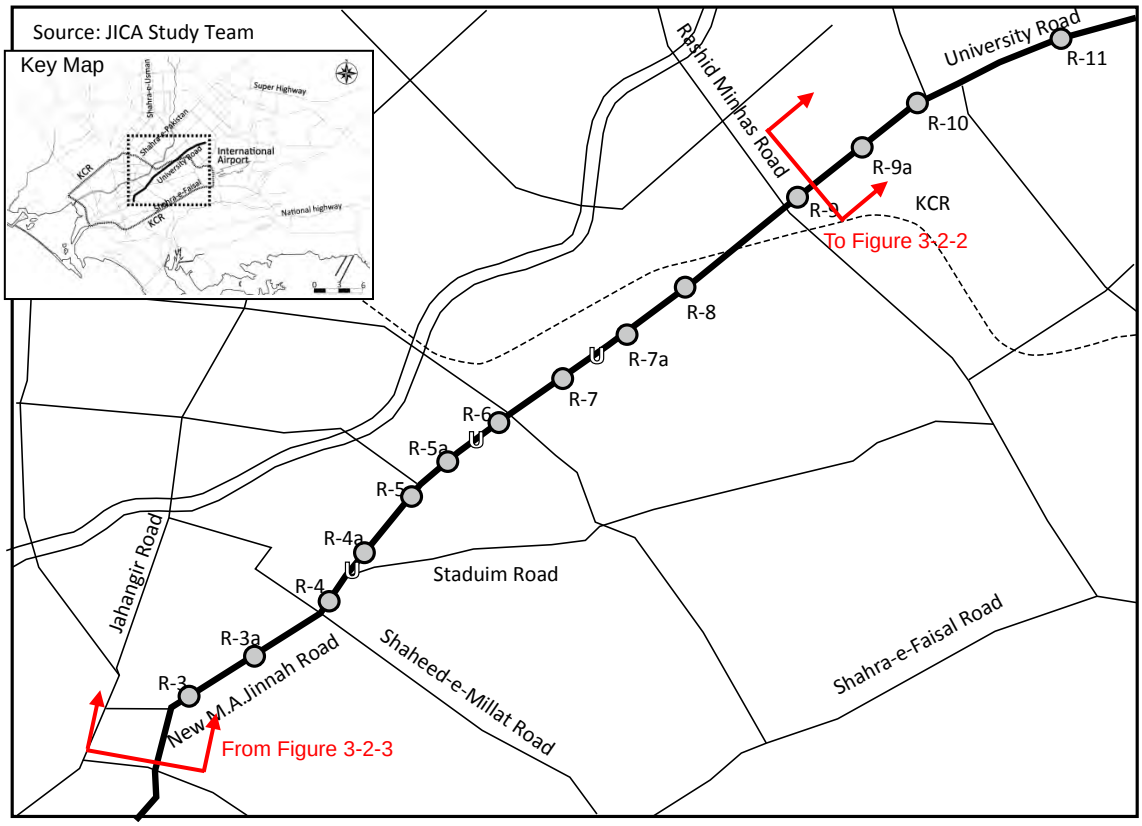
(1) Red Line Stations

Figures 3-2-1 - 3-2-3 show the locations of proposed BRT stations of Red Line. There are 21 stations proposed for Red Line in which one station (R01) is as same as the Green Line station at the same place. The station locations should be finalized considering the relation with intersection and traffic management along University Road because the corridor is currently developed as Signal Free Corridor.

Table 3-2-1 List of BRT Station (Red Line)

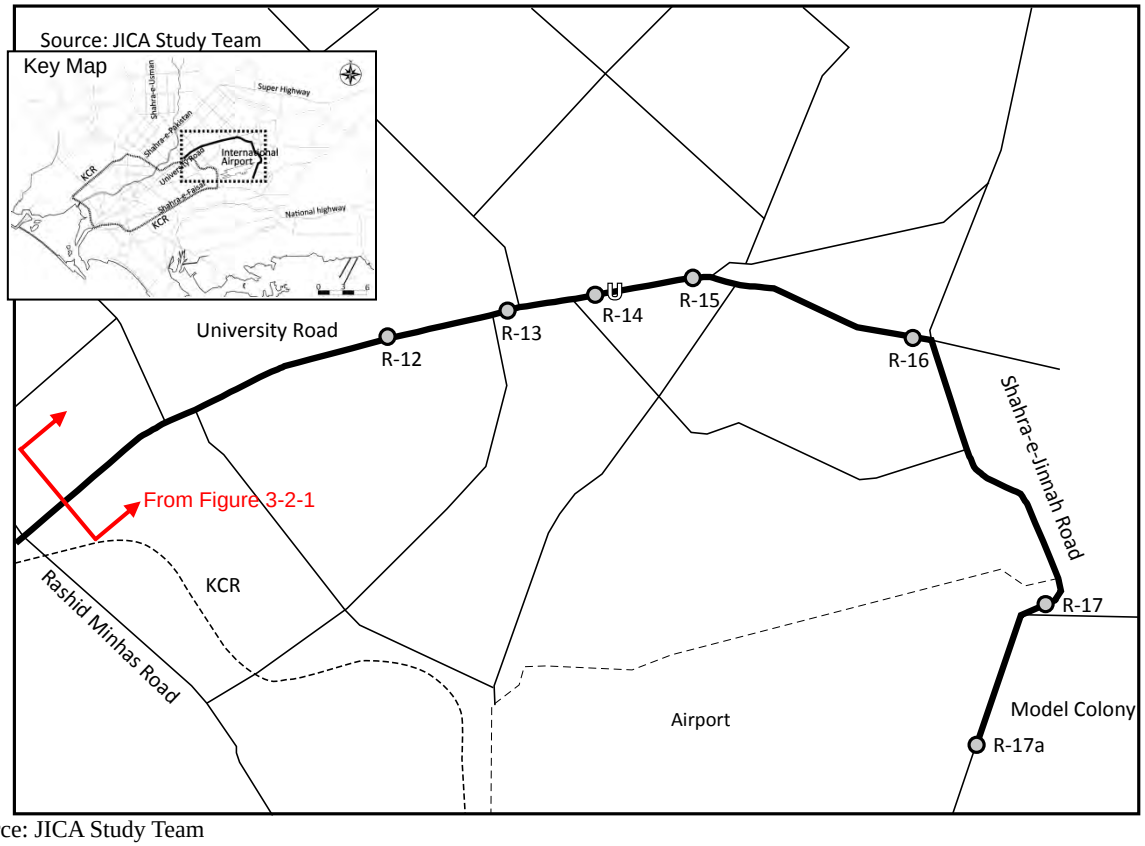
No.	Location	Remark
R01	West of Quaid-e-Azam	Same station as Green Line
R02	North of Quaid-e-Azam	Middle of intersections
R03	People's Roundabout	Between roundabout and Jail road
R03a	Car Dealer Shop	
R04	Center Jail	Near flyover
R04a	U-turn Stadium Road	
R05	Askari Park	Both sides of T-intersection
R05a	Near U-turn Gulsan Iqbal	
R06	Civic Center	Between Askari Park and Flyover
R07	PIA Planetarium	
R07a	Hakeem Sayeed Family Ground	Transfer to Jilani KCR Station
R08	Urdu University	Before flyover
R09	National Institute Management (N.I.M)	After flyover
R09a	Near Elevated U-turn	
R10	Safari Park	Near interchange
R11	NED	After flyover
R12	University of Karachi	Near Shaikh-Zaid Islamic Center
R13	City Towers	Before T-intersection at Rabia Villas
R14	Near Blue mt CNG Station	Near Ranger Office (proposed depot)
R15	Safura Circle	Before Safura Circle
R16	Malir Cant Check Post	Near PSO Petrol Pump
R17	Gulshan-e-Roomi	Reservation for future development
R17a	Model Colony	Near End Point
R18	Model Colony	End point of Red Line
P1	Regal Chowk	Elevated Station (U-turn point)
P1a	Empress Market	Elevated
P2	CDGK Parking Plaza	Transfer terminal proposed
P3	Shah Ahmad Noorani Chowrangi	Reservation for future development
P3a	Near Numaish Underpass	

Source: JICA Study Team



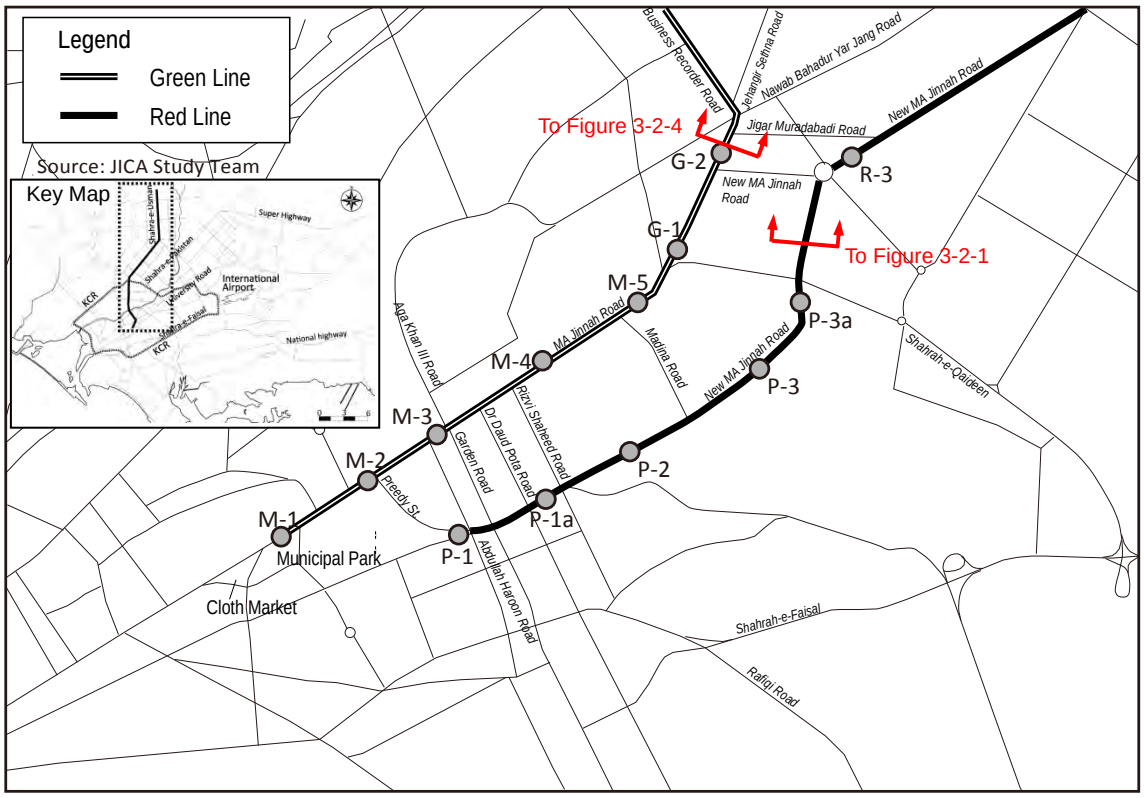
Source: JICA Study Team

Figure 3-2-1 Station Locations along Red Line (1)



Source: JICA Study Team

Figure 3-2-2 Station Locations along Red Line (2)

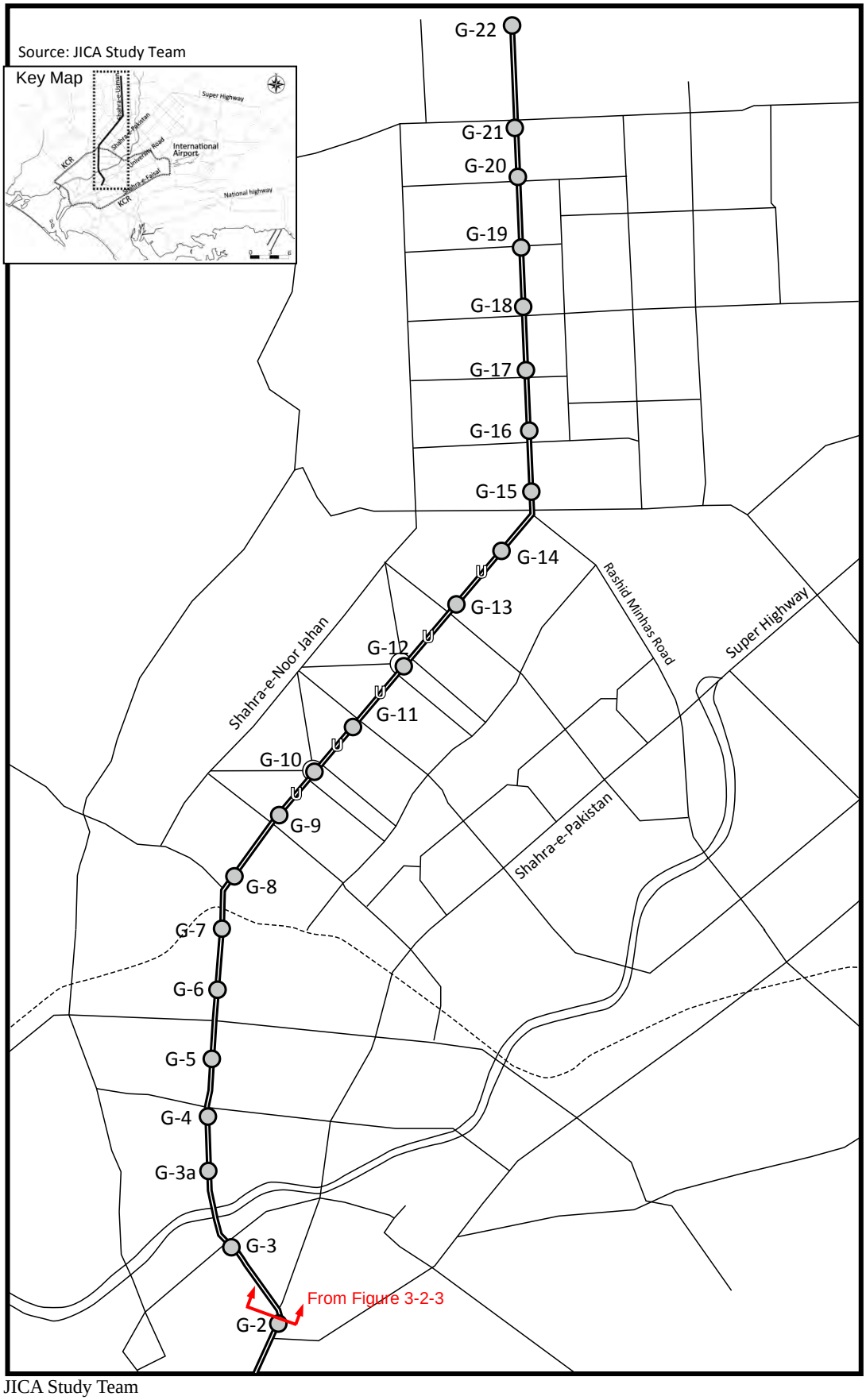


Source: JICA Study Team

Figure 3-2-3 Station Locations along Red Line and Green Line in CBD

(2) Green Line Station

The station locations of Green Line were proposed based on "Karachi BRT Pre Feasibility Planning Study, ADB". In addition to the proposed 18 stations in the study, additional four stations are proposed. Figure 3-2-3 and 3-2-4 shows the proposed location of Green Line. The list of the stations is shown in Table 3-2-2.



Source: JICA Study Team

Figure 3-2-4 Station Locations along Green Line

Table 3-2-2 List of BRT Station (Green Line)

No.	Location	Remark
M1	Municipal Park	Start point (or end point) of Green Line/ Without passing lanes/ Access by pedestrian crossing
M2	Radio Pakistan	A transfer terminal is proposed in the vacant area near Garden Square/ Without passing lanes/ Access by pedestrian crossing
M3	Garden Square	Without passing lanes/ Access by pedestrian crossing
M4	Taj Medical Complex	Without passing lanes/ Access by pedestrian bridge
M5	KGA ground	
G01	West of Quaid-e-Azam	The same station as Red Line/ Access by Pedestrian Bridge
G02	Gurumandir	Between Gurumandir and G01
G03	Lasbela Chowk	North side of Lasbela Chowk
G03a	Sanitary Market	
G04	No. 1 Chowrangi	South side of No.1 Chowrangi
G05	Model Park	Additional proposal in KTIP
G06	Baqai Hospital	Access by a pedestrian bridge
G07	Public Park near Bridge	At Nazimabad No. 7 intersection
G08	Board Office	Access by a pedestrian bridge
G09	KAD Chowrangi	Additional proposal in KTIP
G10	Hydri Market	Access by a pedestrian bridge
G11	Five Star Chowrangi	Both sides of the intersection
G12	Jummah Bazaar	Access by a pedestrian bridge
G13	Sakhi Hassan Chowrangi	Both sides of the roundabout
G14	Erum Shopping Emporium	Between Nagan Chowrangi and Sakhi Hassan Chowrangi
G15	Nagan Chowrangi	Between the first and second pylon in front of Haji Qadir Pakwan Sheermal House
G16	U.P. Mohr intersection	South of roundabout
G17	Rd 2400	Signalizing T-intersection
G18	Power House Chowrangi	South of the roundabout
G19	Rd 4200	Signalizing T-intersection
G20	2 minutes Chowrangi	North of the pylon outside Sultan Plaza Complex
G21	Surujani Chowrangi	The north of the roundabout
G22	KDA Chowrangi Surjani Town	Outside CDGK site office on the southern side of 5000 Road
G23	KESC Power House	Terminal station

Source: JICA Study Team

3.3 Cross Section

3.3.1 Station Place in Road Space

As discussed in Chapter 2, there are two types of cross section proposed for BRT in Karachi. One is the center station for right-door buses, and the other is curb-side stations for left-door buses.

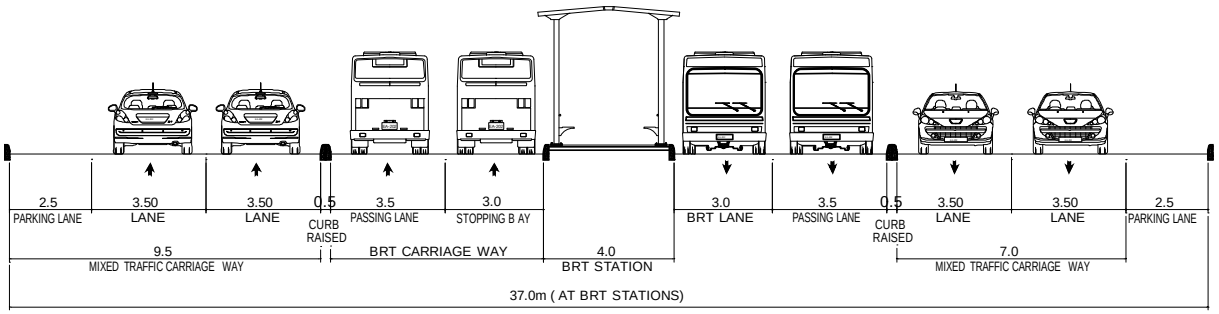
In the beginning of the F/S, cross section with curb side stations in both sides of bus lanes for left door buses was proposed so that the BRT buses can go use mixed traffic lanes. The proposal to introduce direct services for BRT was rational since the trunk-feeder system seemed to be a difficult option considering various challenges in Karachi. On the other hand, after the further analysis and discussion with KMTC, it was decided that BRT buses need not run in mixed traffic lanes. BRT buses only run on the dedicated lanes except for intersections. From this, the door configuration of BRT buses and station place in road space were selected difference criteria.

The JICA Study Team proposed the cross section of center station for the right door buses, and KMTC agreed the plan. The major reasons for the selection are:

- Approach to stations should be provided by a pedestrian bridge instead of pedestrian crossing because of heavy traffic of the corridor. Separation of stairs for both side stations will increase the cost.
- Passing lanes should be provided at major stations. Center side stations are better than curb side stations in view of design.
- Protecting paid area from unpaid passenger is an important issue in Karachi BRT. Center side stations are easier to manage paid and unpaid passengers than curb-side stations.

3.3.2 Cross Section at Station

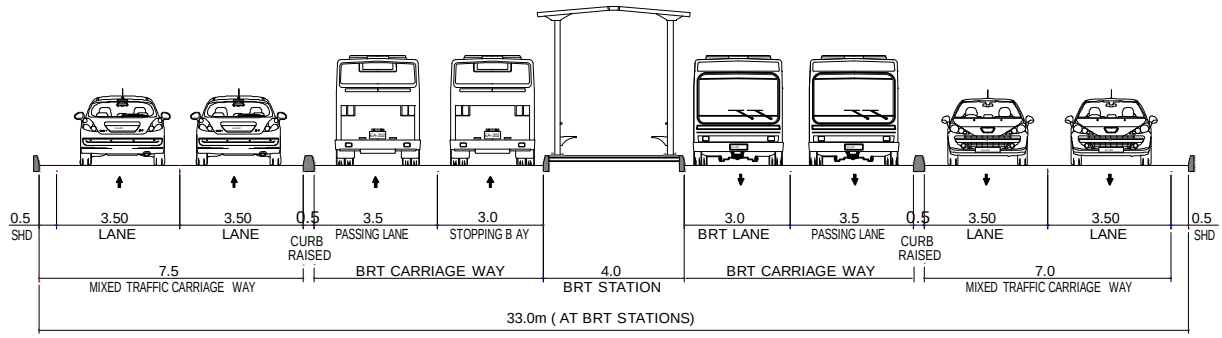
Figure 3-3-1 shows the cross section at station with passing lanes for both sides. The station is wide enough for both boarding and alighting with 4m width. Parking lanes are provided for both sides of carriageways. The road with one-lane for mixed traffic is not recommended as a BRT corridor. Therefore, at least two lanes for one direction are necessary. The road width excluding pedestrian walks is 37m. Only North Nazimabad, New Karachi and a part of University Road have enough space to satisfy this width. However, after the analysis of the corridors, it was decided that passing lanes would not be provided at the BRT stations because of limited spaces of roads.



Source: JICA Study Team

Figure 3-3-1 Cross Section at Station (37m)

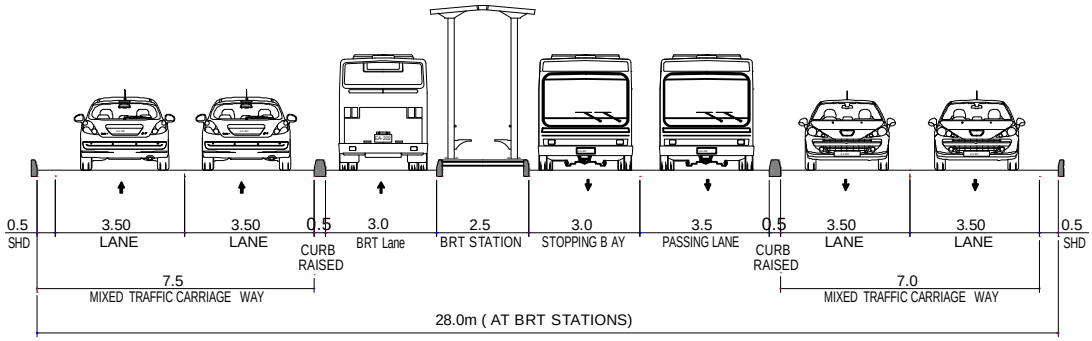
Alternative cross sections were studied to evaluate the possibility to provide passing lanes. If the parking lanes are not provided at station section, the width can be reduced to 33m as shown in Figure 3-3-2. The width of 33m was not acceptable considering the available space of roads.



Source: JICA Study Team

Figure 3-3-2 Cross Section at Station (33m)

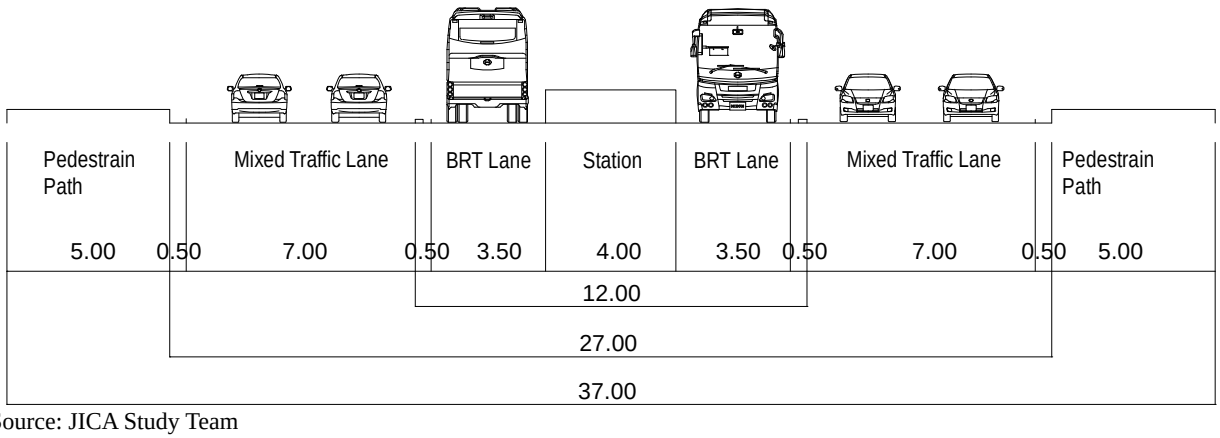
If platforms are provided at different locations by direction, the necessary width can be reduced to 28m as shown in Figure 3-3-3. However, the length of a station becomes longer. This plan was not applied because the length of a station would become long and it would not be cost efficient.



Source: JICA Study Team

Figure 3-3-3 Cross Section at Station (28m)

In case that passing lanes are not provided, the width of cross section at BRT station is 27m as shown in Figure 3-3-4. The capacity of BRT system becomes small if passing lanes are not provided. In addition, express bus services would not be possible. The station with passing lane would bring about a large scale of negative impact on road traffic because of narrow sections along the corridors. The advantages and disadvantages were studied, and it was finally decided that the BRT stations would be planned without passing lanes.

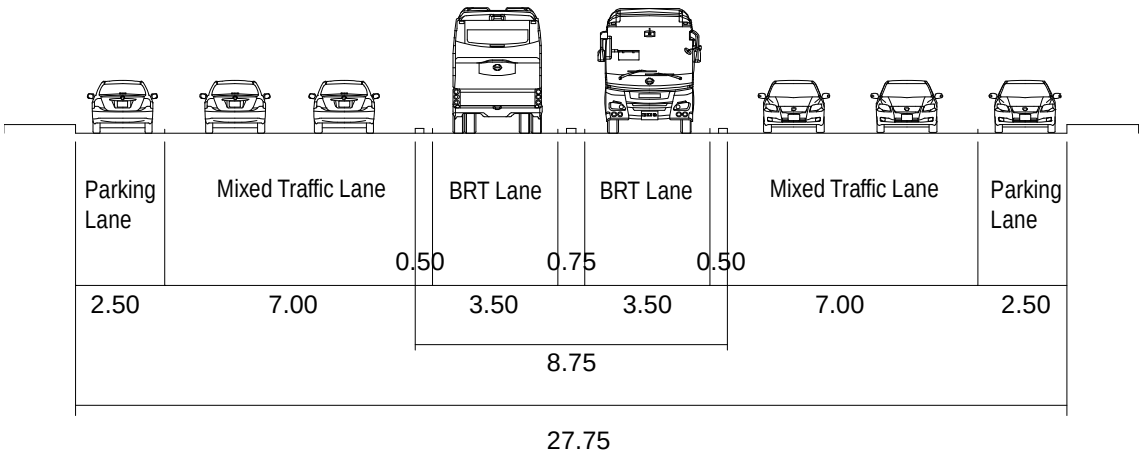


Source: JICA Study Team

Figure 3-3-4 Cross Section at Station (Without Passing Lane)

3.3.3 Cross Section between Stations

Figure 3-3-5 shows the cross section between stations where parking demand along the road exists. The necessary width is 27m. If parking lanes are not provided, the width can be reduced to 23m.



Source: JICA Study Team

Figure 3-3-5 Cross Section between Stations (With Parking Lanes)

3.4 Vehicle Type

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

3.5 Demand Forecast

3.5.1 Present Traffic

The number of passengers along major corridors was estimated in detail in "Confirmatory Green Routes Study for Karachi, March 2010". Table 3-5-1 shows the passenger volume per direction per hour along Green Line, Red Line, and M.A. Jinnah Road taken from the result of the estimation in the study.

Table 3-5-1 Present Passenger Volume in a Peak Hour

Corridor	Code	Motorcycle	Bus	Total	Period
Green Line	MB-C39	3,743	4,337	12,913	19:00-20:00
	MB-C70	5,343	9,076	20,156	19:00-20:00
	MB-28	6,720	7,616	24,194	18:00-19:00
	MB-C27	8,174	10,277	23,827	09:00-10:00
	MB-56	4,319	7,011	19,865	08:00-09:00
Red Line	MB-77	429	1,976	2,823	12:00-13:00
	MB-79	2,231	5,021	13,524	18:00-19:00
	MB-80	3,479	15,042	32,262	08:00-09:00
	MB-C78	2,780	14,573	23,376	21:00-22:00
M.A. Jinnah Road	MB-10	7,542	21,340	34,171	19:00-20:00
	MB-C8	4,040	8,445	17,802	18:00-19:00
	MB-C2	1,563	3,599	6,686	18:00-19:00
	MB-C7	1,985	10,982	17,287	09:00-10:00

Source: Confirmatory Green Routes Study for Karachi, March 2010

Bus passenger volume in the peak hour is approximately 10,000 passengers per hour per direction (PHPDT) along Green Line, while the volume is as low as 4,337 in New Karachi (MB-C39). Total passenger volume (the sum of all mode traffic) is approximately 24,000 PHPDT along Green Line.

This means that a standard BRT is enough along Green Line at present.

Bus passenger volume along University Road is as large as 15,000 PHPDT between Rashid Minhas Road and Shaheed-e-Millat Road. However, the volume decreases to 5,000 PHPDT near NED and drops to 2,000 PHPDT after universities. Bus passenger demand slightly exceeds the capacity of a standard BRT. If motorcycle demand is added to public transport, the passenger volume becomes 18,000, which is nearly the capacity of a saturated BRT. Total passenger volume is approximately 32,000 PHPDT at peak section along Red Line. If public transport needs to satisfy traffic demand of all modes along Red Line, a standard BRT is not enough although this case needs not to be considered.

Bus passenger volume is as large as 21,000 PHPDT along M.A.Jinnah Road in front of Quaid-e-Azam Mausoleum, which exceed the capacity of most BRT systems except for TransMillenio in Bogota. However, boarding and alighting demand is not so high at this point and the passenger volume is the sum of traffics toward Surjani, Super Highway, and University Road. In other words, passing demand is the majority of these passengers and a standard BRT will be capable of this demand.

On the other hand, bus passenger demand drops to 8,500 PHPDT near Garden Square and 3,600 near Cloth Market. This is not the result of the demand. Rather, this is the result of constraints from the heavy congestion along M.A. Jinnah Road. Bus passenger volume is 11,000 in the one-way section of M.A. Jinnah Road between Tower and City Park.

Not all bus passengers will shift to BRT. Some passengers will remain in mixed traffic using feeder services. From this, a standard type of BRT is enough for public transport under the present traffic demand.

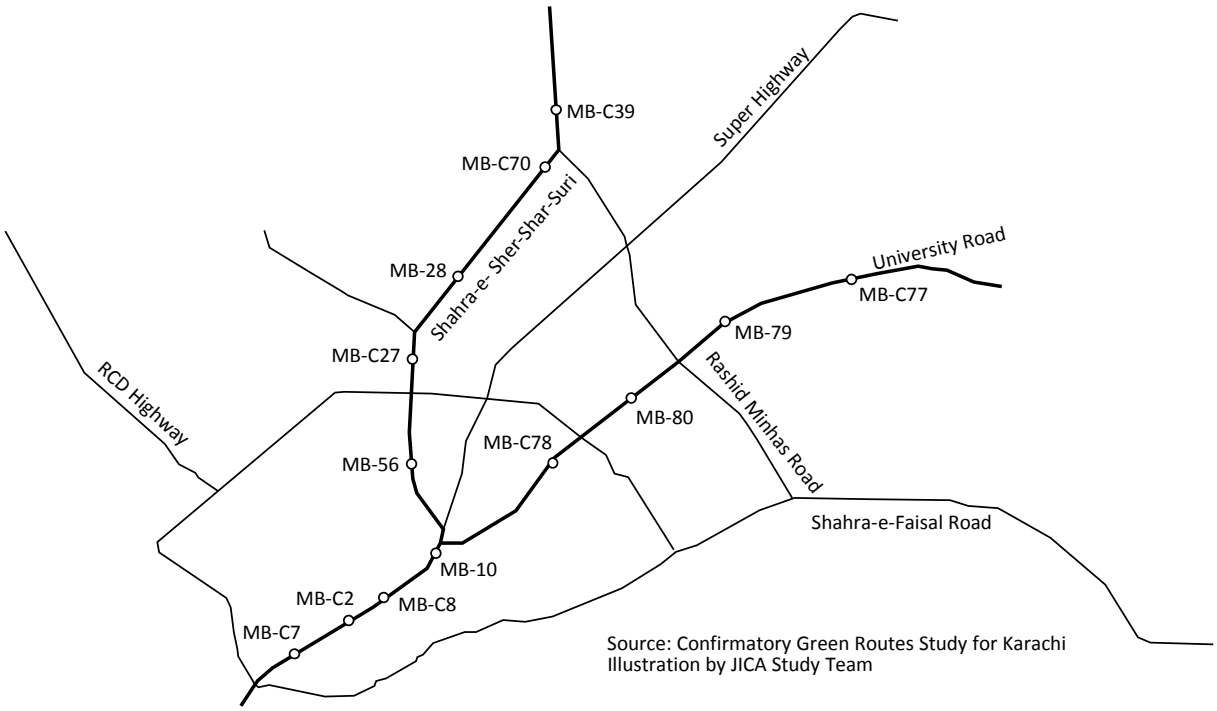


Figure 3-5-1 Survey Locations in Confirmatory Green Routes Study for Karachi

3.5.2 Future Traffic Methodology

(1) OD Matrices

Passenger demand of BRT was estimated by the traffic assignment using the network model developed in Master Plan Stage. The JICA-STRADA format was used for the traffic assignment.

There are five OD matrices prepared in Master Plan Stage as shown in the table below. For the demand forecast, OD matrices of (B) and (C) were used.

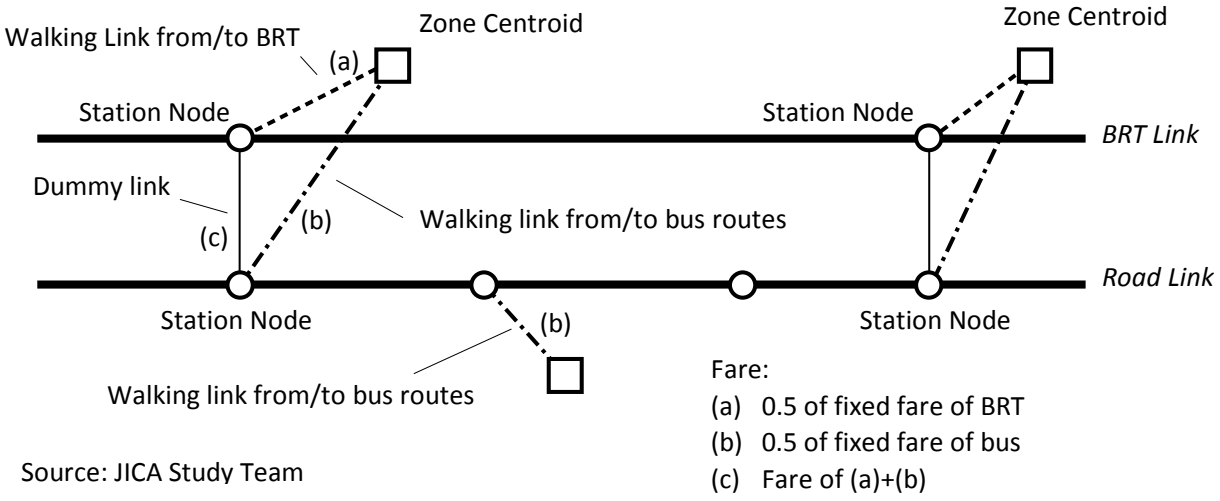
Table 3-5-2 OD Matrices

Scenario	2010	2020	2030
Without public transport development	(A)	(B)	(C)
With public transport development	--	(D)	(E)

Source: JICA Study Team

(2) Assignment Type

There are two types of traffic assignment: highway type assignment and transit type assignment. Modeling of public transport routes by highway type assignment is too simple for transit services that have fixed routes and complex fare system to estimate the passenger volume. Therefore, it is better to apply a transit type assignment for the estimation of the passenger volume of BRT. However, modeling of transit network in the traffic assignment mode requires the future plan of transit network which has not been proposed yet. At this beginning stage of BRT planning, the highway type assignment was used. The technique of modeling is illustrated in the figure below. In the demand forecast, it was assumed that passengers need to pay additional fare every time of transfers. There is a restraint in the model about the locations of stations because a zone centroid represents a traffic zone which is as same as UC.



Source: JICA Study Team

Figure 3-5-2 Network Modeling of BRT Lines in Highway Type Assignment

(3) Volume and Speed Relationship (QV)

The volume and speed relationship (QV) of road links are as same as the network model developed in Master Plan Stage (Chapter 5 of Interim Report-1). However, the maximum speed of buses was set as 17km/h based on Confirmatory Green Routes Study for Karachi (2010). In Interim Report-2, the QV function of the passenger capacity of 20,000 PHPDT was applied assuming that the standard BRT would be introduced. However, after the finalization of BRT system, the QV formula was reviewed and the flat-type QV formula of a capacity of 12,000 PHPDT at a speed of 25km/h was applied. In this QV formula, the speed is fixed at 25km/h but the like is blocked when the passenger volume exceeds 12,000 PHPDT. The proposed BRT system can carry more than 12,000 passengers per hour but the speed of 25km/h will not be possible. In order to maintain the level of services, the BRT lanes should not be overloaded by buses. The traffic demand forecast considered this capacity constraint. Since the OD matrix in this study is a daily base, the capacity

of the QV was set at the equivalent of 320,000 (12,000/0.075).

(4) Value of Time

To convert the fare to time in the assignment, a logit model for bus and BRT selection was developed based on the result of the passenger interview survey. The parameter for the time valuable (in minutes) was -0.03826 (a) while that of the fare parameter (in Rs.) was -0.05745 (b). From this, the time value factor (time/cost) was estimated as (b)/(a) = 1.5 minutes per rupee.

If BRT is more comfortable than existing minibuses, more passengers will shift to BRT even if it takes more time and higher fare. The logit model gives a constant value for mode choice although this is based on the comparison between a minibus and a railway system. The constant value was calculated as Rs. 15 equivalent. Passengers' preference to use BRT compared to minibus is smaller than that of railway systems. Therefore, actual demand is found between the constant values of 0 and Rs. 15. For the demand forecast, Rs.10 was charged for buses.

(5) Fare Setting

In Interim Report-2, the BRT fare was set as Rs. 15 and no additional fare was charged for the transfer between BRT and other buses because it assumed direct services. After the finalization of BRT system, the BRT fare was set at a flat fare of Rs. 20 but the fare was not integrated with other buses. It was assumed that the fare of railway network is a flat fare of Rs. 30. The fare of railway systems and buses were separated and additional fare would be charged for the transfer between railway network and bus network.

(6) Network Scenario

The traffic assignment network was prepared for five network scenarios.

(A) Green & Red Lines on the present road network (2010)
(B) Master Plan (M/P) network (2020).
(C) M/P network (2020) without KCR
(D) M/P network (2030)
(E) Green & Red Lines + KCR on the 2030 road network

Road network is assumed to be developed as proposed in the M/P as shown in Table 3-5-3. Road capacity was reduced from the M/P along BRT routes assuming that two lanes (one lane each) are removed.

Table 3-5-3 Arterial Road Length in Master Plan

Year	Expressway	Highway	Principal Highway	Minor Arterial	Total
2010	25.6	173.2	157.2	527.9	884
2020	35.8	173.2	199.8	547.7	956.5
2030	76.9	257.2	229.1	609.2	1,172.4

Source: The Study for KTIP

In the M/P network, KCR is included in 2020 network while Blue Line and Brown Line are included in 2030 network as railway system. For the network in 2020, "Without KCR" scenario was prepared (C). This is the case when only Green & Red Line are developed as mass transit system by 2020. The scenario (E) is the case when no mass transit system is implemented after Green & Red Lines and KCR by 2030.

In addition to above scenarios, the following scenarios were prepared for the "Without Project" analysis.

- M/P network (2020) without Green & Red Lines

- M/P network (2030) without Green & Red Lines

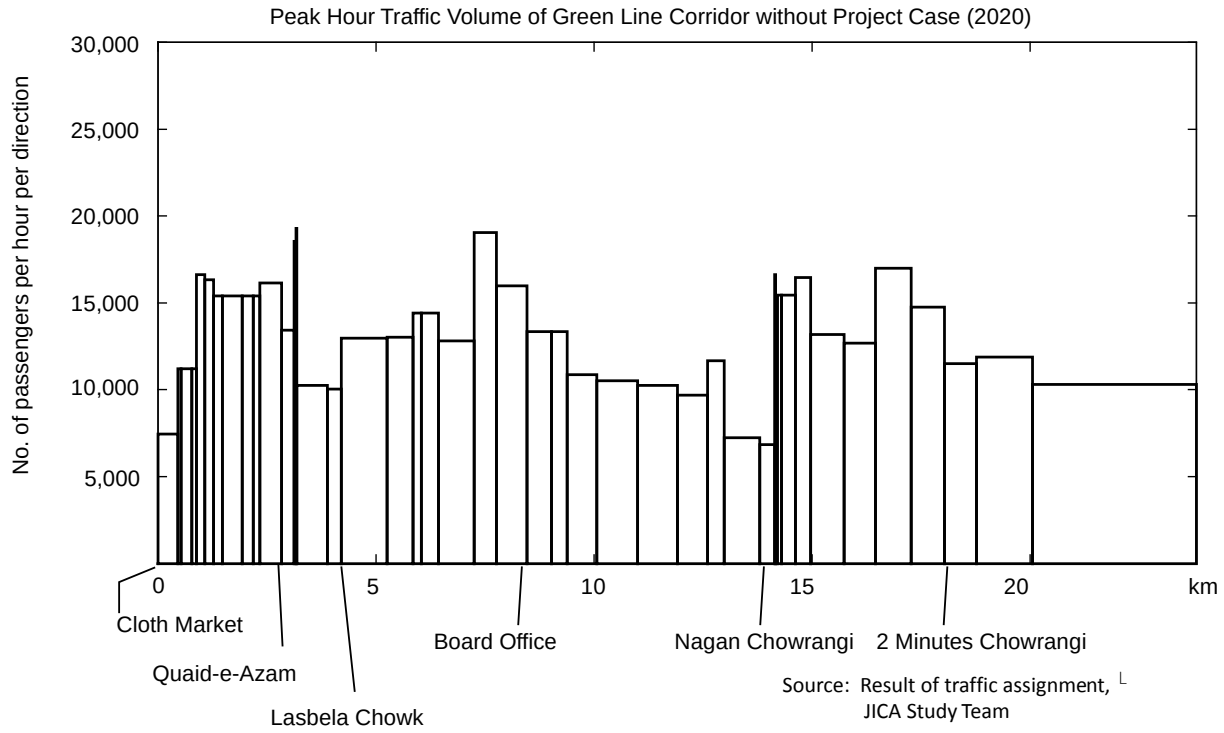
3.5.3 Without Project Case

(1) Without Green Line and Red Line

Figure 3-5-3 shows the projected number of bus passengers of the corridor of Green Line in 2020 without the BRT project, while Figure 3-5-4 shows that of the corridor of Red Line in the same conditions. Each bar represents the traffic of a link in JICA STRADA data.

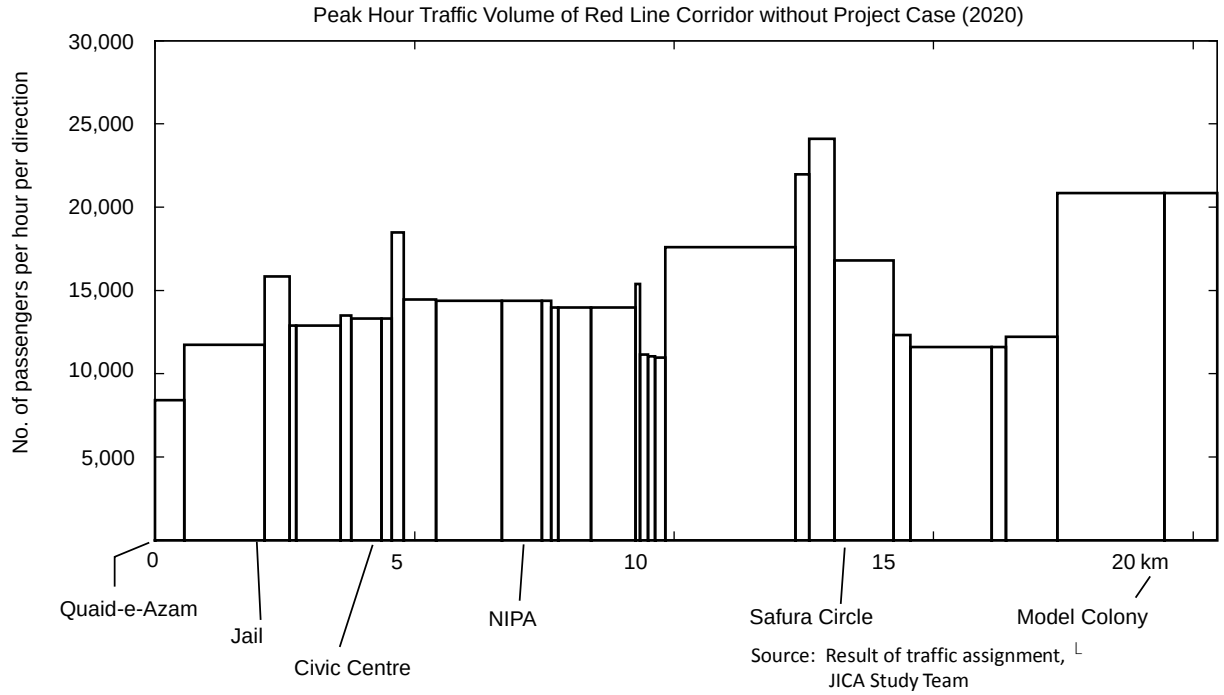
The figure illustrates the number of bus passengers per hour per direction in the peak hour. The demand exceeds the capacity of standard BRT systems (10,000 PHPDT) at some links along Green Line.

Bus passenger demand exceeds 15,000 PHPDT in most sections along University Road. The demand characteristics along Red Line are quite different from the present situation in which traffic demand rapidly becomes low in the east of universities. In 2020, the demand becomes high in the east of the corridor near Model Colony.



Source: JICA Study Team

Figure 3-5-3 Bus Passenger Demand along Green Line (2020), without Project Case



Source: JICA Study Team

Figure 3-5-4 Bus Passenger Demand along Red Line (2020), without Project Case

3.5.4 Results of Demand Forecast of Green & Red Lines

(1) Green & Red Lines on the present road network (2010)

This is the result of the demand forecast of Green & Red Lines in 2010 if these BRT lines existed at present.

Passenger volume per hour per direction of Green Line would be 2,000-5,000 PHPDT (peak hour peak direction traffic) between Quaid-e-Azam Mausoleum and 2-minutes Chowrangi as shown in Figure 3-5-5. The volume would be smaller in the north section of North Nazimabad and New Karachi at 2,000-4,000 PHPDT. From Surjani to the north area, the volume would be as small as approximately 1,000 PHPDT. The volume along M.A. Jinnah Road up to Quaid-e-Azam Mausoleum would be approximately 3,000 PHPDT. This is smaller than the peak section because not all passengers along Green Line go through M.A. Jinnah Road.

The passenger volume of Red Line would be 3,000-3,500 PHPDT between Jail Road and NIPA. The volume between NIPA and NED would be approximately 3,500 PHPDT. From NED to the east along University Road, the volume would be smaller than other sections as approximately 2,500 PHPDT. The volume along New M.A. Jinnah Road and Preedy Street would be approximately 1,500 PHPDT.

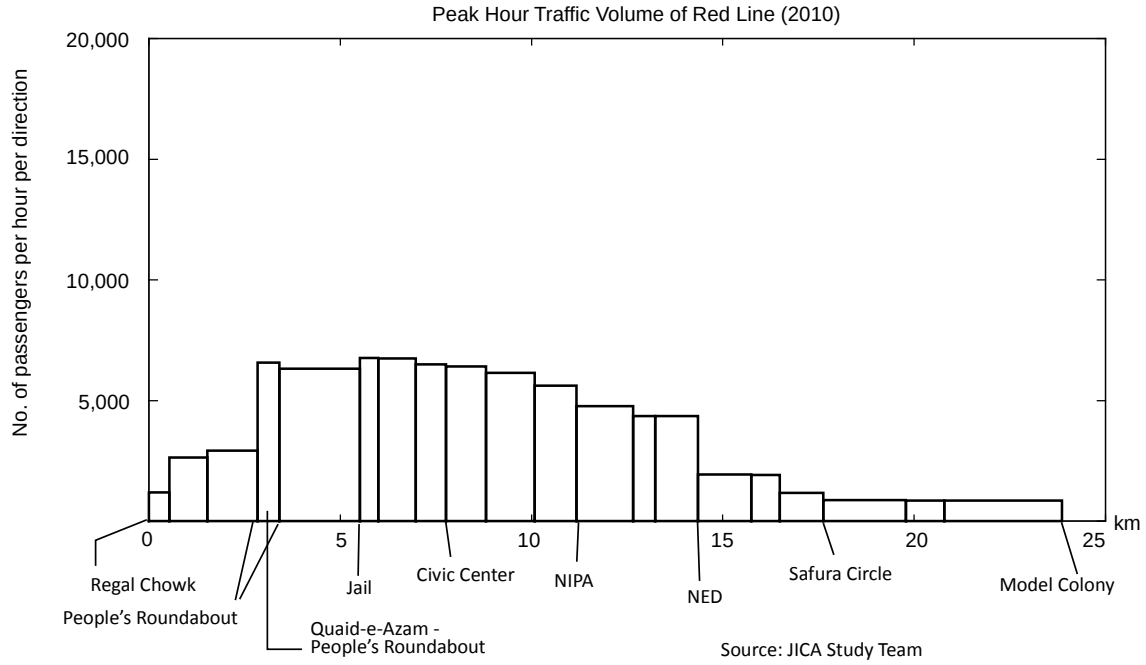
The demand forecast shows that passenger volume in Saddar Area is smaller than other peak sections. Since the length of BRT lines in Saddar Area is short, it cannot attract those passengers whose origin and destination are not along Green or Red Line outside Saddar Area. Note that fare integration between BRT lines and other lines is not considered in the demand forecast. Therefore, passengers transferring existing system and BRT lines need to pay extra fare while transfer between Green and Red Lines is free in the demand forecast model.

Since the capacity is determined in the QV formula for each link of the BRT lines, the result of the

forecast of traffic volume does not exceed the capacity.

Source: JICA Study Team

Figure 3-5-5 Peak Hour Traffic Volume of Green Line (2010)



Source: JICA Study Team

Figure 3-5-6 Peak Hour Traffic Volume of Red Line (2010)

(2) Master Plan network (2020)

This is the case of the M/P network. Green & Red Lines and Karachi Circular Railway (KCR) are developed as mass transit system and road projects in the M/P in 2020 are completed in this case. Figure 3-5-7 and 3-5-8 shows the result of traffic demand forecast in 2020 for Green Line BRT and

Red Line BRT, respectively.

Passenger volume of Green Line would be 8,000-13,000 PHPDT between Quaid-e-Azam Mausoleum and Surjani. Passenger volume from Surjani to the north area would increase to 5,000 - 6,000 PHPDT because of population increase in Gadap.

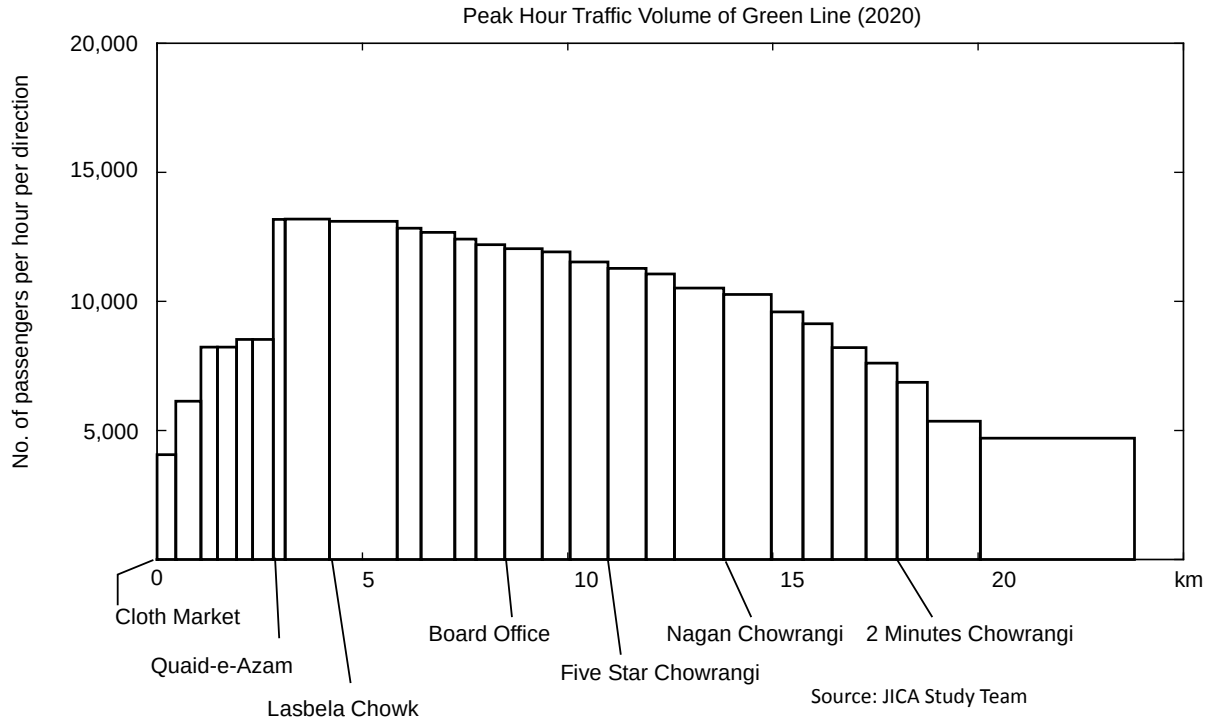
Passenger volume of Red Line would be 10,000 – 13,000 PHPDT along University Road up to Malir Gate, while it is approximately 8,300 PHPDT between Malir Gate and Model Colony. Compared to the demand in 2010, the passenger volume by section would become flat. This is because of the estimated population and industrial growth in Bin Qasim which will increase traffic demand for the east west corridor along Shahrah-e-Faisal and National Highway.

(3) M/P network (2020) without KCR (2020)

This is the case when Green & Red Lines are developed but KCR does not exist in 2020. Road projects by 2020 in the M/P are included. The difference from M/P network (2020) is the absence of KCR. Figure 3-5-9 and 3-5-10 show the results.

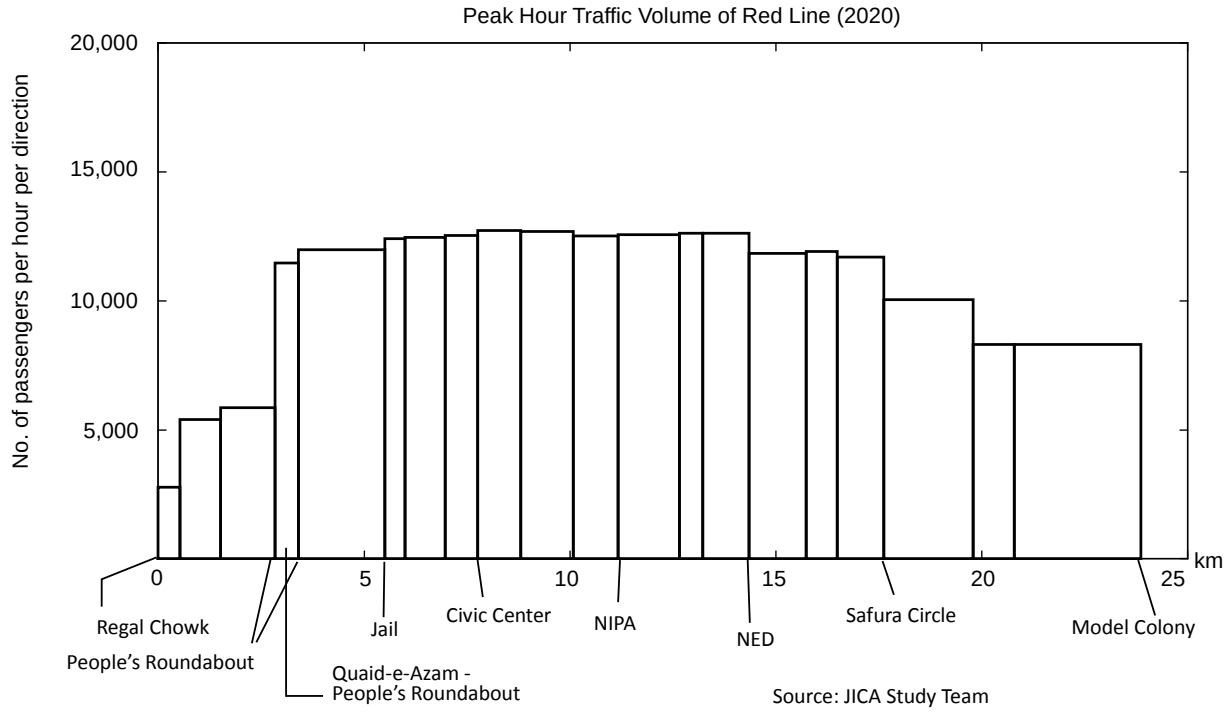
Passenger volume of Green Line in North Nazimabad, New Karachi, and the north area would be almost the same as the M/P network (2020) case. However, passenger volume of Green Line from Board Office to Surjani would be 15% smaller than the M/P network (2020) case.

Passenger volume of Red Line will increase by approximately 10% along University Road if KCR does not exist. This is because of KCR has a parallel section with University Road. KCR passengers between North Nazimabad Station and NIPA Station would shift Green and Red Line in case of the absence of KCR. In this case, passengers need to transfer between the two lines.



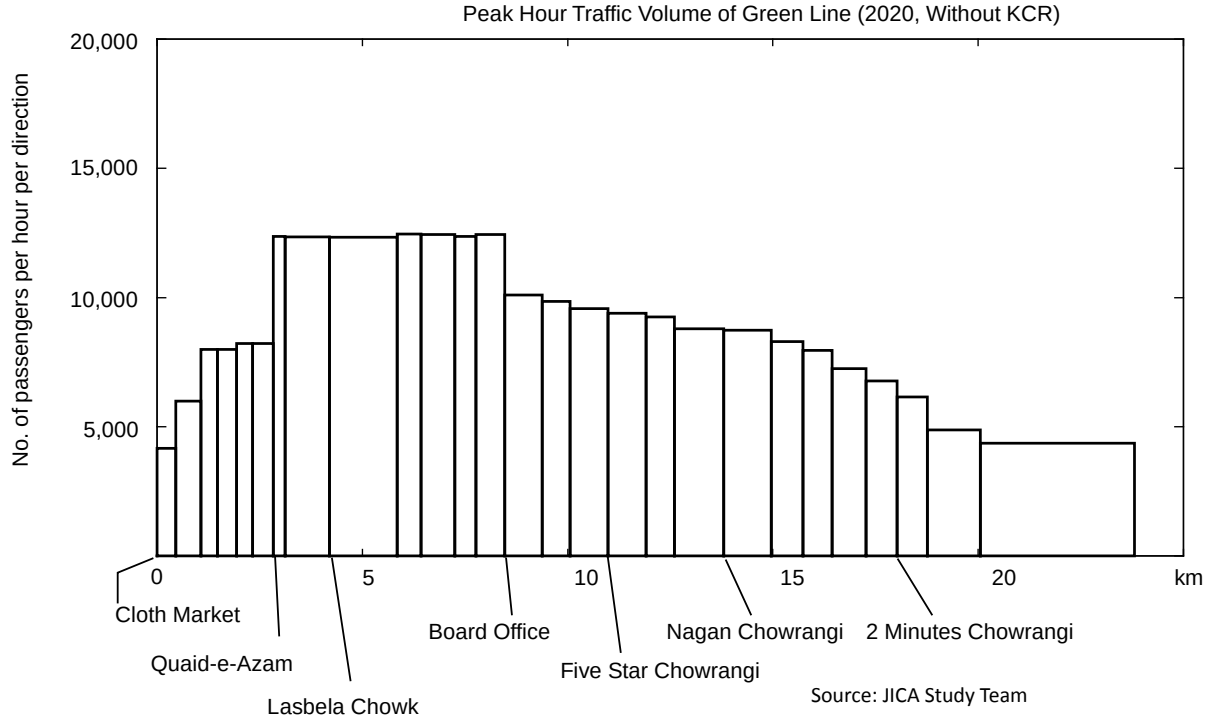
Source: JICA Study Team

Figure 3-5-7 Peak Hour Traffic Volume of Green Line (2020)



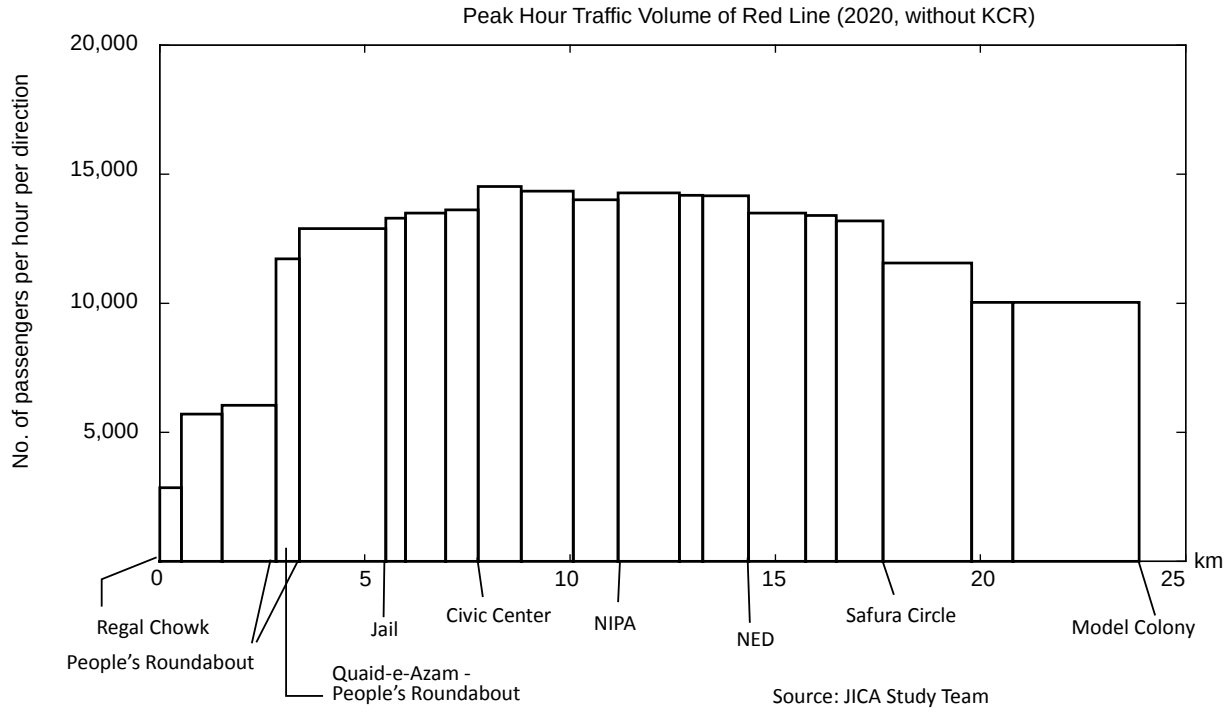
Source: JICA Study Team

Figure 3-5-8 Peak Hour Traffic Volume of Red Line (2020)



Source: JICA Study Team

Figure 3-5-9 Peak Hour Traffic Volume of Green Line (2020)



Source: JICA Study Team

Figure 3-5-10 Peak Hour Traffic Volume of Red Line (2020)

(4) M/P network (2030)

Blue Line and Brown Line are developed as railway system in addition to KCR by 2030 in M/P network (2030) scenario. The length of arterial roads is 1,172km.

Figure 3-5-11 shows the passenger volume of Green Line in 2030. The passenger volume between Nagan Chowrangi and Surjani would become larger than that of 2020 (M/P). However, there would be a drop in passenger volume between Board Office and Nagan Chowrangi. The volume becomes 9,000-10,000 PHPDT in this section. Since Blue Line, which run through Super Highway, Shahrah-e-Pakistan, and M. A. Jinnah Road provides quick access to the center of the city, traffic from New Karachi and its northern area will shift to Blue Line via Brown Line. In the traffic assignment, many bus passengers will remain in mixed traffic because of the increase in travel speed along the corridor by Blue Line. Passenger volume between Quaid-e-Azam Mausoleum and Board Office is 11,000-12,000 PHPDT.

Figure 3-5-12 shows the passenger volume of Red Line in 2030. Passenger volume between Quaid-e-Azam Mausoleum and NED is smaller than that of 2020 projection by approximately 18%. The volume is approximately 9,000-10,000 in this section. The volume between NED and Safura Circle is approximately 9,000 PHPDT, which is also smaller than that in 2020 projection. The volume near Model Colony is 35% smaller than the 2020 projection. This is because of development of Blue Line and Brown Line. KCR extension and other BRT lines also contribute to the reduction of the passenger volume of Red Line.

Note that the capacity of BRT links is set as 12,000 PHPDT and the volume-speed relationship is as given in Figure 3-5-3, considering that a standard BRT would be suitable in Karachi. If a full scale BRT like Bogota is introduced, the passenger demand would be higher than this forecast.

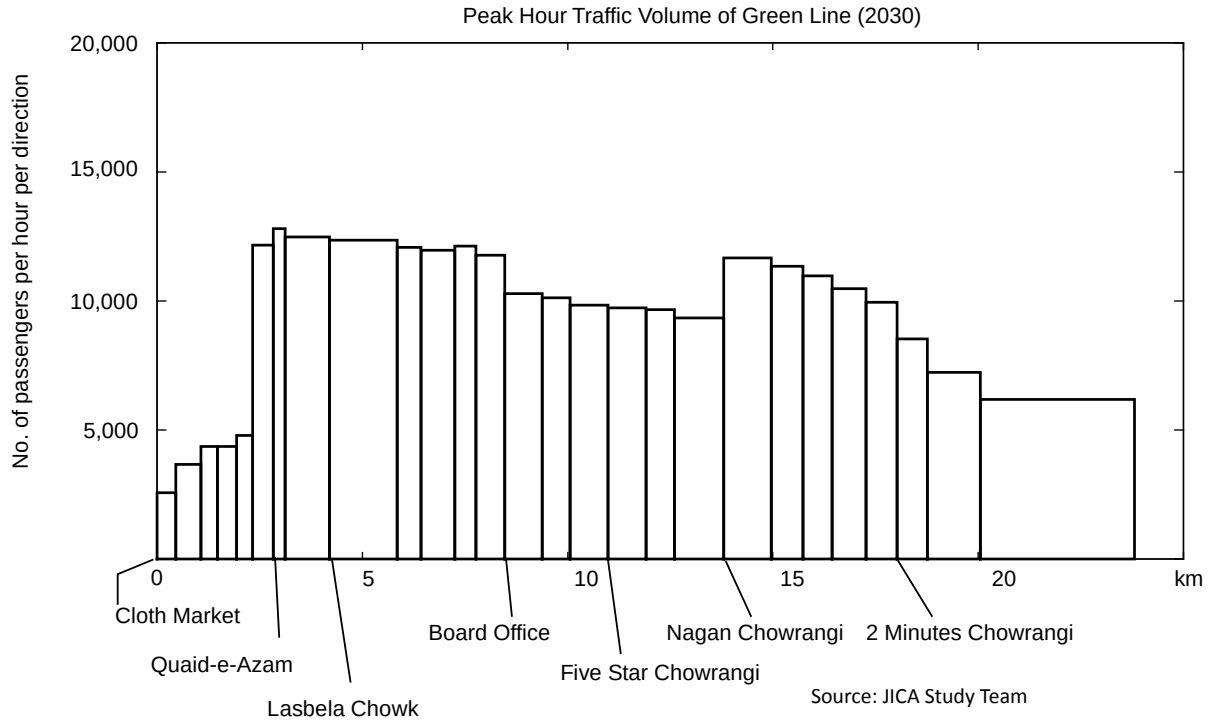
(5) Green & Red Lines + KCR on the 2030 road network (2030)

In this case, Green Line, Red Line and KCR exist in 2030 but no other mass transit system is implemented by 2030 while road projects are implemented as the M/P.

Figure 3-5-13 shows the passenger volume of Green Line in this case. Passenger volume is larger than that of 2020 projection for all sections. It is 10,000-12,000 for most sections.

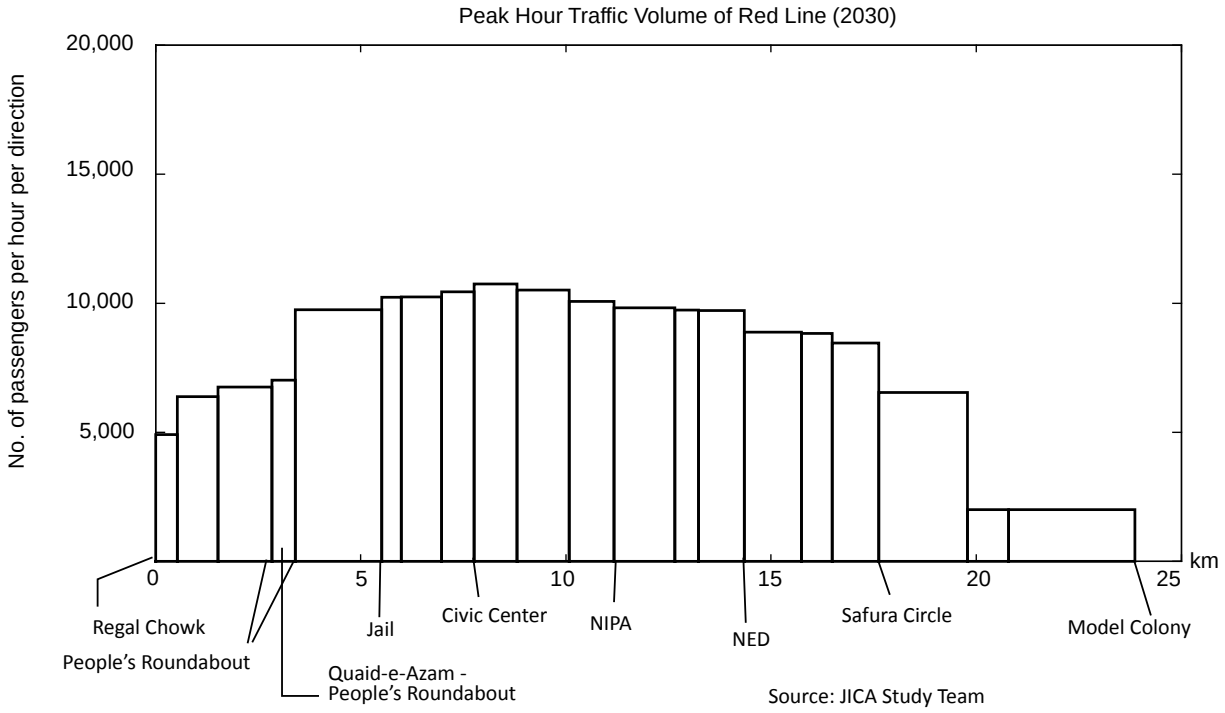
Figure 3-5-14 shows the passenger volume of Red Line in this case. Passenger volume is almost the same as that of 2020 projection for most sections. Passenger volume near Model Colony shows a reduction by 50%. This is because of road development such as Malir Expressway which will reduce traffic congestion for the east-west corridor.

Figure 3-5-15 and 3-5-16 show the passenger volume of mass transit system in 2020 and 2030, respectively.



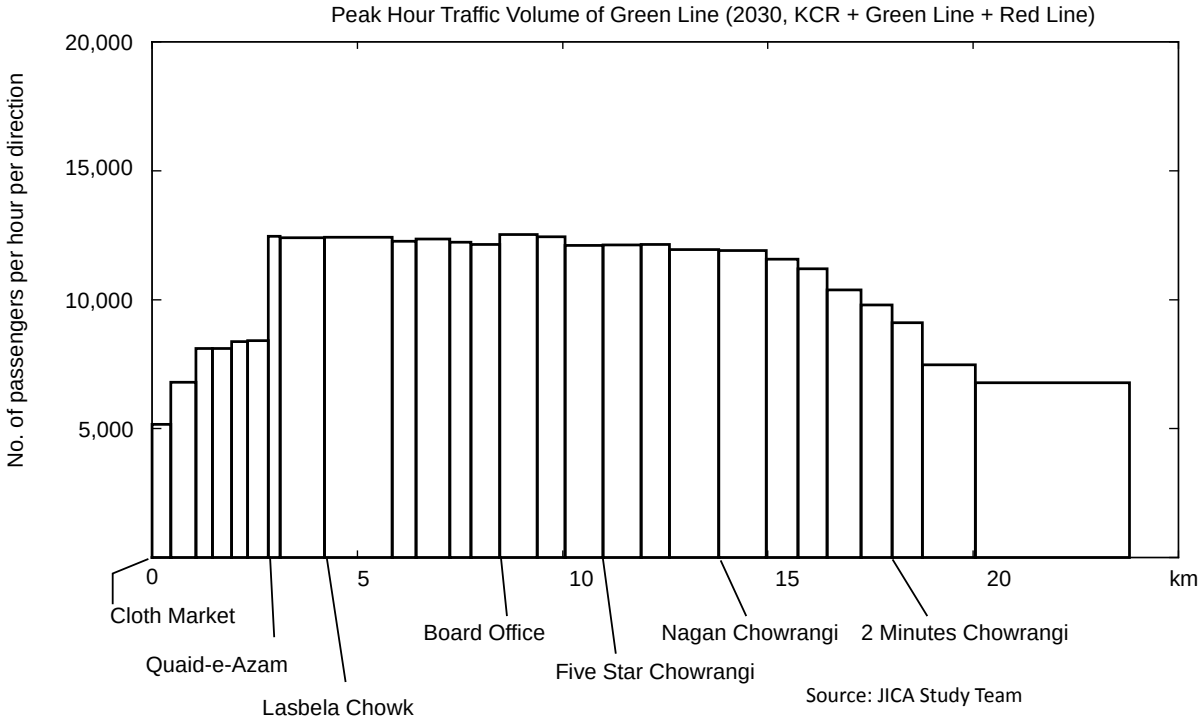
Source: JICA Study Team

Figure 3-5-11 Peak Hour Traffic Volume of Green Line (2030)



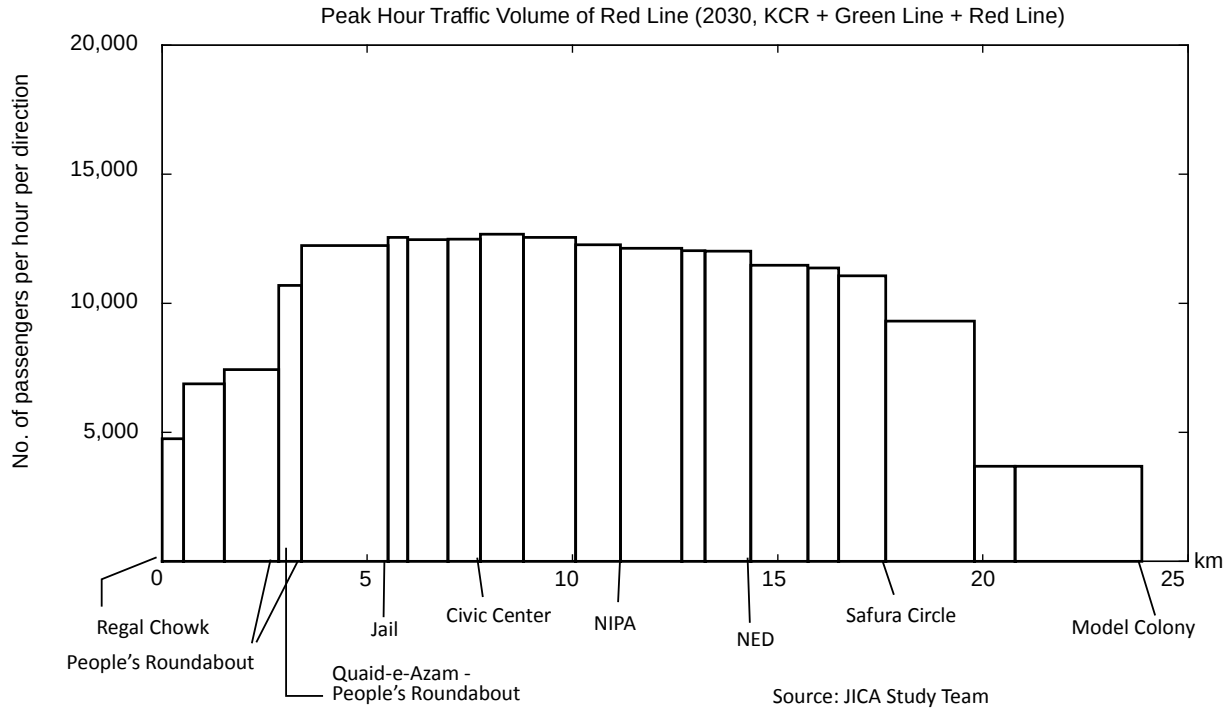
Source: JICA Study Team

Figure 3-5-12 Peak Hour Traffic Volume of Red Line (2030)



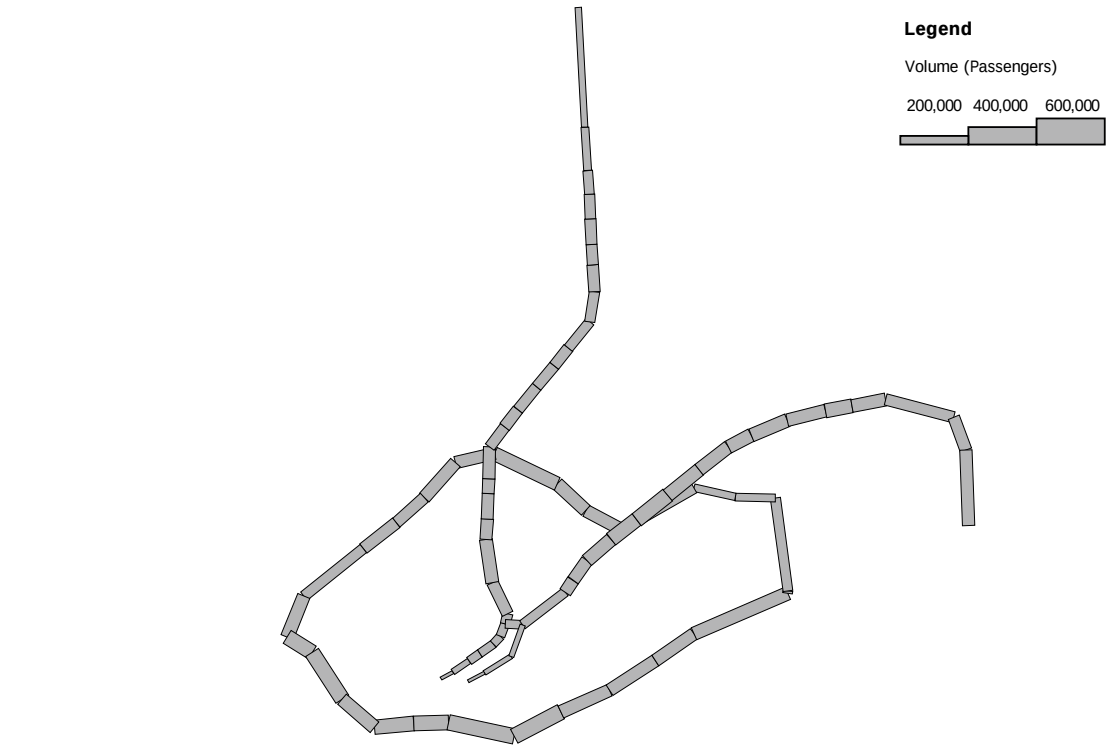
Source: JICA Study Team

Figure 3-5-13 Peak Hour Traffic Volume of Green Line (2030)



Source: JICA Study Team

Figure 3-5-14 Peak Hour Traffic Volume of Green Line (2030)



Source: The Study for KTIP

Figure 3-5-15 Result of Demand Forecast in 2020 for Mass Transit

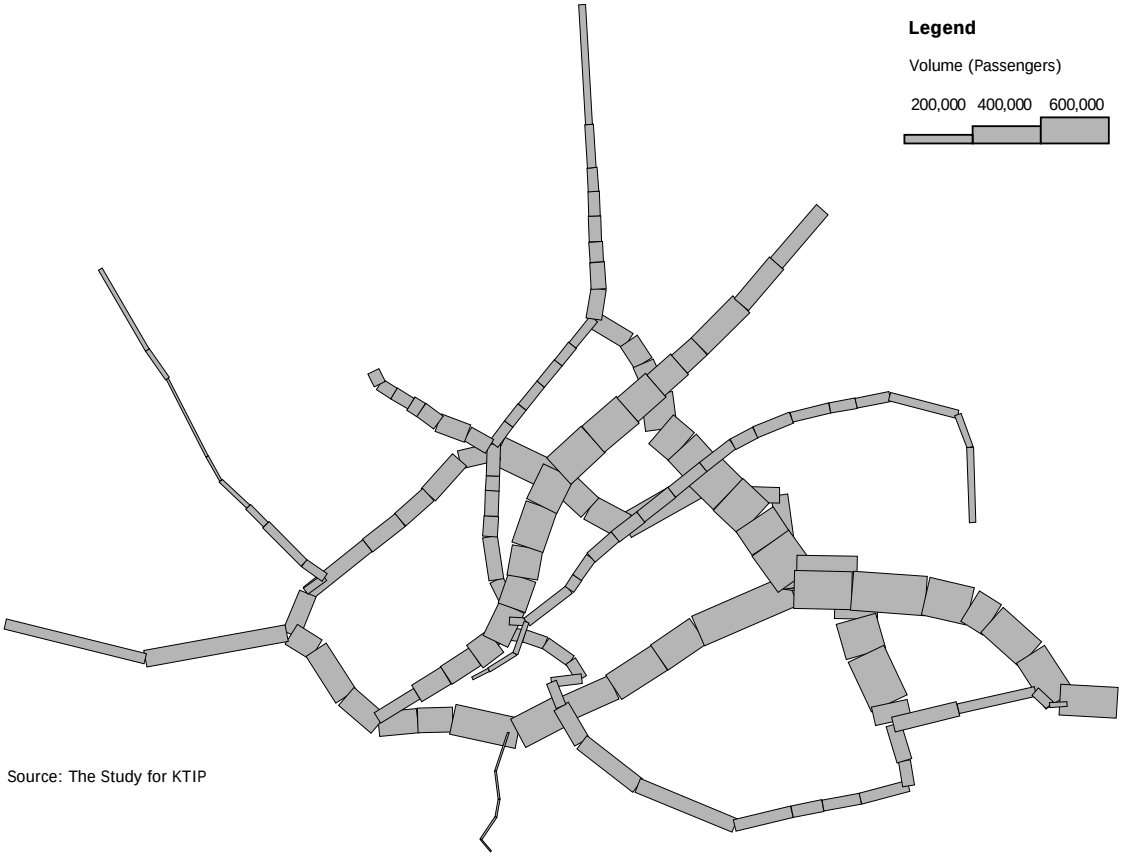


Figure 3-5-16 Result of Demand Forecast in 2030 for Mass Transit

3.5.5 Traffic Volume Data of the Demand Forecast

Table 3-5-4 shows the result of the demand forecast of the daily passenger volume (both directions) of Green Line and Red Line for the five scenarios. This is computed by traffic assignment using daily OD matrices. The codes in the section column represent station codes.

Table 3-5-5 shows the peak hour passenger volume per direction. This was calculated from the daily traffic volume assuming the peak hour rate of 7.5% per direction.

Table 3-5-6 shows the result of the demand forecast of the number of passenger boarding at stations. The total number of passenger boarding is 370,000 in 2010, 733,000 in 2020, and 1.26 million in 2030. The number of daily passenger boarding was used for revenue calculation.

Table 3-5-7 shows the passenger boarding and alighting at stations in peak hour. The peak hour rate of 7.5% was used to calculate the volume.

3.5.6 Passenger Shift from Present Road

BRT will be constructed in existing roads and a part of passengers using a road section will shift to the BRT in the same section. Although BRT passengers will come from not only the same road but also other roads, the majority would be the passengers from the same section. To calculate how many passengers who are using a road section in without BRT case will shift to BRT in the same road section in with BRT case, OD data of each link was prepared by incremental traffic assignment method. The assigned volume to a BRT link was aggregated as the shift traffic if the same OD of the same mode was also assigned to the road link where the BRT link was introduced. The following is the formula to calculate the shift.

$$VS^{k} = \sum_{i=1}^{N} \sum_{m=1}^{M} \sum_{s=1}^{Z} \sum_{e=1}^{Z} V_{i,m}^{k}[s,e] \times \delta_{i,m}^{k}[s,e]$$

Where, VS^k = passenger volume of the shift from road to BRT link k, N= No. of iterations of incremental assignment, M = No. of travel modes, Z= No. of zones, $V_{i,m}^k[s,e]$= passenger volume from origin s to destination e by mode m assigned to link k in iteration of i, $\delta_{i,m}^k[s,e]$= 1 if passenger volume from origin s to destination e by mode m is assigned to the road link parallel to link k and 0 if not.

Table 3-5-8 and 3-5-9 shows the result of the calculation for 2010 and 2020, respectively. From this, approximately 40-70% of bus passengers will shift to BRT while 3-10% of motorcycle and car passengers will shift to BRT. Note that in the traffic assignment, it was assumed that motorcycle and car passengers would not use feeder bus system. Therefore, only OD pairs which are directly connected by BRT links were assigned in case of motorcycle and bus passengers.

The result shows that not all passengers will shift to BRT. Capacity limitation of BRT is one of the reasons. If more passengers use the BRT, it is necessary to increase the BRT capacity which will reduce the travel speed of BRT.

Table 3-5-4 Daily Passenger Volume (Both Directions)

Section	2010	2020		2030	
	Green&Red	Green&Red +KCR	Green&Red only	M/P Network	Green&Red +KCR
Green Line					
M1 - M2	27,331	108,576	111,176	68,591	137,886
M2 - M3	50,652	163,869	159,635	98,152	181,132
M3 - M4	60,626	219,570	213,086	116,576	216,460
M4 - M5	64,356	227,498	219,097	127,526	223,614
M5 - G01	64,356	227,498	219,097	324,218	224,376
G01 - G02	99,988	351,322	329,634	341,679	331,913
G02 - G03	92,630	351,803	329,187	332,852	330,689
G03 - G04	105,650	349,676	328,967	329,743	331,430
G04 - G05	107,604	342,338	332,130	322,007	326,906
G05 - G06	111,780	337,996	331,825	319,421	329,414
G06 - G07	116,056	331,097	329,879	323,692	326,072
G07 - G08	113,491	325,385	331,569	314,107	323,818
G08 - G09	118,665	321,376	269,543	274,452	333,970
G09 - G10	119,608	317,880	262,673	269,905	331,772
G10 - G11	117,519	307,462	255,031	262,488	322,763
G11 - G12	112,723	300,958	250,234	259,553	323,357
G12 - G13	112,371	294,944	246,776	257,933	323,765
G13 - G14	98,061	280,266	234,292	249,359	318,555
G14 - G15	96,659	273,816	233,175	311,136	317,481
G15 - G16	92,053	255,923	221,088	302,777	308,643
G16 - G17	89,519	243,757	212,219	293,032	298,653
G17 - G18	79,153	218,931	193,416	279,485	276,881
G18 - G19	64,177	202,752	180,420	265,497	261,234
G19 - G20	43,622	183,059	163,954	227,668	242,607
G20 - G21	24,514	142,839	130,044	193,148	199,210
G21 - G22	15,966	125,190	116,540	165,327	181,014
Red Line					
P1 - P2	16,383	73,929	76,406	131,002	126,860
P2 - P3	35,335	144,188	152,647	170,098	183,761
P3 - R02	39,290	156,145	161,530	180,026	198,487
R01 - R02	91,495	305,943	312,655	186,971	285,196
R02 - R03	88,770	319,558	343,745	259,949	326,565
R03 - R04	94,971	330,721	354,953	272,817	334,848
R04 - R05	94,941	332,169	360,123	272,954	332,411
R05 - R06	91,392	334,209	363,184	278,360	333,044
R06 - R07	90,064	339,391	387,292	286,537	338,479
R07 - R08	85,549	338,727	382,556	280,030	334,805
R08 - R09	78,424	333,843	373,503	268,320	327,285
R09 - R10	66,424	335,472	380,595	261,901	323,547
R10 - R11	61,339	336,729	378,565	259,313	321,120
R11 - R12	61,339	336,546	378,184	259,125	320,938
R12 - R13	26,327	315,611	359,950	236,960	305,918
R13 - R14	26,193	317,730	357,840	235,219	303,462
R14 - R15	15,629	311,832	351,940	225,203	295,250
R15 - R16	11,716	267,839	308,345	174,579	248,537
R16 - R17	11,412	221,604	267,932	53,359	98,408
R17 - R18	11,412	221,604	267,932	53,359	98,408

Source: The Study for KTIP

Table 3-5-5 Peak Hour Passenger Volume per Direction

Section	2010	2020		2030	
	Green&Red	Green&Red +KCR	Green&Red only	M/P Network	Green&Red +KCR
Green Line					
M1 - M2	1,025	4,072	4,169	2,572	5,171
M2 - M3	1,899	6,145	5,986	3,681	6,792
M3 - M4	2,273	8,234	7,991	4,372	8,117
M4 - M5	2,413	8,531	8,216	4,782	8,386
M5 - G01	2,413	8,531	8,216	12,158	8,414
G01 - G02	3,750	13,175	12,361	12,813	12,447
G02 - G03	3,474	13,193	12,345	12,482	12,401
G03 - G04	3,962	13,113	12,336	12,365	12,429
G04 - G05	4,035	12,838	12,455	12,075	12,259
G05 - G06	4,192	12,675	12,443	11,978	12,353
G06 - G07	4,352	12,416	12,370	12,138	12,228
G07 - G08	4,256	12,202	12,434	11,779	12,143
G08 - G09	4,450	12,052	10,108	10,292	12,524
G09 - G10	4,485	11,921	9,850	10,121	12,441
G10 - G11	4,407	11,530	9,564	9,843	12,104
G11 - G12	4,227	11,286	9,384	9,733	12,126
G12 - G13	4,214	11,060	9,254	9,672	12,141
G13 - G14	3,677	10,510	8,786	9,351	11,946
G14 - G15	3,625	10,268	8,744	11,668	11,906
G15 - G16	3,452	9,597	8,291	11,354	11,574
G16 - G17	3,357	9,141	7,958	10,989	11,199
G17 - G18	2,968	8,210	7,253	10,481	10,383
G18 - G19	2,407	7,603	6,766	9,956	9,796
G19 - G20	1,636	6,865	6,148	8,538	9,098
G20 - G21	919	5,356	4,877	7,243	7,470
G21 - G22	599	4,695	4,370	6,200	6,788
Red Line					
P1 - P2	614	2,772	2,865	4,913	4,757
P2 - P3	1,325	5,407	5,724	6,379	6,891
P3 - R02	1,473	5,855	6,057	6,751	7,443
R01 - R02	3,431	11,473	11,725	7,011	10,695
R02 - R03	3,329	11,983	12,890	9,748	12,246
R03 - R04	3,561	12,402	13,311	10,231	12,557
R04 - R05	3,560	12,456	13,505	10,236	12,465
R05 - R06	3,427	12,533	13,619	10,439	12,489
R06 - R07	3,377	12,727	14,523	10,745	12,693
R07 - R08	3,208	12,702	14,346	10,501	12,555
R08 - R09	2,941	12,519	14,006	10,062	12,273
R09 - R10	2,491	12,580	14,272	9,821	12,133
R10 - R11	2,300	12,627	14,196	9,724	12,042
R11 - R12	2,300	12,620	14,182	9,717	12,035
R12 - R13	987	11,835	13,498	8,886	11,472
R13 - R14	982	11,915	13,419	8,821	11,380
R14 - R15	586	11,694	13,198	8,445	11,072
R15 - R16	439	10,044	11,563	6,547	9,320
R16 - R17	428	8,310	10,047	2,001	3,690
R17 - R18	428	8,310	10,047	2,001	3,690

Source: The Study for KTIP

Table 3-5-6 Daily Passenger Volume of Boarding Only

Code	Station	2010	2020		2030	
		Green&Red	Green&Red +KCR	Green&Red only	M/P Network	Green&Red +KCR
	Green Line					
R0-01	M1	19,518	32,934	36,436	27,105	68,943
R0-02	M2	17,288	27,648	24,232	28,256	21,624
R0-03	M3	11,225	27,857	26,731	14,415	17,664
R0-05	M4	4,781	3,988	3,030	9,248	4,062
R1-01	G01	10,212	9,470	10,778	25,049	10,974
R1-02	G02	15,400	11,098	7,850	21,324	11,353
R1-03	G03	33,583	19,667	15,069	45,422	23,611
R1-04	G04	14,861	7,137	26,770	22,964	8,549
R1-05	G05	18,129	8,791	10,108	21,829	12,745
R1-06	G06	19,185	11,136	9,318	30,406	13,665
R1-07	G07	13,369	4,709	6,133	13,559	4,893
R1-08	G08	17,284	17,982	35,071	17,350	17,556
R1-09	G09	24,927	3,452	4,910	10,126	4,397
R1-10	G10	9,850	6,504	5,117	17,438	6,944
R1-11	G11	13,940	4,195	3,551	8,611	6,920
R1-12	G12	7,967	4,184	2,911	8,351	5,749
R1-13	G13	15,879	8,642	7,710	13,224	13,926
R1-14	G14	9,354	5,127	5,550	6,600	7,394
R1-15	G15	14,374	10,062	7,159	15,460	12,737
R1-16	G16	11,802	6,677	5,029	16,444	6,831
R1-17	G17	12,275	14,225	11,047	16,989	15,903
R1-18	G18	16,610	8,659	7,068	22,876	9,951
R1-19	G19	25,273	10,845	9,231	39,806	14,408
R1-20	G20	21,126	21,434	18,651	31,897	25,033
R1-21	G21	10,630	9,136	7,646	28,116	11,278
R1-22	G22	15,870	62,595	58,270	127,903	90,507
	Red Line					
RZ-00	P1	16,057	36,965	38,203	157,630	63,430
RZ-01	P2	22,301	35,289	29,498	31,978	28,670
RZ-02	P3	9,021	6,091	4,570	12,488	7,586
R3-02	R02	5,241	3,005	2,688	4	4,147
R3-03	R03	13,611	10,731	9,441	21,573	12,614
R3-04	R04	78	4,524	6,094	1,498	5,262
R3-05	R05	39,307	14,635	10,603	32,719	16,485
R3-06	R06	11,611	14,244	20,865	34,585	16,998
R3-07	R07	34,874	17,318	16,146	48,042	18,207
R3-08	R08	29,869	12,282	12,126	31,727	13,484
R3-09	R09	15,248	11,909	12,128	17,647	10,652
R3-10	R10	6,489	5,274	5,240	5,659	2,454
R3-11	R11	0	91	190	96	91
R3-12	R12	35,171	22,938	18,046	61,360	28,961
R3-13	R13	139	5,366	2,551	988	2,981
R3-14	R14	10,004	6,511	5,454	17,328	6,372
R3-15	R15	3,913	31,412	40,990	26,914	26,187
R3-16	R16	304	25,663	23,005	60,636	88,494
R3-17	R17	0	0	0	0	0
R3-18	R18	11,373	110,802	133,966	59,347	49,204

Source: The Study for KTIP

Table 3-5-6 Peak Hour Boarding and Alighting

Code	Station	2010	2020		2030	
		Green&Red	Green&Red +KCR	Green&Red only	M/P Network	Green&Red +KCR
	Green Line					
R0-01	M1	2,928	4,940	5,465	4,066	10,341
R0-02	M2	2,593	4,147	3,635	4,238	3,244
R0-03	M3	1,684	4,178	4,010	2,162	2,650
R0-05	M4	717	598	455	1,387	609
R1-01	G01	1,532	1,420	1,617	3,757	1,646
R1-02	G02	2,310	1,665	1,177	3,199	1,703
R1-03	G03	5,037	2,950	2,260	6,813	3,542
R1-04	G04	2,229	1,071	4,016	3,445	1,282
R1-05	G05	2,719	1,319	1,516	3,274	1,912
R1-06	G06	2,878	1,670	1,398	4,561	2,050
R1-07	G07	2,005	706	920	2,034	734
R1-08	G08	2,593	2,697	5,261	2,602	2,633
R1-09	G09	3,739	518	736	1,519	659
R1-10	G10	1,478	976	767	2,616	1,042
R1-11	G11	2,091	629	533	1,292	1,038
R1-12	G12	1,195	628	437	1,253	862
R1-13	G13	2,382	1,296	1,157	1,984	2,089
R1-14	G14	1,403	769	832	990	1,109
R1-15	G15	2,156	1,509	1,074	2,319	1,911
R1-16	G16	1,770	1,002	754	2,467	1,025
R1-17	G17	1,841	2,134	1,657	2,548	2,385
R1-18	G18	2,491	1,299	1,060	3,431	1,493
R1-19	G19	3,791	1,627	1,385	5,971	2,161
R1-20	G20	3,169	3,215	2,798	4,784	3,755
R1-21	G21	1,594	1,370	1,147	4,217	1,692
	Red Line					
RZ-00	P1	2,409	5,545	5,730	23,645	9,515
RZ-01	P2	3,345	5,293	4,425	4,797	4,301
RZ-02	P3	1,353	914	686	1,873	1,138
R3-02	R02	786	451	403	1	622
R3-03	R03	2,042	1,610	1,416	3,236	1,892
R3-04	R04	12	679	914	225	789
R3-05	R05	5,896	2,195	1,590	4,908	2,473
R3-06	R06	1,742	2,137	3,130	5,188	2,550
R3-07	R07	5,231	2,598	2,422	7,206	2,731
R3-08	R08	4,480	1,842	1,819	4,759	2,023
R3-09	R09	2,287	1,786	1,819	2,647	1,598
R3-10	R10	973	791	786	849	368
R3-11	R11	0	14	29	14	14
R3-13	R13	21	805	383	148	447
R3-14	R14	1,501	977	818	2,599	956
R3-15	R15	587	4,712	6,149	4,037	3,928
R3-16	R16	46	3,849	3,451	9,095	13,274
R3-17	R17	0	0	0	0	0
R3-18	R18	1,706	16,620	20,095	8,902	7,381

Source: The Study for KTIP

Table 3-5-7 Passenger Shift from Road to BRT in 2010

Green Line in case of 2010 demand

Section		Road Traffc without BRT			BRT Traffic from Parallel Road			% Shift to BRT		
		M/C	Car	Bus	M/C	Car	Bus	M/C	Car	Bus
Cloth Market	Garden Road	60,032	104,491	161,401	298	0	9,617	0.5	0.0	6.0
Garden Road	Shahra-e-Quaideen	89,754	170,969	235,549	859	0	12,662	1.0	0.0	5.4
Shahra-e-Quaideen	Gurmandir	99,203	196,907	235,549	830	0	12,649	0.8	0.0	5.4
Gurmandir	Lasbela	78,994	157,291	168,121	1,755	0	6,394	2.2	0.0	3.8
Lasbela	Nazimabad No.1 Chowrangi	94,161	149,642	182,107	2,459	0	7,685	2.6	0.0	4.2
Nazimabad No.1 Chowrangi	Board Office	118,458	170,842	257,518	2,123	0	8,177	1.8	0.0	3.2
Board Office	Nagan Chowrangi	90,642	142,388	120,528	1,356	0	3,286	1.5	0.0	2.7
Nagan Chowrangi	Surujani Chowrangi	82,665	105,240	118,266	656	0	3,388	0.8	0.0	2.9

Red Line in case of 2010 demand

Section		Road Traffc without BRT			BRT Traffic from Parallel Road			% Shift to BRT		
		M/C	Car	Bus	M/C	Car	Bus	M/C	Car	Bus
M.A. Jinnah Road	Jail Chowrangi	45,827	140,758	98,355	2,644	53	12,775	5.8	0.0	13.0
Jail Chowrangi	Hasan Square Roundabout	70,235	171,926	126,337	6,956	53	22,326	9.9	0.0	17.7
Hasan Square Roundabout	NIPA Chowrangi	78,855	189,403	110,850	4,292	22	10,172	5.4	0.0	9.2
NIPA Chowrangi	Safari Flyover	38,922	111,487	67,833	2,477	0	6,642	6.4	0.0	9.8
Safari Flyover	Safura Circle	13,794	51,925	83,912	0	0	1,056	0.0	0.0	1.3
Safura Circle	Malir Cant Check Post	6,760	34,291	18,861	0	0	133	0.0	0.0	0.7
Malir Cant Check Post	Model Colony	10,510	44,500	32,496	0	0	0	0.0	0.0	0.0

Note 1: Figures are the number of passengers per day for both directions
Note 2: Estimated by the Demand Forecast Model in KTIP
Note 3: M/C = Motorcycle

Source: The Study for KTIP

Table 3-5-8 Passenger Shift from Road to BRT in 2020

Green Line in case of 2020 demand

Section		Road Traffc without BRT			BRT Traffic from Parallel Road			% Shift to BRT		
		M/C	Car	Bus	M/C	Car	Bus	M/C	Car	Bus
Cloth Market	Garden Road	104,426	154,655	232,999	4,411	4,621	97,035	4.2	3.0	41.6
Garden Road	Shahra-e-Quaideen	142,416	250,349	323,770	7,716	8,761	141,474	5.4	3.5	43.7
Shahra-e-Quaideen	Gurmandir	154,805	282,393	323,770	7,756	8,792	141,495	5.0	3.1	43.7
Gurmandir	Lasbela	117,371	285,853	236,454	13,132	15,773	169,528	11.2	5.5	71.7
Lasbela	Nazimabad No.1 Chowrangi	154,300	299,279	315,854	13,135	15,322	188,024	8.5	5.1	59.5
Nazimabad No.1 Chowrangi	Board Office	208,046	333,971	417,258	13,611	14,048	189,958	6.5	4.2	45.5
Board Office	Nagan Chowrangi	133,347	240,218	326,980	19,740	18,177	223,927	14.8	7.6	68.5
Nagan Chowrangi	Surujani Chowrangi	143,663	259,337	349,300	16,326	14,994	185,646	11.4	5.8	53.1

Red Line in case of 2020 demand

Section		Road Traffc without BRT			BRT Traffic from Parallel Road			% Shift to BRT		
		M/C	Car	Bus	M/C	Car	Bus	M/C	Car	Bus
M.A. Jinnah Road	Jail Chowrangi	71,371	149,351	233,868	8,711	12,753	172,900	12.2	8.5	73.9
Jail Chowrangi	Hasan Square Roundabout	111,000	223,152	273,592	11,602	16,865	202,388	10.5	7.6	74.0
Hasan Square Roundabout	NIPA Chowrangi	143,791	301,714	280,965	10,155	14,978	214,449	7.1	5.0	76.3
NIPA Chowrangi	Safari Flyover	114,990	261,151	259,934	8,632	11,607	219,515	7.5	4.4	84.5
Safari Flyover	Safura Circle	121,321	295,414	435,430	3,986	5,762	238,779	3.3	2.0	54.8
Safura Circle	Malir Cant Check Post	84,743	278,333	238,516	4,190	5,977	136,191	4.9	2.1	57.1
Malir Cant Check Post	Model Colony	92,141	202,697	220,366	4,229	6,035	74,885	4.6	3.0	34.0

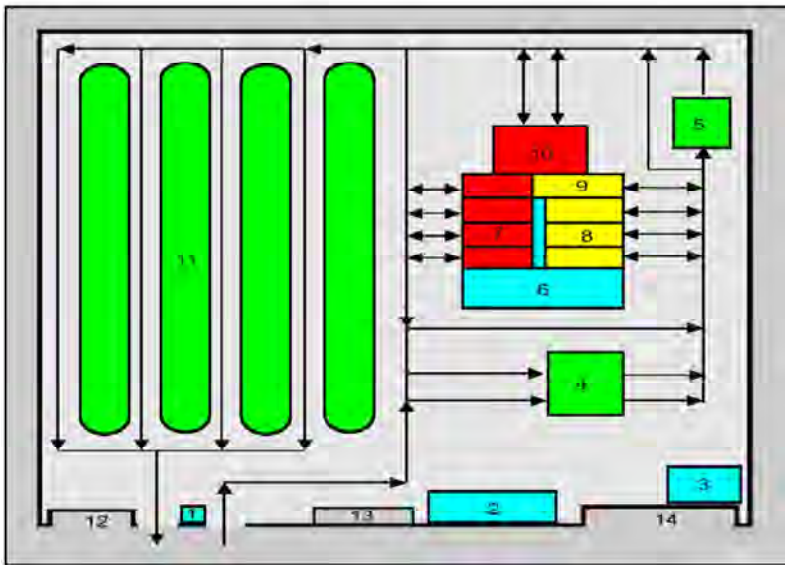
Note 1: Figures are the number of passengers per day for both directions
Note 2: Estimated by the Demand Forecast Model in KTIP
Note 3: M/C = Motorcycle

Source: The Study for KTIP

3.6 Selection of Depot

3.6.1 Total Area of Depot Facility

Depot areas have the role in bus parking areas, re-fuelling facilities, vehicle washing and cleaning, maintenance and repair areas, administrative space for operators and employee facilities. The standard layout for a depot area is described as bellow.



1. Gate and visual inspection area
2, 3 and 6. Administrative offices for the concessioned operators
4. Re-fuelling area
5. Vehicle washing and cleaning area
7 and 10. Major repairs
8 and 9 . Minor repairs and maintenance
11. BRT vehicle parking
12. Private vehicle parking

Green color ; Operational vehicles
Yellow color; Vehicles requiring minor or routine maintenance
Red color ; Vehicles requiring major repairs

Source: Bus Rapid Transit – Planning Guide 2007, Institute for Transportation and Development Policy (ITDP)

Figure 3-6-1 Standard Layout for a depot area

The size of the depots depends on the amount of operational vehicles. Since all vehicles stay in depot in night time, the depot should be large enough to accommodate all vehicles. The number of vehicles was estimated at approximately 200 per corridor.

The necessary area was estimated as 30,000m^2 or more on each line as shown in Table 3-6-1.

Table 3-6-1 Total Area of Depot

Facility	Area(㎡)	
Major Repair	585	Lot:W32.5m*D18m 4 Vehicles at the same time
Parking	23,940	Lot:119.7(㎡) Vehicle: 200
Re-fuelling	413.4	Lot:68.9(㎡) Nozzle: 6
Washing and Cleaning	388.36	Lot:97.09(㎡) 4 Vehicles at the same time
Other	175	Tire Storage, Driver's Rest Room, Security Office, Pray Room etc. # Refer to CNG Bus Project
Service Road	4,500	Sum of Parking Space *20%
Total	**Apx. 30,000 (㎡)**	Reference 7.4 (Acres)

Source: Calculated by JICA Study Team based on operation plan

Depots should be located at the places where vehicles need not travel a long distance between the depots and starting/ending points of BRT to save fuel consumption. If depots are located far from BRT routes and BRT vehicles need to run on mixed traffic lanes, there will be a risk that the BRT vehicles delay due to congestion of the mixed traffic lanes while travelling from the depot.

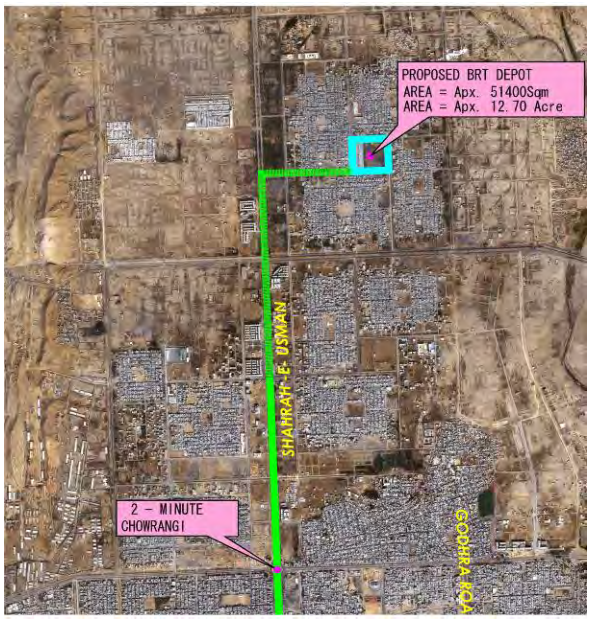
3.6.2 Depot Location

Locations of the depots of each line were selected as follows, based on discussions between the JICA Study Team, KMTC and MPGO.

(1) Green Line

The proposed location of the depot of Green Line is located to the north of New Karachi, approximately 1.3km from the terminal station of Green Line as shown in Figure 3-6-2.

Total Area	51,400m^2
Distance from BRT Route	Approximately 1.3km from the terminal station
Ownership	Government (KMC)
Location	



Source: JICA Study Team

Figure 3-6-2 Depot Location on Green Line

The proposed location is planned as an area of a sports complex in the city's land use plan, but it is currently used as one of the depots of the CNG Bus Project. Based on the discussion with MPGO and KMTC, this area can be reserved for the depot of Green Line by changing the land use plan.

The distance between the terminal station (G23) and the depot is approximately 1.3 km, which is acceptable in view of the fuel consumption before and after the daily service.

Existing Condition

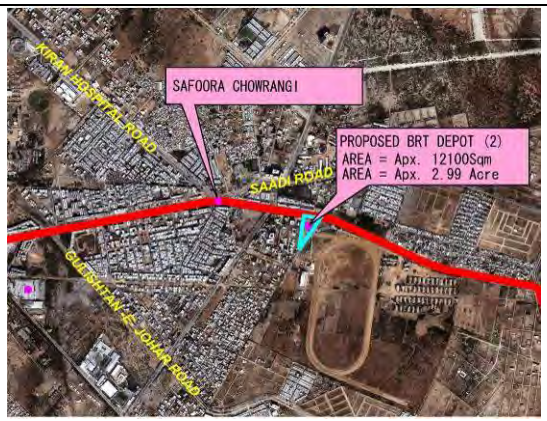
Frontal Road

Source: Photo by JICA Study Team

Figure 3-6-3 Present Condition of Depot area on Green Line

(2) Red Line

For Red Line, the depot is proposed to be constructed at two different locations because an area with large space to accommodate 200 vehicles was not found. One is located in Model Colony, next to Jinnah Airport, the other is the area near the Safoora Chowrangi.

Total Area	17,500m^2 (Red Line Depot 1)	12,100m^2 (Red Line Depot 2)
Distance from BRT Route	Approximately 0.9km from the terminal station of Red Line	Next to BRT Lane
Ownership	Government (GOS and KMC)	Government (GOS and KMC)
Function	Depot and Workshop	Pool Area, which is included of parking/stopping, re-fuelling and breaking area for driver
Picture		

Source: JICA Study Team

Figure 3-6-4 Depot Location on Red Line

Function of each depot is proposed as shown in Table 3-6-2. “Necessary” means that the depot must have the function from the beginning of the operation, while “Possible” means that it will be necessary in the future. “Not Necessary” means that there is no need to introduce the function.

Table 3-6-2 Function of Depot

	Red Line Depot(1)	Red Line Depot(2)
Gate and visual inspection area	Necessary	Necessary
Administrative Office for the concessioned operators	Time keeper Room Cashier Room Operator Room Office Admin & Reception office Kitchen Conference Driver's Resting Room Store	Time keeper Room Cashier Room Operator Room Driver's Resting Room Store
Re-fuelling area	Necessary	Possible
Vehicle washing and cleaning area	Necessary	Possible
Major repairs	Necessary	Not necessary
Minor repairs and Maintenance	Necessary	Not necessary
BRT vehicle parking	Necessary	Necessary
Private vehicle parking	Not necessary	Not necessary
Other		
Tire Storage	Space of 5m x 10m	Not necessary
Security office	Necessary	Necessary
Pray Room	Necessary	Necessary
Napping Room	Possible	Possible
Canteen	Possible	Possible

Source: JICA Study Team

Existing Condition of Red Line Depot(1)

Frontal Road of Red Line Depot(1)

Existing Condition of Red Line Depot(2)

Frontal Road of Red Line Depot(2)

Source: Photo by JICA Study Team

Figure 3-6-5 Present Condition of Depot area of Red Line

Chapter 4 Operation Plan

4.1 Traffic Management

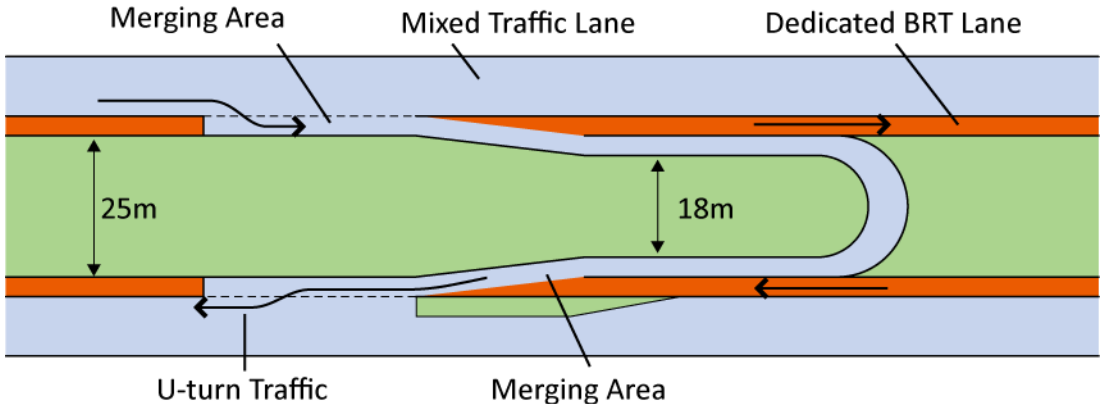
4.1.1 U-Turn Traffic

(1) Problem of U-Turn Traffic along BRT Corridor

Due to the unique street system, it is difficult to control right turn traffic by signal in North Nazimabad Area. There are two median breaks between major intersections, and the traffic volume using the U-turn is too high to be closed although the ADB Study of BRT proposed to close median breaks. Since BRT lanes are proposed in the center of roads, crossing of BRT traffic and U-turn traffic will occur.

To avoid the delay from the conflict between BRT and U-turn traffic, three alternatives are considered. One is a grade separation of BRT lanes and U-turn lanes. In this case, BRT lanes will be constructed as flyovers because it can make use of median area for new structures while U-turn flyovers use the present carriageway for the structure.

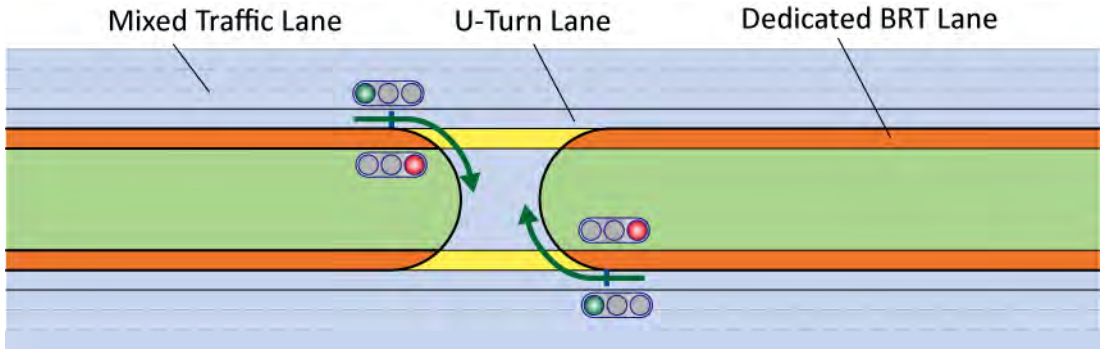
The second alternative is BRT lanes outside of U-turn lanes as shown in Figure 4-1-1. There are merging areas of BRT lanes and U-turn lanes. In this case, the risk of traffic accident becomes high if express bus services are introduced.



Source: JICA Study Team

Figure 4-1-1 U-turn traffic and BRT lanes (1)

The third alternative is installing traffic signals at U-turn location as shown in Figure 4-1-2. U-turn traffic and BRT traffic are separated by traffic signal. In mixed traffic lanes, U-turn lanes should be separated from straight traffic near U-turn section so that the U-turn traffic can smoothly exit U-turn area. Since the width of the median is approximately 25m at present, the radius becomes 18m and large buses cannot use the U-turn lanes.



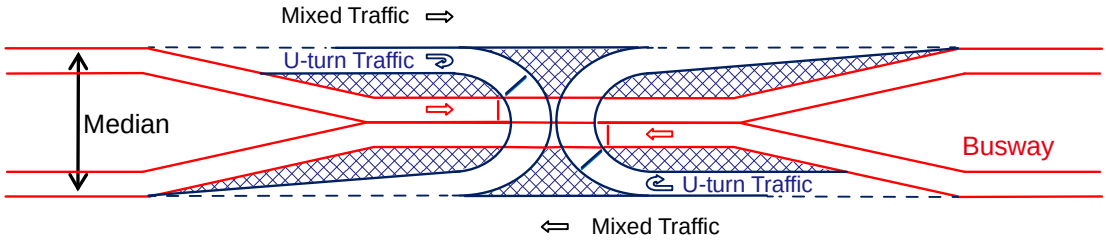
Source: JICA Study Team

Figure 4-1-2 U-turn traffic and BRT lanes (2)

U-turn signal of Bangkok BRT
Photo: Nippon Koei Co., Ltd.

(2) Proposed Solution of U-Turn along Green Line

Figure 4-4-3 shows the proposed plan of busway at U-turns along Green Line. Both upward and downward lanes are located in the center of median area at U-turn, while the two lanes are located outer of median along other sections.



Source: Illustrated by JICA Study Team

Figure 4-1-3 BRT lanes crossing U-Turn

4.1.2 Roundabouts

Roundabouts should be converted to standard 4-leg signalized intersections in principal. In case signalization is difficult due to the existence of monuments or fountain, traffic signals should be installed to the roundabout. Although it is better to convert Powerhouse Chowrangi into a signalized 4-legs intersection, this roundabout should remain with signal installation because there is an aircraft monument at Powerhouse Chowrangi. Table 4-1-1 shows the improvement policy of each roundabout along Green Line.

Table 4-1-1 Roundabouts along Green Line

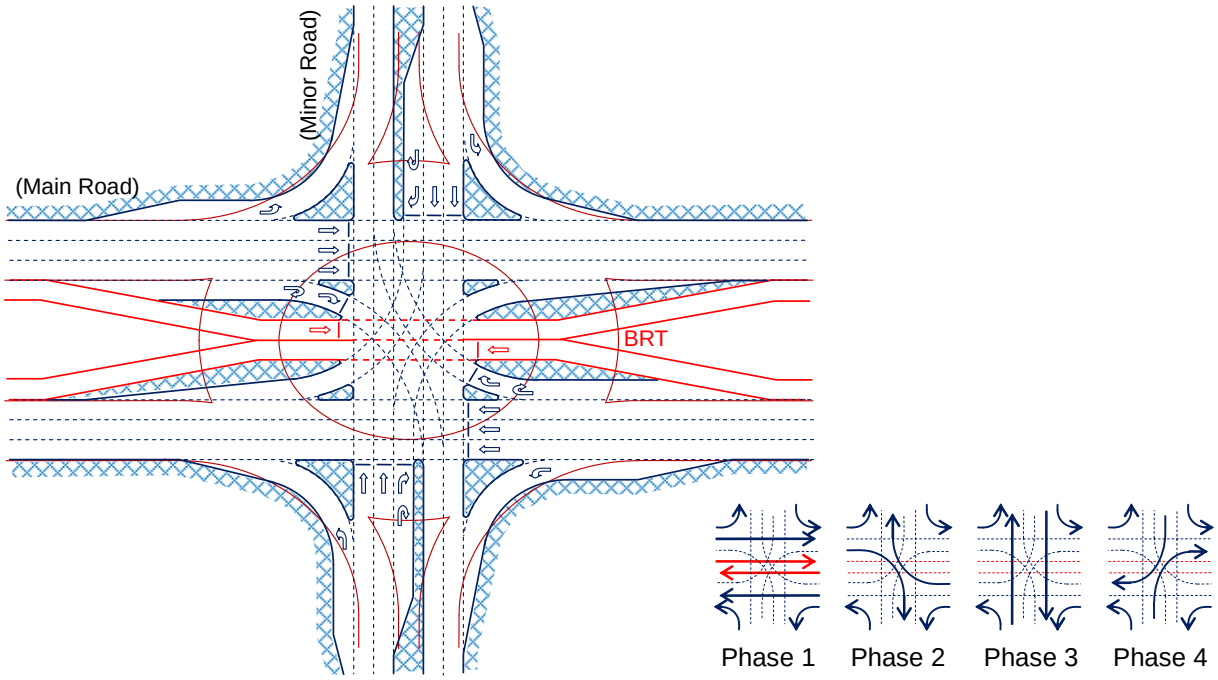
No	Location	Improvement Policy
1	Gurumandir	Signalized Intersection
2	KDA Chowrangi	Signalized + BRT lanes through the roundabout
3	Sakhi Hassan Chowrangi	Signalized + BRT lanes through the roundabout
4	Powerhouse Chowrangi	Signalized roundabout
5	Surjani Chowrangi	Signalized Intersection

Source: JICA Study Team

There are two roundabouts along Red Line. The roundabout near Quaid-e-Azam should be improved as the roundabout with signalized plus BRT lanes through the roundabout. Safura Circle should be signalized.

There is no roundabout along Blue Line.

Figure 4-1-4 shows the configuration of the basic type of a four-leg intersection based on signal control and fully channelized covering all traffic movements from all four legs. A dual direction busway is built into this intersection locating at the center of the main road next to the right-turn lane. A four-phase signal control as given in Figure 4-1-4 is required to allow all traffic movements. The BRT bus will be given green time concurrent with the through traffic on the main road.



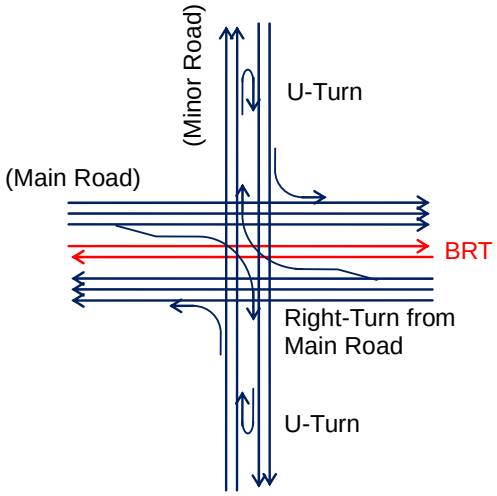
Source: Illustrated by JICA Study Team

Figure 4-1-4 Four-Leg Channelized Intersection

4.1.3 Control of right-turn traffic

Right-turning vehicles will cause substantial delay to through traffic and thus diminish effectiveness of intersection. Therefore, it is believed beneficial and so CDGK has currently practiced that right-turn movements should be prohibited to relieve traffic burden of the intersection and instead guide them to neighboring U-turns and intersections after passing through the intersection, to reach their destinations by alternative routes. However, this indirect right-turn maneuver has disadvantages as well, such as fuel consumption will increase with unnecessary travels and the additional U-turn and left-turn traffic will affect the operation of neighboring roads and intersections. It is generally desirable that right-turns should be allowed as near as practical to the point at which drivers desire to turn right.

It is proposed that U-turns should be removed from main roads and instead a large green time should be given to the right-turn traffic from the main roads at the intersections. In contrast, the right-turn traffic from minor road should be prohibited to give green time more to the main road, for where BRT buses run. By this right-turn control as shown in Figure 4-1-5, BRT buses need not stop between intersections except station stops, and the four signal phases of the intersection will be reduced to three phases by eliminating phase-4.

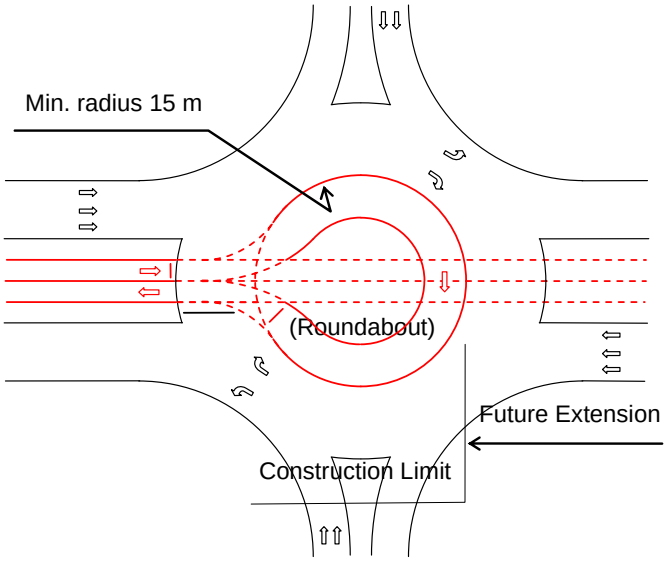


Source: Illustrated by JICA Study Team

Figure 4-1-5 Elimination of Right-Turn Traffic from Minor Road

4.1.4 Design of BRT Bus U-Turn Facility

The BRT bus U-turn facility is required at both ends of a BRT corridor and possibly at the middle point to turn travel direction of buses. The design of bus U-turn facilities proposed here are only for bus turning operation but do not consider station function. At the end of a corridor in suburb, buses can turn easily at an existing roundabout intersection as shown in Figure 4-1-6.



Source: Illustrated by JICA Study Team

Figure 4-1-6 At-Grade BRT Bus U-Turn

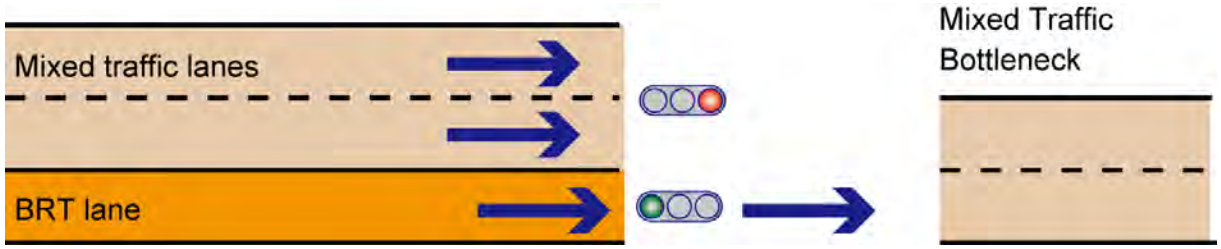
4.1.5 Bottleneck Sections

The proposed BRT routes have bottleneck sections such as the section of Nawab Siddiq Ali Khan Road between Nazimabad No.1 Chowrangi and Lasbela Chowk (Green Line), the section of Business Recorder Road between Lasbela Chowk and Gurmandir (Green Line), and New M.A. Jinnah Road between Roundabout and Jail Chowrangi (Red Line). Although the roads are wide enough to accommodate BRT lanes, parking and stopping demand along roads are so high due to the commercial activities that it is difficult to provide exclusive lanes for BRT.

There are three alternatives for these sections. One is construction of elevated structure for BRT lanes along the section as proposed in the BRT study by ADB. Elevated structure needs ramp section between at-grade and the elevated section. In case that an elevated structure is introduced along Business Recorder Road, the ramp should be constructed at both ends of the elevated section. Ramp sections cannot be constructed along the bottleneck sections because of roadside parking. If roadside parking is removed from the road, the construction of ramps is possible. However, at-grade busway should be constructed in case that roadside parking can be removed. From this, the ramp should be constructed in the south of Gurumandir and the North of Nazimabad Chowrangi, and the length of the elevated section will be approximately 2.7km. This will increase the initial investment cost of the BRT. As described in the financial analysis in Chapter 9, the financial return of the BRT project is very small, and the further increase in the cost will result in the failure of the project. Therefore, the elevated structure is not recommended in view of the financial viability of the project.

For the bottleneck section along M.A. Jinnah Road, construction of a ramp is not possible due to U-turns along the road.

The second alternative is the BRT operation in mixed traffic lanes. In this case, BRT buses will face the same congestion as the present situation. It is necessary to employ traffic management measure to increase travel speed of the buses. Figure 4-1-7 shows “queue jump” solution to give priority to buses. This alternative was discussed in the early stage of the feasibility study, but it was concluded that the BRT vehicles should not be operated in mixed traffic lanes because it will worsen the level of service of the BRT.



Source: JICA Study Team

Figure 4-1-7 Queue Jump at Bottleneck

The third alternative is to clear all illegal parking from the road sides. The curb side lanes are occupied by rickshaws or cars for sales, trucks for loading and unloading, vehicles of customers, rickshaws and taxis waiting for passengers. Removal of these vehicles from the sections will involve a large number of stakeholders, and it will take time to reach the consensus for the removal of parking. However, construction of the busway along these sections at-grade, as same as other sections, is more feasible solution than the construction of elevated structure.

KMTC ensured that clearance of the bottleneck sections would be possible, and this alternative was applied for the BRT plan. On the other hand, it was necessary to consider the parking space for temporary stops, which would reduce the available space for the BRT system, and this became one of the reasons that passing lanes at stations were not provided in the plan.

4.2 Operation Plan

4.2.1 BRT Routes

(1) Cross Operation

It is proposed that both Green and Red Lines go to Cloth Market along M.A. Jinnah Road and Regal Chowk along New M. A. Jinnah Road to avoid transfer between two lines near the center of the city. The demand between Green and Red Lines cannot be ignored, but it is not proposed to connect Green and Red Lines directly because such demand will be covered with other transit lines such as KCR and Brown Line in the future.

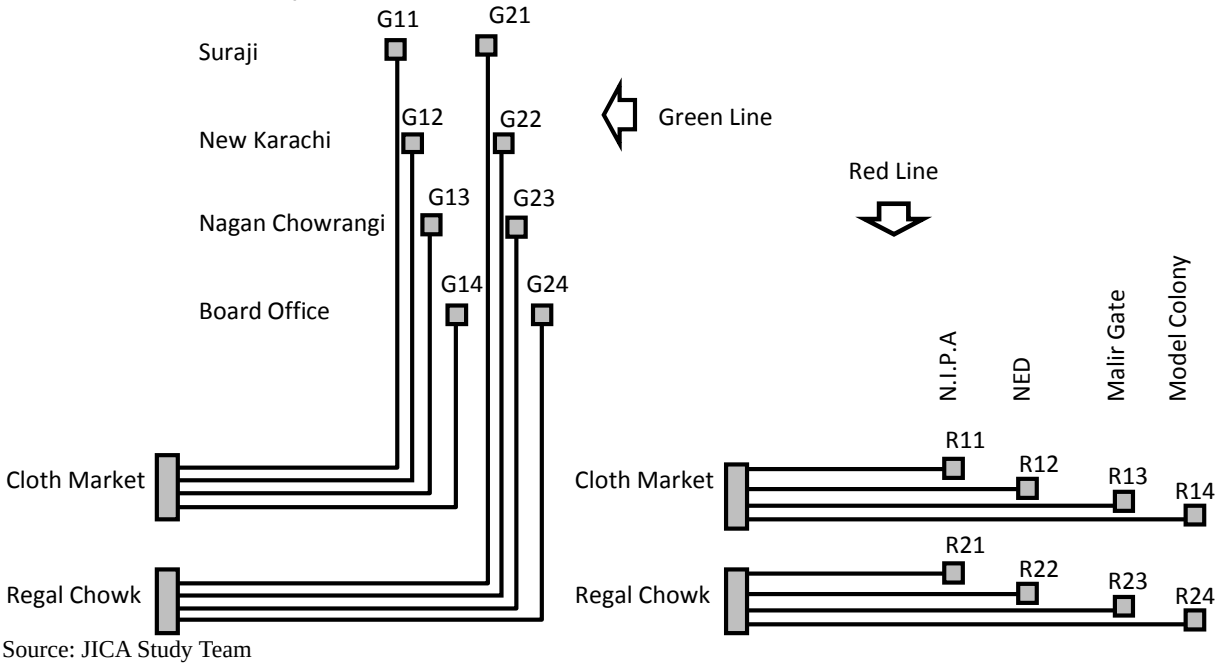
(2) Round Trip

The required number of buses is different by section. In the early stage of the operation, it is not necessary to provide the target capacity along the section which is far from the center. From the results of the demand forecast, it is proposed to provide eight routes for Green Line and four routes for Red Line as shown in Table 4-2-1 and Figure 4-2-1.

Table 4-2-1 Proposed Routes of Green and Red Line

Line	Round Route	Center	U-turn point
Green Line	G11	Cloth Market	Surjani
	G12	Cloth Market	New Karachi
	G13	Cloth Market	Nagan Chowrangi
	G14	Cloth Market	Board Office
	G21	Regal Chowk	Surjani
	G22	Regal Chowk	New Karachi
	G23	Regal Chowk	Nagan Chowrangi
	G24	Regal Chowk	Board Office
Red Line	R11	Cloth Market	N.I.P.A
	R12	Cloth Market	NED
	R13	Cloth Market	Malir Gate
	R14	Cloth Market	Model Colony
	R21	Regal Chowk	N.I.P.A
	R22	Regal Chowk	NED
	R23	Regal Chowk	Malir Gate
	R24	Regal Chowk	Model Colony

Source: JICA Study Team



Source: JICA Study Team

Figure 4-2-1 Diagram of BRT Routes of Green and Red Lines

4.2.2 Peak Hour Operation

The target capacity in peak hours is 12,000 passengers per hour per direction. Since the capacity of a BRT bus is planned as 80 passengers, the necessary frequency is calculated as 150 per hour (2.5 per minute). In this case, buses should arrive at station in 24 seconds interval. From this high frequency, the time table of bus arriving will not be necessary for passengers. However, BRT should be operated based on time tables for efficient operation.

(1) Time at Station

Short boarding and alighting time at stations will increase the capacity. However, it is proposed to fix the boarding and alighting time at stations at 20 seconds to enable the scheduled operation of buses. The time of 20 seconds at a station for boarding and alighting is the popular time of BRT operations in the world.

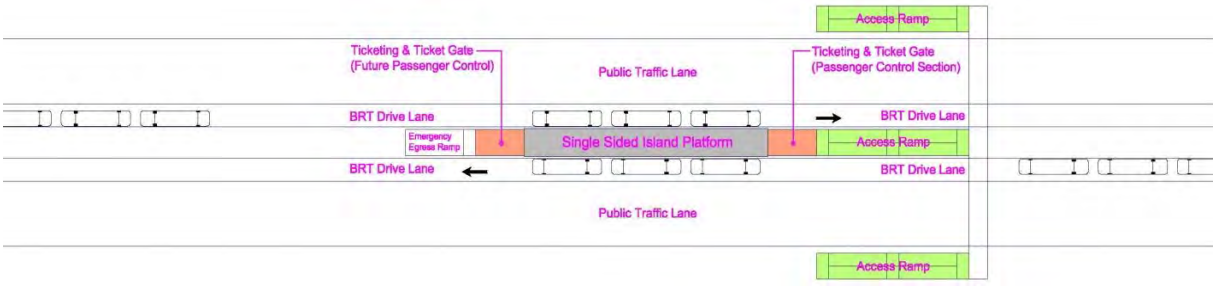
In addition to the boarding and alighting time, deceleration and acceleration time will be necessary at stations. For comfortable riding, rapid deceleration and acceleration should be avoided. The time is approximately 10-20 seconds. In total, 40 seconds will be necessary for a bus at a station.

(2) Speed

If speed is not a matter, the capacity can be increased. For example, if 12m buses with the capacity of 72 passengers per bus are moving continuously like a long train at a waking speed (4km/hour), it can carry 24,000 passengers per hour (= 72/12 * 4,000). However, it is necessary to keep the BRT speed even in peak hours otherwise the benefit of BRT will become small. The target speed is 25km/h.

(3) Convoy system operation

A boarding and alighting slot can deal with only 1.5 buses per minute (60/40). To achieve 2.5 buses per minute, two slots with a passing lane is necessary. However, due to the limitation of available road space, it was decided that passing lanes would not be provided to BRT stations. Instead, three slots for boarding and alighting were proposed to apply a convoy operation. In this case, two or more buses are operated in a group which arrive and departure at the same time. If two buses arrive at a 48 seconds interval, the capacity of 12,000 passengers per hour is possible.



Source: JICA Study Team

Figure 4-2-2 Convoy System Operation Image

(4) Peak Hours

Peak hours along Green and Red Lines differ by section. In morning, approximately two hours from 7:00- 9:00 is peak hour time, while evening peak continue approximately three hours from 18:00-21:00. In total, the peak hour operation should be applied for 5 hours in a day.

(5) Off-peak Hour Operation

The frequency should be reduced according to passenger demand. However, it is necessary to maintain the minimum frequency.

4.2.3 The number of buses

The number of buses needed for the operation (N) was calculated by the following formula.

N = T (minutes) / Peak hour interval (seconds) * 60

Where, T is the smaller one between the round trip time and the peak hour time. Since the round trip time is less than 2 hours both for Green and Red lines, while the peak hours continue more than 2 hours, round trip times were used for the calculation. In addition to the buses calculated above, spare buses will be necessary. The number of additional buses was assumed at 5% of the total number of buses needed for the peak operation. Table 4-2-2 shows the estimation of the number of buses. In total, 425 buses would be needed for the BRT system.

Table 4-2-2 Calculation of No. of Buses Needed for BRT System

Green Line

Section		Distance (km)	No. of buses per hour	No. of buses to be added	Interval sec	Speed km/h	Round time Hour	No. of buses
Cloth Market	Surjani	21.0	80	80	45	25	1.68	135
Mazar Area	Power House	14.8	100	20	180	25	1.18	24
Mazar Area	Nagan Chowrangi	11.0	138	38	95	25	0.88	34
Mazar Area	Board Office	7.2	150	12	300	25	0.58	7
Total								200

Red Line

Section		Distance (km)	No. of buses per hour	No. of buses to be added	Interval sec	Speed km/h	Round time Hour	No. of buses
CBD	Model Colony	23.3	70	70	51	25	1.86	131
Mazar Area	Malir Gate	17.0	100	30	120	25	1.36	41
Mazar Area	NED	11.5	120	20	180	25	0.92	19
Mazar Area	NIPA Station	8.3	140	20	180	25	0.66	14
Total								205

Source: JICA Study Team

Total	405
Spare	20
Grand Total	425

4.2.4 Vehicle-kilometers

The vehicle-kilometer, a unit which represents the total of the travel distance of buses, is one of the most important indicators of BRT systems. The vehicle-kilometers in peak hours can be calculated from the peak operation plan in the previous section. The off-peak operation was prepared based on the assumption of hourly distribution of passenger traffic.

(1) Hourly Distribution of Passenger Traffic

Off-peak operation plans were prepared for the following four traffic groups: 1) 7.5% of daily traffic, 2) 5%, 3) 3%, and 4) 1%. Table 4-2-3 shows the hourly frequency and the number of buses needed by the traffic group.

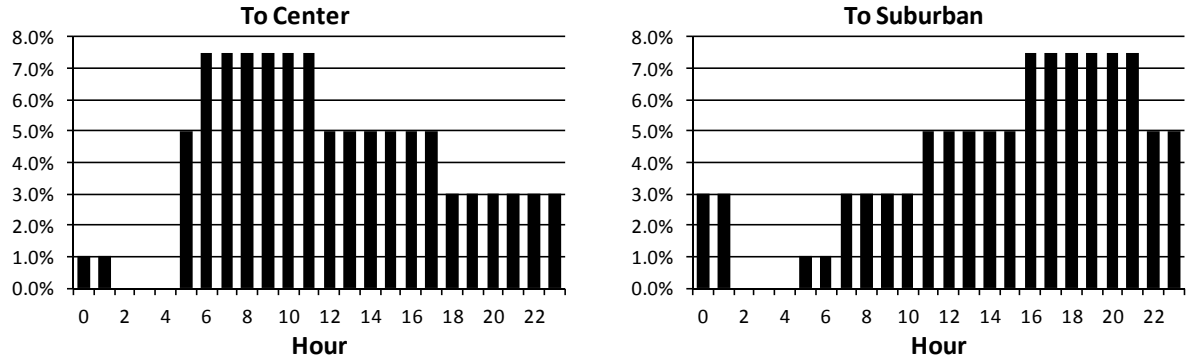
Table 4-2-3 Hourly Traffic Volume by Traffic Group

Line	Section		Traffic Group				No. of Required Buses			
			1	2	3	4	1	2	3	4
			7.5%	5.0%	3.0%	1.0%	0.5%	7.5%	5.0%	3.0%
Green Line	Cloth Market	Surjani	80	54	22	3	80	54	22	3
	Mazar Area	Power House	100	67	27	4	20	13	5	1
	Mazar Area	Nagan Chowrangi	138	92	37	5	38	25	10	1
	Mazar Area	Board Office	150	100	40	6	12	8	3	1
Red Line	CBD	Model Colony	70	47	19	3	70	47	19	3
	Mazar Area	Malir Gate	100	67	27	4	30	20	8	1
	Mazar Area	NED	120	80	32	5	20	13	5	1
	Mazar Area	NIPA Station	140	94	38	6	20	14	6	1

Source: JICA Study Team

Peak characteristics are quite different by directions. The morning peak is observed toward the center direction while the evening peak is observed from the center to suburb. Passenger traffic

distribution was assumed as shown in Figure 4-2-3 for both directions.



Source: JICA Study Team

Figure 4-2-3 % Distribution by Hour by Direction

The number of hours by traffic group was prepared by combining the two charts (the average of the percentage of each hour). The result is 12 hours (7.5%), 7 hours (5.0%), and 2 hours (3.0%). This means that peak hour operation should be applied for 12 hours a day. The number of services was calculated by adding up the product of the number of hours and the number of required buses of each traffic group. Vehicle-kilometers of the BRT system were calculated at 173,000 per day by adding up the product of the number of services and the length of each section.

Table 4-2-4 Calculation of Vehicle-kilometers

Line	Section		No. of Services	Bus-km
Green	Cloth Market	Surjani	1,382	58,044
Line	Mazar Area	Power House	341	10,094
	Mazar Area	Nagan Chowrangi	651	14,322
	Mazar Area	Board Office	206	2,966
		subtotal	2,580	85,426
Red	CBD	Model Colony	1,207	56,246
Line	Mazar Area	Malir Gate	516	17,544
	Mazar Area	NED	341	7,843
	Mazar Area	NIPA Station	350	5,810
		subtotal	2,414	87,443
Total			4,994	172,869

Source: JICA Study Team

4.2.5 Reorganization of Present Bus Network

(1) Green Line

There are 49 routes that compete with Green Line, in which 18 routes should be discontinued because of these routes overlap Green Line for a long distance. Feeder routes should be provided for the 18 routes outside Green Line route. Table 4-2-5 is the list of bus routes that compete with Green Line. The route number with silver color is the proposed routes which should be discontinued for Green Line operation.

Table 4-2-5 List of Bus Routes Compete with Green Line

2-K	F-16	G-25	W-1	401-GUL
4	X-3	G-27	U-8	Khan
4-J	F-18	W-23	W-22	Niaz
1-D	W-11	C-17	X-10	National
4-L	C-25	P-3	U	Shiraz
2-D	F-21	W-55	G-11	Shama
4-X	G-17	W-25	G-3	UTS-1
5-C	W-18	W-19	U11	Masood
6	Z-A	W-21	Umer-Coach	
8	G-13	W-30	201-CITY	

Source: JICA Study Team based on Public Transport Survey in 2010

(2) Red Line

There are 44 routes that compete with Red Line in which 11 routes should be discontinued. Table 4-2-6 is the list of bus routes that compete with Red Line.

Table 4-2-6 List of Bus Routes Compete with Red Line

11-A	G-17	U-10	Umer-Coach	Starline
11-C	P-1	W-19	400-AKBA	9-B
51	G-13	U-8	101-BILA	Masood
53-B	G-27	W-22	401-GUL	51A
4-M	X-24	U	402-GUL	
52-A	C-17	G-11	National	
55	G-10	X-23	Shiraz	
A-3	F-11	G-7	Shama	
D-5	G-19	G-3	Safari	
F-21	S-2	202-DATA	Super Hasanzai	

Source: JICA Study Team based on Public Transport Survey in 2010

4.2.6 Operation Control Center

Control center for the BRT operation at the initial stage will not be considered. However, such facility may be necessary to monitor and control bus operation in order to keep quality service and to distribute convenient information for users when such sophisticated information system is installed for the system.

The center commonly consists of BRT operation and monitoring room (computerized main control center), fare collection administration, computer room, administrative office, training center, conference, canteen and others. It may be located in the depot land if space is available.

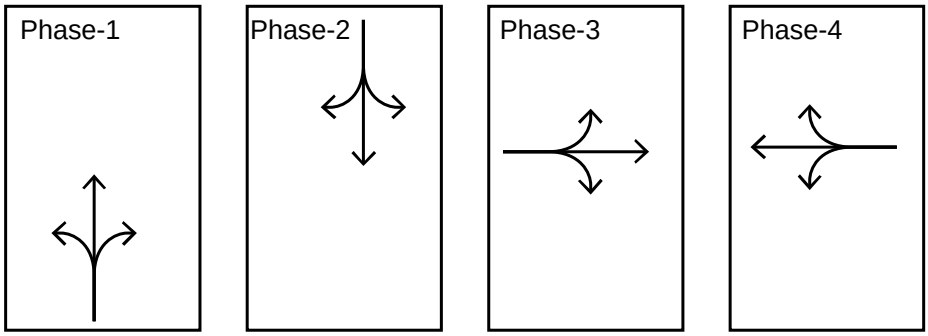
4.2.7 Traffic Signal

(1) Current Condition of Traffic Signal

CDGK had made efforts to introduce SCOOT system including traffic control centre under a World Bank project, which resulted in installation of fixed cycle time traffic signals in the first stage but traffic control center was not implemented. Many signalized intersections are often controlled by traffic polices because the existing traffic signals often stop due to frequent electricity off, and drivers tend to ignore traffic lights.

(2) Phase of Traffic Signals along Study Corridors

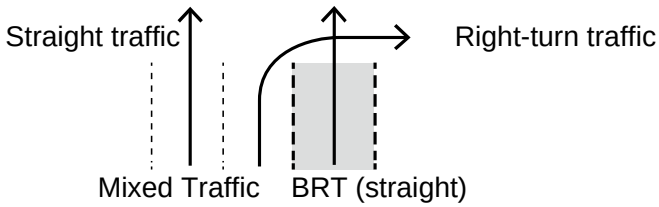
There is no signalized intersection along Red Line because it is Signal Free Corridor. There are 7 signalized intersections along Green Line. Lasbela and Nazimabad No. 1 apply four phases with a single directional approach on each phase as shown in below. Note that left-turn is always possible at these intersections.



Source: Field observation by the JICA Study team

Figure 4-2-4 Signal Phasing at Lasbela and Noazimabad No. 1 Chowrangi

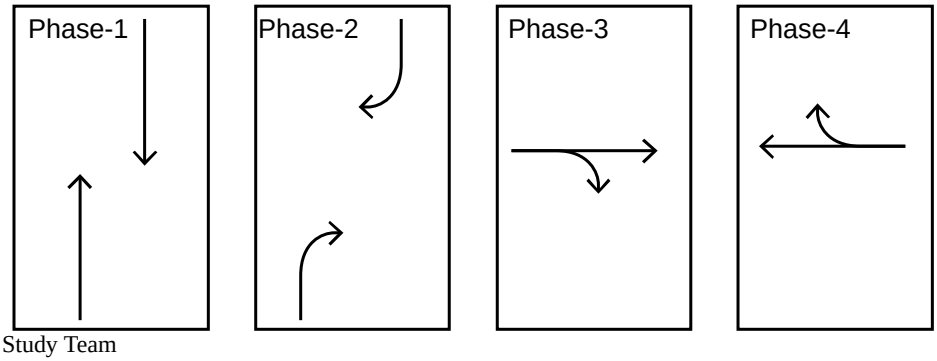
This configuration will cause conflict between buses on BRT lanes and right-turn traffic as shown in Figure 4-2-5.



Source: JICA Study Team

Figure 4-2-5 Conflict of Right-turn and BRT Traffic

To introduce BRT system, it is necessary to separate the straight traffic and right-turn traffic as applied at Five Star Chowrangi and Board Office intersection. Figure 4-2-6 shows the new configuration of the signal phase. Phase-1 is given to BRT traffic.



Source: JICA Study Team

Figure 4-2-6 Proposed Signal Phasing of BRT corridors

This signal phase type will bring about traffic congestion at these intersections. Figure 4-2-7 shows the traffic volume (PCU) at Nazimabd No.1 Chowrangi in an evening peak hour. The straight traffic is the major movement while right turn traffic from Nazimabad Flyover to SITE is also heavy for a right-turn phase. Assuming that the hourly capacity per lane is 2,000 PCUs, and one lane is given, the right-turn movement needs 42% (=831/2000) of a signal cycle for its green time.

Right turn traffic is also heavy at Lasbela Chowrangi as shown in Figure 4-2-8. The right-turn traffic needs 37% of signal cycle on the same assumption.

Presently, 4-lane carriageways are utilized as 5-lane or 6-lane according to the traffic situation. Photo below shows that one-lane is used for Rickshaws, which require narrower width, and the number of lane becomes five. After the introduction of BRT, this type of flexible use of road space will not possible, which will reduce the intersection capacity.

Nazimabad No.1 Chowrangi
Photo: JICA Study Team

On the other hand, the introduction of BRT will reduce the number of vehicles along the corridors. The number of passengers from Lasbela to Nazimabad Flyover at Nazimabad No. 1 Chowrangi is estimated as approximately 17,000 per hour in 17:00-18:00 while the capacity of BRT is expected to be 12,000 per hour per direction. If bus passengers and motorcycle users are shifted to BRT, traffic volume at the movement will become 1,477 PCU compared to 3,142. In addition, it is expected that the number of Rickshaw traffic will decease due to removal of the Rickshaw Market along Business Recorder Road.

Figure 4-2-9 shows the traffic volume at Five Star Chowrangi. The same signal phase will be applied to this intersection after BRT introduction. Although right-turn traffic from south (KDA Chowrangi) to north (Sakhi Hassan Chowrangi) is very heavy, the right-turn carriageway is wide enough, and it is necessary to keep the present width.

Figure 4-2-10 shows the traffic volume at Nazimabad No. 7 Chowrangi. The same signal phase will be applied to this intersection after BRT introduction.

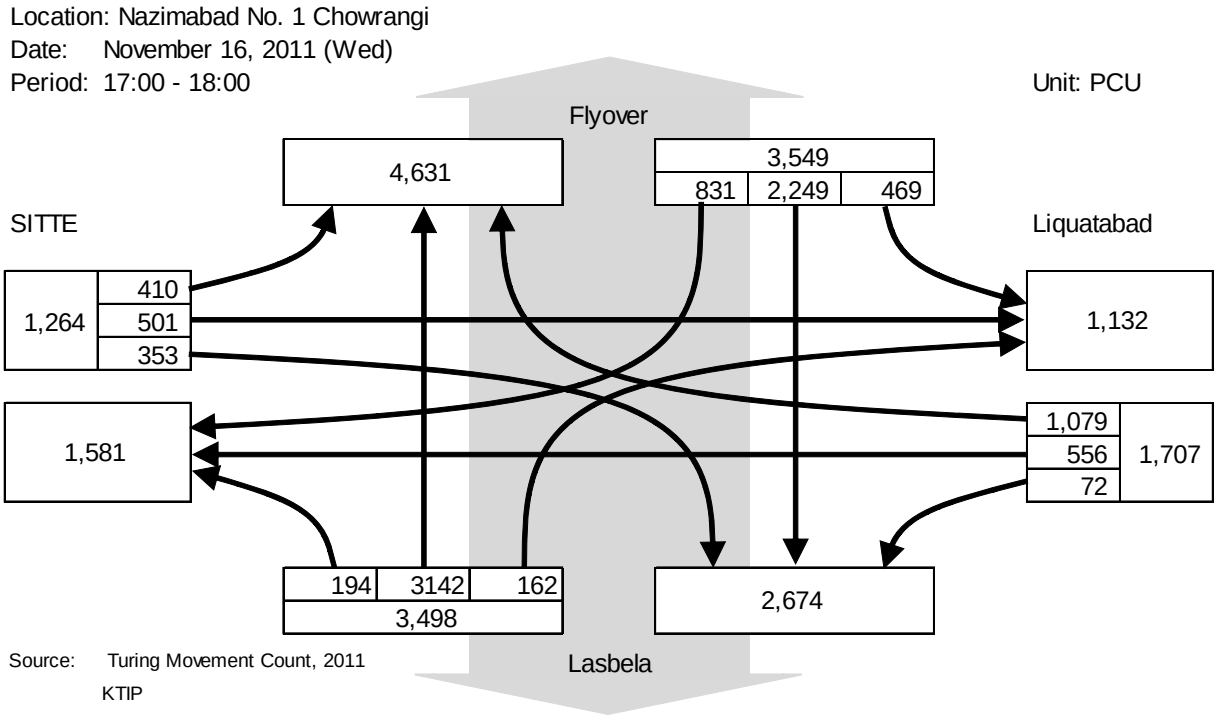


Figure 4-2-7 Traffic Volume by Direction at Nazimabad No.1 Chowrangi

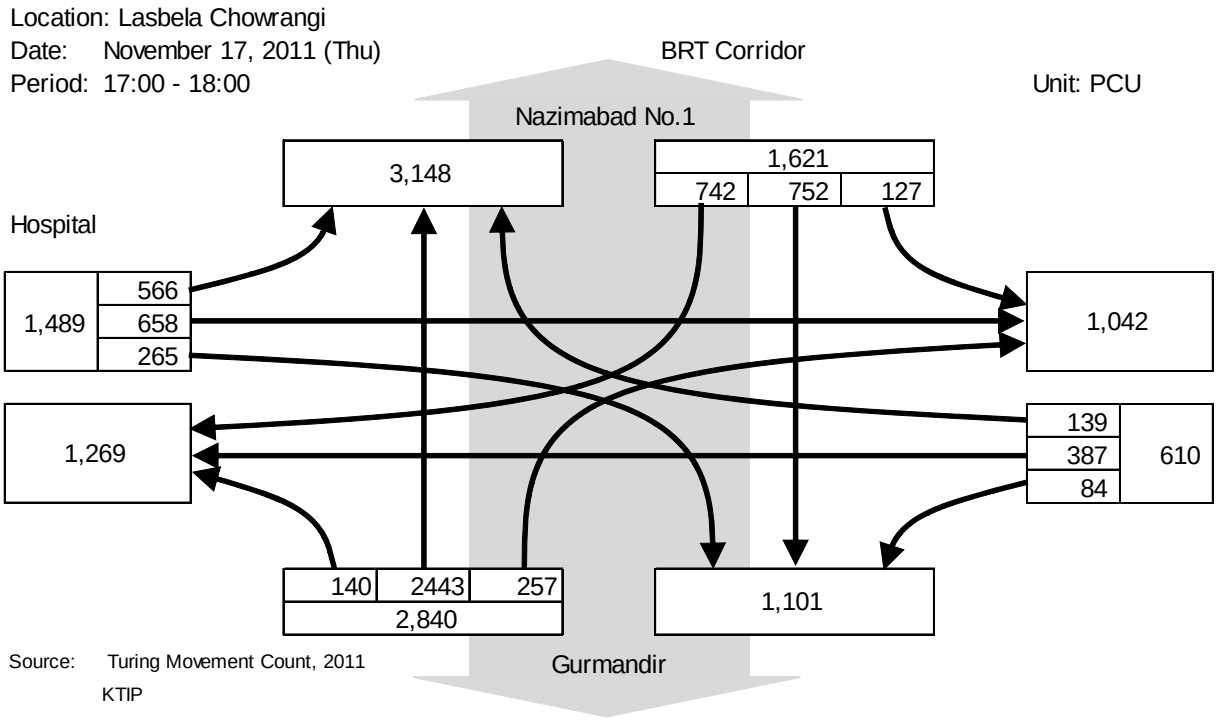


Figure 4-2-8 Traffic Volume by Direction at Lasbela Chowrangi

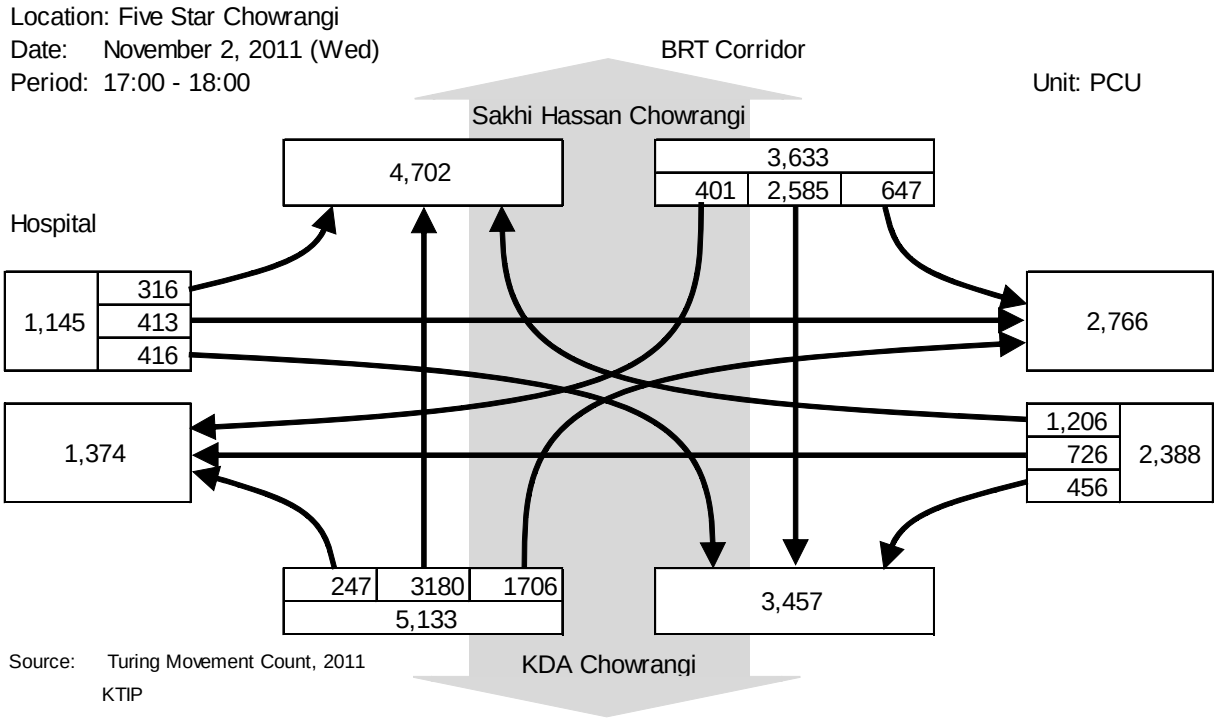


Figure 4-2-9 Traffic Volume by Direction at Lasbela Chowrangi

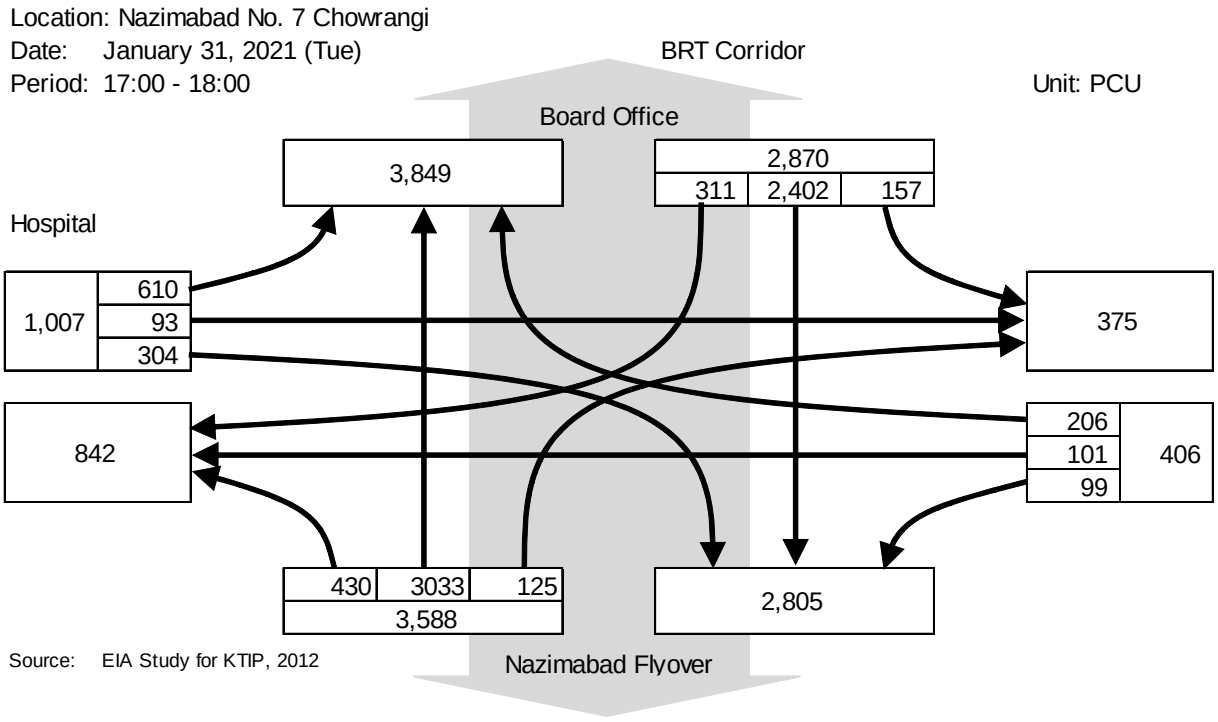
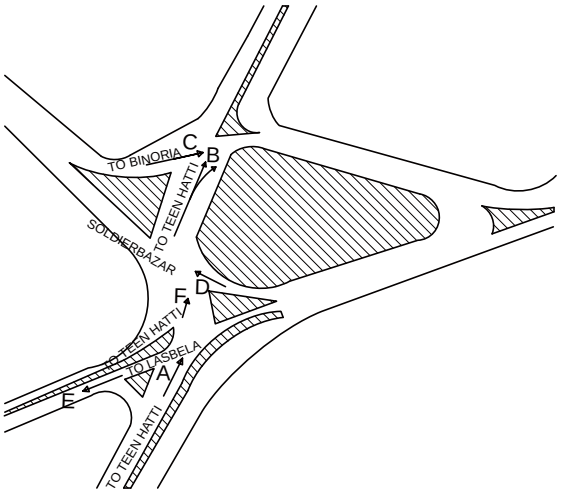


Figure 4-2-10 Traffic Volume by Direction at Nazimabad No.7 Chowrangi

Figures below show the phase of traffic signal along Green Line.

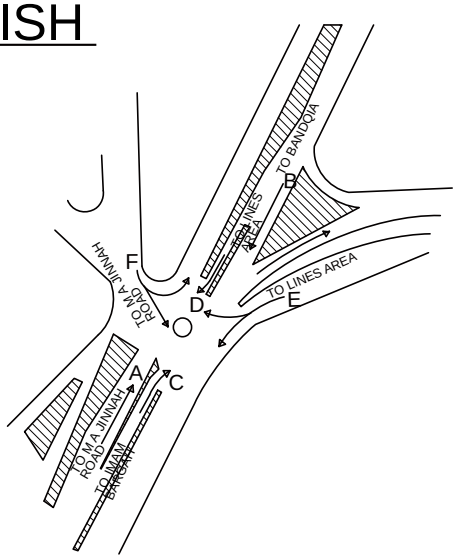
GURUMANDIR



STAGE DIAGRAM

TIMINGS	B→A	C→A	C→	E↓	→F
MORNING PEAK 8.00 AM - 1.00 PM	40	20	22	18	10
AFTERNOON PEAK 1.00 PM - 4.00 PM	50	30	18	20	10
EVENING PEAK 4.00 PM - 8.00 PM	55	30	25	18	10
LATE EVENING PEAK 8.00 PM - 11.59 PM	30	15	10	10	20
NIGHT TIME 0.00 AM - 8.00 AM	Flash	Flash	Flash	Flash	Flash

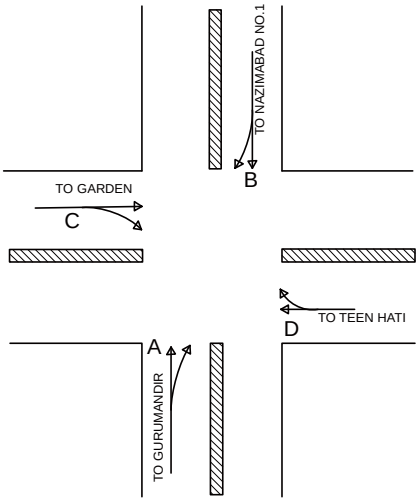
NUMAISH



STAGE DIAGRAM

TIMINGS	A→B	A→C	D→C	E→	→F
MORNING PEAK 8.00 AM - 1.00 PM	40	60	30	20	15
AFTERNOON 1.00 PM - 4.00 PM	40	60	20	15	15
EVENING PEAK 4.00 PM - 11.59 PM	40	60	30	15	15
AFTER 0.00 AM	Flash	Flash	Flash	Flash	Flash

LASBELA

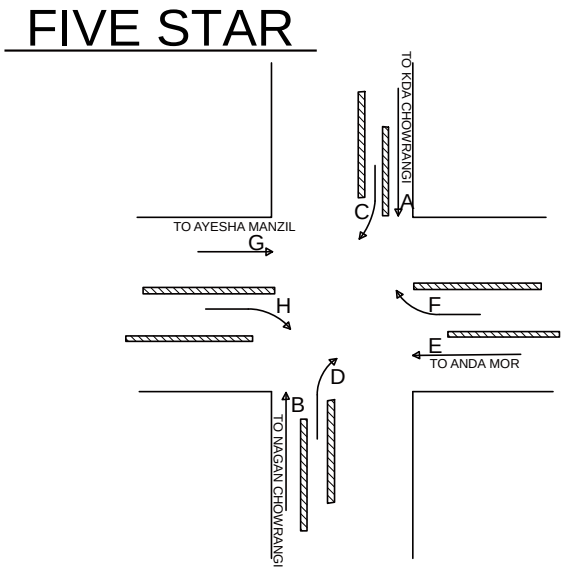


STAGE DIAGRAM

TIMINGS	→A	B→	C→	D→	
MORNING PEAK 8.00 AM - 1.00 PM	45	35	20	20	
AFTERNOON 1.00 PM - 4.00 PM	45	35	20	20	
EVENING PEAK 4.00 PM - 11.59 PM	45	35	20	20	
AFTER 0.00 AM	Flash	Flash	Flash	Flash	

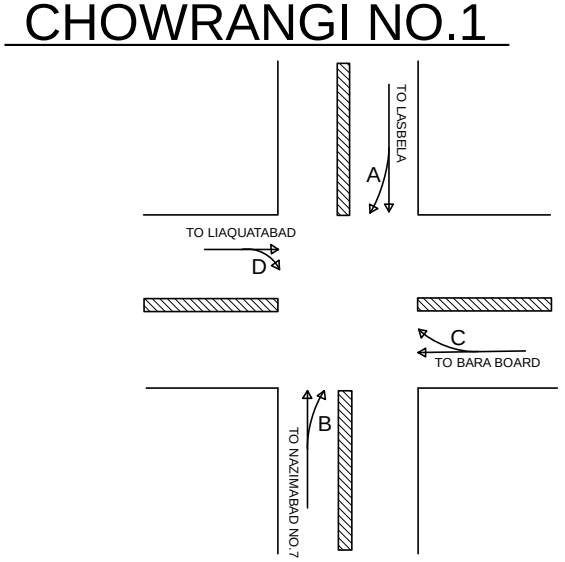
Source: T&C Department, CDGK

Figure 4-2-11 The Phase of Traffic Signal (Gurmandir, Numaish, Lasbela)



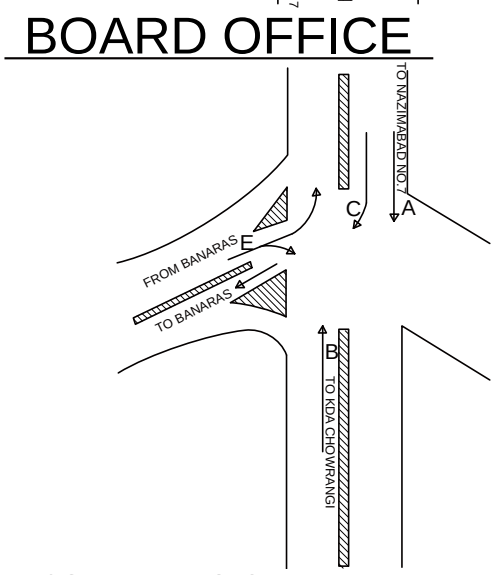
STAGE DIAGRAM

TIMINGS	B A	C D	G E	F H	
MORNING PEAK 8.00 AM - 1.00 PM	40	20	25	25	
AFTERNOON 1.00 PM - 4.00 PM	40	20	30	20	
EVENING PEAK 4.00 PM - 8.00 PM	50	20	40	20	
LATE EVENING 8.00 PM - 1.00 AM	50	30	30	20	
AFTER 1.00 AM	Flash	Flash	Flash	Flash	



STAGE DIAGRAM

TIMINGS	A	B	C	D	
MORNING PEAK 8.00 AM - 1.00 PM	50	40	20	25	
AFTERNOON 1.00 PM - 4.00 PM	50	40	20	25	
EVENING PEAK 4.00 PM - 11.59 PM	50	40	20	25	
AFTER 0.00 AM	Flash	Flash	Flash	Flash	

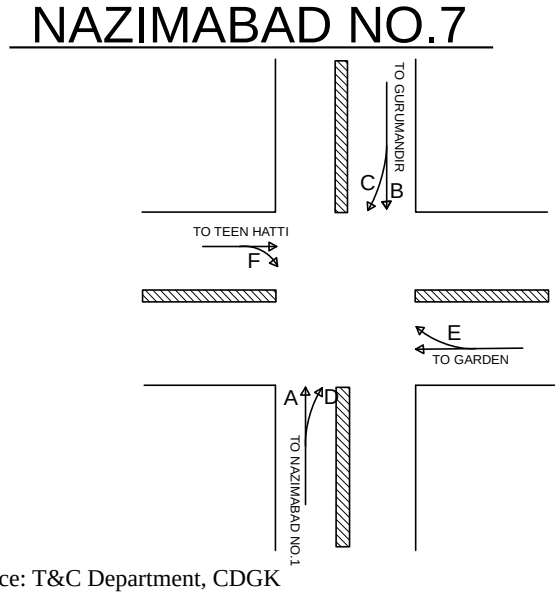


STAGE DIAGRAM

TIMINGS	B A	C A	E		
MORNING PEAK 8.00 AM - 1.00 PM	35	60	24		
AFTERNOON 1.00 PM - 4.00 PM	35	60	24		
EVENING PEAK 4.00 PM - 8.00 PM	35	60	24		
LATE EVENING 8.00 PM - 11.59 PM	35	60	24		
AFTER 0.00 AM	Flash	Flash	Flash		

Source: T&C Department, CDGK

Figure 4-2-12 The Phase of Traffic Signal (Five Star, Chowrangi No.1, Board Office)



STAGE DIAGRAM

TIMINGS	A B	C D	E	F	
MORNING PEAK 8.00 AM - 1.00 PM	60	25	25	25	
AFTERNOON 1.00 PM - 4.00 PM	54	20	25	25	
EVENING PEAK 4.00 PM - 8.00 PM	50	20	28	28	
LATE EVENING 8.00 AM - 11.59 PM	44	20	26	26	
NIGHT TIME 0.00 AM - 8.00 AM	36	20	20	20	

Source: T&C Department, CDGK

Figure 4-2-13 The Phase of Traffic Signal (Nazimabad No.7)

4.2.8 Fare System

Currently, flat fare system is proposed for BRT, because of easy management of fare collection and convenient transfer between Green Line and Red Line. It is necessary to ensure fare collection to avoid any fare evasion. Fare collection before boarding is commonly used method. In case of distance base fare system is employed, passengers need to keep their ticket during their journey and put it into the ticket machine when they leave the station. This will increase the project cost and will not be applied in the initial stage of the project.

The fare level of BRT is considered as Rs.20. Fare integration between BRT and existing minibuses is not proposed at present. This means that bus passengers who use feeder buses for both start and end need to pay approximately Rs.50 (Rs. 15 + 20 + 15) for one trip.

Recently, magnetic type ticket is more popular than coin type ticket for a ticket gate because the maintenance of magnetic ticketing system is easier than that of coin type, which requires complex mechanism to deal with coin in the ticket gate machine. Contactless smartcard is more reasonable than other types because it need not feed the ticket into the ticket gate machine. Magnetic ticket and smartcard enables discount usage such as commuter ticket, elderly ticket, visitor's ticket, and so on. These tickets can be sold or charged at shops near stations which can reduce the congestion at ticket booths in stations.

Chapter 5 Vehicle Plan

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

Chapter 6 Infrastructure Design

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

Chapter 7 Environment and Social Considerations

7.1 Screening and Categorization of the Project

Category A projects defined by the JICA Guidelines generally include i) vital sectors, such as transportation, having sensitive characteristics, or ii) projects located in or around sensitive areas. Moreover, a project causing large-scale involuntary resettlement is classified under Category A project. A project is classified as Category B if potential adverse impacts on the environmental and society are less adverse than those of Category A projects.

As above there is a possibility that the Karachi Transportation Improvement Project (KTIP) could be classified as a Category B project since it is proposed to take place along the centre of the existing wide roads in the already developed area of Karachi and therefore there will be no involuntary resettlement involved in the project area.

According to Pakistan Environmental Protection Agency Regulation, 2000, a proponent of a project falling in any category listed in Schedule II shall file an EIA with the Federal Agency. Since the listed projects are generally major national projects and that they cause potential effect on a large number of people.

The KTIP Project is expected to be classified in the “Federal or Provincial highways or major roads (except maintenance, rebuilding or reconstruction of existing roads) with total cost of Rs. 50 million and above” in Schedule II. The Project needs to proceed into the official procedure for EIA approval prescribed in Pakistan legislation. Therefore, it is suggested that KMC, as the project proponent, should follow the necessary steps on the EIA before implementation of the project.

7.2 Scoping of the Environmental Impacts

Potential impacts on the natural and social environment during the pre-construction, construction and operation stages of the Project have been initially identified using the environmental scoping list and matrices. The results are shown in Table 7-2-1.

Table 7-2-1 Preliminary Scoping of Environmental and Social Impacts

Item	Pre-Construction / Construction Stage	Operation Stage	Description
Pollution control			
1. Air pollution	B-	B+	Some negative impacts on air quality are expected due to operation of heavy equipment/ vehicles as well as traffic jam incidental to construction works, although the expected impacts will be temporary during the construction stage It is expected that emission of air pollutants will be reduced due to the modal shifting of transportation from passenger cars/ buses to the new transportation system.
2. Water pollution	C-	D	Some impacts on water quality would be caused by the turbid water generated from construction yards of digging works, although the expected impacts will be temporary during construction stage. The facilities associated to the new transportation system will be operated according to the Pakistan regulations related to managing the Waste or effluent. Therefore, it is not expected to bring about the serious impacts on water quality in operation stage.
3. Soil Contamination	C-	D	There are no project components or activities, which cause the soil pollution. However, in case that the soil at the construction sites is already contaminated by other reasons, the construction activity of the Project may cause the negative impacts.

Item	Pre-Construction / Construction Stage	Operation Stage	Description
4. Solid Waste and/or Industrial Discharge	B-	D	It is expected that the Project will generate the construction waste in the construction stage. The solid waste from the facilities associated to the new transportation system will be managed according to the Pakistan regulations and guidelines concerned, then it is not expected to cause the serious impacts.
5. Noise and vibration	B-	B+	Some impacts of noise and vibration are expected due to the operation of the heavy equipment/vehicles, although the expected impacts will be temporary during the construction stage. It is expected that emission of noise and vibration will be reduced due to the modal shifting of transportation from passenger cars/buses to the new transportation system.
6. Ground subsidence	D	D	There are no project components or activities that may cause the negative impacts on the ground subsidence since there is no underground section..
7. Odor	D	D	There are no project components or activities that may cause the offensive odor.
8. Bottom sediment	D	D	There are no project components or activities that may cause the negative impacts on the water bottom/sediment to which aquatic life depends.
Natural Environment			
9. Geographical Conditions and Geological Conditions	D	D	Since the alignment of corridor is made along the existing trunk roads, it is not expected that the Project will bring about the significant change or impacts on geographical and geological conditions
10. Soil Erosion	D	D	Since the alignment of corridor is made along the existing trunk roads, it is not expected that the Project will cause soil erosion.
11. Flora	B-	D	There is a possibility of clearing a large number of trees on the road center's green-belt as well as the sidewalk where the stations and equipment for new transportation system are constructed.
12. Fauna	D	D	Negative impacts are not expected on the faunal ecology and biodiversity to be protected, since the most of the Project alignment is designed in developed urban area and out of protected areas.
13. Ground Water	D	D	There is no project component or activity, which would cause the significant change or impacts on the ground water in and around the Project area.
14. Water Body (River, Lakes, etc.)	D	D	There is no project component or activity, which would cause the significant change or impacts on hydrological conditions in and around the Project area.
15. Coastal Environment	D	D	There is no effect on the coastal environment in and around the Project area.
16. Oceanographic	D	D	There is no project component or activity, which would cause the significant change or impacts on Oceanographic conditions in and around the Project area.
17. Natural/Ecological Reserves and Sanctuaries	D	D	Negative impacts are not expected, since the Project alignment is designed in developed urban area and out of the ecological reserves and sanctuaries.
Social Environment			

Item	Pre-Construction / Construction Stage	Operation Stage	Description
18.Involuntary Resettlement	D	D	BRT system is proposed to take place along the centre of the existing wide roads in the already developed area of Karachi and therefore there will be no involuntary resettlement involved in the project area.
19 Local economies (employment, livelihood, etc.)	B+	B+	Some positive effect on the local economy is expected because of possible increment of business/ employment opportunity generated by the project implementation. During operation stage, convenience of passenger of new transportation system would improve commercial activities or commuting to work of the local population along the corridors. Although there are 36 of kiosks on the sidewalk where the pedestrian bridges for the S-21 station of Red Line is planned to construct are subject to relocation, there is no kiosk owner who loses his/her business or those who do not have places to re-establish their present business as they are allowed to move to near-by sidewalk or market place at their own discretion without any extra cost.
20. Water right	D	D	No impact on water use or water right is expected due to the project implementation.
21. Land use and utilization of local resources	D	C-	Since the alignment of corridor is made along the existing trunk roads, extent of changing the land use condition during the construction stage is expected to be negligible. There is no project component or activity which would cause the change of land use condition in operation stages. However, it would be undeniable to cause the land use change secondarily due to the operation of new stations. Negative extent of the secondary change of land use would be necessary to be examined further.
22. Social institutions and community	D	D	Since the alignment of corridor is made along the existing trunk roads, no significant part of the local community would be divided by the Project.
23. Existing social infrastructures and services	B-	B+	Some negative impacts on the existing traffic conditions are expected due to the traffic jam caused by the construction activities, although the expected impacts will be temporary during the construction stage. It is expected to improve the regional infrastructure through the project developing convenient transportation mode during the operation stage.
24. Poor, indigenous, or ethnic people	D	D	Since the alignment of corridor is made along the existing trunk roads, there is no project component or activity which would cause negative impacts additionally.
25.Misdistribution of benefits and damages	C-	C-	The feeling of inequality among the stakeholders might cause anxiety since those in the vicinity of stations would receive benefit from the Project than others Practically inequality among the stakeholders should take place since those in the vicinity of stations would receive benefit from the Project and the others away from the station areas would bear negative feeling on the Project.
26. Local conflicts of interest	C-	C-	It might be expected that inequality among stakeholder and misdistribution of benefit/ damage would cause the local conflict of interest unless the adequate public consultation is not arranged.
27. Gender and	D	D	Since the alignment of corridor is made along the existing trunk

Item	Pre-Construction / Construction Stage	Operation Stage	Description
Children's rights			roads, there is no project component or activity which would cause negative impacts additionally.
28. Cultural heritage	D	D	Since the alignment of corridor is made along the existing trunk roads, there are no project components or activities that may cause the negative impacts on effect on Cultural heritage.
29.Landscape	D	C+/-	There is a possibility of the part elevating section in center of Karachi city though the alignment of corridor is made along the existing trunk roads. As a result of the construction of this corridor, limited area of urban land use and the landscape should be changed to a limited extent.
30. Infectious diseases such as HIV/AIDS	B-	D	During construction, increments of risks are probably expected on infectious diseases among the construction workforce.
31. Public Hygiene	B-	D	During construction, sanitary condition will be deteriorated for wastewater, dust, solid waste from the construction sites.
32. Working conditions (including occupational safety)	B-	B-	Increment of the risks on traffic safety is expected due to the operation of heavy equipment and heavy vehicles during the construction stage. Increment of the risks on traffic safety is expected due to the new traffic services in the operation stage.
Others			
33. Accident and Hazard	B-	D	There is a possibility of accident hazard due to operation of the construction heavy vehicles, though the project is not special method of construction and traffic system.
34. Local Climate	D	D	It is not expected that the Project will cause the significant change on the regional meteorological condition.
35. Global warming	B-	B+	The possibility of increased Greenhouse Gas (GHG) emission is expected due to the operation of heavy vehicles as well as traffic jam incidental to the construction works, although the expected probability will be temporary during the construction stage. It is expected that the GHG emission would be reduced due to the modal shifting of transportation from passenger cars/ buses to the new transportation system.

Note: * Regarding the impacts on "Gender" and "Children's Right", might be related to all criteria of Social Environment.
Rating

A+/-: Significant positive / negative impact is expected.

B+/-: Positive / negative impact is expected to some extent.

C+/-: Extent of positive / negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progress)

D: No impact is expected

Overall rating: Highest rate among the rating of relevant project activities for negative and positive ratings is considered as the overall rating of the Project as a whole i.e. even only one "A-" is included in the above scoping matrix, overall rating of the project in terms of the environmental assessment becomes "A-".

Reference: Appendix 5 of JICA Guidelines for Environmental and Social considerations (April 2010)

Source: JICA Study Team for KTIP

7.3 Preliminary Environmental Impact Assessment

7.3.1 BRT-Green Line

During the Feasibility Study stage, potential impacts on the natural and social environment during the pre-construction, construction and operation stages of the Project of BRT-Green Linehas been identified using the environmental scoping list and matrices. The results are shown in Table 7-3-1.

Key areas of concern on the natural environment is felling of trees planted on the road center's green belt and sidewalks. During the early stage of the project study, at the time of initial environmental examination, all of the trees within the project implementation area are subject to felling. Later, the project design has been so changed that the trees are fell down in the areas where bus stations are constructed. Project design also considered to construct all of its facilities within the publicly owned land area i.e. No involuntary resettlement is involved in the implementation of BRT-Green Line.

Table 7-3-1 Environmental Scoping Matrix for BRT-Green Line

				Project-related Activities							
				Pre-Construction Stage		Construction Stage				Operation Stage**	
	No.	Likely Impacts	Overall Rating	Land acquisition	Change of land use plan, control of various activities by regulations for the construction	Land clearing / tree cutting	Operation of construction equipment and vehicles	Construction of exclusive lane, station, pedestrian bridges and other related facilities	Traffic restriction in construction area	Operation of Buses	Appearance / occupancy of lane and related facilities
Pollution	1	Air pollution	B+/-	D	D	D	B-	B-	B-	B+	D
	2	Water pollution	C-	D	D	D	D	C-	D	D	D
	3	Soil contamination	C-	D	D	D	D	C-	D	D	D
	4	Solid Waste and/or Industrial Discharge	B-	D	D	B-	D	B-	D	D	D
	5	Noise and vibration	B+/-	D	D	D	B-	B-	B-	B+	D
	6	Ground subsidence	D	D	D	D	D	D	D	D	D
	7	Odor	D	D	D	D	D	D	D	D	D
	8	Bottom sediment	D	D	D	D	D	D	D	D	D
Natural Environment	9	Geographical Conditions and Geological Conditions	D	D	D	D	D	D	D	D	D
	10	Soil Erosion	D	D	D	D	D	D	D	D	D
	11	Flora	B-	D	D	B-	D	D	D	D	D
	12	Fauna	D	D	D	D	D	D	D	D	D
	13	Ground Water	D	D	D	D	D	D	D	D	D
	14	Water Body (River, Lakes, etc.)	D	D	D	D	D	D	D	D	D
	15	Coastal Environment	D	D	D	D	D	D	D	D	D
	16	Oceanographic	D	D	D	D	D	D	D	D	D
	17	Natural/Ecological Reserves and Sanctuaries	D	D	D	D	D	D	D	D	D
Social Environment*	18	Involuntary Resettlement	D	D	D	D	D	D	D	D	D
	19	Local economies (employment, livelihood, etc.)	B+	D	D	D	B+	B+	D	B+	D
	20	Water right	D	D	D	D	D	D	D	D	D
	21	Land use and utilization of local resources	C-	D	D	D	D	D	D	D	C-
	22	Social institutions and community	D	D	D	D	D	D	D	D	D
	23	Existing social infrastructures and	B+/-	D	D	D	D	D	B-	B+	D

	No.	Likely Impacts	Overall Rating	Project-related Activities							
				Pre-Construction Stage		Construction Stage				Operation Stage**	
				Land acquisition	Change of land use plan, control of various activities by regulations for the construction	Land clearing / tree cutting	Operation of construction equipment and vehicles	Construction of exclusive lane, station, pedestrian bridges and other related facilities	Traffic restriction in construction area	Operation of Buses	Appearance / occupancy of lane and related facilities
		services									
	24	Poor, indigenous, or ethnic people	D	D	D	D	D	D	D	D	D
	25	Misdistribution of benefits and damages	C-	D	C-	D	D	D	D	D	C-
	26	Local conflicts of interest	C-	D	C-	D	D	D	D	D	C-
	27	Gender and Children's rights	D	D	D	D	D	D	D	D	D
	28	Cultural heritage	D	D	D	D	D	D	D	D	D
	29	Landscape	C+/-	D	D	D	D	D	D	D	C+/-
	30	Infectious diseases such as HIV/AIDS	B-	D	D	D	B-	B-	D	D	D
	31	Public Hygiene	B-	D	D	D	B-	B-	D	D	D
	32	Working conditions (including occupational safety)	B-	D	D	B-	B-	B-	D	B-	D
Others	33	Accident and Hazard	B-	D	D	B-	D	D	D	D	D
	34	Local Climate	D	D	D	D	D	D	D	D	D
	35	Global warming	B+/-	D	D	B-	B-	B-	B-	B+	D

Note: * Regarding the impacts on "Gender" and "Children's Right", might be related to all criteria of Social Environment.
Rating

A+/-: Significant positive / negative impact is expected.

B+/-: Positive / negative impact is expected to some extent.

C+/-: Extent of positive / negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progress)

D: No impact is expected

Overall rating: Highest rate among the rating of relevant project activities for negative and positive ratings is considered as the overall rating of the Project as a whole i.e. even only one "A-" is included in the above scoping matrix, overall rating of the project in terms of the environmental assessment becomes "A-".

Reference: Appendix 5 of JICA Guidelines for Environmental and Social considerations (April 2010)

Source: JICA Study Team for KTIP

7.3.2 BRT-Red Line

During the Feasibility Study stage, potential impacts on the natural and social environment during the pre-construction, construction and operation stages of the Project of BRT-Red Line has been identified using the environmental scoping list and matrices. The results are shown in Table 7-3-2.

Key areas of concern on the natural environment is felling of trees planted on the road center's green belt and sidewalks. During the early stage of the project study, at the time of initial environmental examination, all of the trees within the project implementation area are subject to felling. Later, the project design has been so changed that the trees are fell down in the area where bus stations are constructed. Project design also considered to construct all of its facilities within the publicly owned land area i.e. No involuntary resettlement is involved in the implementation of BRT-Red Line.

Table 7-3-2 Environmental Scoping Matrix for BRT-Red Line

	No.	Likely Impacts	Overall Rating	Project-related Activities							
				Pre-Construction Stage		Construction Stage				Operation Stage**	
				Land acquisition	Change of land use plan, control of various activities by regulations for the construction	Land clearing / tree cutting	Operation of construction equipment and vehicles	Construction of exclusive lane, station, pedestrian bridges and other related facilities	Traffic restriction in construction area	Operation of Buses	Appearance / occupancy of lane and related facilities
Pollution	1	Air pollution	B+/-	D	D	D	B-	B-	B-	B+	D
	2	Water pollution	C-	D	D	D	D	C-	D	D	D
	3	Soil contamination	C-	D	D	D	D	C-	D	D	D
	4	Solid Waste and/or Industrial Discharge	B-	D	D	B-	D	B-	D	D	D
	5	Noise and vibration	B+/-	D	D	D	B-	B-	B-	B+	D
	6	Ground subsidence	D	D	D	D	D	D	D	D	D
	7	Odor	D	D	D	D	D	D	D	D	D
	8	Bottom sediment	D	D	D	D	D	D	D	D	D
Natural Environment	9	Geographical Conditions and Geological Conditions	D	D	D	D	D	D	D	D	D
	10	Soil Erosion	D	D	D	D	D	D	D	D	D
	11	Flora	B-	D	D	B-	D	D	D	D	D
	12	Fauna	D	D	D	D	D	D	D	D	D
	13	Ground Water	D	D	D	D	D	D	D	D	D
	14	Water Body (River, Lakes, etc.)	D	D	D	D	D	D	D	D	D
	15	Coastal Environment	D	D	D	D	D	D	D	D	D
	16	Oceanographic	D	D	D	D	D	D	D	D	D
	17	Natural/Ecological Reserves and Sanctuaries	D	D	D	D	D	D	D	D	D
Social Environment*	18	Involuntary Resettlement	D	D	D	D	D	D	D	D	D
	19	Local economies (employment, livelihood, etc.)	B+	D	D	D	B+	B+	D	B+	D
	20	Water right	D	D	D	D	D	D	D	D	D
	21	Land use and utilization of local resources	C-	D	D	D	D	D	D	D	C-
	22	Social institutions and community	D	D	D	D	D	D	D	D	D
	23	Existing social infrastructures and services	B+/-	D	D	D	D	D	B-	B+	D
	24	Poor, indigenous, or ethnic people	D	D	D	D	D	D	D	D	D
	25	Misdistribution of benefits and damages	C-	D	C-	D	D	D	D	D	C-
	26	Local conflicts of interest	C-	D	C-	D	D	D	D	D	C-
	27	Gender and Children's rights	D	D	D	D	D	D	D	D	D
	28	Cultural heritage	D	D	D	D	D	D	D	D	D
	29	Landscape	C+/-	D	D	D	D	D	D	D	C+/-

	No.	Likely Impacts	Overall Rating	Project-related Activities							
				Pre-Construction Stage		Construction Stage				Operation Stage**	
				Land acquisition	Change of land use plan, control of various activities by regulations for the construction	Land clearing / tree cutting	Operation of construction equipment and vehicles	Construction of exclusive lane, station, pedestrian bridges and other related facilities	Traffic restriction in construction area	Operation of Buses	Appearance / occupancy of lane and related facilities
Social Environment	30	Infectious diseases such as HIV/AIDS	B-	D	D	D	B-	B-	D	D	D
	31	Public Hygiene	B-	D	D	D	B-	B-	D	D	D
	32	Working conditions (including occupational safety)	B-	D	D	B-	B-	B-	D	B-	D
Others	33	Accident and Hazard	B-	D	D	B-	D	D	D	D	D
	34	Local Climate	D	D	D	D	D	D	D	D	D
	35	Global warming	B+/-	D	D	B-	B-	B-	B-	B+	D

Note: * Regarding the impacts on "Gender" and "Children's Right", might be related to all criteria of Social Environment.
Rating

A+/-: Significant positive / negative impact is expected.

B+/-: Positive / negative impact is expected to some extent.

C+/-: Extent of positive / negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progress)

D: No impact is expected

Overall rating: Highest rate among the rating of relevant project activities for negative and positive ratings is considered as the overall rating of the Project as a whole i.e. even only one "A-" is included in the above scoping matrix, overall rating of the project in terms of the environmental assessment becomes "A-".

Reference: Appendix 5 of JICA Guidelines for Environmental and Social considerations (April 2010)

Source: JICA Study Team for KTIP

7.4 Implementation of EIA Study

7.4.1 Selection of Local Consultant

Selection of the local consultant for EIA study for KTIP Project took place in Karachi, Pakistan in December 2011 in accordance with the JICA's Guidelines for the procurement of the subcontractor 2006. As a result, EMC based in Karachi, Pakistan has been awarded for the EIA Study package of KTIP Project. EIA study has been conducted between January 2012 to April 2012 in accordance with Pakistan's guidelines for EIA study as well JICA guidelines for the Environment and Social Consideration as per the conditions of the contract for EIA study.

7.4.2 Contents of EIA Study

Contents of EIA Study are as follows:

- Study/survey for obtaining baseline data on the natural and social environment;
- Examination of alternative KTIP plans and their impacts on the environment;
- Analysis of the Environmental Impacts caused by the Project ;
- Elaboration of the Environmental Mitigation Measures;
- Elaboration of the Environmental Management and Monitoring Plans;
- Holding Stakeholder Meetings for Dissemination of information of the Project as well as to Input of the opinions of the stakeholders; and

- Elaboration of EIA Report in the form acceptable to Pakistan's Environmental Protection Agency for KMC to obtain "No Objection Certificate (NOC)".

Focal areas to be addressed in EIA Study are shown in Table 7-4-1.

Table 7-4-1 List of Study for EIA

Category	Items of Study	
Pollution Control	Air Pollution Water Pollution Soil Contamination	Noise and Vibration Solid Waste and/or Industrial Discharge
Natural Environment	Floral Ecology	
Social Environment	Local Economies (Employment, livelihood, etc.) Land use & utilization of local resources Existing social infrastructures & services Misdistribution of benefits & damages Local conflicts of interest	Landscape Infectious diseases such as HIV/AIDS Public Hygiene Working conditions (including occupational safety)
Others	Global warming	

7.4.3 Methodology of EIA Study

(1) Primary Data Collection

1) Physico-chemical Survey

Primary surveys are conducted for soil, groundwater, air, noise and vibration along the project area as a part of the study of pollution control parameters of the environment in the study area.

2) Biological Survey

For floral environment, using the direct counting method for all of the tree species affected by the Project has been conducted for assessing the impacts on bio-diversity within the study area.

For the faunal environment, secondary data gathering and interviewing of key-informants within the project area are conducted in order to identify faunal species affected by the Project.

3) Stakeholder Meeting and Hearing Survey

During the EIA study period, stakeholder meetings are held as follows:

a. Initial Stakeholder Meeting
   - One at appropriate location in each of Green and Red Line for the purpose of information dissemination on the outline of the project

b. Second Stakeholder Meeting
   - At the location of initial stakeholder meeting on the Green and Red Line for information dissemination of the result of EIA Study

Hearing of the local opinion on the Project as a result of stakeholder meeting held two times during the study period, as well as to hear from the local people running small business that are directly affected by the Project are carried out in order to obtain primary data by the opinion survey as a part of socio-economic baseline data.

(2) Secondary Data Collection

Secondary data collection based on the published data on land use, socio-economics, demography, legal aspects related to EIA study are carried out throughout the study period. Sources of secondary data will be any form of data sets, reports, papers and publications put out by the central and local governments, central and local educational institutions, international donor organizations including JST's master plan study results, and international and domestic NGOs reports relevant to the Project.

(3) Impact Analysis using Matrix System

Scoping is a tool which gives direction for selection of impacts due to the project activities on the environment. As a part of the study, scoping exercise was conducted selecting various types of impacts which can accrue due the Project as per Section 7.2. Based on the project features, site conditions, and the environmental conditions on site, various parameters to be covered as a part of EIA study are selected for further in-depth analysis and that the results are presented in a matrix of environmental impacts.

7.5 Review of Institutional and Legal Framework

7.5.1 Legal Framework for EIA

During EIA study, the laws, regulations and guidelines related to the environmental and social considerations in Pakistan are reviewed. Major laws, regulations and guideline directly governing the EIA study for the Project are listed as follows:

- Pakistan Environment Protection Ordinance (PEPO), 1983;
- Pakistan Environmental Protection Act (PEPA), 1997;
- National Environmental Policy 2005;
- Guidelines for the Preparation and Review of Environmental Reports (1997);
- Guidelines for Public Consultation (1997);
- Sector Guidelines for Preparation of Environmental Reports;
- Pak-EPA (Review of IEE and EIA) Regulations, 2000;
- National Resettlement Policy (2002);
- Project Implementation and Resettlement of Affected Persons Ordinance 2001;
- The Sindh Katchi Abadis Act, 1987; and
- Sindh Public Procurement Rules 2010

In 1983, Pakistan Environment Protection Ordinance (PEPO) was passed as the first substantive policy on the environment in Pakistan. This highlighted the need to have a framework of environmental laws in Pakistan in order to address emerging national issues. PEPO had three goals for the country's environmental protection effort, which are conservation of natural resources, promotion of sustainable development, and improvement of efficiency in the use and management of resources. Fourteen program areas were targeted for priority implementation, including energy efficiency improvements, renewable resource development/ deployment, pollution prevention/reduction, waste management, institutional support of common resources, and integration of population and environmental programs. It is unfortunate that PEPO has remained largely unimplemented.

The Pakistan Environmental Protection Act (PEPA) was enacted on 6th December 1997, repealing the PEPO of 1983. The PEPA of 1997 provides the framework for implementation of National Conservation Strategy (NCS), Establishment of Provincial Sustainable Development Funds, Protection and Conservation of Species, Conservation of Renewable Resources, Establishment of Environmental Tribunals as well as the appointment of Environmental Magistrates, and Framework for Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA).

National Environmental Policy 2005 provides an overarching framework for addressing the environmental issues facing Pakistan. This provides broad guidelines to the Federal Government, Provincial Government, Federally Administrated Territories and Local Government for addressing environmental concerns and ensuring effective management of their environmental resources.

Sindh Public Procurement Rules 2010 provides rules of purchasing goods and services within Sindh Province of Pakistan. It states, in the Article5 "Conflict with International and Inter-Governmental Agreements" as follows.

> *In the event that these rules are inconsistent with, or in conflict with, any obligation or commitment of Government arising out of an international treaty or an agreement with a foreign country or countries, or any international financial institution, the provisions of such international treaty or agreement shall override the provisions of these Rules to the extent of that inconsistency or conflict as the case may be.*

7.5.2 National Environmental Quality Standards

National Environmental Quality Standards (NEQS) were first promulgated in 1993 and were amended in 1995 and 2000. The following standards are specified:

- Ambient Air;
- Allowable concentration of pollutions in gaseous emissions from industrial sources;
- Motor vehicle exhaust and noise; and
- Allowable concentration of pollutions in Municipal and liquid industrial effluents and industrial gaseous emissions.

(1) Air quality

Table 7-5-1 shows national environmental quality standard for ambient air.

Table 7-5-1 National Environmental Quality Standard for Ambient Air

Pollutant	Time-weighted average	Concentration in Ambient Air		Method of measurement
		Effective from 1st July, 2010	Effective from 1st January, 2013	
Sulfur Dioxide (SO_2)	Annual Average*	80μg/m^3	80μg/m^3	Ultraviolet Fluorescence Method
	24 hours**	120μg/m^3	120μg/m^3	
Oxides of Nitrogen as (NO)	Annual Average*	40μg/m^3	40μg/m^3	Gas Phase Chemiluminescence
	24 hours**	40μg/m^3	40μg/m^3	
Oxides of Nitrogen as (NO_2)	Annual Average*	40μg/m^3	40μg/m^3	Gas Phase Chemiluminescence
	24 hours**	80μg/m^3	80μg/m^3	
O_3	1 hour	180μg/m^3	130μg/m^3	Non dispersive UV absorption méthode
Suspended Particulate Matter (SPM)	Annual Average*	400μg/m^3	360μg/m^3	High volume Sampling, (Average flow rate not less than 1.1m^3/minute)
	24 hours**	550μg/m^3	500μg/m^3	
Respirable Particulate Matter (PM_{10})	Annual Average*	200μg/m^3	120μg/m^3	B Ray absorption method
	24 hours**	250μg/m^3	150μg/m^3	
Resipirable Particulate Matter ($PM_{2.5}$)	Annual Average*	25μg/m^3	15μg/m^3	B Ray absorption method
	24 hours**	40μg/m^3	35μg/m^3	
	1 hour	25μg/m^3	15μg/m^3	
Lead (Pb)	Annual	1.5μg/m^3	1μg/m^3	ASS Method after

Pollutant	Time-weighted average	Concentration in Ambient Air		Method of measurement
		Effective from 1st July, 2010	Effective from 1st January, 2013	
	Average*			sampling using EPM 2000 or equivalent Filter paper
	24 hours**	2μg/m^3	1.5μg/m^3	
Carbon Monoxide (CO)	8hours**	5mg/m^3	5mg/m^3	Non Dispersive Infra Red (NDIR) method
	1hours	10mg/m^3	10mg/m^3	
*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval. **24 hourly / 8 hourly values should be met 98% of the in a year. 2% of the time, it may exceed but not on two consecutive days.				

Source: Advertisement regarding public opinion/comments on national standards for ambient air (PEPA)

(2) Noise

Table 7-5-2 shows the standards for motor vehicle noise.

Table 7-5-2 The Motor Vehicle Ordinance (1965) and Roles (1969)

Parameter	Standards (maximum permissible limit)	Measuring method
Noise	85dB(A)	Sound-meter at 7.5meter from the source

Source: Statutory Notification, SRO-7-2(KE)/2009, dated May 16, 2009, Ministry of Environment, Government of Pakistan.

Table 7-5-3 shows the proposed national environmental quality standard for noise.

Table 7-5-3 Proposed National Environmental Quality Standard for Noise

S. No.	Category of Area / Zone	Effective from 1st January, 2009		Effective from 1st January, 2010	
		Limit it in dB(A) Leq*			
		Day Time	Night Time	Day Time	Night Time
1	Residential area (A)	65	50	55	45
2	Commercial area (B)	70	60	65	55
3	Industrial area (C)	80	75	75	65
4	Silence Zone (D)	55	45	50	45

Note: 1 Day time hours: 6.00 a. m to 10.00 p. m
2 Night time hours: 10.00 p. m to 6.00p. m
3 Silence zone; Zone which are declared as such by competent authority. An area comprising not less than 100 meters around hospitals, educational institutions and courts.
4 Mixed categories of areas may be declared as one of the four above-mentioned categories by the competent authority.
*dB(A)Leq Time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.

Source: Advertisement regarding public opinion/comments on national standards for noise (Pak-EPA)

(3) Water quality

The national environmental quality standards for municipal and liquid industrial effluents has been established for the control of the pollution and gone through modifications since 1993 as Statutory Notification by the Ministry of Environment, Local Government and Rural Development, Pakistan. The Standards limit the concentration of a number of quality parameters for discharge into the national waters as shown Table 7-5-4.

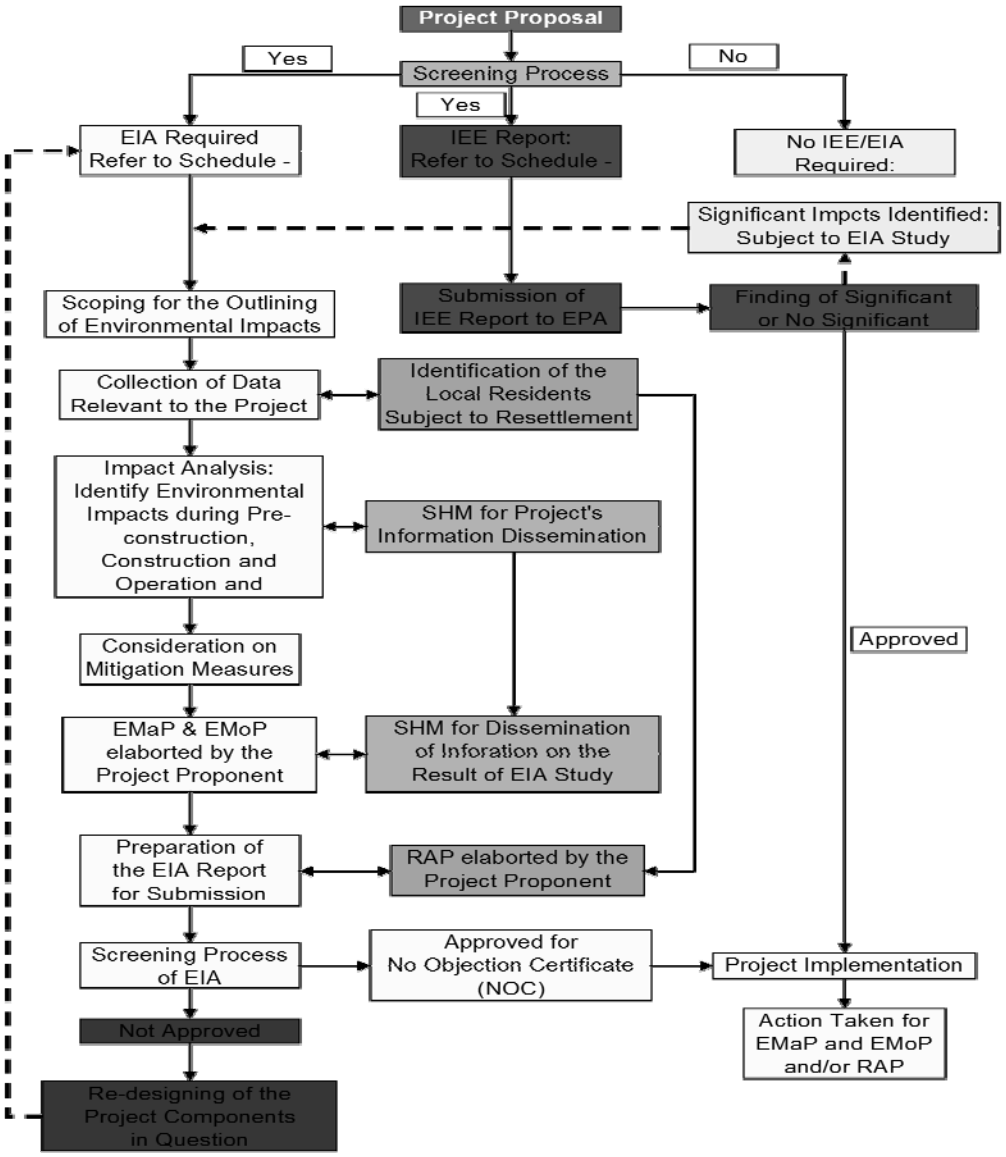
Table 7-5-4 NEQS for Municipal and Liquid Industrial Effluents

S. No.	Parameter	Inland Waters	Sewage Treatment	Sea Waters	Unit
1	Temperature or Temp. increase	<3	<3	<3	^oC
2	pH value (H^+)	6-9	6-9	6-9	
3	Biological Oxygen Demand $(BOD)_5$ at 20 ^oC	80	250	80	mg/l
4	Chemical Oxygen Demand $(COD)_{Cr}$	150	400	400	mg/l
5	Total Suspended Solids (TSS)	200	400	200	mg/l
6	Total Dissolved Solids (TDS)	3500	3500	3500	mg/l
7	Oil and Grease	10	10	10	mg/l
8	Phenolic Compounds (as Phenol)	0.1	0.3	0.3	mg/l
9	Chloride (as Cl^-)	1000	1000	SC	mg/l
10	Fluoride (as F^-)	10	10	10	mg/l
11	Cyanide (as CN^-)total	1.0	1.0	1.0	mg/l
12	An-ionic detergents (as MBAS)	20	20	20	mg/l
13	Sulphate(SO_4^{2-})	600	1000	SC	mg/l
14	Sulphide(S^{2-})	1.0	1.0	1.0	mg/l
15	Ammonia (NH_3)	40	40	40	mg/l
16	Pesticides	0.15	0.15	0.15	mg/l
17	Cadmium	0.1	0.1	0.1	mg/l
18	Chromium (trivalent and hexavalent)	1.0	1.0	1.0	mg/l
19	Copper	1.0	1.0	1.0	mg/l
20	Lead	0.5	0.5	0.5	mg/l
21	Mercury	0.01	0.01	0.01	mg/l
22	Selenium	0.5	0.5	0.5	mg/l
23	Nickel	1.0	1.0	1.0	mg/l
24	Silver	1.0	1.0	1.0	mg/l
25	Total toxic metals	2.0	2.0	2.0	mg/l
26	Zinc	5.0	5.0	5.0	mg/l
27	Arsenic	1.0	1.0	1.0	mg/l
28	Barium	1.5	1.5	1.5	mg/l
29	Iron	8.0	8.0	8.0	mg/l
30	Manganese	1.5	1.5	1.5	mg/l
31	Boron	6.0	6.0	6.0	mg/l
32	Chlorine	1.0	1.0	1.0	mg/l

Source: Statutory Notification, SRO-549(1)/2000, dated August 10, 2000, Ministry of Environment, Local Government and Rural Development, Government of Pakistan.

7.5.3 Environmental Impact Assessment

Environmental issues and their control in Pakistan are in general, governed by PEPA. The act defines the terms of environmental issues including the way of EIA study to be conducted. The act makes it mandatory for the project proponents to carry out IEE or EIA of development projects and incorporate environmental impact mitigation measures as part of the project planning. Figure 7-5-1 shows the EIA process in Pakistan.



Source: Modified by JST based on "Faisal Aslam: ENVIRONMENTAL IMPACT ASSESSMENTIN PAKISTAN – OVERVIEW, IMPLEMENTATION AND EFFECTIVNESS, 2006

Figure 7-5-1 EIA Process in Pakistan

"Pakistan EPA (Review of IEE and EIA) Regulations, 2000" defines and regulates the procedure of IEE and EIA for projects implemented within the borders of Pakistan. Especially, schedule-II in this regulation defines projects requiring EIA study as follows:

> *The Projects in schedule-II are generally major Projects and have the potential to affect a large number of people. They also include Projects in environmentally sensitive areas. The impact of such Projects may be irreversible and could lead to significant changes in land use and the social, physical and biological environment.*

7.5.4 Social Environment

(1) Resettlement Policy

The laws and regulations regarding Resettlement Action Plan (RAP) in Pakistan are provided in National Resettlement Policy (2002). It is not only covering the affected persons (APs) subject to resettlement but also to ensure an equitable and uniform treatment of resettlement issues. This

policy defines objectives of policy as follows:

- Avoid or minimize adverse social impacts in a project wherever possible and where adverse impacts cannot be avoided, the mitigation measures and resettlement activities should be conceived and executed as development programs and the affected persons be provided opportunity to share the project benefits;
- APs be provided with sufficient compensation and assistance for lost assets, that will assist them to improve or at least restore their living standards, income earning or production capacity to the pre-project level;
- Provide a development opportunity to all vulnerable groups. The vulnerable populations should receive special assistance to bring them at least to a minimum living standard at par with the pre-project level; and
- All population adversely affected by the project, should be eligible for sharing the social and economic benefits, envisaged after completion of the project.

"National Resettlement Policy (2002)" is further supplemented by "Project Implementation and Resettlement of the Affected Persons Ordinance, 2002" that has to be adopted by state and local governments. This ordinance provides a comprehensive and detailed procedures and definitions for land acquisition and resettlement of the Affected Persons (APs).

(2) Policy on the Public Consultation

Pakistan Environmental Protection Agency has put out "Guidelines for Public Consultation" in October 1997 and it defines "Objectives of consultation" as follows:

Public involvement is a feature of environmental assessment and can lead to better and more acceptable decision-making. It can be time consuming and demanding, yet without it, proposals are seldom soundly based, and there is likely to be antagonism from affected people, Public involvement, undertaken in a positive manner and supported by a real desire to use the information gained to improve the proposal, will lead to better outcomes, and lay the basis for ongoing positive relationships between the participants. The objectives of public involvement include:

a) Informing the stakeholders about what is proposed;
b) Providing an opportunity for those otherwise unrepresented to present their views and values, therefore allowing mere sensitive consideration of mitigation measures and trade-offs;
c) Providing those involved with planning the proposal with an opportunity to ensure that the benefits of the proposal are maximized and that no major impacts have been overlooked;
d) Providing an opportunity for the public to influence project design in a positive manner;
e) Obtaining local and traditional knowledge (corrective and creative), before decision making;
f) Increasing public confidence in the proponent, reviewers and decision-makers;
g) Providing better transparency and accountability in decision making;
h) Reducing conflict through the early identification of contentious issues, and working through these to find acceptable solutions;
i) Increasing a sense of ownership of the proposal in the minds of the stakeholders; and
j) Developing proposals which are truly sustainable.

As above, Guidelines for Public Consultation introduces effective ways to inform contents of the Project to the general public during the planning stage and that eventually consensus building toward the implementation of project is reached.

Incorporating public involvement into the stages of environmental assessment is explained in the guidelines that public consultation meeting has to be carried out after the works on "developing options, and assessing and mitigating impacts" for comments and assessment.

7.5.5 JICA Guidelines for Environmental and Social Considerations

JICA Guidelines for Environmental and Social Considerations (hereinafter referred to as "JICA Guideline") is commonly applied to JICA's internationally funded projects for overseas economic cooperation. In order to contribute to sustainable development in developing countries, JICA confirms according to the guidelines that the project proponents are undertaking appropriate study on the environmental and social considerations through various measures so as to prevent or minimize impacts on the natural and social environment as project is implemented.

According to the JICA Guideline, "Environmental and Social Considerations Studies" means studies including socio-economic and natural environment baseline surveys, predicting and evaluating adverse impacts and likely impacts that projects are to cause on the environment and local society, and mitigation measures to avoid and minimize these impacts. The items that require investigating natural social environment are as follows:

- Natural environment in general
- Habitat of wildlife
- Resettlement
- Living and livelihood
- Heritage
- Landscape
- Ethnic minorities and indigenous peoples
- Working conditions (including occupational safety)

In addition, it is mandatory according to JICA Guidelines to investigate the following:

- Air quality
- Water quality
- Solid Waste and/or Industrial Discharge Management
- Soil Pollution
- Noise and vibration
- Subsidence
- Odor
- Sediment
- Protected areas
- Ecosystem
- Hydrology
- Topography and geology
- Management of abandoned sites

The impacts caused by the Project on these environmental parameters should be examined and prediction should be made for before during and after the implementation of the Project on the basis of intensity, irreversibility, and cumulative effects on the existing environment.

7.5.6 World Bank Operational Policies

In conjunction with JICA Guidelines, the World Bank Operational Manual BP 4.01 to BP 4.12, January 1999 will have to be used in reference to JICA Guidelines where necessary. General provisions of these operational manuals are essentially the same in its philosophy as provided in JICA Guidelines. However, in the case of resettlement compensation, these operational policies are more stringent in terms of the way APs are compensated against the loss of their property and working opportunities as well as the existing life style.

7.5.7 Other Guidelines on the Environmental and Social Considerations

Other guideline essential to refer to out are listed up as follows:

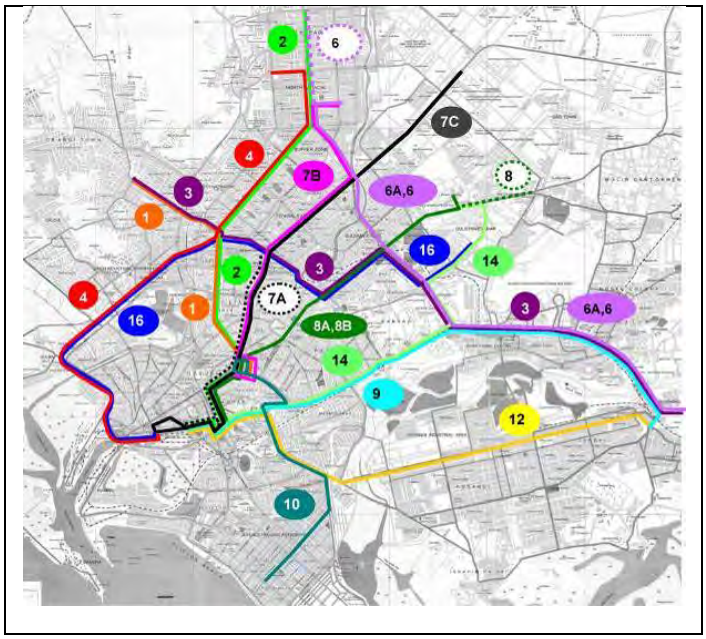
1) EIA for Development Countries in Asia, ADB, December 1997;
2) Handbook on Resettlement: A Guide to Good Practice, ADB, 1998;
3) Safeguard Policy Statement, ADB, June 2009.

The above guidelines are in general the same in its philosophy as provided in the World Bank Operational Manual BP 4.01 to BP 4.12.

7.6 Comparison of Alternative Scenarios

7.6.1 Master Plan's Optional Scenario Analysis

During the Master Plan study period, there have been a number of scenarios developed in order to carry out studies on comparison of various alternatives including "Do-nothing Scenario". As a result, a combination of MRT and BRT as per Figure 7-6-1 and Table 7-6-1 have become the most viable combination of options for the urban transportation development scenario in Karachi.



Source: Detailed Study on a Private/Public Partnership based on Environmental-friendly Public Transport System for Karachi

Figure 7-6-1 Concept of Karachi Urban Transportation Network

Table 7-6-1 List of Mass Transit Route in Master Plan

Code Name	System	Length	No. of stations
KCR	MRT	43.1 km	24
KCR Extension	MRT	14.5 km	11
Blue Line	MRT	22.4 km	18
Brown Line	MRT	18.5 km	16
Yellow Line	BRT	20.4 km	41
Green Line	BRT	12.7 km	25
Red Line	BRT	19.2 km	38
Orange Line	BRT	3.9 km	8
Purple Line	BRT	9.7 km	19
Aqua Line	BRT	11.8 km	24

Source: JICA Study Team

As a result of the analysis, the following is noted:

1) "Do-nothing" scenario simply cannot cater for transportation at any time in the future of the ever-increasing urban population and the current business development trend of Karachi;

2) Holistic approach of the urban transportation development scheme with the development of KCR at its core as precondition should be the most viable option;

3) Road development per se will remarkably improve along major corridor. However, serious traffic congestion should linger over decades;

4) KCR developed as MRT will improve the road traffic in CBD to some extent. However, road traffic congestion will still remain especially for radial directions;

5) Construction of a number of LRT in place of MRT or BRT will not be efficient in terms of cost vs. effectiveness in terms of revenue and cost of the operation and maintenance;

6) Development of elevated LRT or MRT causes a large number of resettlement as well as to cause direct impacts on national heritage sites in CBD area;

7) Developing one or two MRT lines per se would not be able to cater for the future demand of Karachi urban setting;

8) BRT network per se will not be the solution for the ever-increasing traffic demand in the future because of its capacity and impact on road traffic while cost implication could be viable to some extent. Thus the best option for the future mass transit network in Karachi should therefore be considered a mixture of MRT and BRT networks; and

9) The target of mass transit development should be the middle income people, who are using motorcycles as transport mode.

7.6.2 Selection of Corridor(s) for Feasibility Study

Based on the conclusions of Master Plan study on the analysis of alternative study, further selection process for the most viable and acutely necessary transportation corridor(s) took place in order to carry out feasibility study. As a result, the following is considered:

1) KMC originally intended to carry out BRT system based on ADB's study result i.e. JICA Study Team might be in need of studying one of the MRT plan;

2) Within the list of Table 7-6-1, Blue and Brown as MRT corridors have been considered appropriate to carry out followed by Red, Green and Yellow as BRT corridors;

3) During the stakeholder meetings held in March 2011, participants made a demand on bus route in preference to LRT or MRT;

4) Blue Line as MRT corridor is in need of 8 km long underground section in order to clear the geographical as well as geometrical difficulties i.e. the cost of construction will become as large as railway system like KCR; and

5) Brown Line would be much better if it was implemented after the completion of Blue Line in terms of transportation functionality.

As a result, conclusion was made that the Green and Red Line should be selected for feasibility study in view of them viable to implement as soon as possible.

7.6.3 Analysis of the Alternatives for Feasibility Study

(1) Do nothing Scenario vs. Other BRT Development

Analysis of alternatives for feasibility study is broadly divided into "Do it" or "Do nothing" since any BRT development brings positive effects on the socio-economic environment of Karachi as a whole.
"Do-Nothing" is a scenario analysed during the Master Plan study. It means that the improvement of only the existing bus services should takes place with the current plan of road system improvement. In case no action on the public transport is taken in the future, as has been in the past 20 years, the number of buses would not increase even if traffic demand increases. The following is thus noted:

1) It is obvious that most of the roads in Karachi will suffer from traffic saturation;

2) Population growth in Karachi is multiplied by 1.67 times from 2010 to 2030;

3) Forecasted eeconomic growth will increases the trip rate of urban transportation;

4) Forecasted increase in car ownership should further increases the trip rate and road spaces relatively decreases; and

5) Expansion of urbanized areas should increase the trip length by a factor of 1.64 times from 2010 to 2030.

As a result there will be more deterioration takes place on the bus services as well as the road conditions. Thus "Do-nothing" scenario will further causes modal shift to motorcycle and private cars for further increase of the road traffic. This scenario should lead to the chaotic urban transportation in Karachi in the near future.

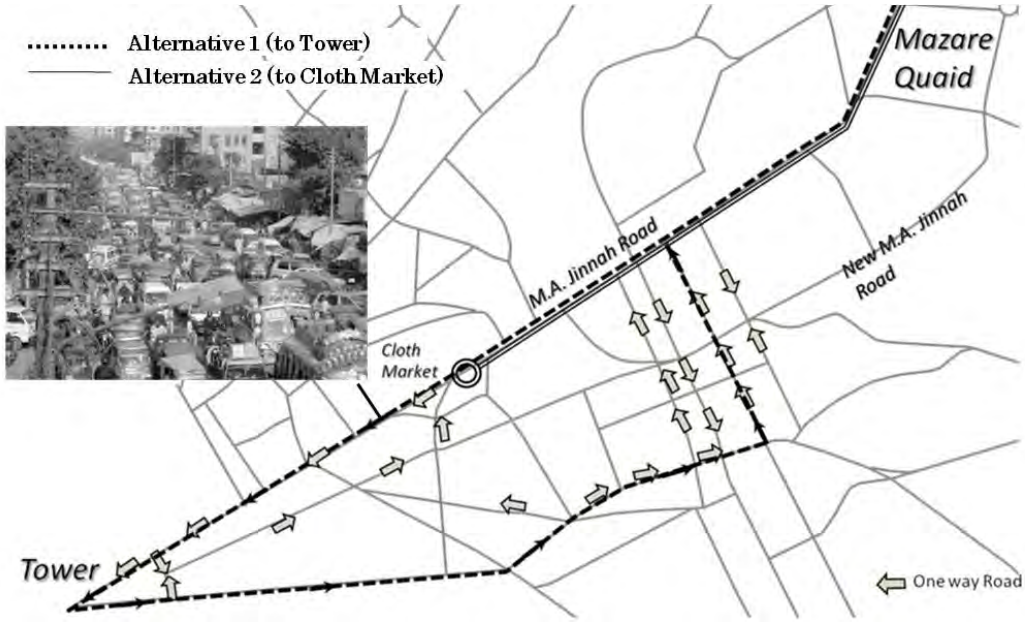
(2) Green Line Development Scenario

Green Line shown in No.2 of Figure 7-6-1 is now Green Line in the Feasibility Study with a few modification made on the southern end of the line. There is no alternative route for Green Line because there is no alternative parallel road along the corridor. It was originally intended to stop as Gur Mandir. However, its southern end has been extended to Jahangir Park where the buses are returning on the loop while there is a strong desire to extend it to Tower area.

The issue of the selection of end point of Green Line as 1) there is a strong requirement of its extension to Tower and 2) it should stop at Jahangir Park. The characteristics of current conditions of M. A. Jinnah Road are observed as follows:

- The width of M. A. Jinnah Road between Tower and Cloth Market, one way section, is generally narrower than the necessary width of bus station section;
- The existing traffic congestion in one way section around this area is very high, since this is very busy commercial area and sophisticated urban construction scheme is necessary; and

In the contexts as above, two alternative plans are prepared for the end point of Green Line as per Figure 7-6-2.



Source: JICA Study Team

Figure 7-6-2 Examination of the end point in CBD for Green Line

- Alternative 1: This route is planned along one way section of approximately 2.6 km to Tower from Jahangir Park. A detour route from Tower to M.A. Jinnah Road with a total length of approximately 5.5 km will have to be provided; and
- Alternative 2: This route is planned to stop at Jahangir Park/Cloth Market. U-turn loop is planned at Jahangir Park/Cloth Market area.

The environmental examination of the end point of Green Line is summarized as follows:

Table 7-6-2 Analysis from Environmental and Social Viewpoints on Green Line

Items	Environmental Impacts
Environmental pollution	- When Green Line is designed to construct on the ground level to Tower from Jahangir Park, there is a possibility of high traffic congestion during not only construction period but also operation period. - In case of elevated/underground system was constructed to the one way section, traffic congestion due to construction work will be severe. - Impacts of air pollution and noise on the surrounding areas due to the construction works/traffic congestion will be higher in case of Alternative 1 for end point of BRT, compared with the case of Alternative 2.
Social Environment	- The case of one way section construction activities would induce the higher probability of causing the land acquisition and resettlement for the area of station facilities. This is compared to the case of two way direction section which would have to double the socio-economic impacts.

Source: JICA Study Team

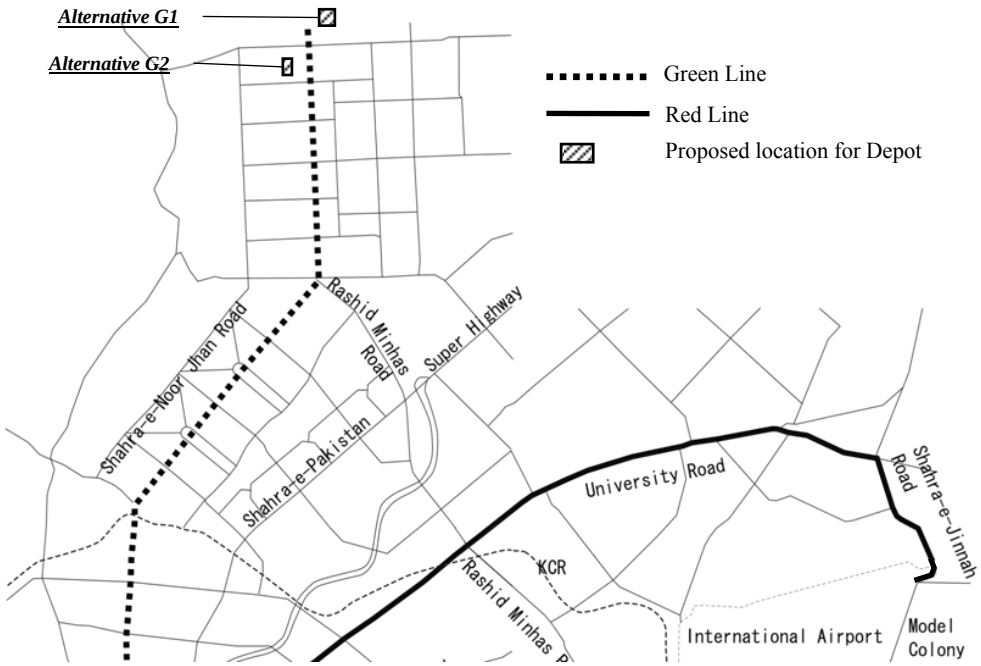
As a result, based on the above analysis, Alternative 2 has been selected in terms of environmental aspect.

There is an alternative plan of the depot as follows.

Table 7-6-3 Alternative plan of the BRT depot for Green Line

Alternative	Ownership	Remark	Area
G1	Governmental Land	There is a parking space of the CNG Bus Project and vacant land.	51,400 ㎡
G2	Governmental Land	There is a depot of the CNG Bus Project. The access road from BRT line to this area is narrow road.	16,000 ㎡

Source: JICA Study Team



Source: JICA Study Team

Figure 7-6-3 Location of Depot for Green Line

This line serves for the workforce going to the northern industrial area of Karachi as well as those of work force commuting to the commercial areas along the corridor and to CBD. Green Line development involves relatively large number of trees fell down. It is the only significant

environmental impacts on the natural environment caused by the Green Line development.

The same way as is explained in the case of Red Line development, Green Line alone functions very well as the line contributes commuting workforce to north as well as to south i.e. socio-economically viable option contributing to the shortage of urban transportation in Karachi. On the other hand, this line alone should create inequality in terms of socio-economic conditions along the Green Line in preference to other areas in Karachi.

Green Line has been selected to construct on the existing major road for passenger convenience for transfer and the conditions of the existing road structures. It is expected to cause minimum negative social impact such as the resettlement and land acquisition does not get involved in the plan. It is proposed to construct along M. A. Jinnah Road.

From the natural environmental view points, only the negative impact of Green Line development is the felling of trees planted on the road side and the road center's green belt.

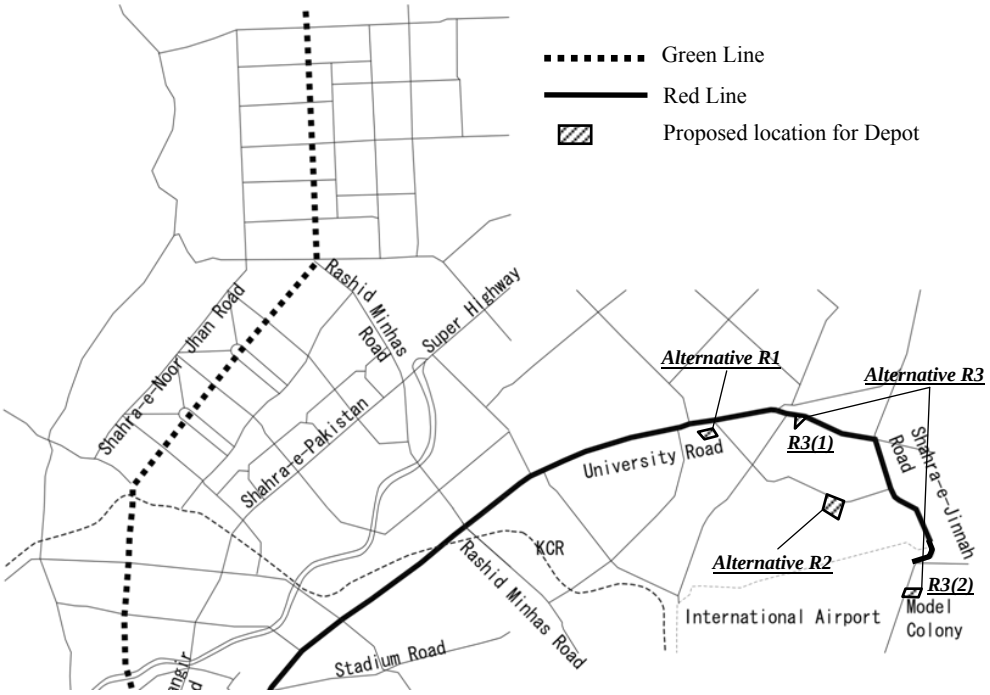
(3) Red Line Development Scenario

There is no alternative route for Red Line because there is no alternative parallel road along the corridor. There are depots located in the vicinity of Red Line, and the alternative plan of the depot is as follows:

Table 7-6-4 Alternative plan of the BRT depot for Red Line

Alternative	Ownership	Remark	Area
R1	Ranger Land	This area has already been occupied by Pakistan Ranger.	33,800 m^2
R2	Private Land	This area is vacant land	24,000 m^2
R3	Governmental Land	These areas are vacant land	(1) 17,500 m^2 (2) 12,100 m^2

Source: JICA Study Team



Source: JICA Study Team

Figure 7-6-4 Location of Alternative Depot for Red Line

In case of Red line, three locations are proposed. Alternative R1 is currently occupied by Pakistan

rangers, where was selected as a depot in the "Confirmatory Green Route Study for Karachi". The area appears to be difficult to build as a depot in this area because of the function of ranger occupied area cannot be shifted from this area to other areas. Alternative R2 is in the north of the Jinnah Airport. This area is not exactly along Red Line. Compensation for land acquisition is necessary for this depot. Although there is no resettlement, a patch of private land as Alternative R3 has two separate locations. Thus Alternative R3 has been selected.

Green Line shown in No 8 of Figure 7-6-1 is now Red Line in the Feasibility Study with a few modifications made on the starting of its western end and the ending point of its eastern end. Its eastern end has been extended to Malir Cantonment where a relatively large scale housing development is taking place i.e. this line should function to feed the workforce that are building up in the eastern side of Karachi. Thus socio-economically, this line will contribute positive impacts along the corridor.

The Red Line development alone can function very well as the line mainly feed work force from the eastern Karachi to the central Karachi. On the other hand, since the corridor goes through higher education area of Karachi, Red Line corridor development alone cannot contribute to the sectors of commerce and industry i.e. inequality in development of urban transportation in terms of socio-economic conditions along the Red Line corridor might be created in preference to other areas in Karachi.

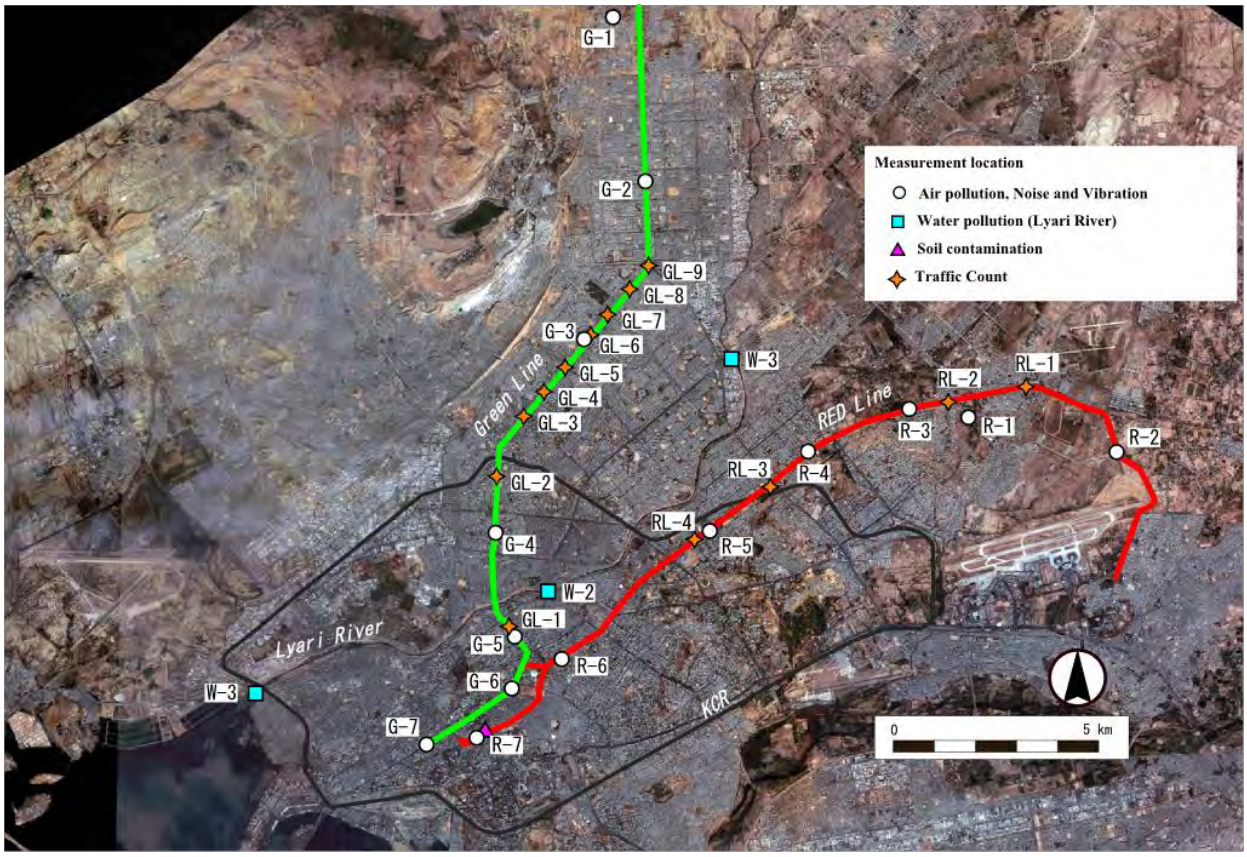
(4) A Combination of Green Line and Red Line Development Scenario

As explained in the section (2) and (3) as above, relatively wide "Area Development" in urban transportation could be achieved rather than "Linier Development" of urban transportation. Thus, in view of the developing much positive impacts on socio-economic environment, a combination of two is considered as viable option.

Not only a combination of Green Line and Red Line, but any other combination BRT line development should remain essentially the same in terms of the environmental impacts caused by the project to the natural and socio-economic environment. Thus the most effective development option of Green Line and Red Line is considered appropriate in view of the environmental impacts caused by the Project.

7.7 Result of Field Survey on the Environment Affected by the Project

Measurement location of field survey is shown in Figure 7-7-1.



Source: JICA Study Team

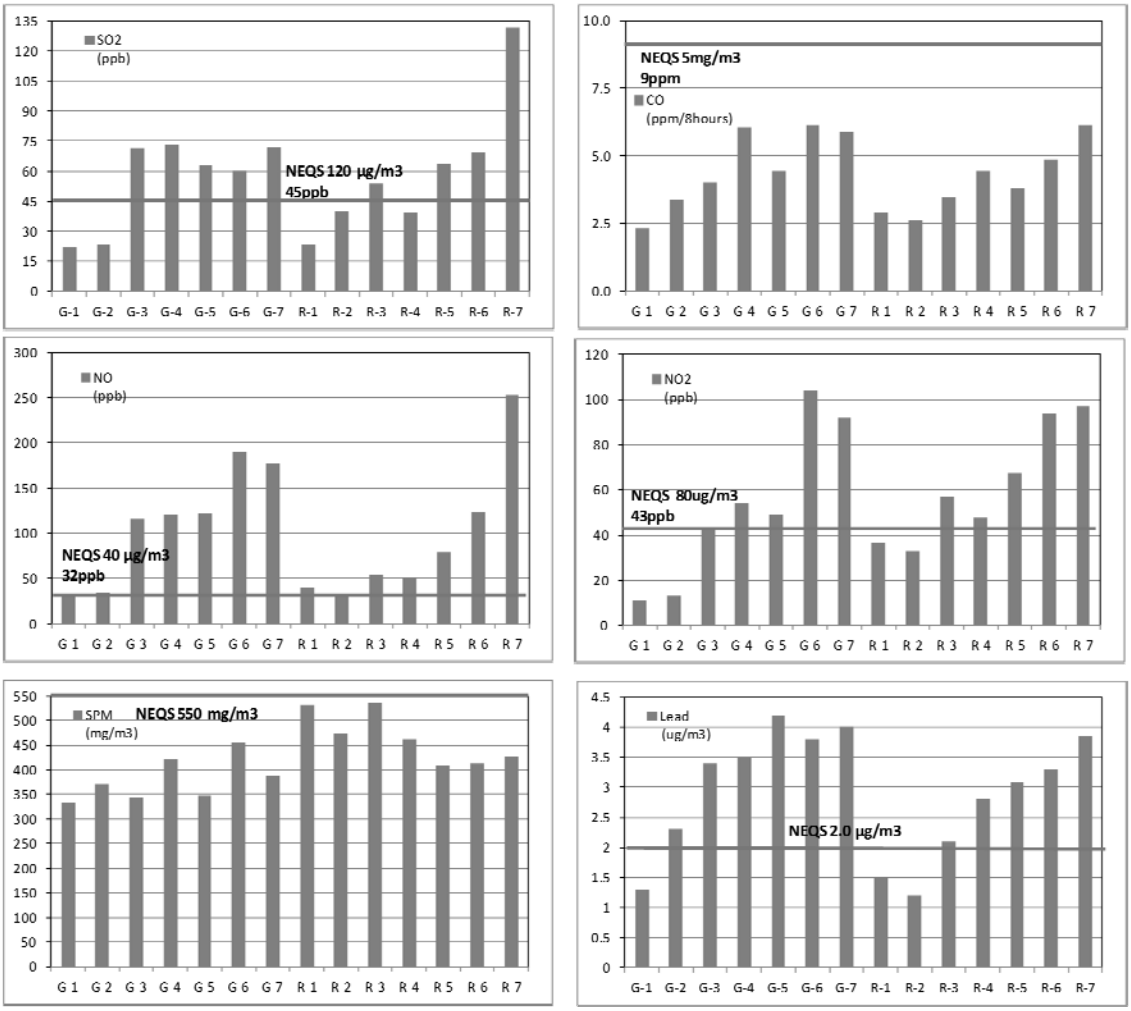
Figure 7-7-1 Measurement location of EIA field survey

7.7.1 Pollution Control

(1) Air pollution

The results of field measurement of air quality along the project route are shown in Figure 7-7-2. The problem of air pollution is more acute in highly business congested area of green and red line where movement of air is minimal. Measurements of NO, and NO_2 at central area of Karachi (R-6, 7, G-6, 7) are particularly higher than the recommended standard by NEQS. This reflects that heavy traffic movement on these intersections in addition to outdated vehicles resulting in emission of lead.

According to the report of Vehicular Emission Control Programme (VECOP) by The Sindh Environmental Protection Agency, regular monitoring and inspection was started from January 2010 and during the last 18 months, about 11,384 vehicles of all categories have been inspected and tested for their emission levels. Out of them, about 3,503 did not comply with the NEQS for vehicles and 1,947 were challenged by the traffic police for violation of the standards.



Source: JICA Study Team

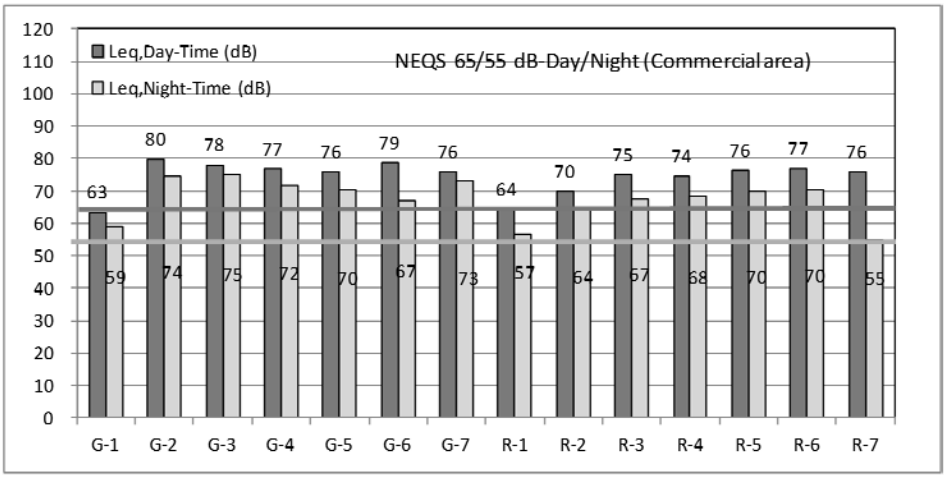
Figure 7-7-2 Result of Field Measurement on Air Quality

(2) Noise and Vibration

The results of field measurement of noise and vibration level along the project route are shown in Figure 7-7-3 and Figure 7-7-4.

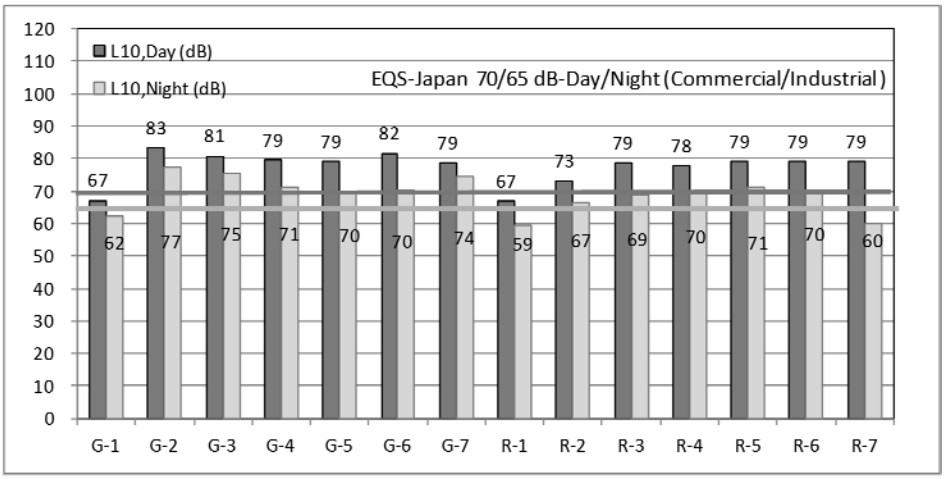
The noise level of all locations except CNG green bus terminal Surjani town (G-1) and Ranger area (R-1) is high as compared to NEQS noise level for commercial area. Regarding the vibration level, all locations except G-1 and R-1 is also higher as compared to Request Limits for Motor Vehicle Vibration in Japan.

G-1 and R-1 is located in the residential area. Other survey points are located along the major corridor. Noise/vibration level during night time at R-7 was very low, since traffic density decreased.



Note: Day time hours: 6.00 a. m to 10.00 p. m, Night time hours: 10.00 p. m to 6.00p. m
Source :JICA Study Team

Figure 7-7-3 Result of field measurement of Noise Level



Note: Day time hours: 7.00 a. m to 10.00 p. m, Night time hours: 10.00 p. m to 7.00p. m
QES-Japan: Request Limits for Motor Vehicle Vibration in Japan
Source: JICA Study Team

Figure 7-7-4 Result of Field Measurement of Vibration Level

(3) Water Quality

According to the water quality survey in Lyari River during two seasons, the effluent stream appears to be viably stabilized in terms of many parameters including DO, BOD, COD, S^{2-}, Nitrogen Ammonia, Detergents and Phenolic compounds etc. Average character of stream during dry and wet season is not showing a viable difference with respect to many of its criteria parameters. Average figures of TDS, Electric Conductivity, PH, Temperature, Chloride and DO were found in very close proximity. The stream chemical character remained almost un-altered during wet and dry season. Average figures of following parameters are exceeding NEQS defined limits:

- Biological oxygen demand (BOD) average figures are 95 and 138mg/l for wet and dry season respectively; both figures are exceeding NEQS figure of 80mg/l.
- Total suspended solids (TSS) average figures are 273 and 138mg/l for wet and dry season respectively, the figure of dry season is less than NEQS figure of 200mg/l.
- Sulphide average figures are 14 and 16mg/l for wet and dry season respectively, both of these figures are exceeding NEQS figure of 1mg/l

(4) Soil Quality

Soil quality measurement was conducted at three locations around digging area for structure on Red Line (R-7) New M.A. Jinnah Road. Three soil samples have been analyzed in laboratory for soil quality of the project area. All samples are low as compared to National Environment Standards for Soil Contamination in Japan as per Table 7-7-1.

Table 7-7-1 Soil Quality Measurement and the Analytical Result

	Compound	LOR	Unit	Sample1	Sample2	Sample3	EQS Ministry of Environment Government of Japan	
							Soil Leachate Standard (Risk for ingestion from ground water etc.)	Soil Concentration Standard (Risk for direct ingestion)
1	pH	0.1	pH	9.9	9.1	9.6	-	
2	Moisture Content	0.1	%	9.1	10.6	2.4	-	
3	Antimony (Sb)	1	mg/kg	<1	<1	<1		
4	Arsenic (As)	1	mg/kg	11	12	5	0.01 mg/l	15 mg/kg
5	Beryllium (Be)	0.5	mg/kg	0.5	0.6	<0.5		
6	Cadmium (Cd)	0.2	mg/kg	<0.2	<0.2	<0.2	0.01 mg/l	150 mg/kg
7	Chromium (Cr)	1	mg/kg	34	41	15	0.05 mg/l	250 mg/kg
8	Copper (Cu)	1	mg/kg	16	16	8		125 mg/kg
9	Lead (Pb)	1	mg/kg	9	8	6	0.01 mg/l	150 mg/kg
10	Nickel (Ni)	1	mg/kg	33	42	8		
11	Selenium (Se)	1	mg/kg	<1	<1	<1	0.01 mg/l	150 mg/kg
12	Silver (Ag)	0.1	mg/kg	<0.1	<0.1	<0.1		
13	Thallium(Tl)	0.5	mg/kg	<0.5	<0.5	<0.5		
14	Zinc (Zn)	1	mg/kg	36	37	21		
15	Mercury (Hg)	0.05	mg/kg	<0.05	<0.05	<0.05	0.0005 mg/l	150 mg/kg
16	Benzene	0.1	mg/kg	<0.1	<0.1	<0.1	0.01 mg/l	
17	1.1.1-Trichloroethane	0.2	mg/kg	<0.2	<0.2	<0.2	1 mg/l	
18	1.1-Dichloropropylene	0.2	mg/kg	<0.2	<0.2	<0.2		
19	Carbon Tetrachloride	0.2	mg/kg	<0.2	<0.2	<0.2	0.002 mg/l	
20	1.2-Dichloroethane	0.2	mg/kg	<0.2	<0.2	<0.2	0.004 mg/l	
21	1.1.2-Trichloroethane	0.2	mg/kg	<0.2	<0.2	<0.2	0.006 mg/l	
22	Simazine	0.05	mg/kg	<0.05	<0.05	<0.05	0.003 mg/l	

Source: JICA Study Team

(5) Traffic Survey

The results of field measurement of traffic count are shown in Table 7-7-2. Traffic Count Survey was conducted for 14 hours (7:00-21:00) on a weekday (Monday-Thursday). The objective of the Traffic Count Survey is to obtain traffic volume data by direction (left, right, and straight) by approach at major intersections along Green and Red Lines.

Table 7-7-2 Result of Traffic Count

Location	Cars/Jeeps/ Taxis/Vans	Motor cycles & Scooters	Auto Rickshaws	Motorcycle Rickshaws	Pickups	Mini Buses & Coaches	Large Buses	Rigid Trucks & Trailors	Total
GL-1; U-turn of Business Recorder Road (near Fatima Bai Hospital)									
From Guru Madir	9,517	25,628	7,873	20	1,483	360	442	258	45,581
From Garden	1,844	1,783	1,792	3	288	66	10	20	5,806
From Lasbella	9,588	27,364	7,857	22	1,028	371	463	191	46,884
From Patel Para	584	1,244	1,629	1	254	6	5	3	3,726
Total	**21,533**	**56,019**	**19,151**	**46**	**305**	**803**	**920**	**472**	**101,997**
GL-2; Nazimabad No.7									
From Nazimabad Underpass	18,008	48,007	7,986	55	3,483	957	727	987	80,210
From Abbasi Shaheed Hospital	4,704	11,321	3,929	736	646	536	94	70	22,036
From Matric Board Office	16,710	50,543	7,229	91	2,805	789	811	874	79,852
From Nazimabad No. 4	2,840	4,588	2,188	706	656	95	8	34	11,115
Total	**42,262**	**114,459**	**21,332**	**1,588**	**7,590**	**2,377**	**1,640**	**1,965**	**193,213**
GL-3: U-turn between KDA Chowrangi and Hyderi Market									
From KDA	19,779	32,915	7,189	29	3,094	1,118	642	746	65,512
From Hyderi Market	257,237	42,296	10,362	29	3,530	1,270	689	871	84,284
Total	**45,016**	**75,211**	**17,551**	**58**	**6,624**	**2,388**	**1,331**	**1,617**	**149,796**
GL-4: U-turn between Hyderi Market and Five Star Chowrangi									
From Hyderi Market	24,120	38,809	7,365	29	5,003	995	585	847	77,753
From Five Star Chowrangi	23,070	35,036	8,073	38	2,828	1,192	566	995	71,798
Total	**47,190**	**73,845**	**15,438**	**67**	**7,831**	**2,187**	**1,151**	**1,842**	**149,551**
GL-5:U-turn between Five Star Chowrangi and New Hyderi Market									
From Five Star Chowrangi	19,352	50,318	7,277	26	3,153	1,190	603	974	82,893
From New Hyderi Market	20,852	54,628	8,153	36	2,930	2,089	504	1,007	90,199
Total	**40,204**	**104,946**	**15,430**	**62**	**6,083**	**3,279**	**1,107**	**1,981**	**173,092**
GL-6:U-turn between New Hyderi Market and Sakhi Hassan Chowrangi									
From New Hyderi Market	15,834	46,533	7,643	54	3,130	1,113	601	908	75,816
From Sakhi Hasam	15,773	52,626	7,715	33	2,960	1,300	579	702	81,696
Total	**31,607**	**99,159**	**15,358**	**87**	**6,090**	**2,421**	**1,180**	**1,610**	**157,512**
GL-7:U-turn in front of Haroon Shopping Center									
From Sakhi Hasan Chowrangi	14,401	41,076	4,633	71	2,841	1,310	480	929	65,741
From Nagan Chowrangi	15,668	52,540	6,227	124	3,410	1,412	591	971	80,943
Total	**30,069**	**93,616**	**10,860**	**195**	**6,251**	**2,722**	**1,071**	**1,900**	**146,684**
GL-8:U-turn between Haroon Shopping Center and Nagan Chowrangi									
From Haroon Shopping Centre	14,038	42,040	6,886	85	3,069	1,253	630	981	68,982
From Nagan Chowrangi	14,409	46,062	6,222	361	3,461	1,539	653	948	73,655
Total	**28,447**	**88,102**	**13,108**	**446**	**6,530**	**2,792**	**1,283**	**1,929**	**142,637**
GL-9:Nagan Chowrangi									
From Sohrab Goth	13,276	23,176	4,856	546	2,598	1,356	286	885	46,979
From Sakhi Hasan	14,053	41,774	6,641	401	2,777	1,226	531	994	68,397
From Anda Morr	1,092	2,215	597	4	251	30	17	21	4,227
From UP Morr	18,487	69,914	10,174	900	2,923	1,558	546	1,097	105,599
From Godhra	712	877	184	6	112	81	81	37	2,090
Total	**47,620**	**137,956**	**22,452**	**1,857**	**8,661**	**4,251**	**1,461**	**3,034**	**227,292**
RL-1; Safura Chowk									
From Karachi University	7,450	5,240	874	838	578	801	82	299	16,162
From Kiran Hospital	3,259	2,183	406	213	238	478	8	136	6,921
From Saadi Road	3,511	2,912	285	144	304	129	64	180	7,529
From Malir Cantt	4,346	4,437	483	203	439	329	50	292	10,579
Total	**18,566**	**14,772**	**2,048**	**1,398**	**1,559**	**1,737**	**204**	**907**	**41,191**
RL-2; Intersection of Road from Kamran Chowrangi (Gulistan-e-Jauhar) & University									
From Karachi University	10,295	10,082	1,747	904	979	974	117	150	25,248
From Kamran Chowrangi	6,778	4,232	947	1,073	272	166	29	193	13,690
From Safoora Chowrangi	16,685	15,266	3,169	1,400	1,115	1,174	103	383	39,295
Total	**33,758**	**29,580**	**5,863**	**3,377**	**2,366**	**2,314**	**249**	**726**	**78,233**
RL-3; NIPA. Chowrangi									
From Johar Chowrangi	23,718	25,003	4,543	45	1,883	1,504	181	1,040	57,917
From Civic Centre	26,386	16,481	4,979	1,083	1,317	3,344	383	490	54,463
From Gulshan	31,362	31,188	6,206	424	2,730	2,498	303	1,090	75,801
From Karachi University	33,804	25,168	5,754	260	1,395	2,577	347	489	72,139
Total	**115,270**	**97,840**	**21,482**	**4,157**	**7,325**	**9,923**	**1,214**	**3,109**	**260,320**
RL-4; U-turn between Bait-ul-Mukkarram Masjid and PIA Garden									
From PIA Garden	29,370	35,523	7,823	353	2,002	1,873	300	419	77,663
From Bait-ul-Mukkarram	37,445	31,294	6,912	280	1,753	2,040	284	432	80,440
Total	**66,815**	**66,817**	**14,735**	**633**	**3,755**	**3,913**	**584**	**851**	**158,103**

Source: JICA Study Team

7.7.2 Biological Environment

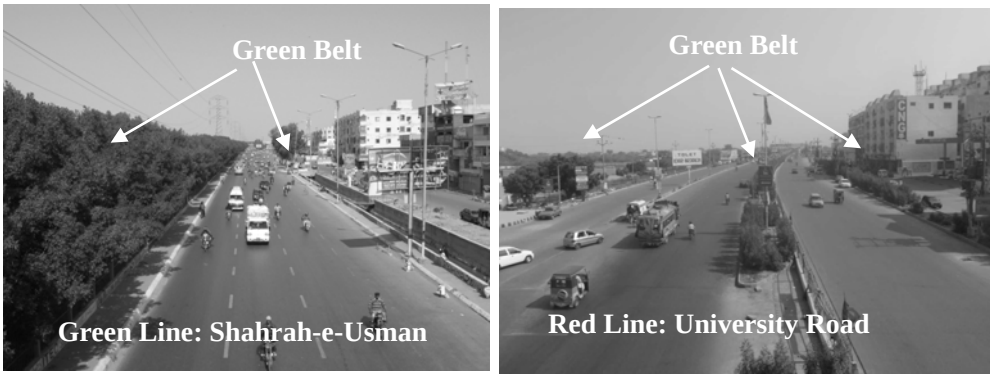
(1) Flora

As many as 72 species of plants have been recorded from the project area of Green and Red line. The plant species subject to fell down are *Conocarpus*, *Eucalyptus* and *Lignum species*. There are a number of medicinal plants such as *Azadirachta indica*, *Aerva* javanica, *Calotropis procera*, *Cassia fistula*, *Fagonia indica*, *Melia azidarach*, Morinaga oleifera, *Ricinus communis*, and *Tecomela undulata*. There are shade trees commonly found in the project area such as *Albizzia procera*, *Azadirachta indica*, *Eucalyptus citriodora*, *Fiscus bengalensis*, *Fiscus religiosa*, *Melia azidaroch*, *Pithcellobium dulce*, *Tamarindus indica* and *Zizyphus nummularia*. Fruit trees are also affected such as Mango, Jaman, Naryal, Badam, Jangal jalebi, Imli, Lahsora, Gondni, Ber, Date palm, and Amla. Four *Tecomella Undulata* in total have been identified as endangered species on the right lane of Red Line between Malir Cantt. to Safoorah Chowrangi. Total number of tree counted on both corridors is shown in the Table 7-7-3.

Table 7-7-3 Result of Tree Counting along the Corridors

BRT	Number of Trees			Total
	Left Lane	Median Lane	Right Lane	
Green Line	1,701	13,456	1,480	16,637
Red Line	1,504	9,662	4,632	15,798
Sub-total	3,205	23,118	6,112	32,435

Source: JICA Study Team



Source: JICA Study Team

Figure 7-7-5 Typical Cross Sections Showing Tree Counting Areas

The dominant plant species are obviously *Conocarpus*, *Eucalyptus* and *Lignum species*. The flora included some medicinal plants such as *Azadirachta indica, Aerva javanica, Calotropis procera, Cassia fistula, Fagonia indica, Melia azidarach, Morinaga oleifera, Ricinus communis, and Tecomela undulata.* The shade trees were also commonly found such as *Albizzia procera, Azadirachta indica, Eucalyptus citriodora, Fiscus bengalensis, Fiscus religiosa, Melia azidaroch, Pithcellobium dulce, Tamarindus indica and Zizyphus nummularia.*

The fruit trees included Mango, Jaman, Naryal, Badam, Jangal jalebi, Imli, Lahsora, Gondni, Ber, Date palm, and Amla.

(2) Fauna

As regards the fauna, 16 species of animals were recorded comprising of 4 species of mammals, 10 species of birds and 3 species of reptiles. All of them are common species whose inhabitants are in industrial area Karachi.

7.7.3 Socio-economic Environment

(1) Framework of Socio-economic Impact Assessment

1) Identification of Adverse Impacts

Emphasis has been given to identifying and mitigating adverse impacts to the socio-economic conditions of the project area generally following the existing road. These impacts should be specified and reported for each of Green Line and Red Line. Particular attention has been given to highlighting adverse impacts on people who are sensitive or vulnerable strata. Classification is based on the age, gender, ethnicity, caste, poverty or other factors.

2) Method of Predicting Socio-economic Impact Assessment

Method for predicting socio-economic impacts varies from one project to the other depending on the combination of the nature of project and the existing natural and social conditions. In general the Project takes place on the major roads of Karachi where major characteristic is a heavily populated urban setting. Thus a combination of the following methods will have to be used:

a) Trend extrapolations: projecting current trends, such as population change or employment, into the future (with or without modifying the rate of change);
b) Population multipliers: extrapolated increases in population size are coefficients for the change in other variables, such as employment and demand for housing, infrastructure or services;
c) Consultation to urban development experts: use of expert knowledge such as researchers, professional consultants, local authorities, or knowledgeable citizens on the urban planning and/or urban transportation development;
d) Scenario development: exercises to develop "Do-nothing" and other alternatives or preferred future urban transportation development of Karachi as a Pakistan's largest city. A number of sscenarios have to be developed to compare different outcomes; and
e) Comparative studies: examining how an affected community has responded to change in the past, or the impact on other communities that have undergone a similar action.

(2) Socio-economic Conditions of the Area along Green Line

1) Socio-economic Characteristics of the Green Line Corridor

Based on the baseline survey, the following tables illustrate general characteristics of the Green Line Corridor. Table 7-7-4 illustrates the result of socio-economic survey on the population fronting the road subject to BRT development for Green Line. As is shown approximately 81 percent of respondents of the survey is engaged in commercial activities and most of them are non-residents, while 16.5% respondents are residents. This is compared to the general characteristics of each township that the Green Line goes through as is expressed in the following section.

Table 7-7-4 General Distribution of Respondents

Type of Structure	No.	Percentage
Residential	58.0	16.5%
Commercial	284.0	80.9%
Residential Cum Commercial	3.0	0.3%
Others	6.0	1.7%
No Response	2	0.5%
Total	351	100%

Source: JICA Study Team for KTIP.

Table 7-7-5 illustrates details of respondents engaged in commercial activities. Among the respondents engaged in commercial activities, 82% are retail shop owners, managers, helpers; service providers (telecommunication, internet, cable TV, etc.), 13% respondents are providing recreational/catering services while the rest are engaged in academic institutions, health service institutions and similar activities in the commercial sector.

Table 7-7-5 Activity-wise Distribution of Commercial Respondents

Type of activity	No.	Percentage
Retailer/Service Provider	235	81.7%
Eateries/Recreational	36	12.7%
Others (Medical Facilities/Academic Institutions etc)	16	5.6%
Total	287	100%

Source: JICA Study Team for KTIP.

Table 7-7-6 illustrates details of residents in terms of their mode of living. Among the respondents, 24% of the live in apartments and also 24 % of the residents live in multi-story houses, while 19 respondents live in single story house and approximately 33 % of the live in flats. In broad generalization, most of the respondents living in single-story and multi-story houses are relatively well-off residents followed by those of middle to low income families living in apartment complex and flats.

Table 7-7-6 Resident-wise Distribution of Respondents by Type of Structure

Type of structure	No.	Percentage
Single-story house	11	18.97%
Multi-story house	15	24.14%
Flat	20	32.76%
Apartment Complex	15	24.14%
Total	61	100%

Source: JICA Study Team for KTIP.

2) Townships along Green Line Corridor

Green Line of BRT goes through the following townships from north to south. Characteristics of each township that the Green Line goes through are briefly described as follows:

a) North Karachi Township

Major land use coving approximately 60% of the township is predominantly urban residential area recently developed for ever increasing population in Karachi. North Karachi is a supplier as well as recipient of work force to and fro the adjacent UC's/Towns including North Karachi Industrial Area. In general there are lower middle to low income families occupy the area. Industrial covers approximately 10 % of the total land area.

b) North Nazimabad Township

Major land use of the township is relatively old but well developed residential area which covers 70 % of the total land area. This township is well planned and compact in respect of infrastructure facility development. The area is a supplier of high level as well as middle level work force to the adjacent North Karachi Industrial Area. Relatively small scale commercial activities are concentrating in the area along major roads.

c) Liaquatabad Township

Major land use is residential and covers around 70% of the urbanized area. The population density is very high with middle class to lower middle class income families. Commercial areas are concentrating along the major road in the south of township.

d) Jamshed Township

Major land use is predominantly urbanized residential area and it covers approximately 70% of the total land area. There is a mixture of high to upper middle income families as well as middle to lower income families. There is approximately 30 % of residential area formed by kachi abadi, or squatter settlement. Heavy concentration of commercial activities along the major road is observed.

e) Saddar Township

Saddar is commercial and administration hub of Karachi city. Major portion of the area is predominantly commercial and Central Business District (CBD) of Karachi City occupies most part of the township. CBD plays a major role of the financial and commercial centre in Pakistan. The main financing function such as national bank, stock market and headquarters of major enterprise are located in CBD. Most of federal and provincial offices are also located in this township.

(3) Socio-economic Conditions of the Area along Red Line Corridor

1) General Socio-economic Characteristics of the Red Line Corridor

Based on the baseline survey, the following tables illustrate broadly generalized characteristics of the Red Line Corridor. Table 7-7-7 illustrates the result of socio-economic survey on the population fronting the road subject to BRT development for Red Line. As is show, 78 percent of respondents of the survey are engaged in commercial activities and most of them are non-residents while 17 percent in total of the respondents are residents. This is compared to the general characteristics of each township that the Red Line goes through as expressed in the following section.

Table 7-7-7 General Distribution of Respondents

Type of Structure	No.	Percentage
Residential	26	9%
Commercial	237	78%
Residential Cum Commercial	24	8%
Others	7	2%
No Response	8	3%
Total	302	100%

Source: JICA Study Team for KTIP.

Table 7-7-8 illustrates economic activities along the Red Line. Among the respondents engaged in commercial activities in the corridor, 95.4 percent are retail shop owners, managers, helpers; service providers (telecommunication, internet, TV cable), followed by 3.4 percent of recreational/catering services and others counting for 1.3 percent engaged in academic institutions, health service institutions and similar activities.

Table 7-7-8 Activity-wise Distribution of Commercial Respondents

Type of activity	No.	Percentage
Retailer/Service Provider	249	95.36%
Eateries/Recreational	9	3.38%
Others (Medical Facilities/Academic Institutions, etc.)	3	1.27%
Total	261	100%

Source: JICA Study Team for KTIP.

Table 7-7-9 illustrates residents living in various type of housing. Among the respondents, 62 percent live in apartments followed by 27 percent of them living in flat, 11.5 percent of them living in single-story house. Thus general picture of the corridor is that there are no relatively well-off families living in multi-story building followed by middle to low income families living in apartment complex and single-story houses.

Table 7-7-9 Residents-wise Distribution of Respondents by Type of Structure

Type of structure	No.	Percentage
Single-story house	6	11.54%
Multi-story house	0	0%
Flat	13	26.92%
Apartment Complex	31	61.54%
Total	50	100%

Source: JICA Study Team for KTIP.

2) Townships along the Red Line Corridor

Red Line goes through the following townships generally from east to west. Characteristics of each township that the Red Line goes through are briefly described as follows:

a) Malir Township

The area is predominantly residential. While in general western half of the township covers residential area, eastern half of it is rural setting and 20 % of the township is covered by agricultural area.

b) Malir Cantonment

Malir Cantonement is a largest military training and residential area in Karachi. Relatively wide area of the cantonment is not occupied.

c) Gulshan-e-Iqbal Township

This township is predominantly residential and it covers 40 % of the total land area. This township also houses most of the large scale educational facilities including Karachi University.

d) Jamshed Township

As described in the Section 7.8.2, Major land use is urbanized residential area and it covers approximately 70% of the total land area. However, approximately 30 % of residential area is formed by kachi abadi, or squatter settlement. Heavy concentration of commercial activities along the major road is observed.

e) Saddar Township

As described in the Section 7.8.2, Saddar is commercial and administration hub of Karachi city. Major portion of the area is predominantly commercial and Central Business District (CBD) of Karachi City occupies most part of the township. CBD plays a major role of the financial and commercial centre in Pakistan. The main financing function such as national bank, stock market and headquarters of major enterprise are located in CBD. Most of federal and provincial offices are also located in this township.

7.8 Stakeholder Meeting

7.8.1 Outline of Stakeholder meeting

Two rounds of consultation meetings were carried out as shown Table 7-8-1. Detail of stakeholder meeting is shown in Appendix.

The stakeholders meetings were arranged at one location each on the two corridors on date that was advertised in the press and by invitation extended to all major stakeholders.

Objectives of Stakeholder Meeting are defined as follows:

1) To disseminate information on the outline of the development plans for Karachi Transportation Improvement Project (KTIP) for concerned citizens;

2) Provide information on environmental and social benefit of the project;

3) To offer opportunities to vice the concerns of the stakeholders regarding the project during the planning stage;

4) Dissemination of information on the project in respect to the alignment, schedules and plan;

5) To consult with stakeholders on draft environmental scoping and draft TOR for EIA Study during primary stakeholder meeting; and

6) To disclose all main findings from Draft Environmental Impact Assessment (EIA) study during secondary stakeholder meeting

Table 7-8-1: Outlines of Stakeholder Meetings

Stage	Main Contents	Venue	Date/Time	Number of participants
Scoping Stage	-Outline of the Project. -Sharing and discussing the draft scoping. -Methodology for EIA study and issues to be considered in the study.	Taimuria Library (Green Line Corridor)	31st January 2012	109
		NED University (Red Line Corridor)	8th February 2012	90
Disclosure of Findings from Draft Final Report	-Outline of the Project. -Sharing and discussing the draft EIA.	Largess Restaurant (Green Line Corridor)	27th April 2012	87
		Hotel Ramada Plaza (Red Line Corridor)	28th April 2012	102

Source: JICA Study Team

7.8.2 Initial Stakeholder Meeting

During initial stakeholder meeting, the presentation was focus on the project outline, environmental baseline, the scope of EIA and mode of operation of the BRT system.

Question and Answer was followed by questionnaire to obtain feedback on the status of the transportation system and the likely improvement that the participants would foresee incase the BRT system is introduced. All the participants were requested to responds to the set of questions laid down in the questionnaire.

(1) Green Line

The main comments from participants of initial stakeholder meeting on Green Line are summarized as follows:

1) The project should be seriously and actively implemented for solving the problem of urban transportation system in Karachi;

2) The fares should be affordable to the general public of the Karachi especially it can be easily accessible to the poor sector of the society;

3) The project will have to be able to minimize the traffic congestion faced during the peak hours;

4) Traffic accidents will have to be reduced by the accomplishment of this project;

5) Special arrangements should be made for the facilitation of disabled-persons in the transport project;

6) Project will have to provide instant transport service by accommodating a massive population of Karachi at one time from one place to another; and

7) Project will have to provide a provision of stations on particular locations without disturbing any business/residential or institutional activity.

(2) Red Line

The main comments from participants of initial stakeholder meeting on Red Line are summarized as follows:

1) Earlier implementation is the key to the success of this ambitious project;
2) Current political, social and economic situation of the country is the main factor which hinders the development of an efficient BRT system in the city;
3) JICA guidelines and other international standards regarding occupational, health and safety should be considered before implementation of the project;
4) Proposed BRT system should provide feeder service to the Karachi Circular Railway and both systems should be interlinked to each other;
5) All concerned parties like Bus Associations etc. should be taken on board and their participation should be made necessary for the smooth implementation of the proposed project;
6) The fares should be affordable to the general public of the Karachi, especially it can be easily accessible to the poor sector of the society;
7) The project should minimize the current level of traffic congestion;
8) The BRT line should be made available for ambulances in time of emergency; and
9) Traffic accidents should be reduced by the accomplishment of this project.

(3) Questionnaire Survey

1) Green Line

The Table 7-8-1 to 2 shows the result of the initial stakeholder meeting on Green Line of BRT. For the purpose of opinion polls, a survey form distributed to the participants for opinion survey. It is designed to obtain comprehensive feedback of the participants in terms of the importance, what they understand the problems, hurdles and comments on the Project. Among 109 participants, there have been 55 valid answers.

Table 7-8-1 Assessment of Stakeholders feedback - Green Line

S.No	Questions	No. of Respondents				Percentage (%) of Respondents			
		Positive Views	Negative Views	Others	Total	Positive Views	Negative Views	Others	Total
1	I am satisfied/not satisfied with the performance of current transport system	1	54	0	55	2%	98%	0	100%
2	After implementation of Bus Rapid Transit (BRT) in Karachi; congestion of Roads will increase/decrease.	14	37	4	55	25%	67%	8%	100%
3	(a)Presently I travel through Bus/Car/Motorcycle to reach my work place.(b) I would prefer /not prefer BRT in future for travel	47	8	0	55	85%	15%	0	100%
4	BRT will improve/not improve social life, environmental condition and economic activities in city	53	2	0	55	96%	4%	0	100%
5	There are technical hurdles/no hurdles in the implementation of BRT on Redline and Greenline	32	23	0	55	585	42%	0	100%

Source: JICA Study Team for KTIP

Among them 98 % of respondents are not satisfied with the performance of current transport system and just 2% of them are satisfied i.e. majority of the stakeholders understand the importance of this project.

On the other hand increases or decreases the congestion of the roads, only 25 % of the total number of respondents thinks that our at present roads are already congested and 67 % of the stakeholders says that there will be no congestion as the majority of people prefer traveling by BRT.

Among the respondents 85 % are willing to travel in BRT because it is expected to be cheap, comfortable and reliable. The rest of people are willing to travel by private transport.

As an overall rating, 96 % are in favor of socio-economic and environmental conditions that will be improved by the project and the rest of people had opposite opinion.

There are issues of technical hurdles in the project implementation and 58 % of the total respondents saying that there will be hurdles to clear because of transport mafia, land mafia, political pressure from various political parties. The rest of 42 % are thinking that there will be no technical hurdle.

Table 7-8-2 Travelling Mode-Green Line

S.No	Travelling Mode	No of Respondent	Percentage of Respondents
1	Bus	10	18%
2	Car	15	27%
3	Motorcycle	3	5%
4	Car & Motorcycle or both	4	7%
5	No Response	23	43%
	Total	55	100%

Source: JICA Study Team for KTIP

On the other hand current traveling mode of the stakeholder's responses have had shown different points of view in respect of travelling routes. Because some of them are using buses and rest of them are traveling by private vehicles, as the above table indicates 18% of the stakeholders that are travelling by local public transport are contending that it is insufficient and fewer numbers of buses are running in this route of Green Line. This view if reflected by the others using their private cars and motor cycles or both, which is accounted for 36 % of the total number of respondents.

Some of the local residents have to change different points to reach their destination if buses are used. Therefore, 5 % of the total number of respondents use motorcycles as it is cheaper and less time consuming then local transport while 7% of the total number of respondents travel by private cars and motorcycles exchanging one to the other because the bus stations are far from their residence.

2) Red Line

The Table 7-8-3 and 4 shows the result of the initial stakeholder meeting of the Red Line. For the purpose of opinion polls, a survey form distributed to the participants for opinion survey. It is designed to obtain comprehensive feedback of the participants in terms of the importance, what they understand the problems, hurdles and comments on the Project. While there have been 90 participants, 49 of them returned valid answers.

Among them, 96 % of respondents are not satisfied with the performance of current transport system and 4% are satisfied. It would mean that the majority of stakeholders understand the importance of this project.

For the question on the increase or decrease the congestion of the roads in the future with the Project, only 29 % of the total number of respondents thinks that the roads in Karachi would become congested while 71% of the total number of respondents thinks there will be no congestion after the implementation of the Project because the majority of people prefer traveling through BRT.

Among the respondents, 71 % are willing to travel in BRT because it is cheap, comfortable and reliable and the rest of people willing to travel by private transport.

Over all 82 % are in favor of this project because socio-economic and environmental condition will be improved by this project. However, many thinks that there are issues of technical hurdles regarding the implementation of the project as 65 % of the total respondents saying that there will be transport mafia, land mafia and political pressure in time of the implementation of the Project. There are 29 % of the total number of respondents that they think there will be no technical hurdles while the 6 % are not confirm either it would be completed or not. In conclusions, the majority of people appreciated and supported the Project.

Table 7-8-3 Assessment of Stakeholders feedback for - Red Line

S.No	Questions	No of Respondents				Percentage (%) of Respondents			
		Positive Views	Negative Views	Others	Total	Positive Views	Negative Views	Others	Total
1	Iam satisfied/not satisfied with the performance of the current transport system	2	47	0	49	4%	96%	0%	100%
2	After implementation of Bus Rapid Transit (BRT) in Karachi; Congestion of Roads will increase/decrease	14	35	0	49	29%	71%	0%	100%
3	.(a) presently I travel through Bus/Car/Motorcycle to reach my work place. (b) I would prefer/not prefer BRT in future for travel.	35	14	0	49	71%	29%	0%	100%
4	BRT will improve/not improve social life, environmental condition and economic activities in city	40	9	0	49	82%	18%	0%	100%
5	There are technical hurdles/no hurdles in the implementation of BRT on Redline and Green line	32	14	3	49	65%	29%	6%	100%

Source: JICA Study Team for KTIP

Current traveling modes of the respondents have been different from the respondents of Green Line corridor. Some of the respondents in Red Line corridor are using buses and rest prefers traveling by private vehicles. The Table 7-8-10 indicates the proportion of traveling modes of the respondents in Red Line corridor.

Among the respondents, 45 % of them travel by local public transport while there is insufficient and less number of buses run on this route. This implies that there are relatively low income families living in this area. For the private car users, there has been 35 % of the total number of respondents and 10 % of others use motor cycles. A combination of car and motor cycle riding respondents has amounted for 8 % because the bus stations are far from their place.

Table 7-8-4 Travelling Mode-Red Line

S.No	Travelling Mode	No of Respondent	Percentage % of Respondents
1	Bus	22	45%
2	Car	17	35%
3	Motorcycle	5	10%
4	Car & Motorcycle both	4	8%
5	No Response	1	2%
	Total	49	100%

Source: JICA Study Team for KTIP

3) Conclusions

For those using car, motorcycle or a combination of two are amounted for 39 % of the total number of respondents in Green Line and that of in Red Line is amounted for 53 %. These people are considered as potential BRT commuters. If included those using buses, 57 % of the respondents in Green Line and 98 % of the respondents on Red Line would become potential commuters of BRT.

Further, if those who did not respond to the survey in Green Line were included, provided that those were one way or other commuting to work, although some may own small business within the local area, the great majority of the local residents would become potential user of BRT.

7.8.3 Second Stakeholder Meeting

Outline of the stakeholder meeting was shown as Teble7-8-1. During secondary stakeholder meeting, all main finding from draft environment Impact Assessment study were disclosed. Presentation was focus on the project details, environmental baseline, screening of potential environmental impacts and proposed mitigation measurements.

(1) Green line

The main suggestion/comments from participants of secondary stakeholder meeting on Green Line are summarized as follows:

1) Exclusive lanes for BRT from Nazimabad to Business Recorder Road may disturb the traffic in the mixed lanes because the RoW in these areas is already narrow.
2) The road width should be carefully studied along the corridor and BRT design should be made accordingly to avoid disturbance to the residential and commercial areas.
3) Boarding and alighting timings at stations should be carefully studied.
4) Engines should be well designed and equipped with such technologies that may control emissions.
5) The observation was with regard to the boarding and alighting facility for old age people.
6) The question was with regard to the benefits and security measures for females in BRT system
7) Public awareness campaign about BRT should be accelerated and rules and regulations should be made effective;

(2) Red line

The main suggestion/comments from participants of secondary stakeholder meeting on Red Line are summarized as follows:

1) Public Toilets should be provided at all stations;
2) Separate compartments should be provided for women;
3) Prepaid card system may be introduced for passengers using BRT;
4) The question was with regard to the provisions of the labor laws and international standards on occupational health, safety and environment, the criteria for operators, sudden incident, the project implementation period and so on.

7.9 Environmental Impacts Caused by the Project and The Mitigation Measures

7.9.1 Pollution Control

(1) Air pollution

1) Construction stage

During construction stage, dust sources from the construction site of BRT are likely to create significant impacts. The worst effects are likely to be in the most constricted areas such as the construction works of elevated sections, around the station locations and depot areas. Vehicles carrying construction material are expected to result in increased SPM levels adjacent to the haul roads. Such construction activities can be of potentially hazardous if construction vehicles

concentrate and pass through residential areas. At the construction yard, the dust levels are also expected to increase due to loading and unloading of construction materials. Also, there will be slight increase in concentration of NOx and CO due to the increased general vehicular traffic as the existing road width is cut down to the construction yard. The impacts of such activities would, however, be temporary and restricted to the construction phase which runs for 3-4 years only. The impacts will be confined within the project boundary and is expected to be negligible outside the project boundaries in general.

In order to mitigate the impact of air pollution and dust from construction equipment and activities, preparation of adequate mitigation measures such as water sprinkler, periodical inspection of air quality and maintenance of the construction machinery and vehicles are importation. It is also important to carry out training of the technicians and the operators of the construction machinery and drivers of the construction vehicles. Air quality monitoring in the project site during construction phase is need of the important tools in order to feed back actions to be taken for mitigation measures.

2) Operation stage

The BRT system of Green Line and Red Line are designed to run within the existing median of major roads on paved surfaces. Thus no significant traffic air pollution along the corridors should be caused. It is expected that emission of air pollutants will be reduced due to the modal shifting of transportation from passenger cars/ buses to the new transportation system.

Other hands, in accordance with BRT operation start, emissions of air pollution from BRT vehicles will be generated around the depot areas proposed in vacant land currently.

In order to mitigate the impact of air pollution around the depot area, traffic control person should be placed at the gate of the depot to evade traffic congestion like bottle neck and keep smooth traffic flow. And BRT vehicle drivers should be trained on safety and low-speed operation in accessing the depot through residential area.

3) Prediction of the changes of NOx Intensity by the Implementation of BRT

Based on traffic demand forecasting, changes of the air quality by the implementation of BRT is predicted to some extent. Appropriate method of measurement for air quality is still being in the stage of trial and error in Pakistan. The exhaust unit volume of vehicles on air quality factors is not ensured yet for the prospect of air quality in the surrounding areas of the Project. In addition, it is difficult to obtain adequate long term meteorological data for in each forecasting point that are set out along the project area for air quality survey. Therefore, application of Atmospheric Dispersion Model (Plume-Puff Model, etc.) as popularly applied elsewhere in other countries is not so easy to apply in the case of Project.

Thus JICA Study Team proposes the mathematical method in estimating the exhaust coefficient of the total NOx volume emanated from BRT lines. The effect of proposed project is evaluated by comparing the NOx volumes of both “with” and “without” project. The forecast of summary of road traffic volume is shown in Table 7-9-1. Unit volume of exhaust gas are shown in Table 7-9-2. The flow of the mathematical method for the NOx volume forecast is shown in Figure 7-9-1.

Table 7-9-1 Forecast of Summary of Road Traffic

Green Line

Section		Length	2020 Road Traffic (KCR + Green Line + Red Line)				2020 Road Traffic (Only KCR)			
			M/C	Car	Bus	BRT	M/C	Car	Bus	BRT
Cloth Market	Garden Road	0.88	72,000	35,000	4,500	1,632	88,000	45,000	6,000	0
Garden Road	Shahra-e-Quaideen	1.30	104,000	60,000	6,000	1,632	120,000	74,000	8,500	0
Shahra-e-Quaideen	Gurmandir	0.94	116,000	65,000	6,000	1,632	128,000	83,000	8,500	0
Gurmandir	Lasbela	1.08	84,000	67,000	4,000	1,632	96,000	84,000	6,000	0
Lasbela	Nazimabad No.1 Chowrangi	1.65	108,000	73,000	5,500	1,632	128,000	88,000	8,000	0
Nazimabad No.1 Chowrangi	Board Office	3.53	152,000	86,000	8,000	1,632	172,000	98,000	11,000	0
Board Office	Nagan Chowrangi	4.82	116,000	73,000	5,500	1,455	112,000	71,000	8,500	0
Nagan Chowrangi	New Karachi	4.00	116,000	77,000	6,000	1,200	120,000	76,000	9,000	0
New Karachi	Surujani Chowrangi	5.61	116,000	77,000	6,000	840	120,000	76,000	9,000	0

Red Line

Section		Length	2020 Road Traffic (KCR + Green Line + Red Line)				2020 Road Traffic (Only KCR)			
			M/C	Car	Bus	BRT	M/C	Car	Bus	BRT
M.A. Jinnah Road	Jail Chowrangi	2.11	44,000	29,000	4,000	1,632	60,000	44,000	6,000	0
Jail Chowrangi	Hasan Square Roundabout	2.45	68,000	48,000	4,500	1,632	92,000	66,000	7,000	0
Hasan Square Roundabout	NIPA Chowrangi	3.07	96,000	71,000	5,500	1,632	120,000	89,000	7,000	0
NIPA Chowrangi	Safari Flyover	1.63	72,000	61,000	5,000	1,632	96,000	77,000	6,500	0
Safari Flyover	NED	0.97	84,000	74,000	8,000	1,632	100,000	87,000	11,000	0
NED	Safura Circle	4.00	84,000	74,000	8,000	1,089	100,000	87,000	11,000	0
Safura Circle	Malir Cant Check Post	2.16	60,000	65,000	5,000	1,089	72,000	82,000	6,000	0
Malir Cant Check Post	Model Colony	4.08	72,000	59,000	5,000	1,089	76,000	60,000	5,500	0

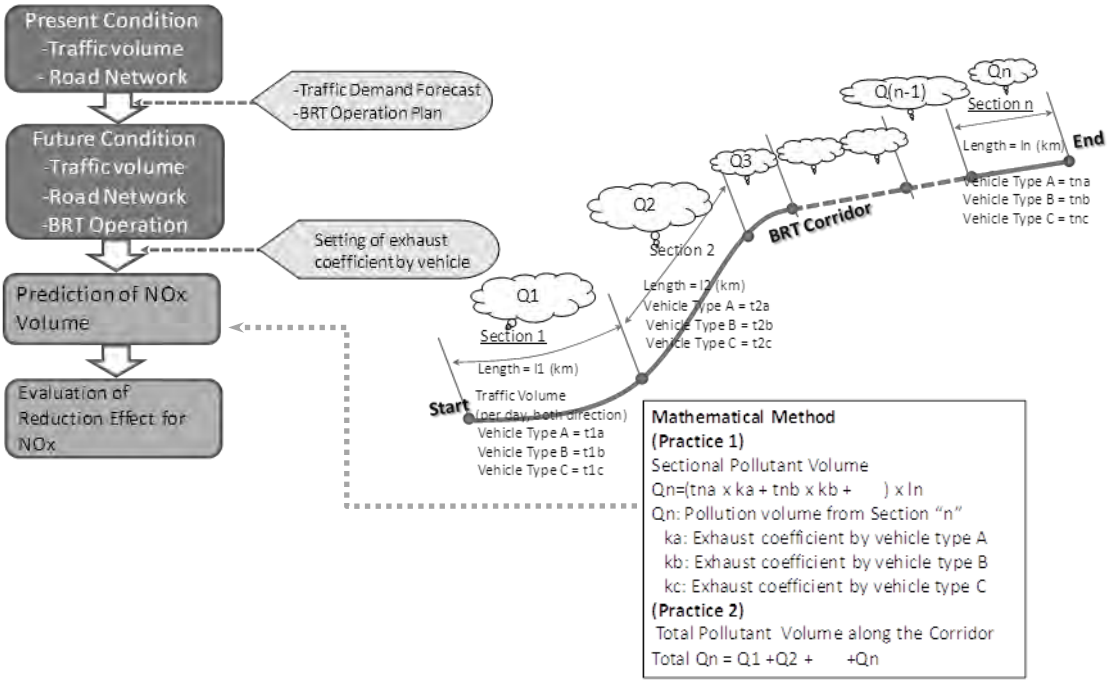
Note 1: Figures are the number of vehicles per day for both directions
Note 2: Estimated by the Demand Forecast Model in KTIP
Note 3: M/C = Motorcycle

Source: The Study for KTIP

Table 7-9-2 Unit Volume of Exhaust Gas

Vehicle Type	NOx (g/km)	Fuel type
Motor Cycle	0.20*	Gasoline
Car	1.10*	Gasoline
Bus	14.90*	Diesel Oil
BRT Vehicle	11.175**	CNG

Source: *Pakistan GHG Source and sink coefficient 1997 Asia Least-Cost Greenhouse Gas Abatement Study (ALGAS)
**Pakistan GHG Source and sink coefficient 1997 ALGAS and CNG Bus Emissions Roadmap: from Euro III to Euro VI, International Council on Clean Transportation 2010)



Source: JICA Study Team

Figure 7-9-1 Prediction Flows in NOx Volumes

It is expected that the exhaust pollution gas is reduced approximately 14% by modal shift due to the implementation of BRT as shown Table 7-9-3.

Table 7-9-3 Reduction Ratio in Air Quality

BRT	Forecast of NOx volume along the BRT line :Q (g/day)		Reduction due to the implementation (%)
	With the BRT Project Road Traffic (KCR + Green Line + Red Line)	Without the BRT Project Road Traffic (Only KCR)	
	Q_w	Q_{wo}	$(Q_{wo}-Q_w)/Q_{wo}$
Green Line	4,981	5,782	13.9%
Red Line	8,684	10,073	13.8%
Total	13,665	15,855	13.8%

Source: JICA Study Team

(2) Noise and Vibration

1) Construction stage

During construction stage, the construction activities would generate significant amount of noise and vibrations. However, these increased noise levels from the present conditions will prevail only during the construction stage.

In order to mitigate the impacts of noise and vibrations from construction equipment, the contractors should prepare the adequate mitigation measures such as regular maintenance of the construction machinery and equipment. It is also important to carry out training of the technicians and the operators of the construction machinery and drivers of the vehicles. Use of portable noise barriers and implementation of regular monitoring should also be periodically carried out.

Construction plants and machinery with high intensity of noise and vibration will be allowed to operate during specified/designated time of the day. In case it is necessary to take construction activities in night shift in order to catch up with the required construction schedule, permissions from local authorities should be obtained.

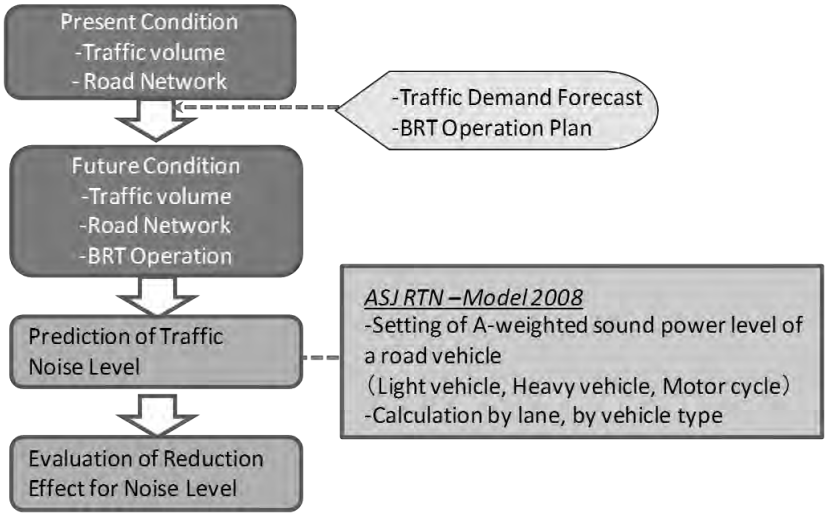
2) Operation stage

During operation stage, the BRT system of Green and Red Line are designed to run within the existing median of major roads on paved surfaces. Therefore additional significant traffic noise and vibration to the present traffic should not be generated.

3) Prediction of the Change of the Traffic Noise Level by the Implementation of BRT

Based on the traffic demand forecasting, prediction of the change of the traffic noise level as a result of the implementation of BRT is expected to take place. In general noise and vibration will be reduced due to the modal shift of transportation from passenger cars/buses to the new transportation system of BRT.

For prediction of the changes of the level of noise, there is no appropriate method has not yet been established officially in Pakistan. The noise source level of vehicles in Pakistan has also not ensured to date. In addition, there is no scientific establishment of the noise source in each forecasting point set out for the Project. Therefore, in respect of grasping the traffic noise improvement by the modal shift of transportation from present to BRT system, JICA Study Team proposes that the power level using the simulation method of the Acoustic Society of Japan (ASJ RTN-Model 2008) is applied with the existing model volume for calculation of the traffic noise level changes. Five points along the Green/Red line are selected as prediction locations, where there was the same section of field survey points. The flow of the mathematical method for the traffic noise level forecast is shown in Figure 7-9-2.



Source: JICA Study Team

Figure 7-9-2 Prediction Flows in Traffic Noise Level

BRT operation plan and traffic demand forecast are same as the prediction for NOx. The result of the noise level forecast is shown in Table 7-9-4. It is expected that the traffic noise level is reduced up to approximately 2.1 % by modal shift due to the implementation of BRT.

Table 7-9-4 Reduction Ratio in Noise Level

BRT	Location	Traffic Noise Level				Reduction rate (%)	
		With the BRT Project Road Traffic (KCR + Green Line + Red Line)		Without the BRT Project Road Traffic (Only KCR)			
		NL_w		NL_{wo}		$(NL_{wo}-NL_w)/NL_{wo}$	
		Day	Night	Day	Night	Day	Night
G-3	Shahrah-e-Shershah Suri Opposite Farooq-e-Azam Mosque, North Nazimabad	73.9	67.8	73.9	67.8	0.0%	0.0%
G-4	Nawab Sadiq Ali Khan Road, Munnu Bhai Park, Pedestrian Bridge, Nazimabad No.1	81.3	74.4	81.9	74.9	0.7%	0.7%
G-5	Business Recorder Road Opposite Subhani Mosque	79.1	73.6	79.9	74.3	1.0%	0.9%
G-6	M.A.Jinnah Road Numaish Intersection near Rangers	77.6	73.7	78.3	74.4	0.9%	0.9%
G-7	M.A.Jinnah Road Opposite Radio Pakistan near Sabri KMC Orangzeb Market	79.3	74.1	80.1	74.9	1.0%	1.1%
R-3	University Road Opposite Sheikh Zayed Islamic Centre	79.6	72.2	80.3	72.9	0.9%	1.0%
R-4	University Road Opposite Chiniot School near Safari Park	76.9	70.5	77.9	71.4	1.3%	1.3%
R-5	Bait-ul- Mukkarran University Road	80.0	73.3	80.9	74.2	1.1%	1.2%
R-6	University Road near Car Dealers, Dawood Engg. College	76.1	68.3	77.4	69.4	1.7%	1.6%
R-7*	New M.A. Jinnah Road End Point, Opposite Church at Abdullah Haroon Road	78.7	70.0	80.2	71.5	1.9%	2.1%

Note: Day time: Day time hours: 6.00 a. m to 10.00 p. m, Night time hours: 10.00 p. m to 6.00p. m
*Noise level was simulated in consideration of the elevated structure of BRT.

Source:JICA Study Team

(3) Water Pollution

1) Construction stage

Construction activities of the Project would cause minor impacts on hydrology and ground water quality of the project area as a whole unless otherwise the case that the construction chemicals seep through the ground.

The majority of the road construction works are designed to take place within the existing median of major roads on paved surfaces and therefore soil erosion and sedimentation should not take place at all.

The impact of storm water runoff might on the other hand become very significant for operation and maintenance of the Project during rainy season as low-lying area's water ponding should hamper the bus operation for several days.

2) Operation stage

During operation phase, to prevent surface and ground water contamination on account of oil/grease etc., leak proof containers should be used for storage and transportation of oil/grease used for construction plants and machinery. The floors of oil/grease handling area should be kept effectively impervious. Any wash off from the oil/grease handling area or workshop should be drained through impervious drains and effluent should be treated appropriately before releasing it.

(4) Solid waste and Land Contamination

1) Construction stage

Solid waste is mainly generated from the construction debris and the packaging material as well as some from human activity i.e. workers at construction site. The entire solid waste generated

at the construction site should be recyclable except for the food waste which is perhaps considered to be a major issue in regard to contamination from non-construction waste. However the amount of food waste could be negligible in comparison to the total solid waste generated during the construction phase.

Appropriate solid management program should be planned at the time of the commencement of construction works. Description in the contract documents the safe disposal mainly through recycling process would provide a viable solution against land contamination that could otherwise be caused by solid waste disposal during the construction phase. Excavated soil and other construction debris should be checked for containing any harmful materials before disposal.

2) Operation stage

During operation stage, there is a possibility of generation of the waste solid from the depot due to the repair /maintenance of the BRT vehicles. These waste materials are expected to be treated by the special contracts for services of waste collection/recycling/ sewage treatment and reuse.

(5) Overall Impact Assessment

Identification of Impacts and proposed mitigation measurement are summarized in Table 7-9-5.

Table 7-9-5 Identification of Impacts and Mitigation Measurement for Pollution Control

S. No	Environmental Attributes	Aspect	Potential of Impact	Proposed Mitigation Measures
Pre-Construction Phase				
1	Physical Impacts	- Designing and planning works will be implemented during pre-construction stage.	- No significant impacts	-
Construction Phase				
1.	Ambient Air Quality	- Dust emissions from site preparation, excavation, material handling & other construction activities at site.	- Minor and short term negative impact around site - No negative impact outside site.	- Regular water sprinkling on the exposed surfaces to reduce dust emission - Proper maintenance of all equipment at regular intervals
2.	Noise & Vibration	- Noise & Vibration generated from construction activities, operation of construction machinery, equipment and their movement	- Short term negative impact around site - Noise and vibration generation sources confined within the construction site. - No significant negative impact on ambient noise levels outside site.	- Regularly maintenance of construction machinery and vehicles, with particular attention to silencers and mufflers in order to keep construction noise levels to minimum level. - Carry out training of the technicians and the operators of the construction machinery and drivers of the vehicles - Notify the local people in case of plants and machinery with high intensity of noise and vibration are used. - Permissions from local authorities should be obtained in case of night time activities.
3.	Water Quality	- Surface runoff from project site (particularly during the rainy season) might be of an obstacle to the operation and maintenance of the Project - Oil/fuel & waste spills from construction area due to the	- No significant negative impact.	- Construction methods and techniques and disposal of waste water need to be designed for proper drainage and control of discharge (i.e. local drainage, oil and grease traps) - Avoid excavation during rainy

S. No	Environmental Attributes	Aspect	Potential of Impact	Proposed Mitigation Measures
		repairing and maintenance works of equipment/ vehicles on site - Improper debris disposal - Discharge of sewage from labor camp.		season.
4.	Solid waste	- Disposal of excavated soil, construction debris and other waste including domestic waste which can cause soil contamination and other health & safety issues - Disposal of solid waste from labor camp	- Minor negative impact	- Proper solid waste management program should be designed and executed for the construction and operation phases of the Project as integrated in the EMP. - The entire solid waste generated at the construction site and camp site is recyclable but for the food waste.
5.	Soils contaminant	- Construction and excavation activity leading to topsoil removal & erosion.	- Minor and short term negative impacts	-
Operation Phase				
1	Ambient Air Quality	- Particulate and gaseous emissions from vehicle movement	- Minor negative impact inside premises with no impact outside. Limited alongside the routes	- Vehicle Emission Control - Driver training on safety
2	Noise	- Noise from vehicle movement	- No significant impact at sensitive receptors.	-
3	Water quality	- Oil/fuel and waste spills. - Discharge of contaminated water - Spillage of oil and grease from the vehicles and wastewater generated from on-site activities such as vehicles washing, workshop etc.	- No significant adverse impact. - No wastewater discharge to the nearby water sources.	- Wastewater treatment/pits at depots should be installed to mitigate the impact.
4	Solid waste	- Disposal of repaired parts and tires	- No remarkable negative impact	- Contracts for services of waste collection/recycling/ sewage treatment and reuse shall be formulated
5	Soil contamination	- Accidental fuel and material spills	- No negative impact	- Proper waste management plan and spill response plan should be implemented

Source: JICA Study Team

7.9.2 Natural Environment

(1) Flora

There are several locations where there are trees present in the median of the both BRT corridors. As many as 72 species of plants were recorded during roadside trees measurement on green and red line. The total of tree count on the median of both corridors is found to be 23,118. The dominant plant species are obviously *Conocarpus, Eucalyptus* and *Lignum* species.

There are at least 9,020 trees on Red Line and 4,145 trees on the Green Line. This number relates to trees that are on the median and the same will have to be removed to yield to BRT-RoW where road width is narrow along the Green Line and Red Line corridors as well as the station sites. Among affected trees, approximately 70-80% of the trees are maturing while 20-30 % are mature. Tentative cost of removal of trees /Plants as well as re-plantation is estimated Rs. 500/Tree.

Soft landscaping should be installed in the median under the elevated sections to improve the appearance of the completed works. Other opportunity spaces should be sought by KMC to re-plant trees as near the locations of the felled tree as possible (e.g. Depot, non-affected major roads). The contracts drawn up by KMC for the BRT should require that wherever possible the trees are transplanted for use elsewhere in the project (e.g. amenity areas at intersections). The cut wood shall

not be burned on site. All stumps and surplus vegetation shall be disposed of at landfill via routes or other destinations as designated and instructed by KMC.

(2) Fauna

No significant impact is likely to register as there is no considerable fauna in the project area particularly along the green and red line. The project area does not have wetlands also the sections passing across rivers and water bodies are not directly affecting the associated ecosystems particularly the movement and feeding / breeding grounds of migratory birds.

(3) Topography & Geology

During the construction phase the chances of severe impacts are less because the existing site is fairly leveled. Considering the region is flat with no deposits of minerals on site leading to loss of revenue. The development is planned according to the international standards for earthquake protection. Hence the impacts will be minor and not noteworthy.

(4) Soil Erosion and Sedimentation

The majority of the road works proposed are designed to be within the existing median of major roads on paved surfaces and therefore soil erosion and sedimentation should not be a significant impact.

Identification of Impacts and proposed mitigation measurement are summarized in Table 7-9-6.

Table 7-9-6 Impacts and Proposed Mitigation Measures for the Natural Environment

S. No	Environmental Attributes	Aspect	Potential of Impact	Proposed Mitigation Measures
Pre-Construction Phase				
1.	Flora & Fauna	- Habitat disturbance during construction activity.	- Minor negative impacts on short term	- Scores of cutting trees during construction should be minimized.
Construction Phase				
1.	Flora & Fauna	- Habitat disturbance during construction activity.	- There are affected trees on the median on the BRT corridors.	- It is required to adopt appropriate techniques while undertaking construction activities to minimize ecological disturbances - Re-plant - Appropriate compensatory plantation should be carried out around the station or depot, if possible.
2.	Topography & Geology	- Site development	- No significant impacts	-
3.	Soil erosion	- Run off	- No significant impacts	-
Operation Phase				
1.	Flora & Fauna	- flora & fauna	- Land use change	- When trees are planted as compensation during construction, appropriate maintenance should be carried out.

Source: JICA Study Team for KTIP

7.9.3 Socio-economic Environment

(1) Pre-construction and Construction Period

1) Kiosks Subject to Relocation

As is shown in Figure 7-9-3, there are 36 of kiosks on the sidewalk where the pedestrian bridges for the S-21 station of Red Line is planned to construct are subject to relocation. They have been notified informally as a part of pre-construction information. They will be further notified officially in writing prior to the commencement of the construction works.

These kiosks are allowed to put up in the present location on the basis of CDGK's permission under various regulations including "Karachi Building Town Planning Regulations, 2002" that requires a payment of Rp.1,000/month per kiosk. Thus during the construction period, their location of business are newly assigned by KMC, which issues official letter to each kiosk owners 15 days before the commencement of the Project.

The structures of these kiosks are temporarily constructed. Each kiosk is consisting of four bamboo poles and a sheet of fabric with a moveable table for vending various good such as fruits, vegetables, household goods, etc.

Relocation works of these kiosks are carried out by the owners of these kiosks themselves without incurring any extra cost for relocation. There is no kiosk owner who loses his/her business or those who do not have places to re-establish their present business as they are allowed to move to near-by sidewalk or market place at their own discretion without any extra cost.

Source: JICA Study Team for KTIP

Figure 7-9-3 Kiosks Subject to Relocation

2) Traffic Disruption

The proposed Green and Red Line BRT corridors will be constructed on the existing road with live traffic. Construction activities along these routes are likely to cause hindrance to the general road traffic depending on the construction practice. A temporary traffic management plan therefore will have to be developed and submitted by the contractor at least one month before commencement of construction works. The main objectives of the plan are to maximize the safety of the general public and the workforce of the Project. The plan should also pay attention to maintain traffic flow as much free as possible.

The temporary transport management plan should include but not limited to the consideration of the following:

- Maximize the availability of traffic flow in the traffic diversion sections and minimize the traffic flow passing through the works site;
- Seek road closures and the necessary government/police orders in order to minimize traffic congestion;

- Establish acceptable working hours and constraints at the work site;
- Establish traffic flow so as to delay the peak hours of traffic congestion;
- Co-ordination with other planned road and street works as well as building works;
- Traffic signs and warning instructions for the information of other road traffic are displayed at sites and along the proposed routes;
- As measures to mitigate the impacts to the general public, period of construction and area/location of construction site should be informed to the general public. Specifically important is to notify the local residents adjacent to the planned depot where the local houses are exposed to the construction works. Notify the timing of construction works intended to carry out at each depot and explain construction method and machinery intended to use. Monitor the noise and vibration at the construction location of each depot. Accept complaints of the local people and carry out mitigation measures considered important to mitigate the impacts;
- Any closure of the roads and deviations should be informed clearly through standard signs and displays;
- Discuss with KMC for its role on the inspection and monitoring; and
- Establish accident management system for the duration of construction works.

The plan will have to be reviewed by KMC for approval. Resources from the contractor, KMC, the Consultants and the traffic police will have to be provided as per the plan made before the commencement of construction works.

3) Job Opportunities

The local people would obtain job opportunities related to the construction works of BRT. Jobs would be created for unskilled, semi-skilled as well as skilled laborers, for which local population would be given preference. Expenditure incurred by those employed at the project will boost further local economy to some extent. Thus, the project is expected to contribute to the overall development of the area.

4) Working Conditions, Infection diseases, Public Hygiene, Accident and Hazard

The health and comfort aspects are the major environmental issues that need to be taken into consideration at the construction stage of the project. Health of the workforce and of the residents in the surrounding area may be affected to some extent from emissions of dust, noise and construction debris. The construction activity itself is a nuisance and must be mitigated to the level of tolerance.

Based on observations that an adequate level of sophistication of health and safety is applied in local construction practices, it can be assumed that the chances of serious injury or accident during the construction activities on the Green Line and Red Line corridors will be above the level of expectation. The health and safety aspects will have to be strengthened nevertheless by training on Occupational Health and Safety besides fire fighting.

Mitigation Measures are following:

- The campsite will be equipped with provision of safe drinking water, waste disposal facilities and first aid box as well as an ambulance to deal with cases of emergency.
- The workforce will also be given access to a doctor for routine checks and medical examinations if necessary.
- In order to maintain adequate hygienic and sanitary conditions at the construction site temporary toilets will be provided.
- The workforce shall be properly informed of the potential risks and hazards associated with their jobs, which might impact on their health and safety.

- All workers shall be provided with information which allows them to assess a risk in simple terms.
- Health education including vulnerability to sexually transmitted infections including HIV shall be provided.
- Disciplined behavior on the part of the workforce shall be made a condition for continued engagement at the site.
- The safe disposal of solid waste will be outsourced to a contractor.

(2) Operation and Maintenance Period

There are a number of minor items that might otherwise cause relatively positive impacts to the general public as follows:

a) Increase of job opportunities

Activities during the operation and maintenance period would contribute to local economy by providing job opportunities. These benefits will definitely increase the socio-economic status of the project area. Hence the overall impact will bring the positive change.

b) Improvement of Infrastructure Facilities

The development of project will also create or improve the amenities/services like road, communication, health, education, and other aspect of the urban setting.

c) Wider Economic Growth

The proposed project will increase the economic activities along the Green and Red Line corridors, creating avenues for direct/indirect employment in the post-project period. There would be a wider economic impact in terms of generating opportunities for other business related to commerce and industry in general.

d) Improvement of Road Transportation

During the operation and maintenance period, the local road will likely be improved without any obstructions. As more commuters are diverted to BRT, the traffic conditions will improve due to reduction in traffic flow, which further suggests improved air quality and general, environmental conditions associated with vehicular traffic along the Green and Red corridors.

e) Reduced Health Risk and Accidental Hazards

The construction of separate BRT lane will greatly reduce the accidents associated with the roads. While ensuring maximum operational safety of BRT lines, it suggests that road accidents are minimized. Health risks due to vehicular/exhaust emissions experienced in congested traffic conditions are likely to be avoided by the commuters travelling on BRT.

f) Creation of Depot

Depot is to maintain maintenance services of bus i.e. use of water for washing buses and maintenance works using mechanical tools as well as to run engines after repairing works. These activities should cause ambient noise newly introduced to the depot areas where there was none. Thus monitoring ambient noise around the local residential areas should be carried out. It is also important to accept complaints from the local residents and carry out mitigation measures as required.

7.10 Environmental Management and Monitoring Plan

7.10.1 Establishment of KTIP-EMS

Creation of an Environmental Management Unit within the organization of Karachi Metropolitan Corporation (KMC) is one of the pre-requisite of Japanese loan agreement. Thus KMC is requested to establish Environmental Management System, for now it is preliminarily termed as KTIP-EMS, within its organization. As is shown in Figure 7-10-1, KTIP-EMS is to provide systematic and continuous support committed to the implementation of Environmental Management and Monitoring Plan for the Project. Role of KTIP-EMS should include the following:

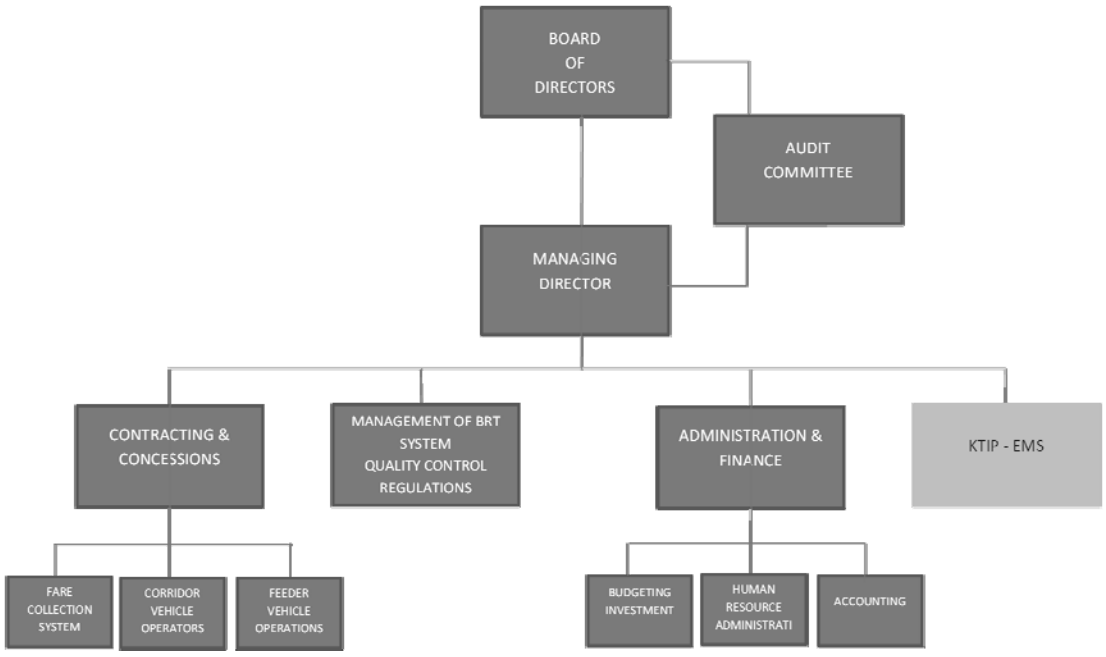
a) Environmental Management;

b) Environmental Monitoring;

c) Personnel Training;

d) Regular Environmental Audits & Corrective Action; and

e) Documentation of the standardized operation procedures, Environmental Management and Monitoring Plans & other relevant records.



Source: EMS, "EIA Study for KTIP"

Figure 7-10-1 Organization of KTIP-EMS

7.10.2 Functions of KTIP-EMS

(1) Responsibility of KTIP-EMS

KTIP-EMS will take overall responsibility for the actions required to implement for environmental management, monitoring and implementation of mitigation measures which was summarized in Table 7-9-5 and 7-9-6. Detail of their function should be included but not limited to the following:

a) Establish and maintain procedures to identify the environmental issues pertaining to the activities of BRT Green and Red Line and the services that the project office controls;

b) Monitoring the progress of the proposed management plans and actions to be taken for the project. KTIP-EMS as an organization within KMC will have to be headed by a qualified environmental engineer. Other members of the unit include but not limited to environmental scientists for the natural and social environment, environmental chemists, industrial safety officers and field survey operators;

c) Overseeing the environmental performance of the facilities, installations, construction sites along BRT corridors at regular interval to demonstrate compliance with existing National Environmental Quality Standards and guidelines;

d) Oversee the environmental performance in a manner that their operation as well as maintenance will neither degrade the environment along BRT corridors nor its macro environment;

e) KTIP-EMS manages facilities such as ISO 9000 certified Quality Control Laboratory (QCL) for all environmental sampling related to the Project. It will also arrange specialists or laboratories to perform the monitoring works within the parameters specified by NEQS, or as advised by EPA Sindh as well as the requirement made by World Bank Guidelines;

f) Follow the environmental management practices adopted by ISO 14,000 certified organizations and also support in the elaboration to safeguard the environment along BRT corridors of Green and Red Line;

g) KTIP-EMS will ensure that the characteristics of the significant impacts that are considered off-course of the environmental objectives that the project elaborates to maintain, and will keep information up-to-date and disclose it to the general public;

h) KTIP-EMS establishes and maintains procedures to identify and have access to legal requirements that are applicable to the environmental quality of the project activities and services including grievance redress system. While establishing and reviewing the environmental objectives of the Project, it observes legal and other requirements, significant environmental features, technological options and its financial, operational and business requirements in order to obtain the views of stakeholders;

i) KTIP-EMS establishes and maintains documented environmental objectives and targets within its organizational set up;

j) KTIP-EMS maintains a database and its own archives in order to keep abreast of modern environmental legislation, emission norms that are now technologically-specific that there are their own limits and standards; and

k) Comply with all the existing environment-related laws and regulations, guidelines and other requirements, including safety regulations, applicable to different systems and products of the Project.

National legislation and environmental guidelines on specific emission limits have not been set out in many cases in Pakistan. World Bank Guidelines are widely used as the minimum norm if the host country does not have its own specific legislation. KTIP-EMS will therefore have to follow the World Bank Guidelines until such time that the regulation on the technologically-specific limits, closely corresponding to national and provincial as well as the actual conditions become available. Detail of environmental management plan and environmental monitoring plan will be prepared in EIA report in accordance with Pakistan's regulation and examined by Pakistan Environmental Protection Agency.

(2) Proposed staff organization of KTIP-EMS

In the context of the implementation arrangement for mitigation measures and monitoring, human resources are also proposed to be arranged to fulfill the functional requirements. Specific responsibilities of the EHS Manager, Safety manager, Chief/site coordinator are detailed below.

1) EHS Manager

- ✓ Managerial and technical supervision of all EHS unit's activities
- ✓ Liaise with the top management of Karachi Bus Rapid Transit Corporation (KBRT) on matters concerning the environment
- ✓ Be fully conversant with the EIA of the project, the conditions of the approval of EIA, and all relevant environmental legislations.
- ✓ Conduct audits to ensure compliance to the EMP.
- ✓ Prevent actions that will harm or may cause harm to the environment, and take steps to prevent pollution on the site.

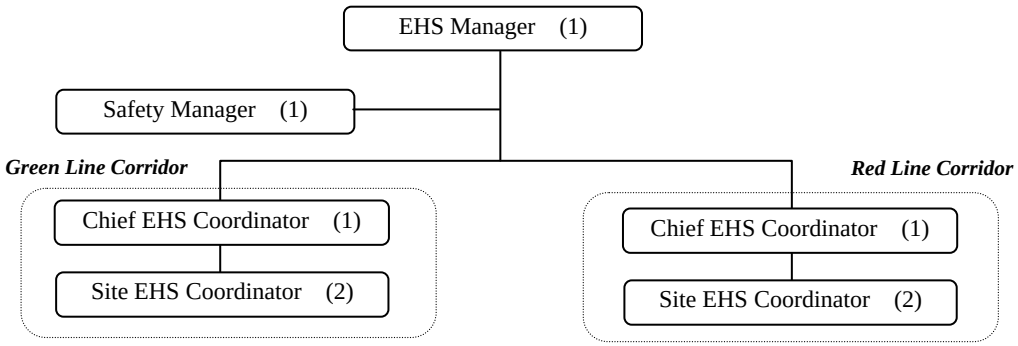
2) Safety Manager

- ✓ Identify road safety deficiencies at various stages in the development of the Project.
- ✓ Critically examine all aspects of the project which may have adverse safety implications, considering carefully the needs of all road users.
- ✓ The Safety Report shall specifically describe the safety deficiencies, potential or real, which have been identified along with the relevant references to accepted standards, practices and highway safety principles.

3) Chief/Site EHS Coordinator

- ✓ Be fully conversant with the EIA and conditions of its approval.
- ✓ Be fully conversant with the EMP.
- ✓ Be fully conversant with all relevant environmental legislation, policies and procedures, and ensure compliance with these.
- ✓ Undertake regular and comprehensive inspection of the site and surrounding areas in order to monitor compliance with the EMP.
- ✓ Take appropriate action if the specifications contained in the EMP are not followed.
- ✓ Monitor and verify that environmental impacts are kept to a minimum, as far as possible.
- ✓ Ensure that activities on site comply with all relevant environmental legislation.
- ✓ Compile progress reports on regular basis for submission to the EHS Manager, including a final post construction audit.

Figure 7-10-2 shows the proposed staff organization of KTIP-EHS



Source: JICA Study Team

Figure 7-10-2 Proposed Staff Organization of KTIP-EHS

Table 7-10-1 shows the proposed outline of human resource requirements, including qualification standard, major job description expected.

Table 7-10-1 Proposed Function of KTIP-EHS

Human resources	Numbers	Qualification and job description
EHS Manager	1	-Bachelor of science, experiences more than ten years in HSE field, preferably. -Managerial and technical supervision of all EHS unit's activities
Safety Manager	1	-Bachelor of science, experiences more than five years in HSE field, preferably. - Identify road safety deficiencies at various stages
Chief EHS Coordinator	2 (one person per one corridor)	-Bachelor of science, experiences more than ten years in specific field, preferably. -Technical supervision and performing the actions.
Site EHS Coordinator	4 (two person per one corridor)	-Middle technical education -Technical application and performing the actions.

Source: JICA Study Team

7.10.3 Environmental Monitoring Plan

Environmental Monitoring Plan should be an integral part of a good environment management in every stage of the project implementation. The main purposes of the Environmental Monitoring Plan are to provide a continuous feedback to the project implementation as well as to the operation and maintenance so as to identify actual or potential successes/problems of the Project. It is also designed to take action in timely manner in terms of the environmental management activities of the project as a whole. The results of monitoring should be examined from the viewpoints of evaluating the effectiveness of the impacts mitigation measures and other efforts of the project. Contents of the environmental monitoring during the construction and operation period shall include environmental impacts associated with water, air, noise, land including wastewater, solid waste generation and socioeconomic such as land acquisition, demolition and resettlement, economic development triggered by the BRT, etc.

Contents of monitoring shall include all direct and indirect impacts generated during the construction period and the operation period. These issues may be eased or nipped at root as much as possible through environmental control measures and environmental monitoring process.

The program on observing air, noise and vibration environment is conducted at locations of the stations as specified by the project plan. Following arrangements will also be ensured and monitored by Contoractor/Independent Monitoring Consultant appointed by KMC

Table 7-10-2 shows suggested environmental monitoring plan.

Table 7-10-2 Suggested Environmental Monitoring Plan

	Monitoring Item	Monitoring Parameter	Monitoring Frequency/Duration	Monitoring location	Unit Cost
Construction Stage					
I	Noise Monitoring	L_{eq} (dB(A))	2 time / month, 16 hours / day.	Stations/ Depot/ Residential areas Sensitive areas	Rs. 25,000/sample
II	Vibration Monitoring	L_p (dB)	2 time / month, 16 hours / day.	Stations/ Depot/ Residential areas Sensitive areas	Rs. 25,000/sample
III	Air Quality Monitoring	CO, SO_2, NO, NO_2, dust and microclimate parameters	Measuring twice a month, 6 samples at one location.	Stations / Depot / intersections	Rs. 40,000/sample

	Monitoring Item	Monitoring Parameter	Monitoring Frequency/Duration	Monitoring location	Unit Cost
IV	Water Quality Monitoring	TSS, TDS, pH, Temperature, BOD, COD, Metals, Sulphates, Carbonates, Oil and Grease, Anionic Detergents	Once fortnightly for surface and groundwater. Grabs Sampling to be done once at each identified location.	Surface water bodies / lagoons / ponds, etc. in proximity to construction sites	Rs. 25,000/sample
V	Land Contamination Monitoring	Alkalinity, Salinity, pH, Electrical Conductivity	Once fortnightly for surface and sub-surface samples. Sampling to be done grab once at each identified location	Exposed surfaces in and around areas in proximity to construction sites particularly at stations & depot. Subsurface sampling in areas around piling, excavation, quarrying and batching plants.	Rs. 40,000/sample
VI	Mitigation Measures	All Treatment Works	Continuous	Environmental Mitigation measures during Constructions	N/A
VII	Site Restoration	Restoring the sites to finished project sites without unnecessary delays.	After completion of each section	Construction Sites	N/A
VIII	Social Aspects	-The new employment opportunity on KTIP operation will be created for them with suitable training. -Communicable Diseases Prevention Program will be prepared for construction workers or residents near the construction sites -Cultural and Archaeological Site	Continuous	KTIP-RoW	N/A
IX	Occupational Health Monitoring	-Safety of workers and general public also checking unauthorized access. -Protective gear and safety. -Basic training of personnel in health and safety and responding to emergencies.	Half Yearly	KTIP-RoW	N/A
Operation Stage					
I	Noise Monitoring	L_{eq} (dB(A))	Measuring 1 time per quarter during the first 12 months, 24hours / day,	Stations/ Depot/ Residential areas / Sensitive areas	Rs. 25,000/sample
II	Vibration Monitoring	L_p (dB)	Measuring 1 time per quarter during the first 12 months, 24 hours / day.	Stations/ Depot/ Residential areas Sensitive areas	Rs. 25,000/sample
III	Air Quality Monitoring	CO, SO_2, NO, NO_2, dust and microclimate parameters	Measuring 1 time per quarter during the first 12 months, 6 samples at one location.	Stations / Depot / intersections	Rs. 40,000/sample

	Monitoring Item	Monitoring Parameter	Monitoring Frequency/Duration	Monitoring location	Unit Cost
IV	Water Quality Monitoring	TSS, TDS, pH, Temperature, Oil & Grease, Anionic Detergents.	Measuring 1 time per quarter during the first 12 months	Surface water bodies / lagoons / ponds, wells etc. in proximity to depot.	Rs. 25,000/sample

Source: JICA Study Team

7.11 Draft Environmental Checklist

During the feasibility study period of the Project, various environmental and social parameters have been examined through EIA study. The key points obtained in the course of environmental and social considerations studies for the Project should be summarized and compiled in a form of check list for the Environmental Monitoring Pan. A format of the "Environmental Checklists, No. 7 for Road Construction Project", defined in JICA Guidelines for Confirmation of Environmental and Social Considerations (April, 2010) is suggested to use as Environmental Checklist as is shown in Table 7-11-1.

Table 7-11-1 Draft Environmental Checklist of JICA Guidelines

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1. Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	N	(a) According to Pakistan law, the Project is required to proceed into the official procedure for EIA approval. Draft EIA report is under preparation as of May, 2012.
		(b) Have EIA reports been approved by authorities of the host country's government?	N	(b) EIA report has not been submitted to Sindh Environmental Protection Agency (SEPA) as of May, 2012. Draft EIA report is scheduled to be submitted to SEPA in June, 2012.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	(c) Ditto
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	N	(d) There is no additional environmental approval to be obtained by the project proponent.
	(2) Explanation to the Local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	Y	(a) Information disclosure to public at the draft EIA report stage was arranged through the 2nd stakeholder meeting held on 27th April 2012 for Green line and on 28the April 2012, and potential impacts with proposed mitigation measures ware explained with plain expression.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	Y	(b) Various opinions and suggestions were exchanged at the primary and secondary stakeholder meeting. Comments raised at the meeting were integrated in the final EIA reports as well as project design accordingly.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	Y	(a) As for route selection, environmental and social aspects such as land acquisition and resettlement have been examined as well as technical and economic aspects. During Master Plan Stage, Mass Transit System including BRT will be proposed trunk lines with considering of ROW and no-resettlement. Some alternative mass transit system/route is examined, and the Green line and Red line is selected. During Feasibility Study Stage, Alternative plan of the BRT Depot location and the end of point in center business district for green line have been examined with social and environmental considerations..

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2. Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken?	Y/N	(a) According to the air quality survey, SO_2, SPM, NO, NO_2 and Lead level along the major corridor are higher than the recommended standard by NEQS. The purpose of the BRT project is improvement of the current traffic problem in Karachi. Thus, implementation of the BRT project is most effective mitigation measurement. It is expected that the concentration of NOx is reduced approximately 14 % by modal shift of transportation from passenger cars/ buses to the new transportation system.
		(b) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	N	(b) Ditto
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas?	N	(a) There is no possibility of soil run off because the BRT line will be based on existing road.
		(b) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater?	N	(b) There is no underground section and no activities in the water bodies in the Project. Therefore there is no possibility of water contamination.
		(c) Do effluents from various facilities, such as parking areas/service areas comply with the country's effluent standards and ambient water quality standards? Is there a possibility that the effluents will cause areas not to comply with the country's ambient water quality standards?	Y	(c) The effluent from Depot/parking area will not be treated appropriately before releasing it.
	(3) Wastes	(a) Are wastes generated from the project facilities, such as parking areas/service areas, properly treated and disposed of in accordance with the country's regulations?	Y	(a) There is a possibility of generation of the waste solid from the depot due to the repair /maintenance of the BRT vehicles. These waste materials are expected to be treated by the special contracts for services of waste collection/recycling/ sewage treatment and reuse.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Noise and Vibration	(a) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	N	(a) The noise level of all locations except CNG green bus terminal Surjani town (G-1) and Ranger area (R-1) is high as compared to NEQS noise level for commercial area. G-1 and R-1 is located in the residential area. Other survey points are located along the major corridor. The purpose of the BRT project is improvement of the current traffic problem in Karachi. Thus, implementation of the BRT project is most effective mitigation measurement.It is expected that the traffic noise level is reduced up to approximately 2.1 % by modal shift due to the implementation of the BRT project. Regarding vibration, there is no standard in Pakistan. All locations except G-1 and R-1 are also higher as compared to Request Limits for Motor Vehicle Vibration in Japan for commercial area. The configuration of the measurement of vibration level is similar to noise level. Therefore, improvement by BRT is expected of the vibration as well as noise.
3. Natural Environ-ment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N	(a) The Project area does not include protected areas, and does not locate close to protected area. There is no possibility to affect the protected area due to Project.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N	(a) The Project area is located in metropolitan city with highly urbanization. Therefore, there are no issues on ecosystem to be cautioned.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	N	(b) Ditto
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N	(c) Ditto
		(d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock?	N	(d) Ditto

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (nonnative invasive) species and pests? Are adequate measures for preventing such impacts considered?	Y	(e) There are several locations where there are trees present in the median of the both BRT corridors. As many as 72 species of plants were recorded during roadside trees measurement on Green and Red Line. The total of tree count on the median of both corridors is found to be 23,118. There are at least 9,020 trees on Red Line and 4,145 trees on the Green Line. During construction the vegetation present on the median lane will be removed on the areas where the bus station will be constructed. In order to mitigate the felling of trees by the Project, modification location/area should be reviewed at sites with considering of minimizing before construction and the affected trees should be re-planted to the other spaces (e.g. Depot, on the center of the non-affected roads)
		(f) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?	N	(f) Same as (a)
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	N	(a) There is no tunnel section in the Project. Therefore, there are no significant issues on hydrology to be cautioned.
	(4) Topography and Geology	(a) Is there any soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed?	N	(a) Green and Red Line alignment will pass along the existing trunk line and there is no tunnel section. Therefore, there are no significant issues on topography and geology to be cautioned.
		(b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides?	N	(b) Green and Red Line alignment will pass along the existing trunk line level, no cutting and filling section. A part of red line, near the Leagal Chownk, is proposed the elevated section. Therefore, there is no possibility of slope failures or landslides.
		(c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	N	(c) The surface areas where cut and cover method will be applied are limited to the stations' construction and elevated section. Therefore, the possibility of soil runoff due to construction work will be negligible.
4. Social Environment	(1) Resettlement	(a) Is there any involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are there any efforts made to minimize the impacts caused by the resettlement?	N	(a) There is no involuntary resettlement, although 36 kiosks along the Red line have to change to near-by area as the Project is implemented.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(b) Have there been adequate explanations on compensation and resettlement assistance given to affected people prior to resettlement?	N	(b) Replacement cost for 36 kiosks is not incurred, because these kiosks are allowed to put up in the present location on the basis of CDGK's permission under various regulations including "Karachi Building Town Planning Regulations 2002". The structures of these kiosks are temporarily constructed. Each kiosk is consisting of four bamboo poles and a sheet with a moveable table.
		(c) Is there any resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socio-economic studies on resettlement?	N	(c) No resettlement plan was made.
		(d) Are the compensations going to be paid prior to the resettlement?	-	(d) N/A
		(e) Are the compensation policies prepared in document?	-	(e) N/A
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	-	(f) N/A
		(g) Are agreements with the affected people obtained prior to resettlement?	-	(g) N/A
		(h) Is there organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	-	(h) N/A
		(i) Are there any plans developed to monitor the impacts of resettlement?	-	(i) N/A
		(j) Is the grievance redress mechanism established?	-	(j) N/A
	(2) Living Conditions and Livelihood	(a) Where roads are newly constructed, is there a possibility that the project affected the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of livelihood, or unemployment? Are adequate measures considered for preventing these impacts?	N	(a) There is a lot of Mini-Bus route or transportation means including rickshaw, which basically consist the feeder line network. Meanwhile, the BRT line is proposed in the trunk line and long distance. There is a different objective between two transportation means.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary?	N	(b) Although there are 36 of kiosks on the sidewalk where the pedestrian bridges for the S-21 station of Red Line is planned to construct are subject to relocation, there is no kiosk owner who loses his/her business or those who do not have places to re-establish their present business as they are allowed to move to near-by sidewalk or market place at their own discretion without any extra cost.
		(c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary?	Y	(c) In the case where contractor(s) workers' camps are established, the health care system including prevention of communicable diseases will be planned such as preventing diseases, providing first aid treatment for onsite injuries and providing healthcare services to the workforce.
		(d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)?	Y	(d) There is a possibility that traffic congestion due to installing the new transportation system. The traffic police will be adequated arranged.
		(e) Is there any possibility that roads will impede the movement of inhabitants?	N	(e) The related structures on the road are stations and elevated piers. Regarding of stations, there is no possibility to impede the movement of inhabitation because stations are proposed within the center diviver area. Regarding of piers, necessary efforts to minimize the impacts due to obstruction have been made in the Project design to keep existing traffic lanes during elevated section
		(f) Is there any possibility that structures associated with roads (such as bridges) will cause a sun shading and radio interference?	N	(f) BRT Structures such as stations and pedestrian bridge are proposed in the center of the Major roads, on the existing ground level. In this case, there is no sun shading and radio interference. In case of elevated section near the Legal Chowk, elevated section is proposed limited, not residential and designed in the center of the road which is standard road structure in Urban area of Karachi. The most of shade of structure is expected within the ROW. Therefore, sun shading and radio interference might be negligible.
	(3) Cultural Heritage Area	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	(a) BRT line is proposed within the existing road, no new modification/expanding road. Therefore, the new /additional damage to the Heritage along the existing road will be negligible.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	(b) As a result of the construction of bus stops and elevated section likely to cause the change of the local landscape. But, limited area of urban land use and the landscape should be changed to a limited extent.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	N	(a) There is no ethnic minority and indigenous people in the project area.
		(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources to be respected?	-	(b) N/A
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	N	(a) The Project proponent will fulfill the requirements to protect working conditions according to the Labors laws.
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	Y	(b) Safety considerations to prevent the injuries and accidents to individuals, such as first-aid kit, Personal Protective Equipment (PPE) , secure tamper-proof fence, security lighting, regular security patrols , etc.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	N/Y	(c) Safety and health program are not prepared concretely at this stage, but the proposed organization Set-Up for KTIP-EMS will ensure the health, safety and security issues.
		(d) Are appropriate measures being taken to ensure that security guards involved in the project not violate safety of other individuals involved, or local residents?	Y	(d) Traffic police for BRT will be arranged appropriately.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	(a) Adequate measures will be planned and provided to mitigate the negative impacts of environmental pollution during construction stage as described follows: i. Noise and vibration: planning the deliberate and efficient equipment use, regular maintenance of construction machines; ii. Turbid water: Avoid excavation during monsoon season; iii. Dust, exhaust gases: Regular water sprinkling, regular maintenance of equipment and trucks; iv. Wastes: A designated solid waste disposal site should be secured away from human settlements. In addition, a disposal site should be away from water streams and any archaeological and historical monuments.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	N	(b) No significant impact is likely to register as there is no considerable fauna in the project area particularly along the Green and Red Line. The project area does not have wetlands also the sections passing across rivers and water bodies are not directly affecting the associated ecosystems particularly the movement and feeding / breeding grounds of migratory birds.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	Y	(c) Adequate measures such as temporary traffic management plan will be planned and provided to reduce the negative impacts to the social environment during construction stage.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	(a) Environmental monitoring plan will be proposed for pre-construction, construction and O&M stages of the Project, based on the impact prediction and mitigation measures proposed in the Draft EIA report.
		(b) What are the items, methods and frequencies of the monitoring program?	Y	(b) Items, methods and frequencies of the monitoring will be expected to be mentioned in environmental monitoring plan in the Draft EIA report.
		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	(c) Institutional arrangement to carry out the mitigation measurement and monitoring is proposed.
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	N	(d) There is no regulatory requirement in Pakistan such as reporting system of monitoring results.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Sample Writing on the Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
6 Note	(1) Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation).	N	(a) There is a possibility of clearing the man-made greenbelt of the road, because Green and Red Line alignment will pass along the existing trunk line. However, the developing area is only proposed station area in the ROW.
		(b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	N	(b) There is no relevant item such as power plant or distribution.
	(2) Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	N	(a) Although, there is a possibility of increased GHG emission due to the operation of heavy vehicles as well as traffic jams incidental to the construction works, this impact will be temporary. On the other hand, it is expected that the GHG emission will be reduced due to the modal shift of transportation from public people vehicle to the BRT.

Note:

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

Source: JICA Study Team

Chapter 8 Project Impact

8.1 Operation and Effect Indicators

Operation indicators and effect indicators will be identified to monitor the level of utilization of BRT infrastructure and rolling stock and their effects. Indicators that can show the utilization and effects concisely and are easy to be aggregated or estimated were selected. Table 8-1-1 shows the operation and effect indicators. As the BRT system is a new mode of transport in Karachi, the "Effect Indicators" are minimal, because no comparison with the existing situation is expected. So, most of the indicators are related to operation indicators which exhibit target values based on the development plan. The indicator A, D, I, and J are most important for evaluating the project after the commencement of the operation.

Table 8-1-1 Operation and Effect Indicators

Category	Indicator		Description	Unit	Target Values after 2 years of Operation
Operation Indicator	A	Transport volume	Daily boarding passengers	Person	700,000
	B	Transport volume by bus stop	Daily passengers by bus stop	Person	8,750
	C	Transport volume (vehicle - km)	Daily vehicle-km	Vehicle-km	146,820
	D	Number of bus services	Number of bus services per day	Number of service	4,241
	E	Transport efficiency	A / D	Person /Service	165
	F	Transport efficiency	A / number of employees	Person	265
	G	Annual average number of operated vehicles per day	Annual average number of operated vehicles per day	Vehicles	344
	H	Annual average number of operational (available) vehicles per day	Annual average number of operational (available) vehicles per day	Vehicles	405
	I	Vehicle operation rate	(G / H) x 100	%	80 - 90 %
	J	Vehicle availability	(H / total number of vehicles) x 100	%	80 - 90 %
Effect Indicator	A	Transport volume	Daily boarding passengers	Person	700,000
	K	Travel speed performance	Travel speed / planned speed (27.4km/h)	%	80 - 90 %

Source: JICA Study Team

8.2 Analysis of Environmental Improvement

8.2.1 Air quality

It is expected that NOx volume of exhaust gas is reduced approximately 26% by modal shift of transportation from passenger cars/ buses to the BRT system. Prediction procedure is described in Chapter 7.4.6. Improvement by BRT is expected of not only NOx but also other exhaust gas such as SO_2, SPM.

8.2.2 Noise and Vibration

It is expected that the traffic noise level is reduced approximately 0.1% to 2.1 % by modal shift of transportation from passenger cars/ buses to the BRT system. Prediction procedure is described in Chapter 7.4.6.

The field measurement shape of the vibration level is similar to noise level, since major influential factor is traffic density along the major road. Therefore, improvement by BRT is expected of the vibration as well as noise.

8.2.3 Green House Gas

The JICA Study Team proposes the mathematical method in estimating the improvement of the total CO_2 volume from the BRT corridors in respect of the modal shifting of transportation from passenger cars/ buses to the new transportation system. The effect of the Project is evaluated by comparing the CO_2 volumes of both cases (with and without-project). The exhaust coefficient of small and large vehicles is shown Table 8-2-1. The flow of the mathematical method for the CO_2 volume forecast is same as prediction flows in NOx volumes (see Figure 7.6.4). BRT operation plan and traffic demand forecast are same as the prediction for NOx (see Figure 7.6.3).

Table 8-2-1 Exhaust Coefficient of CO_2

Vehicle Type	CO_2 (g/km)*	Fuel type
Motor Cycle	116.10	Gasoline
Car	210.70	Gasoline
Bus	245.5	Diesel Oil
BRT Vehicle	239.5	CNG

Source: *2010 guidelines to Defra/DECC's GHG Conversion Factors for Company Reporting, 2010 Department for Environment, Food and Rural Affairs (Defra)

It is expected that the total emission factor for CO_2 is reduced approximately 12 % in respect of the modal shifting of transportation from passenger cars/ buses to the new transportation system.

Table 8-2-2 Reduction Ratio in GHG (CO_2)

BRT	Forecast of CO_2 volume along the BRT line (g/day)		Reduction rate (%)
	With the BRT Project Road Traffic (KCR + Green Line + Red Line)	Without the BRT Project Road Traffic (Only KCR)	
	GHG_w	**GHG_{wo}**	**$(GHG_{wo}-GHG_w)/GHG_{wo}$**
Green Line	689,120	802,531	14.1%
Red Line	270,251	292,469	7.6%
Total	959,370	1,095,000	12.4%

Source: JICA Study Team

Reduction in vehicle emission is one of the most expected outcomes about environmental

improvement by introduction of a mass transit system. The impact can be estimated form the result of with-without analysis in economic evaluation by applying unit vehicle emission of each system.

8.3 Qualitative and Quantitative Check

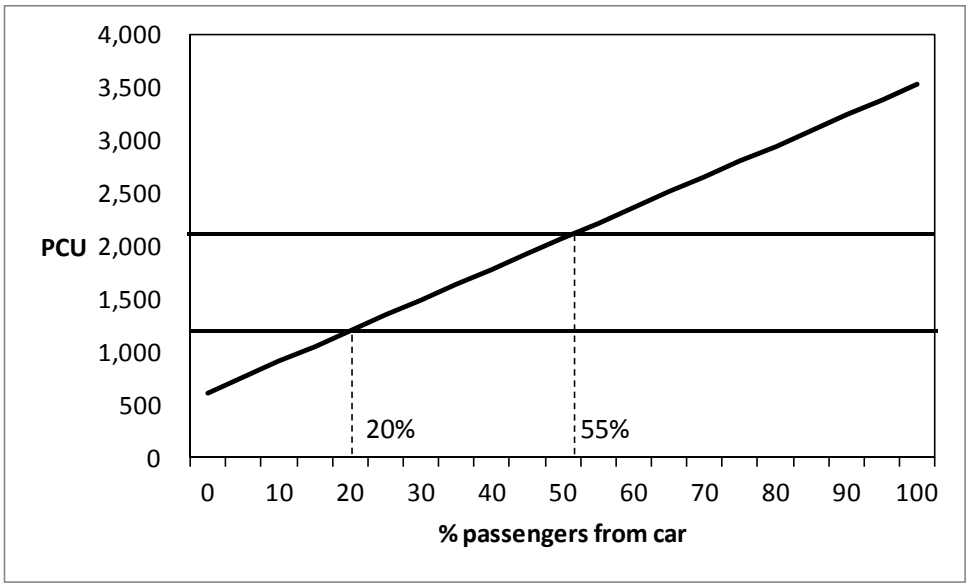
8.3.1 Quantitative Impact

There are some measurable impacts by the BRT project such as reduction in travel time, reduction in vehicle operating cost, and reduction in vehicle emission. There will be negative traffic impact because the project will use existing lanes of the corridors.

(1) Traffic Impact

The capacity of the proposed BRT system is 12,000 passengers per hour per direction, which is equivalent to 343 minibuses (35 passengers per minibus) or 686 passenger car units (PCUs). In case that the capacity of a lane of a road is less than 686 PCUs, converting the lane to the BRT lane will increase the road capacity. Generally, the capacity of a lane is 2,200 PCUs if there is no intersection, and converting such lane to the BRT lane will reduce the road capacity. However, if all BRT passengers are from car users, 3,530 PCUs will be removed from the road, which will increase the road capacity in any case. Figure 8-3-1 shows the reduction in PCUs by the percentage of BRT passengers who are shifted from cars. In case that 55% of BRT passengers are from cars, conversion of a traffic lane to a BRT lane will not decrease the road capacity because it will reduce 2,200 PCUs from the traffic lane. The capacity of a lane of urban roads is less than the lane capacity of 2,200 PCUs due to red time at intersections. Assuming the green time is 60% of a signal cycle, the capacity is approximately 1,200 PCUs per lane. In this case, if the passengers from cars account for 20% of the BRT passengers, the reduction in road capacity can be compensated by the reduction in road traffic.

However, most BRT passengers are expected to be those shifted from buses. Therefore, the reduction in road capacity will be larger than the reduction in road traffic, which will increase volume to capacity ratio of the road.



Source: JICA Study Team

Figure 8-3-1 Equivalent PCUs of a BRT lane by % of Car Users

(2) Travel Time Reduction of Bus Passengers

Presently, the average speed of a minibus is approximately 17km/h in Karachi[1]. It is expected that the BRT system will be operated at an average speed of 25 km/h. This will reduce the travel time of bus passengers.

(3) Reduction in Vehicle Operating Cost

Introduction of large buses for the BRT system will reduce the number of buses, which will save fuel consumption and vehicle operating costs.

(4) Environmental Impact

As discussed in 8.2, the BRT system will improve environment.

8.3.2 Qualitative Impact

The following impacts are expected by the BRT project, although measuring the impacts in numeric units are difficult.

(1) Improvement of City's Image

Megacities in the world have introduced mass transit system including BRT systems in recent years, which have impressed the world that the cities are economically growing. Mass transit system in these cities became a symbol of the steady growth of the city. BRT system with modern type vehicles will improve the image of Karachi.

(2) Increase in Women's Trip

Presently, the trip rate of women in Karachi is very low because of the social and cultural background. However, poor transport system is also one of the reason. BRT system will provide safer transport system than existing minibuses. The project will encourage women to make more trips to participate social activities.

(3) Crime Reduction

BRT system will ensure transparent fare collection by installing ticket gates and monitoring cameras to avoid free riders. Cameras will be also installed at major intersections to monitor the operation of BRT buses. The presence of security cameras can reduce crime in the city. Lighting at stations will also contribute to reduce crime in night time.

(4) Pedestrian Safety

Pedestrian bridges will be constructed to access BRT stations. People can use the pedestrian bridges even if they do not use BRT. The new pedestrian bridges will increase the number of crossing points along the corridors, which encourage people to use the bridges instead of crossing roads of heavy traffic. It is expected that traffic accident on road involving crossing pedestrian and cars will decrease.

(5) City Development

Development in Gadap Town is one of the important land use development. Since the BRT corridor connect the north of New Karachi to the center of the city, urban development in the north area will be promoted.

[1] Confirmatory Green Routes Study for Karachi, 2010, Exponent Engineers

8.4 Economic Evaluation

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

8.5 Financial Analysis

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

Chapter 9 Operation & Maintenance Plan

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

Chapter 10 Implementation Framework

10.1 Institutional Arrangement

10.1.1 Institutional Structure

(1) Basic Concept

BRT is a technology choice to be implemented and managed by an organization that can be a focused specialized agency to a large transport department that oversees all forms of public and private transport systems. These institutions can be either highly autonomous from the local government or closely controlled by elected officials and civil servants. The responsible level of government for a control is, in some instances, by provincial governments or even federal ministries. The institutional oversight of a BRT system can be implemented through existing agencies or a newly created organization. Curitiba, Brazil and TransMilenio, Colombia, are public organizations created by a municipal law while Metrovia of Guayaquil, Ecuador is a NGO. All of these institutions successfully operate their respective BRT systems. Transport for London (TfL) manages the operations of London bus system, London underground system, light rail lines, traffic management and taxi regulation. TfL was created as a Public-Private Partnerships (PPP) company in 1998 in order to secure a long-term investment in London transport infrastructure. Today, there are over 40 institutions in six continents implementing and managing BRT operations. Curitiba and TransMilenio are smaller organizations with focused mandate. They are public corporations reporting to the mayors of their respective cities through their board of directors. These new public transport systems represent a fresh opportunity to establish an effective institutional structure for the entire transport sector. After all, establishment of a sustainable and effective institution for a BRT system is a political process and unlikely to be achieved without political skill of the project sponsor. The quality and safety of Karachi bus services are inferior, and public acceptability of urban transportation will only be achieved if bus services are drastically improved and all other mass transit systems are implemented and operated to an acceptable standard. Furthermore, to facilitate the increasing number of commuters in Karachi a mass transit network consisting of BRT, LRT, Metro and any other modes of public transport systems need to be developed and put in operation within a reasonable time. In designing the institutional structure for a BRT or any other mode of MRT system for Karachi, it is necessary to envision an overall institutional oversight structure. Karachi BRT System is one of the transport agencies to be established under the CDGK overall oversight regulatory structure. The institution, regardless of shapes and forms, must secure required funds for the development and maintenance of infrastructure and vehicle operations, and it is likely that the large portion of these finds come from public sector since private sector funding is difficult. Under the current political and economic environment of Pakistan, it is unlikely that a BRT can be implemented and managed by private sector financing alone under any project financing scheme. To create incentives for the private sector to operate in the public interest GOS and CDGK need to work on the policy decisions by the highest level of public officials and effective regulations. It will take a new form of Public-Private Partnerships in which the public agency (CDGK) takes full responsibility of the construction, regeneration, improvement and maintenance of infrastructure (i.e., dedicated corridors, stations, terminals, depots, pedestrian bridges, etc). GOS has promulgated Sindh Public-Private Partnership Ordinance 2009 aimed at, amongst others, expanding transport infrastructure services and improving their reliability and quality. This legislation provides a legal framework for participation of private entities in public transport development in Karachi.

(2) Establishment of New Institution

After the careful analysis of institutional set up of mass transit administration in Karachi and in consultation with various public and private organizations including Karachi Mass Transit Cell (KMTC), Transport and Communication Department (TCD), Works and Services Department of CDGK and Public-Private Partnerships (PPP), a unit of Finance Department, GOS, a concept for the new institution was developed.

The new institution shall be a public corporation, and its stakeholders will be public sector (51%), and private sector (49%). The new institution will be tentatively called as the "Karachi Bus Rapid Transit Corporation (KBRTC)". In order to create a new institution for a mass transit system from scratch, it is the first thing to make it sure that there is a political will and financial and human resources to set up and operate the institution. Operations of public transportation system either by public or private sector or both are usually running in deficit requiring government subsidies in a large scale. The BRT system's sustainability depends as much on the system's "software" (the regulatory and business structure) as it does on the "hardware" (vehicles, stations, terminus, and other infrastructure). The new institution must operate as a commercial and business entity. It is designed to secure long-term investments from public and private sector and leverage local, provincial, central government funds as well as private funds, maximize the level of private sector investment over the long terms in Karachi BRT system. The KBRTC's initial institutional structure is a public company, but it is a dynamic form of "corporatization" which is a final form of institution in the privatization process. KBRTC is designed to be 100% private within next several years. Meanwhile, the new institution must create an environment to utilize the efficiencies, innovativeness, flexibility and speed of the private sector to provide better infrastructure and service at an optimal cost. In other words, attempting to plan an institutional structure it is necessary to maximize private sector participation in the BRT operations and infrastructure development within a Public-Private Partnerships framework (e.g. private sector finances vehicles and fare collection equipment).

As mentioned earlier, there are other institutional options available including a transportation authority and SPC (special purpose company- a PPP company), etc. A transportation authority is usually an organization with wide oversight on all public transport activities. A state or city owned monopoly is low cost-effective due to confused corporate objectives (services or profits?), low, sporadic or inappropriate investment resulting in poor services and large subsidy requirement. What is needed for the implementation and management of Karachi BRT is a focused business-oriented organization that is able to perform a balancing act of corporate objectives. The SPC is a PPP company created to engage in the financing, development, operation and maintenance of BRT system under a concession agreement. Under the current domestic and international market conditions, it is unlikely that a private company or consortium is capable to implement and manage the BRT system alone.

(3) Regulatory Structure

BRT corridors will be taken out from CDGK regulatory control and placed under the KBRTC's control. KBRTC would be running the BRT system independently, and it will manage the BRT Corridor vehicle operations through the concessions with private sector vehicle operators and, in later stage, feeder vehicles operators. It will control and administer revenues through independent concession for fares collection system. Handling the revenue is the key of the whole operation of BRT system. An independent fare collection process means that none of the vehicle operators have any relationship to handling the fares. Furthermore, through the use of real-time sharing of fare information, all parties have an open and transparent view on revenues, creating an environment of confidence in the system. CDGK is the regulatory authority of Karachi public transport system and owner of system assets. Furthermore, CDGK would have overall responsibility to deliver services to the traveling customer and for overall safety of the Karachi public transport systems. CDGK will finance, develop, and maintain through competitive bidding corridors, stations, terminals, depots, pedestrian bridges, and other

infrastructure to the standards and performance levels required in order to give the public with a reliable service over the network in a safe, efficient and economic manner. Responsibilities for mass transit, major road transport, traffic management and infrastructure development are currently shared among three departments of CDGK: Karachi Mass Transit Cell (KMTC), Transport & Communications Department (TCD), and Works & Services Department. KBRTC will play the leading role in the implementation and management of the BRT system. KMTC will focus on the transport policy, planning and setting standards for Karachi MRT system in collaboration with TCD and Master Plan Department of CDGK. TCD, on the other hand, regulates traffic and transport of the City. The Works and Services Department will through competitive bidding develop and maintain required infrastructure for BRT system operations in close consultation and coordination with KBRTC.

(4) Business Structure

There is a growing consensus over the form of the best practice business structure through the experience in Bogota, Curitiba and Guayaquil. While each city will likely have its own unique conditions that will ultimately determine the actual form of the business structure, based on the experiences to date, there are many common features that can lead to an effective structure. In each of these successful cases, there has been the basic formula of private sector competition within a publicly controlled system. In Bogota, TransMilenio, a public company holds overall responsibility for system management and quality control. Private sector concessions are used to deliver all other aspects of the system including fare collection and bus operations and maintenance. The vehicles and even fare collection equipment are purchased by the private sectors firms. TransMilenio and the municipal government are able to leverage private sector investment and defer large portion of the financial risks while retaining overall control on the shape of the system. Furthermore, the independent concession for fare collection helps ensure the system's revenue are properly controlled and administered. Generally, each corridor will host plural operators. However, none will have an inceptive to operate in an overly-competitive manner on the corridors as each operator is making its revenues from the vehicle-kilometers traveled rather than from the number of passengers collected. The feeder services can be particularly important in terms of finding a place for many existing operators in the new system. These contracts are tendered separately from the Corridor operators.

10.1.2 KBRTC

(1) Organization

Based on the institutional, regulatory and business principles KBRTC will be established as an overall lead body invested with the legal powers for establishing and implementing BRT policy. It will be the implementation agency for Karachi BRT system. KBRTC will be a public company, registered with Securities Exchange Commission of Pakistan (SECP) with the following shareholders: CDGK (41%), Government of Sindh (10%) and Private Sector (49%). It will serve as a regulatory authority for planning, implementing and managing BRT system of Karachi. The company's Board of Directors has the following structure: Administrator/Mayor (Nazim) Karachi, Chairman, Secretary of Finance, GOS(Member) and two members from CDGK viz EDO Transport & Communications and Director Genera, Karachi Mass Transit Cell (KMTC). The Board will also have two (2) members from the public traffic and transport control agencies, three (3) members from NGO and Managing Director, KBRTC as Secretary to the Board. KBRTC reports to the Chairman through its board of directors. The management of KBRTC consists of Managing Director who is supported by three (3) Deputies.

(2) KBRTC Board of Directors,

- Administrator /Mayor (Nazim) Karachi (Chairman)
- Secretary of Finance, GOS (Member)

- EDO, Transport & Communications, CDGK (Member)
- Director General, Karachi Mass Transit Cell, CDGK (Member)
- Deputy Inspector General (DIG), Karachi Traffic (Member)
- Representative of District Regional Transport Authority (DRTA) (Member)
- Representative of Karachi Public Transport Society (Member)
- Representative of the Chartered Institute of Transport (Member)
- Representative of Association of Road Users of Pakistan (Member)
- Managing Director, KBRTC as Secretary to the Board

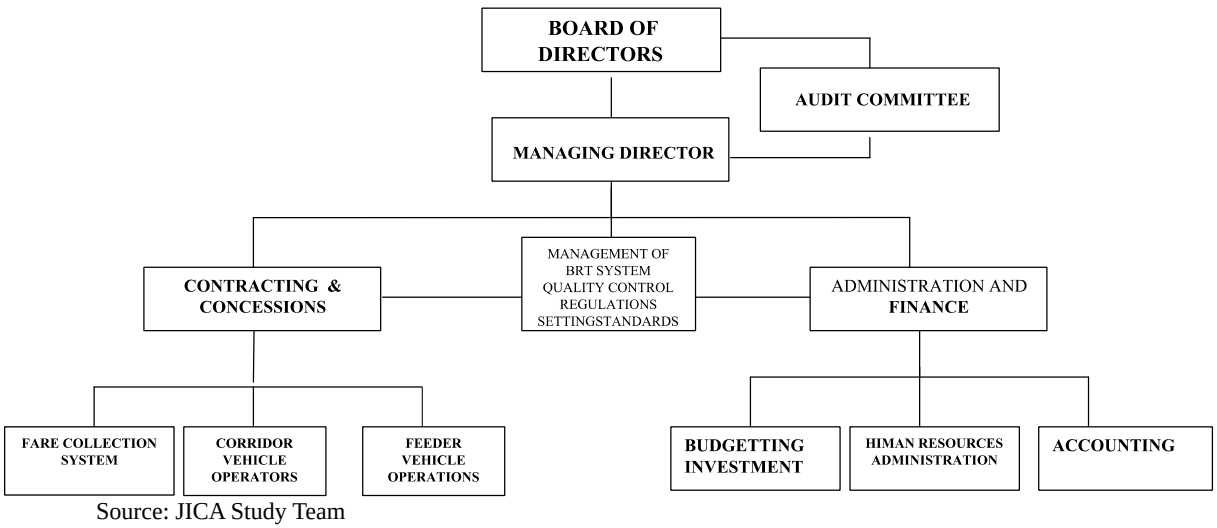
(3) Powers and Rights of KBRTC

KBRTC will be invested with the legal powers for the management of the BRT system operation. It will have exclusive rights for the following activities:

- Receive investments from public and private sectors.
- Exclusive right to regulate BRT Corridors.
- Regulate vehicle operation on BRT corridors
- Collect fares from BRT vehicles
- Set standards for fares and service parameters
- Quality control of BRT system operations
- Safety and security of BRT corridors and vehicle operation
- Enter performance contracts with the vehicle operators
- Enter independent concessions for fare collection system.

(4) Duties and Responsibilities of KBRTC

- Policy Making and Setting Standards
- Regulate BRT Corridors
- Planning and Design of BRT Corridors, stations and pedestrian bridges, etc.
- Management of concession for fee collection, accounting and distribution
- Quality control of BRT System operations
- Management of performance contracts with vehicle operators
- Marketing



Source: JICA Study Team

Figure 10-1-1 Organizational Structure of KBRTC

(5) Legal Framework of KBRTC

- Singh public-Private Partnership Ordinance, 2009
- Motor Vehicle Rules, 1969
- Motor Vehicle Ordinance, 1965

10.1.3 Transit Authority

Presently, Karachi Mass Transit Cell (KMTC), Karachi Municipal Corporation (KMC) is responsible for planning and regulation of mass transit development in Karachi. However, the present organization does not have enough power, human resources, and budget. Since the Karachi BRT is only a part of corridors, it is necessary to strengthen the organizational structure. For this, Establishment of Karachi Mass Transit Authority is proposed as well as a new law namely, Mass Transit Authority Act. Laws and regulations relating to mass transit development will be compiled into the act, and legal power and responsibilities will be given to the new authority. The authority will have the power to establish public corporations for public transport services such as BRT and MRT.

10.2 Project Scope

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

10.3 Project Cost Estimates

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

10.4 Construction Plan

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

10.5 Financing

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

10.6 Implementation Schedule

10.6.1 Conservative Schedule

Figure 10-5-1 shows the project implementation schedule for Karachi BRT Project. In order to meet the schedule, the events listed below are required to be made in Pakistan before the project is materialized, following this Feasibility Study.

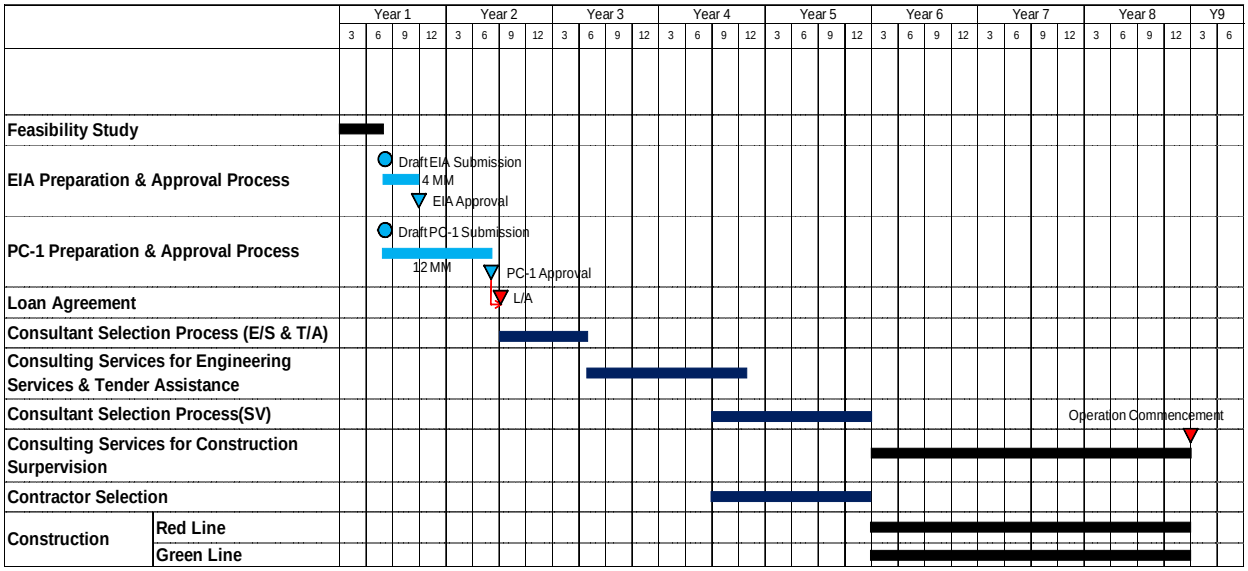
- EIA approval in Pakistan
- PC-1 approval in Pakistan

EIA approval in Pakistan usually takes four (4) months after a draft EIA report is submitted to the relevant authority of the central government of Pakistan. The approval of PC-1, a document to be submitted to Planning Commission of Pakistan for budged allocation, takes approximately twelve (12) months after submission. However, the duration of EIA and PC-1 approval procedure in Pakistan is varied depending on the project.

It should be noted that this implementation schedule is based on the case that the initial

investment cost of the project will be partially or fully funded by Japanese yen loan. And thus, the Loan Agreement (hereinafter referred to as L/A) between Pakistan and Japanese government will be one of the major milestones to be made. Although L/A can be signed by both governments only after the project is officially approved in borrower country, it is proposed that the procedure for JICA's appraisal of the project can be put forward in parallel with PC-1 approval process in Pakistan, so that L/A can be signed right after the PC-1 is approved. This is necessary for this project to be implemented earlier since early realization is one of the key advantages of BRT introduction. It is understood that this scheme can be made possible considering the fact that the Japanese government is presently promoting to accelerate yen loan procedures to materialize the development project at an earlier date.

After the project is materialized, the critical path for the project completion (construction completion) widely relies on the procurement scheme of consultants and contractors. The procurement scheme for the project is described later in the following section.



Source: JICA Study Team

Figure 10-6-1 Implementation schedule

10.6.2 Issues on the Implementation Schedule

There might be some difficulties in implementation of the project to meet the schedule proposed in this study. The following describes possible issues on the implementation schedule.

a. Unclearness of the implementation agency for the project can be one of the critical issues.

b. Development of laws & regulations for BRT system can also be a problem which might disturb the project implementation.

c. Financial arrangement between central government of Pakistan and local government (KMA) may have to be made in order to fix the financial sharing of the development loan from international lending agency. The consensus building on this agreement may take longer than expected, depending on the borrower country's business custom and the speed of political decision makings.

10.7 Procurement

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

10.8 Capacity Development Programme

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

10.9 Possible Assistance Services for Operation and Maintenance

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

Chapter 11 Conclusion and Recommendation

11.1 Conclusion

11.1.1 Master Plan

A person trip survey including interview to 40,000 households was conducted in 2010, and a traffic demand forecast model was developed. The master plan was formulated for the year 2020 and 2030 based on the demand forecast.

(1) Insufficient Transport System for Future Demand

Population of Karachi is 18.9 million in 2010, which is expected to increase 10 million in the next 10 years and reach 27.6 million in 2020 and 31.6 million in 2030. The land use plan assumes that these residents will be accommodated in the suburban areas such as Gadap, Bin Qasim, and Keamari. The number of trips was estimated 19.9 million in 2010, 29.0 in 2020, and 33.3 million in 2030. The large scale increase in population in these towns will increase traffic volume in Karachi because travel distance will become longer. The demand analysis shows that the present transport network can not deal with the future transport demand.

(2) Need Road Development

Road network is a fundamental infrastructure for the successful development in the suburban area such as Gadap, Bin Qasim, and Keamari Towns. Demand forecast analysis shows that road development is very important to meet the traffic demand in the future. In a technical aspect of the demand forecast, it is difficult to estimate the traffic volume on the assumption that there would be no road development in the future. Road development is more important than mass transit development. The master plan includes road development in a total length of 288 km

(3) Need Mass Transit Development

The demand analysis shows that road development in the master plan is not enough to reduce the projected traffic congestion in Karachi. In order to improve the traffic situation in the future, it is necessary to construct mass transit system. Karachi Circular Railway (KCR) will contribute to provide better transport in the center of the city, but it is proposed that the line should be extended to east because the future demand in Bin Qasim is expected to be very high. The demand analysis shows that the traffic demand will be high not only radial directions including Tower – Super Highway, but also the corridor along Rashid Minhas Road. Railway systems are proposed for the two corridors.

(4) Cost Efficient Development

It is necessary to compromise between the fully developed transport system and the available budget. Considering the city's budget including the provincial and federal subsidy, railway construction, in addition to KCR, will be difficult, and two more lines would be the maximum investment on the railway system in the next 20 years. In the master plan, BRT system is proposed instead of the railway system except for two corridors even if traffic demand is high enough to justify railway system due to the budget constraints and implementation period. The total length of the mass transit network is 189.8 km in which MRT network accounts for 98.5 km and BRT network for 91.8 km.

(5) Naming of Mass Transit Corridors

In the existing plan, mass transit corridors are named as Corridor-1, 2, and so on as well as BRT corridors 1, 2, 3, etc. This causes confusion of corridor identification in planning. For better understanding of mass transit corridors, color names are given to each corridor such as Green, Blue, Red, Brown, Yellow, Purple, Aqua, Orange, and Silver.

11.1.2 Feasibility Study

Green Line (M. A. Jinnah Road - Business Recorder Road – Nawab Sadiq Ali Khan Road – Khyaban-e-Sher Shah Suri Road - Shahrah-e-Usman Road – Chaudry Fazal Ellahi Road) and Red Line (Shahrah-e-Liaquat Road – Pready Street – New M.A. Jinnah Road - University Road) are studied in the Feasibility Study Stage.

(1) Demand

Passenger demand is higher than the system capacity. Generally, a standard BRT system can carry 10,000 – 20,000 passengers per hour per direction, but the passenger demand for mass transit system along the corridors exceeds the capacity. Therefore, traffic demand is estimated under the capacity constraints. The total number of passengers of Green Line and Red Line is expected as 700,000 passengers per day.

(2) BRT Type

A typical style of BRT is proposed: a dedicated busway in the median of the roads, median stations, right door buses, and pre-boarding ticket system. This system has a number of advantages over other types such as direct services and on-board fare collection. After the discussion about the availability of the median of narrow roads, it was concluded that dedicated lanes can be constructed up to the CBD area which enabled to apply this system.

(3) BRT Route

There are narrow sections along the corridors such as Nawab Sadiq Ali Khan Road, Business Recorder Road, and New M.A. Jinnah Road. The roadsides of these roads are occupied by sanitary market, rickshaw market, and car market, respectively. For BRT construction, it is necessary to remove these markets from roadsides, and it seemed to be difficult. However, KMTC ensured that eliminating illegal parking along the roadsides is possible if public transport system can be improved. M.A. Jinnah Road is very busy road and narrow. It was concluded that the construction of BRT lanes between Tower and Cloth Market is almost impossible. Since the introduction of BRT in CBD area is very important, it is proposed to use existing park (Municipal Park) near Cloth Market as a terminal point of Green Line. On the other hand, KMTC proposed elevated structure near Empress Market. From this, Regal Chowk is planned as the terminal point of Red Line.

(4) Introduction of Large Buses to BRT system

Standard large buses in the length of 12m are introduced for the BRT system. Generally, successful BRT systems in the world use articulated buses to increase the capacity. On the other hand, the available space is limited in CBD area in Karachi, and it was found that the introduction of articulated buses along M.A. Jinnah Road and Shahrah-e-Liaquat Road would be impossible. The capacity of local manufactures is also considered for the type of the BRT vehicle.

(5) Multiple Stopping Bays

Since the width of roads along the corridors is not wide enough in the central area, passing lanes at stations are not proposed. Without a passing lane, the capacity of the BRT becomes smaller than usual full scale BRT systems with a passing lane. In order to avoid occurring queues at stations, three stopping bays for each direction is planned.

(6) Institutional Setup

For the successful operation of a BRT system, the system should be profitable and subsidy free. The new institution is proposed as a public corporation, namely, Karachi Bus Rapid Transit Corporation (KBRTC). A common business structure of BRT in the world is proposed. Private operators are given concession to operate buses along the corridors. The fare is collected by a fare collection company and becomes the revenue of KBRTC. The private operators are responsible of operation costs and receive contract amount based on the performance.

(7) Economic Benefit

The BRT project will bring about economic benefit such as travel time reduction for BRT passengers, vehicle operating cost reduction, and vehicle emission reduction. On the other hand, the project will cause negative impact on road traffic. Since existing bus passengers will use the BRT, and the system will reach its capacity by them, shift from car users to BRT system will not be large enough to compensate the reduction in the number of lanes. However, the total economic benefit is positive, and the Economic Internal Rate of Return (EIRR) is calculated as 26.6%, which shows that the project is economically feasible.

(8) Necessary Actions by KMC

The following actions should be taken by KMC for the implementation of the project.

- Finalization of EIA report based on the draft EIA and its approval
- Finalization of PC-1 based on the draft PC-1 and its approval
- Clearance of encroachments along the project corridors
- Consensus building on the traffic plan (changing the policy of the Signal Free Corridor)
- Notification of the right-of-way (ROW) along the corridors
- Agreement with KUTC on the removal of North Nazimabad Flyover

11.2 Recommendation

(1) Monitoring of Urban Development

Since the master plan depends on the future land use plan, it is necessary to monitor urban developments in Karachi, especially in Bin Qasim and Gadap Town. If the development in Bin Qasim delays, it will affect the traffic demand of KCR. If the development along Super Highway does not take place, the plan of Blue Line should be reconsidered. The next national population census will be the best timing to review the socio-economic framework in the master plan.

(2) Preparation of a New Law

Mass transit system can be developed under the present laws and regulations in Pakistan. However, there is a risk that exclusive use of lanes of roads by a private company will cause legal problem even if it is authorized by public sector. In order to promote mass transit

development, it is proposed to establish a new law which deals with mass transit system instead of amending relevant chapters of various laws and regulations.

(3) KCR Project

Maj Arshad Bridge, crossing over KCR line near North Nazimabad Station, is old and need to be reconstructed. The KCR project was planned on the assumption that the bridge would exist or would be reconstructed as the same type. However, it is recommended that KCR should be elevated so that connection between Green Line and KCR become easier. The close coordination of KUTC and KMTC is strongly recommended.

(4) CNG Green Bus Project

The BRT project will cause negative impacts on traffic although it will bring about the positive impact on bus passengers at the same time. It is necessary to demonstrate how modern public transport is nice for people in Karachi. CNG Green Bus Project will give a good impression to the public for the next BRT project.

(5) Feasibility Study of Blue Line and Brown Line

The two railway lines (Blue and Brown) are proposed as mid-term projects in the master plan. However, the implementation of a railway project takes time, and it is recommended to start a feasibility study for these lines within several years.

(6) Redevelopment in CBD

Narrow roads and streets in the central area are the major issue in the transport in Karachi. Since buildings in the area are old, and redevelopment will be taken place in the future. It is recommended to widen roads and streets during the redevelopment time. Jahangir Road is one of the roads which should be widened.

(7) Stakeholder Consultation on Busway along Bottleneck Sections

The BRT project will use the center lanes of roads as the dedicated lanes for BRT vehicles, which reduces the number of lanes for other vehicles. Meanwhile, there are three sections where commercial activity on roadsides is so high that goods and parking cars occupy the travel lanes to the extent that only one lane can be used in peak hours. The three bottleneck sections are: 1) Rickshaw market on Business Recorder Road, 2) Sanitary market on Nawab Sadiq Ali Khan Road, and 3) Car dealers market on New M.A. Jinnah Road near Jail Road. Construction of the busway along the sections will block lanes for other general vehicles. It is one of the most important issues for the project to remove such encroachment from the travel lanes. Since the clearance of the roadside activity involves a large number of stakeholders, dialogue between them and KMC is very important for the project implementation. It is recommended that stakeholder consultation on this matter should be held.

APPENDIX-1 PRE-FEASIBILITY STUDY OF BLUE LINE

To ensure fairness of procurement process as well as project implementation, information should not be disclosed for a fixed period.

APPENDIX-2 STAKE HOLDER MEETING

1 Hand out (Scoping stage)

KARACHI TRANSPORTATION IMPROVEMENT PROJECT STUDY

Under JICA & KMTC, KMC
(Feasibility Study of two BRT Line)

KMC KARACHI METROPOLITAN CORPORATION KARACHI MASS TRANSIT CELL

JICA

Consulting Partners

Environmental Management Consultants


Bogutu, Liberia (Africa)


Cebu, Philippines

Contact:
Environmental Management Consultants (EMC),
503, Anum Estates, opp Duty Free Shop,
Shahrae Faisal, Karachi.
Tel: 021 34311466, Fax: 021 34311467,
Email: mail@emc.com.pk

3. Identification and Assessment of environmental & social impacts caused by the project.
4. Propose necessary mitigation measures as Environmental Management Plan based on the predicted impacts.
5. Prepare preliminary Environmental Monitoring Plan for the project;
6. Conduct Stakeholder Meeting for EIA;
7. Integrate all findings and prepare EIA report.

Environmental Management Consultants (EMC) team will collect **Relevant Baseline Data** pertaining to **Natural Environment**: Protected Area, Topography, Geology, Hydrology, Climate, Flora and Fauna, Landscape, Hazard, Global Warming. Environmental quality and monitoring, **Social Conditions:** Social structure, Economic activity, Social infrastructure and public facilities, Land acquisition/ Involuntary resettlement, Heritage, Sanitation, **Legal:** Environmental standards and regulations, Procedure of EIA.

Field surveys will be conducted for primary data collection with regard to the Ambient Air Quality, Noise and Vibration Level Measurement, Traffic Count Survey, Soil Quality Measurement, Roadside Trees Measurement and Land use and Illegal resident confirmation.

Objectives of Stakeholder Meeting at the Scoping Stage

The objective of stake holder meeting is to incorporate the opinion and suggestion of the public and all other stakeholders into the EIA study for the KTIP.

- Provide information on environmental and social benefit of the project.
- To offer opportunities to vice the concerns of the stakeholders regarding the project during the during the planning stage and obtain opinions during stakeholder meeting and feed back to the planning process of the project
- Dissemination of information on the project in respect to the alignment, schedules and plan;

As per the requirements of PEPA 1997 and JICA guidelines, **Stakeholder Meeting** has been planned to be conducted at two stages: 1) one for each corridor during the preparation of EIA Study and 2) after submission of draft final EIA report to EPA.

Thank you!

EIA Study Team

KARACHI TRANSPORTATION IMPROVEMENT PROJECT

The Environmental Impact Assessment Study

Introduction

The City District Government of Karachi (CDGK) approved Karachi Strategic Development Plan-2020 (KSDP 2020) in 2007 which offered improvement of public mass transit system to provide the convenience and inexpensive mode of transportation for the people of Karachi. Subsequently the Government of Pakistan requested Japan International Cooperation Agency (JICA) to formulate an urban transportation improvement project for Karachi.

Accordingly under the agreed arrangement, the JICA Study Team of 24 consultants/experts in different fields kicked off the study in April 2010 and implemented the task of the development of Karachi Urban Transport Master Plan 2030 vision in June 2011, as its first phase in close association with KMTC.

Based on that study, JICA and KMTC agreed that a Bus Rapid Transit (BRT) study would be conducted for two (Green and Red Line) proposed BRT routes in the Feasibility Study Stage.

The Environmental Impact Assessment (EIA) is one of the on-going studies executing by Environmental Management Consultants that will achieve the key objectives of the KTIP leading to prioritization and implementation of mass transit system for Karachi.

Proposed Transport System - Beijing, China

What is Bus Rapid Transit (BRT) System?

Bus Rapid Transit (BRT) is an advanced urban bus system with railway like features by lower cost. The concept of BRT is based on railway system, i.e. running along exclusive way, high speed, accurate travel time, and high capacity.

- Faster / reliable travel time: Free from traffic jam
- Higher capacity: High frequency by multi slot bus stop and large bus fleet.
- Higher comfort must be competitive to private car/ motorcycle.

Objective of the Project

The objective of the BRT Project is to construct the mass transit corridor, thereby shifting cars users to public transport and consequently reducing the traffic congestion and Chaos.

Bus Rapid Transit System - Bogota, Colombia

Project Location

Green and Red BRT routes are designed in the center of the wide existing major road in Karachi. Green line originating from Surjani Town passing through Road 5000 (Sakhi Hassan round about), Sher Shah Suri Road (Board Office round about), Nazimabad Chowrangi, Gulbahar / Golimar, Business Record Road (Lasbela), Gurumandir to M.A.Jinnah Road up to Radio Pakistan/ Jamia Cloth Market and terminate at Regal Chowk Saddar. Red line originating from Model Colony (Tank Chowk) and passing through Check Post No.6 of Malir Cantt, Safoora Mazar-e-Quaid / People's Party Secretariat to Preedy Street extension, Empress Market and end at Regal Chowk.

Proposed BRT Corridors (Green & Red Line)

Purpose of EIA

Section 12 of Pakistan Environmental Protection Act 1997 and Pakistan Environmental Protection Agency (PEPA) Review of IEE/EIA Regulations 2000 require that all development initiatives in Pakistan have to be preceded by an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA), depending upon the size and severity of impacts anticipated during construction, commissioning and operation of the project.

The purpose of EIA is to give environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activities before action is taken. Early identification and characterization of critical environmental impacts allows the public and the government to form a view about the environmental acceptability of the proposed developmental project and what conditions should apply to mitigate, reduce or compensate those risks and impacts.

Objectives of EIA Study for KTIP

The EIA study for KTIP will cover all the aspects related to the natural environment, social conditions along with legal and institutional framework in the proposed project area.
The main objectives of the EIA study are:

1. Collection of the relevant baseline data for the environmental information fronting the Study Areas which are directly affected by the Project;
2. Implement field survey and collect primary data as necessary;

2 Hand out (Draft EIA stage)

- Dissemination of information on the project in respect to the alignment, schedules and plan;

Expected Outcomes from the Stakeholder Consultation Meeting

Stakeholders are requested for their valuable input and comments on the Red and Green Line that have been identified in the project's EIA:

- Reduction in traffic congestion;
- Reduction in traffic accidents;
- Benefits for disabled people who may be end-consumers of the proposed BRT
- Following socio-economic benefits for the large number of people who would be using the proposed BRT service, either for transport from one place to another or as a "feeder service" for the Karachi Circular Railways:
  - Reliability of BRT
  - Punctuality of BRT
  - Reduction in travelling time for end-users
  - Affordable and Transparent fare system
  - BRT will provide sufficient passenger capacity at comfortable loading standards.

Expected Outcome of the EIA

Following expected outcomes have been identified in the project's EIA.

- On the macro-environment the impact would be reduction in the air emissions due to expected switch over to a more environment friendly mode of transport which would curtail unnecessary delays in traffic that results in excessive vehicular emissions in the events of road jams particularly during peak hours.
- The project BRT does not directly involve any discharge of effluents into the surrounding environment, except for the certain locations identified in the project where physical activities involving excessive or commercial use of water is involved, which may therefore require proper treatment prior to disposal. The main sources of wastewater regarding the BRT operation include each station and depot.
- Noise will have no significant impact at sensitive receptors, BRT buses will generate less noise.
- The majority of the road works proposed are designed to be within the existing median of major roads on paved surfaces and therefore soil erosion and sedimentation will not takes place hence no geological disturbances.
- The trees are present in the median of both BRT corridors, on the median lane minimal trees will be removed on the points where the bus station and depot will be constructed. Trees will be retained and maintained wherever possible on the rest of the corridors
- Median will not be disturbed and will only be disturbed at station location
- Track will be beside the towards median so existing road median site will be utilized hence resettlement of any kind is foreseen .
- No business will be affected with the implementation of this project.
- BRT is provided with dedicated lane; hence it will not create any hindrance in the traffic flow. Moreover, additional space will not be required for the BRT buses.

Thank you!

EIA Study Team

Contact:
Environmental Management Consultants (EMC),
503, Anum Estates, opp Duty Free Shop,
Shahrae Faisal, Karachi.
Tel: 021 34311466, Fax: 021 34311467,
Email: mail@emc.com.pk

KARACHI TRANSPORTATION IMPROVEMENT PROJECT STUDY

Under JICA & KMTC, KMC
(Feasibility Study of Two BRT Lines)

KMC KARACHI METROPOLITAN CORPORATION KARACHI MASS TRANSIT CELL

Consulting Partners

Environmental Management Consultants

KARACHI TRANSPORTATION IMPROVEMENT PROJECT

The Environmental Impact Assessment Study
(Stakeholder Consultation Meeting)

Introduction

The City District Government of Karachi (CDGK) approved Karachi Strategic Development Plan-2020 (KSDP 2020) in 2007 which offered improvement of public mass transit system to provide the convenience and inexpensive mode of transportation for the people of Karachi. Subsequently the Government of Pakistan requested Japan International Cooperation Agency (JICA) to formulate an urban transportation improvement project for Karachi.

Accordingly under the agreed arrangement, the JICA Study Team of 24 consultants/experts in different fields kicked off the study in April 2010 and implemented the task of the development of Karachi Urban Transport Master Plan 2030 vision in June 2011, as its first phase in close association with KMTC.

Based on that study, JICA and KMTC agreed that a Bus Rapid Transit (BRT) study would be conducted for two (Green and Red Line) proposed BRT routes in the Feasibility Study Stage.

The Environmental Impact Assessment (EIA) is one of the on-going studies executed by Environmental Management Consultants that will achieve the key objectives of the KTIP leading to prioritization and implementation of mass transit system for Karachi.

What is Bus Rapid Transit (BRT) System?

Bus Rapid Transit (BRT) is an advanced urban bus system with railway like features by lower cost. The concept of BRT is based on railway system, i.e. running along exclusive way, high speed, accurate travel time, and high capacity.

- Faster / reliable travel time: Free from traffic jam.
- Higher capacity: High frequency by multi slot bus stop and large bus fleet.

Proposed Transport System - Beijing, China

- Higher comfort must be competitive to private car/ motorcycle.

Objective of the Project

The objective of the BRT Project is to construct the mass transit corridor, thereby shifting cars users to public transport and consequently reducing the traffic congestion and Chaos.

Bus Rapid Transit System - Bogota, Colombia

Project Location

Green and Red BRT routes are designed in the center of the wide existing major road in Karachi.

Green Line:

Green line originating from Surjani Town passing through Road 5000 (Sakhi Hassan round about), Sher Shah Suri Road (Board Office round about), Nazimabad Chowrangi, Gulbahar / Golimar, Business Record Road (Lasbela), Gurumandir to M.A.Jinnah Road up to Radio Pakistan/ Jamia Cloth Market and terminate at Regal Chowk Saddar.

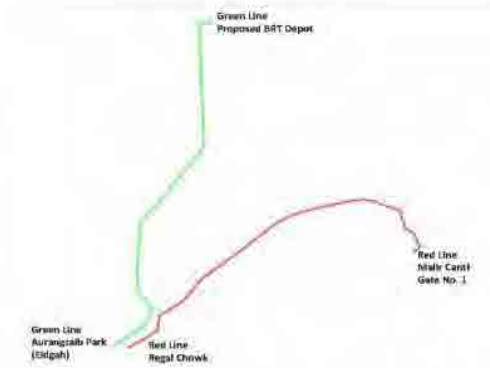
Red Line:

Red line originating from Model Colony (Tank Chowk) and passing through Check Post No.6 of Malir Cantt, Safoora Mazar-e-Quaid / People's Party Secretariat to Preedy Street extension, Empress Market and end at Regal Chowk.

Purpose and Objectives of the EIA Study

Section 12 of Pakistan Environmental Protection Act 1997 and Pakistan Environmental Protection Agency (PEPA) Review of IEE/EIA Regulations 2000 require that all development initiatives in Pakistan have to be preceded by an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA), depending upon the size and severity of impacts anticipated during construction, commissioning and operation of the project.

The purpose of EIA is to give environment its due place in the decision-making process by clearly evaluating the environmental consequences of the proposed activities before action is taken. Early identification and characterization of critical environmental impacts allows the public and the government to form a view about the environmental acceptability of the proposed developmental project and what conditions should apply to mitigate, reduce or compensate those risks and impacts.



Proposed BRT Corridors (Green & Red Line)

The EIA study for KTIP has covered all the aspects related to the natural environment, social conditions along with legal and institutional framework in the proposed project area.
The main objectives of the EIA study are:

1. Collection of the relevant baseline data for the environmental information fronting the Study Areas which are directly affected by the Project;
2. Implement field survey and collect primary data as necessary;
3. Identification and Assessment of environmental & social impacts caused by the project.
4. Propose necessary mitigation measures as Environmental Management Plan based on the predicted impacts.
5. Prepare preliminary Environmental Monitoring Plan for the project;
6. Conduct Stakeholder Meeting for EIA;
7. Integrate all findings and prepare EIA report.

Environmental Management Consultants (EMC) team has collected **Relevant Baseline Data** pertaining to **Natural Environment**: Protected Area, Topography, Geology, Hydrology, Climate, Flora and Fauna, Landscape, Hazard, Global Warming, Environmental quality and monitoring. **Social Conditions:** Social structure, Economic activity, Social infrastructure and public facilities, Land acquisition/ Involuntary resettlement, Heritage, Sanitation. **Legal:** Environmental standards and regulations, Procedure of EIA.

Field surveys has been conducted for primary data collection with regard to the Ambient Air Quality, Noise and Vibration Level Measurement, Traffic Count Survey, Soil Quality Measurement, Roadside Trees Measurement and Land use and Illegal resident confirmation.

Objectives of Stakeholder Meeting

The objective of stake holder meeting is to incorporate the opinion and suggestion of the public and all other stakeholders into the EIA study for the KTIP.

- Provide information on environmental and social benefit of the project.
- To offer opportunities to vice the concerns of the stakeholders regarding the project during the during the planning stage and obtain opinions during stakeholder meeting and feed back to the planning process of the project

3 Presentation (Scoping stage)

Green line (Taimuria Library on 31st January, 2012) and Red Line (NED University on 8th February, 2012)

1) Introduction

KMC

KARACHI TRANSPORTATION IMPROVEMENT PROJECT

January 31, 2012

by

Mr. Rasheed Mughal
Director General
Karachi Mass Transit Cell
KMC, Karachi.

KMC

Presentation Format

- Karachi Mass Transit Cell, KMC
- Overview of Karachi Transport System
- Karachi Transportation Improvement Project (KTIP) by JICA - Progress
- Next Step

KMC

KARACHI MASS TRANSIT CELL, KMC

Functions of KMTC:

- **Arrange for provision of adequate Transport facilities for all segments of the population.**
- **Identify, plan and implement various transport routes structures / alignments for Mass Transit modes.**
- **Coordinate, management, control and develop public transport, procure plans, machinery, instruments, equipment and materials required for its use.**

KMC

KARACHI MASS TRANSIT CELL, KMC

- **Seek and obtain advice and assistance from Government or any agency for the preparation & execution of any plan, program or project related to Mass Transit.**
- **Case studies, surveys, experiments and technical researches to be made in facilitating the Mass Transit System in the city**
- **Create general awareness among masses of public through seminar, workshop, media conference and other publicity sources.**

KMC

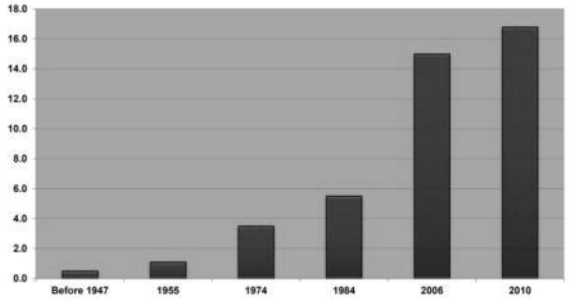
NEED OF MODERN BUS & RAIL BASED COMMUTER SYSYTEM

- Increase in city population is more than annual growth rate
  - 22 million person trips generated in the city every day
  - 60% person trips catered by buses, coaches, etc.
  - Only 6% share of public vehicles on the road
- Optimization of road capacity
- Enormous problems for commuters due to non-existent of effective mass transit framework

5

KMC

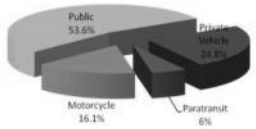
Population of Karachi *(in million)*



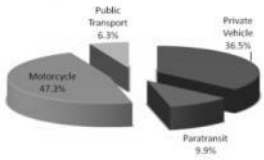
6

KMC

Modal Distribution on by Persons



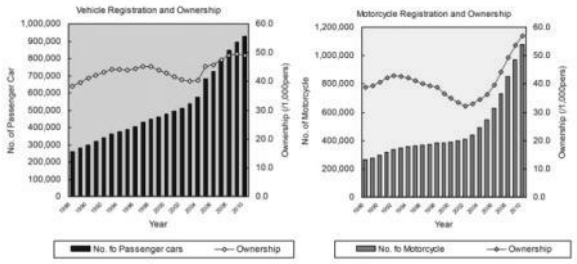
Modal Distribution of Vehicles



7

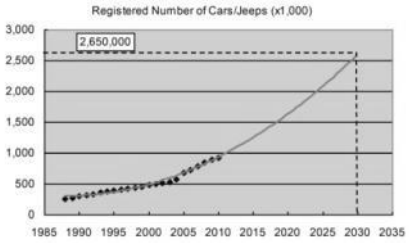
KMC

Car Ownership of Karakhi in last 20 Years



KMC

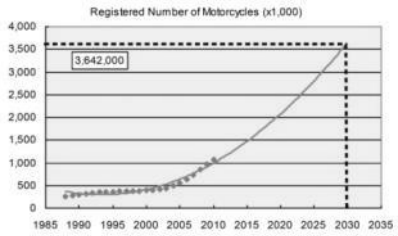
Estimation of Registered Number of Private Cars



	2010	2030
Registered Number	929,000	2,650,000
Population	18,930,000	31,580,000
Ownership (veh./1,000population)	49.1	83.9

KMC

Estimation of Registered Number of Motorcycles



	2010	2030
Registered Number	1,078,000	3,642,000
Population	18,930,000	31,580,000
Ownership (veh./1,000population)	57.0	115.3

KMC

Scenes of Traffic Jam in Karachi

11

KMC

12

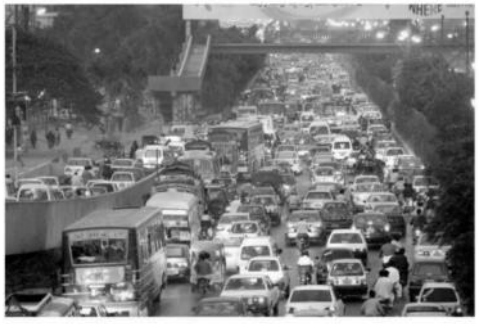
KMC

13

KMC

14

KMC



15

KMC

16

KMC

17

KMC

PRESENT SCENARIO

- Over crowding
- Passengers travel on roof of buses/coaches
- Serious traffic jams
- Increasing bottle-necks on the main roads
- Increase in travel cost
- Increase in road accidents
- Reduction in travel speed
- Reduced ROW on the roads
- Deteriorating health due to more toxic emission from vehicles
- Less/marginalized output in offices due to mental stress

18

KMC

SOLUTION

- Need vehicles of large passenger carrying capacity moving on higher speed
- Mass Transit (BRT) an ideal choice with higher carrying capacity

Importance of Mass Transit

- Mass Transit System will be environment friendly with less air & noise pollution & socially acceptable
- Mass Transit to provide safe, efficient, reliable, dignified, speedy modern urban rail or Bus based commuter system

19

KMC

Bus Rapid Transit

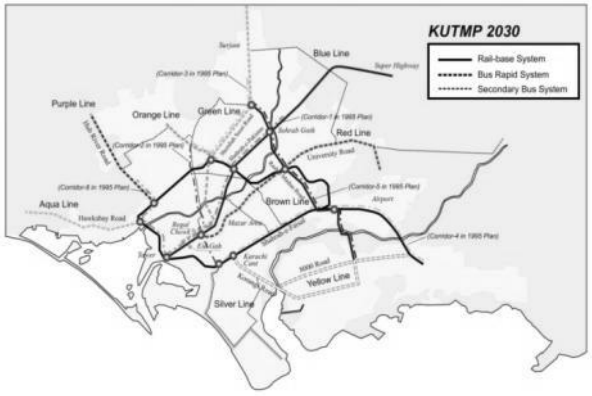
KMC

KTIP Study

It was initiated by signing the agreement on 7th October, 2009 between JICA, GOP, GOS and CDGK for the study project under Grant-in-Aid

Main Objectives:

- **Development of Karachi Urban Transport Master Plan (KUTMP) for year 2030.**
- **Demand based validation and screening of projects already identified by KSDP 2020 in transport sector.**
- **Identification of additional projects in the light of KUTMP 2030.**
- **Demand based Prioritization of Projects identified in TOR Outline / Scope of work.**
- **Feasibility Study of a high priority project on mass rapid transit system based on outcomes of the study.**



KMC

Thanks for your attention

2) Scoping

ENVIRONMENTAL IMPACT ASSESSMENT

Karachi Transportation Improvement Project (KTIP)

Bus Rapid Transit (BRT) Corridors

KMC JICA

AGENDA

- WHAT IS BRT?
- OUTLINE OF THE PROJECT
- EIA METHODOLOGY
- STUDY SCHEDULE

What is Bus Rapid Transit (BRT) ?

Bus Rapid Transit (BRT)

BRT is a High Quality Bus System as Compared to Traditional Bus Services, by Providing a Solution for the Urban Transport Problem of Karachi in the following manner:

- Cost Effective
- High Capacity
- Comfortable Services
- Accurate Traveling Time
- High Speed
- Reliability
- Running along Exclusive Way

Why BRT ?

Actually, BRT Improves road capacity

- One car lane in one direction moves about 1200 passengers per hour
- One BRT lane in one direction can carry:
  - 3min headways: 3000 passengers
  - 2 min headways: 4500 passengers
  - 1 min headways 9000 passengers
  - With passing lanes: 20,000+ passengers

ONE BRT bus =125 cars

A global view of transit improvement

Bus Transit Projects Completed

Europe

North America

Latin America

Africa

Asia

Oceania

Projects at the planning or construction stages

Latin America
North America
Asia
Europe
Africa
Oceania
Pakistan

Video

Proposed BRT Features

- Reduced Travel Time
- Punctual & Efficient Service
- Safe & Comfortable Journey
- Commercial Speeds of BRT Depend on the Number of Stations because Buses Need to Spend a Time at Each Station for Boarding and Alighting.
- Capacity = 3,000 – 13,000 per hour per direction

Bogata, Liberia (African)

Delhi, India

BRT For Karachi

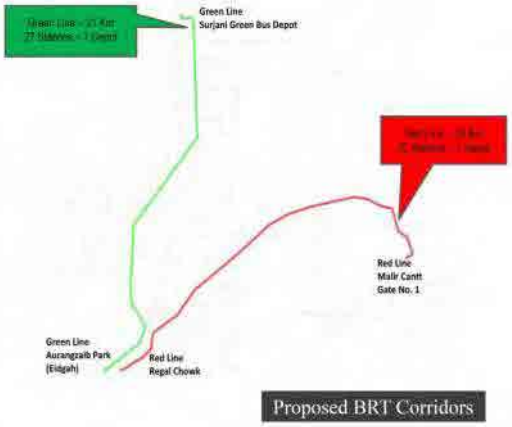
- ***Buses Run BRT Lanes Only***

  In Case of BRT, Buses are only operated on the Dedicated Lanes controlled by a single operator along the Lanes.

- ***Quality Buses with Higher Frequency***

  Since the BRT Buses need not run in General Traffic Roads, these buses will have higher Frequency and Speed.

Outline of the Project



Location

1. Red Line

Originating From Model Colony (Tank Chowk) and Passing through Check Post No.6 of Malir Cantt, Safoora Mazar-e-Quaid / People's Party Secretariat to Preedy Street Extension, Empress Market, Regal Chowk.

Location

2. Green Line

Origination From Surjani Town and Termination at Regal Chowk Saddar Passing through Road 5000 (Sakhi Hassan Round About), Sher Shah Suri Road (Board Office Round About), Nazimabad Chowrangi, Gulbahar / Golimar, Business Record Road (Lasbela), Gurumandir to M.A.Jinnah Road upto Radio Pakistan/ Jamia Cloth Market.

Criteria Of BRT Station Location

1. Approximately 500m Distance

2. Major Street Intersections

Major street intersections should be considered for station location in order to link other mode of public transportation.

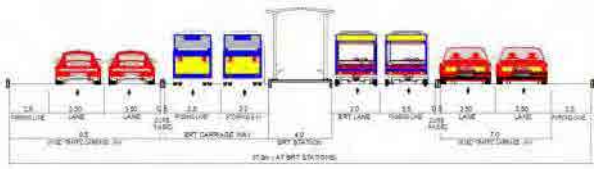
3. Public Facilities

Any public facilities, such as civic center, shopping center and college, should be considered for station location for convenience.

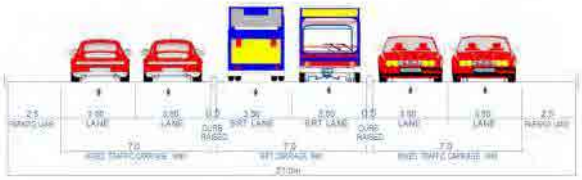
4. Traffic Control

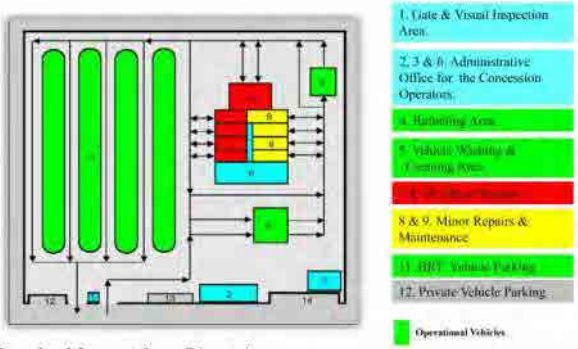
Due to traffic control at major street section, some stations may be set split in north bound and south bound

Cross Section at Station



Cross Section at Road





Standard Layout for a Depot Area
Source: Bus Rapid Transit – Planning Guide 2007, Institute for Transportation and Development Policy (ITDP)

Proposed Depot

S.No	Location	Area
1	Gulistan-e-Johar Depot, ST-1, Block-6, Sch-36, Gulistan-e-Johar near Mahakma Massamyat	8.36 Acres
2	Plot No. St-5/1, Sector 7A, Surjani Town	4.00 Acres

Source: Illustrated by JICA Study Team based on the Confirmatory Green Routes Study for Karachi
Presented Situation of Depot area on Confirmatory Green Routes Study for Karachi

EIA Methodology

Need For EIA Study

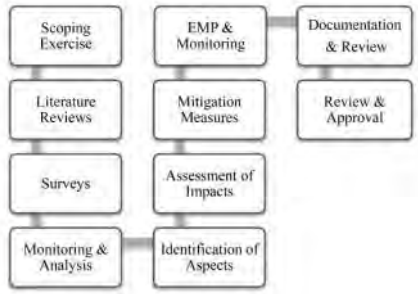
Compliance with section 12 of Pakistan Environmental Protection Act 1997.

Scope of EIA

- To address any major adverse impact on the environment (physical and ecological) during different stages of the project.
- Identified socioeconomic aspects &
- Adequate mitigation measures
- Environmental Management Plan (EMP) for sustainable development & operation of the project.

EIA Methodology

Conducted in accordance with the EIA Regulations and Guidelines of the Government of Pakistan and JICA Guidelines



Scoping- An initial stage in EIA

- The objective is to incorporate the opinion and suggestion of the public and all other stakeholders into the EIA study for the KTIP
- Provide information on environmental and social benefit of the project.
- To offer opportunities to vice the concerns of the stakeholders regarding the project during the during the planning stage and obtain opinions during stakeholder meeting and feed back to the planning process of the project
- Dissemination of information on the project in respect to the alignment, schedules and plan;

Collection Of Relevant Baseline Data

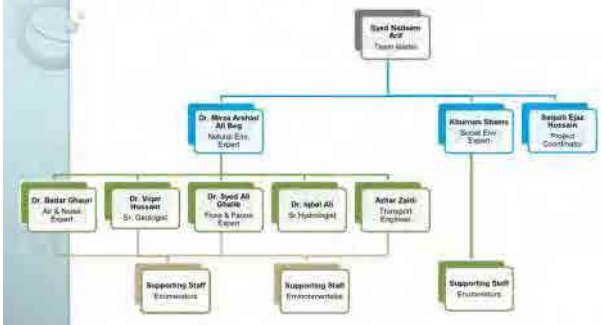
Content	Items
Natural Environment	Protected Area, Topography, Geology, Hydrology, Climate, Flora and Fauna, Landscape, Hazard, Global Warming, Environmental quality and monitoring
Social Conditions	Social structure, Economic activity, Social infrastructure and public facilities, Land acquisition/ Involuntary resettlement, Heritage, Sanitation

Field Survey Plan

EMC will be conducted field surveys for primary data collection from 30th Jan to 29th Feb with regard to:

- Ambient Air Quality
- Noise and Vibration Level Measurement
- Traffic Count Survey
- Soil Quality Measurement
- Roadside Trees Measurement
- Land use and Illegal resident confirmation

EIA Study Team



Study Schedule

Study Schedule

EIA Work Schedule

Thank You For Your Participation

Your feedback please