JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

A GOVERNMENT OF THE PUNJAB PROJECT

TRANSPORT DEPARTMENT

THE PROJECT FOR LAHORE URBAN TRANSPORT MASTER PLAN IN THE ISLAMIC REPUBLIC OF PAKISTAN

FINAL REPORT
VOLUME II

March, 2012

ALMEC CORPORATION

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PREFACE

In response to a request from the Government of the Punjab in the Islamic Republic of Pakistan, the Government of Japan decided to conduct "The Project for Lahore Urban Transport Master Plan in the Islamic Republic of Pakistan" and entrusted to the study to Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Takashi Shoyama of ALMEC Co., LTD. and consists of ALMEC Co., LTD. and Oriental Consultants Co., LTD. between April, 2010 and March, 2012.

The study team held discussions with the officials concerned of the Government of the Punjab, conducted field surveys in the study area, prepared a Lahore Urban Transport Master Plan (LUTMP) and its Action Plan, conducted a capacity development through On-the-Job-Training (OJT), and prepared this final report.

The project was composed of two phases; i) Phase I to conduct a Home Interview Survey (Person Trip Survey) and other transport/ traffic surveys and develop a transport demand analysis model, and ii) Phase II to prepare a master plan and its action plan. This report is presents the study findings of both Phases.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Punjab for their close cooperation extended to the study team.

March, 2012

KONISHI Atsufumi,
Director, Economic Infrastructure Department
Japan International Cooperation Agency

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ABBREVIATIONS & ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AD	Assistant Director
ADB	Asian Development Bank
ADP	Annual Development Program
ALOS	Advanced Land Observation Satellite
BOT	Build Operate Transfer
C&W	Communication and Works Department
CantB	Cantonment Board
CBD	Central Business District
CDG	City District Government
CDGK	City District Government, Kasur
CDGL	City District Government, Lahore
CDGS	City District Government, Sheikhupura
CNG	Compressed Natural Gas
DCO	District Coordination Officer
DHA	Defence Housing Authority
DIG	Deputy Inspector General
DPL	Development Policy Loan
DRTA	District Regional Transport Authority
DSMD	District Support and Monitoring Department
E&T	Excise and Taxation Department
EDO	Executive District Officers
EPA	Environment Protection Agency
EPD	Environmental Protection Department
ETC	Electronic Toll Collection
F&P	Finance and Planning
FDI	Foreign Direct Investment
FMR	Farm to Market Roads
GDP	Gross Domestic Product
GIS	Geographic Information System
GoPb	Government of the Punjab
H&PP	Housing and Physical Planning Provincial Department
H&UPDD	Housing and Urban Physical Development Department
HIS	Household Interview Surveys
HOV	High Occupancy Vehicle
HP&EP	Housing Physical & Environmental Planning
HRT	Heavy Rapid Transit
HUD&PHED	Housing, Urban Development and Public Health Engineering Department
ICT	Information and Communication Technology
IFC	International Finance Corporation
IMF	International Monetary Fund
ITS	Intelligent Transport System
LCCHS	Lahore Cantonment Cooperative Housing Society
LDA	Lahore Development Authority
LDRTA	Lahore District Regional Transport Authority
LIT	Lahore Improvement Trust
LRMTS	Lahore Rapid Mass Transit System
LRR	Lahore Ring Road
LRRP	Lahore Ring Road Project
LRT	Light Rail Transit
LSE	Lahore School of Economics
LTC	Lahore Transport Company
LTD	Lahore Transport Database
LUTMP	Lahore Urban Transport Master Plan
MCC	Manual Classified Count
MD	Managing Director
MRT	Mass Rapid Transit
MS	Municipal Services

MTDF	Medium Term Development Framework
MVO	Motor Vehicles Ordinance
MVR	Motor Vehicle Rules
NEC	National Economic Council
NESPAK	National Engineering Services Pakistan
NFC	National Finance Commission
NHA	National Highway Authority
NHMP	National Highway and Motorway Police
NHSO	National Highway Safety Ordinance
NMT	Non-Motorized Transport
NTCIP	National Trade Corridor Improvement Program
NTRC	National Transport Research Centre
NWFP	North West Frontier Province
O&M	Operation and Management
OBU	On Board Unit
OD	Origin-Destination
OJP	On-the-Job Participation
OJT	On-the-Job Training
P&D	Planning and Development Department
PHA	Parks and Horticultural Authority
PHATA	Punjab Housing and Town Planning Agency
PHED	Public Health Engineering Department
PMDGP	Punjab Millennium Development Goal Program
PMU	Project Management Unit
PNR	Pakistan National Railway
PPHPD	Passenger Per Hour Per Direction
PPO	Punjab Police Office
PPP	Public Private Partnership
PPTA	Punjab Provincial Transport Authority
PRTC	Punjab Road Transport Corporation
PSP	Private Sector Participation
PTA	Provincial Transport Authority
PTPS	Pakistan Transport Plan Study
PTUIS	Public Transport User Interview Survey
PUTC	Punjab Urban Transport Corporation
R&B	Rehabilitation and Building
RCC	Roller Compacted Concrete
RIS	Road Interview Survey
RMTS	Rail-based Mass Transit System
RTAs	Regional Transport Authorities
STREAM	Sustainable Transport in East Asian Mega-cities
TD	Transport Department
TDM	Traffic Demand Management
TEPA	Traffic Engineering and Transport Planning Agency (Under LDA)
TEVTA	Technical Education and Vocational Training Authority
TEVTC	Technical Education and Vocational Training Council
TMA	Town Municipal Administrations
TPU	Transport Planning Unit
TSDI	Transport Sector Development Initiative
UA	Union Administration
UCs	Union Councils
UN	United Nations
UNESCO	United Nations Educational Scientific Cultural Organisation
UU	Urban Unit
W&S	Works and Services
WASA	Water and Sanitation Agency (Under LDA)
WB	World Bank

Volume-II – Chapter-1

TRANSPORT/ TRAFFIC SURVEYS

FINAL REPORT

1 TRANSPORT/ TRAFFIC SURVEYS

1.1 Introduction

Transport/ traffic surveys are an integral component of a comprehensive transport planning study. These helps to understand the current socio-economic conditions, travel patterns, travel characteristics, existing transport system demand and supply linkages both for private and public transport modes in the Study Area. The baseline data, apart from helping in understanding the existing transport situation along with its problems and constraints; is used in the development, calibration, and validation of the travel demand forecast models. Eleven different surveys were conducted as a part of the Study.

In addition, significant data from secondary sources pertaining to demographic, socio-economic characteristics, and public transport system was collected to supplement the survey data. The final transport database is analysed at various stages by different transport planning experts with respect to requirement to understand the prevailing problems, issues in the sector of their interest.

1.2 Outline of Surveys

Eleven different types of transport/ traffic surveys were conducted for the Study. Brief detail of each survey conducted is given in Table 1.2.1. Each survey was designed with specific objectives as an integral part of transport/ traffic database.

The following section provides detail of surveys undertaken for the Study with their objectives, methodology, and survey locations. The complete details of each survey including the survey forms, survey locations, and survey manuals could be found in previous reports of this Study. Procedures and guidelines specifically designed for the implementation of the Household Interview Survey (HIS) with respect to local conditions are described in Section 1.3.

Table 1.2.1 List of Surveys with Their Objective, Methodology and Scope

No.	Survey	Objective	Methodology	Scope
1	**Household Interview Survey (HIS)**	• Capture travel behaviour of residents in relation to their socio-economic characteristics.	• Household interview by interviewers. • Stratified random sampling.	• Entire Study Area. • Sampling rate of 1 % (18,000 households)
2	**Cordon Survey**	• Capture travel behaviour and travel patterns to and from the Study Area.	• Traffic count by vehicle type and by direction (18/24hrs) • Interview 10~20% sampled vehicles: O/D, trip purpose, type of load, vehicle occupants.	• 13 locations at the outer boundary of the Study Area, railway station and airport
3	**Screenline Survey**	• Count traffic volume by vehicle type and record vehicle occupancy at screenlines to validate O/D matrices obtained from HIS and Cordon surveys.	• Traffic count by vehicle type and by direction (18/ 24 hrs). • Observation survey of vehicle occupancy by vehicle type.	• 64 locations crossing the Railway and Canal Bank Road Screenlines.

No.	Survey	Objective	Methodology	Scope
4	**Traffic Count Survey**	• Count traffic volume by vehicle type at key junctions, and roads, including turning volumes.	• Traffic count by vehicle type and by direction (18/ 24 hrs). • At some locations occupancy counts.	• 14 locations, similar to those of the 1991 JICA study, and two sections of LRR.
5	**Public Transport (PT) User Interview Survey**	• Capture PT users' characteristics and perception to assess and plan improved public transport service.	• Interview survey of users of large bus, AC-bus, wagon, auto rickshaw, and Qingqi.	• 1,000 samples at major bus terminals and bus stops.
6	**Travel Speed Survey**	• Identify the current average journey times.	• Measurement of travel speed by moving observer method.	• Surveys along 10 major routes in the morning, evening and off-peak periods.
7	**Bus Occupancy Survey**	• Determine the utilization of public transport.	• Record the number of passengers boarding and alighting.	• 10 bus routes in morning, evening and off-peak periods.
8	**Parking Survey**	• Capture characteristics of on-street and off-street parking.	• Periodic observation and recording of parked vehicles by surveyors. Recording on entry and exit of off-street parking facilities.	• Seven 100 -m sections of urban streets and four shopping mall parking areas.
9	**Road Inventory Surveys**	• To collect data on physical structure of road network, Junctions along the road.	• By site visit and measurements	• About 2,300 +km of road network surveyed.
10	**Willingness to Pay Survey**	• To collect information on user value of time by different transport modes: private car, bus, Rickshaw, and Qingqi users.	• By interviewing different transport mode users in different parts of the Study Area. All income class people.	• 2,000 sample interviews of car, Rickshaw, Qiqnqi, wagon, and bus users.
11	**Road Junctions and Traffic Signal Survey**	• To collect junction geometry and signal operation data.	• Junction field survey to record existing condition. Drawing AutoCAD plans and measure phasing time of each signalized junction.	• Total 26 junctions out of which five were non-signalized, three roundabouts, and 18 signalized.

Source: JICA Study Team

For the Study vehicles were classified into thirteen categories for all type of surveys. Vehicles classification is given in Table 1.2.2.

Table 1.2.2 Vehicle Classification for the Study

No.	Description
1	Bicycle
2	Motorcycle
3	Rickshaw, Qingqi (Motorcycle Rickshaw)
4	Car, Taxi, 4 WD, Jeep, Land Cruisers, Hiace, Single/ Twin-cabin passenger pick-up
5	Wagon, Suzuki, Minibus (up to 16 seats)
6	Mazda, Coaster (up to 30 seats)
7	Large bus (>30 seats)
8	Pick-up, Delivery truck, Utility vehicles, Ambulances
9	2 Axle truck
10	3 -Axle truck, 3 +-Axle truck
11	Tractors (with or without trolley)
12	Other mechanized vehicles (including construction vehicles)
13	Animal-driven carts

Source: JICA Study Team

All type of transport/ traffic surveys were completed on schedule, the start and finish dates of surveys are given in Table 1.2.3.

Table 1.2.3 Transport/ Traffic Surveys Schedule

No.	Survey Type	Survey Start Date	Survey End Date
1	Household Interview Survey	5-Oct-2010	15-Dec-2010
2	Cordon Survey	13-Dec-2010	4-Jan-2011
3	Screenline Survey	20-Sep-2011	4-Oct-2011
4	Traffic Count Survey	5-Oct-2010	11-Oct-2010
5	Public Transport User Interview Survey	13-Dec-2010	13-Dec-2010
6	Travel Speed Survey	14-Oct-2010	25-Oct-2010
7	Bus Occupancy Survey	14-Oct-2010	22-Oct-2010
8	Parking Survey	26-Oct-2010	4-Dec-2010
9	Road Inventory Survey	15-July-2010	31-Aug-2010
10	Willingness to Pay Survey	1-Jul-2011	31-Jul-2011
11	Road Junctions and Traffic Signal Survey	1-Aug-2011	31-Aug-2011

Source: JICA Study Team

1.2.1 Household Interview Survey

The Household Interview Survey (HIS) is designed to capture the travel behaviour of the residents by survey zone with respect to their socio-economic information, their daily travel activity, opinions of transport users on existing transport issues and environment (traffic congestion and safety, public transport and transport measures), and for making assessment indicators for the future strategies. HIS was used to explain the following issues broadly:

- Socio-economic information of the randomly selected households by each zone;
- Total travel activity generated by the each household resident above 5 years of age by mode, and by time; and
- Resident's opinions on existing transport situation and environment.

HIS field survey was systematically planned, designed and executed with the help of local survey company under the daily guidance, supervision, and control of JICA Study Team. Sample size calculation for the HIS survey was estimated keeping in view the statistical reliability of the data, budget and time constraints. JICA Study Team has designed sample rate based on conditions explained next;

Statistical Reliability of Sample:

Assuming 80 % reliability and a 20 % relative error, a 1 % sampling rate would be sufficient for estimating the trip generation/ attraction for a 100-zone system and with two modes (public and private). In terms of O/D matrices, although 1 % would not be enough for a 100-zone system, its accuracy would be satisfactory for a 60-zone system, as it is highly unlikely that one would observe 100x100 zone to zone movements.

Note: The relationship between relative error, sampling rate, reliability coefficient, number of categories and population is expressed below (assuming r=0.01, k=1.28, C=7200 (that is 60 Zones x 60 Zones x 2 Modes (Private and Public)), and N=17,160,000 (two trips per day by 8,580,000 population above 5 year), and RE becomes 0.18).

$$RE = k\sqrt{\frac{1-r}{r} * \frac{C-1}{N}}$$

Where:
- RE: relative error (0.18)
- r: sampling rate 1 %
- k: reliability coefficient (1.28 at 80 % reliability)
- C: number of categories (number of zones (60), and modes (2))
- N: population (number of total trips)

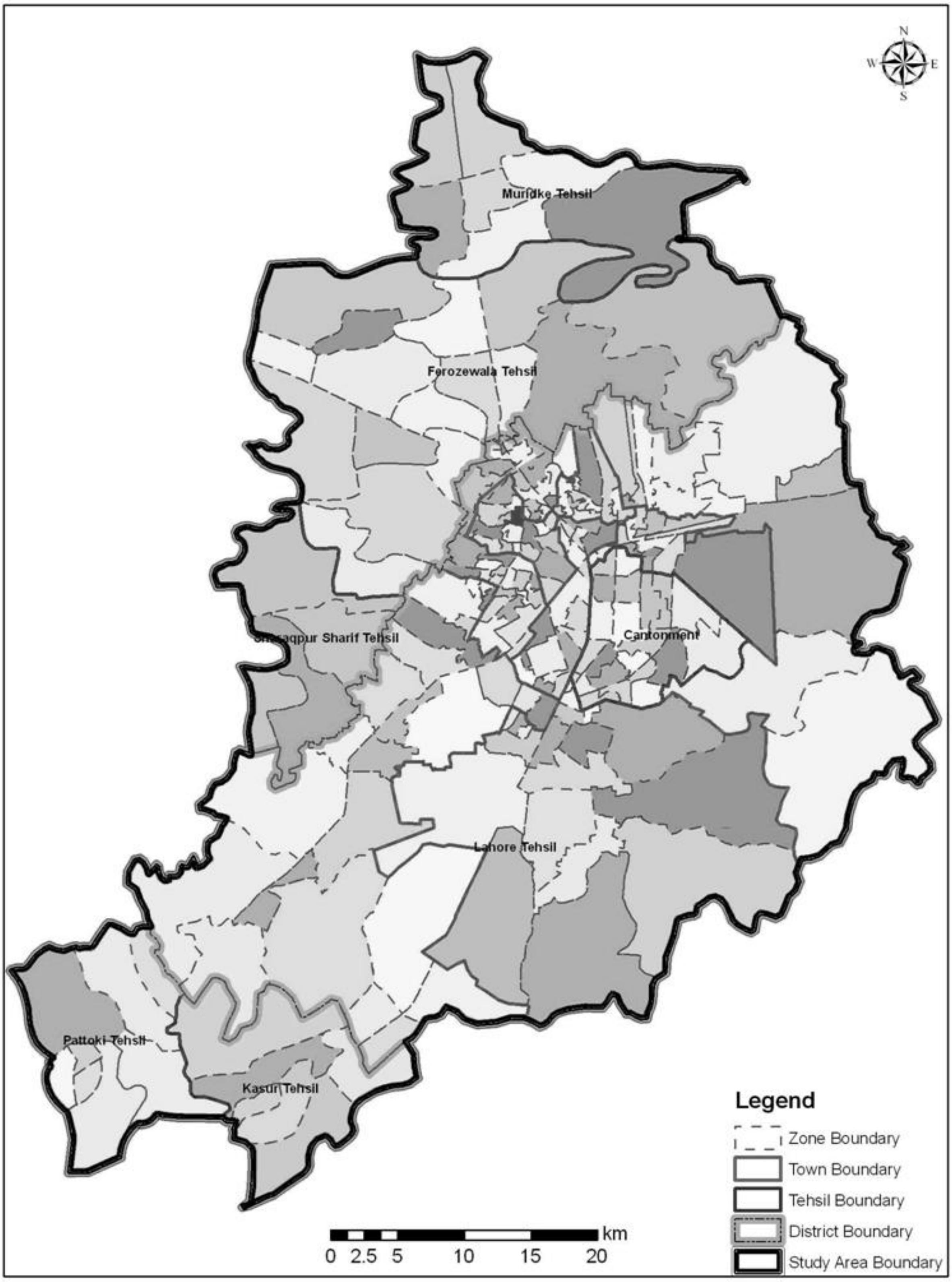
Different steps were involved in planning of HIS survey; which are described next.

1) Study Area and Traffic Zone System

The Study Area, comprising 3,044 km^2, covers the whole district of Lahore and parts of the Kasur and Sheikhupura districts as shown in Figure 1.2.1. Existing administrative division system of the Study Area has been used as base for developing the zone system. Local administrative division is selected because of several reasons: like availability of administrative boundaries, socio-economic information, and census data by union council.

This administrative division (Union Councils) were then further allocated sequential zone numbers and some of the union councils were further divided in to several zones as Railway or Canal Screenlines crossed through these union councils. It was necessary to split these zones to capture the cross screenline trips from HIS and Cordon surveys.

Figure 1.2.1 Household Interview Survey – Study Area and Zone System



Source: JICA Study Team

The Study Area zoning system consist of total of 228 internal zones, 30 external zones for covering trips made from outside the Study Area, and 68 special generator zones for modal interchange facilities like Airport, Railway Stations, Intra-city and Inter-city Bus Termini. A complete list of Zone System with area coverage is given in Annex-I to this volume.

2) Number of Samples

HIS was conducted to record socio-economic characteristics and travel patterns of all household members of 5 years of age or above. Sampling rate was set at 1 % of the Study Area households. The detail of the number of samples by each Town/ Tehsils is given in Table 1.2.4.

Table 1.2.4 Household Interview Survey – Estimated Number of Samples

No.	Town / Tehsil	Total 2010		HIS Samples (Sampling Rate: 1%)	
		Population	Households	Population above 5 Years	Households
1	Ravi Town	1,007,335	183,200	8,870	1,832
2	Data Gunj Baksh Town	969,922	176,400	8,540	1,763
3	Samanabad Town	984,013	179,000	8,660	1,791
4	Shalimar Town	854,223	155,400	7,520	1,553
5	Gulberg Town	778,106	141,500	6,850	1,413
6	Aziz Bhatti Town	666,724	121,300	5,870	1,212
7	Wahga Town	655,928	119,300	5,780	1,193
8	Nishtar Town	945,064	171,900	8,320	1,719
9	Iqbal Town	960,377	174,700	8,460	1,746
10	Cantonment	830,747	151,100	7,320	1,512
11	Ferozewala Tehsil	533,816	97,100	4,700	972
12	Muridke Tehsil	266,232	48,500	2,350	484
13	Sharaqpur Sharif Tehsil	100,804	18,400	890	183
14	Kasur Tehsil	167,504	30,500	1,480	305
15	Pattoki Tehsil	207,246	37,700	1,830	376
1-10	**Lahore**	**8,652,439**	**1,573,200**	**76,150**	**15,734**
11-13	**Sheikhupura**	**900,852**	**163,800**	**7,930**	**1,639**
14-15	**Kasur**	**374,750**	**68,200**	**3,300**	**681**
1-15	**The Study Area**	**9,928,041**	**1,805,100**	**87,370**	**18,062**

Source: JICA Study Team
Note: Average household size at 5.5 persons/HH and percentage of population of above 5 years is estimated to be 88 %.

The method of sampling was geographically stratified random sampling, where samples within each area were randomly selected in the field.

1.2.2 Cordon Survey

The Study Area is encircled by an imaginary line, and all roads entering or exiting to or from the Study Area are marked as cordon survey locations – location map is at Figure 1.2.2. The survey conducted: covered 100 % vehicle counts by vehicle type, and 10~20 % sample of roadside interviews of drivers of private vehicles, and passengers of public vehicles.

The cordon survey is used to estimate the volume of traffic that enters and leaves the Study Area within a typical day, and the volume that passes through, with neither origin nor destination in the Study Area.

Cordon survey is to collect following information:

1. Trip information (origin and destination, purpose, mode, vehicle occupancy, freight type, access mode, 10~20 % sample)
2. Vehicular traffic count (100 % sample by 13 vehicle types)

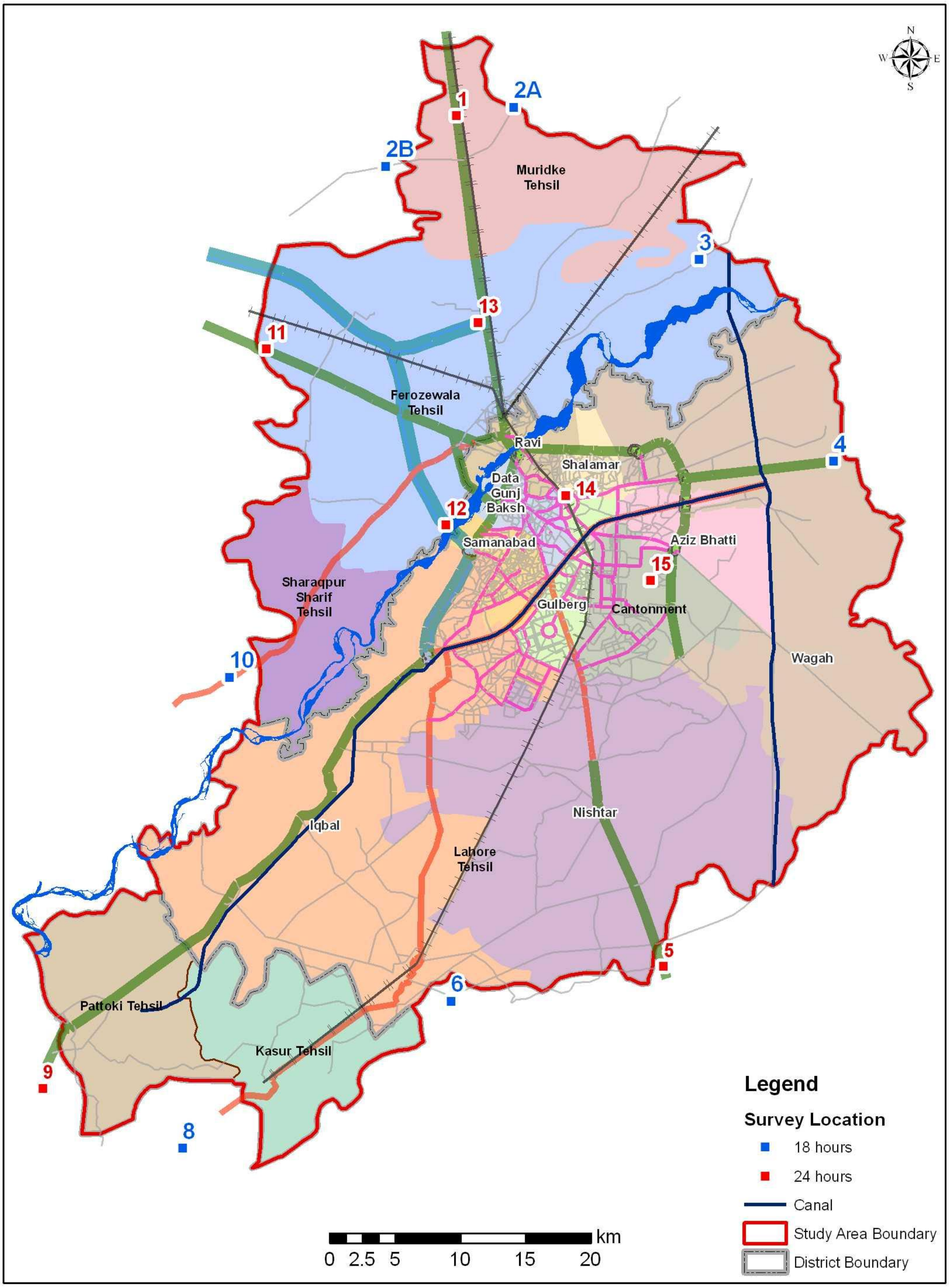
The interviews were conducted by surveyors flagged down vehicles with the help of policemen. The survey was conducted at a total 15 locations, 13 major roads, Allama Iqbal International Airport and Lahore Railway Station. Survey detail is given in Table 1.2.5.

Table 1.2.5 Cordon Survey Locations

Site	Survey Station (Boundary)	Survey Date	Survey Duration	
			Traffic Count	OD Interview
1	G.T. Road near Muridke	**27-Dec-2010**	**24 hour**	**24 hours**
2A	Narowal - Muridike Road	21-Dec-2010	18 hour	18 hours
2B	Sheikhupura - Muridike Road	21-Dec-2010	18 hour	18 hours
3	Kala Khatie - Narang Mandi Road	22-Dec-2010	18 hour	18 hours
4	G.T. Road near Wahga Border	6-Jan-2011	18 hour	18 hours
5	Lahore-Kasur Road near Mustafa Abad	**28-Dec-2010**	**24 hour**	**24 hours**
6	Kasur – Raiwind Road near Raiwind	23-Dec-2010	18 hour	18 hours
8	Pattoki-Raiwind Road near Changa Manga	23-Dec-2010	18 hour	18 hours
9	Multan Road near Bhai Pheru	**3-Jan-2011**	**24 hour**	**24 hours**
10	Jaranwala-Lahore Road near Sharaqpur Sharif	22-Dec-2010	18 hour	18 hours
11	Lahore-Sheikhupura Road (near Sheikhupura)	**1-Jan-2011**	**24 hour**	**24 hours**
12	Ravi Motorway (M-2) Toll Plaza	**29-Dec-2010**	**24 hour**	**24 hours**
13	Kala Shah Kaku Toll Plaza (Lahore Bypass)	**28-Dec-2010**	**24 hour**	**24 hours**
14	Lahore Railway Station	**4-Jan-2010**	**-**	**24 hours**
15	Allama Iqbal International Airport	**13-Dec-2010**	**-**	**24 hours**

Source: JICA Study Team

Figure 1.2.2 Cordon Survey Sites



Source: JICA Study Team

1.2.3 Screenline Survey

The Study Area is divided into four main parts by the BRB Canal and Pakistan Railway Line. Two screenlines were selected, and named as the “Rail Screenline” and the “Canal Screenline”. 100 % Vehicular traffic was counted by 13 vehicle types in both directions. Vehicle occupancy survey counted the number of vehicle occupants (passenger and driver) for a target of 10 to 50 % sample of vehicles crossing the screenline.

The surveys were conducted at 64 locations at main railway crossings or bridges on the two screenlines; 20 sites were surveyed for a period of 24 hours, while 44 sites were surveyed for 18 hours (6:00-24:00). Location map of both screenlines is given in Figure 1.2.3, and survey details are given in Tables 1.2.6 and 1.2.7.

Table 1.2.6 Railway Screenline Survey Locations

No	Site Code	Roads Crossing Railway Screenline	Duration (Hours)	Survey Date
1	R-1	Hardosohal Muslim Road	18	4-Oct-2010
2	R-2	Kala Khatai Narang Mandi Road	18	
3	R-3	Shahdara Town Underpass	18	
4	R-4	Jahangir Tomb Road	18	
5	R-5	Lahore Ring Road	24	
6	R-5A	Lahore Ring Road Underpass Level-crossing	18	
7	R-6	Badami Bagh Flyover	18	1-Oct-2010
8	R-6A	Badami Bagh Level-crossing	18	
9	R-6B	Mandi Wala Level-crossing	18	4-Oct-2010
10	R-7	Misri Shah Underpass	18	1-Oct-2010
11	R-8	Ek Moria - Underpass	18	
12	R-9	Do Moria Underpass	18	
13	R-10	Garhi Shahu Bridge	24	
14	R-11	Mughalpura Road (to Workshop)	18	30-Sep-2010
15	R-12	Allama Iqbal Road Underpass	24	
16	R-13	Dharumpura Underpass (to Mall Road)	24	
17	R-13A	Dharumpura Underpass (to Mughalpura)	24	
18	R-13C	Dharumpura Level-crossing (to Mughalpura)	24	
19	R-13B	Dharumpura Underpass (to Mall Road)	24	
20	R-13D	Level-crossing (to Mall Road)	24	
21	R14	Mian Mir Bridge (to Mall Road)	18	29-Sep-2010
22	R14A	Mian Mir Underpass (Sikandar Road)	18	28-Sep-2010
23	R15	Abid Majeed Road (Sherpao Bridge)	18	29-Sep-2010
24	R16	Allaudin Road	18	
25	R17	Jinnah Flyover	18	
26	R17A	Jinnah Flyover (Level-crossing)	18	
27	R17B	Jinnah Flyover (Underpass)	18	
28	R18	Ferozepur Road (Flyover)	24	28-Sep-2010
29	R18A	Ferozepur Road (Level-crossing)	24	
30	R18B	Between Ferozepur Road and Peco Road	24	
31	R19	Peco - Ferozepur Road Link	18	
32	R20	Depot Road	18	

No	Site Code	Roads Crossing Railway Screenline	Duration (Hours)	Survey Date
33	R21	Defense Road - College Road	18	27-Sep-2010
34	R22	Defense Road - Ferozepur Road Link	18	
35	R23	Raiwind Road - Lahore Road	18	
36	R23A	Kasur Road - Manga Road	18	
37	R-2A	G.T. Road	24	4-Oct-2010

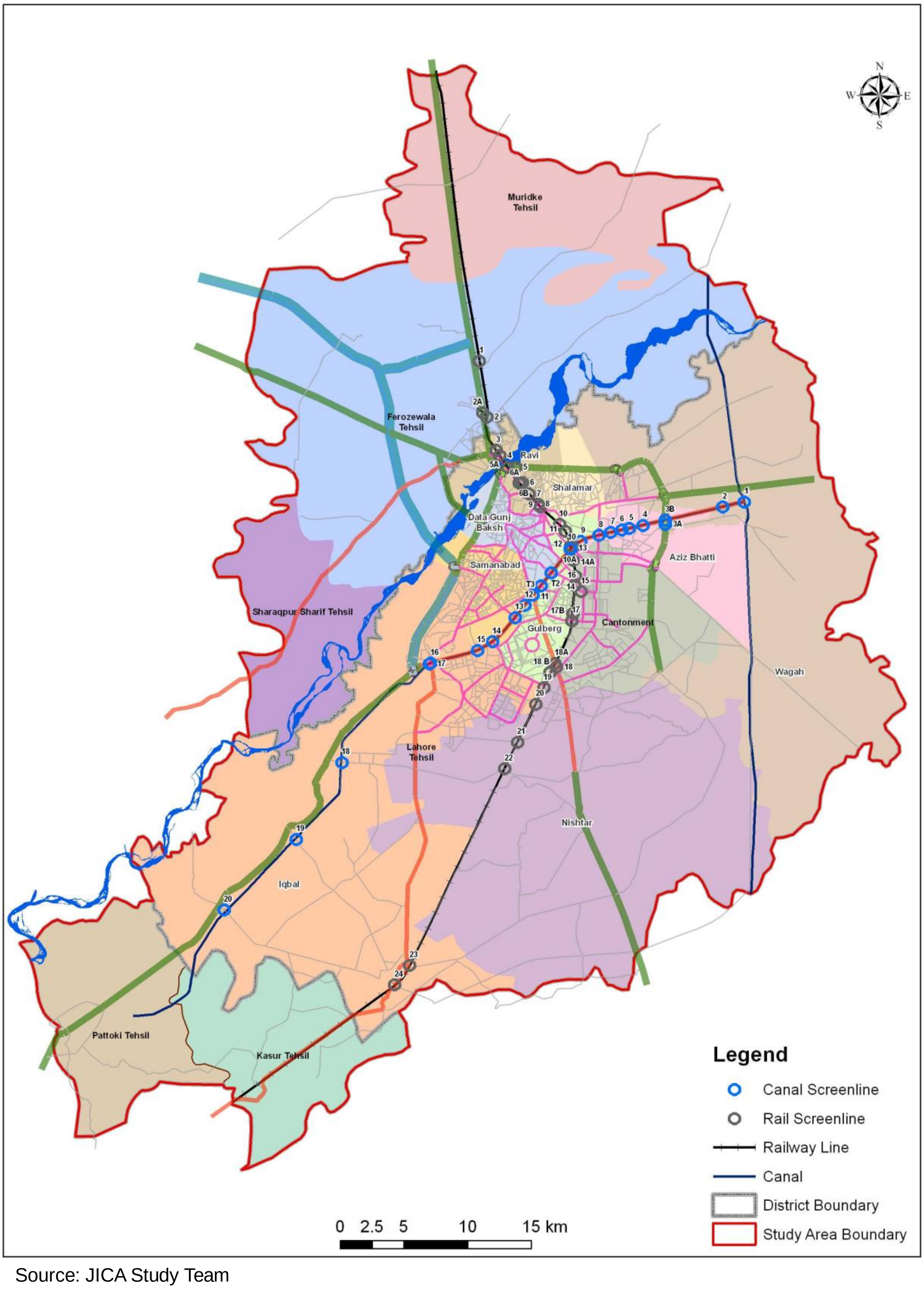
Source: JICA Study Team

Table 1.2.7 Canal Screenline Survey Locations

No	Site Code	Roads Crossing Canal Screenline	Duration (Hours)	Survey Date
1	C1	GT Road - Barki Road Link	18	20-Sep-2010
2	C2	Jallo Park Access Road	18	
3	C3A	Lahore Ring Road / Harbanspura flyover	18	
4	C3B	Lahore Ring Road / Harbanspura on road	18	
5	C4	Taj Bagh Bridge	18	
6	C5	Fatah Garh Bridge	18	
7	C6	Trasburaski Road (Nawan Bridge)	18	21-Sep-2010
8	C7	Lal Pul Bridge	18	
9	C8A	Shalamar Link Road Flyover	18	
10	C8B	Shalamar Link Road on Road	18	
11	C9	Chobacha Bridge	18	
12	C10	Zarrar Shaheed Road (Dharumpura Bridge)	24	22-Sep-2010
13	C10A	Sundardas Road (Dharumpura Bridge)	24	
14	T3	Mall Road	24	7-Oct-2010
15	T2	Jail Road	24	8-Oct-2010
16	C11	Zahoor Elahi Road (FC College Bridge)	18	21-Sep-2010
17	T1	Ferozepur Road	24	11-Oct-2010
18	C12	New Muslim Town	18	22-Sep-2010
19	C13	Campus Road	24	
20	C14	Jinnah Hospital Bridge	18	23-Sep-2010
21	C15	Doctors Hospital Bridge	18	
22	C16	Canal View Main Road Bridge	18	24-Sep-2010
23	C17	Thokar Niaz Baig on Road	24	23-Sep-2010
24	C17A	Thokar Niaz Baig Flyover	24	
25	C18	Defense Road	18	24-Sep-2010
26	C19	Sundar Road	18	
27	C20	Raiwind Road	18	

Source: JICA Study Team

Figure 1.2.3 Canal and Railway Screenline Survey Locations



Source: JICA Study Team

1.2.4 Traffic Count Surveys at Key Roads near Major Intersections

Traffic counts survey was conducted to collect traffic characteristics in relation to the 1991 JICA study traffic counts at the same 14 intersections in the Study Area. The additional locations selected are Old Ravi Bridge and Lahore Ring Road.

The survey counted the vehicle volume by 13 vehicle type, in two directions and by two time period: 6 sites were selected for 24 hour counts; whereas the 8 other sites were surveyed for 18 hour (6:00-24:00). Location map of survey sites is shown in Figure 1.2.4, and details are given in Table 1.2.8.

Table 1.2.8 Traffic Count Survey Locations

<table>
<tr><th>No.</th><th>Duration</th><th colspan="2">Survey Station</th><th>Survey Date</th></tr>
<tr><td>T1</td><td rowspan="3">24 hour Turning Movement Count</td><td colspan="2">Canal Bank Road / Ferozepur Road Intersection</td><td>11-Oct-10</td></tr>
<tr><td>T2</td><td colspan="2">Canal Bank Road / Jail Road Intersection</td><td>8-Oct-10</td></tr>
<tr><td>T3</td><td colspan="2">Canal Bank Road / Mall Road Intersection</td><td>7-Oct-10</td></tr>
<tr><th>No.</th><th>Duration</th><th>Road</th><th>Road Section</th><th></th></tr>
<tr><td>T4</td><td rowspan="3">24 hour Vehicular Traffic Count</td><td>Multan Road</td><td>between Bund Road E and Sodiwal Road</td><td>5-Oct-10</td></tr>
<tr><td>T5</td><td>G.T, Road</td><td>between Shalamar Link Road and Shalimar Garden</td><td>6-Oct-10</td></tr>
<tr><td>T6</td><td>Ravi Bridge</td><td>between with Bund Road E and G.T. Road</td><td>6-Oct-10</td></tr>
<tr><td>T7</td><td rowspan="8">18 hour Vehicular Traffic Count (6:00 to 24:00)</td><td>Old Ravi Bridge</td><td>between Lahore Ring Road and Jahangir Tomb Road</td><td>6-Oct-10</td></tr>
<tr><td>T8</td><td>Multan Road</td><td>between Bahawalpur Road and Samnabad Main Boulevard.</td><td>5-Oct-10</td></tr>
<tr><td>T9</td><td>Ferozepur Road</td><td>between Bahawalpur Road and Camp Jail</td><td>5-Oct-10</td></tr>
<tr><td>T10</td><td>Ferozepur Road</td><td>between Gulberg main Blvd and Model Town</td><td>5-Oct-10</td></tr>
<tr><td>T11</td><td>Jail Road</td><td>between Gulberg Main Blvd and Zafar Ali Road</td><td>5-Oct-10</td></tr>
<tr><td>T12</td><td>Allama Iqbal Road</td><td>between Canal bank Road and Mughalpura Road</td><td>1-Nov-10</td></tr>
<tr><td>T13</td><td>Lahore Ring Road</td><td>between Ring road BRB Canal and Band Road S</td><td>6-Oct-10</td></tr>
<tr><td>T14</td><td>Lahore Ring Road</td><td>between Amjad Chaudhry Road and Canal Bank Road</td><td>6-Oct-10</td></tr>
</table>

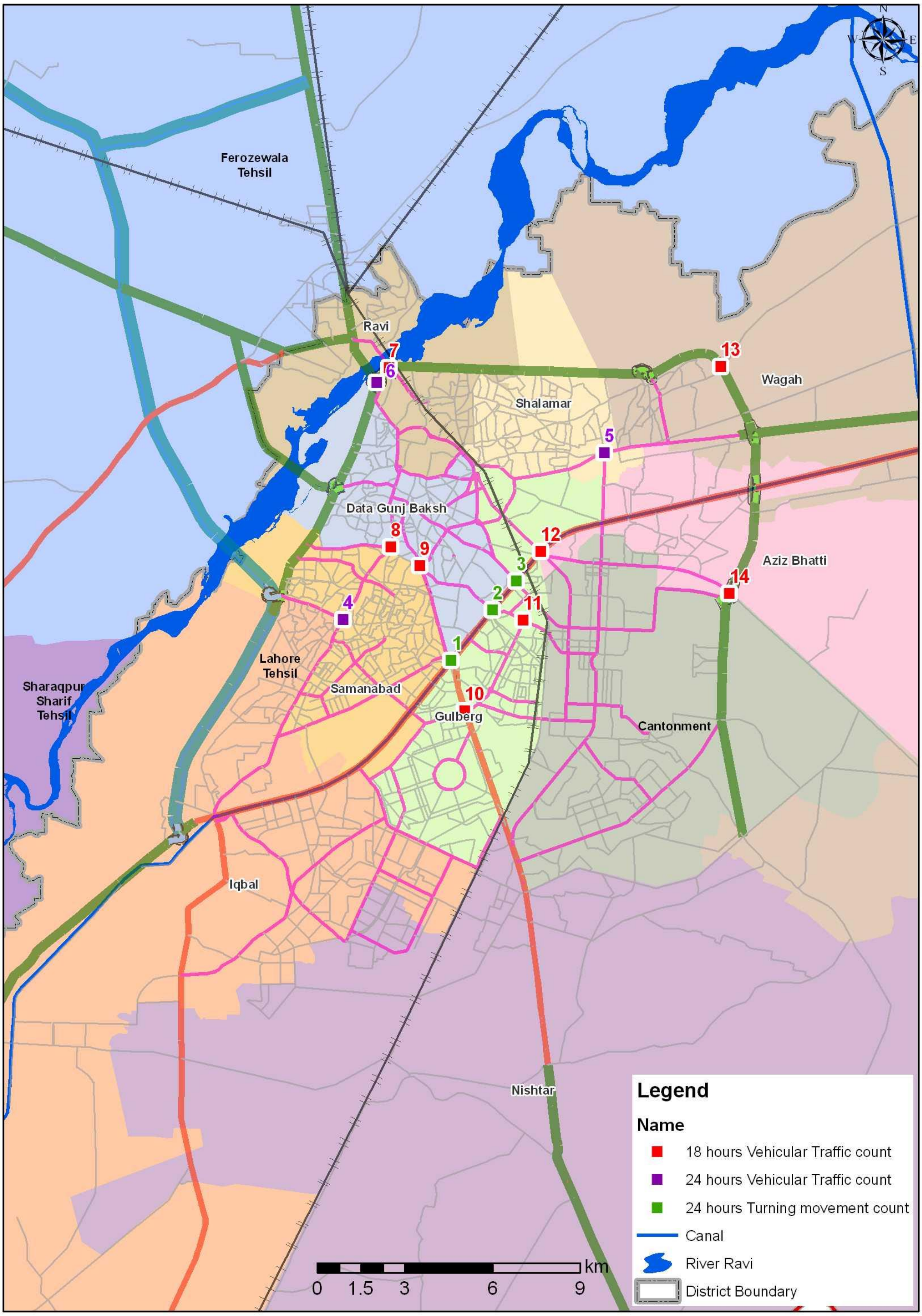
Source: JICA Study Team

1.2.5 Public Transport (PT) User Interview Survey

PT user interview survey (passengers of: Bus, AC-bus, Wagon, Rickshaw, and Qingqi collected information on: Socio-economic characteristics of user, O/D, trip purpose, travel time and fare paid, and perceptions of existing and proposed public transport services. This is to ascertain the current urban transport situation in Lahore, and prepare database for future public transport facilities, Table 1.2.9 gives the detail of surveys.

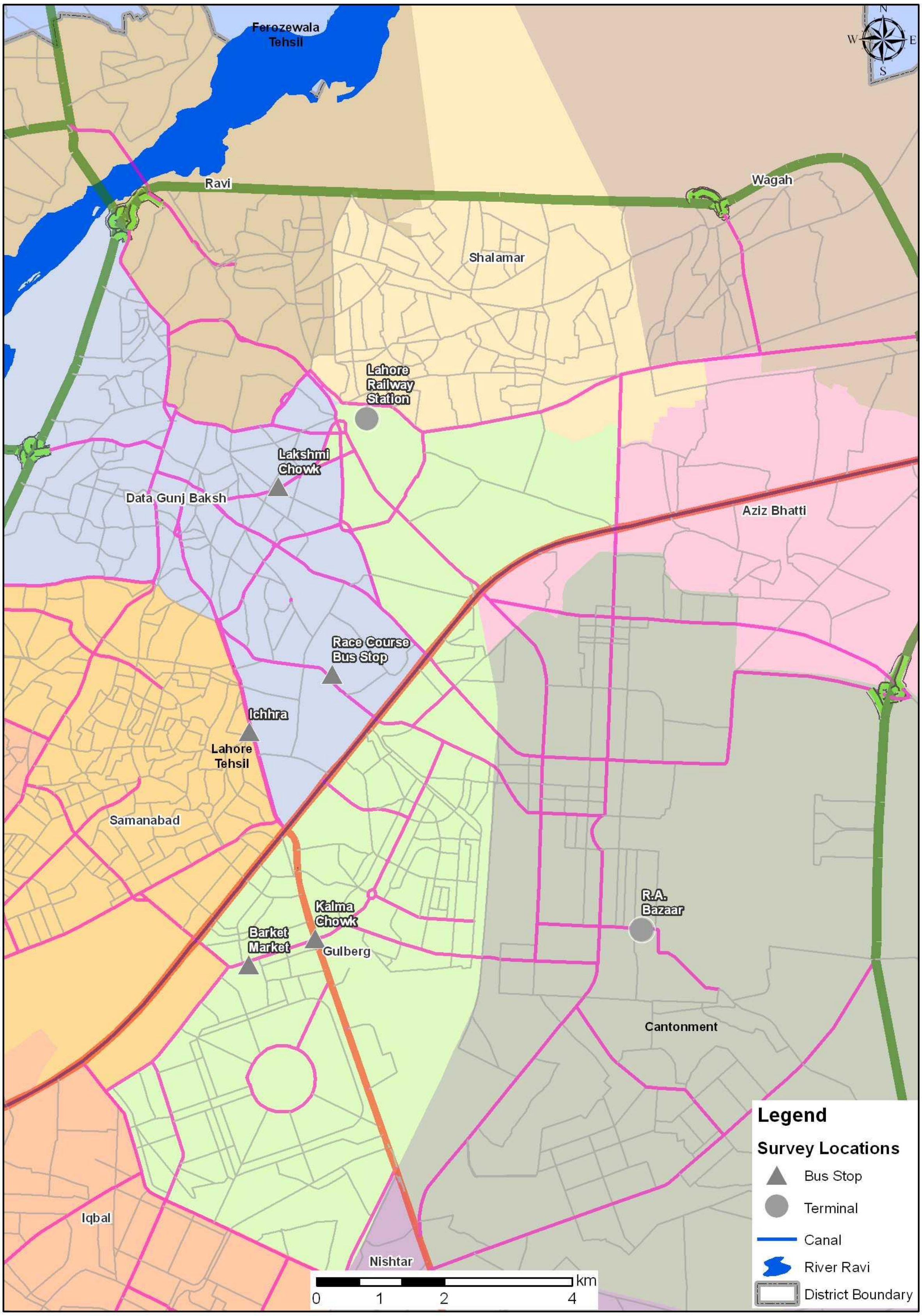
One thousand (1,000) interview samples were randomly conducted at major intra-city terminals and bus stops for 12 hours, with a predetermined proportion of samples for each public transport mode. Socio-economic characteristics of user, public transport journey time, opinion of public transport services and perceptions of likely future facilities were recorded. Location map of survey sites is given in Figure 1.2.5.

Figure 1.2.4 Traffic Count Survey Locations



Source: JICA Study Team

Figure 1.2.5 Public Transport User Interview Survey Locations



Source: JICA Study Team

Table 1.2.9 Public Transport User Interview Survey Locations

No.	Description	Survey Date
1	Lahore Railway Station	13-Dec-2010
2	R.A. Bazaar	
3	Race Course Bus Stop	
4	Kalma Chowk	
5	Barkat Market	
6	Icchra	
7	Lakshmi Chowk	

Source: JICA Study Team

1.2.6 Travel Speed Survey

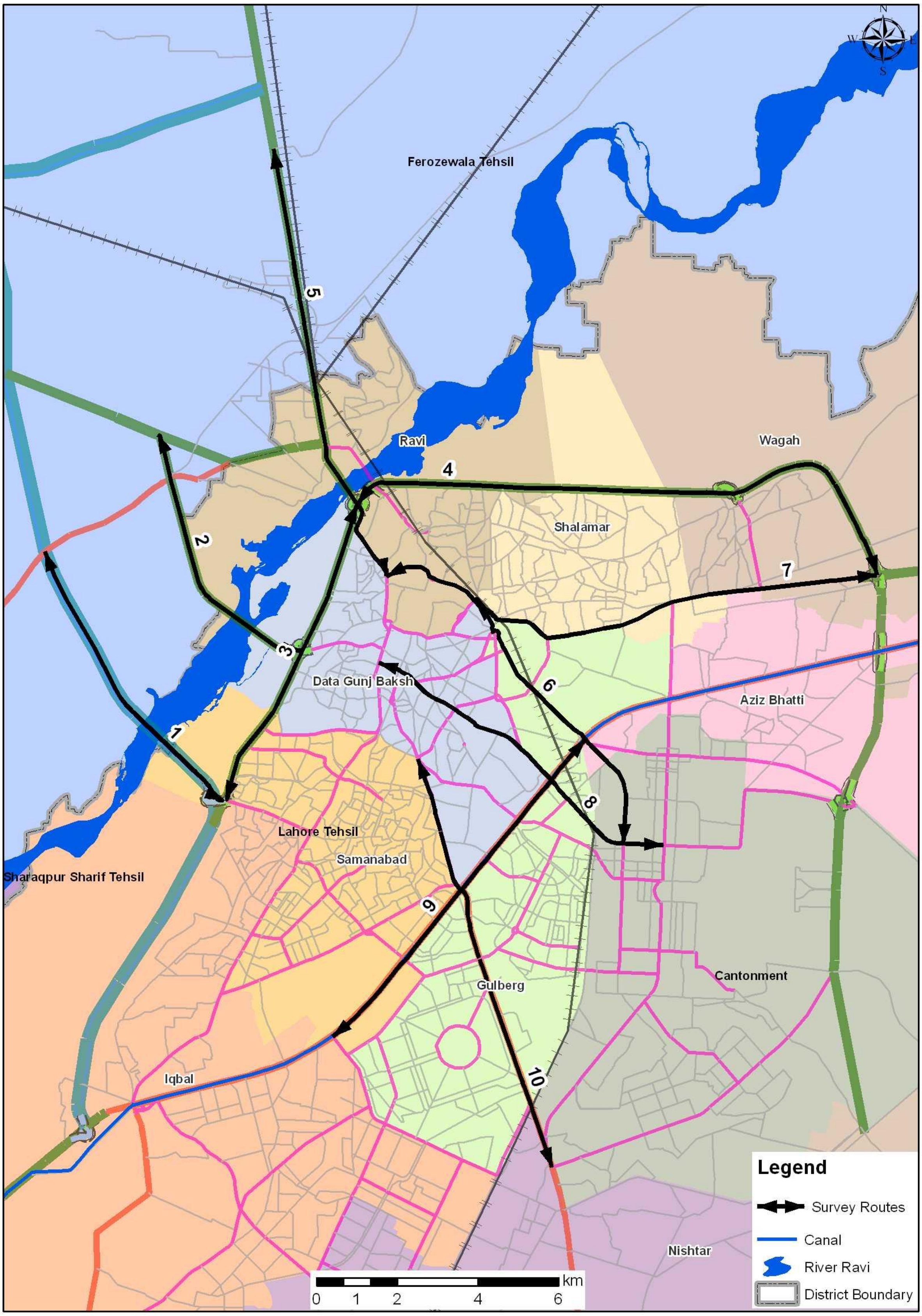
Travel speed survey (Journey Time Survey) was conducted along 10 major road corridors in the city in order to ascertain travel speed and major congestion issues. Travel speed surveys were conducted during morning, evening, and off-peak periods in both directions. The survey followed the ‘floating car method’, which requires the survey vehicles to keep the same position in the traffic flow. Travel time, time of passing intersection and reasons for delays were recorded. Survey routes are illustrated in Figure 1.2.6, and routes descriptions are given in Table 1.2.10.

Table 1.2.10 Travel Speed Survey Routes

No.	Journey Time Survey Route Description	Length (km)	Survey Date
1	Motorway M-2 (Babu Sabu interchange to Faizpur interchange)	7	14-Oct-10
2	Sagian Wala Bypass (intersection with Sheikhupura Road to intersection with Bund Road)	7	14-Oct-10
3	Bund Road and Lahore Ring Road (intersection with Bund Road to Ravi Bridge interchange)	7	15-Oct-10
4	Lahore Ring Road (Ravi Bridge interchange to intersection with G.T. Road)	14	15-Oct-10
5	G.T. Road (Yadgar Chowk to intersection with Hardosohal Muslim Road)	11	18-Oct-10
6	Circular Road, Allama Iqbal Road, Infantry Road, Shami Road (Yadgar Chowk to intersection with Aziz Bhatti Road)	8	19-Oct-10
7	G.T. Road (intersection with circular Road to intersection with Lahore Ring Road)	8	20-Oct-10
8	Mall Road, Aziz Bhatti Road (from Mahfooz Chowk to intersection Lower Mall Road)	8	21-Oct-10
9	Canal Bank Road (intersection with Allama Iqbal Road – intersection with Maulana Shaukat Ali Road)	10	22-Oct-10
10	Ferozepur Road (Intersection with Defense Road to Qartba Chowk)	10	25-Oct-10

Source: JICA Study Team

Figure 1.2.6 Travel Speed Survey Routes



Source: JICA Study Team

1.2.7 Bus Occupancy Survey

Bus occupancy survey was conducted along ten (10) ‘notified’ bus routes during bus operating hours, in both directions of operation. Data was collected with surveyors riding a bus from origin to its destination, counting the number of boarding and alighting passengers, and start time at each bus stop. This provided the passengers boarding, alighting and loading profile by individual bus route, and by time of day. Location of bus survey routes are given in Figure 1.2.7, and detailed in Table 1.2.11.

Table 1.2.11 Bus Occupancy Survey Routes Ten

Route No.	Bus Company	From	To	Survey Date
4	New Khan	Lari Adda	Jallo More	14-Oct-2010
5	Daewoo	Railway Station	DHA Y-Block Market	20-Oct-2010
8	New Khan	Lari Adda	Airport	21-Oct-2010
9	Premier Bus Service	Railway Station	Purana Khana	15-Oct-2010
12	Premier Bus Service	Railway Station	Youhanna Abad	19-Oct-2010
16	Daewoo	Railway Station	Umer Chowk	20-Oct-2010
17	New Khan	Railway Station	Jallo Pind	21-Oct-2010
19	Premier Bus Service	Purana Ravi Pull	Chungi Amar Sidhu	18-Oct-2010
22	New Khan	Jallo More	Thokar Niaz Baig	22-Oct-2010
33	METRO	Railway Station	Green Town	22-Oct-2010

Source: JICA Study Team

1.2.8 Parking Survey

Parking survey objective was to capture parking characteristics including: number of parked vehicles and duration by vehicle type in an area. This survey was conducted by periodic (1/2 hour beat) observation and by recording of number plate of parked vehicles along the road-side. At all closed sites number plates were recorded at entry and exit points. Seven 100-meter sections of roads and five off-street parking facilities (shopping malls) were surveyed in the LUTMP urban area. Locations of survey sites are given in Figure 1.2.8, and detailed in Table 1.2.12.

Table 1.2.12 Parking Survey Locations

NO.	Road Section	Survey Site Description	Survey Date	Survey Duration
1	Mall Road	In front of Croweater Gallery and restaurant	26-Oct-10	06:30-23:00
2	Mall Road	In front of Dubai Islamic Bank	27-Oct-10	06:30-23:00
3	Mall Road	In front of Panorama Shopping Centre	26-Oct-10	07:00-23:00
4	Mall Road	In front of Bank Alfalah	27-Oct-10	07:00-23:00
5E	Khayaban-e-Aiwan-e-Iqbal	In front of Lahore Stock Exchange	28-Oct-10	07:00-23:00

NO.	Road Section	Survey Site Description	Survey Date	Survey Duration
5W	Khayaban-e-Aiwan-e-Iqbal	Opposite side of Lahore Stock Exchange	28-Oct-10	07:00-23:00
6	Kashmir Road	Opposite side of LDA Plaza in front of Passco	28-Oct-10	06:30-23:00
7	Liberty Market	At Entry and Exit Points of Liberty Market	29-Oct-10	11:00-22:30
8	Gulberg Main Boulevard	In front of Hafeez Center	29-Oct-10	07:00-2300
9A	METRO – Model Town	at Entry and Exit Points	4-Nov-10	12:00-23:00
9B	MACRO – Link Road	at Entry and Exit Points	4-Nov-10	13:30-23:30
C	MACRO – Ravi Road	at Entry and Exit Points	4-Nov-10	16:45-22:15

Source: JICA Study Team

1.2.9 Road Inventory and Junction Characteristics Surveys

The Study Area road network inventory survey covered primary, secondary, and tertiary roads, whereas small streets and roads inside the closed housing societies were not surveyed. For each key road section; road length, right of way width, carriageway width, footpath width, no of lanes, proportion of road section (link) used for parking, encroachment, bus stop, and predominant land use; were recorded.

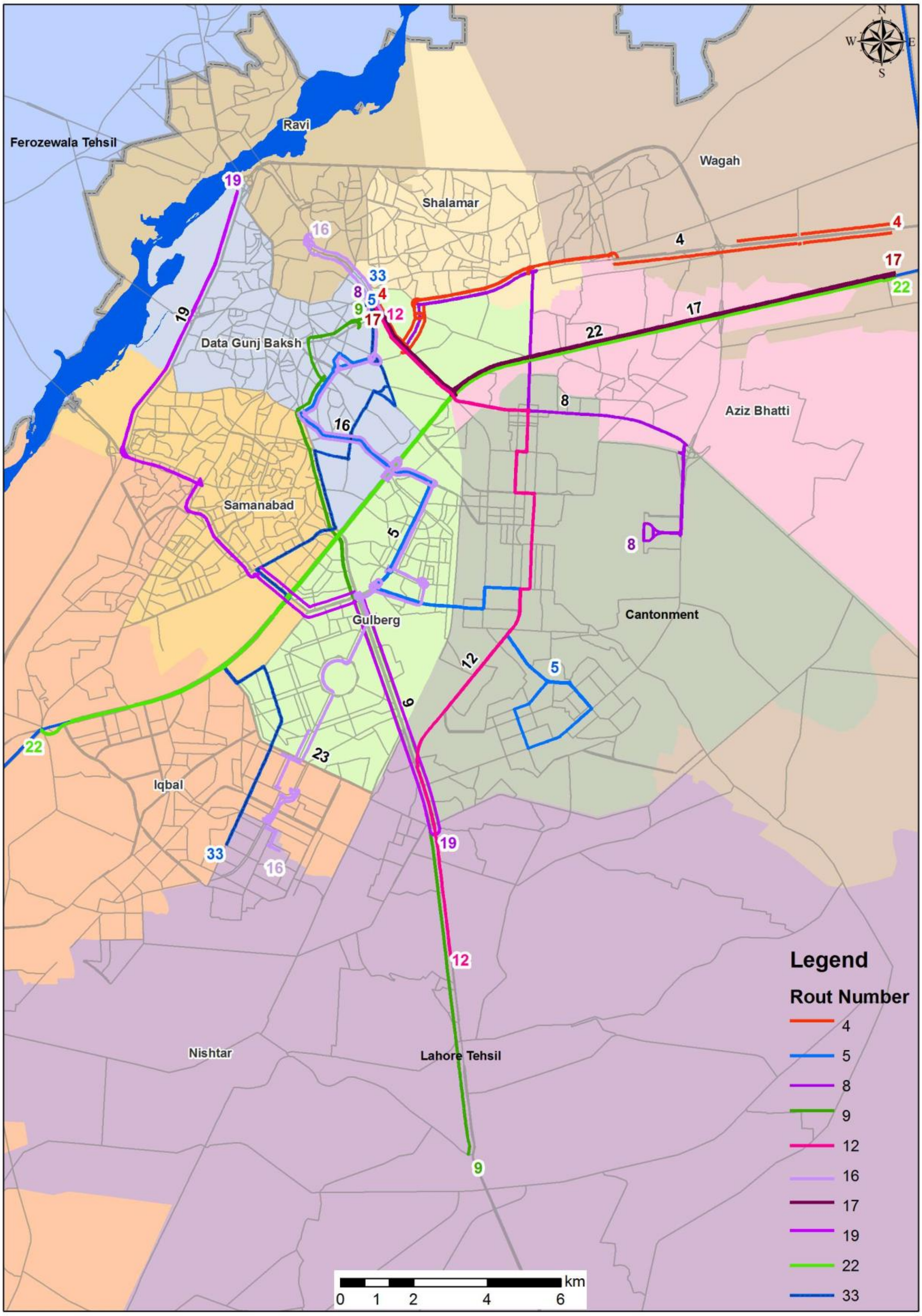
The junction survey recorded data for each key junction at major and minor cross roads. The recorded data included number of lanes entering the junction, type of junction. Road network covered by inventory survey is shown in Figure 1.2.9, and a summary is given Table 1.2.13.

Table 1.2.13 Road Inventory Survey Summary

Type	Unit	Total
Roads (sections)	Count	1021
Junctions	Count	264
Total Length	Km	2,233
Average Right of Way	Meter	18.85
No. of Links	Count	2,412
Bus Stops	Count	373
One-way Links	Count	939
Two-way Links	Count	1,473
Single Carriageway Links	Count	765
Dual Carriageway Links	Count	1,647

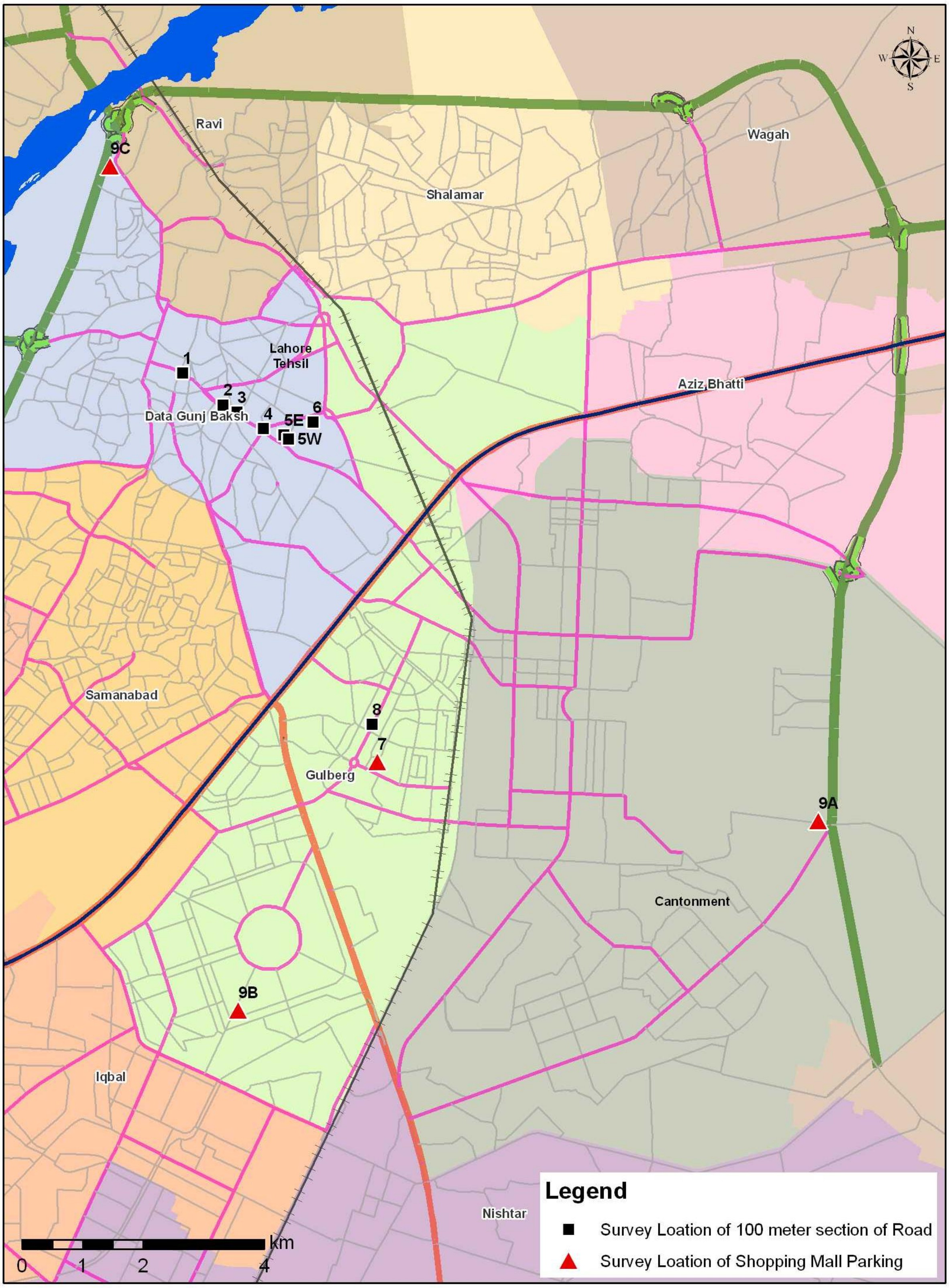
Source: JICA Study Team

Figure 1.2.7 Bus Occupancy Survey – Ten Bus Routes



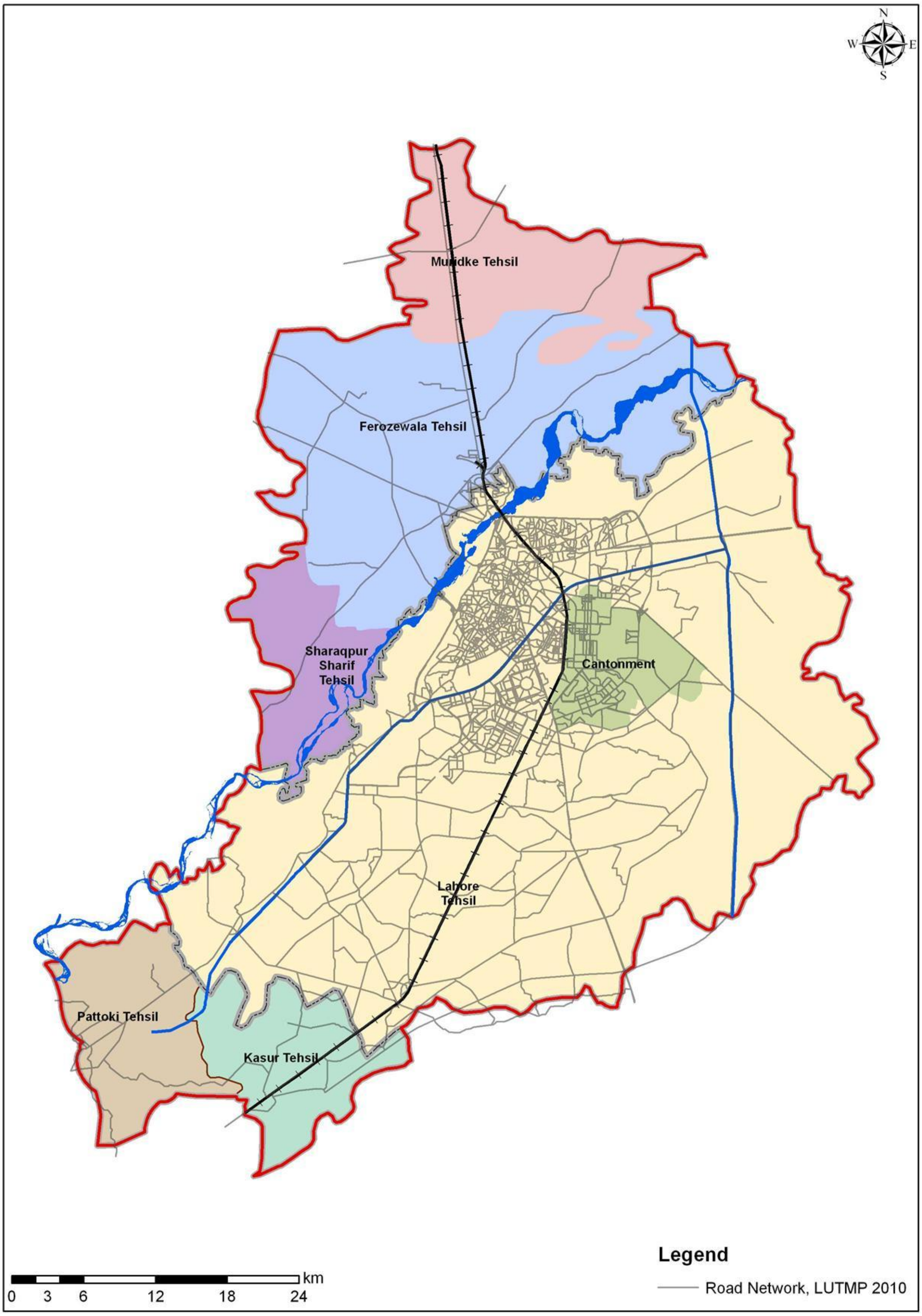
Source: JICA Study Team

Figure 1.2.8 Parking Survey – Road Sections and Sites



Source: JICA Study Team

Figure 1.2.9 Road Network Inventory Survey – Coverage Area



Source: JICA Study Team

1.2.10 Willingness to Pay Survey

Willingness to pay survey aimed to collect information on travel behaviour and travel budget. The objective was to estimate value of time of different transport mode users, and their willingness to pay for transport services improvement. Interviews were conducted with different transport mode users include: Car (31 %), Rickshaw (31 %), Qingqi (6 %), Wagon (8 %), Bus (18 %), and AC Bus (6 %) of a total sample about 2,100 respondents. This survey was conducted at a number of locations in the Study Area like: fuel stations, educational institutions, shopping malls, intra-city bus terminal, to avoid sampling bias. Location map of interview sites is given in Figure 1.2.10, and details are described in Table 1.2.14.

Table 1.2.14 Willingness to Pay Survey Sample Details

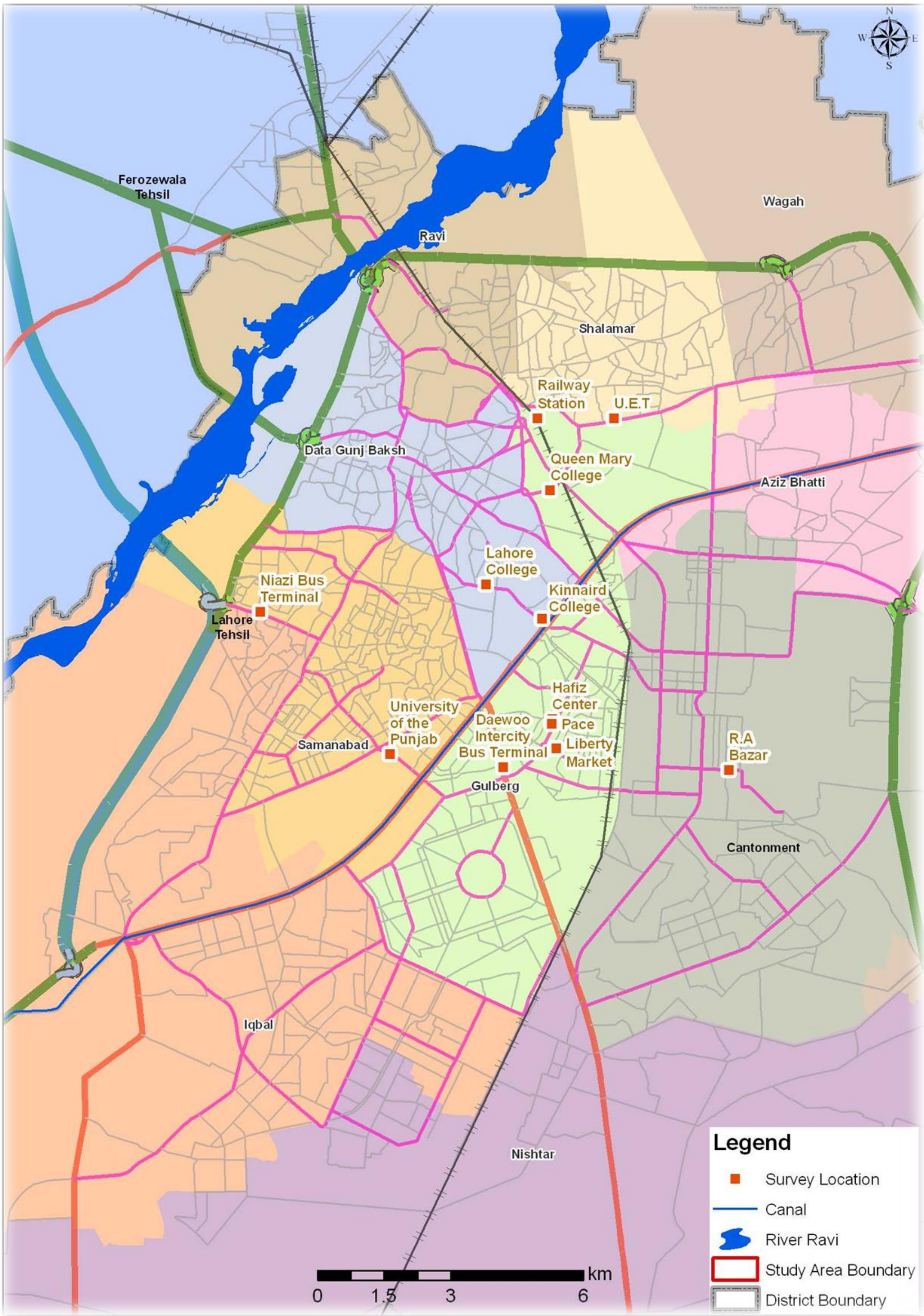
Transport Mode Used	Sample	Questionnaire Type	Percent Sample
Car	645	3	31%
Rickshaw	647	3	31%
Qingqi	125	3	6%
Wagon	175	3	8%
Bus	385	3	18%
AC - Bus	115	3	5%
Total	**2,092**	**-**	**100%**

Source: JICA Study Team

1.2.11 Road Junction and Traffic Signal Survey

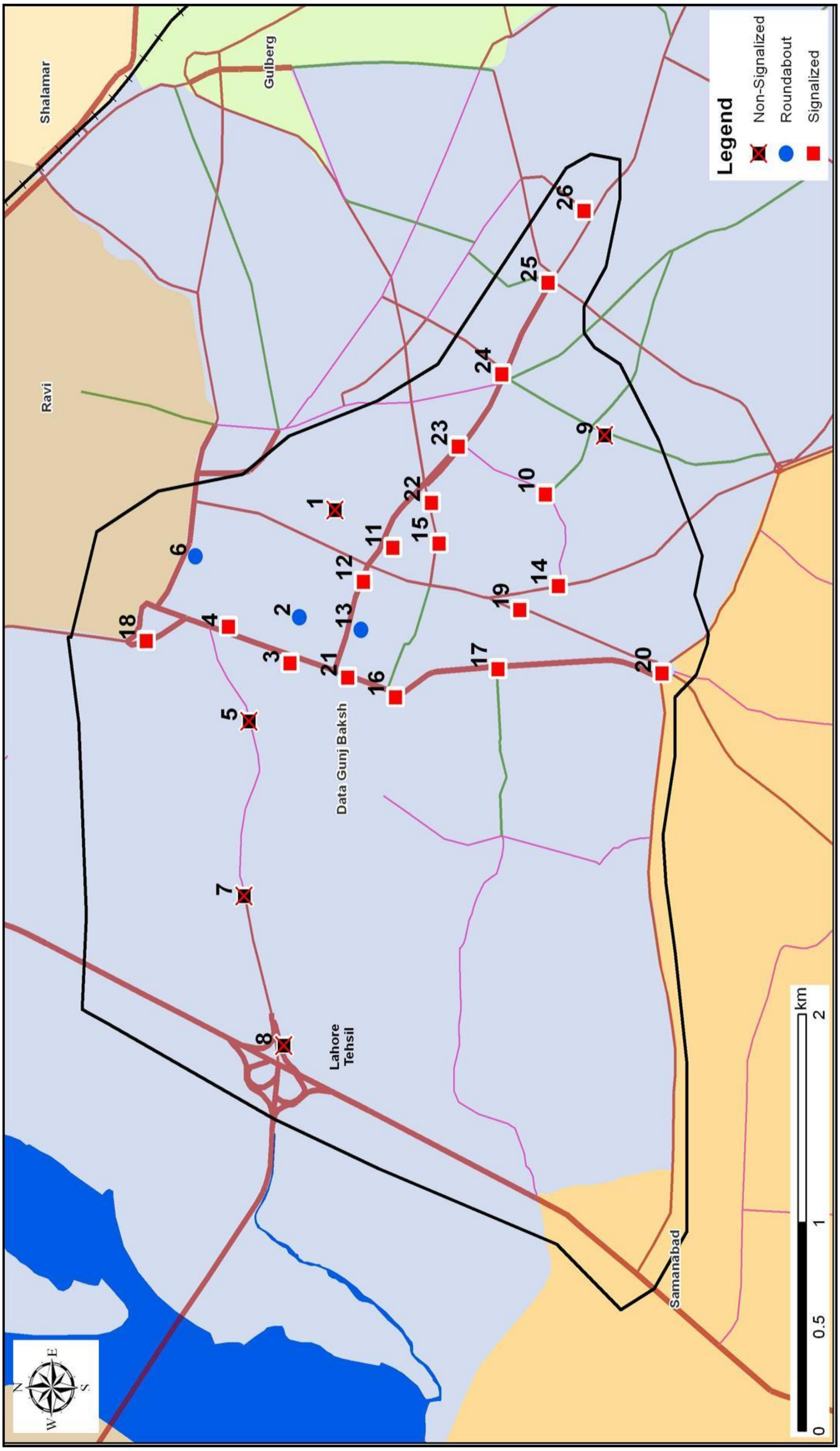
Road junction and traffic signal survey focused to collect data in the Central Business District (CBD) area of Lahore, south, and south east of the Walled City. The survey collected broad junction layout, junction geometric design, traffic circulation, and signal phasing information. In total 26 junctions were surveyed: out of which three (3) were Roundabouts, eighteen (18) were signalized, including six (6) three arms, and the rest were 4 to 6 arms; and five (5) junctions were uncontrolled. Location map of junctions is given in Figure 1.2.11 and details are summarized in Table 1.2.15.

Figure 1.2.10 Locations of Willingness to Pay Survey Sites



Source: JICA Study Team

Figure 1.2.11 Locations of Junctions Surveyed for Road Junctions and Traffic Signal Survey



Source: JICA Study Team

Table 1.2.15 Details of Road Junctions Survey

No.	Junction Name and Description	Type of Junction
1	Neela Gumbad Chowk	Unsignalized
2	Government College Chowk	Roundabout
3	Outfall Road and Lower Mall	Pre-Timed
4	Rettigan Road and Lower Mall Road	Pre-Timed
5	Rettigan Road and Outfall Road	Unsignalized
6	Lohari Gate Chowk	Roundabout
7	Rettigan Road and Abdul Qadir Jillani Road	Unsignalized
8	Saggian Bypass and Outfall Road	Unsignalized
9	Mozang Road and Temple Road	Unsignalized
10	Mozang Road and Begum Road	Pre-Timed
11	Mcload Road and Mall Road	Pre-Timed
12	Anarkali Road and Mall Road	Pre-Timed
13	Town Hall Chowk	Roundabout
14	Lytton Road and Begum Road	Pre-Timed
15	Mclean Road and Bank Road	Pre-Timed
16	Lower Mall Road and Mall Road	Pre-Timed
17	MAO College Chowk	Pre-Timed
18	Bhatti Chowk	Pre-Timed
19	Babri Chowk	Pre-Timed
20	Chauburji	Pre-Timed
21	Post Master General Chowk	Pre-Timed
22	YMCA Chowk – Mall Road	Pre-Timed
23	Fane Road and Mall Road	Pre-Timed
24	Regal Chowk	Pre-Timed
25	Chairing Cross	Pre-Timed
26	Awari Chowk	Pre-Timed

Source: JICA Study Team

1.3 HIS Survey Implementation

Implementation of Household Interview Survey (HIS) includes the following steps;

i. Questionnaire Design

ii. Sampling

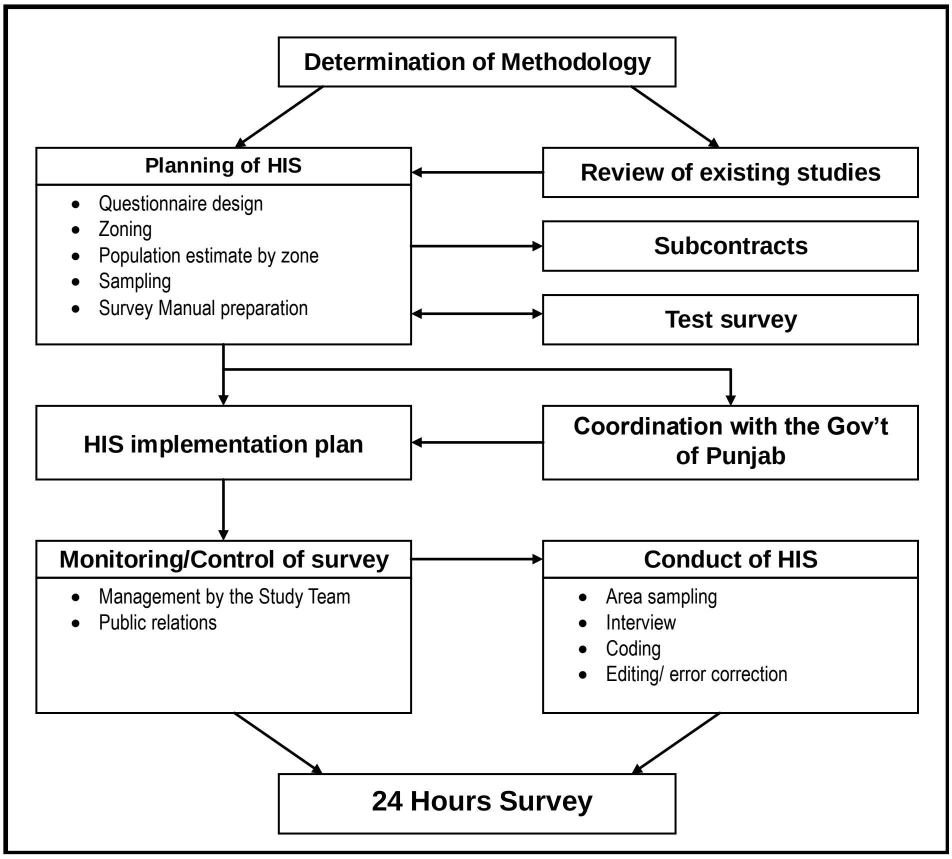
iii. Preparation of Field Survey

iv. Conduct of Field Survey

v. Data Processing

However, for all other types of survey; steps include; define survey locations, design survey form, training of survey staff with respect to each survey type, field supervision for quality assurance, data coding, data encoding, and simultaneous range and logic checks to minimize error in data entry. HIS survey control procedure designed for successful implementation of filed survey is presented in Figure 1.3.1. Steps involved for the preparation, and conduct of HIS survey are described next.

Figure 1.3.1 Household Interview Survey – Quality Control Procedure



Source: JICA Study Team

1.3.1 HIS Questionnaire Design

Questionnaire design is a very complex process; which needs local cultural knowledge in order to define questions in a context; so that to enhance acceptance by general public and avoid any cultural or societal conflict. Some questions are highly unacceptable by certain societies around the world which could not be incorporated directly to every culture and may result in local public grievances, as an impediment in the implementation of HIS surveys.

Questionnaire was designed for its requirement to be used for the specific purpose of travel demand model development, calibration, and validation, and also for the alternative socio-economic development analysis. Basic contents covered information regarding the socio-economic condition of each household and its members, travel log of each household member 5 years or above, their trip details, and each household assessment of present traffic, transport situation and the environment in the Study Area.

Questions included were defined according to maximum interview time of 30 minutes per household with 3-5 members, social constraints and interview response time. A short (HIS) pilot survey was conducted in different parts of the Study Area to cover most classes of people to check responses. Later questionnaire was modified as necessary.

An Urdu (direct translation of English) version of questionnaire was also tested in the small pilot. It was found to be not acceptable in the field as people started reading the questionnaire, and argued unnecessarily. This was time consuming and a constraint to complete the survey within the scheduled time.

For simplicity and ease of handling; questionnaire was divided into five parts, and each part was printed on a different colour paper;

Part-0 – Survey Control Page – **White**
Part-A – Household Information – **Off White**
Part-B – Household Member Information – **Blue**
Part-C – Daily Travel Log – **Pink**
Part-D – People’s opinion on Transport and Environment – **Green**

Detail contents of the Household Interview Survey are given in Table 1.3.1.

Table 1.3.1 Household Interview Survey – Contents

Item		Content
Socio-Economic Information	**PART A**: Household Information	• Accommodation Information • Household Composition • Household Income • Vehicle Ownership • Other Household Socio-economic Features
	PART B: Household Member Information	• Age, Sex, Education, Occupation, Income • Vehicle Availability
Trip Information	**PART C**: Daily Travel Activity Information	• Trip Purpose (including pick-up/ drop-off) • Origin / Destination, Departure/ Arrival time/ Transfer Point • Travel Mode • Travel Time, Cost, Fare, Tolls, Parking
Assessment of Trip	**PART C**: Assessment of Daily Travel Activity Information	• Reason of mode choice (Time, Comfort, Convenience, Cost, Safety, Other choices etc.) • Assessment of Trip (Time, Convenience, Safety, Other)
Assessment on Present Traffic Conditions and Transport System	**PART D**: People's Opinion of Transport and Environment	• Traffic Congestion • Traffic Safety (accident experience and opinions for traffic safety) • Public Transport (Bus and other Modes) • Transport Measures

Source: JICA Study Team

1.3.2 Sampling

Sampling is concerned with selection of subset of individual households within a population. The main advantages of sampling are that; the cost is lower, data collection is faster, and since the data set is smaller, it is possible to ensure homogeneity and to improve the accuracy, and the quality of data. Sample calculation and its statistical reliability are discussed in detail in Section 1.2.1.

1.3.3 Preparation of Field Survey

1) Organization Set-up

The survey was conducted under the supervision of JICA Study Team. Following organization setup was maintained during the Survey. Organization set up of one survey group is given in Figure 1.3.2:

a) Chief Supervisor: chief supervisor was responsible for overall survey activities and reporting works. Therefore, he/ she was in direct contact with JICA Study Team during the course of the surveys;

b) Area Coordinators: area coordinator to assist chief supervisor in the course of the field survey and be responsible for survey activities in specific area, training of their allocated teams, monitoring and control of overall progress of his/ her survey group;

c) Supervisors: supervisors to assist area coordinator during the course of survey and mainly responsible for field reconnaissance, deployment of allocated teams, field survey supervision, and quality assurance;

d) Group Leaders: group leaders of specific teams to assist their supervisors in the course of field survey, and be mainly responsible for logistics, sample control of his/ her teams, to ensure timely completion of field survey, quality checking of survey forms, handing over completed survey forms with short report to supervisor, and safe return of survey teams;

e) Surveyors: surveyors were responsible for field work;

f) Coders: coders were employed for the data coding. HIS Surveyors were preferred for the basic coding of HIS Survey Forms after the completion of HIS field survey. Whereas, for Zone Coding; Shortlisted Supervisors and Surveyors having better understanding and familiarity of the Study Area were employed.

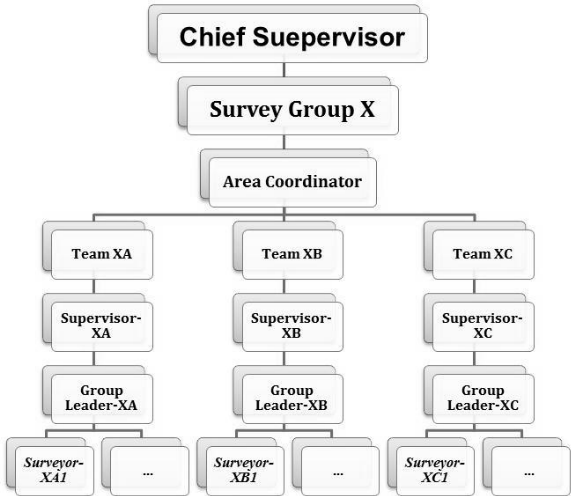
g) Chief Encoder: chief encoder was deployed to assist Chief Supervisor in the course of the data processing, and to ensure the quality of encoded data through different range and logic checks during data entry;

h) Encoders: encoders were employed for data entry in a database using specially designed software.

The survey company has arranged insurance to secure the safety of the survey team. During the survey, members of the JICA Study Team and the staffs of the Transport Planning Unit, Transport Department visited the sites to oversee and monitor the conduct of the surveys at locations and often at random.

Completed survey forms and coded results were sent weekly to the JICA Study Team for inspection and additional quality checks. An office for the survey staff and the JICA Study Team working together on daily basis was arranged for close cooperation.

Figure 1.3.2 Organizational Setup of One Survey Group



Source: JICA Study Team

2) Preparation of HIS Survey Manuals

JICA Study Team prepared detail Household Interview Survey manual; which explained each individual question with its objective, and brief explanation through practical interview examples.

Coding manual was prepared separately to give instructions to coding staff; so as to bring the consistency in all survey form coding and to avoid any type of systematic or random errors.

3) Preliminary/ HIS Pilot Survey

In order to get conformity of survey form in local context, and training core team of survey expert, a pilot survey was conducted with selected number of HIS Surveyors. They were trained before sending them to the field. This team was then used to further train the additional survey staff through properly organized, training workshops, and on the job training in the field with experienced surveyors.

HIS survey form was finalized based on the pilot survey analysis and recommendations field staff experience. The pilot survey was conducted in five different parts of the Study Area, representing mostly different societies. Those survey zones were Deenanath (Kasur District), Sharaqpur (Sheikhupura District), DHA Phase-8, Sabzazar, and Maraka (Lahore District).

4) Training of Surveyors

A temporary Human Resource Management (HRM) section was established to look after the recruitment and training of the survey staff. Rate of absentees were reduced by employing well educated staff at good wage rate.

At the start of each survey training session, briefing was given by the Study Team on the key objectives of the Study, relevance of data to the future of the city; and for the motivation of survey staff. Training was conducted using actual survey forms and manuals by dividing the Staff into groups with each supervisor training the allocated staff.

First day of survey for new staff, after short training from HRM section; they have been sent to the field with experienced staff to get familiarity with the task at hand, understand respondent behaviour and responses. Later on; to cover small absentees in the staff, HRM section was continuously recruiting and training new survey staff.

5) Management of the Field Survey

The following system was established for the field survey management.

a) Field reconnaissance and sampling system;

b) Surveyor assignment system;

c) Check system for surveyors' dishonest activities;

d) Schedule of management system;

e) Progress control of HIS;

6) Coordination with GoPb

JICA Study Team requested various stakeholder public authorities/ agencies through Transport Department, GoPb for issue of Authority Letters, Public Notices, in their jurisdiction and Staff I.D. Cards to develop public confidence to avoid any misunderstanding between general public and survey staff.

Transport Department, and City District Government of Lahore, Sheikhupura and Kasur had issued authority letters and public notices; whereas for Lahore Cantonment area, Lahore Cantonment Board (LCB) issued Authority Letter for the conduct of HIS survey in the vicinity. However, Askari-X housing society refused to acknowledge LCB authority and demanded for GHQ permission for sample interview survey.

HIS survey teams have to carry the copies of all such Authority Letters and Public Notices with them as proof of the Study and their own I.D. Cards for identification.

7) Publicity Campaign for Surveys

There were many robbery cases reported, where persons entered the households in Lahore impersonating the surveyor of Pakistan Government's Income Support Program for verification of Household's eligibility for Income Support; as this program was advertised in Print and Electronic media.

In this regard, Survey Company recommended to JICA Study Team for avoiding advertising LUTMP Survey to circumvent any conflict or confusion with general public which might adversely affect the Surveys.

1.3.4 Conduct of HIS Field Surveys

1) Field Reconnaissance

Supervisors were specially trained in each group to do the field reconnaissance. They visited survey area one day in advance accompanied with detailed survey zones maps containing all landmarks, major/ minor roads, and to divide survey zone into equal parts for random household sampling.

Each team consisted of two persons preferably male/ female. But this paring depended upon the field reconnaissance of the area to be surveyed. In some areas like Walled City, outskirts or rural areas of Sheikhupura and Kasur, and Lahore only male pairs were sent to avoid discrimination and safety reasons.

2) Survey Teams Deployment

Supervisors discussed plans with their team group leaders for their survey teams to the field one day in advance of reconnaissance survey, and deployment of selected marked sub-areas.

3) Field Supervision

Supervisor to deploy teams and also check in field or vehicle or walk to check the forms completed by Surveyors. In case of suspicion of incomplete information, they have to go to specific Household for verification or completion of survey forms.

4) Field Accomplishment

At the end of field survey, each team group leader had to ensure the completion of the sample allocated to that team, ensure quality, and prepare short summary table of households samples completed. Supervisor to cross check the forms, transport to survey office and to submit to databank in-charge.

5) Field Dispatching

Supervisor and surveyors were instructed together at the drop – location of field, and once the survey is complete, they should immediately returned to same location. Supervisors then dispatch the teams from the field after successful completion of sampled households by each team.

6) Quality Check

Supervisors have to submit accomplished survey forms to Quality Assurance team for checking, in case of discrepancies and incomplete forms were rejected and referred to Tail Team for re-survey. Each surveyor was instructed to take mobile/ or home phone number of the interviewed household; because in case of any member missing information it could be later pursued by the Tail Team over the phone for recovery of data.

7) Tail Team

Tail Team to verify the missing information of the survey forms by dedicated Phone-Calls in the evening time; when most of the respondents were likely to be at home. In case of incompletion, tail team had to re-survey the rejected samples, to complete sample size for that zone.

1.3.5 Data Processing

Data from complete coded survey forms were entered in excel format by the following procedures:

(i) Editing:

Accomplished survey forms were checked again and corrected by editors, where possible.

(ii) Coding:

Coding was divided into two categories, basic coding for all fields and special coding for O/D Zones;

a) Basic Coding

Basic coding was done for the HIS form except, addresses;

b) Zone Coding

Selecting a zone code for different addresses itself was a very laborious task and depended on the understanding and familiarity of a person with the Study Area. Selected HIS Surveyors and Supervisors were recruited for this assignment. They were given special training provided with mapping and GIS System to assist with zone coding.

(iii) Encoding:

a) Software Development

Data Entry software was specifically developed for encoding of HIS data due to large volume. This was to minimize data entry discrepancies, and perform range and logic checks simultaneously. All possible logic checks were applied at this stage of data processing which limited the entry of incorrect information into the database.

(iv) Data Check:

a) Printing and Manual Checking

Completed sample data of each survey zone was printed and 10 % was checked by different supervisors for verification against original survey forms.

b) Complete Data Check and Data Merging

Each Data File was checked by a specially developed program to check the integrity of complete data set of a sample zone. Completely checked data files were then merged using a specially developed program to form the HIS database without introducing further errors.

Volume-II – Chapter-2

TRANSPORT DEMAND FORECAST

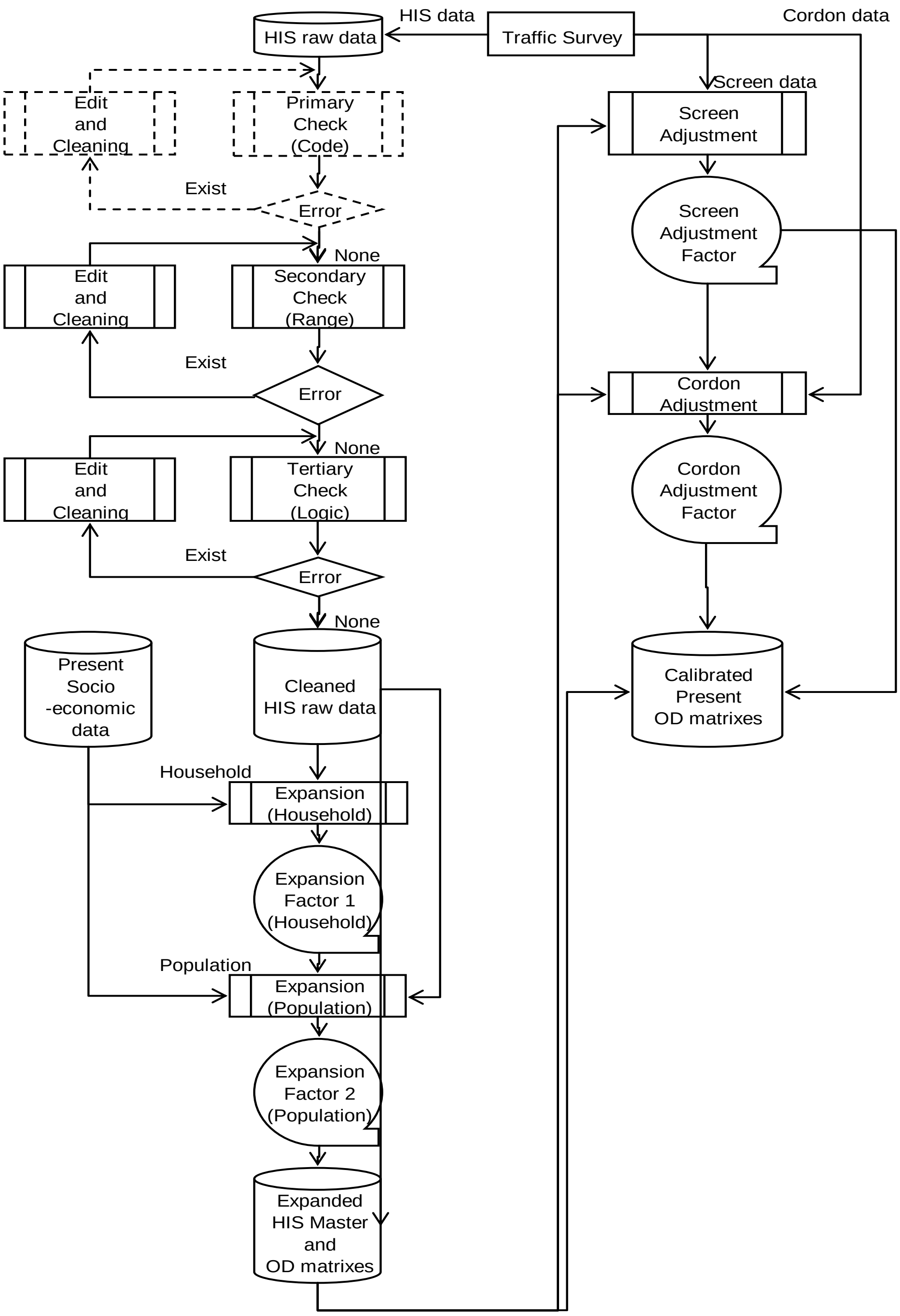
FINAL REPORT

2. TRANSPORT DEMAND FORECAST

2.1 Preparation of Present (2010) O/D Trip Matrices

The master file of HIS and present O/D (Origin/ Destination) trip matrices are prepared, and validated based on a series of transport/traffic surveys. The process is complex and iterative. The complete process and the use of various transport and traffic surveys at various stages of the trip matrices development is given in Figure 2.1.1.

Figure 2.1.1 Procedure of Creating Present OD Matrices



Source: JICA Study Team

2.2 Study Area Zone System

The basis of any transport model development for travel demand analysis and forecast is the division of the Study Area in to homogenous sub-areas, collectively called a Zone System. The travel patterns are then represented as travel within or between zones. The size of zones usually determines the level of detail and accuracy of demand analysis/ forecasts. However, it is constrained by the level of accuracy of planning data and network detail available for each zone. Therefore a compromise is reached on how many traffic zones the Study Area could be divided into, to be able to achieve the demand forecast accuracy for the desired level of detail for the Study. The Study Area was divided into 228 internal zones, boundaries of which were mostly based on the Union Councils in each Town, Tehsil and District. In addition special areas such as bus and freight termini, railway stations and airport were given special zone numbers (229-290). The rest of the world outside the Study Area is given external zones 291-320.The structure of LUTMP zone system has three main categories of zones; Internal Zones, Special Generator Zones and External Zones.

2.2.1 Internal Zones

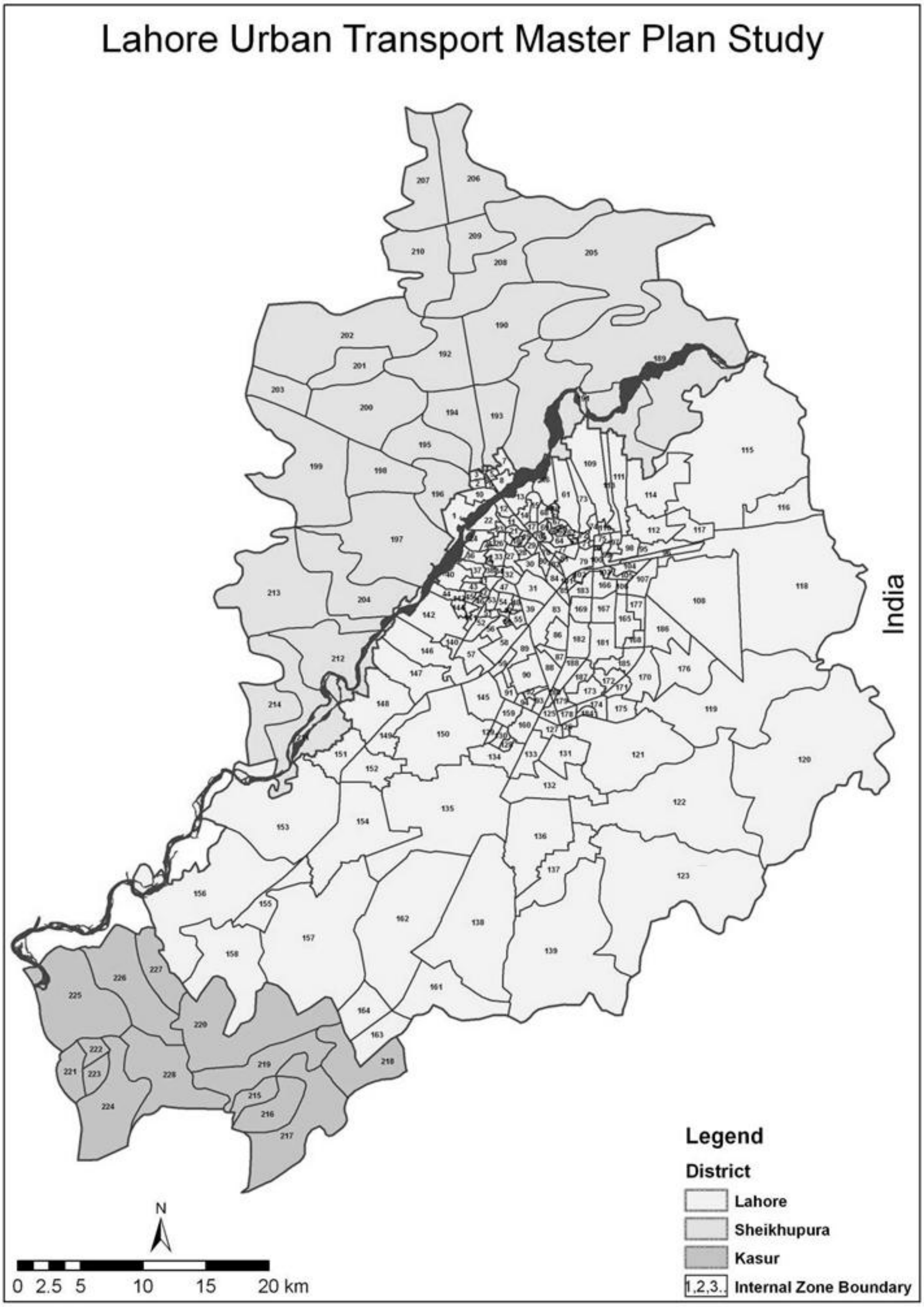
Zones inside the Study Area are termed as Internal Zones. Lahore district has a total of 188 zones. Parts of Sheikhupura and Kasur Districts areas included in the Study have 26, and 14 zones respectively. Internal Zones are shown in Figure 2.2.1. Summary of internal zones is given in Table 2.2.1 and complete description of zone system is presented in **Annex-I**, **Volume-II**.

Table 2.2.1 The Study Area - Internal Zones

No	District	Tehsil	Town	No of Zones
1	**Lahore (188)**	**Lahore City (164)**	Ravi	21
2			Data Gunj Baksh	18
3			Samanabad	20
4			Shalamar	17
5			Gulberg	18
6			Aziz Bhatti	14
7			Wagah	12
8			Nishtar	19
9			Iqbal	25
10		Cantonment	Cantonment	24
11	**Sheikhupura (26)**	Ferozewala	Ferozewala	16
12		Muridke	Muridke	6
13		Sharaqpur Sharif	Sharaqpur Sharif	4
14	**Kasur (14)**	Kasur	Kasur	6
15		Pattoki	Pattoki	8
1-15	**The Study Area**	**All**	**All**	**228**

Source: JICA Study Team

Figure 2.2.1 The Study Area Internal Zone System



Source: JICA Study Team

2.2.2 Special Generator Zones

Zones which have facilities for mode change are termed as Special Generator Zones like bus termini, airport, railway stations, and truck terminals. The Study Area has 62 Special Generator zones, as summarized below by the type of activity:

a) 1 Airport – Domestic Pax

b) 10 Intercity and Intra-city Bus Termini;

c) 25 Railway Stations

d) 10 Freight Terminals

e) 16 Other current and proposed future facilities.

2.2.3 External Zones

Zones outside the Study Area are termed as External Zones. External zones are defined to capture people's travel to and from the Study Area. Areas adjacent to the Study Area are aggregated into expanding level of detail according to the distance from the Study Area, zone size of areas nearby are kept small, while areas father away are aggregated. There are 30 external zones, including one representing international travel by air. A complete list is given in Annex-I, Volume-II.

2.3 Transport Demand Models

2.3.1 Introduction

LUTMP master plan study required a strategic travel demand model capable of forecasting implications of changes in future socio-economic framework, and to determine an optimal/ near optimal transport network which best serves the city's travel demand. A well used and internationally acceptable approach of using conventional 4-stage model was adopted. CUBE software package is a well known, state-of-the-art and internationally acclaimed was used to calibrate, develop and apply the demand forecast models. The remaining parts of this section document the components of the LUTMP travel demand model and broad forecast results.

2.3.2 Trip Production/ Generations Models

Household by Vehicle Ownership Category

This step of the four stage model aims to estimate the total travel demand (by all modes) by the Study Area zone, by household category and trip purpose. For this estimation trip rates are estimated from HIS for each category of household by trip purpose. For this purpose household were divided into three main categories: No-vehicle or Bicycle, Motorcycle and car owning household. Household having multiple motorcycles are included in the motorcycle category, and those owing mixture of motorcycle(s) and car(s) are included in the car category. As there were insufficient number of households with just bicycles, and their income levels and other characteristics were analyzed, and found to be similar to the households owning no-vehicles these were therefore included in the No-vehicle owning category of household.

Trip Purpose Category

A number of trip purposes were observed and analysed and later aggregated to a level of detail which could be statistically significant to calibrate the models. For the final demand analysis only four trip purposes were adopted: to-work, to-school, to-home and all the remainder in 'Other' category

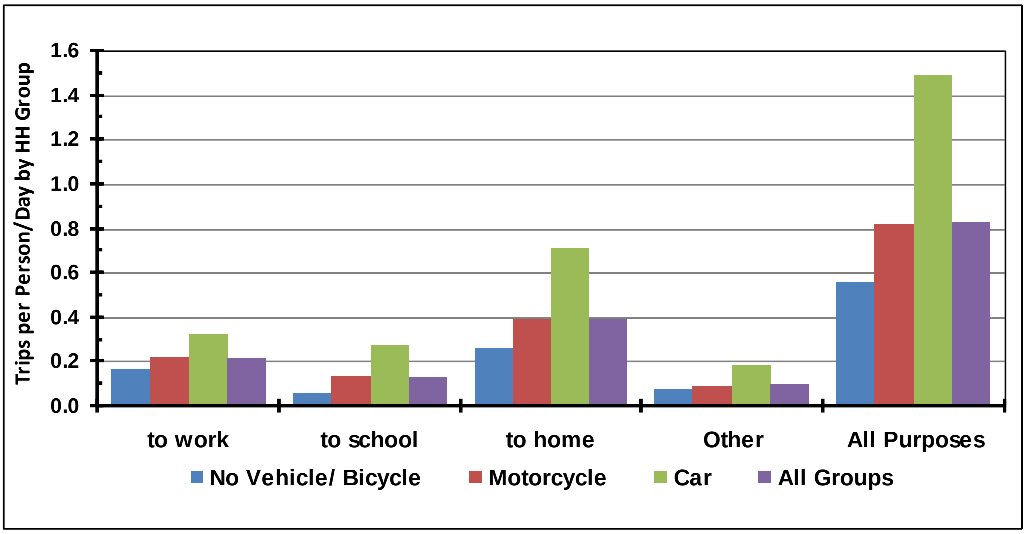
Trip production rates generally increase with vehicle ownership category, and differ by trip purpose. The estimated trip rates by household vehicle ownership category and trip purpose are give in Table 2.3.1 and compared in Figure 2.3.1.

Table 2.3.1 Person Trip Rates by Household Vehicle Ownership Group and by Trip Purpose, 2010

Household Vehicle Ownership Group	Trip Purpose				
	To-Work	To-School	To-Home	Other	All Purposes
No Vehicle/ Bicycle	0.163	0.058	0.259	0.071	0.552
Motorcycle	0.219	0.129	0.390	0.085	0.823
Car	0.323	0.273	0.714	0.182	1.492
All Groups	0.214	0.124	0.391	0.095	0.824

Source: JICA Study Team

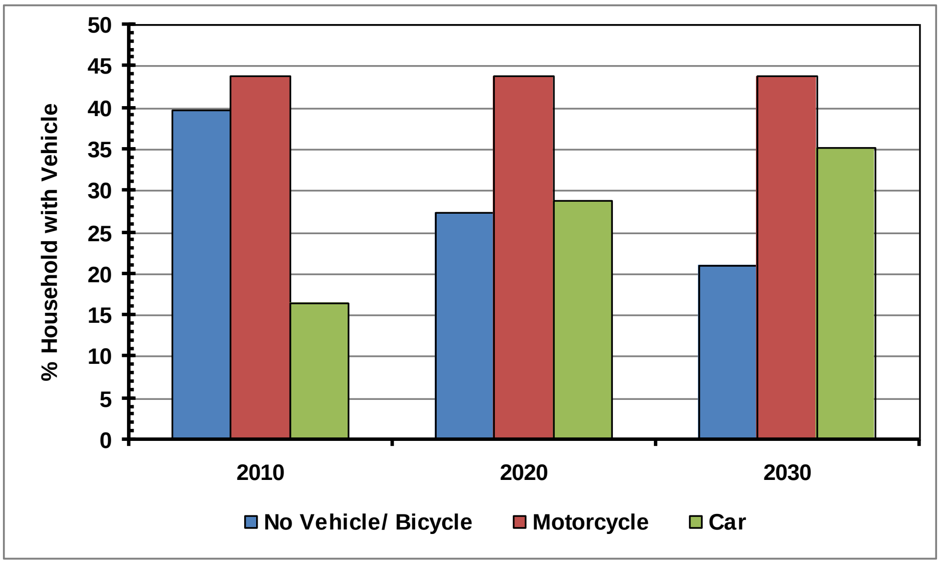
Figure 2.3.1 Person Trip Rates by Household Vehicle Ownership Group, and by Trip Purpose, 2010



Source: JICA Study Team

In future the car ownership is forecast to grow from 18 % in 2010 to 29 % and 43 % by 2020 and 2030, respectively. This is detailed in Socio-economic framework chapter. Share of motorcycle ownership is forecast to remain at almost similar levels as at present. Judging from the current correlation between household income and motorcycle ownership it can be seen that as the household incomes goes above certain threshold, then the households move from motorcycle ownership to car ownership. Therefore the forecast, that the proportion of motorcycle owning households in the Study Area would be similar to that in 2010. These trends are illustrated in Figure 2.3.2.

Figure 2.3.2 Forecast Changes in Household Vehicle Ownership



Note; The Values for 2020 and 2030 represent development Scenarios-2 and are similar to those for Scenarios 1 and 3, as at the Study Area level the population and income growth is same between all three scenarios.
Source: JICA Study Team

The zonal trip productions/ generations are estimated using separate equations for each household group and trip purpose using statistically significant independent variables, and then are controlled to zonal level control using aggregate zonal equations. The individual and zonal control total equations are calibrated using 2010 trips and using only statistically significant independent variables. These trip production equations are given Table 2.3.2. There is one equation for each the 12 household vehicle ownership category and trip purpose.

The observed and modelled numbers of trips by each household vehicle ownership group and by trip purpose are compared in Table 2.3.3. The table reflects the errors in modelling, in most cases it is under 5%. In the forecast process the ratios of modelled to observed was carried forward as calibration factors in order to minimise error of over estimation of trips by each household group for each trip purpose. These trip control totals represent trips made by the Study Area residents within the Study Area. Trips made between the Study Area and the outside world is estimated separately and are not included here, and detailed elsewhere, under External Trip Models.

Table 2.3.2 Calibrated Trip Production/ Generation Models

Purpose	Regression	Ownership	Variable	Coeffcient	t-value	R^2
Home to Work	by Each Group	CAR	Night Time Car Owning Workers	1.1138	28.7	0.78
		Motorcycle	Night Time M/Cycle Owning Workers	0.8141	38.6	0.87
		None/ Bicycle	Night Time No-Veh Owning Workers	0.5823	22.0	0.68
	Zonal Aggregate	CAR	Night Time Car Owning Workers	1.0287	7.5	0.84
		Motorcycle	Night Time M/Cycle Owning Workers	0.9964	9.0	
		None/ Bicycle	Night Time No-Veh Owning Workers	0.4253	3.9	
Home to School	by Each Group	CAR	Night Time Car Owning Students	2.3450	31.6	0.81
		M/Cycle	Night Time M/Cycle Owning Students	1.3843	33.6	0.83
		None/ Bicycle	Night TimeNo-Veh Owning Students	0.6710	13.7	0.45
	Zonal Aggregate	CAR	Night Time Car Owning Students	2.2686	12.2	0.84
		Motorcycle	Night Time M/Cycle Owning Students	1.2310	6.2	
		None/ Bicycle	Night Time No-Veh Owning Students	1.0586	4.4	
Return to Home	by Each Group	CAR	Students Day Time - Total	0.6081	10.7	0.78
			Employment Day Time - Total	0.3372	13.0	
		Motorcycle	Students Day Time - Total	0.4898	11.4	0.92
			Employment Day Time - Total	0.5639	28.8	
		None/ Bicycle	Students Day Time - Total	0.0651	1.9	0.82
			Employment Day Time - Total	0.3624	23.2	
	Zonal Aggregate	ALL	Students Day Time - Total	1.1629	11.9	0.92
			Employment Day Time - Total	1.2635	28.4	
Other	by each Group	CAR	Night Time Car Owning Population	0.1629	17.0	0.56
		Motorcycle	Night Time M/Cycle Owning Population	0.0818	29.7	0.80
		None/ Bicycle	Night Time No-Veh Owning Population	0.0616	12.0	0.39
	Zonal Aggregate	CAR	Night Time Car Owning Population	0.1946	7.5	0.67
		Motorcycle	Night Time M/Cycle Owning Population	0.0784	3.7	
		None/ Bicycle	Night Time No-Veh Owning Population	0.0621	3.1	

Source: JICA Study Team

Table 2.3.3 2010 Observed and Modelled Trips by Household Group and by Trip Purpose

Purpose	Ownership	Observed	Modelled	M/O
Home to Work	CAR	525,900	493,200	0.94
	Motorcycle	951,600	979,800	1.03
	None/ Bicycle	646,200	613,900	0.95
	Total	2,123,700	2,086,900	0.98
Home to School	CAR	444,600	407,700	0.92
	M/Cycle	558,000	555,500	1.00
	None/ Bicycle	230,800	218,200	0.95
	Total	1,233,400	1,181,400	0.96
Return to Home	CAR	1,162,800	1,432,400	1.23
	M/Cycle	1,694,800	1,944,600	1.15
	None/ Bicycle	1,024,500	1,036,200	1.01
	Total	3,882,100	4,413,200	1.14
Other	CAR	296,400	285,800	0.96
	Motorcycle	368,100	366,800	1.00
	None/ Bicycle	281,700	250,200	0.89
	Total	946,200	902,800	0.95
All Purposes	CAR	2,429,700	2,619,100	1.08
	Motorcycle	3,572,500	3,846,700	1.08
	None/ Bicycle	2,183,200	2,118,500	0.97
	Total	8,185,400	8,584,300	1.05

Source: JICA Study Team

2.3.3 Trip Attractions

Zonal trip attraction models are even more complex to calibrate. In case of Lahore no land use data in the form of employment by category (primary, secondary and tertiary or by Industrial classification), school places data or other similar variables, like industrial / shopping floor space is available. Therefore, day/ night population from HIS as a proxy for above variables was estimated to derive trip attraction rates. These rates were used to estimate to get trip attractions by zone and then these totals are controlled to Trip productions estimated above. The trip attraction models are summarised below in Table 2.3.4.

Table 2.3.4 Trip Attraction Model Calibration

Purpose	Regression	Ownership	Variable	Coeffcient	t-value	R^2
Home to Work	for each Group	CAR	Employment Day	0.27390	24.7	0.73
		Motorcycle	Employment Day	0.44561	41.7	0.88
		None/ Bicycle	Employment Day	0.24567	32.9	0.83
	Aggregate	All	Employment Day	0.96519	45.1	0.90
Home to School	for each Group	CAR	Student Day	0.54393	28.6	0.78
		Motorcycle	Student Day	0.54555	40.7	0.88
		None/ Bicycle	Student Day	0.18142	16.8	0.56
	Aggregate	ALL	Student Day	1.27090	43.5	0.89
Return to Home	for each Group	CAR	Population Night	0.11035	13.4	0.44
		Motorcycle	Population Night	0.17237	30.0	0.80
		None/ Bicycle	Population Night	0.09996	14.8	0.49
	Aggregate	ALL	Population Night	0.38269	30.6	0.80
Other	for each Group	CAR	Employment Day	0.12026	21.5	0.67
		Motorcycle	Employment Day	0.13744	34.3	0.84
		None/ Bicycle	Employment Day	0.08711	11.7	0.38
	Aggregate	ALL	Employment Day	0.34481	28.6	0.78

Source: JICA Study Team

As the zonal trips are controlled to trip production, the lower accuracy of trip attraction models does not affect the over demand levels.

2.3.4 Trip Distribution Models

Twelve doubly constrained Gravity Models were calibrated, one for each of the three household vehicle ownership groups, and by for four trip purposes. The general form of the model may be described as:

$T_{ij} = a_i * b_j * \boldsymbol{\alpha} * EXP(-\boldsymbol{\beta}*(C_{ij}))$; where:

Tij = trips between Zone i and Zone j;
Cij= Generalised cost of travel between Zone i and Zone j;
α & β is the calibrated parameter; Separate **β** values were calibrated for Inter-zonal trips i.e. Tij for i#j and for Intra-zonal trips i.e. for all i=j.

ai & bj are the balancing factors estimated through iterative process, with the following constraints:

i) ΣTij = Gi (sum overall j; and ii) ΣTij = Aj (sum over all i); and Gi and Aj are production and attractions estimated at trip production and attraction stage of the models.

Table 2.3.5 details the model calibration parameters and simplified comparisons of observed and modeled values.

Table 2.3.5 Gravity Model Calibrated Parameters by Household Group and by Trip Purpose

Trip Purpose	Household Vehicle Ownership Group	Intra-zonal Trips I=j		Inter-zonal Trips (i#j)	Av. Trip Length (km)	
		α	β	β	Observed	Modelled
To Work	No Vehicle + Bicycle	5.6	0.026	0.015	14.3	14.3
	Motorcycle	5.2	0.035	0.006	10.5	10.3
	Car	7.8	0.0060	0.004	14.4	14.2
To School	No Vehicle + Bicycle	3.3	0.052	0.003	9.9	9.9
	Motorcycle	4.2	0.058	0.003	7.6	7.5
	Car	6.4	0.0192	0.012	10.2	10.2
To Home	No Vehicle + Bicycle	7.6	0.032	0.022	14.1	14.2
	Motorcycle	5.8	0.040	0.007	9.5	9.2
	Car	9.5	0.0080	0.007	13.3	13.0
Other	No Vehicle + Bicycle	5.5	0.026	0.030	17.4	17.1
	Motorcycle	6.0	0.035	0.006	10.3	9.8
	Car	9.0	0.0055	0.007	15.4	15.1

Source: JICA Study Team

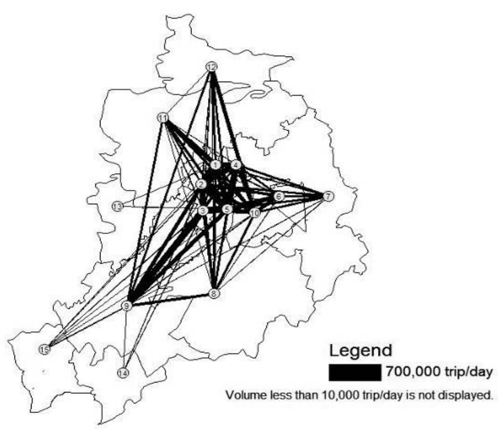
Table 2.3.6 Forecast Average Trip Length by Trip Purpose

Trip Purpose	Trip Length (km)(2010 Network)						
	2010	2020 Scenario 1	2030 Scenario 1	2020 Scenario 2	2030 Scenario 2	2020 Scenario 3	2030 Scenario 3
To Work	11.8	12.8	13.5	13.0	13.9	14.6	14.5
To School	8.4	9.1	8.3	10.0	8.6	9.3	7.6
To Home	10.6	11.4	11.8	11.8	12.1	12.9	12.8
Other	13.5	13.9	13.8	13.9	14.2	15.0	15.7

Source: JICA Study Team

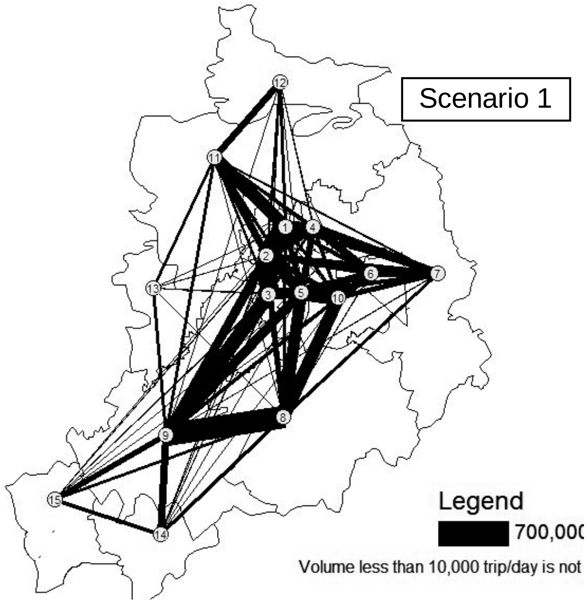
Figures 2.3.3, 2.3.4 and 2.3.5 show estimated trip distribution patterns for total trips for 2010, 2020 and 2030 for all three scenarios. Although the pattern of trip distribution seems similar among urban development scenarios, the details show considerable changes, e.g. by trip purpose and by traffic zone pair.

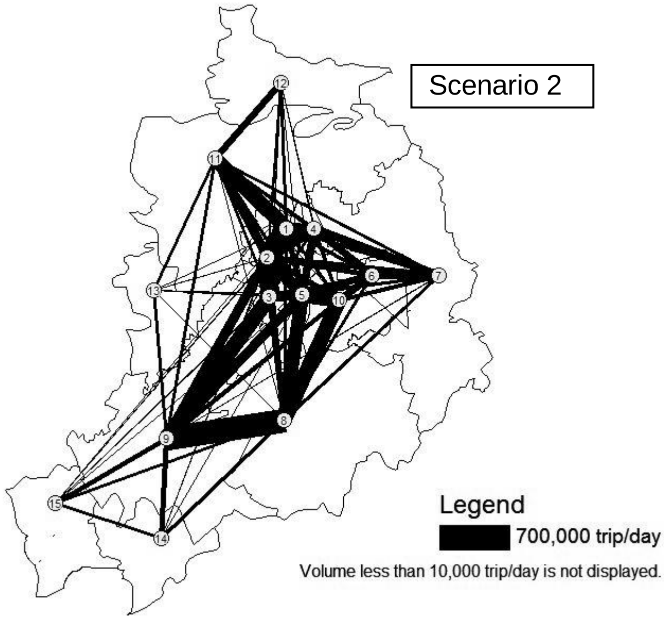
Figure 2.3.3 Trip Distribution, All Purpose, 2010

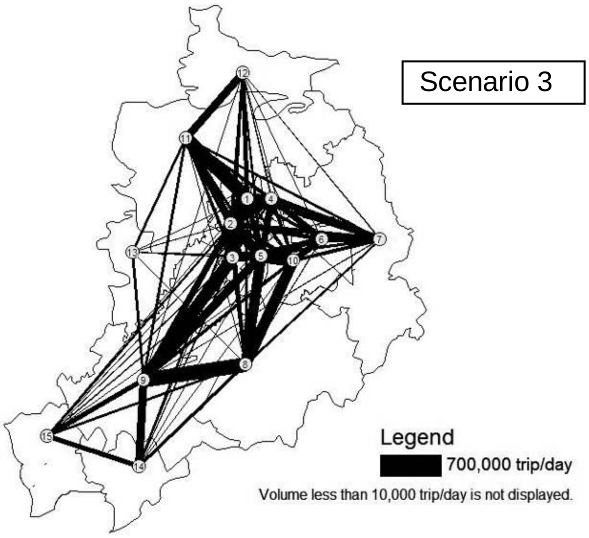


Source: JICA Study Team

Figure 2.3.4 Trip Distribution, All Purpose, 2020

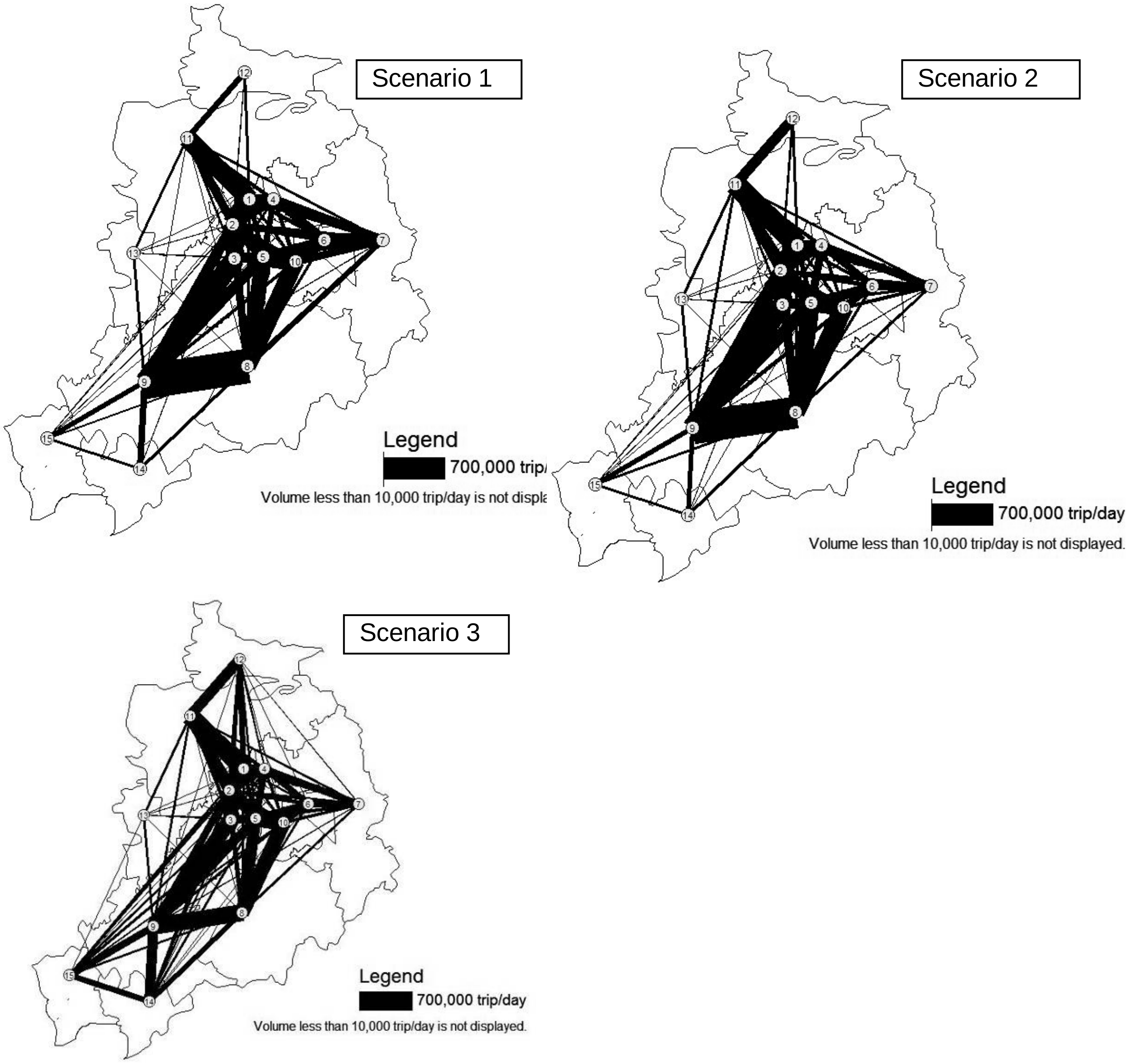






Source: JICA Study Team

Figure 2.3.5 Trip Distribution, All Purpose, 2030



Source: JICA Study Team

2.3.5 Modal Split Models

Modal split models were developed and calibrated for each of the three household vehicle ownership groups, i.e. No vehicle/ bicycle, motorcycle and car ownership for all trip purposes combined and for Inter-zonal trips only. It should be noted that at this stage of the modelling all intra-zonal trips are removed and only Inter-zonal trips are subjected to mode-choice models. Walk trips have been extracted at the outset. These are dealt with in separate walk model and are no longer part of the general modal split models.

1) Modal Split Models for Trips by Households with No Vehicle/ Bicycle

Regression models were developed for this group to extract trips by (travel mode) Bicycle, Motorcycle, and Car. These trips were then subtracted from the total trips, and remainder trips are deemed to use public transport (i.e. Bus or paratransit modes like Rickshaws/ Qingqi). Model developed, calibrated and used were based on distance travelled between zone i and j. (i.e. Dij)

a) % Share of Bicycle Trips = 0.23 – 0.0559 Ln(Dij) (R^2=0.70)
b) % Share of Motorcycle Trips = 0.127 – 0.0287 Ln(Dij) (R^2=0.60)
c) % Share of Car Trips = 0.144 – 0.0372 Ln(Dij) (R^2=0.40)
d) Bus Share is the remainder of the trips in the trip matrix after extraction of above three modes. Split between bus and paratransit is carried out in the trip assignment model.

All three models (a, b and c) may not appear statistically very strong, but in all cases the sign of the constants and coefficients are sensible, and do show that as the distance increases the % trips decreases by that mode. Table 2.3.7 below presents the calibration results and trips for 2020 and 2030 Scenario 2.

Table 2.3.7 Non-Vehicle/ Bicycle Owning Household Modal Split Model Calibration Results

Trip Type	No-vehicle/ Bicycle Owning Household Trips by Mode of Travel				
	Bicycle	Motorcycle	Car	Bus and Para	Total
Observed (Inter+Intra) Zonal	279,000	129,200	49,200	1,725,800	2,183,200
Observed Intra-zonal	114,000	32,500	6,600	249,100	402,200
Observed Inter-zonal	**165,000**	**96,700**	**42,600**	**1,476,700**	**1,781,000**
Observed % by Mode Share	***9.3***	***5.4***	***2.4***	***82.9***	***100.***
Modelled Inter-Zonal	**177,100**	**107,800**	**31,400**	**1,465,300**	**1,781,600**
Modelled % by Mode Share	***9.9***	***6.0***	***1.8***	***82.3***	***100.***
Trips (Modelled– Observed)	**+13,100**	**+11,100**	**-11,200**	**-7,400**	**0.**
% Difference	+7.9	+11,.4	-26.3	-0.5	0.

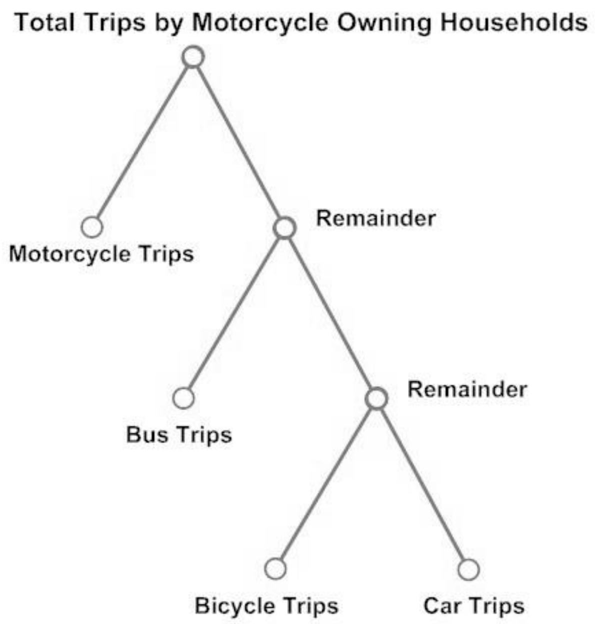
Source: JICA Study Team

It can be seen that model performs well for the Bus/ Para share, which is by far the largest share. Hence the model was considered to be suitable for use in the forecast years. In case of modes other than bus are relatively very small, and as compared with the observed (rather ‘lumpy’) matrices, it would be very difficult to get better calibration results.

2) Modal Split Models for Trips for Motorcycle Owning Households

In the case of Motorcycle owing households the situation is more complex, and the cost of travel by alternative mode affects the mode choice. Therefore, a hierarchical logit mode choice model was developed. Note that the mode choice at each stage is based on the relative generalised cost differences between the selected mode and the difference of the next mode of choice in the hierarchy. The general form of the logit model is schematically shown in Figure 2.3.7.

Figure 2.3.6 Structure of Hierarchical Logit Model (Motorcycle Owning Households)



Source: JICA Study Team

The calibrated parameters are tabulated below, and in all cases the 't' statistics for both parameters were statistically significant.

Motorcycle Owning Household Hierarchical Logit Mode Choice Models

Mode Choice Extracted	Remainder	Constant	Coefficient
Motorcycle Trips	Bus+Bicycle+Car	-0.4437	0.6546
Bus Trips	Bicycle+Car	-1.3383	0.4985
Bicycle Trips	Car as remainder	-0.6639	-0.8158

Table 2.3.8 Motorcycle Owning Household Modal Split Model Calibration Results

Trip Type	Motorcycle Owning Household Trips by Mode of Travel				
	Bicycle	Motorcycle	Car	Bus and Para	Total
Observed (Inter+Intra) Zonal	172,600	2,190,000	93,400	1,116,400	3,572,400
Observed Intra-zonal	74,800	473,300	15,100	174,500	737,700
Observed Inter-zonal	**97,800**	**1,716,700**	**78,300**	**941,900**	**2,834,700**
Observed % by Mode Share	***3.5***	***60.5***	***2.7***	***33.3***	***100.***
Modelled Inter-Zonal	**96,100**	**1,716,900**	**75,100**	**946,600**	**2,834,700**
Modelled % by Mode Share	***3.4***	***60.6***	***2.6***	***33.4***	***100.***
Trips (Modelled – Observed)	**-1,100**	**+200**	**-3,200**	**+4,100**	**0.**
% Difference	-1.1%	0.0%	-4.1%	4.4%	0.

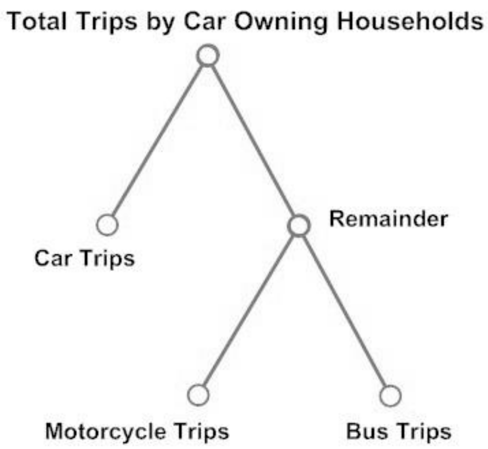
Source: JICA Study Team

Table 2.3.8 demonstrates that the synthesised models perform well and reproduces the observed models almost exactly. In cases, where there is larger % difference, the absolute number of trips is small.

3) Modal Split Models for Car Owning Household Trips

Car owing households generally tend to travel by car and make maximum use of their investment in vehicle. The usage of car is also higher as occupancy can be higher than motorcycle. Therefore the number of trips made by modes other than car, by car owning households tends to be small. Here it should be noted that if a household owns one or more cars, or one or more motorcycles as well, such household is treated as a car owning household. The trips made by motorcycle may be using the motorcycle the household owns. Therefore, same as for motorcycle owing households a hierarchical logit mode choice model was developed. However, in this case the choice of Bicycle was so small that it was considered as not a realist choice of mode by the Car Owning household, with the exception of few leisure trips on Sunday afternoon! Note that the mode choice at each stage is based on the relative generalised cost differences between the selected mode and the next choice of mode of the remaining modes in the hierarchy. The general form of the logit model is schematically shown in Figure 2.3.8.

Figure 2.3.7 Structure of Hierarchical Logit Model (Car Owning Households)



Source: JICA Study Team

The calibrated parameters are tabulated below, and in all cases the 't' statistics for both parameters were statistically significant. Modal calibration results are summarized in Table 2.3.9.

Car Owning Household Hierarchical Logit Mode Choice Models

Mode Choice Extracted	Remainder	Constant	Coefficient
Car Trips	Motorcycle + Bus	0.0973	-0.3157
Motorcycle Trips	Bus as remainder	-0.0200	1.0365

Table 2.3.9 Car Owning Household Modal Split Model Calibration Results

Trip Type	Car Owning Household Trips by Mode of Travel				
	Bicycle	Motorcycle	Car	Bus and Para	Total
Observed (Inter+Intra) Zonal	31,500	538,100	1,397,900	462,100	2,429,600
Observed Intra-zonal	15,200	99,900	140,300	71,700	327,100
Observed Inter-zonal	**16,300**	**438,200**	**1,257,600**	**390,400**	**2,102,500**
Observed % by Mode Share	***0.8***	***20.8***	***59.8***	***18.6***	***100.***
Modelled Inter-Zonal	**Add to bus**	**438,300**	**1,257,600**	**406,600**	**2,102,500**
Modelled % by Mode Share	***n/a***	***20.8***	***59.8***	***19.3***	***99.9.***
Trips (Modelled – Observed)	**n/a**	**+100**	**0**	**+16,200**	**0.**
% Difference	n/a	0.0%	0.0%	4.1%	0.

Source: JICA Study Team

It can be seen that model fits well and reproduces the observed models almost exactly. In cases, where there is somewhat larger % difference, the absolute number of trips is small.

The result of model application is shown in Tables2.3.10, 2.3.11 and 2.3.12 for 2010, 2020 and 2030, respectively.

Table 2.3.10 Modelled Number of Trips by Mode ('000) and Mode Share, 2010

Mode of Travel	Inter-Zonal Trips by Household Vehicle Ownership Group				
	No Vehicle / Bicycle	M/cycle	Car	Total Trips	Mode Share
Bicycle	177,100	96,100	0	273,200	4.1%
Motorcycle	107,800	1,716,900	438,300	2,263,000	33.7%
Car	31,400	75,100	1,257,600	1,364,100	20.3%
Bus and Para transit	1,465,300	946,000	406,600	2,817,900	41.9%
Total	**1781,600**	**2,2834,700**	**2,102,500**	**6,718,200**	**100.%**

Source: JICA Study Team

Table 2.3.11 Modelled Number of Trips by Mode ('000) and Mode Share, 2020

Mode of Travel	2010		Inter-zonal Trips by Development Scenario, 2020					
			Scenario-I		Scenario-II		Scenario-III	
	Total Trips	Mode Share	Total Trips	Mode Share	Total Trips	Mode Share	Total Trips	Mode Share
Bicycle	273,200	4.1 %	239,600	2.4 %	239,700	2.4 %	233,000	2.3 %
Motorcycle	2,263,000	33.7 %	3,133,000	31.9 %	3,126,500	31.6 %	3,147,500	31.1 %
Car	1,364,100	20.3 %	3,032,700	30.9 %	3,074,400	31.1 %	3,259,200	32.2 %
Bus and Paratransit	2,817,900	41.9 %	3,415,000	34.8 %	3,455,600	34.9 %	3,474,500	34.4 %
Total	**6,718,200**	**100. %**	**9,820,300**	**100. %**	**9,896,200**	**100. %**	**10,114,200**	**100. %**

Source: JICA Study Team

Table 2.3.12 Modelled Number of Trips by Mode (‘000) and Mode Share, 2030

Mode of Travel	2010		Inter-Zonal Trips by Development Scenario, 2030					
			Scenario-I		Scenario-II		Scenario-III	
	Total Trips	Mode Share	Total Trips	Mode Share	Total Trips	Mode Share	Total Trips	Mode Share
Bicycle	273,200	4.1 %	188,600	1.3 %	184,200	1.3 %	192,600	1.4 %
Motorcycle	2,263,000	33.7 %	3,860,300	27.5 %	3,886,700	27.0 %	3,595,700	25.8 %
Car	1,364,100	20.3 %	6,162,700	43.9 %	6,478,800	45.0 %	6,583,600	47.2 %
Bus and Para transit	2,817,900	41.9 %	3,833,300	27.3 %	3,847,500	26.7 %	3,580,800	25.7 %
Total	**6,718,200**	**100. %**	**14,044,900**	**100. %**	**14,397,200**	**100. %**	**13,952,700**	**100. %**

Source: JICA Study Team

It can be seen that in do-nothing scenario the mode share of bicycle would decline by a percentage point on average under all scenarios to just over 1% by 2030. In other developed cities cycling is encouraged and mode share of cycle is on the increase particularly with increase in the provision of cycle lanes and priority to cyclists at crossroads.

As far motorized trips are concerned, in case of do nothing scenario, the trend shows a declining use of motorcycles and a considerable decline in the share of public transport in favour of car. During scenario development stage these facts will be addressed further.

2.3.6 Walk Trips

The above modelling covered the Study Area mechanized/ motorized mode trips. Walk trips were also observed, recorded, and analyzed. It was noticed that in outer areas there are some exceptionally long walk trips. It was considered that it is impossible for anyone to walk such distances on regular basis. Hence all inter-zonal trips above 10km were deemed to be made by the same mode vehicle as owned by that household owns. In case No-vehicle owning households these trips (105,000) were included in the public transport (Bus/ paratransit) mode, 60,400 trips by motorcycle, and 7,200 trips by Car.

Based on the changes in socio-economic framework from 2010 to 2020 and 2030 the walk trips transferred to motorized mode were forecast. Table 2.3.13 below summarizes the walk trips for 2010 and 2020 and 2030 in Table 2.3.14.

Table 2.3.13 2010 Observed Walk Trips

Description	2010			
HH Group	Total Trips	Intra-Zonal Trips	Inter-zonal Trips	Inter-zonal Trips>10km
No vehicle/ Bicycle	2,012,400	1,673,600	338,800	105,000
Motorcycle	1,528,100	1,250,900	277,200	60,400
Car	286,200	240,400	45,800	7,200
Total	**3,826,700**	**3,164,900**	**661,800**	**172,600**

Source: JICA Study Team

Table 2.3.14 2010 Inter-Zonal Observed Walk Trips and Forecasts for 2020, 2030

HH Group	Observed Walk Trips and Forecast for 2020 and 2030						
	2010	2020 Scenario 1	2030 Scenario 1	2020 Scenario 2	2030 Scenario 2	2020 Scenario 3	2030 Scenario 3
No Vehicle/ Bicycle	338,800	249,200	150,700	252,300	154,100	249,500	160,700
Motorcycle	277,200	295,500	304,700	298,100	304,700	300,000	308,000
Car	45,800	100,500	170,800	102,000	170,800	100,000	163,000
Total	**661,800**	**645,200**	**626,200**	**652,400**	**629,600**	**649,500**	**631,700**

Source: JICA Study Team

2.3.7 External Trips

The above modelling covered internal the Study Area trips – i.e. those trips with both ends in the Study Area zones (1~228). Trips with one or both end outside the Study were modelled using the observed trips (from the LUTMP cordon surveys) as seed. The forecast methodology differed from internal trips. The methodology adopted for the external trip distribution was:

For Internal-to-external and external-to-internal trips 'Fratar' technique was used to get the relative growth in trips in the internal to the Study Area. For external-external (through) trips straight growth factoring based on growth in the Study Area GDP and trip type elasticity was used. The resultant forecast trip totals are shown in Table 2.3.15.

Table 2.3.15 2010 Observed and 2020 and 2030 Forecast External Person Trips

Mode	2010	2020	Growth over 2010	2030	Growth over 2010
M/Cycle	37,100	45,100	21.6 %	45,300	22.1 %
Car	216,900	367,500	69.4 %	575,600	165.4 %
Bus	586,900	647,000	10.2 %	760,100	29.5 %
Total	**840,900**	**1,059,600**	**26.0 %**	**1,381,000**	**64.2 %**

Source: JICA Study Team

2.3.8 Goods Vehicle Trips

All non-passenger carrying vehicles were separately classified. After initial analysis these were aggregated to three groups:

i) Pick-up Trucks – these are open back 2-axle vehicles or closed back delivery trucks, used mostly for small goods delivery and distribution, ambulances, etc

ii) 2 Axle Trucks – this is the most common type of trucks used in Pakistan.

iii) All other Vehicles (these include large trucks, construction vehicles, Tractors, tractor trolleys, other agriculture vehicles, animal drawn carts etc)

It is known to the Study Team that trucks are not allowed on most city roads during the day. However, delivery pick-up vans/ trucks are used mostly during along with animal drawn carts etc. These vehicles are included in the modeling process. Their forecast was dependent on changes in GDP. Demand elasticity was estimated and the forecast was made using the growth in GDP and the demand elasticity. The observed 2010 and forecast number of trips are summarized in Table 2.3.16 below.

Table 2.3.16 2010 Observed and 2020 and 2030 Forecast Goods Vehicle Trips

Vehicle Type	2010	2020	Growth over 2010	2030	Growth over 2010
Pickup	49,600	65,700	32.5 %	71,600	44.4 %
Trucks	44,100	83,400	89.1 %	149,400	238.8 %
Other	58,100	68,000	11.0 %	87,700	50.9 %
Total Vehicles	**152,800**	**217,100**	**42.1 %**	**308,700**	**102.0 %**

Source: JICA Study Team

2.4 Study Area Transport Network

2.4.1 Overall Traffic Assignment

Travel demand matrices from modal split mode, walk model, and external models are aggregated to common unit called Passenger Car Unit (PCU) for highway assignment. Public Trips are directly assigned as person trips to Public Transport network, which in addition to the same highway network as for private mode includes bus/ wagon routes with headways, and the Pakistan Rail network. PT network is assigned first, the person trip volumes on bus routes are converted to Bus PCU's and the remainder paratransit mode passengers are converted to Rickshaw/ Qingqi (paratransit PCU's) modes. These Public mode PCU's are then added to Highway assignment process as pre-loads as the bus routes are fixed, and paratransit loads wherever these are take up road capacity not available to private mode users.

The vehicle occupancy and PCU conversation factors used to convert all trips to PCU's are given below in Table 2.4.1.Vehicle occupancy factors are average of several traffic surveys carried out in the Study Area, whereas the PCU factors are universal, and commonly used. The same factors were also applied for the forecast year assignment models.

Table 2.4.1 Applied Observed and Forecast Goods Vehicle Trips

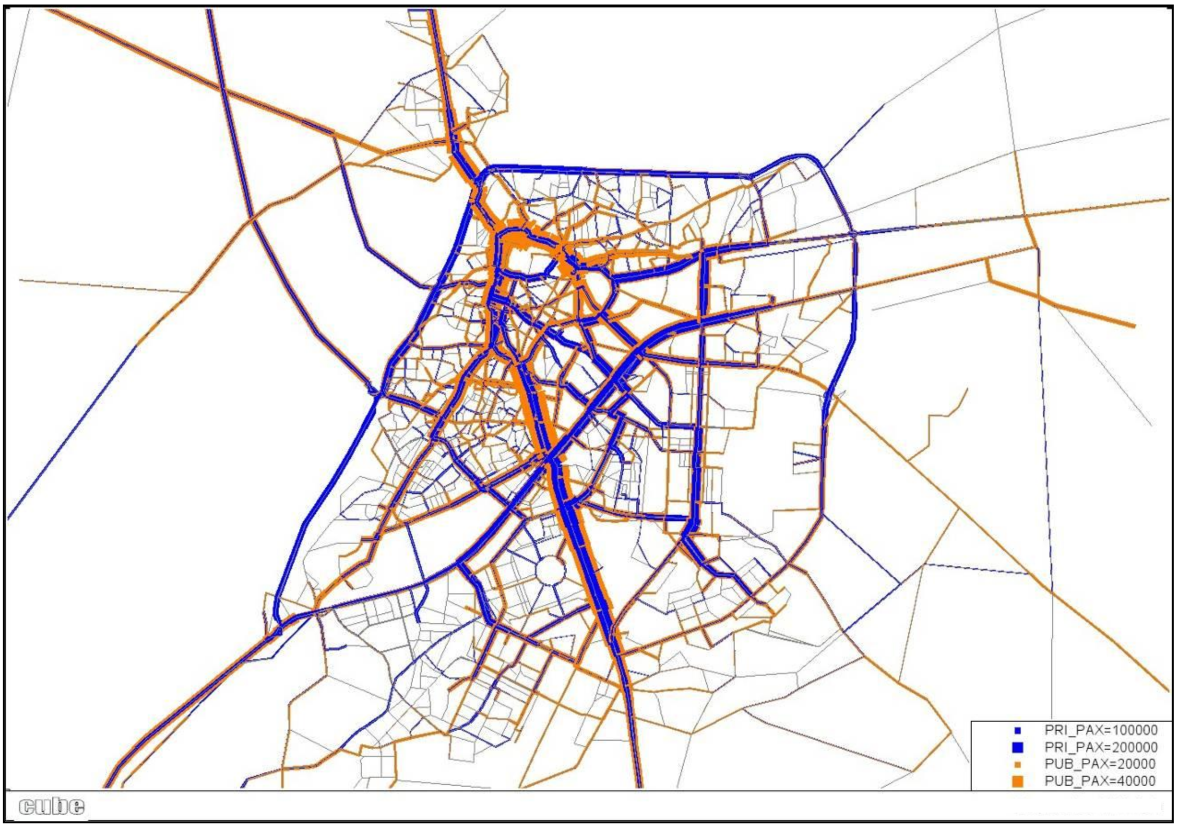
Vehicle	Occupancy	PCU Factor
Bicycle	1.0	0.20
Motorcycle	1.65	0.30
Rickshaw	1.7	0.50
Qingqi	5.0	0.50
Average for Rickshaw and Qingqi	3.28	0.50
Car	2.43	1.00
Wagon	10.5	1.50
Coaster	20.0	1.75
Mini-Bus (Mazda)	35.0	2.00
Bus	50.0	2.50
Articulated Bus (Future)	90.0	3.50
Average Bus	15.58	2.00
Pick-up	1.0	1.25
2 Axle Truck	1.0	2.0
3 Axle Truck	1.0	2.5
Tractor	1.0	3.5
Other Motorized	1.0	3.0
Animal Drawn	1.0	4.5

Source: JICA Study Team

The results are shown in Figures 2.4.1, 2.4.2 and 2.4.3. In these figures the thickness of the line represents the person trips along that section of the road, and colour indicates the mode of travel (Blue: Private – Includes Cycle, motorcycle and car, where as Orange shows public transport i.e. Rickshaw, Qingqi, Wagon Bus and Pakistan Rail). The person trip volumes are well spread out in the Study Area. Busy corridors are obvious, such as Ferozepur road, Canal Bank road, Western section of LRR, GT road, Allama Iqbal road, around the wall city area and the Ravi Bridge. Only limited person travel is notice able on the northern and particularly on eastern section of the LRR.

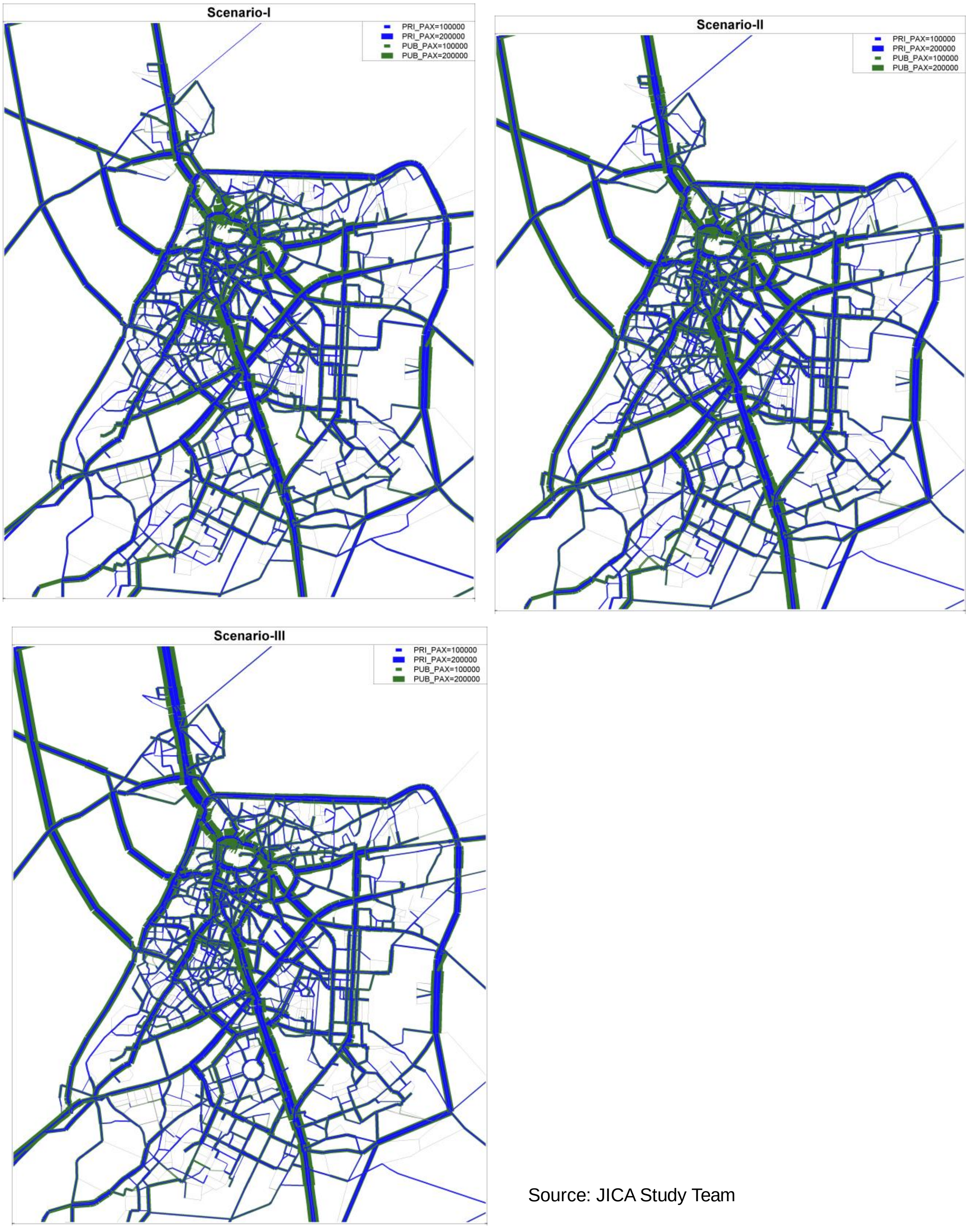
However the pictures changes rather rapidly by 2020 and more dramatically by 2030. The person trips assignment for these forecast years 2020 and 2030 for all three scenarios are presented in Figures 2.4.2 and 2.4.3 respectively. This exercise implies the necessity to take strong countermeasures to enhance the transport network capacity and its systems in Lahore. Further discussion on demand supply analysis is given in Volume 1, Chapter 4.

Figure 2.4.1 2010 Modelled Traffic Assignment – Private and Public Person Trips



Source: JICA Study Team

Figure 2.4.2 2020 Modelled Traffic Assignment – Private and Public Person Trips



Source: JICA Study Team

Figure 2.4.3 2030 Modelled Traffic Assignment – Private and Public Person Trips

Source: JICA Study Team

2.4.2 Demand/ Supply Analysis

The forecast presented in this Chapter detailed the methodology adopted and affects of application of such models on the overall transport demand in 2020 and 2030 under the three development scenarios and same network condition. These forecasts did not take account of supply side development. This was intentional to understand the behaviour of the demand models.

Comparison of demand forecast in terms impact on highway and public transport supply have been discussed in Chapter-4 Volume-1 of this report.

Volume-II – Chapter-3

SUB-SECTOR PLANNING

FINAL REPORT

3 SUB-SECTOR PLANNING

3.1 Road

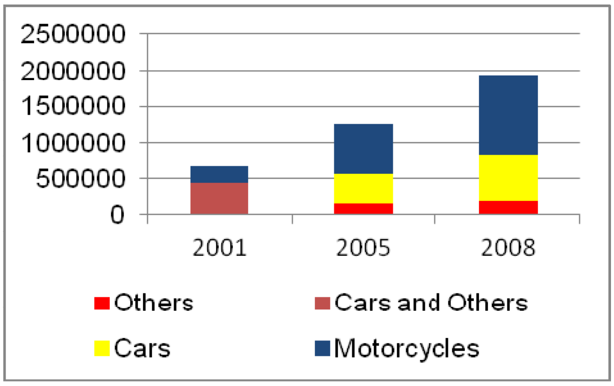
3.1.1 Present Condition of Road Sub-Sector

The overall characteristics of road sector in Lahore are as follows:

1) Motorization

In 2008, 1.95 million motorized vehicles were registered in Lahore. It has become a major transport problem mainly due to rapid motorization. The number of vehicles in Lahore District had increased by 294 % from the one of 2001 to the 2008. The growth is higher than the provincial motorization trend, i.e., 212 % during the same period. Especially, motorcycle had increased by 483 % during the same period.

Figure 3.1.1 Trend in Registered Motorized Vehicles in Lahore District



Source: Punjab Development Statistics

Table 3.1.1 below shows the number of registered vehicles with DRTA, for all districts of Lahore division. Around 1,950,000 vehicles are registered within the Lahore area, to be compared with only 34,000 and 52,000 for Kasur and Sheikhupura. Motorcycles make up for more than half (56 %) of all registered vehicles.

Table 3.1.1 Number of Registered Motor Vehicles ('000) in June 2008

District	Lahore	Kasur	Nankana Sahib	Sheikhupura	Lahore Division Total
Cars, Jeeps and Wagons	638	0	0	4	642
Motorcycles	1,110	6	2	21	1,140
Trucks	16	0	0	1	17
Delivery Vans	40	0	0	0	41
Buses	33	0	0	1	34
Taxis	12	0	0	0	12
Auto-Rickshaws	66	1	0	2	70
Tractors	29	26	0	23	77
Others	1	0	0	0	2
Total	1,945	34	3	52	2,034

Source: Punjab Development Statistics, 2009

Due to such rapid motorization, the number of motorized vehicles per 1,000 residents substantially increased from 95 vehicles in 2001 to 238 vehicles in 2008.

2) Vehicles in the Study Area

Most of Lahore citizen's travel means is dependent on road traffic. The population of the Study Area in 2010 is estimated at about 9.9 million, of which 8.65 million (87 %) are resident in Lahore district. The car ownership is about 350,000 cars, and motorcycle ownership is about 850,000 motorcycles that are 42 % of all households, in total 1.2million vehicles in the Study Area. The classified road vehicles are shown below.

a. Public buses, Large and medium size

b. Mini buses (Delivery Vans), Mini-vans called Wagons

c. Auto Rickshaws, Qingqis (a motorcycle driven Rickshaw)

d. Taxis, and donkey carts

Figure 3.1.2 A Motorcycle Rickshaw - Qingqi

Figure 3.1.3 Donkey Cart

Source: JICA Study Team

3) Urban Road Transport Services

Urban road transport services are mostly based on private transportation. Current conditions are characterized by the dominant presence of motorcycles, increasing number of cars, and decreasing number of bicycles. Public transportation services are provided by Buses (Large/ Medium Size), Mini-vans (Wagon), and Auto Rickshaw. However, their share in urban traffic is low.

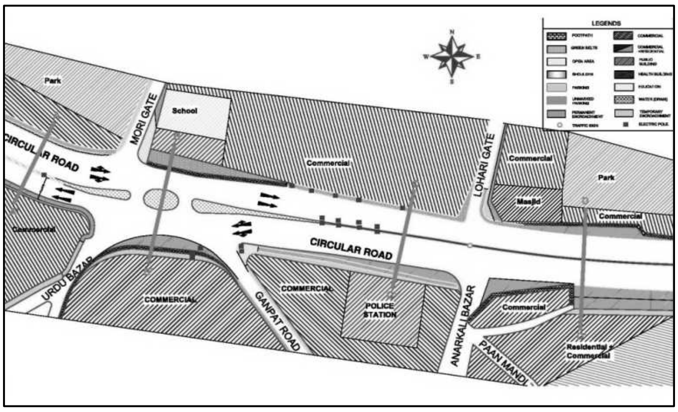
4) Road Intersections/ Junctions

Junctions/ Intersections are very poorly designed and space is not allocated properly to all movements; which results in unnecessary delay for some traffic movements. Street linkages are provided on some of the junction without at any junction priority; this results in cross conflict with main stream movement on junction as shown in Figure 3.1.4. Five streets are directly entering to main flow of traffic; which results in severe traffic congestion and grid locking of traffic in peak periods.

Pre timed traffic signals are installed at 168 (about 64 %) junctions in Lahore out of total 261 with pre-historic timings. Timings for all signalized junctions are same for all time periods which could not accommodate the peak period and special day's traffic flow. All signalized junctions are operating in isolation without any network coordination. There is no provision for safe movement and crossing of pedestrians in midblock locations and at road junctions. Overall, junctions are poorly designed without following safety or geometric design criteria or guidelines.

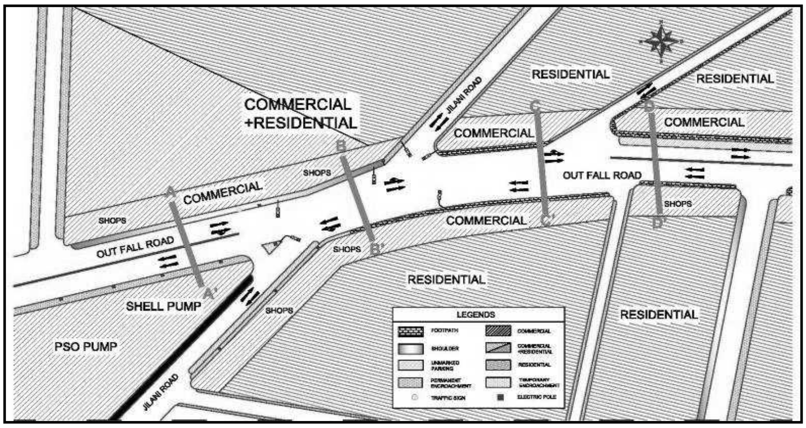
Traffic circulation is provided without any area wide junction study and various (some illegal/ contra-flow) movements are allowed to enter the junction; which creates unexpected and unsafe situation for drivers. Six two way local roads/ streets are entering the junction from all around in Lohari Gate junction as shown in Figure 3.1.4, and poor design of junction on lower bound of Sagging Bridge is shown in Figure 3.1.5.

Figure 3.1.4
Lohari Gate Junction – Poor Junction Design



Source: JICA Study Team

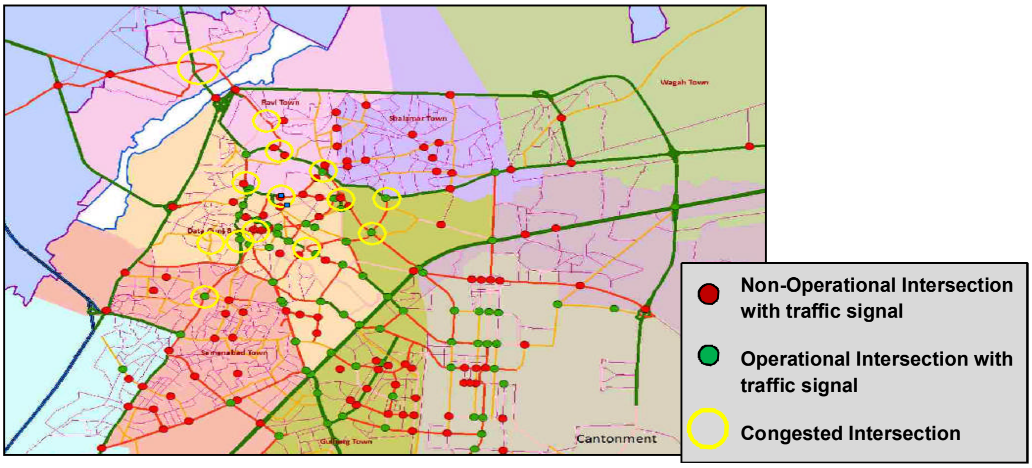
Figure 3.1.5 Corporation Chowk at Exit of Saggian Bridge toward Lower Mall Road – Poor Junction Design



Source: JICA Study Team

Overall the junctions perform poorly and are major traffic bottlenecks especially in old Lahore area between Ravi River and Canal. This is mostly due to poor geometric design, side friction and commercial activities within the junction area. Some of the junctions identified as major bottlenecks during the survey shown in Figure 3.1.6.

Figure 3.1.6 Location Map of Congested Intersections



Source: JICA Study Team

Areas growth of Canal toward southwest of Lahore are recently developed over last few decades, and are not facing congestion problems. Roads are wide with less side friction due to limited commercial activities along most of the sections except some central shopping areas. Traffic calming is neglected in these areas, and most of the roads are high speed passing through residential areas which would not be sustainable.

The concept of high speed signal free corridors should be changed for the sections of roads passing through communities, commercial and recreational areas etc. Signals need to be connected with network operation for optimization and reduce delays. However most of the commercial activities in these areas are uncontrolled on the same pattern as in old Lahore city. Commercialization is at peak without any traffic or development impact assessment. This is generating unplanned traffic demand for the junctions and results in traffic congestions and creates bottlenecks in peak periods.

5) Traffic Safety

The numbers of traffic accident are increasing, in number of fatalities per year from 100 in 1990 to over 400 by 2007 – see Table 3.1.2. The vulnerable road users are more exposed, traffic fatalities are: 30% pedestrian, 10% cyclist and 8% motorcyclists due to inadequate footpath, cycle path and poor driving manner.

Table 3.1.2 Road Accidents and Casualties, Lahore

Year	Accidents			Casualties		
	Total	Fatal	Non-fatal	Total	Killed	Injured
2005	806	394	412	982	432	550
2007	759	443	316	1,003	455	548

Source: Punjab Development Statistics, 2007 and 2009

6) People's Opinions

The present traffic situation should improve; nearly 90 % people feel it is "Very Bad" or "Bad". Other major reasons; "Increase of Car and Motorcycle Traffic", "Bad Driving Behaviour", "Lack of Enforcement" and "Lack of Public Transport".

7) Road Network

Figure 3.1.7 shows the road network of Lahore in 2010. It was comprised of Motorways, Trunk Roads, provincial roads, and urban roads (including district and other roads) with a total length of about 2,647 km. The Motorways (M-2), G.T. Road, Multan Road (N-5) and Sheikhupura Road are intercity linkages to and from Lahore. Provincial roads connect mainly between urban districts. The urban road network is a radial pattern from the city center (walled city).

8) Present Road Condition

The total road length in LUTMP area is 2,647 km (Motorway = 64 km, Trunk Road = 230 km, Primary Road = 200 km, and urban road = 2000 + km). The density of urban roads in the central area (Walled City) is 3.5 – 5.5 km/km^2. About 85% of roads are paved by asphalt or concrete pavement roads and in rural areas road is either gravel or earth. Lahore has 3 bridges crossing the Ravi River. The right of way in Lahore city is wide and surface condition of most roads is good in general.

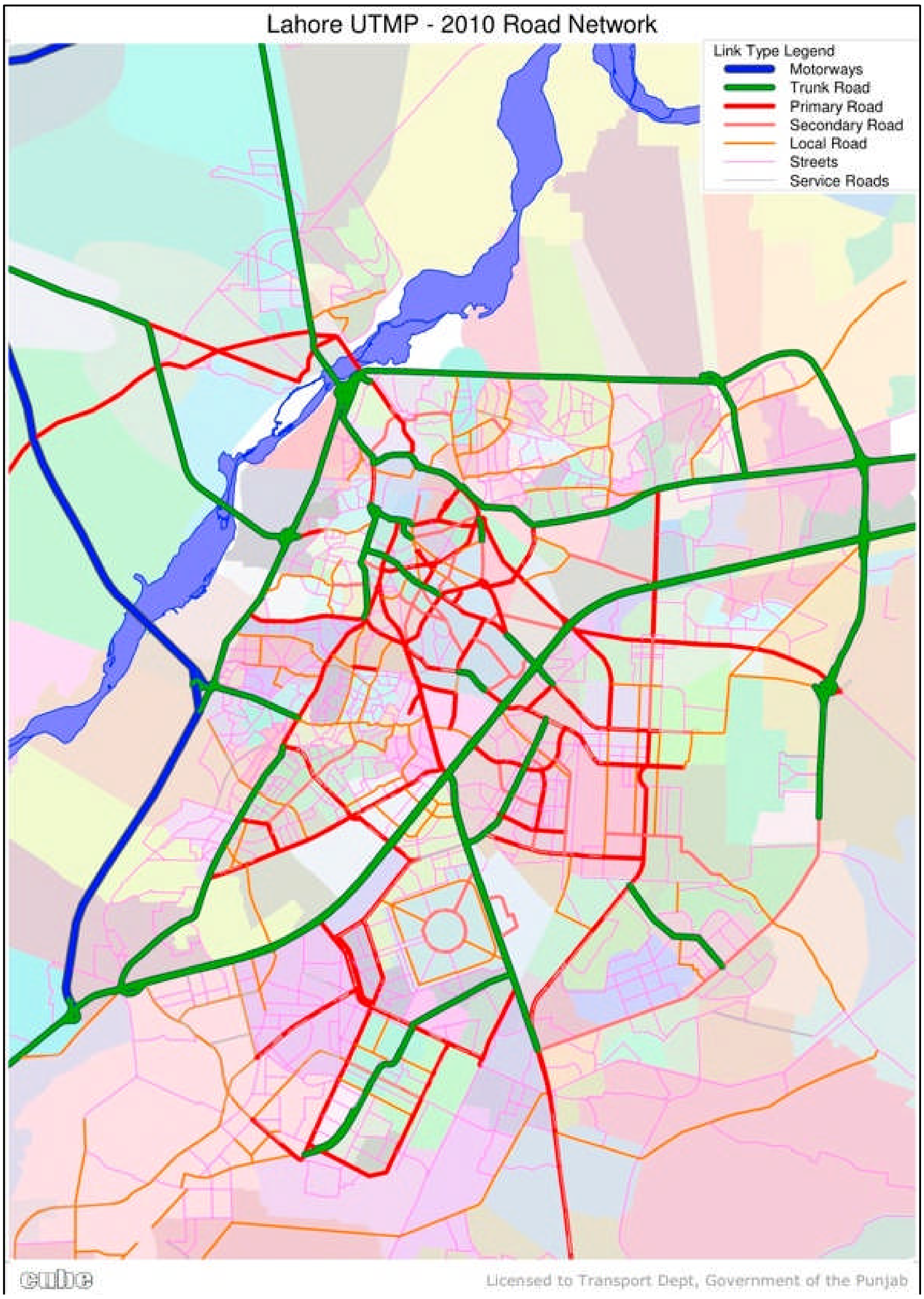
(i) Road Development and Maintenance

Motorway and G.T Roads are developed and managed by National Highway Authority (NHA). However, the management of some sections nearer to the large city is the responsibility of city government. In the case of Lahore, Motorway (M-2), G.T. Road is managed by NHA. TEPA carries out direct management and regular repairs of inner city roads.

(ii) Road Width / Number of Lanes

Figure 3.1.8 shows LUTMP road network by number of lanes. Primary Roads, Motorway and G.T. Road and some major urban roads have four or more lanes with center median and sidewalks (in some areas) except walled city area.

Figure 3.1.7 The Study Area Road Network



Source: JICA Study Team

Table 3.1.3 Road Length and Right of Way

Category	Name/ No.	Section From	Section To	Length (km)	Right of Way (m)	Carriageway No. of Lanes + Service Road	Remark
Motorway	Motorway (M-2)	Sheikhupura Road	Lahore Ring Road (LRR)	12.2	70-75	6	
		Lahore Ring Road (LRR)	Multan Road	8.8	70-75	6	
Trunk Road	Sheikhupura Road.	Sheikhupura Road	G.T. Road	30.5	65-68	4	
	Saggian Bypass	Sheikhupura Road	Lahore Ring Road (LRR)	6.8	50	4	Ravi Bridge W=20.0m
	G.T. Road	Sheikhupura Road	Ravi Road	4.0	55-60	6+2	Ravi Bridge W=7.0m
		Ravi Road	Allama Iqbal Road	3.7	50	6	
		Allama Iqbal Road	Lahore Ring Road (LRR)	5.5	50	4	
	Lahore Ring Road (LRR)	M-2	Bedian Road	34.6	50-60	6+4	
		Bedian Road	Ferozepur Road	6.8	60	6+4	Under Construction
		Ferozepur Road	Motorway (M-2)	11.9		4+4	
	Canal Bank Road	Multan Road	Ferozepur Road	11.3	120	4	
		Ferozepur Road	Lahore Ring Road (LRR)	12.5	105	6+4	
	Multan Road	Canal Bank Road	Bhai Pheru Road	40.0	29	4	
	Ferozepur Road	Kahna Nau Road	Temple Road	20.0	45-70	4+4	
	Main Boulevard Gulberg	Ferozepur Road	Jail Road	3.8	60	6+4	
Primary Road	Shalamar Link Road	G.T. Road	Zarrar Shaheed Road	3.7	25	6	Flyover W=19.0m
	Walton Road	Ferozepur Road	Aziz Bhatti Road	5.6	65	4+4	
	Jinnah Flyover	Walton Road	Ferozepur Road	4.6	30	4+4	Flyover W=13.0m
	Zarrar Shaheed Road	Lahore Ring Road (LRR)	Canal Bank Road	6.7	30	4	
	Wahdat Road	Canal Bank Road	Multan Road	6.6	24	4	
	Main Boulevard Allama Iqbal Town	Multan Road	Wahdat Road	3.7	35	6+4	

Source: JICA Study Team (Road Inventory Survey)

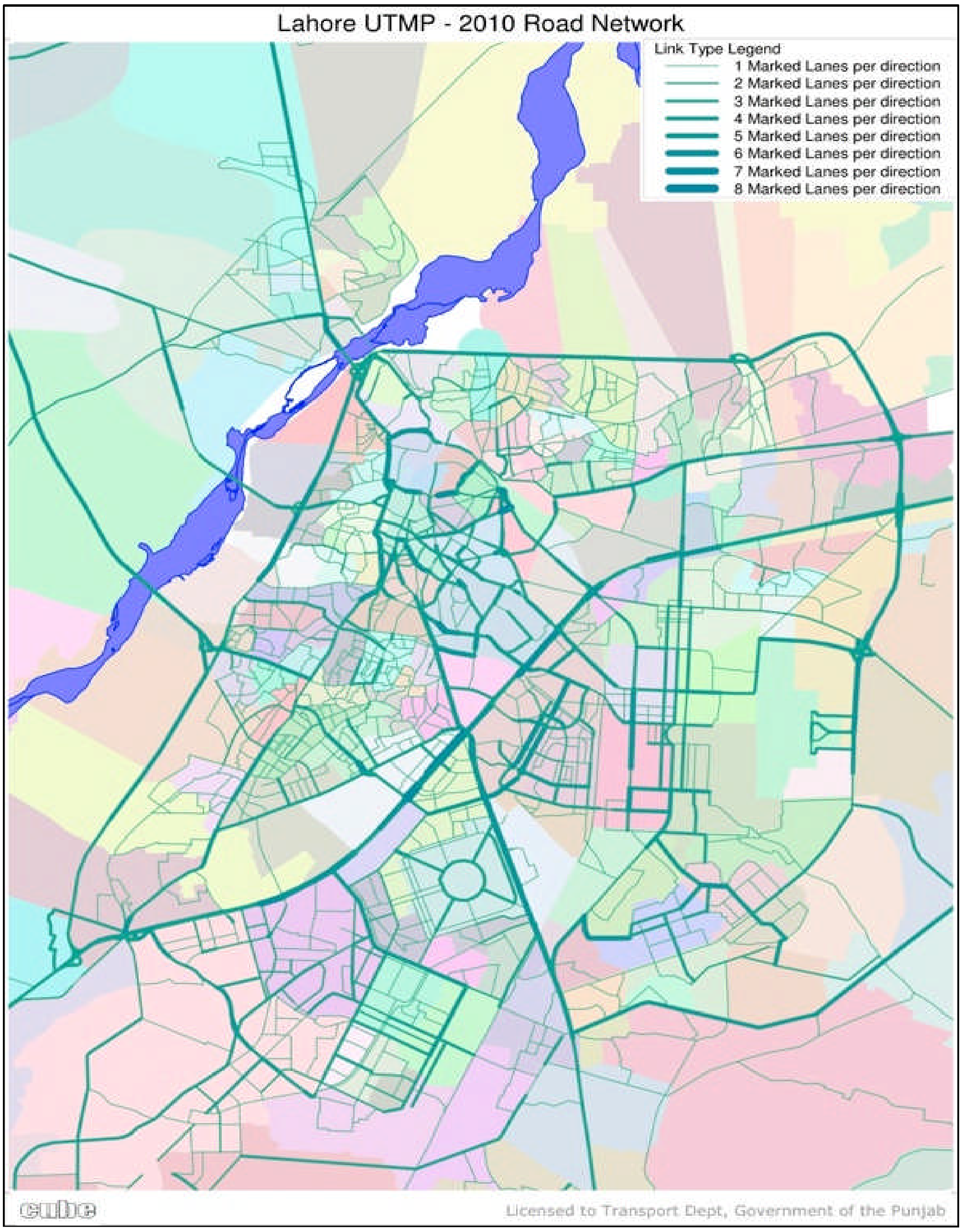
(iii) Condition of Major Roads

a) Motorway (M-2)

The motorway (M-2) is the principal road of Pakistan. It is 367 km length and connects Lahore with Islamabad.

M-2 is passes through the west of Lahore city and it is connects with National Highway No. 5 (N-5) at the Thokar Niaz Baig junction. In Lahore city (LUTMP area) length is about 36km.

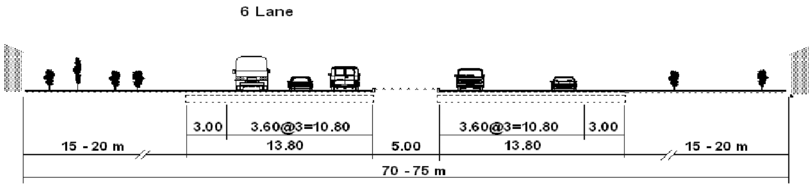
Figure 3.1.8 LUTMP Road Network by Number of Lanes



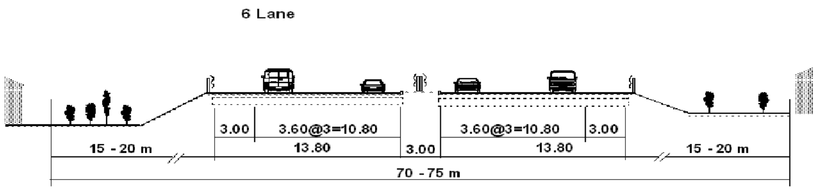
Source: JICA Study Team

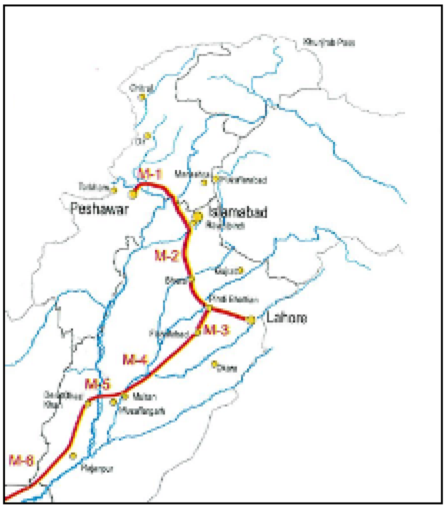
Figure 3.1.9 Motorway Typical Cross Section

Motorway (Sheikhupura Road – LRR)



Motorway (LRR – Multan Road)





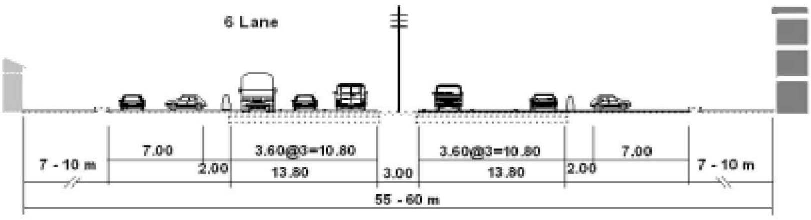
Source: JICA Study Team

b) G.T. Road (Grand Trunk Road/ National Highway, N-5)

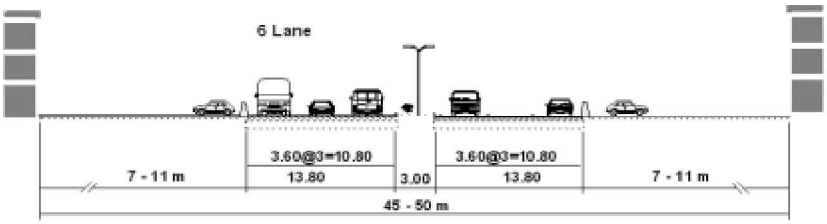
In Pakistan, there are 14 National Highways. G.T. Road (N-5) is the longest and most important highway, connecting Peshawar, Islamabad, Lahore, Multan, Hyderabad and Karachi. Typical cross section of N-5 is dual 4-lane road with median.

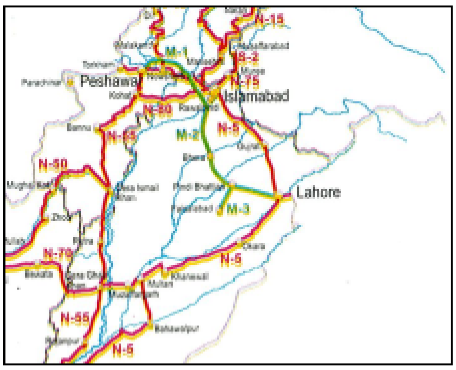
Figure 3.1.10 G.T. Road Typical Cross Section

G.T. Road (Sheikhupura Road – Ravi Road)



G.T. Road (Ravi Road – Allama Iqbal Road)



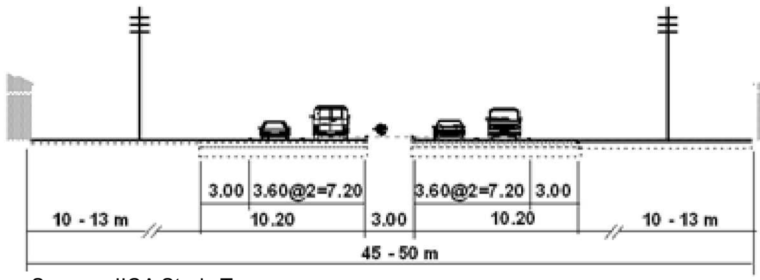


Source: JICA Study Team

The Saggian bypass was built as a bypass road to reduce traffic congestion from Lahore center area. It connects Lahore city, Kot Abdul Malik and Jaranwala and Nain Sukh. The bypass reduces congestion at Shahdra chowk and distributes traffic on Ravi Bridge.

Figure 3.1.11 Saggian Bypass Typical Cross Section

Sheikhupura Road - LRR



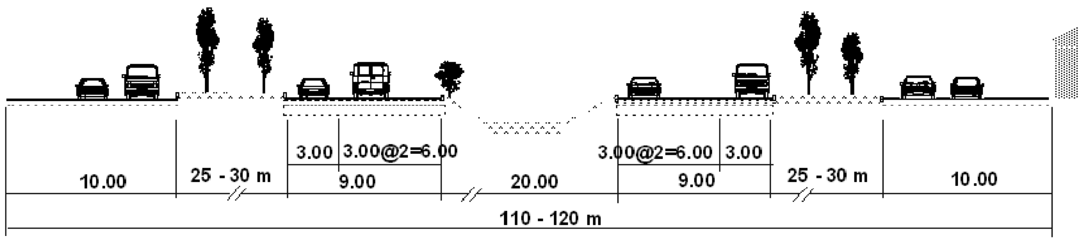
Source: JICA Study Team

d) Canal Bank Road

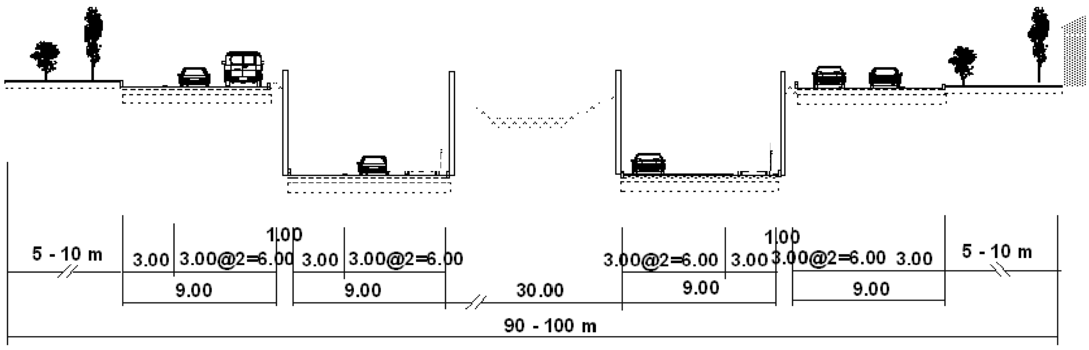
Canal Bank Road runs through the northern part and the western part of Lahore along both banks of BRB Canal.

Figure 3.1.12 Canal Bank Road Typical Cross Section

Canal Bank Road (Multan Road – LRR)



Canal Bank Road (Underpass)

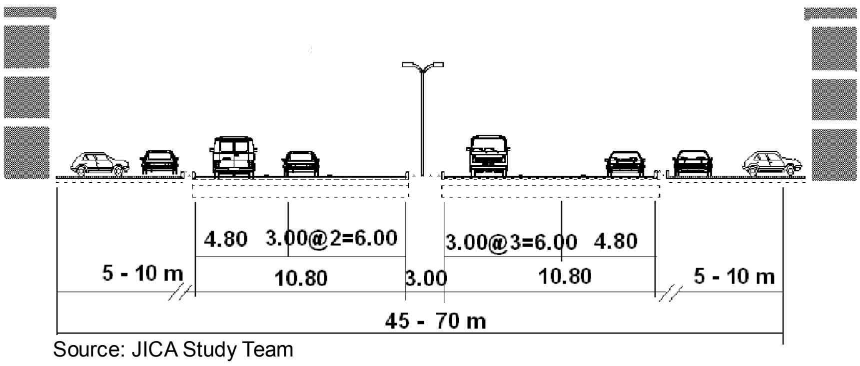


Source: JICA Study Team

e) Ferozepur Road

Ferozepur Road is a primary north-south road. It connects the city from Qartaba Chowk to Kasur District. It is one of the most important business corridors in the Study Area. There are connecting major roads like Canal Bank Road and Gulberg Main Boulevard at Kalma Chowk. Ferozepur Road has many congestion points and mostly due to mixed traffic. It is also one of the major corridors considered for mass transit in median space scince1991 JICA Master Plan.

Figure 3.1.13 Ferozepur Road Typical Cross Section



Source: JICA Study Team

3.1.2 Problems and Issues

1) Quality of Road Infrastructure

Minimum 4-lane dual carriageways are desirable for the arterial system, but this feature is currently limited to trunk roads and a limited number of provincial roads. The main problems regarding road infrastructure in Lahore are as follows:

2) Encroachment

Lahore has the highest number of underpasses and overpass in Pakistan other than Karachi. Despite these improvements, Lahore is struggling for safety on its roads, which are dangerous because the number of vehicles overwhelms the road space, creating traffic congestion and traffic accidents.

There is no segregation between markets and roads in Lahore. All roads are market places in Lahore. The reasons are:

- Many street vendors are working to earn their daily income.
- Parking spaces are limited or non-existed in most of commercial shops and business buildings.

The solutions to remove the encroachment will not be easy because it depends on a kind of social policy. The possible solutions will be:

- The street vendors are required to develop their economy and ply their trade in markets so as to discontinue the street vending (overall economic development is needed.).
- The shops and buildings owners have to determine to invest in infrastructure for the required parking spaces for the development not park in the street.

3) Insufficient Network of Lahore Ring Road (LRR)

Half of the LRR is completed or under construction. The rest of the sections seem difficult to obtain the required land. To complete the LRR is inevitable to ease the traffic congestion in the city areas. Early implementation of the LRR is required.

4) Lack of Ravi River Bridges

Lahore has four bridges over the Ravi River. However, in the 1991 JICA Lahore Master Plan, three additional bridges over Ravi River were proposed on base of the future traffic demand. The outstanding one is from the south end of the Canal Bank Road to the north-west over the Ravi River. For the development of the city to the west of the Ravi River, addition to Ravi River crossing capacity would be required.

5) Inverted V-shaped Development to the South-west

Present new housing and industrial development schemes are mostly located in the inverted V-shaped areas between Multan Road and Ferozepur Road (south-west direction). Development towards east, north and even west is not much planned or considered except high income DHA Housing Scheme.

For the balanced development of Lahore, all directional development should be sought; otherwise more traffic will end upon Ferozepur Road.

6) Lack of Road Classification and Inventories

At present, road classification of each road is not clear and not notified by law. For the long term development and smooth implementation of each road, the classification should be well planned and the road inventories should be prepared by relevant agencies.

7) Vertical Clearance of Underpasses

In May 2010, several pupils sitting on the roof-top of a bus were killed by one of the underpasses along Canal Bank Road. Existing vertical clearances of most of underpasses varies and it generally 4m, sub-standard even with AASHTO standard (min. 4.3 m).

3.1.3 Planning Direction

1) Urban Transportation Development Integrated with Urban Growth Management

Taking into account of the factors analyzed and discussions presented in this report, basic spatial structure for the city has been prepared with the following features:

a. Proposed scenario is the compact development with improvement of living environment and mobility by development/enhancement of public transport. This scenario is friendly to people's travel, living environment and natural environment. Many of the current urban problems will be alleviated although sizeable public investment and administrative capacity of the government are required.

b. Ribbon Development in the North should be suppressed to enhance land use efficiency in this area. The industrial estates are considered to become the relocation site of iron/ steel industries located in the north of Lahore station at present. Residential development are also planned to absorb the increasing population.

c. As this scenario assumes urban Rail-based Mass Transit System (RMTS) to be the trunk public transport system of Lahore, dense urbanization will occur along these RMTS alignments. The combination of industrial estates and academic town proposed in Ferozewala Tehsil area has a possibility to lead high-tech industrial development of not only Punjab but entire Pakistan. Though there are difficult targets of development of competitive public transport system and planned urban development, many cities in the world have overcome these issues. It is feasible if institutional and financial problems could be resolved.

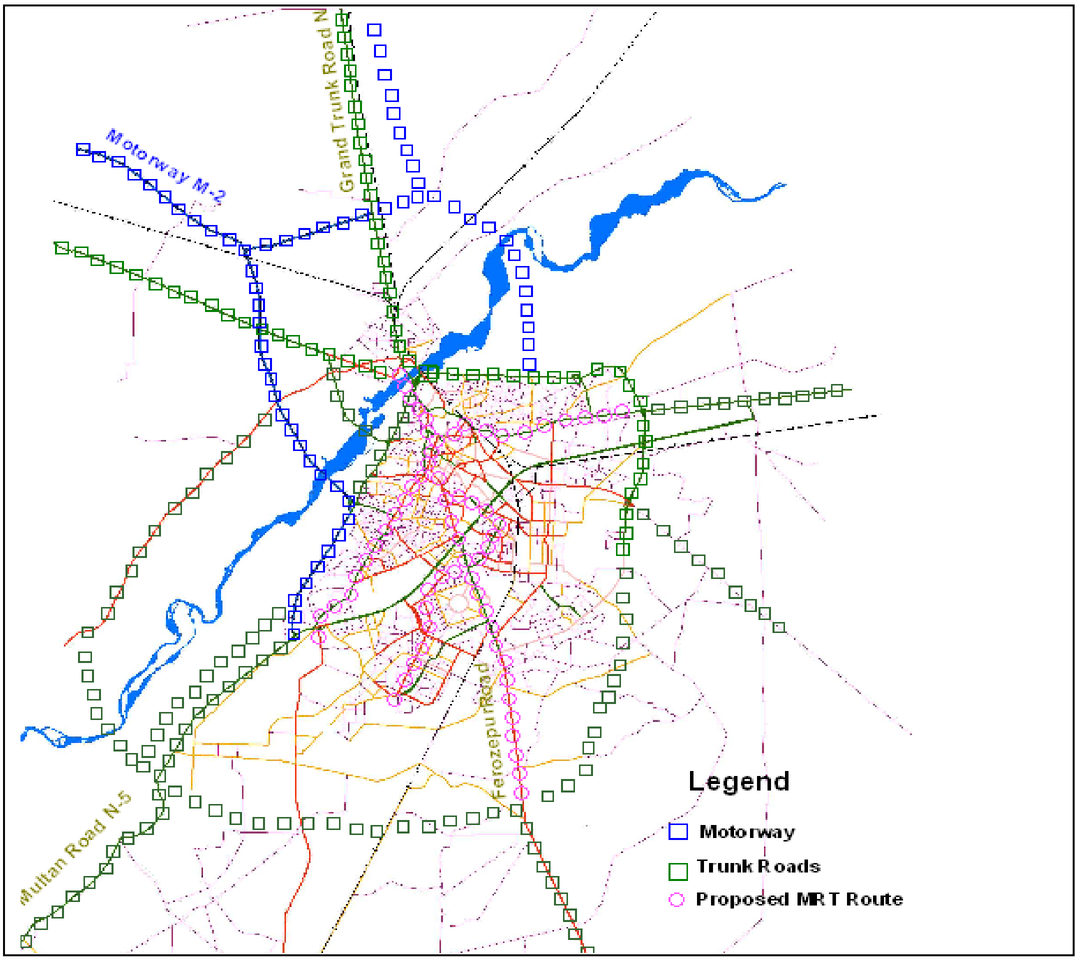
d. Transportation network will be composed of in a linear in incremental form consisting of (i) National/ regional transportation corridor, and (ii) Main urban axes which are connected with each other by lateral primary and secondary urban roads.

   National/ Regional Transportation Corridor: The corridor comprises all regional transportation networks such as Motorway (M-2) and, G.T. Road, into Multan coming from Islamabad to Lahore. The regional and inter-provincial traffic can be effectively separated from urban traffic.

   Main Urban Axes: This forms the backbone of the urban area connecting urban centres and providing access to all other main parts of the city. These axes need to be provided with efficient public transport system to ensure safe and convenient urban transport service for all groups of people. These axes would also be extended to integrate future urban areas of Punjab Province.

e. Integrated land use and urban development with transportation and environmental management is the key to realize sustainable urban form. This concept is illustrated in Figure 3.1.14.

Figure 3.1.14 Proposed Structure of Transport Network



Source: JICA Study Team

2) Proposed Basic Structure of Urban Transport Network

The basic structure of urban transport network for Lahore was preliminary formulated based on the analysis conducted in LUTMP. Urban transport infrastructures are basically planned within the Study Area.

The principles in developing urban transport network is to cater the transport infrastructure and services for various needs and functions to be satisfied, and these are described as follows:

(i) Inter-city Passenger Transport Network:

The bus terminals serving as connecting facility for intercity passengers to smoothly transfer to city transport services should be moved to more strategic location, such as RMTS terminals and future sub-urban centers of Lahore. This will provide easy transfer for passengers and re-distribution in the Study Area.

(ii) Inter-city Freight Transport Network:

Freight terminal plays an important role in intercity transport of goods to and from Lahore. A large volume of cargo is transported to/ from three freight terminals (Multan Road, G.T Road and International Airport). In order to accommodate a large volume of truck traffic, primary road network is carefully planned. In this case, the following conditions should be taken into consideration:

(a) To efficiently link several hubs of freight transport such as freight terminals and industrial zones with inter-city road network such as G.T Road (N-5) and Motorway (M-2).

(b) To avoid large volume of truck traffic entering the urban center. Hence completion of LRR is a necessity.

(iii) Road Network:

This is a combination of primary and secondary roads. A primary road network serves mainly for inter-town traffic with relatively longer travel distance. Scale and characteristics of urban development are taken into consideration of network planning. On the other hand, a secondary road network will supplement primary road network and serve for intra-district traffic with relatively short travel distance. Density of urban development is taken into consideration at network planning stage.

(iv) Mass Transit Corridors:

In order to provide efficient traffic/ transport services between major area and points where large volume of traffic demand is generated and attracted, i.e. existing and new urban centers, town centers, railway stations, airport, new development areas designated in the urban development scenario and to avoid excessive investment on road development, RMTS network serving for major mass transit corridors are planned.

(v) Other Transport Systems:

Above-mentioned major transport networks are supported by the plans for efficient and effective traffic management, walking and non-motorized transport (cycling). Roads will play the central role in developing the entire transport network of Lahore. Roads should assist other transport infrastructures to function fully to its maximum capacity.

3.2 Railway

3.2.1 Present Condition of Railway Subsector

At present there is no urban railway in Lahore. Although Pakistan Railway (PR) serves Lahore, its role is limited in the urban transport system of Lahore carrying only intercity passengers and some freight.

1) Railway Network of Pakistan Railway

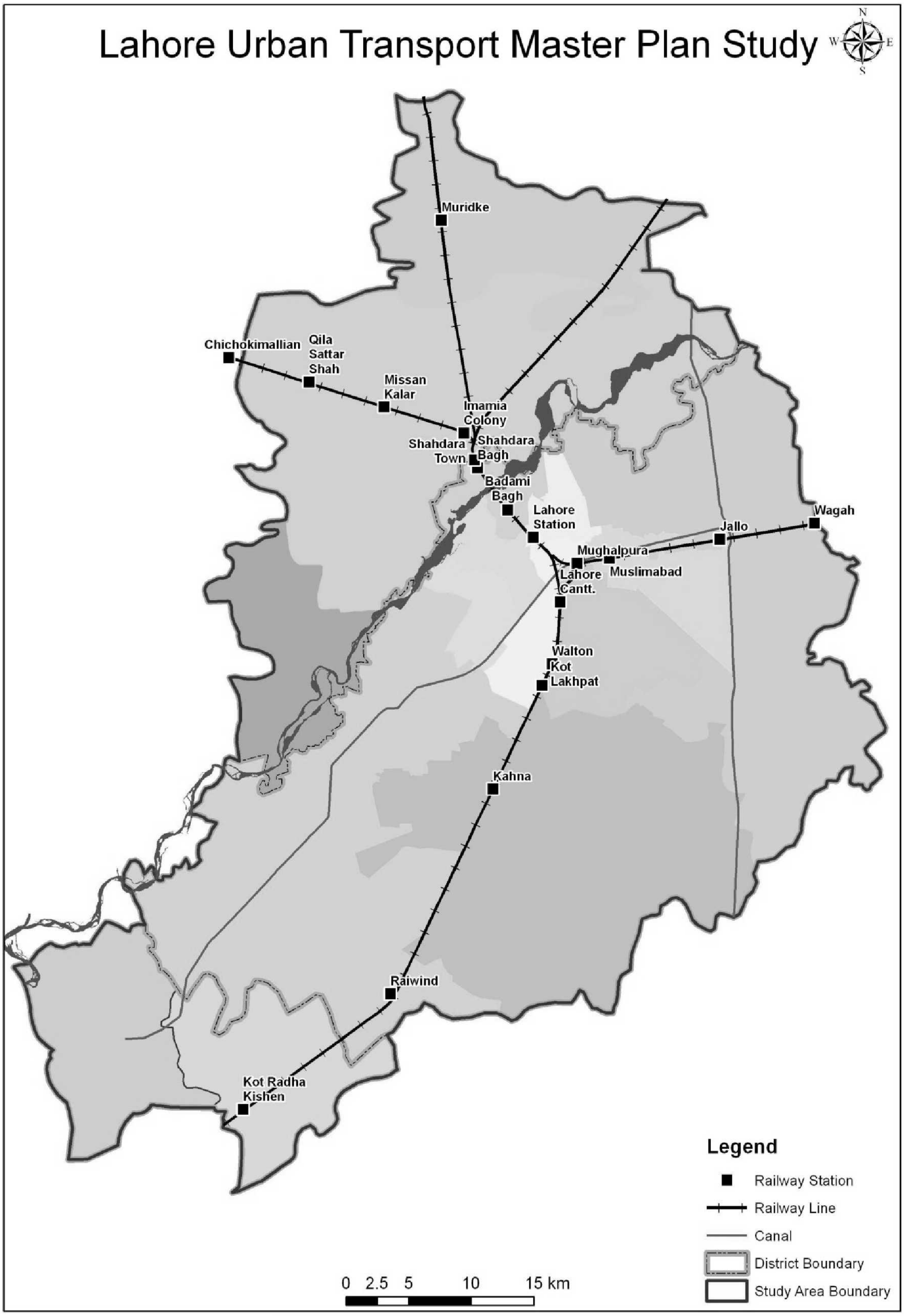
North-south line of Pakistan railway passes through Lahore with 1500km length. Within the city, there are seven railway stations including Lahore Main Railway Station which is located in the center of the city. This rail line provides inter-city passenger and cargo transport services between Rawalpindi and Karachi at the Lahore Station.

2) Pakistan Railway Stations

Lahore Station was built by British between1859-1860. The railway network established by the British was extensive and was one of their contributions to the culture and infrastructure of Punjab region. It still remains to be one of the important passengers and limited freight generating sources in Lahore. It is surrounded by residential and commercial areas. At the Lahore Station, there is a space for pick-up and drop-off of passengers and bus services are available on the road in front of the station. In 2006, the station handled 375 thousand passenger departure and arrivals.

Other stations in Lahore have a very limited role in handling of both passengers and freight.

Figure 3.2.1 Pakistan Railway Routes and Stations in LUTMP Area



Source: JICA Study Team

3.2.2 LRMTS Project

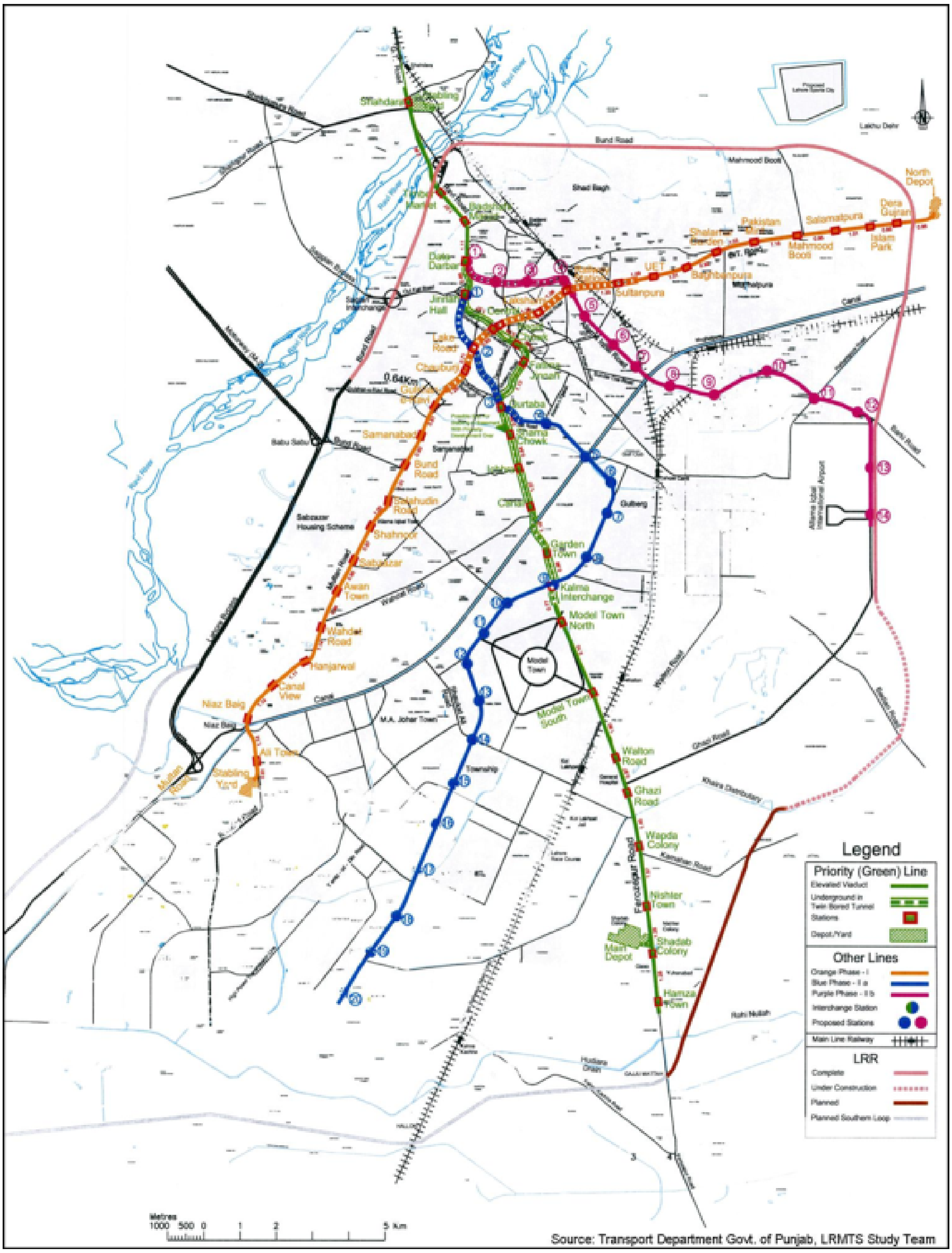
There is an urgent need in Lahore for Rapid Mass Transit System (RMTS) transport facilities to help meet travel demand. The benefit of RMTS network are that it will assist a matching demand and supply for the urban traffic system and contribute to assist in developing a sustainable transport plan for Lahore. Lahore has many of the criteria for a successful urban RMTS. With a population approaching 10 million, it is of sufficient "size" to support a successful urban RMTS. The protection plan for the historical city centre also lends itself to an RMTS solution due to limitations on potential road development and consequential road capacity problems. The supply-demand mismatch for road-space is leading to highway congestion, lower bus speeds and unreliable bus services, and therefore the opportunity for a city that desires to preserve its environment and heritage. Furthermore, there is also a need for good quality links from the suburban areas to the city centre by an environmental friendly travel mode.

1) Review of LRMTS Project in Lahore

Lahore Rapid Mass Transit System (LRMTS) is a project envisioned to provide mass transit facilities to Pakistan's second largest city Lahore. The project is expected to complete in 2025. In the first phase, two medium capacity rail based mass transit lines will be constructed. The priority Green Line between Shahdara and Hamza Town (mostly along Ferozepur Road), a feasibility study was completed in 2006, and was immediately followed by its reference design, which was completed in 2008 by SYSTRA. The Green Line was likely to be completed by 2015 at a cost of USD 2.4 billion. The funding source for the construction could not been decided. The feasibility study of the second priority line (Orange Line) was completed in August 2007. No further work has been carried on the mass transit project since June 2008. The Green Line has been treated as the priority route with an estimated EIRR of 13%.

The work on the project was stopped in June 2008. Since then there has been no progress on any component of the project. ADB had initially expressed interest in funding the Green Line capital cost by about USD 1.0 billion. This funding was contingent upon GoPb putting the project on PPP basis for raising part or all of the remainder (USD 1.4 billion) of the capital cost and to secure private sector operator. As the GoPb showed no interest in funding the project through ADB loans, the proposed financing model collapsed. Due to economic downtown GoPb alone could not afford to fund the project capital cost. As a result the project remains suspended until some form of capital cost funding could be secured.

Figure 3.2.2 Proposed LRMTS Network



Source: LRMTS Study

Phase-I:

Green Line (Total Length= 27km) - Shahdara to Hamza Town

11.6 Km-—underground in twin bored tunnels: with 12 Stations.
15.4 Km—Viaduct; with 10 Stations.

(from north to south) Shahdara, Timber Market, Data Darbar, Regal Chowk, Qartaba Chowk, Ichhra, Canal, Kalma Chowk, Model Town, Walton Road, Wapda Colony, Shadab Colony, and Hamza Town.

Orange Line (Total Length=27 Km) – Dera Gajran to Ali Town

6.9 km—underground with 6 Stations in twin bored tunnels
20.2 Km—Viaduct with 20 Stations
(from east to west) Dera Gajran, Islam Park, Salamatpura, Pakistan Mint, Baghbanpura, UET, Railway Station, Lakshami, Chauburji, Samanabad, Shahnoor, Sabzazaar, Wahdat Road, Canal View, Thokar Niaz Baig, and Ali Town.

Phase-II

Blue Line (Approximate Total Length=24Km) – Jinnah Hall to Green Town

4.0 km—Underground with 3 Station
20.0Km—Viaduct with 17 Station

(from north to south) Jinnah Hall, Qartaba Chowk, Gulberg, Garden Town, Moulana Shaukat Ali Road, Township, Green Town.

Purple Line (Approximate Total Length =19Km) – Airport to Data Darbar

3.4 km—Underground with 4 Station
15.6 Km—Viaduct with 10 Station

(from east to west) Airport, Barki Road, Allama Iqbal Road, Data Darbar.

2) Issues of LRMTS

(i) Electrification System

The 3rd rail 750 DC system was assumed as power supply source. This system has been used at first for a subway in Tokyo, i.e., MARUNOUCHI Line and GINZA Line and recently used in urban railways in Bangkok called Sky-train. This system has an advantage to minimize the tunnel cross-section as much as possible, and electric poles would not be constructed on the viaduct, however this system has safety disadvantage because of existence of high voltage equipment at lower part beside the train. Along at-grade section in Depot, safety measures would be required for the maintenance staff.

(ii) Structure

In the feasibility study of LRMTS, U-shape girder is proposed as standard viaduct structure. Concrete girder surrounds lower part of railway track, and it states this style as environmentally friendly. U-shape girder has been also constructed in Japan only at unavoidable section, i.e. where necessary height under the girder cannot be secured and normally deck girder like PC box-girder, PC T-shape girder, and so on has been used as viaduct structure. This girder called SYSTRA U-shape Girder has been used in Delhi Metro, Santiago in Chile, Dubai Metro in the United Arab Emirates, Taipei Metro in Taiwan, and recently in Korea. Currently many urban railways using viaduct have been constructed all over the world, deck girder such as PC box girder has been used in most cases. Because of main girder is located beside railway tracks, the supporting pier has to overhang outside, and widespread lower bottom part of the girder may seem oppressive to the people. Delhi Metro in India used PC box deck girder at first, and later U-shape girder was used at extension section. The deck type PC box girder is also suitable for urban viaduct structures, but the U-Shape tend to be cheaper because of overall lower height.

(iii) Earthquake Resistant Designs

According to the “CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES: Fifth Revision”, (Bureau of Indian Standards), a huge earthquake of a magnitude of about 8.0 had happened at approximately 500 km north-east of Lahore. Therefore, earthquake resistant design would be required for urban railway structures in Lahore city. This would need to be checked at detail design stage.

a) Avoid top heavy structure

The standard viaduct pier presented in the Feasibility Study report is of single column type. The entire superstructure's load should then be supported by the independent column. However, sufficient reinforcement of column may be quite difficult in case of major earthquake. If possible, two columns type may be studied and evaluated at detail design stage.

b) Strengthen for shearing force

The structure will be designed based on destruction by Bending Moment. Destruction by Shearing Force should be considered for easy repair after earthquake damages.

c) Study at supporting point of superstructure

Sufficient length from the support of superstructure to the edge of supporting beam in sub-structures shall be secured to prevent falling of superstructure, and some counter measure equipment of girder will be also required.

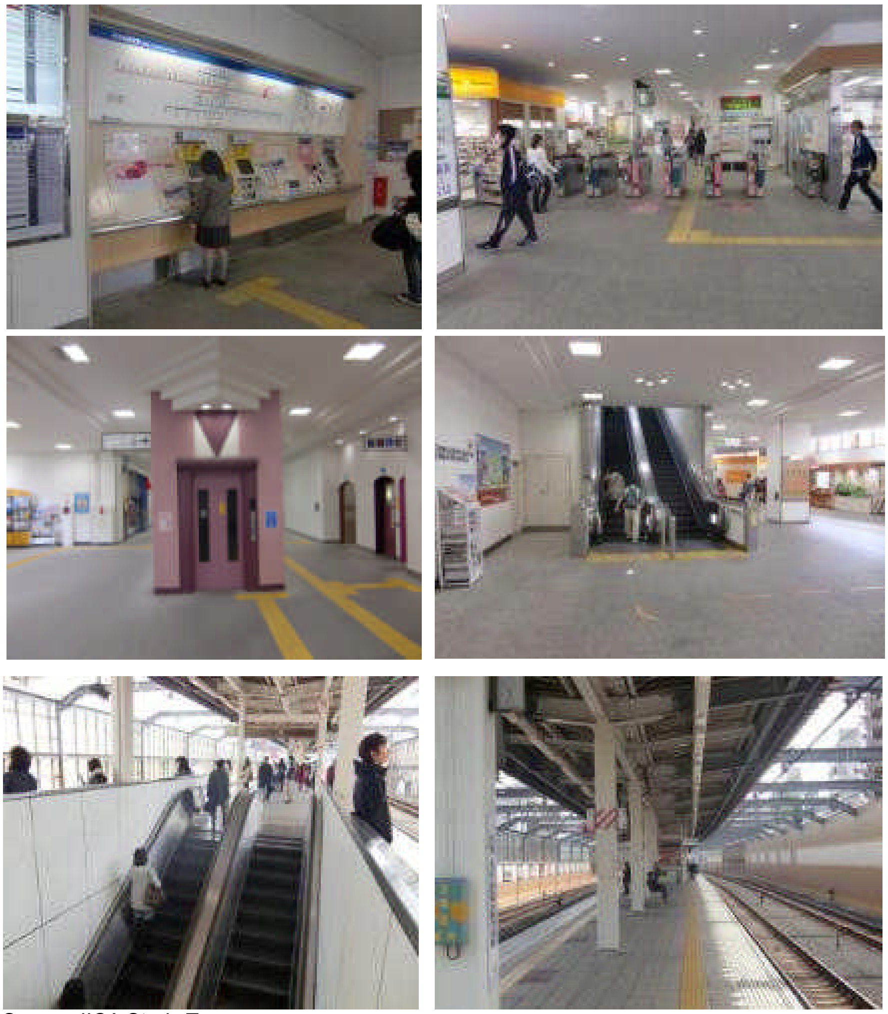
d) Length from Pile edge to end of footing

The length between pile edges to end of footing shown in drawings seems extremely short. The check of Push-out Shear Stress is quite important in seismic case, because big pile reaction will occur in an earthquake.

(iv) Assistance for Handicapped Person

Elevator and wheelchairs have been proposed in the design report for the aged and the handicapped. In addition to these, Braille paving block for blind people may also be provided at LRMTS stations. For reference, an example in Japan at NAKAMURABASI Station, Seibu Railway, Japan is shown in the figure 3.2.3.

Figure 3.2.3 Yellow Braille Block, Nakamurabashi Station, Japan



Source JICA Study Team

(v) Others Issues

a) Steel bar arrangement drawings

Drawings of steel bar arrangement are not found in the design report. Reinforcement of column in the seismic loading case and support in the beam around shoe of substructure and others should be considered at detail design stage.

b) Platform length

In the LRMTS report platform length is set at total train length+5.0 m. However, because of high density of train operation and mass transport passengers, platform length of urban railway is decided at total train length+10m in Japan. However, this may not be necessary as all platforms will have screen doors excluding the platform area to avoid accidents – unlike open platform as in Japan.

3.2.3 Planning Direction

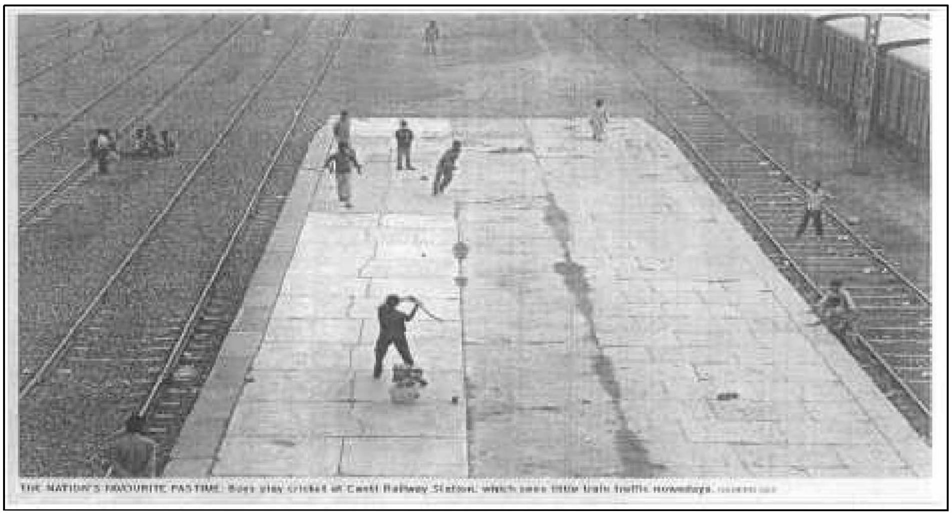
1) Limited Potential of Using Pakistan Railway for Urban/ Suburban Transport Service

The operation of Pakistan Railway has declined as mentioned earlier. Actually, for the short- to medium-term, it is almost hopeless to use Pakistan Railway as an urban transport service in and around Lahore due to depilated tracks, signal system, lack of train/ platform capacity etc.

Pakistan Railway needs entire restructuring as the national railway. Various initiatives have been taken to re-vitalize Pakistan Railway, but all have failed. If urban or suburban railway is operated in Lahore as a part of Pakistan Railway or using the Pakistan Railway assets, its operation will be affected by the current intercity operation of Pakistan Railway. New trains and other facilities including signal and communication equipment purchased or installed for the urban/ suburban service would be used together with the existing totally obsolete assets of Pakistan Railway. Under these circumstances, safe and modern operation of railway is almost impossible.

In the long run, however, the potential of Pakistan Railway in urban transport service should not be ignored. If restructured and totally modernized, there will be opportunities for PR to become a major supplier of suburban transport service in the Study Area.

Figure 3.2.4 Playing Cricket at Lahore Cantonment Station



Source: Lahore News, Oct 12, 2011

2) Urban Railway Development

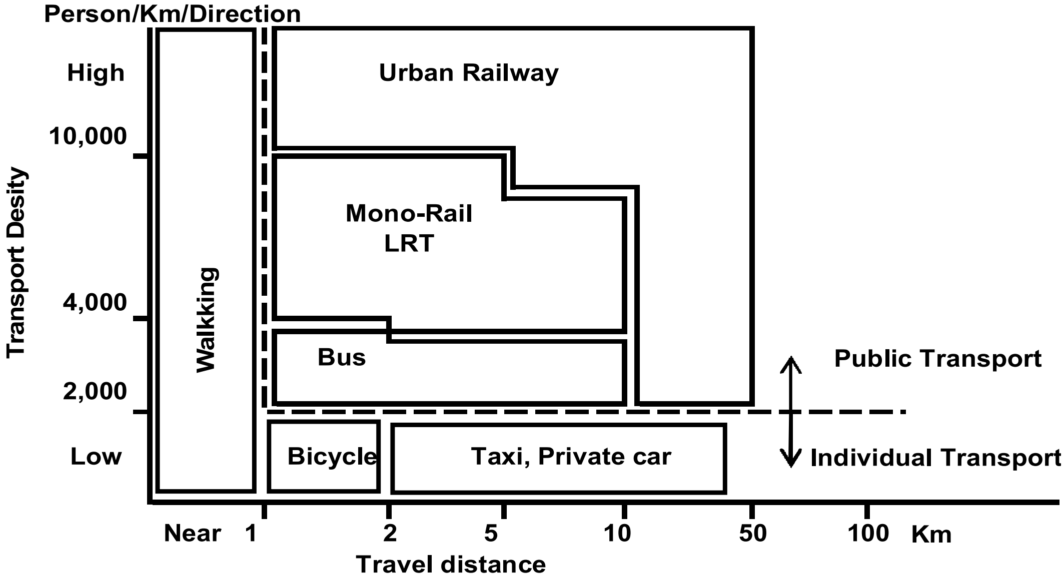
(i) Key Principles

The weakest point of the railway is inferior in door-to-door service while this point is the strongest merit of personal (individual) transport. It is so difficult that the people who use personal transport are highly unlikely to shift to the railway. Thus it is most essential to raise comfort, convenience and accessibility of urban railway to the maximum extent to have enough patronage for the railway. Therefore the following points should be reasonably incorporated in the plan.

- Connectivity between railway terminals/ stations and activity centers.
- Appropriate station location and interval.
- Safe and well-organized operation through trained railway staff.
- Rapid train operation to be competitive with road transport journey time.

Although there are a number of transit systems in the world such as LRT, MRT, Monorail, etc, most suitable railway system should be selected by comparing transport demand with transport capacity in addition to the points disused above.

Figure 3.2.5 Classification of Urban Railway System



Source: JICA Study Team

(ii) Railway Management

The management of urban railway should be in charge of the private sector. For operating urban railway after construction, a lot of expenditure is required; i.e. huge initial construction cost, equipment purchase, various facilities maintenance cost, interest charges and so on, and gross revenue from passenger fare is limited. Therefore revenue and expenses do not balance just after opening. Public subsidy/ assistance to cover this imbalance, presumably in the form of PPP, will be necessary for realization of the railway business. The scheme of "Separation of Infrastructure and Operation" could be adopted as it was applied to many railways in the world.

Urban railway's management will require modern technology and engineering in various fields since railway is a “system”. Principal issues are enumerated as follows;

(iii) Operational System

Entirely simple system that needs less man power should be used as much as possible to curtail expenses. Introduction of latest model equipment should be considered based on the comparison of increasing capital investment with decrease of manpower expenses.

a) One-man operated train

One-man operated train will be suitable if passenger safety is ensured and traffic accident can be handled properly.

b) Simplify the driving system at station

Railway operation will be operated by Central Control Room, and passengers ride on and off should be managed by driver as much as possible. Station-staff who takes charge of unusual occasion could be concentrated at major stations and dispatched from there.

c) Mechanization of ticket vending machine and ticket gate

Automated ticket vendor and ticket gate should be introduced as much as possible, as proposed by LRMTS Studies.

d) Institution of unified order system

Unified order system in emergency of train operation is absolutely necessary to minimize serious accident and resume train operation. It is desirable that all senior engineering staffs are concentrated at Central Control Center

(iv) Maintenance System

a) Integration of various technology

Railway engineering includes track works, power, signal, telecommunication and rolling stock. Hence, many workplaces have been conventionally provided individually, but since railway is a system technology, workplaces should be designated to enable closer cooperation.

b) Introduction of foreign technology

When technical problem arises, application of foreign technology should be positively considered for outsourcing.

3) LRMTS Project as LUTMP Proposal

In the light of the magnitude of traffic demand, its distribution and the need to shift mode choice from private to public, JICA Study Team considers that the existing LRMTS proposals are quite reasonable.

Table 3.3.1 Inter-city Bus terminals in Lahore

Station No.	Name	Location
1	Larri Adda	Badami Bagh
2	City District Government Lahore Terminal	Bund Road
3	Niazi, Abdullah and Skyways Terminal	Bund Road
4	New Khan, Rahber and Kohisatn Terminal	Bund Road
5	Daewoo Bus Terminal	Ferozepur-Road
6	Shahdara	G.T. Road

3.3 Road-based Public Transport

3.3.1 Present Conditions of Road-based Public Transport

1) Bus Terminal

Lahore has three different types of bus terminals, one an intercity bus terminal; other is inner-city bus terminal and private bus terminal. Intercity bus terminal provides services for other city.

2) Public Transport Structure and Organization

The government has further encouraged the private sector in public transport operation, and the current public transport structure in Lahore is a direct heritage of the 1998 transport policy review, which revamped the structure of public transport services. The franchise scheme was introduced in 1999 by support of the government through the Transport Sector Development Initiative (TSDI).This promoted a privatization and deregulation of public transport, while government agencies only to regulate the services. New private operators then entered the market, increased the number of buses in operation and significantly improved the public transport situation in Lahore since 1999.

The public transport administration, policy making and planning in Punjab is coordinated by the Punjab Transport Department, which was established in 1987 under the West Pakistan Motor Vehicles Ordinance 1965. It is responsible for the licensing of high-occupancy bus services in Lahore and other large cities, and of public transport services outside the major cities of Punjab through the Punjab Provincial Transport Authority (PPTA). Minibus routes are granted by the Lahore District Road Transport Authority (DRTA), which was established in 2001 by the Punjab Transport Department, and reports to the City District Government of Lahore (CDGL) and PTA.

However, in the 2000s the government’s attention shifted to other projects (road projects, LRTMS, and 4-stroke rickshaws), and as the bus system in Lahore received little consideration the improvements seen since 1999 stopped and the situation worsened in the past few years. The number of buses in operation stated to decrease from 2008 due to poor maintenance, lack of investment, and competition with the other road-based modes (wagons). Between 2008 and 2010 no operator entered the market and no bus had been added to the depleted fleet.

While the number of buses declined and private operators were unable to meet the overall demand, the services of public transport were provided by smaller, private vehicles such as Wagon, Rickshaw and Qingqi, which have had a significant growth over the last decade.

In an effort to improve the situation of road-based public transport, the Lahore Transport Company (LTC), a state-owned company, was established in December 2009, taking over the infrastructure and regulation responsibilities from the DRTA Lahore office.

LTC is primarily a regulation body and is now the sole organ responsible for custody of all public transport infrastructures in Lahore and its operations through a network of private operators. Infrastructures include bus stops, shelters, bays, depots and terminals, while the regulation and operational aspects cover service routes and the buses provided by and operated through a network of private operators.

3) Bus Service

Bus service in Lahore was planned over 53 routes, based on 2006 survey of passengers and published in Punjab Gazette 2006. However, only 30 routes are operated due to lack of supply and demand. Most public transport is served by non-operational bus routes with non-registered wagons, coasters, rickshaws and Qingqis.

Recently, several bus companies operate in Lahore. Premier Bus Services, owned by the Beaconhouse Group, have started in 2003. It provides premium transportation services to the general public of Lahore, with hundreds of buses running on exclusive routes. This is the largest public transport service provider in Lahore. The buses are in the process of being converted to Compressed Natural Gas (CNG) for environmental and economic reasons, and Daewoo City Buses provide high-end (higher fare) city and inter-city public transport. Though these buses are fewer in number, these are air conditioned and provide better comfort to passengers. In addition to these two major companies, there are several other small companies (New Khan Metro, Niazi etc.) that provide services within Lahore; they cover only particular routes and are limited in number. The urban bus operation is regulated through Lahore Transport Company (LTC), setup by the GoPb.

Figure 3.3.1 Daewoo City Bus

Source: JICA Study Team

4) Minibuses and Wagons

Many public transport vehicles operate without valid license, current registration. It has also been reported that many wagons and coasters driven by drivers without licenses, and that many do not follow the authorized route, providing services to neighboring towns and illegally competing with urban bus although they are not allowed to serve urban passengers.

Wagon and bus routes should normally be controlled and enforced by DRTA now LTC, but the inefficiency of public-owned public transport has led to increase of private vehicles mostly motorcycles.

5) Auto-Rickshaws and Qingqis

The number of rickshaws operating in Lahore is estimated to be 66,000 as per registration data of the Lahore District Registration Authority, but up to 80,000 may actually ply the routes of Lahore when taking into account unregistered vehicles. About 5,000 route permits have also been issued for Qingqis, but it is estimated that as many as 40,000 are currently operating in Lahore, many along primary and secondary roads which are also served by licensed bus services. While there has been no change in the design of the auto-rickshaws over the last 4 decades, the government is currently trying to ban two-stroke engines in favour of CNG four-stroke rickshaws.

6) Mode Share

Tables below show estimated mode share and trip-making in Lahore by TEPA for 2007 and by the JICA Study Team for 2006 and 2011. The proportion of non-motorized trips is high, at 45%, while the proportion of public transport trips among motorized trips is around 35% (TEPA) to 38% (LRMTS). There is a declining trend of public transport mode share in proportion in favour of car and motorcycle trips, but considering the growth of population and trip-making, the actual number of trips made with public transport services will increase over the next decade.

Table 3.3.2 Estimated Daily Trips in Lahore (TEPA)

Mode		Trips (,000)	Proportion
Public Transport		3,409	19.3%
Private Vehicles	Cars	2,894	16.4%
	Motorcycles / Bicycles	3,314	18.8%
Walk		8,050	45.6%
Total		17,667	100%

Source: TEPA, 2007

Table 3.3.3 Estimated Daily Motorized Trips in Lahore (LRMTS)

Travel Mode	2006		2011 (Forecast)	
	Total ('000)	Proportion	Total ('000)	Proportion
Motorcycle	1,292	18.5%	1,532	18.3%
Rickshaw	1,014	14.5%	1,157	13.9%
Car/Taxi/4WD	1,991	28.5%	2,561	30.7%
Public Transport	2,699	38.6%	3,100	37.1%
Total	6,996	100.0%	8,350	100.0%

Source: LRMTS Study, 2007

7) Operational Details

The table below shows the distance bands and fares for bus and wagon routes.

Table 3.3.4 Bus and Wagon Fares, June 2010

Distance (km)	Fare (PKR)
0 – 4	13
4.1 – 8	18
8.1 – 14	22
14.1 – 22	25

Source: JICA Study Team – Transport Dept. GoPb.

Bus fares have significantly increased since the introduction of the franchised scheme, as they had started at only PKR 3 for the 0-3 km distance band (representing more than twice the 1999 price when taking inflation into account).

The cost of free of charge ridership those are not paid is high, and is estimated at 10 to 15% of all passengers according to a study for TD, GoPb.

Table 3.3.5 Outline of Bus Operation

Specified headways (minutes)	Peak	5.7
	Off Peak	8.2
Observed headways (minutes)	Peak	9.3
	Off Peak	11.5
Average speed (kph)		19
Passenger trip length	<=4 km	39.9%
	<=8 km	66.5%
	<=14 km	89%
Bus kilometres (km/day/bus)		234
Operating cost (PKR/km)		29

Source: Transport Department, GoPb

3.3.2 Current Problems and Issues

The public transport network in Lahore is currently under-developed, fragmented, inadequately managed and highly inefficient.

1) Under-Development

More than 800,000 passengers use public transport in Lahore where about 500 high occupancy buses are operated by 13 private companies. Evidently the public transport network is under-developed and there is a great gap between the demand and provision of an efficient and environment friendly public transport. Despite a considerable demand and several projects (Green, Orange, Blue and Purple Mass Rapid Transit lines), there is currently no MRT line in Lahore.

2) Fragmentation

Historically, the provincial governments in Pakistan have owned and operated intercity and urban public transport services. However, over the years, the government, according to the guidelines of the World Bank, advocated to encourage the private sector in operating public transport. The decline of state-owned public transport services created a vacuum that was filled by private operators in accordance with these guidelines. Initially, the market was opened to private operators in parallel with public-owned public transport. However, the availability of public transport has not grown at the same rate as the population. Therefore, a large number of small private operators were permitted to fulfil this gap in a fragmented way. As a result, a chaotic mass of individually-owned small vehicles (Wagon, Qingqi, Rickshaw etc.) operate in Lahore, competing for road space.

3) Inadequate Public Transport Management

Public transport organizations have a long history of deficiency in professional, administrative, and financial capacity to manage public transport services. In the absence of human resources, coordination, research, and financial capacity of public transport institutions in Punjab, public transport has now become fully the prerogative of the private sector as described in the previous paragraph. The incomplete bus routes, high fares, fewer-than-required buses, gender discrimination, and even absence of bus routes in parts of urban areas is common. Whole public transport is grossly mismanaged with least objective of service provision, limited and inadequate condition of the public transport facilities (including bus terminals and buses) and chaotic use of road space due to traffic mix. Public transport operations should be improved by extending franchised bus operations along major corridors and restricting small vehicles operations to feeder routes. It will require emphasis on high-capacity buses rather than a multitude of smaller vehicles.

Transport related functions (transport planning, engineering and maintenance, and licensing, registration, regulation and operation of public transport routes) hence, not concentrated into one single and efficient authority: public transport routes and the definition of stops are under the control of the GoPb Transport Department, DRTA issues the route permits for wagons on behalf of the Transport Department. TEPA has no longer any involvement, and licenses are issued without the assistance of any transport planning processes.

4) Performance

Due to rapid motorization (majority motorcycles) increase and traffic volume over the last two decades, the road network has many congested sections in cities and towns along the roads, which increases travel delays and reduces bus travel speeds, implying a less competitive public transport network, especially in the Central Business District where commercial and trading activities are located.

Current public transport services are suffering greatly due to irregularity. On certain routes waiting times for the passengers are too long whereas on other routes buses wait for passengers and may move when feel. Such a situation prevails because routing and licensing is not based on passenger demand analysis but based on convenience of operators and lack of regulator ability to assess. Efficiency is acceptable on certain routes but reliability is poor, there being no scheduling at all.

3.3.3 Current Plans and Practices

1) Multimodal Inter-City Bus Terminals in Lahore *(a Transport Department Project)*

Lahore has two (2) general bus stands under City District Government of Lahore, and eleven (11) private inter-city bus terminals. All bus terminals are inside the city area, which results in traffic congestion in those areas, and leading to these terminals. Currently, Transport Department intends to shift existing bus terminals to the outskirts of city including major bus terminal at Badami Bagh.

Project Description:
Construction and operation of 3 inter-city bus terminals in Shahdara, Ferozepur Road near Hudyara Drain and Thokar Niaz Baig/ Ex-PRTC Workshop Sites on Build Operate Transfer/ Public Private Partnership basis

Status:
Request letter has been written to Senior Member Board of Revenue to transfer land owned by Industries Department in favor of Transport Department. Thokar Niaz Beg land is already owned by Transport Department, which is temporarily under the use of Traffic Police.
Feasibility study for Thokar Niaz Beg bus terminal is being conducted for Transport Department. Expressions of Interest (EOI) for the Transaction Advisor (TA) to manage these studies were advertised on 31st January, 2011 by Transport Department. EOI for the potential bidders to be shortlisted would begin shortly after the TA is on-board.

Location/ Area:

Locations of Shahdara, Ferozepur Road near Hudyara Drain and Thokar Niaz Beg (Lahore) are shown in the following figure.

Estimated Cost:

No Cost Estimate is available.

Financial Source:

(i) GoPb transaction advisory services and land costs

(ii) Build operate transfer/ public private partnership for construction and operation

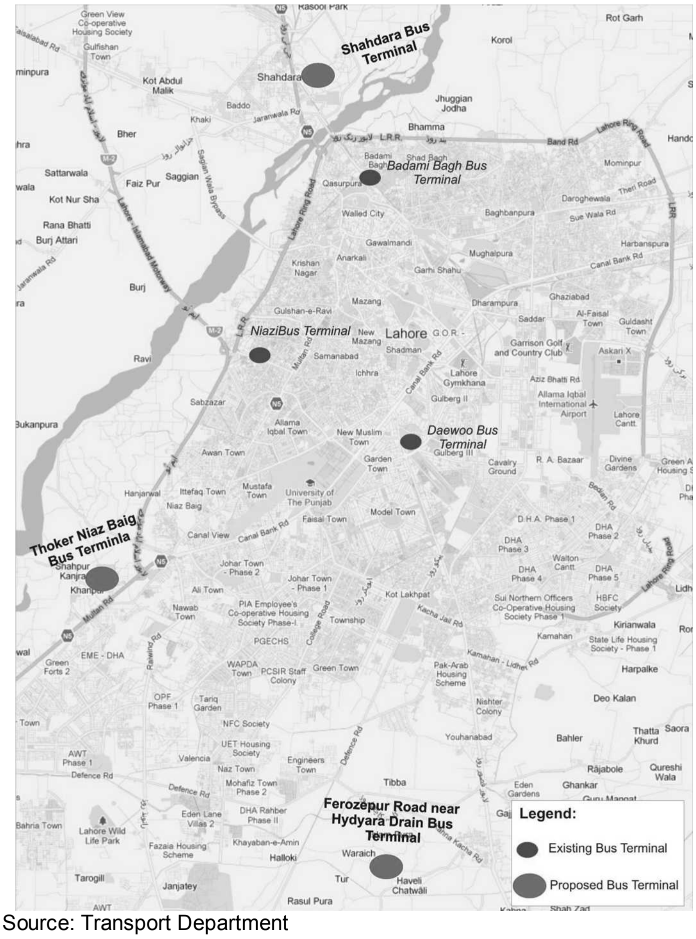
Schedule:

2011 – Onward

Implementing Authority:

Transport Department, GoPb, in coordination with City District Government of the Lahore

Figure 3.3.2 Location of Multimodal Intercity Bus Terminal



Source: Transport Department

2) Effective and Efficient School Bus Service (*a Transport Department Project*)

During peak periods, most of the road space is occupied by the cars meant for dropping and picking up school children. It is believed that an effective and efficient “School Bus

Service" may reduce the number of cars used for this purpose.

The Transport Department is preparing a plan in consultation with Education Department with the following objectives to provide School Bus Service:

- To improve enrollments in government schools
- To achieve maximum attendance
- To ensure efficient and productive use of time
- To ensure safe, quick and direct access to schools
- To provide comfortable and efficient transport service to students
- To reduce the risk of road accidents
- To reduce congestion
- To provide alternative to the parent's duty

Project Description:

- No. of routes have been established on the basis of geographical mapping of school and its pupils
- No. of buses on each route will be allocated keeping in view the ridership
- Pick-up point of each route will be notified to the parents/students through electronic/print media
- School routes will be notified by the Transport Department in consultation with the Education Department.

Table 3.3.6 Expected Beneficiaries and Required Bus Fleet

City	High Education Secondary Schools	Enrollment	Beneficiaries (50% Enrollment)	No. of Buses (53 Seat/Bus)
Lahore	230	229,139	114,570	2,162
Rawalpindi	72	49,902	24,951	471
Gujranwala	43	43,608	21,804	411
Multan	48	68,154	34,077	643
Faisalabad	82	104,683	52,342	988
Bahawalpur	31	28,118	14,059	265
D.G. Khan	13	15,333	7,666	145
Total	519	538,937	269,469	5,085

Source: Transport Department

Terms and Condition (Source: Transport Department):

i. Buses will be provided by the Government
ii. Buses will ply on specified routes to be determined by Government in the seven cities to provide free pick-up and drop-off services to students
iii. Buses will be exclusively used for school students
iv. Operators will ply these buses as per time schedule given by the Government
v. The Government will provide overnight parking space

vi. Registration, Fitness, Insurance, Token Tax and Diesel/lubricants will be borne by the Government. All other expenses will be borne by the operator
vii. The operator will submit re-imbursement claims by adding 15% to actual expenses as profit margins
viii. The Government will reimburse the claims within one month
ix. The operator(s) selection, monitoring, and inspection shall be carried out under the supervision of respective DCO
x. The operator(s) shall not be allowed to assign, sublet or subcontract whole or part of service of the operation
xi. The operator(s) shall maintain adequately equipped automobile workshops. They may enter into an agreement with some suitable workshop
xii. Separate Section in the bus shall be provided for female students
xiii. The Government shall have the right to check the operation to ascertain whether service being provided is in accordance with the agreed terms and conditions
xiv. The operator(s) shall be responsible for any loss which may arise as a result of accident/damage
xv. Performance Guarantee Deed will be executed with the operator(s)
xvi. Initially, the agreement with the operators to launch School Bus Service will be for three years

Location/ Area:

Lahore, Rawalpindi, Gujranwala, Multan, Faisalabad, Bahawalpur, and D.G. Khan

Estimated Cost:

Total cost of providing 5,085 Buses in seven major cities of Punjab is estimated to be PKR17.8 billion.

Table 3.3.7 Anticipated Cost of the Overall Project

City	No. of Buses	Total Cost (PKR millions)
Lahore	2,162	7567.0
Rawalpindi	471	1,648.5
Gujranwala	411	1,438.5
Multan	643	2,250.5
Faisalabad	988	3458.0
Bahawalpur	265	927.5
D.G. Khan	145	507.5
Total	5,085	17,797.5

Source: Transport Department – Cost of one bus is PKR 3.5 million

For Pilot Project with 100 Buses the cost comes to PKR 350 million

Table 3.3.8 Anticipated Cost of Pilot Projects

City	No. of Buses in Pilot Project	Cost of Pilot Project (PKR Million)
Lahore	35	122.5
Rawalpindi	15	52.5
Gujranwala	10	35.0
Multan	10	35.0
Faisalabad	15	52.5
Bahawalpur	10	35.0
D.G Khan	5	17.5
Total	**100**	**350**

Source: Transport Department

Fuel Cost/ Bus/ Year: PKR 265,400
Management/ Maintenance Cost/ Bus/ Year: PKR 306,000
Operational Cost/ Bus/ Year: PKR 571,400

Financial Source:

GoPb: Buses Fleet, Operation and Maintenance

Private Operator: Management Cost

Schedule:

2011 – Onward

Implementation Body:

Transport Department in Collaboration with Education Department

3) Up-gradation of Bus Stands– (*a Transport Department Project*)

Operational efficiency of the General Bus Stands in Lahore city is not up to the mark, and regarded as poor ambience and service control by general public. Locations of these stands are still questionable. There is no mechanism of revenue and expenditures control, this is resulting in enormous amount of pilferage, causing extra charging to passengers by bus operators.

GoPb, Transport Department has a vision to change the mishandling of finance and operation of bus stands by enforcing proper revenue generation and collection mechanism. This includes expenditure control of each bus stand, control of fares and bus operators charges, providing facilities to passengers providing parking, bus bays, intra-city feeder services.

Project Description:

Transport Department completed in-house survey of two (2) main bus stands. The Urban Unit is working on concept paper and proposal for improvement of Government owned bus stands in the Lahore City. Components of the functional Bus Stand to be identified and proposed so as to develop air-port style facilities for meeting and matching passenger needs and comfort. Four such bus stands have been proposed in Lahore to meet the demand. Lahore Urban Transport Master Plan study proposals will be considered in this regard for future steps in development of General Bus Stands in the Lahore Area.

Status:

Project is in the inception stage.

Location/ Area:

Lahore District

Estimated Cost:

No cost estimates are available.

Financial Source:

GoPb or Public Private Partnership

Schedule:

2011 – Onward

Implementation Body:

Transport Department, GoPb

4) Integrated Bus Operation (*a LTC Project*)

Preliminary analysis shows that there is excessive overlapping of routes as classified in Gazette 2006, and many routes are not operational since their classification. LTC recommended re-organization of routes to reduce overall travel distance and offered routes on public private partnership, to attract investors and solve most of the problems of existing system of 'notified' routes operation. It is expected that integrated bus operation will reduce daily bus travel-km by approximately of 100,000km. Further, saving of time, elimination of illegal transport, better headway, attractive to investors for operation are other benefits of the project. Buses will operate in the system on trunk and feeder system with classification of vehicle type on the basis of passenger demand as opposed to the existing system, where all current routes are classified for large buses.

Project Description:

Feasibility study will be prepared after LUTMP.

Projects Components:

1. Built-transfer –lease of routes i.e. offering routes on the basis of per km of operation to bus operator;
2. Bus management system and E-ticketing system;
3. Construction of bus stop shelters.

Note: Re-organization of routes considering LUTMP recommendations.

Status:

LTC is waiting for the Study final report, particularly with regard to the trunk public transport system. RfP has been issued for the Bus Management and E-ticketing system. Bus shelters have been proposed on different important corridors at appropriate locations. There will be constructed through private sector involvement.

Location/ Area:

Lahore District

Estimated Cost:

PKR 6,410 Million

Financial Source:

Lahore Transport Company: E-ticketing and Bus Management System

Private Bus Operators: Buses

Schedule:

No Schedule available.

Implementation Body:

Lahore Transport Company

5) Establishment of Multimodal Bus Terminal(Shahdara) – (*an Urban Unit Project*)

Sheikhupura district population was about 2.9 million in 2000. The city is well connected with its surrounding urban centres like Lahore, Faisalabad, Sargodha and Gujranwala. Parts of Sheikhupura District, Tehsil of Sharaqpur, Ferozewala, and Muridke are in the the Study Area.

Presently there are 2 bus terminals operational in Sheikhupura city:

– 32 Chowk Bus/ Wagon Stands

– Daewoo Bus Stand at Sultan Colony

But these are operating without any proper facilities and even lack basic public amenities. These bus stands are incapable of handling current demand of public Transport. The buses and wagon are using the road-side for their daily operations; this situation is creating traffic congestion. In this regard, a multi-modal bus terminal facility is required to be built to cope with the problems and to facilitate the public transport passengers. The purpose of multi-modal bus terminal is to provide fast and efficient multi-modal terminal facilities for inter and intra-city travel.

Project Description:

The word “multi-modal” has been used, it means a comprehensive multi modal transport has to encourage best fit model to the economy and needs of the hour. This will be a multi-modal including truck/ freight terminal.

Status:

Land has to be identified and acquired, which is in process. Later on contractor and consultant will be hired to do the construction and supervision job respectively.

Location/ Area:

Sheikhupura Lahore Bypass, location has to be finalized yet. Proposed area for bus terminal is shown below in Figure 3.3.3.

Estimated Cost:

No cost estimates are available

Financial Source:

City District Government of Sheikhupura, GoPb

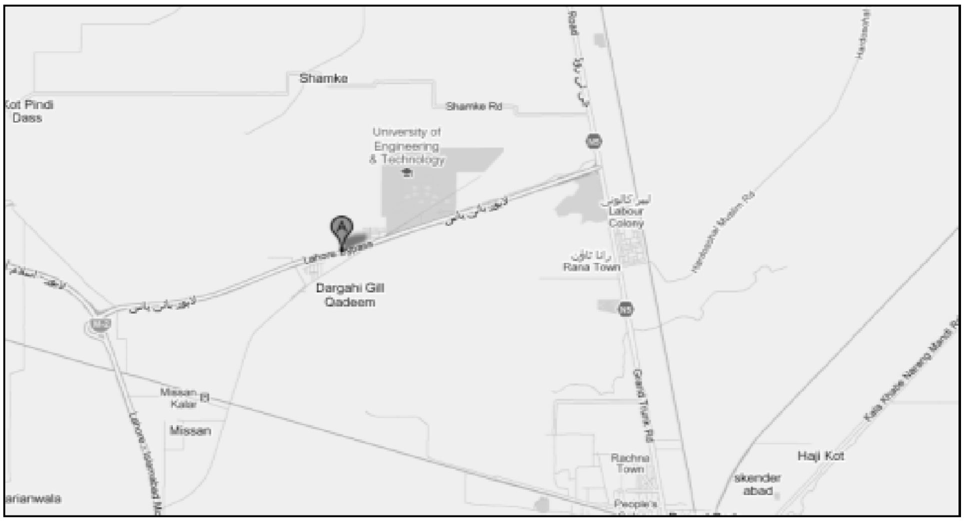
Schedule:

2011 – Onward

Implementation Body:

City District Government of Sheikhupura

Figure 3.3.3 Proposed Area of Shahdara Multi-Modal Bus Terminal



Source: Transport Department

6) Bus Rapid Transit (BRT) System Study (a LTC Proposal)

A Korean Group of investors have expressed interest in providing BRT system along the LRMTS Green and Orange Lines corridors on BOT basis. The GoPb has requested the Korean investors to prepare detailed feasibility study, giving details of technology, financing and implementation plan for a BRT system along both corridors. The feasibility report was expected in February 2011 but it has not been submitted until November 2011.

7) Monorail System in Lahore

An international group (lead by Malaysian Co.) has recently submitted an unsolicited bid to build and operate a monorail system along the Green Line alignment on BOT basis. The proposal is currently being examined by the GoPb for its viability and characteristics. The technical specifications of the proposed system are also being scrutinised and confirmed. Some relate to the bidders ‘claims’ regarding the system capacity, operational characteristics, source of funding, hence its technical and financial viability is in question. As a result, there has been no decision as yet on implementing a Monorail system in Lahore.

3.3.4 Main Planning Issue

Transport, accessibility, and mobility are arguably the single biggest issue raised by Lahori citizens as a severe problem in their daily lives as they suffer the stress of traffic congestion and reducing mobility in the city. The human toll in terms of lost time, opportunity effects on health and education and employment are vast, and its effects on society will be generational. The city as a whole carries a large social and economic cost, and incurs environmental degradation from the effects of traffic congestion.

Lahore city has a demography that ranges from the affluent, to the middle class and to large areas of economically disadvantaged populations whose daily life is a constant struggle. While the traffic congestion in the city and its regions affects all levels of society, increasing vehicle ownership and traffic congestion worsens conditions for the poor, reducing access and mobility to opportunity for employment, education, and access to other civic services and recreation.

The decline in the transport condition is typified by the combination of a collapse in the public bus system, rising car ownership, greater use of motorcycles, and a huge dependency on Rickshaws and Qingqis to shoulder the burden of public transport. Para-transit fares exceed regulated bus fares, with Rickshaws operating on negotiated fares and Qingqis fares ranging from PKR 15-30, impacting on the cost of travel and contributing to the suppression of demand – where people reorganize their lives to cope with the situation, or abandon opportunities they may have otherwise taken up.

Middle income earners comprise the largest sector of motorcycles users being a low cost commute option compared to cars and due to the lack of public transport options. Evident in the travel surveys is a strong indication that improvements to public transport would easily win over this sector.

The overall failure of transport in Lahore can be attributed to a failure in urban governance with a bureaucratic and project–centric approach (under an infrastructure led strategy) is inadequate to meet rising transport challenges. A history of non-materialized projects has culminated in the present situation with ad-hoc planning with little strategy and coordination, and a lack of consensus across political lines.

The overall public transport system in Lahore has been grossly and continually underfunded due to regulated fares that cannot sufficiently recoup sometimes even operating costs. The collapse of public bus operations and the lack of willing investors indicate a general sense that the business is not financially viable. In response to the poor economic prospects of the business there are indicators that operators have in some cases exploited government support to improve their financial condition/ profitability.

The cost of bus operations has been adversely affected by reducing traffic speed, slowing buses, reducing fleet efficiency and fleet productivity, and increasing fuel costs. The increasing price of fuel without commensurate fare increases has also played its part in the demise of the system.

Ultimately, the attitude of private investors is formed through their perception of risk. Where operators carry risk, they cannot manage, there is little prospect of success. Considerable effort has been made to reinvigorate the public bus industry, and presently the LTC aims to structure a subsidy scheme to attract and support bus operations, but unless sustainable business models are developed that address risk, build investor and operator confidence, these initiatives will also fail.

Ultimately a social policy of regulating fares without sufficient compensation will (and has resulted) in financial collapse of the operator, or the delivery of poor services. Such social policy is therefore a poor social outcome. The outcome has been that passengers are either denied a service, or pay much higher fares for Para-transit modes.

However, Lahore is not alone in this situation as many worldwide cities (including the world's leading cities) struggle under the challenges of managing city traffic and developing more sustainable and efficient transport systems (and learning how to win over passengers from their private means of travel). Contemporary approaches to public transport institutions are more commercially-oriented, aiming towards business sustainability and built-in incentives to improve system performance and customer services. Where this can be achieved, governments win through improved transport efficiency (reduced costs), cities win by improving production and quality of life, and passengers are provided with affordable and quality travel.

For Lahore, the critical task and central focus should be to improve mobility and accessibility in the city, and by doing so, improve economic opportunities and production; ensure social inclusion for all; and create a city that offers a quality of life to its citizens and future generations.

3.3.5 Development Strategy

1) Strategic Planning Approach

The transport problems of Lahore City are all-encompassing, requiring a range of synchronized policy approaches and solutions. A strategic planning approach will develop clear and defined (and agreed) objectives aiding the planning process toward desired outcomes. Strategic planning must be underpinned by sound principles to ensure successful outcomes and can serve as a basis for consensus amongst all stakeholders regarding direction and objectives. The following items are listed as the essential underlying planning principles for the city and its transport, which will direct and support the strategic planning framework.

2) City Vision

Firstly, policymakers must envision the future of the city. In a 21st century world, cities face new and different challenges; among them: energy cost and security; pollution and climate change, the necessity to limit carbon emissions and increasing conflict over road space.

Defining a vision requires questioning: “Will Lahore is a city for cars or a city for people?” “Can its rich cultural heritage, its artifacts and its charm survive the onslaught of changes wrought by development and misguided infrastructure development?” “Can its significant tourism potential be realized and safeguarded?”

European cities in facing the same challenges adopt bold urban design and management policies to make car travel more difficult (as a demand control measure) and to encourage, support and promote pedestrian space, cycling and public transport. The cultural attractions, lifestyle and city environment are thus preserved.

3) Focus on Accessibility and Mobility

A policy focus on accessibility and mobility (not just infrastructure for cars) has a multilayered impact. It encourages the improvement of road management and better use of existing infrastructure; promotes public transport (which is more energy efficient and emissions sustainable) and can rebalance the way roads function in the city.

By focusing on the public transport network, access improves, firstly by a person’s proximity to the network and secondly, once on the network, a choice of destinations that can be easily reached. Transport access can also be a strong poverty reduction strategy, by connecting the poor to the economic opportunities in an expanding economy.

4) Create a Balance in Road Use

Worldwide experience shows that traffic congestion may actually never be ‘solved’, and the logic of building more roads to ‘ease’ traffic congestion is a highly questionable strategy. Given the growth and demand for personal travel, any increase in road space will be quickly absorbed by more cars. The adage ‘more roads equals more cars’ is true, and flyovers built to ‘solve’ congestion will, in many cases, just speed up traffic to the next bottleneck, actually worsening congestion.

Clearly, cities do need basic and adequate roads infrastructure in the transport network, but road widening projects aimed at reducing traffic congestion are likely to be ultimately ineffective and will cause negative impacts on the living environment in the city. It would be preferable for Lahore to concentrate on developing basic roads in needy areas rather than widening roads for more traffic, such as the proposed Canal Bank Road widening project.

The only sustainable strategy is to improve the management and utilization of roads, recognizing that cities are for people, not cars and reclaim space for walking, cycling, and communities to enjoy public space. Efficient transport systems like BRT can absorb demand and improve road capacity allowing cities to be rejuvenated as communities. Improving the quality of public transport can help to make it a “lifestyle choice” reducing the tendency for increasing car use.

Cycling, while often regarded a ‘poor man’s travel’ in developing cities is making a huge comeback in first world cities, where space and conditions are provided for safe cycling. In European cities the mere reduction in city traffic has allowed cycles to mix safely with other traffic on inner city roads. Cycle ways have become a popular and essential part of road development and promotes a healthy a low cost, energy efficient and environmentally friendly transport alternative. Cycle ways are a good supporting measure for public transport and a valid option for all income groups. It also offers low cost mobility to poor sectors of society.

Using road or congestion charging to manage road use is also a mechanism to balance the use of the road, while raising revenue to invest into public transport (the London model). Ultimately, traffic congestion can be regarded as an incentive for motorists to switch to a faster and more efficient public transport system.

Figure 3.3.4 Integrating Public Transport and Redesigning Inner City Road Use - Europe

Source: JICA Study Team

Figure 3.3.5 Restoring City Centres to Create People Friendly City Environment - Europe

Source: JICA Study Team

5) Develop a Clear and Defined Transport and Development Strategy Specific Aims and Objectives Targeted in an Action Plan

Locally, transport policy and planning have typically been the domain of political players, predominantly focused on specific projects, often as ad-hoc responses to varying needs and issues that arise from time to time. Previous master plans and feasibility studies, while being prescriptive in projects and timelines, have not provided sufficient strategic support and guidance as to why and how projects will achieve objectives. In fact, objectives are often not defined, save the objective of building 'something'. Lack of strategic thinking and poorly defined objectives also limits stakeholders in their innovation toward non-traditional approaches and does not enable the critical evaluation of projects; how they meet objectives; which projects to prioritize or synchronize for greater impact.

The lack of strategic framework in master planning often does not allow policymakers to adapt to changes during the plan's effective period (changes caused by national or global financial constraints, specific components of the plan not materializing etc) leaving them uncertain as to what alternative actions to take. Consequently, Master Plans are often have a short shelf life if they are not supported by a sound strategic framework.

One further advantage of establishing a strategic planning framework is that it can be used to develop a first level of consensus and agreement amongst stakeholders – a common ground of agreement and a point of reference, useful where disagreements surface in more detailed discussions.

6) Improve Institutional Regulation and Management of Transport

Failures in transport are always institutional failures. There are three specific areas where improvements should be made, being:

Firstly, it is the lack of coordination in managing the urban transport function in the city. This is a worldwide issue, as traditionally governments have various unrelated departments managing individual elements of transport within the city. The increase in the size of cities and spreading urban conglomerations (often traversing municipal boundaries), has demonstrated the need for better coordination to manage urban transport (and urban development) as a single function. To achieve this, strategic policy development should be placed under a single policymaking umbrella. There also needs to be a separation of function, with strategic policy development at the highest level, executing agencies at service delivery management level and actual service delivery under contract. This creates proper oversight and accountability and defines clear functional roles, responsibilities and obligations.

Secondly, there is a lack of a system network in the sphere of public transport. A collection of single routes does not make a network. Individual operators collect single fares for single trips and will often work against the network to maximize their own returns. Managing the network as a system is essential, with system wide planning, integrated fares and ticketing (one ticket across the network) and revenue spread across the system to provide equitable levels of service.

Thirdly, the failure of regulation is mainly due to the risk borne by operators (and also there being a very large number of individual operators to manage) where the economic survival instinct of operators is often in conflict (and stronger) than the regulations designed to govern their activities. Management and business models must be designed to assign risk between the parties to where it can be best managed, where the bus agency becomes the system manager (taking business risk and acting a commercial and business-like entity) and bus operators plying buses under a sound and financially viable business model.

7) Develop Viable Business Models to Support and Develop Public Transport

Transport must operate in a commercial and business-like way. Subsidized transport operations are seldom efficient as there is little incentive to improve revenues and increase efficiency. A business model driven by revenue growth (not subsidy) is more likely to identify and develop business opportunities; develop revenue; improve management; meet the needs of its customers; develop an efficient passenger network (travel time and destination choice); efficiently manage its fleet utilization and costs, and keep fares more affordable.

8) Develop Efficient Public Transport Infrastructure

Travel speed is critical to operate the bus fleet efficiently and keep costs under control. Passengers benefit from faster travel times thereby attracting patronage and increasing revenues. Bus speed directly impact on costs thereby impacting on commercial fare levels and subsidy requirements. The multiple benefits of improving bus speeds are illustrated in Figure 3.3.6.

9) Ensure Sustainable Funding Structures

(i) Funding Public Service Delivery

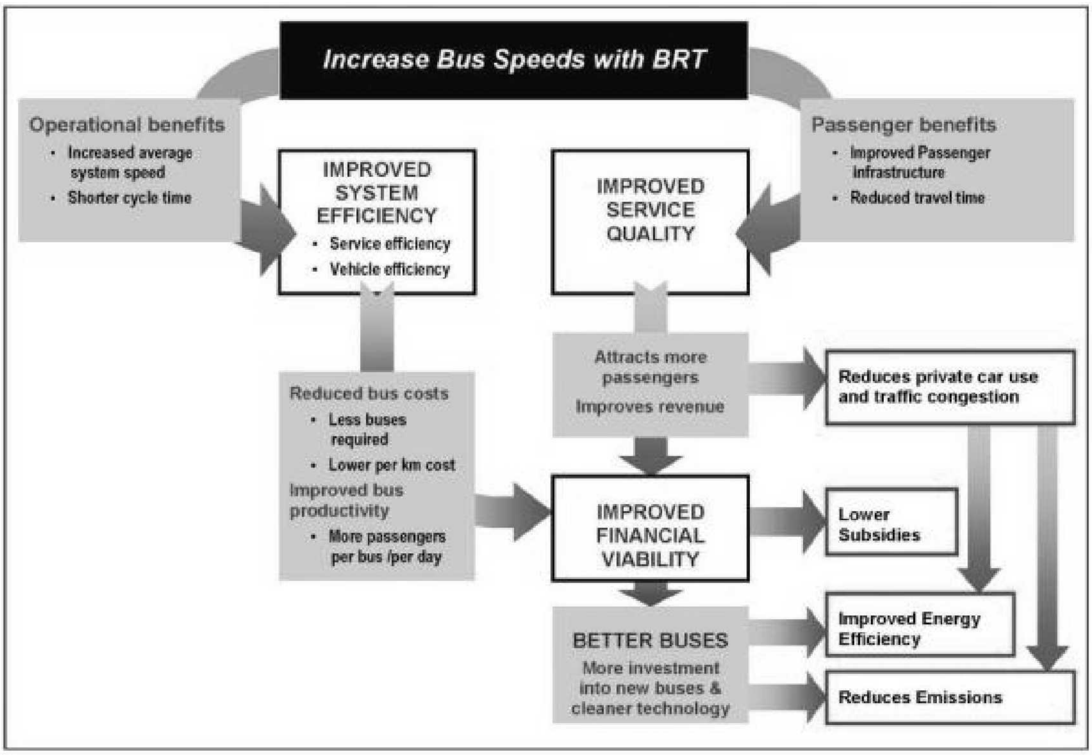
Public transport services should not be designed under the lowest common denominator fare. Adequate system funding and efficiency go hand in hand, where revenue and efficiency is managed on a system wide basis. Centrally managing system revenue has multiple benefits: it separates the system revenue from operators thereby improving revenue control, improving equity across the system (distributing benefits across the system with higher performing routes cross subsidizing poorer routes), and provides the necessary revenue sharing mechanism for an integrated ticketing system. It is the task of the agency to manage fare policy to maximize returns, develop patronage (e.g. discounts for volume users and create market incentives) in the same way a business would manage its competitive pricing policy.

(ii) User Pays Principle

All public service delivery has a cost and someone will pay – the user or the government. Where operators shoulder the burden of an artificially set fare, they will ultimately collapse or provide minimum levels of service typically resorting to illegal or unsafe practices to ensure sufficient returns to survive.

Fares should be set at a commercial fare level – a level that allows full system cost recovery. Where the government invests in improved efficiency like a BRT system, the agency can be expected to be able to reduce or eliminate reliance on subsidy. Should the government choose to provide a user-subsidy it would fully compensate the agency for revenue shortfall.

Figure 3.3.6 Multiple Benefits of Increasing Bus Speeds



Source: JICA Study Team

Similarly, the same argument applies to road users, who presently do not pay for the use of road space (provided free of charge by the government). Road-user charging is a good option to raise funds for road upkeep as well as providing funds that support more sustainable and efficient travel modes such as public transport.

Better financial support of public transport will improve services levels and also serve to influence motorist's behavior. The road user charge can serve as a tool to manage efficient use of road space (the Singapore model) – adjusting toll levels to reduce traffic until road efficiency is reached. However, good public transport system should exist in parallel to road charging so motorists have an option to avoid the user charge.

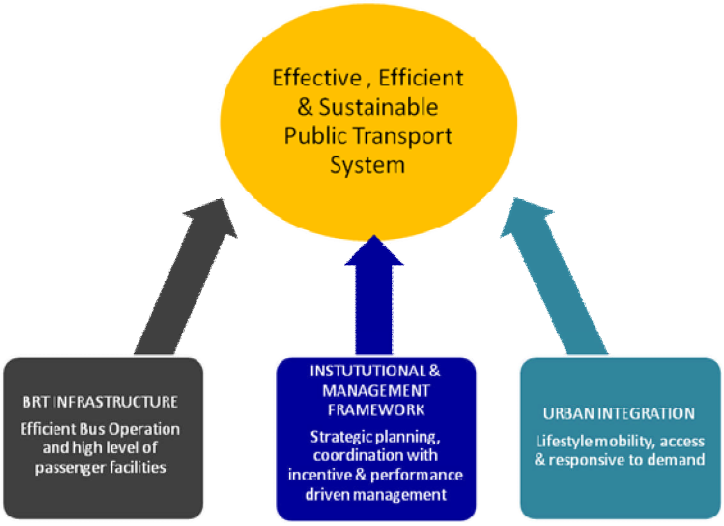
3.3.6 BRT System as Public Transport Development Strategy

Bus Rapid Transit (BRT) has become increasingly popular as a mass transit mode as it addresses the full range of planning principles outlined above. Its benefits are that it can be well integrated into the city to provide the essential transport network, is designed to offer a high level of operating efficiency which reduces costs, and provides a 'metro' level of passenger service.

BRT is more than just attractive infrastructure making buses efficient. Three essential pillars of support underpin its success as shown in Figure 3.3.7. The institutional and management framework is critical to its success, as is its design into the lifestyle and function of the city. Each BRT must be designed specifically to suit the city in which it operates and yet maintain its design objectives to guarantee its performance.

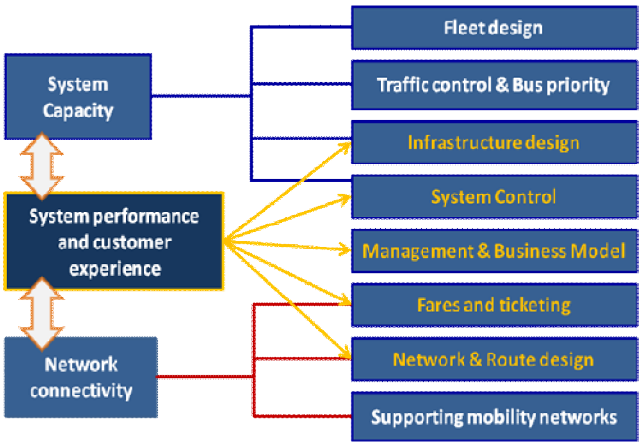
The components of BRT and their connection to service performance, capacity and network connectivity is shown in Figure 3.3.8.

Figure 3.3.7 Supporting Pillars for BRT System



Source: JICA Study Team

Figure 3.3.8 Components of BRT



Source: JICA Study Team

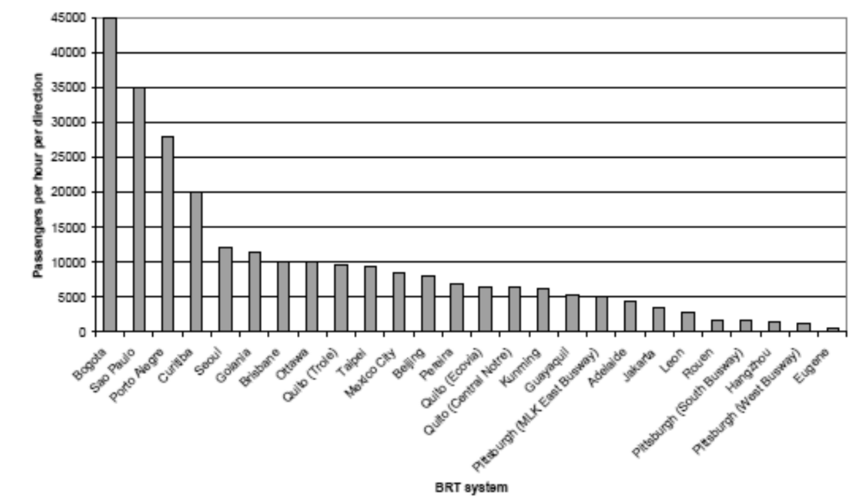
1) BRT Planning Objectives

BRT planning objectives are based on the following criteria:

(i) Ridership

BRT must be designed flexibly to manage a low to high level of ridership on high demand corridors. BRTs in the world are designed to match a wide range of transport demand as shown in the Figure 3.3.9. Given the road and travel demand situation in Lahore all major arterial bus routes should operate as a BRT in order to achieve operating efficiency sufficient to support their viability.

Figure 3.3.9 Actual Peak Ridership of Various BRT System

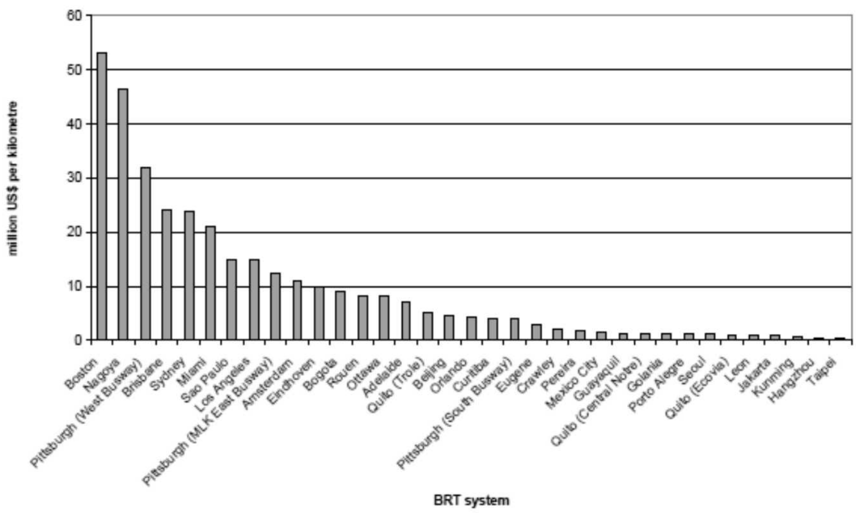


Source: "Bus Rapid Transit Systems – a comparative assessment", David A. Hensher, and Thomas F. Golob, University of Sydney

(ii) Capital Cost Effectiveness

Major corridors in Lahore are sufficiently wide enough to accommodate BRT so there is little apparent requirement to widen road or develop 'right of ways'. Where minor inner city roads need to accommodate a BRT, alternative road use can be considered such as one way traffic (or one way BRT loop service) or converting the street to a transit corridor and removing cars altogether. Figure 3.3.10 shows total infrastructure cost of selected BRT systems around of the world. The cost changes vary from USD 0.35 to 53.2 million per km depending on the design requirements such as station quality, modal exchange facility at terminals and separation from other road traffic.

Figure 3.3.10 Total BRT Infrastructure Cost (per km)



Source: "Bus Rapid Transit Systems – a comparative assessment", David A. Hensher, and Thomas F. Golob, University of Sydney

(iii) Operating Cost Efficiency

A high level of service quality and frequency improves both passenger services and fleet efficiency. The BRT network improves transfer opportunities and reduces the overall number of bus routes that would be necessary in a traditional bus route network.

(iv) Urban and Economic Development

BRT due to its presence as an established transport infrastructure will support city development along the corridor and vice versa (development will support BRT). More compact development and increasing land values along a BRT system will stimulate more efficient travel patterns.

(v) Accessibility Improvements

High quality passenger infrastructure, a strong corridor presence and good connectivity across the network improves the reach and accessibility of BRT across the city and into suburban areas, greatly improving access and mobility.

2) BRT Design Objectives

Identifying clear objectives is a good starting point for designing a suitable system. The following design objectives will guide the planning process:

- To design a system with a mass transit image that offers a high standard of service.
- Give BRT a clear priority over other traffic and be well integrated into the city landscape to make it the transport 'lifeblood' of the city and deliver a balanced use of road space resource.
- Use BRT as an opportunity to maximize corridor capacity while reclaiming space for NMT (cycling) and pedestrians.
- Develop a full network of trunk, intermediate and feeder routes for maximum access and connectivity – a few kilometers of high technology will not deliver a transport solution for the city. The inaugural project should consist of two intersecting lines.
- Use of advanced e-ticketing technology and integrated fares across the network to enable passenger transfers at no extra cost.
- Use advanced technology for bus control in order to develop high reliability, punctuality, convenience, and safety.
- Make BRT financially sustainable and avoid where possible, dependence on government subsidy.
- Improve bus system management with a sustainable business model.
- It must be environmentally-friendly in respect of emissions, energy use, and urban

infrastructure impacts.

- It must use a level of technology compatible to the city, mindful of maintenance skills required and where possible enhance skills development and support local industry.
- The system should be able to cater for future growth in capacity and network coverage with a measure of flexibility to adjust to changes in demand that may occur over time.

Table 3.3.9 shows characteristics of some Asian BRTs. These examples clearly show that there is no fixed concept and BRT and Lahore can develop its own BRT system if proper planning process is followed.

Table 3.3.9 Characteristics of Selected Asian BRT Systems

Characteristics	Jakarta (1st Line)	Seoul (Median Bus Lane)	Beijing (Southern Axis Line 1)
Running Way	12.9 km fully segregated median bus-way from Blok M to Kota.	37.2 km median bus lane colored but not physically segregated.	16 km physically segregated except for a part (2 km).
Station	Elevated platform connected to sidewalk by pedestrian bridges.	Shelters installed on medians.	Stops installed on medians connected to sidewalk by cross-road or pedestrian bridge.
Vehicle	Air-conditioned 56 buses as per Euro II.	Low-floor buses, CNG buses and articulated buses.	15 CNG articulated buses, 40 BRT buses and 50 regular buses.
Service	Headway of 2-3 minutes during peak and 3-4 minutes during off-peak period 5:00-22:00.	Headway 3-5 minutes during peak hours and 7.6 minutes on average.	2-3 minutes.
Route Structure	One dedicated at-grade lane.	Divided into trunk lines and feeder lines. Buses color-coded and numbered by line.	One dedicated at-grade lane.
Fare Collection	Contactless fare card system in advance at stations. Flat fare of 30 cents per ride. Discounted fare applied by time of day.	IC card. Flat fare of 85 cents per trip. Transfer discount applied.	Fare collected manually at bus stops. Flat fare of 25 cents.
ITS	On-board variable message sign. Announcement of next station in Indonesian and English.	At bus stops, passengers are informed of arrival time of next bus.	Next stop announcement system.
Integration with Other Modes	None.	Transfer information on IC card.	None.
Operating body	TransJakarta BP, a publicly managed company.	Private company with public intervention.	A state-owned BRT company with private but subsidized Beijing General Bus Company

Source: Compiled by JICA Study Team based on “Analysis of Policy Processes to Introduce BRT Systems in Asian Cities from the Perspective of Lesson-Drawing”, Naoko Matsumoto, Institute for Global Environmental Strategies

3) Sustainable Plan for BRT System

(i) Management Structure for BRT System

Separating the areas of policymaking, management and operation into three clear hierarchal levels, can be achieved through the following distinct functions:

- Policy, regulation and coordination level - consisting of representatives of all key stakeholders, being the departments and agencies, responsible for strategic urban policy; regulation and coordination of urban transport.
- Management level – responsible for bus system management; customer service delivery and central ticketing and revenue collection, and operating as a commercial business enterprise.
- Operation level – managed under a service delivery contract; a performance-based contract fully funded and responsible for delivering bus services on per km basis.

In addition, the US Transportation Research Board paper “Bus Rapid Transit” (2003) stresses the importance of the support from local community to implement a BRT project successfully.

(ii) BRT Management Organization

The proposed Transport Management Board (TMB), Punjab Urban Transportation Planning and Engineering Institute (PUTPEI), Lahore Transport Development Company (LTDC) and Lahore Urban Transport Advisory Council, a further expanded concept from the previously proposed Urban Transport Authority, will improve coordination through high level consensus and develop a strategic urban transport policy to guide implementing organizations in their tactical planning and business operations. Urban development must also be included in strategic planning. The advantage of such a body is that it can develop a shared vision for the city; provide an exchange of ideas and perspectives, and reach a consensus in decision-making for which it can assign responsibility and budgets. It can also recommend major policy direction to the government.

The LTDC will have a Board of Management (TMB) comprising all relevant stakeholders (including heads of implementing agencies and divisions of RTDC) who jointly develop an integrated Strategic Urban Transport Policy. It manages and monitors strategic policy implementation through the line agencies (who are all represented at Board level) and can make adjustments as necessary to adapt to changing circumstances. It has a secretariat and a research and planning section to provide support. It would meet monthly, bi-monthly or as appropriate.

(iii) The Lahore Transport Company (LTC)

The Lahore Transport Company, which is proposed to be merged into PUTPEI and LTDC, would be commissioned to operate as the BRT management company and manage the expanded system including intermediate and feeder bus routes. The LTC would operate in a commercial and business-like fashion focusing on business performance, to win customers, develop revenues, and manage costs efficiently. The business risk of the system will be borne by LTC.

With a BRT system, reducing or eliminating subsidy is achievable, as BRT is highly efficient and able to carry large numbers of passengers. The government would subsidize social fare discounts (where it sets a social fare level below the commercial cost of operation) as a 'user subsidy' and phase out subsidy for operating losses.

Managing the bus operator through a performance-based contract gives the LTC a strong hand to control quality and performance issues (enforcing penalties for performance failures) but also gives operators a viable and profitable contract to operate.

The Bus Operating Contracts are paid on per kilometer formula that covers operational cost and a return in investment. It ensures bus operations are properly funded to maintain the fleet in good order, to provide trained and skillful drivers and meet the service specifications and standards as required under the contract.

Figure 3.3.11 Example of BRT (TransMillenio, Bogota, Colombia)

The TransMillenio BRT management company in Bogota operates with socially affordable fares and free of government subsidy, relying 100% on revenue generated from the system

Source: JICA Study Team

The specific responsibilities of the LTC would be to:

- Plan and manage the system network
- Manage the bus operator contracts
- Centrally collect revenue
- Manage the integrated fare system
- Manage the BRT control centre
- Manage information and marketing.

(iv) Bus Operating Companies

The kilometer-based contract for bus operating companies provides a sound investment framework to generate investor confidence and fund bus operations adequately. It has to support the required service standard and quality standards stipulated under the contract as well as maintain the fleet in good order, and provide trained and skilful drivers. Contracted payments for kilometers of services provided removes the revenue risk for operators but also gives the LTC a strong mechanism of control over quality and performance.

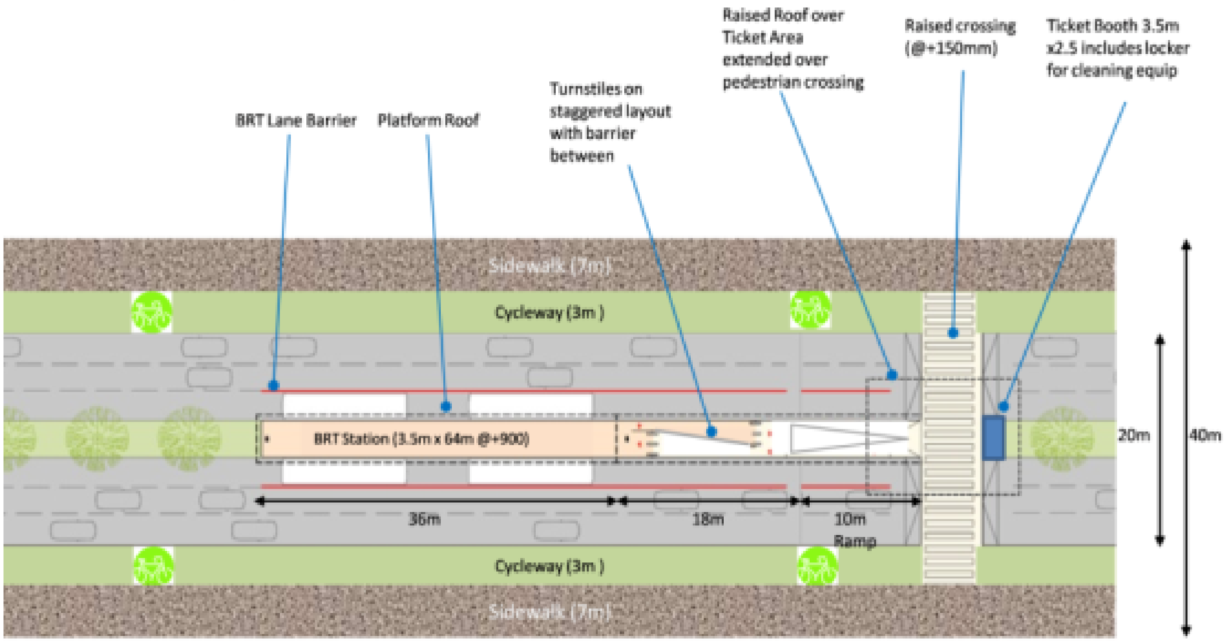
4) BRT Design

(i) Bus-way Construction

Median bus-ways offer the advantage of separating bus traffic from curbside conflicts which will improve traffic flow for both cars and buses. An added advantage is that it allows passengers to transfer between services on the same platform without crossing the road. Median bus stations also consolidate all ticketing and station platform activity in one central location, avoiding the cost of operating two platforms and ticket booths. Median bus stations also remove busy station activity from the footpath areas and do not incur any extra road crossings for passengers.

However, pedestrian crossings across the roadways need to be safely managed using signaling and raised crossing sections which can also act to slow traffic and create driver awareness of a shared pedestrian zone. Typical road cross sections for BRT are shown in the following Figures 3.3.12 to 3.3.15.

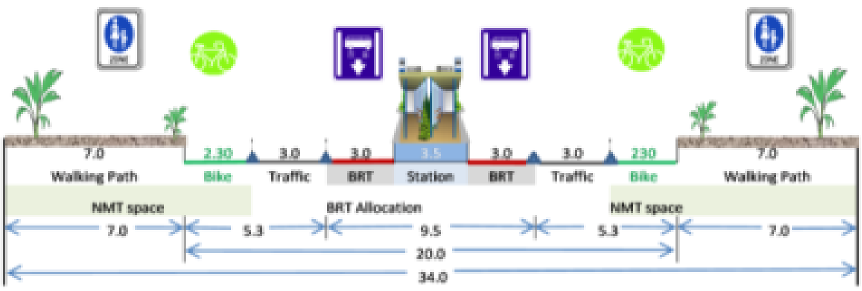
Figure 3.3.12 Plan View of BRT Station



Source: JICA Study Team

Figure 3.3.13 Inner City Narrow Corridor

34 m cross section with BRT Station

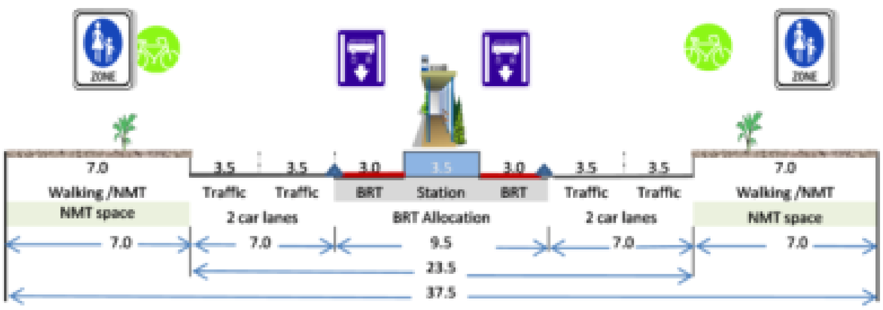


Station	YES
Cross section	34 metres
Cycleway	Separate
Mixed traffic lanes	1 in each direction

Source: JICA Study Team

Figure 3.3.14 Median Station with 2 Traffic Lanes

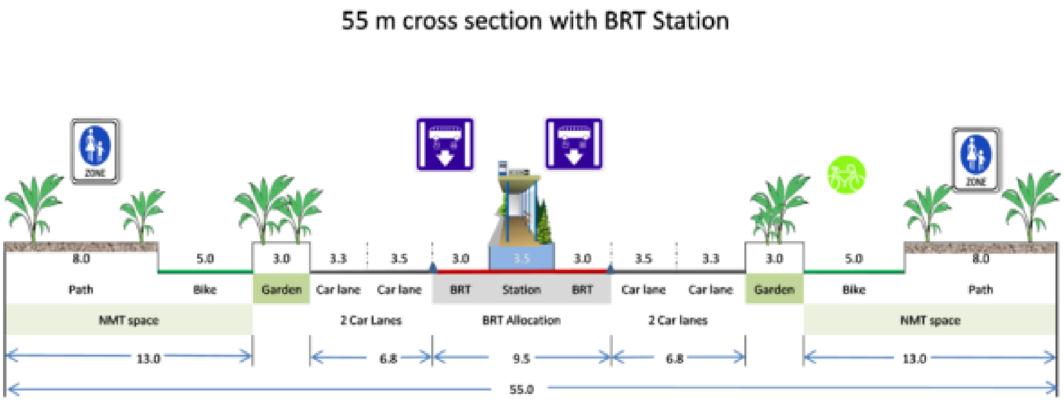
37.5 m cross section with BRT Station



Station	YES
Cross section	37.5 metres
Cycleway	No (could share with sidewalk)
Mixed traffic lanes	2 in each direction

Source: JICA Study Team

Figure 3.3.15 55m Right of Way at Station Location with Cycle Paths



Station	YES
Cross section	55 metres
Cycleway	Separate
Mixed traffic lanes	2 in each direction

Source: JICA Study Team

(ii) BRT Stations

BRT stations are more than ‘bus stops’; they are an important infrastructure element that influences customer service and amenity. They must also present an attractive and modern appearance and use high quality building materials to ensure a long life and that standards are maintained with little maintenance required.

Facilities such as ticketing equipment, ticket sales counter, disabled access, clear signage and beautification are all important elements that need skilled design.

BRT station design suitable for Lahore should include the following:

- Cost effective with clean design lines
- Closed station platforms minimum 3.5 meter wide with prepaid ticketing
- Varying length and configuration to manage fleet density
- Integrated into urban space with signalized level crossings
- Attractive image and strong system branding
- Quality built for easy maintenance and long life.

(iii) Pre-board Ticketing and Customer Service

Pre-board ticketing is used at bus stations and passengers pass through a turnstile on entry and/ or at exits. A ticketing sales counter is located at every station for passengers wishing to purchase cards or recharge value on their cards. Ticket vending machines can also be placed at high volume stations. Security staff assists on station platform and ensure rules of travel are enforced.

(iv) Mass Transit Image

System branding and a consistent brand image are important to make the system highly recognizable and attractive. Good information signage and promotional material will make the system easier to use and convince passengers of the system benefits.

(v) Bus and System Control

A defining feature of BRT is the central control of the system in real time to monitor service schedules and operations. GPS vehicle tracking provides managem ent and passenger information. A typical central system is illustrated in Figure 3.3.16.

The Control Centre can manage service disruptions quickly and attend to any security or safety risk events. Constant communication with each bus and schedules managed in real time ensure reliability of services. GPS tracking of buses at the Control Centre also provides automatic 'next bus' information to passengers at stations (suitable wher e services are less frequent). This makes services more predictable and reliable, r emoving the uncertainty often associated with public transport use.

BRT systems can use 'green light' signal priority to minimize traffic disruption and ensure schedule compliance. By using GPS tracking, the system 'knows' where the bus is, allowing bus movements to be synchronized with green light phases to provide bus priority with less impact on cross traffic.

Figure 3.3.16 Bus and System Control

Control Centre Brisbane

Graphic interface showing bus locations

Source: JICA Study Team

5) Integrated Ticketing and Seamless Transfers

To create a full public transport network requires integration of feeder buses with the BRT and a compatible ticketing system across the network, as shown in Figure 3.3.17.

Intermediate buses are secondary routes designed to operate off the BRT on suburban routes where they can operate kerbside boarding and alighting the same as a standard bus. However upon reaching the BRT they can dock at the BRT platform (on the paid side of the platform) using a level boarding doorway on the right hand side of the bus. This allows a seamless and efficient ‘on- platform’ transfer from feeder buses. These intermediate buses however must be provided with varying bus priority treatments even though they will often operate in mixed traffic. As these buses are BRT compatible, there is a flexibility offered to allow the operation of these buses on the BRT track during off-peak or where a short distance operation on the BRT is required.

Ticketing is integrated across the whole BRT fleet, with passengers swiping the IC card on the intermediate and being able to connect to the main BRT service without needing to re-enter the system via the ticket gate. Passengers can also transfer between routes at any BRT station where the routes overlap and do not incur a penalty cost by transferring across services.

Figure 3.3.17 Integrated Ticketing and Seamless Transfers

Ticketing turnstiles at entry exit to a prepaid platform area (Bangkok BRT)

Smart card ticketing at turnstiles records each trip at allows free transfer across the network

Source: JICA Study Team

3.4 Traffic Management

3.4.1 Present Condition and Problems

1) Driving Behavior

(i) Driver Education

There are no proper driver training schools/ institutes exist in Lahore. There are many small training schools established locally focused on limited training and high profitability and neglect the basic principles of traffic safety and travel behavior on the road.

Road Traffic safety and travel behavior is not part of syllabus in schools and colleges. This results in complete unawareness of road safety. Traffic police is trying on its own to give talks in schools and colleges, and also conducting traffic safety and driver behavior seminars to limited extent. These efforts are not sufficient at all to create proper travel behavior and road safety awareness in general public.

Traffic police has started Rasta (Road and Traffic Safety Awareness) website. This is a good step toward creating public awareness but this couldn't be productive if it is not supported by educational institutions which may lack computing facilities.

(ii) Licensing System

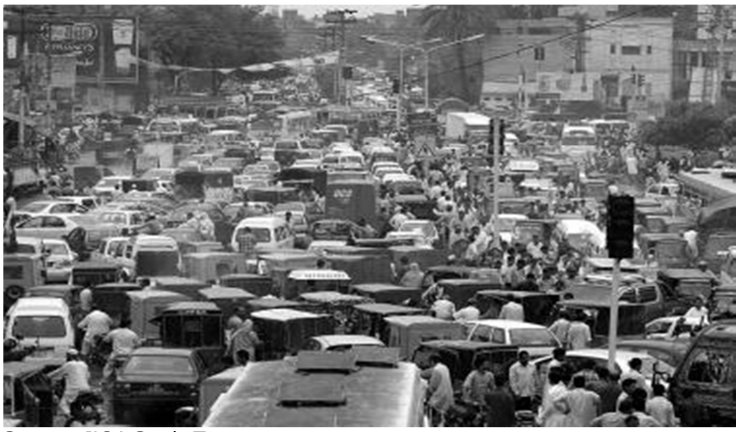
Traffic Police of Lahore is responsible for issuing driving licenses for all type of vehicles. New applicant has to get learner license valid for 3 months. After that there is a driving test in Traffic Police training school of the candidate. Applicant has to get training in that period and learn the Traffic Codes.

Traffic police don't refer any training school due to absence of such facilities. This results in poor training of drivers and complete lack of understanding of complex traffic situation of Lahore. Applicants learn driving on their own, from their fellows or relatives; who themselves had received no proper training thus can't teach except how to drive the vehicle.

(iii) Driver Behavior

Due to lack of proper training of drivers, results in strange driver behavior on roads which contributes to traffic congestion, traffic accidents, and at times a total gridlock of some junctions as shown in Figure 3.4.1.

Figure 3.4.1 Traffic Gridlock at Qartaba Chowk, Ferozepur Road



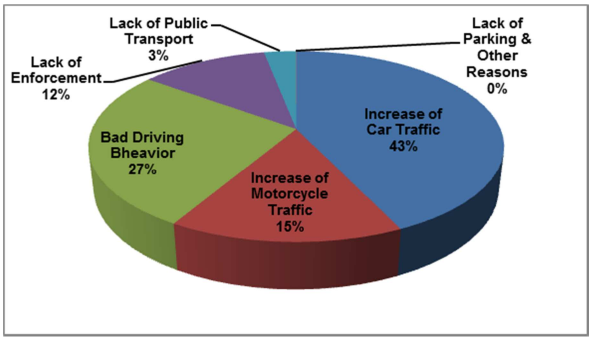
Source: JICA Study Team

Drivers generally do not have sense of traffic and safety; commonly everyone tries to drive in the fast lane including Rickshaw, Qingqi, Car, Motorcycle, Bus. This results in clogging of fast lane, and then drivers shift to middle or slow lanes which happen to be little use, this result in violation, i.e. overtaking from the left side or the lane of right of way of pedestrians, cyclists, and accidents in most cases.

Weaving behavior of drivers on main arteries results in lane changes from fast to slow and slow to fast at all time. This can be observed along Canal Bank Road from Ferozepur Road underpass to Jail Road underpass during peak periods.

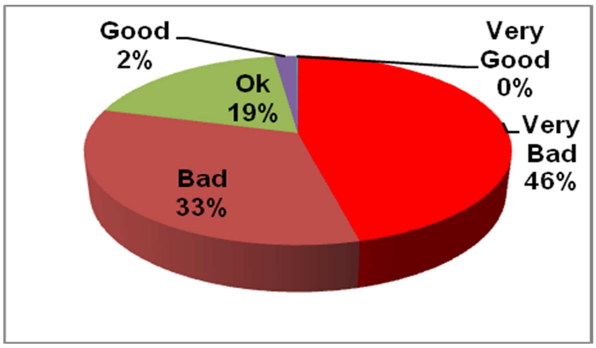
Drivers do not wait at junctions for their signal phase and often cross the stop line, even come in the middle of junctions along major arteries like Mall Road, Jail Road, G.T. Road, Ferozepur Road, Gulberg Main Boulevard, Airport Road and in some time in and around the walled city area.

Figure 3.4.2 Public Opinion of Traffic Congestion Reasons; Bad Traffic Situation (27%) and Lack of Enforcement (12%)



Source: LUTMP HIS

Figure 3.4.3 Public Opinion of Driving Behavior of Motorcyclists



Source: LUTMP HIS

2) Traffic Enforcement

(i) Institutional Set-up

Traffic enforcement is managed by a mixture of institutions that have varying degree of responsibility for enforcing traffic rules and regulations in Lahore. Traffic police is controlling traffic violations, encroachment and parking up to limited extent. This is done in coordination with TEPA and CDGL. CDGL controls illegal parking and encroachment. LTC is responsible for removing illegal operation of Qingqi, Wagons from notified bus routes and for the regulation of bus, wagon route permits. RTA and PTA control permits for inter-city bus operators, bus stands, and truck operators and stands.

Traffic police staff is about 3,700 which consist of 3,030 traffic wardens. Traffic enforcement is not fully effective in the city due to additional duties of traffic police for traffic operation, management of day to day circulation plans, VIP movement's control, and special management plans for riots, protests. 12% people responded in LUTMP HIS that lack of traffic enforcement is the main cause of traffic congestion in the Study Area.

Traffic signal operation of major signalized junctions is in very poor condition, signal timing is not based on traffic situation; which results in manual operation of traffic in peak hours by Traffic Wardens. These above mentioned factors are severely minimizing the effectiveness of such a large force of traffic wardens in the city as they are involved in doing functions of TEPA. CDGL do not have enough administrative capacity to effectively control the illegal parking and encroachment in down town area and along other major roads in Lahore.

LTC has constituted a force of traffic control wardens to control illegal operation along bus routes by Wagons and Qingqis; but it is ineffective due to shortage of buses on these routes, results in passengers using available mode (wagon) operating on these routes.

RTA and PTA are issuing route permits without any proper record and compliance of regulation. In any case, many illegal bus and truck operators ply on almost all inter-city routes, and have also established illegal bus and truck stands throughout the city, especially in downtown areas of Ravi and Samanabad Towns.

(ii) Introduction of Intelligent Transport System (ITS)

Automatic Number Plate Recognition (ANPR) system could not be implemented in Lahore due to presence of numerous type and size of vehicle registration number plates. Traffic Police has no control over the use of standard number plate issued by Excise and Taxation (E&T) Department. Everybody is using different design, position and even color for registration number plates. These cannot be read through sophisticated ANPR system as shown in Figure 3.4.4.

Although ITS system is expected to be effective in the current traffic situation of Lahore, the problem of non-standardized number plate has become one of the serious obstacles to its implementation such as the use of ITS technologies for Electronic Toll Collection (ETC).

Figure 3.4.4 Non-Standard Number Plates

Source: JICA Study Team

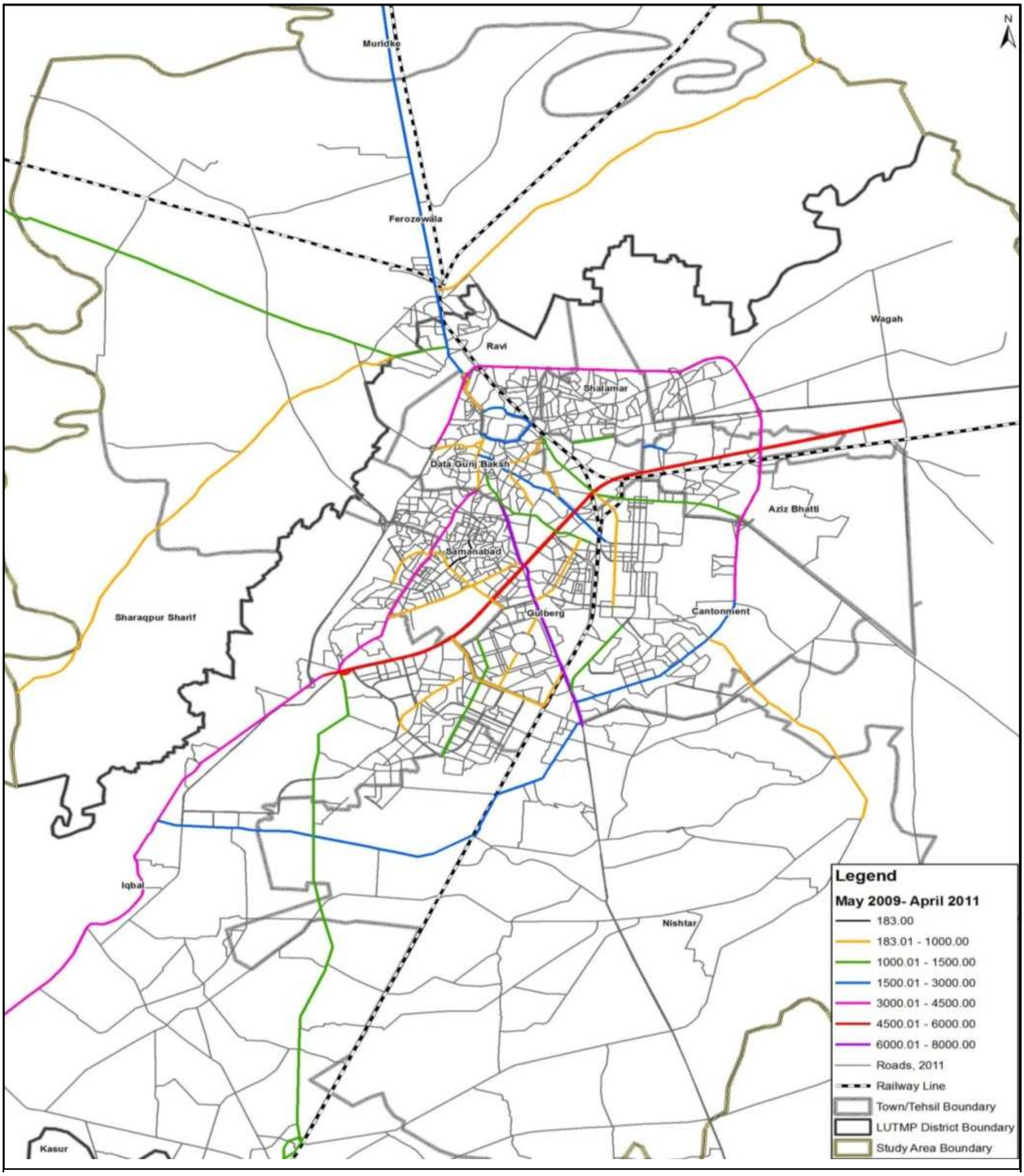
3) Traffic Safety

Traffic safety is the most overlooked traffic management issue of Lahore, there is no such previous study addressing the issue of traffic safety comprehensively in relation to the existing traffic condition. This seriously needs to be addressed under the current circumstances as most authorities/ agencies are moving on the paradigm of widening of all possible road facilities up to the maximum use of existing right of way. This in turn encourages the car and motorcycle drivers to over-speed causing a serious safety hazard. Road accident data for the last two years from May, 2009 to April, 2011 clearly shows the increase in traffic accidents on Ferozepur, Multan, G.T., Canal Bank, and Lahore Ring Roads as shown in Figure 3.4.5.

Problem of road safety in Lahore has been worsening largely due to lack of proper diagnostics. No research has been conducted in the past, and traffic safety issue cannot be addressed properly until the real contributing factor to this problem has been identified.

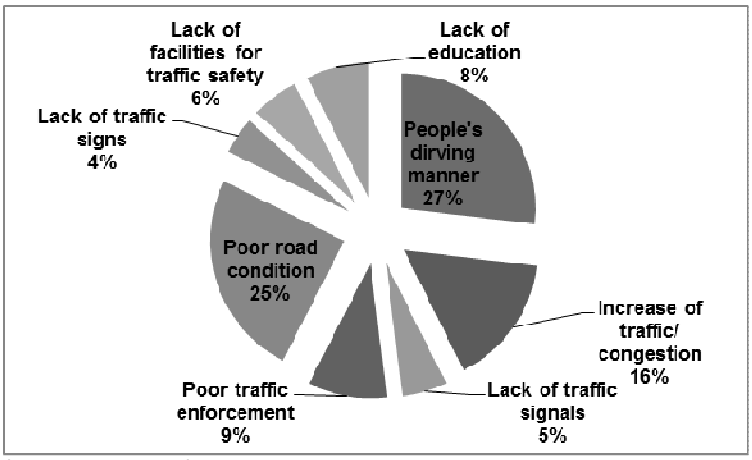
When asked about the factors contributing to traffic safety issues in the Study Area people driving behavior, and poor road junction conditions were the major factors identified by public as illustrated in Figure 3.4.6.

Figure 3.4.5 Total Number of Accidents – 2009 to 2011



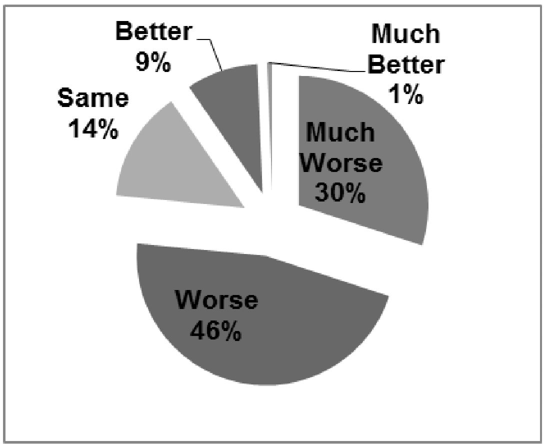
Source: Lahore Emergency Services (Rescue 1122)

Figure 3.4.6 Factors Contributing to Traffic Safety



Source: LUTMP HIS

Figure 3.4.7 Traffic Safety Situation Compared to 5 Years Ago



Source: LUTMP HIS

20% of the households responded, have been involved in traffic accidents in the Study Area in last five years; 60% of them suffered slightly injured 29% seriously, and 11% minor or no injury. Whereas, 76% of the respondents replied that traffic safety situation has become much worse or worse in last 5 years. This shows effective counter measures are necessary as shown in Figure 3.4.7.

(i) Traffic Mix

Heterogeneous traffic has unique safety issues in Lahore. These are mainly due to interaction between the disparity in vehicle speeds and sizes. The mix of traffic is the largest determinant of traffic fatalities. Effect of uncontrolled traffic mix is shown in Figure 3.4.8. Proportion of non-motorized traffic (NMT) and motorized vehicles in a traffic mix resulted in increased number of NMTs fatalities.

Figure 3.4.8 Traffic Chaos Traffic Mix near Data Darbar

Source: JICA Study Team

Figure 3.4.9 Pedestrians Road Crossing – At Their Own Risk

Source: JICA Study Team

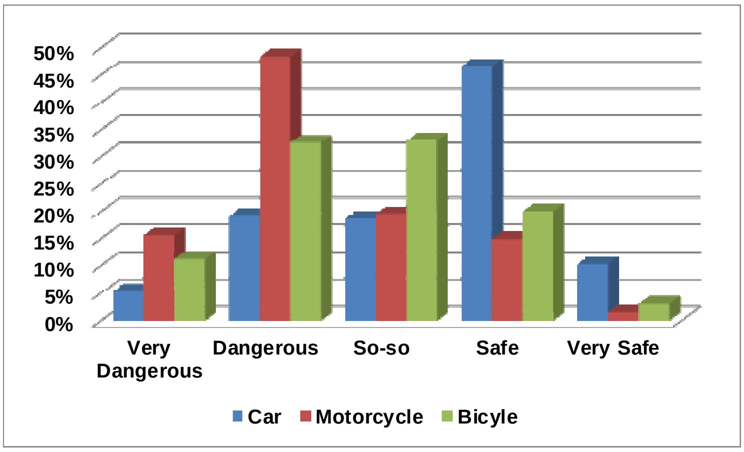
Exposed vulnerable road users such as NMTs are in proximity to higher speeds unavoidably causes conflicts and road accidents. Vulnerable pedestrians in Qartaba Chowk are shown in Figure 3.4.9. It is confirmed by Lahore Emergency Service record that majority of fatalities and injuries are related to pedestrians, cyclists, and motorbike riders.

The composition of higher-speed vehicles in the traffic mix can cause drastic differences in the fatality rates. Another significant determinant for heterogeneous traffic fatalities is street width and severance caused by barriers in the divided carriageways. Due to loose or no lane discipline smaller slower vehicles are at high risk for collisions. One of the unnoticed causes of major fatalities in Lahore is the poor manner of using public transport services, such as buses are crowded, and when one is involved in a collision, a large number of people are at risk. This is especially the case for those hanging from the footboards of the bus doorways, and sitting on the bus roof top e.g. Recently an accident took place on Canal Bank Road underpass killing five children sitting on top of the bus.

Local illegal public transport vehicles like Qingqis are the most vulnerable vehicles prone to accident due to its highly unsafe design and tendency to topple over at speed more than 30kph on sharp turns or even when breaking.

People were asked about the traffic safety in LUTMP HIS survey; how unsafe they feel when using car, motorcycle or bicycle about 50% responded motorcycle and 35% bicycle are dangerous to use in existing traffic condition. Car is regarded as safe to use as shown in Figure 3.4.10.

Figure 3.4.10 Traffic Safety in Different Private Vehicles



Source: LUTMP HIS

(ii) Vehicle Inspection and Certification System

Transport Department, GoPb is responsible for vehicle inspection, and issuing fitness certificates to inter-city and intra city public transport and goods vehicles. Motor vehicle examiners (MVO) are responsible for each vehicle inspection for its safe operational condition, physical condition of bus overall, safety, sitting environment and comfort for passengers etc. MVOs must have diploma in mechanical engineering and field experience of vehicle maintenance and inspection to be eligible for this post.

However, these MVOs do not have any vehicle inspection workshop equipped with testing machinery and proper mechanism of checking testing of all components related to vehicles road-worthiness. Permits and fitness certificates are commonly issued on visual inspection or no inspection, and further there is no enforcement mechanism in the field to check, and verify the vehicle fitness certificates.

Further, there is no legal requirement for yearly inspection of private vehicles including Qingqi. This is one of the major reasons of environmental pollution like smoke and noise, and also contributes to traffic accidents. Survey shows in Pakistan, about 3.5% of all vehicles are allegedly involved in traffic accidents due to mechanical failures corresponding figure for the developing countries is 2.5%.

(iii) Roadway Design and Traffic Control Devices

There is a strong association between road traffic accident rates, road design, and its surface condition. Well-designed roads promote safety and reduce accident. It is clear from the road accident records of Lahore that wider roads are associated with higher rate of accidents than narrower ones.

Roads in Lahore are not designed for all weather conditions, as in the rainy season almost all major roads are flooded due to poor implementation of geometric design based on AASHTO standards without taking into account the rain water drainage under local conditions as shown in Figure 3.4.11.

Figure 3.4.11 No Properly Designed Drainage System Results in Submerging of Roads

Source: JICA Study Team

There is no roadway geometric design standards exists in Punjab, and most of the designs are prepared on ad-hoc basis or perceptions. Major highway design firms in Lahore are following American Standards (AASHTO) for design of any urban or rural street, or road in Lahore. These standards are designed for the homogeneous traffic; like they do not consider the impact of strange traffic mix of Rickshaw, Qingqi, Motorcycles, Carts and animal carts and poor driving behavior in developing countries like Pakistan. When these standards are directly applied without due consideration of existing traffic situation, this would result in severe traffic safety issues at junctions and road alike.

JICA 1991 study proposed underpasses on canal road which were implemented by GoPb through LDA, TEPA; who unfortunately lacked the technical capacity to design such structures. Underpasses were designed of less than the standard height, and buses and trucks with a height of more than 3.6m cannot pass as shown in Figure 3.4.12, this resulted in many severe accidents in the past. Jail road underpass is shown in Figure 3.4.13 showing scratches to roof due to several accidents.

Figure 3.4.12 Low Height Underpass with 3.6m Vertical Clearance

Source: JICA Study Team

Figure 3.4.13 Jail Road Underpass – Scratches on Underpass Ceiling

Source: JICA Study Team

Secondly, the intercity or primary roads like Multan Road, and Ferozepur Road suffer the highest accident rate, have capacity far in excess of the traffic demand which results in free flow condition and high speed driving. This encourages un-disciplined behavior with vehicle wandering all over the carriageway.

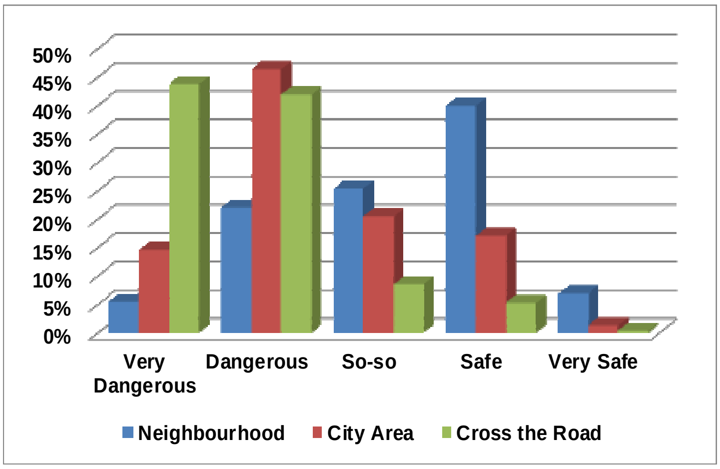
A research has been carried out in Rawalpindi-Islamabad; where selected locations were well engineered, with proper road marking, and controlled by a very conspicuously placed stop sign. The 90-97% of the drivers of various types of vehicles did not stop or even slow down. When interviewed such drivers why they didn't slow down, about 85% responded there was no stop sign installed at the intersection. This can be explained by the fact that the road markings and signs are primarily needed to guide all drivers in the traffic stream to their destination safely. For those familiar with their routes, these signs do not give any additional information.

Traffic control devices standard has been developed by The Urban Unit, GoPb. This manual lacks local context, and more or less is the copy of MUTCD British Standards which are not directly applicable to local complex traffic. TEPA is responsible for planning and installation of traffic control devices in Lahore. They have no technical capacity to understand or develop the installation guidelines, and relying on the private traffic signs manufactures for signage and their installation; who themselves do not have technical capacity to carry out such tasks and do not even bother to consult the manual prepared by The Urban Unit.

(iv) Road User Behavior

Pedestrians are the most vulnerable road users and do not have any awareness how to cross the road safely. Pedestrian crossings are poorly laid out or totally absent. 90% of people responded that crossing the roads is very dangerous or dangerous as shown in Figure 3.4.14. In addition lack of footpaths forces the pedestrian to use the road space for walking which results in further increase in causalities.

Figure 3.4.14
Traffic Safety Level in the Study Area



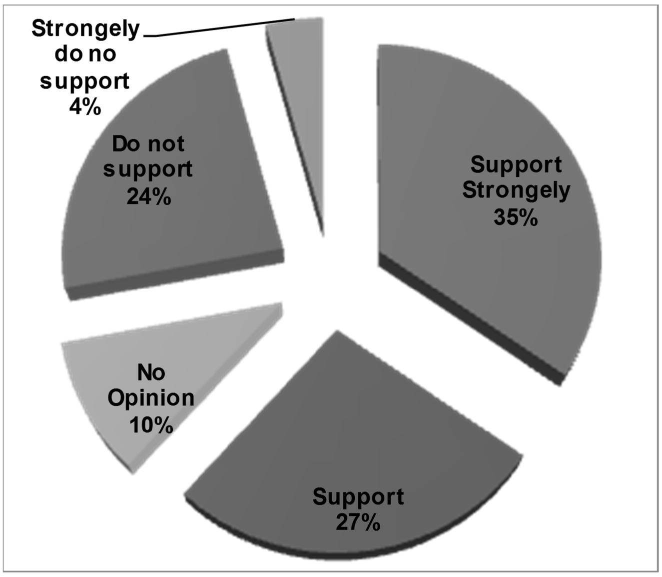
Source: LUTMP HIS

(v) Auto-Rickshaw and Qingqi

It is most common in Lahore that young children below 18 years age are driving Qingqis and Rickshaws mostly illegally without license on self-defined routes. This is also a major cause of accidents due to poor driving standards. There is total lack of enforcement mechanism to curb such illegal drivers. 62% of the people supported removal of this Qingqi from the existing transport system as the transport improvement in the Study Area as reported in the Figure 3.4.15.

Motorcycle has 54% of share in all type of vehicular traffic in the Study Area, and most commonly used by males of all age groups. The driving problem is the same young generation below 18 years without any training or license ride motorcycles without any fear of accidents or awareness of traffic laws. They are often involved in traffic accidents sometimes fatal due to their own poor driving/ behavior.

Figure 3.4.15 Public Opinion on Removal of Qingqi



Source: LUTMP HIS

(vi) Data Records and Accident Black Spot Analysis

Traffic accidents record keeping is not clearly the responsibility of anyone organization or institution. Mostly, serious accidents are reported to nearby police station; which have no technical training or capacity to analyze the cause or the reason of traffic accident and other conditions. Police take notes of some basic information like type of vehicle, registration number, and driver's credentials for prosecution. Sometimes, information is based on crowd comments on accidents. Traffic police do not have any record keeping mechanism for use of accident data analysis.

Emergency Service (1122) also has manual record keeping process involving type of accident like fatal or injury and vehicles involved etc. as their main objective is to give first aid and provide additional medical help to patient or transport of the injured to hospital as priority.

Developing traffic accidents record, and to do accident black spot analysis for improving accident prone sites through better traffic management is in the domain of TEPA in coordination with Traffic Police and Emergency Services. However, TEPA has no capacity to conduct such analysis.

Emergency Service (1122) collects the accident data for their own specific purposes. This data can be effectively utilized by improving the capacity of 1122 for data collection and establish a comprehensive database. This database could be further investigated by

Traffic engineers or traffic safety experts in TEPA to improve the safety at accident sites.

4) Road Junctions and Traffic Signal Operation

Road junctions are provided as interchange facility between roads at-grade. Various traffic movements result in full or partial conflicts between traffic flow and pedestrians crossings at junctions.

Therefore, junctions are designed to remove or minimize the impact of vehicle-vehicle and vehicle-pedestrian conflicts. Conflict between vehicle and pedestrian is controlled by distributing the junction time and space to them. Proportionate time allocated to each movement should be based on vehicle/ capacity ratio, and delay analysis of each movement. Different techniques like through traffic signals (pre-timed, semi actuated, fully actuated), roundabouts, and priority junctions are designed. Developed world has prepared proper guidelines and geometric design standards in order to minimize conflicts and delays through junction design which is safe.

(i) Road Junction Design

There is no junction design guideline in Punjab for geometric design of different type of junctions. AASHTO guidelines are sometimes referred for junction design in Lahore; these do not consider local traffic mix condition and travel behavior of both NMTs and motorized traffic. There is no analysis tool used by TEPA for such designs except using AutoCAD for preparing sketches which are consider as design. Some local companies are using Road Calc for junction design whereas this software is for rural road design and to estimate cut and fill road alignment etc. Road Calc is not recommended for the urban area junction design and analysis. This is needed to be designed through micro-simulation using specialized software; Paramics, VISSIM, or SIDRA for a single junction. SYNCHRO which is developed for right hand drive traffic, is not compatible with local left hand drive routes and is calibrated with respect to American traffic conditions and travel behavior.

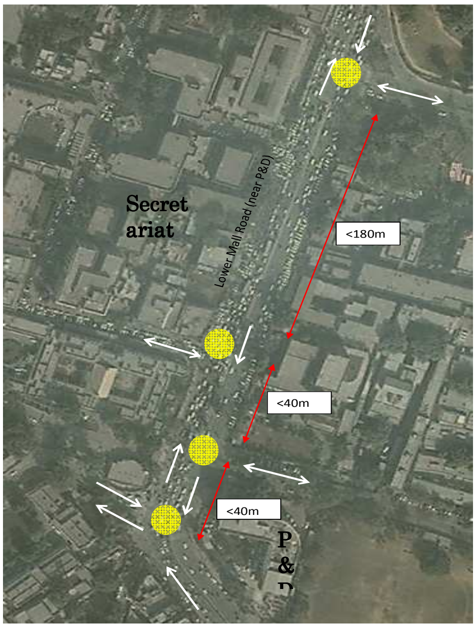
The poor junction design has resulted in complete neglect of safety consideration, cross conflicts, and provision for pedestrians and bicycle at junctions. This causes bottlenecks and junctions gridlocks in peak periods. Existing design is mostly based on perception of TEPA engineers without traffic analysis. Some of the major issues found in junctions are signalized and un-controlled junctions are located within 100m of each other. This causes blocking of traffic due to queues at the upstream junction as shown in Figure 3.4.16.

Flyovers are perceived as an answer to resolve traffic conflicts, instead to improve through simulation and modern safe design. The flyover only solves the flow of single movement and the rest of turning movements remain clogged due to poor junction layout below the flyover as shown in the Figure 3.4.17.

Multi-arm junctions also suffer from poor layout as can be seen at Qartaba Chowk in Figure 3.4.18.

LUTMP junction survey recorded brief characteristics of 264 junctions in the Study Area: out of which 125 were signalized, 22 roundabouts, 14 gyratory, 10 manual control, and 93 uncontrolled. This data can be used for junction improvements.

Figure 3.4.16 Distance between Junctions Less than 100m



Source: JICA Study Team

Figure 3.4.17 Kalma Chowk Flyover and Turning Traffic Below

Source: JICA Study Team

Figure 3.4.18 Poor Junction Layout at Qurtaba Chowk with Conflicts

Source: JICA Study Team

(ii)Traffic Signal Design

Traffic signals are considered to be next best alternative from priority control of junctions once it exceeds certain traffic volume. Unfortunately there is no standard or guidelines available with GoPb for traffic signals system installation warrants, operational control, cycle time calculation, phase split design, and coordination between signalized junctions' network. JICA Study Team has conducted detailed road junctions/ traffic signal operation survey in vicinity of Mall Road, covering a total of 26 junctions out of which 18 junctions are signalized.

All signalized junctions were operational on pre-determined cycle timing; over the day, without any peak period distinction. There is no proper phase splits and cycle time distribution according to traffic volumes, and are based on perception instead of any analytical work.

Each of the signalized intersection is operating in isolation and does not have any coordination or network connectivity with adjacent junctions. There is no controlled system. This results in unnecessary and excessive delays at most junctions to heavy traffic movement and causes long queues as shown in Figure 3.4.19.

Figure 3.4.19 Ferozepur Road – Long and Constant Queue from Ichhra Chowk to Shama Chowk

Source: JICA Study Team

(iii) Adaptive Traffic Control System

Lahore has a total of 134 signalized Junctions out of which 95 traffic signals are compatible with Urban Traffic Control (UTC) system technology and 39 are stand alone non-UTC. The 95 UTC capable signals are compatible with Australian adaptive traffic control system technology known as Sydney Coordinated Adaptive Traffic Control System (SCATS). These can be effectively utilized to establish a centrally controlled system. This would reduce delays up to 20-40%. TEPA has made a coordinated effort with the Urban

Unit to establish such a system by commissioning a consultant, who offered design and build technology based on Split Cycle Offset Optimization Technique (SCOOT). If selected for implementation, all existing signals would have to be removed due to non-compatibility with SCOOT technology. The project in turn collapsed due to large budgetary requirements and lack of technical capacity of TEPA.

(iv) Existing Traffic Signal System Condition

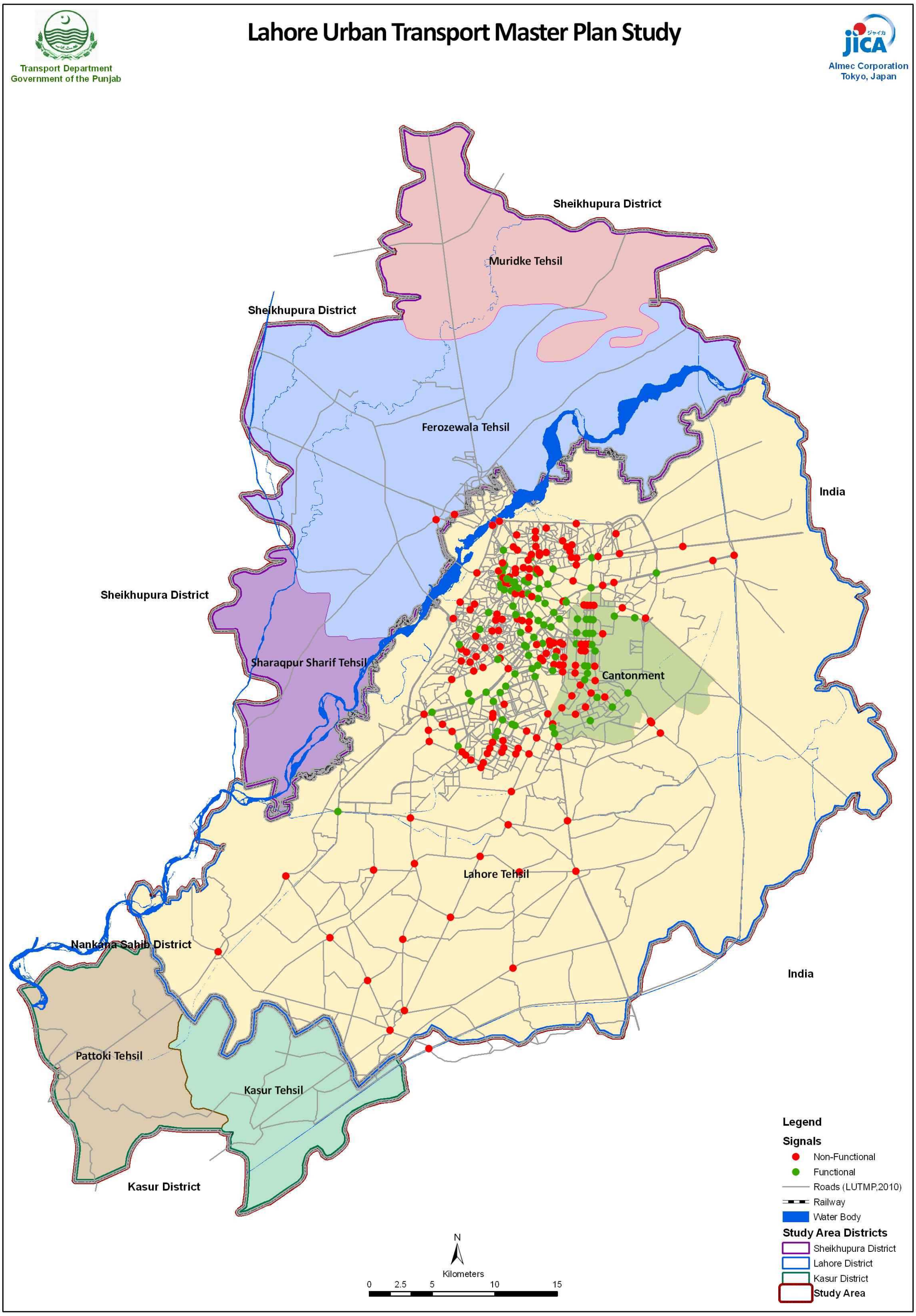
TEPA has installed traffic signals in Lahore which include: pre-timed, semi-actuated, and fully actuated signal systems. All traffic signals in Lahore are operating on pre-timed basis for which timing has never been updated since installation, and operating on similar timings for all traffic movements. No semi or fully actuated traffic signals in Lahore are functional. Various construction activities like road maintenance, installation of different public utilities like gas, landline cables, water and sewerage pipes have severely damaged embedded loops in the roads and these have never been repaired. Further, existing signals are not maintained and their physical condition is deteriorating with time as shown in Figure 3.4.20.

LUTMP conducted road traffic junction survey, and the results are illustrated in Figure 3.4.21. About 60% of the traffic signals were found to be non-functional or were not working at the survey time. LUTMP surveys showed that 70% of the surveyed junctions are not working in morning, afternoon and evening peak periods and were controlled by traffic wardens.

Figure 3.4.20 Traffic Signal Covered by Shop Shade

Source: JICA Study Team

Figure 3.4.21 Working Condition of Traffic Signals in Lahore



Source: JICA Study Team

5) Parking Management

Parking management is one of the most critical issues in the absence of appropriate land use planning and control in each union council level. Commercialization and land use control violation are continuing at full pace, and land use along major and minor roads are in continuous process of being converted from residential to commercial without their traffic impact assessment.

(i) Parking Policy and Existing Legislation

There is no parking policy for Lahore or Punjab for the overall management of parking provision and appropriate parking facilities. This has resulted in complete ignorance for the provision of adequate facilities and managing the parking demand/ supply in the city by the responsible authorities/ agencies. Parking management is not the priority for the authorities, and mostly road space has been continuously encroached by illegal parking in Lahore. This reduces the operational capacity of road due to side friction of parked vehicle and reduced number of lanes available to traffic.

GoPb Ordinance, 2001 defines the responsibility of union councils, towns and district government for planning, managing and control of on and off street parking facilities. However, existing city district government of Lahore has little technical capacity to plan for city wide parking system, and has transferred this responsibility to respective TMAs.

LDA existing by-laws defines the requirement of limited Traffic Impact Assessment (TIA) mostly related to parking requirements for all commercial developments. However, due to lack of technical capacity and ability to fully assess and evaluate, development projects have been approved without full realization of the TIA. This created traffic demand resulting junctions failure, illegal parking along service roads and main carriageways near such commercial areas as shown in Figure 3.4.22.

(ii) Current Parking Facilities

CDGL has provided small scale parking stands along 32 corridors in Lahore for motorcycles and cars. These are ill planned, lack capacity and result in encroaching the service roads and main carriageways. Existing condition of parking stands on Mall Road are shown in Figure 3.4.22 and 3.4.23. There are vague parking design standards/ guidelines for Lahore. Parking facilities are often provided without considering the demand and the impact on junctions, service roads and main carriageways.

Parking was observed in LUTMP road network inventory survey along both sides of roads as shown in Figure 3.4.24, and parking stands provided by CDGL with their capacity is shown in Figure 3.4.25. This clearly shows the neglect Lahore CBD area parking demand around Mall Road in the south and southeast of the Walled City area. There are only three off-street car parking plazas provided by TEPA; which have about 700 car parking spaces. Total parking spaces provided by both CDGL and TEPA are for 7,200 motorcycles and 2,000 cars. These are insufficient when compared with parking demand in these areas.

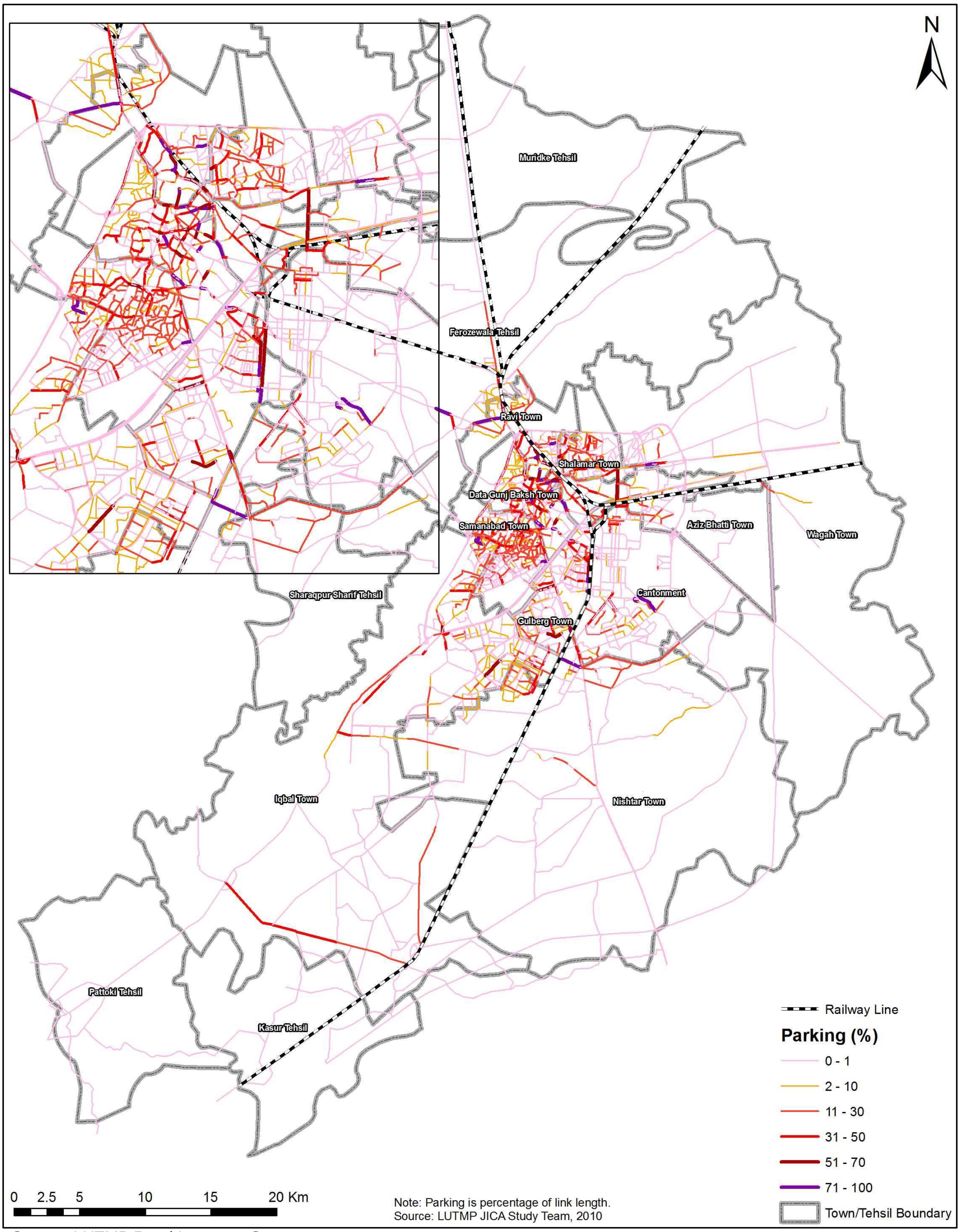
Figure 3.4.22 Parking at Panorama Shopping Center Covering almost Whole Service Road along Mall Road

Source: JICA Study Team

Figure 3.4.23 Parking on Opposite Side of Panorama Shopping Center Blocking Service Road

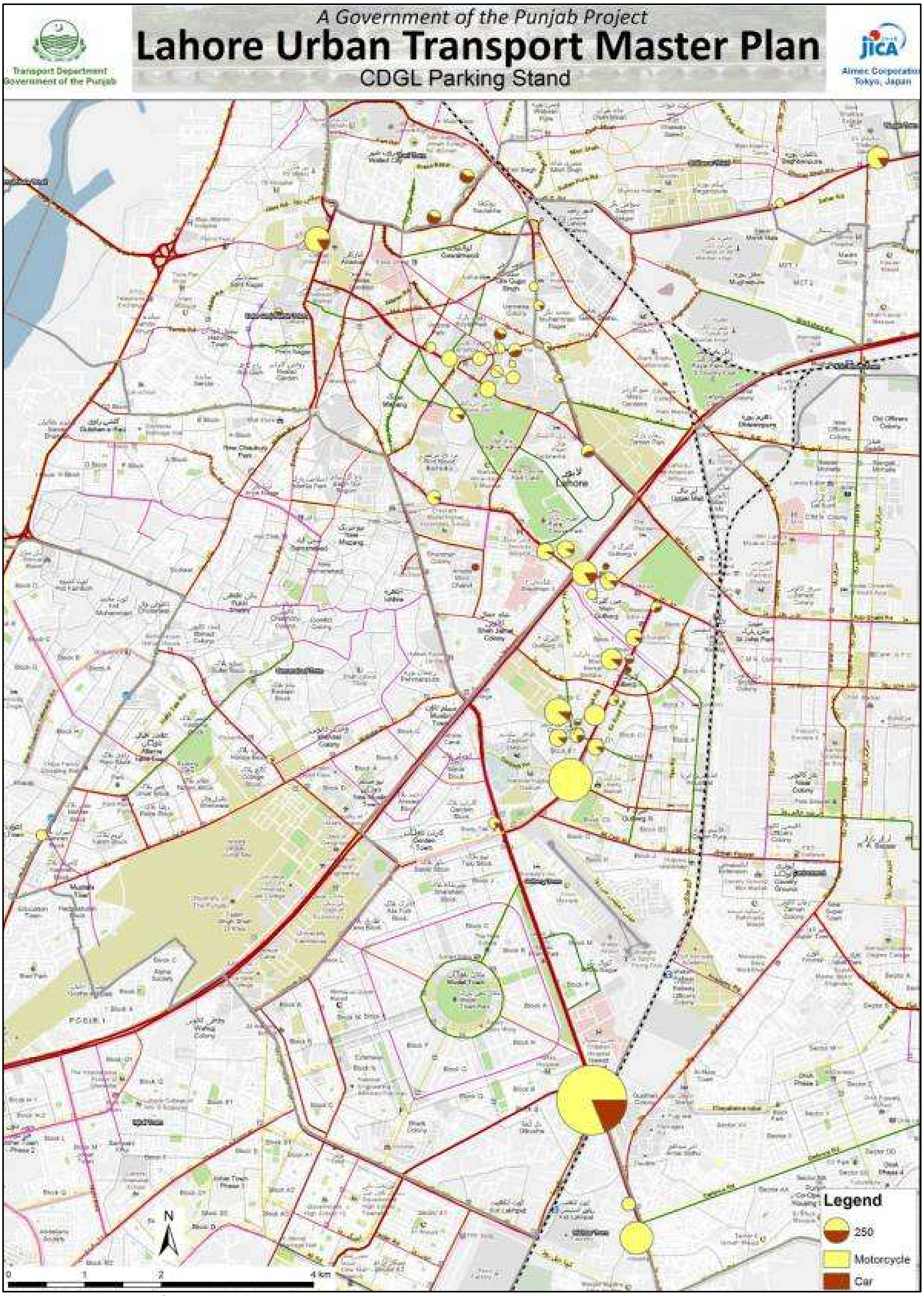
Source: JICA Study Team

Figure 3.4.24 Distribution of On-Street Parking, 2010



Source: LUTMP Road Inventory Survey

Figure 3.4.25 CDGL Parking Stands and Spaces in Lahore



Source: LUTMP Road Inventory Survey

(iii) Illegal Parking

Mostly commercial areas do not have enough parking capacity in Lahore for either on or off-street locations. Commercialization has been done in the recent past, it was without any consideration of such impacts. The illegal parking often results in severe traffic congestion. Ferozepur Road north of canal is suffering most traffic congestion in Ichhra section; as this is the major market area. Lack of parking spaces along this section results illegal parking on service road and on main Ferozepur Road, causing severe traffic congestion as depicted in Figure 3.4.26.

Figure 3.4.26 Congestion on Ferozepur Road Ichhra Section due to Illegal Parking on Service Road and Main Carriageway

Source: JICA Study Team

South of Lahore is not facing serious parking problems except along some commercial centers like Hafeez Center, Model Town Link road, Moon Market, Ghazi road. LDA has started preparing the existing land use map of the area under their jurisdiction to control existing and future land use for sustainable development. However, rest of the Lahore remains free from such policy. Existing situation is worsening with time as motorization is increasing.

3.4.2 Other Current Projects

The following '9' projects have been planned for the Study Area.

1) Conversion of Two Stroke Cab Rickshaws to CNG fitted Four Stroke Cab Rickshaws

Two stroke cab Rickshaw (TSCR) have worse environmental impacts of all vehicles. It has old technology fitted with two stroke engine, which emits unbearable noise and consumes oil that produces smoke; a major cause of respiratory problem. Central area of Lahore city has been affected severely with this nuisance causing major health problems and environmental concerns for travelers and residents alike.

It is not possible to remove thousands of rickshaws from road, as this is a major component of public transport in the city. Transport Department decided to reduce the impact of Rickshaws by converting these to CNG fitted 4-Stroke engines; which will cause less air pollution.

Project Description:
In initial phase, 20,000 TSCR will be converted to CNG fitted Four Stroke Cab Rickshaws. Financial assistance in the form of 50% conversion cost will be provided to the TSCR owners.

Status:
PC1 has been submitted to Planning and Development Department for approval, the procedure has delayed due to budget limitations.

Location / Area:
Lahore, Gujranwala, Faisalabad, Rawalpindi, and Multan

Estimated Cost:
PKR 1052.6 Million

Financial Source:
Transport Department, GoPb

Schedule:
2011 – Onward

Implementation:
Transport Department, GoPb

2) Vehicle Inspection and Certification System (VICS)

Transport Department, GoPb intended to establish an international standard vehicle inspection and certification system for safe traffic environment.

Project Description:
IT based vehicle inspection and certification system would be established to replace old manual vehicle inspection system on Public Private Partnership basis. In 1st phase public service vehicles and commercial vehicles will be tested and certified under the system. Currently, about 150,000 public service vehicles need bi-annual certification in Punjab. Transaction Advisory services may be commissioned for the establishment of this system.

Status:

Project has been advertised for proposals, pre-bid meeting of the firms submitted EOIs was held on 4th February, 2011 in Transport Department. The last date for submission of EOI for TA was 18th February, 2011. IPDF had to open EOIs and shortlist the firm for issuance of RFP document. Once, TA is on board, RFP for the shortlisted bidders will be prepared and issued by TA.

Location/ Area:

Lahore District (will be expanded to other large cities of Punjab after pilot scheme Lahore)

Estimated Cost:

Transport Department will disclose the cost after selection of Transaction Advisor.

VICS cost will be decided between investing company and Transport Department.

Financial Source:

GoPb: Transaction Advisory Services

Public Private Partnership: Vehicle Inspection and Certification System

Schedule:

2011 – Onward

Implementation:

Transport Department, GoPb

3) Establishment of Centralized Driver Licensing Authority

Project Description:

Centralized driving licensing authority will be established with latest IT equipments. The system will also assist in training of licensed drivers for further training.

Status:

At proposal stage

Location/ Area:

Punjab

Estimated Cost:

No estimate available.

Financial Source:

GoPb or Public Private Partnership

Schedule:

None

Implementation:

Transport Department, GoPb (In coordination with Excise and Taxation Department and Traffic Police, Punjab)

4) Parking Management and Company

Project Description:

To resolve the parking problems on sustainable basis, it is suggested that institutional strengthening of the CDGL should be carried out on priority basis by establishing the Lahore Parking Company (LPC) under the CDGL. LPC should be a public sector company (a special purpose vehicle) established in Lahore on the pattern of ISPARK of Turkey Istanbul. LPC should be assigned the exclusive task of planning and development of new parking facilities; and management, control, and operation of the existing public/ private parking facilities in Lahore. Specifically, the LPC shall be responsible to:

- Prepare parking laws/ regulations
- Regulate and enforce parking in the city,
- Meet parking demand spaces by developing new parking lots, and park and minimizing road side parking,
- Provide incentives to the private sector for development of parking plazas,
- Develop a medium and long term plan to meet the parking needs of the city,

The LPC will generate its revenues from the following sources:

- Time based parking fee from the existing public parking spaces.
- One time seed money by Govt. of the Punjab for the establishment of LPC
- Token fee from the private parking plazas

It is proposed that:

- LPC under the CDGL may be established.
- The LPC may be the agency to regulate parking and parking fee.
- The LPC may be assigned the responsibility of all types of parking in Lahore city.
- Total revenue from parking fee may be in the range of ~PKR 1.0 to PKR 3.5 billion annually, and allocated as follows:

  a) CDGL to receive 25% of the net parking revenue

  b) LPC to retain 25% for its annual budget requirements.

  c) The remaining 50% to be reserved for the development of new parking facilities by LPC.

Off-street parking facilities will be provided in the first phase. TEPA has to create a cell for parking management under the Director, Traffic Engineering. TEPA will coordinate with ISPARK (Turkish Municipality, Parking Company) for the acquisition of technology and capacity building to streamline and manage off-street parking.

Status:

The Chief Minister Punjab, during the presentation on Transport Delegation's visit to Turkey, was pleased to desire as under:

"The parking facilities in Lahore city will be developed on fast track and concessionaire rights of the existing parking facilities will be assigned to a single agency. The Secretary Transport will hold meeting with Director General LDA and concerned stakeholders to prepare a comprehensive proposal for development, up gradation and regulation of the parking facilities in the city on the pattern of ISPARK Istanbul who shall be approached for assistance and an agreement will be signed with them. The draft agreement will be ready before the forthcoming visit of Istanbul's Mayor in June 2010 and signed".

PC-II for the establishment of the Parking Company has been prepared by the Urban Unit, and forwarded to the City District Government of Lahore.

Summary for establishment of parking company has been forwarded to Chief Minister via DCO and Chairman P&D by Transport Department.

Location/ Area:

Lahore District

Estimated Cost:

No Cost estimate is available.

Financial Source:

TEPA/ LDA/ CDGL Parking Company

The LPC shall be responsible to develop required parking facilities under its own arrangement; PPP and/or Private Sector alone!

Schedule:

2011 – Onward

Implementation:

1. Parking Management: TEPA
2. Parking Company: CDGL

5) Construction of New Parking Plazas

TEPA has planned to construct parking plazas, especially in historic old city of Lahore.

Project Description:

Proposed parking plazas locations are listed below and showed in figure 3.4.27

1. Model Town Link Road
2. Outside Delhi Gate (Near Tonga Stand)
3. Outside Mochi Gate (In Circular Garden)
4. Outside Shah Alam Gate (In Circular Garden)
5. Outside Masti Gate (In Circular Garden)
6. Railway Station (Near Taxi Stand)
7. Moon Market Allama Iqbal Town (Near Parking Stand)
8. Halli Road, Gulberg (Rear of Chen One)
9. Outside Lohari Gate (In Circular Garden)
10. NilaGumbad (Fountain Site)
11. M.M. Alam Road (Doongi Ground)
12. In front of KEM University (Adjacent to Hostel)
13. In front of PIC Shadman-II (Rear of KFC)
14. In front of H. KarimBuksh, Liberty
15. Adjacent to Delhi Muslim Hostel, Anarkali
16. Behind Old Tolington Market
17. Behind Naqi Market
18. Victoria Park, Shahrah-e-Quaid-eAzam
19. Behind Regal Cinema – Mall Road
20. Behind Dayal Singh Mansion
21. Liberty Commercial Area
22. Near Gulberg Plaza, Liberty (In front of Salt and Pepper Restaurant) - Completed

Status:

Neela Gumbad project is delayed due to the lack of funding. For the rest, feasibility studies are in process.

Location/ Area:

As listed

Estimated Cost:

PKR 800 million per Parking Plaza

Total Cost: PKR 17 billion

Financial Source:

PPP/ BOT, or funded by LDA, GoPb.

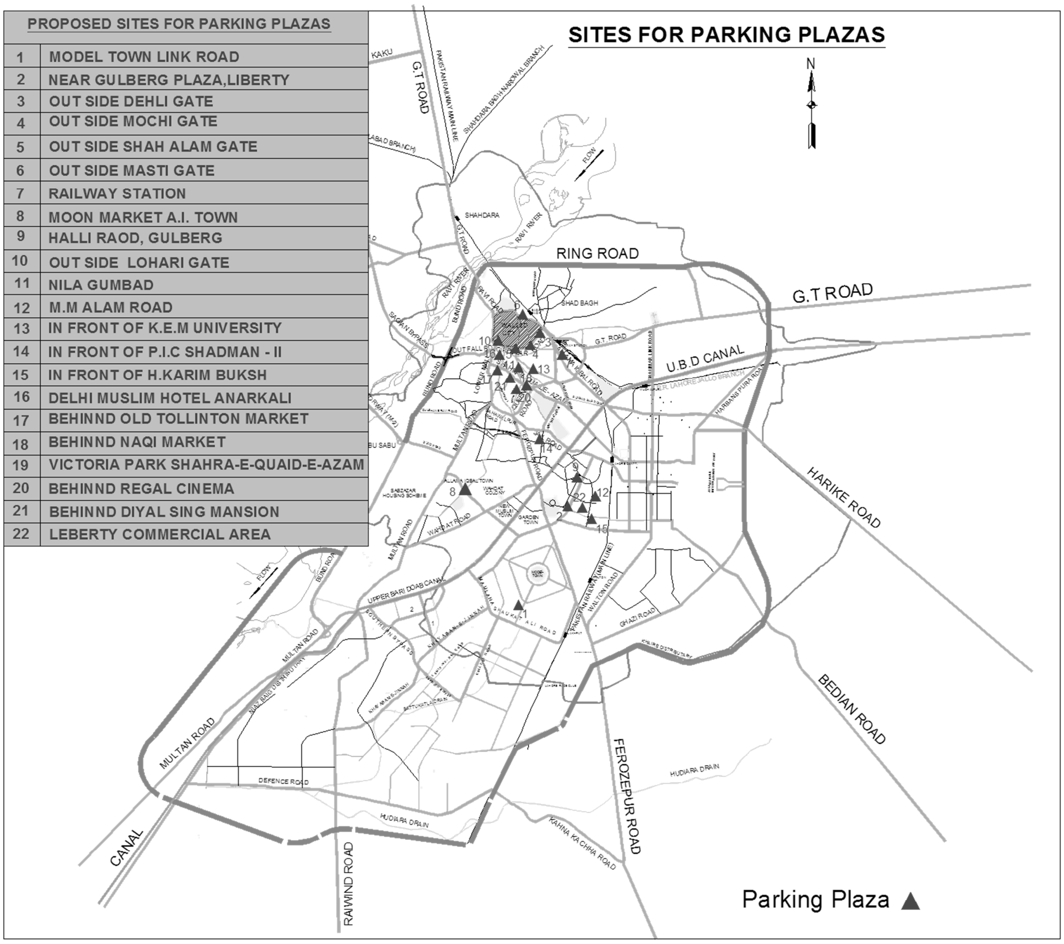
Schedule:

2011 – 2016

Implementation:

Traffic Engineering and Transport Planning Agency (TEPA, LDA)

Figure 3.4.27 Locations of Proposed Parking Plazas



Source: TEPA

6) Improvement of 52 Junctions

Project Description:

- For each of the 52 Junctions, Traffic Signals will be either installed or repaired;
- Signals timing will be coordinated with adjacent signals in the network.
- Geometric design of the junctions will be evaluated and re-designed based on the requirement;
- Pedestrian crossing phased and lane marking and traffic control devices will be installed at each junction;

Status:

In evaluation stage; Junctions which will be prioritized and financing mechanism will be agreed with LDA/ GoPb.

Location/ Area:

List of the junctions is given in Table-3.4.1, and location map is shown in location map Figure 3.4.28

Estimated Cost:

PKR 50 million/ Intersection

Total Cost: PKR 2.6 billion

Financial Source:

GoPb

Schedule:

2011 - 2016

Implementation:

Traffic Engineering and Transport Planning Agency (TEPA)

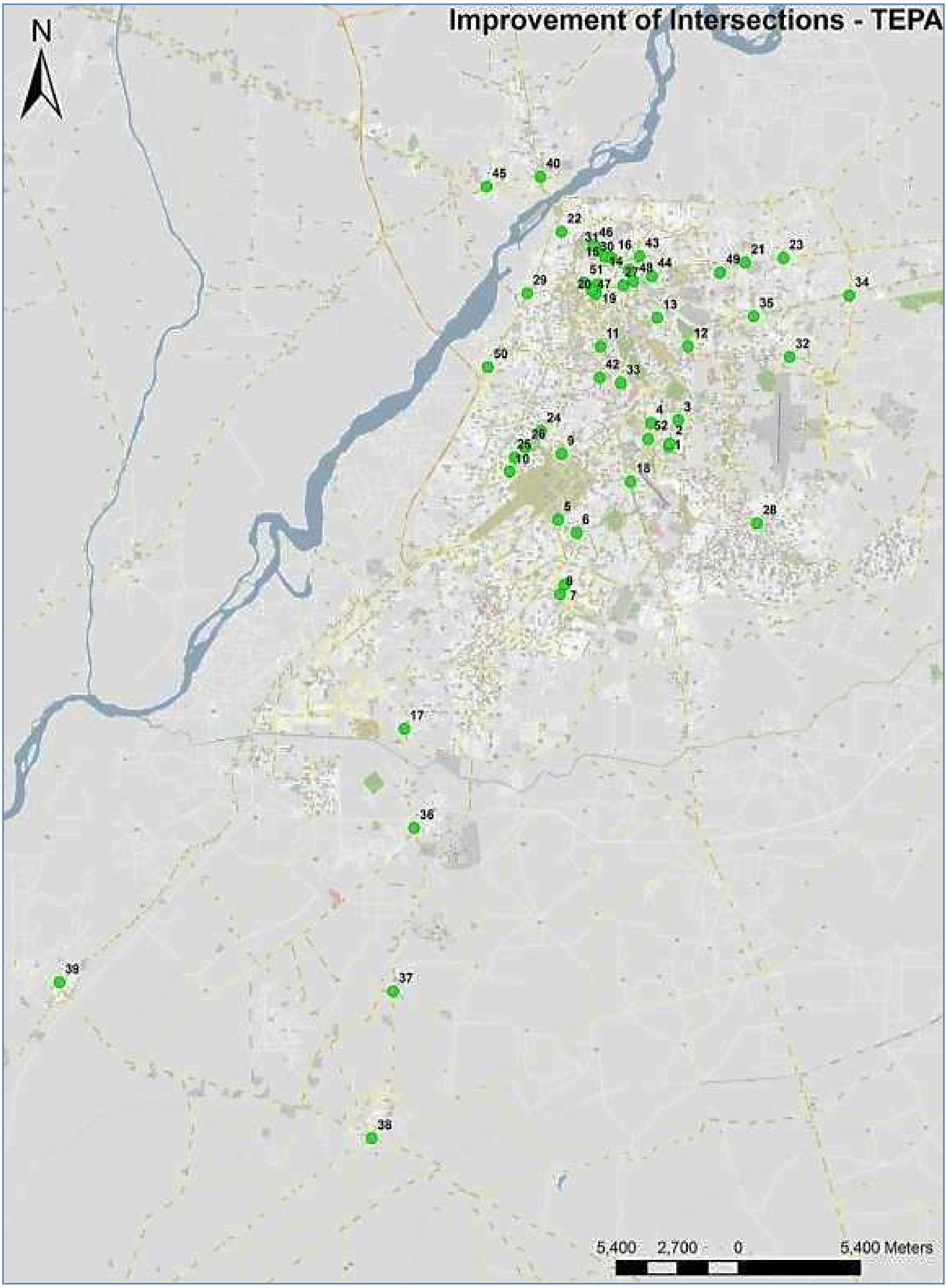
Table 3.4.1 List of Junctions Planned for Improvement by TEPA

No.	Name of Intersections
1	Pizza Hut, M. M Alam Road
2	KFC, M. M Alam Road
3	MCB, Gurumangat Road
4	B-Block, ZahoorElahi Road
5	Faisal Chowk, Faisal Town
6	Central Flats, Faisal Town
7	Muhammad Ali Chowk, College Road
8	KhokharChowk, College Road
9	Dubai Chowk, A. I. Town
10	Karim Block Market ,Wahdat Road
11	WarisChowk ,Queens Road
12	Dharampura Y Junction
13	Taj Crown Cinema, GarhiShahu
14	Do Moria Outer, Circular Road
15	Kashmiri Gate Outer, Circular Road
16	Sheranwala Outer, Circular Road
17	Bhubatian, Raiwind Road
18	Nursery Chowk, Model Town
19	MEO Hospital, Gawalmandi
20	Shah Alam Inner, Circular Road
21	SukhNeher, G. T. Road
22	Kasurpura, Ravi Road
23	Daroghawala, G.T. road
24	Chenab Pully, A. I. Town
25	Karim Block Drain, A. I. Town
26	Double Pull, GulshanIqbal Park

No.	Name of Intersections
27	DalgiranChowk, Brandrith Road
28	Masjid Chowk, DHA
29	Saggian, Bund Road
30	Baba HaiderSayen
31	NayyerwastiChowk
32	Jouray Pull, ZararShaheed Road
33	Shadman, Roundabout
34	Harbanspura, Canal Bank Road
35	Lal Pull, Canal Bank Road
36	Adda Plot, Raiwind Road
37	Pajian, Raiwind Road
38	Khara, Raiwind Road
39	Manga Mandi, Multan Road
40	Shahadra Chowk, G. T. chowk
41	Shazoo Lab, G.T. Road
42	Peer Ghazi Chowk, Ichra
43	ChowkNakhunda, Misri Shah
44	Total Petrol Pump, Misri Shah,
45	BeghumKot, Sheikhupura Road
46	Double Sarkan, LariAdda
47	LohariChowk/ Hospital Road
48	Zafarshaheed, Railway Station
49	GhasMandi, G. T. Road
50	SheraKot
51	Mori Gate/ Urdu Bazar
52	HaliChowk ,Behind PACE

Source: TEPA

Figure 3.4.28 Location of Junctions Planned for Improvement by TEPA



Source: TEPA

7) Institutional Development of Lahore Metropolitan Road Transport Authority (LRMTA) – By The Urban Unit

Project Description:

The proposed changes in the functional organization are as follows:

1. The Authority should be named Lahore Metropolitan Road Transport Authority (LMRTA) and must assimilate TEPA.
2. The Authority should be a standalone or one under the Transport Department (TD), and should not remain under LDA as there are no common objectives between the LDA and TEPA.
3. The authority should have its own Managing Director holding the titles of DG LMRTA/ Chief Metropolitan Transport Engineer (CMTE) who must control four major functional departments as follows;
   a. Transport Planning Department
   b. Traffic Engineering and Operations Department
   c. QA/ QC/ Safety Department
   d. Administrative Department
4. Each Department should be headed by its own director and to include staff to perform duties as per Job Description. The staff should generally include:
   i. Directors of Expert Areas
   ii. Senior Specialists
   iii. Technical II
   iv. Technical I
   v. Research Associate

The proposed LMRTA shall be instituted to meet the technical demand arising due to increase in traffic conflicts, and deploy the use of advanced concepts and tools to resolve such conflicts. The charter of the Lahore Metropolitan Road Transport Authority (LMRTA) shall be as follows:

Charter of LMRTA – as defined by the Urban Unit

- Constantly and effectively build and maintain the capacity and productivity to address the Transport issues by hiring and retaining professionally qualified staff from internationally recognized universities.
- Standardize Traffic Signals, traffic Signs, Lane markings junction and road design through the implementation of the standards prescribed in the Punjab Traffic and Transport Manual.

- Establish an Intelligent Transport System cell to install area-wide Control Center and mechanisms for the efficient movement of vehicles on roadways and junctions.
- Own, update, and streamline the implementation process of the Lahore Urban Transport Master Plan Projects.
- Provide effective coordination with the Transport Planning Unit of Transport Department to speedily conceive sustainable solutions to the outstanding transport problems and to implement State of the Art Traffic Management techniques
- Ensure transport flow and reduce congestion by optimizing the signal timings relative to the traffic volume, which will reduce delays, fuel consumption and minimize vehicle emission to promote environment friendly transport system
- Improve public transport service delivery by studying feasibility of providing exclusive bus lane at different corridors of the city; which will enhance passenger mobility and reduce travel time
- Improve road safety for road users by conducting road safety audit of the accident prone corridors/ intersections/ stretches in the city and will be responsible for their remedial measures and implementation

Functions of LMRTA – as defined by the Urban Unit

The LMRTA shall exercise and discharge the following powers and functions, such as;

- To plan, prepare and conduct Transport Modelling
- To perform Urban Transport planning studies and to make strategic plans for the sustainability of transport system.
- To develop Transport Management Plans
- To review and approve opening year and twenty (20) year Traffic Impact Analyses for the new developments
- To develop and implement Regional Impact Assessment and the associated monetary infrastructure concurrency Procedures for large developments.
- To conduct the Pre-feasibility and Feasibility Analyses of Streets, Highways, and Expressways.
- To develop, promote, design, and implement BRT/HOV systems and infrastructure
- To establish sustainable Rail Rapid Mass Transit System (RMTS)
- To classify and develop a numbering mechanism of Streets, Highways, and Expressways.
- To design comprehensive plans for Traffic Signals.

- To develop complete system and proper mechanism for Traffic Signing and Marking and its Maintenance.
- To Design Roadway Traffic Lighting Plans and to make improvements by recognizing the deficiencies in the design
- To install Traffic Telemetric Devices and Systems.
- To design and install Wrong-way signals.
- To Design Bus Rapid Transit (BRT) and High Occupancy Vehicle Lanes (HOV) and to make comprehensive strategies for its sustainability.
- To design Rail Rapid Mass Transit system and to develop strategies for the future.
- To recognize Utility Conflicts to Transport infrastructure and to make plans for its improvements.
- To develop comprehensive and high quality Intelligent Traffic System to meet the international standards.
- To develop, implement, improve, and maintain Urban Traffic Control System.
- To establish a comprehensive Incident Management system.
- The authority would also be responsible for road closures, detour plans, and general Maintenance of Traffic through Work Zones and for Special Events.
- To plan, design, maintain and improve Bus Stations and Truck Stops and Public Rest Areas.
- To conduct traffic and other necessary surveys.
- To carry out the signalized and un-signalized Intersection Studies and its improvements.
- To perform Interchange Studies
- To perform Parking Studies and to prepare Parking Systems and Plans.
- To develop a comprehensive plan and mechanism for Weigh Station.
- To carry out Pedestrian Studies and to make plans for pedestrian safety.
- To conduct Arterial Studies and develop plans for corridor improvement.
- To plan, design, and implement Traffic Calming Measures on Streets and Roadways
- To perform comprehensive Network planning Studies.
- To carryout Ramp Metering Studies
- To conduct Toll Plaza studies and manage and control Toll Plaza Operation
- To perform Expressway Merge, Diverge, Weaving, On-ramps, and Off ramps Studies
- To conduct Signal Timing, Phasing, and Coordination Studies.
- To develop complete roadway plans.

- To review the Roadway Design Plans and to ensure their compliance and adherence to the standards provided in the latest versions of the Punjab
- Geometric Design Manual (PGDM) for Streets, Roadways, and Expressways; and the Punjab Traffic and Transport Manual (PUTTM); and any other manual providing guidelines and policies for the Safe, Uniform, Efficient, and Pedestrian Friendly design of Roadway Plans for livable cities; as may be developed or updated from time to time by the Transport Department or the Urban Sector Policy and Management Unit (P&D Department).
- To perform Safety Audit Studies and to take appropriate actions for the improvement of safety.
- To conduct Mass Transit Studies.
- The authority would perform Park and Ride Studies and would make plans for improvements.
- The authority would also be responsible for providing and conducting Traffic related Training of Traffic Police Wardens.
- To plan and conduct Seminars on different topics for the improvement and sustainability of the Transport system.

Status:

Proposal by the Urban Unit

Location/ Area:

Lahore (Metropolitan) Area

Estimated Cost:

No Cost Estimate available

Financial Source:

GoPb

Schedule:

Proposal stage

Implementation:

Planning and Development Department, GoPb

8) Establishment of Multimodal Truck Terminal in Sheikhupura

Project Description:

This terminal will facilitate the General Public with Spacious (*sic)* sitting arrangements, waiting halls, canteen, parking areas, and CCTV Cameras for safety point of view. Project pertains to Building and Road components and will be carried out by the Engineering staff of District Government through skilled pre-qualified contractors under the supervision of the consultant.

Status:

Land has been acquired for the Terminal, whereas the contractor and consultant will be hired for the construction and supervision.

Location/ Area:

Sheikhupura Lahore Bypass, location map is reproduced in Figure 3.4.29.

Estimated Cost:

No Cost Estimate available

Financial Source:

City District Government of Sheikhupura, GoPb

Schedule:

2011 – Onward

Implementation:

City District Government of Sheikhupura

Figure 3.4.29 Location Map of Sheikhupura Truck Terminal

Source: City District Government Sheikhupura

9) Traffic Education and Travel Behavior – by Traffic Police

The objective of this program is to improve the travel behavior on road by providing complete knowledge of road sense. This is only possible through proper setup of educational institutes and through other media programmes. The main purpose of this traffic education will be;

- Awareness to general public about traffic rules and regulations;
- To maintain road discipline among road users;
- To sensitize the public regarding significance of road safety;

- To educated students who play an efficient role to sensitize the citizen about traffic discipline.

The established goals of this program to produce awareness about; Traffic Rules, Traffic Signals, Traffic Signs, Line/ Lane System, Cell Phone, Seat Belt, Helmet, Lights/ Indicators, LCD, Pedestrians and about valid driving licensing.

Project Description:

(i) On-going Programmes of Traffic Education

- To visit all the Academic Institutions to deliver lectures on Road Traffic;
- To approach all quarters of the society through special programs and special campaigns;
- Public Seminars and Workshops on Traffic awareness;
- To hold Traffic Weeks, Traffic Walks, Traffic Rallies, Traffic Mela;
- TV Programs;
- Literature distribution like leaflets, pamphlets, and handbills

(ii) Planned Programs of Education

- Summer Camps
- Traffic Internship Program
- Arrange Traffic Campus
- TV Talk Shows
- Traffic Awareness Campaigns in professional and traders organizations;
- Working with Private Sector;
- Working with Government Institutions;

(iii) Proposed Projects of Traffic Police for Traffic Education

- Establishment of Authorized Driver Training Institutions
- High Profile Traffic Instructors Courses
- Professional Training of Traffic Officers
- Traffic TV Channel
- Theme Village
- Short Refresher Courses for Traffic Wardens;
- Public Service Messages on Electronic Media

Status:

Following things has been achieved and others are either in pipeline or in proposed stage;

1. City Traffic Police, Website: www.ctplahore.gop.pk

All requisite information about traffic rules and regulations, traffic education brochures, traffic police works and units, campaigns, licensing forms, first aid information, contacts, new updates etc.

2. 24 Hour Helpline, “1915”
    - General Traffic info on roads;
    - Closures/ Diversions Plans
    - Guidance about directions, routes, means of transport
    - Information about license, traffic ticket, fines, etc.
    - Repairs, digging, road cutes, and constructions;
    - Accident/ fire information;
    - Alerts on emerging situation, mob action, processions,
    - Vehicle breakdown help;
3. Radio Channel, Rasta FM 88.8
    - Every 5 minutes traffic updates;
    - Bus, trains, flights updates;
    - Breaking news and regular updates,
    - Latest weather reports,
    - Traffic talk, public calls etc.

Location/ Area:

Lahore District

Estimated Cost:

No Cost Estimate Available

Financial Source:

GoPb

Private Sector for Publicity Campaigns

Schedule:

On-going, and 2011 – Onward

Implementation:

City Traffic Police of Lahore

10) Traffic Management Plan of City

City Traffic Police is concentrating strongly on road engineering with the coordination of TEPA and other concerned agencies. Over the last few years, Traffic in the Lahore city has become a great challenge for Higher Authorities. Management and Planning Cell of City Traffic Police deal with this matter. They are planning new routes for better and smooth Traffic circulation.

City Traffic Police already has the following capabilities to deal with the traffic of Lahore;

- Traffic wireless control system;
- Radio channel "88.8 FM" for public awareness;
- Help line 1915 to help and guide the traffic;
- Information through website, www.ctplahore.gop.pk;
- Best internal communication system;
- Effective VVIP/ VIP route management;
- Lahore is divided in to 37 traffic sectors to regulate and manage the flow of traffic.

Traffic Police is still facing big traffic issues in managing the traffic of Lahore, and therefore has established Planning and Management Cell to look after up to some extent and wants to improve through other small planning projects;

Project Description:

Traffic Police wants to improve the existing capabilities for improvement in traffic management for city of Lahore through following proposed measures;

- Increase in traffic management sectors of Traffic Police for Lahore;
- Improvement in communication system;
- Setting new wireless control units;
- Separate traffic unit against encroachment;
- Separate traffic Anti-Parking unit;
- Mobile workshops;
- Health treatment for operating officers;
- Coordination with head of markets

Status:

Proposals will be prepared and discussed with GoPb. Help of international agencies will be taken in this regard for enhancement of traffic management capabilities of Traffic Police;

Location/ Area:

Lahore District

Estimated Cost:

No Cost Estimate Available

Financial Source:

GoPb

Public Private Partnership

Schedule:

2011 – Onward

Implementation:

City Traffic Police of Lahore

3.4.3 Planning Direction

In the context of above discussion on traffic management situation; north of Lahore, especially surrounding areas of the Walled City; is suffering with stark issues of mobility and accessibility, worsening through various factors, contributing directly or indirectly such as traffic safety, non-motorized traffic, heterogeneous traffic, lack of parking facilities, encroachments, etc.

South of Lahore is the recent development over the last few decades; whereas north is the old development which continued to expand in a radial pattern from the Walled City without any traffic and transport planning. This resulted in deterioration of existing transport environment, critically impacting the socio-economic conditions of this area. This area has mixed land use of service sector, restaurants, educational institutions etc. and believed as the CBD area of Lahore District.

1) Improvement of Traffic Management of Surrounding Areas of the Walled City

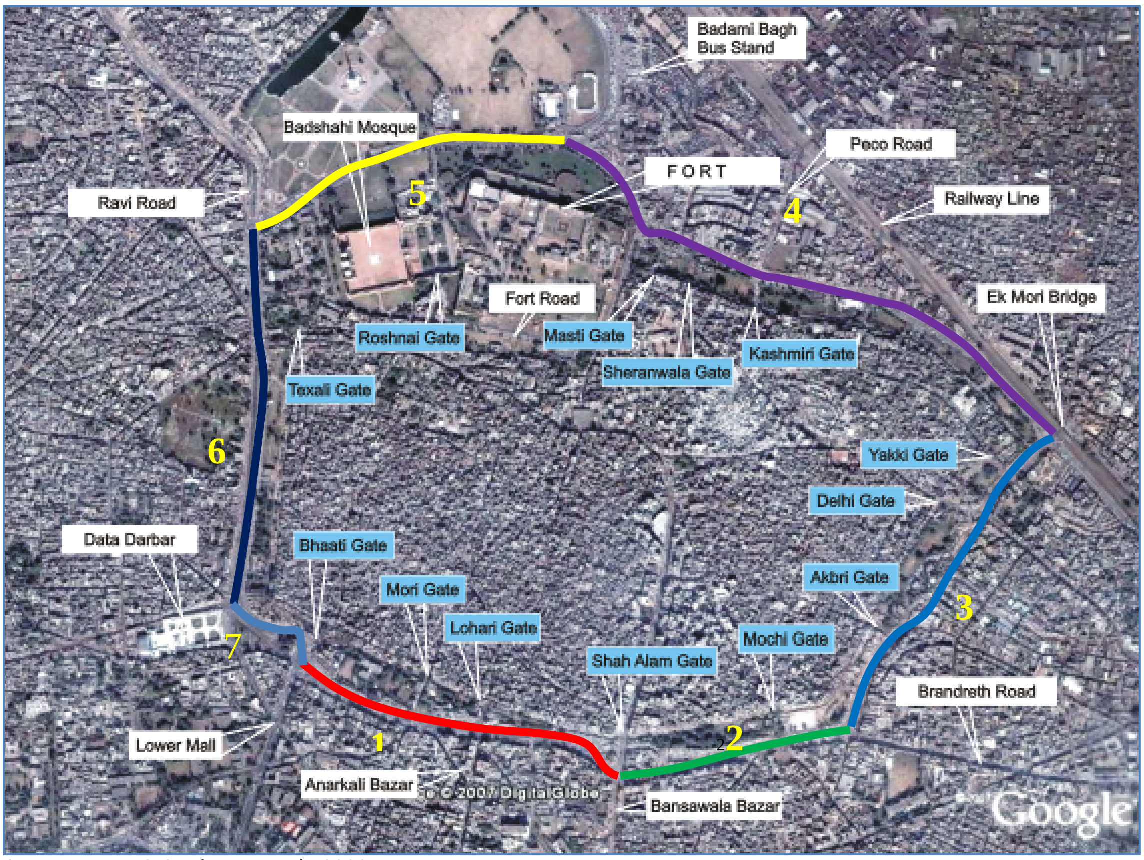
The table below shows the observed average travel speed on the Circular Road surrounding the Walled City, the traditional trade centre of Lahore. During afternoon to evening period, travel speed on the Circular Road drops sharply along most of its sections. In addition, it is reported by TEPA that there are at least 68 bottleneck intersections at present in the surrounding areas of the Walled City.

Table 3.4.2 Average Travel Speed of Circular Road by Section, 2008

No.	FROM	TO	Average Speed (Km/h)			Length	Average
			Morning	Afternoon	Evening	Km	Km/h
1	BhatiChowk	ShahalmiChowk	28	14	9	1.00	**13**
2	ShahalmiChowk	Crown Adda	24	13	11	0.65	**14**
3	Crown Adda	EikMoria	21	12	9	1.00	**13**
4	EikMoria	NayyarWasti	28	18	19	1.58	**21**
5	NayyarWasti	YadgarChowk	27	29	26	0.92	**27**
6	YadgarChowk	Data Darbar	25	26	19	1.05	**23**
7	Data Darbar	Bhati Gate	19	18	14	0.35	**17**
Total Route (Sections 1-7)			**25**	**17**	**14**	**6.55**	**17**

Source: LRMTS Study, MVA Asia 2008

Figure 3.4.30 Location of Listed Road Sections



Source: LRMTS Study, MVA Asia 2008.

This needs immediate attention of authorities to conduct a comprehensive traffic management study covering all facets as described above to prepare a pragmatic traffic demand management plan for this area to revitalize its economy and social structure to provide sustainable mobility and accessibility.

LUTMP intends to propose a set of traffic management projects to alleviate the serious traffic situation of this area. Although some projects have a long-term nature, most projects should be implemented in the short- to medium-term. These projects will form the core of the LUTMP Action Plan.

2) Strengthening Management

The Action Plan of LUTMP aims to come up with various counter measure to tackle the following issues.

(i) Rules and Regulations

In general, traffic related regulations are insufficient, ineffective and obsolete; moreover, enforcement of rules is quite weak, which globally implies a chaotic and an in-disciplined traffic on roads, and therefore results in high rates of loss of life, injuries and damages to properties. This is exacerbated by the diversity of the traffic mix in Lahore. The traffic laws are not applied on cyclists, animal-drawn carts, hand-pushed carts and pedestrians, even though these modes make up around 70% of the total road users. The typical traffic enforcement fines are quite low and are in the range of around PKR 50 to PKR 300. Also there are no appropriate punishments for damaging the road infrastructure; and compensation for a death in a road accident is around only PKR 10,000 with a third party insurance. Road safety is globally declining resulting in increase in number of fatalities per year.

Management of the public space available in Lahore is poor, resulting in disorderly traffic mixed with various modes, many encroachments and illegal parking, and few facilities for pedestrians and cyclists. Lahore is characterized by a disorderly traffic mixed with pedestrians, animal-drawn carts, hand-pushed carts, bicycles, motorbikes, rickshaws, Qingqi, cars, vans, mini-buses, inter-city coaches, trucks etc. The animal driven carts and the other slow-moving non-motorized vehicles need to be eliminated from using the main carriageway and separated from general traffic. These slow modes cause disturbance in traffic resulting in acceleration of other faster passenger vehicles and prompting severe traffic accidents. It is observed that such animal driven vehicles and slow modes are frequently parked beside shoulder or move close to the pedestrians and create many health problems.

Wide spread encroachments of roadside, both permanent and temporary, reveal a lack of parking policy in Lahore; they block sidewalks in many locations and inhibit both pedestrian and vehicular flows. For instance, large solid waste containers are placed on main roads, from where they are hauled away every day. They obstruct traffic and, while this procedure eases solid waste collection, it is clearly contrary to any modern principles of traffic management. Due to encroachments, the slow modes and two wheelers have to come on high speed lanes which make travelling difficult and increase the risk of accidents as well as traffic congestion. There is a strip/ liner commercial development along the transportation corridors without proper offsets, set-backs and access management as per planning and building bye-laws; causing severe encroachments and traffic jam. Moreover, traffic police does not have the adequate authority to remove encroachments.

On the other hand, facilities for pedestrians and cyclists are either non-existent or inadequate. These are the most vulnerable groups and are the victims of 50% road accidents. Most sidewalks are in poor condition or encroached by parked vehicles or commercial activities, forcing pedestrian to walk on the street and therefore affecting traffic safety and vehicle speed.

Figure 3.4.31 Disorderly Traffic Mix in Lahore

Source: LRMTS Study, 2007

(ii) Physical Infrastructure

Management of the physical infrastructure, of particularly concern is road maintenance. The poorly developed transport network in Lahore is under-maintained. One of the key weaknesses in the system is indeed relatively low priority given to the maintenance of existing infrastructure. Some roads are in completely dilapidated condition resulting in frequent pavement failures and require full rehabilitation. Road maintenance is generally ignored till reconstruction becomes due and essential. Secondary and tertiary road / drainage networks in lower income parts of the city have been neglected and become impassable in the rainy season for pedestrians and vehicles alike.

(iii) Traffic Control

Traffic control devices include all signs, signals, markings and devices placed on or adjacent to, a street or highway by, and is obviously a key element in managing traffic flow. There is no standard practice of using uniform traffic control devices in Punjab. The only Manual for Uniform Traffic Control Devices available is the NTRC Manual for Signs, Signals ad Markings (1989), which has never been modernized. Furthermore, there are many gaps and missing areas in the NTRC Manual e.g. work zone area, school children signage etc. Many of the traffic signals (only 120 in Lahore city) are inoperative and signage system is totally inadequate. In Lahore, traffic signals are largely being managed by TEPA as originally stipulated. There was a period in the late 1990s when the traffic signal functions were re-assigned to an agency responsible for civil works, with the result that most signals ceased to function. In recent years, some signals have been installed and managed by other agencies, such as the GoPb Communications and Works Department, the National Highway Authority (on National Route N-5) and The

Cantonment Board, which is managing about 50 signal installations in the Defence Housing Areas. Similarly, traffic signs and road markings are placed and maintained by TEPA, CDGL and PHA, and also by other agencies engaged in road construction. For the sake of efficiency, uniformity and economy, it would be desirable to combine these functions in a city-wide single traffic agency.

(iv) Management of the Drivers

The current situation in Lahore is also worsened by a weak management concerning the drivers, both private and public transports, with a considerable proportion that are lacking proper training and licensing, while roads are often without basic markings and signage. Commuters and transporter have globally no traffic sense resulting in a chaos like situation. A lack of operators discipline in this complex environment reduces traffic capacity further and increases safety concerns. Traffic police also suffers from inadequate strength and needs further training. There is finally a significant safety issue concerning the motorbikes use, sometimes transporting more than two riders, commonly without helmet for both driver and passengers. The general situation causes a failure to follow traffic rules, which in turns leads to a worsening in levels of congestion and contribute to road accidents rate.

(v) Other Management Issues

Other management issues are the rationalization of on-street parking and occupied road-side space by vendors. It is necessary to remove these encroachments for safe and comfortable pedestrian sidewalks.

Volume-II – Chapter-4

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

FINAL REPORT

4 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

4.1 Present Condition in the Study Area

In general, existing environment condition is described in several components which further subdivided various environmental items. However, expression of the components and items often varies with projects and relevant competent organizations, government and donors. According to Guidelines for the Preparation of Environmental Reports (Government of Pakistan, November 1997), in order to describe a brief but clear picture of the existing environmental resources the following four components are described:

i. Physical resources – topography, soils, climate, surface water, groundwater, geology/ seismology;

ii. Ecological resources – fisheries, aquatic biology, wildlife, forests, rare and endangered species;

iii. Human and economic development – population and communities, industries, basic infrastructure, institutions, transportations, land use planning etc.;

iv. Quality of life values – socioeconomic values, public health, recreational sources, aesthetic values, archaeological or historic treasures, cultural values.

In this report existing environment are expressed in three components: i.e. social environment, natural environment and environmental pollution and sub-divided environmental items as mentioned above mostly referring to JICA Guidelines for Environmental and Social Considerations.

a) Social Environment – Land acquisition and resettlement, local economy, land use and utilization of local resources, social institutions/ split of communities, existing social infrastructure and services, transport and traffic conditions, the poor, indigenous or ethnic people; gender, children’s rights, misdistribution of benefit and damage, local conflict of interests, cultural property and heritage, fishing rights, water rights and rights of commons; public health and sanitation, infectious diseases such as HIV/ AIDS, working condition, hazard/ risk, accidents and severance;

b) Natural Environment – Topography and geology, soil erosion, groundwater, river, canal and storm water drainage; flora, fauna and biodiversity; protected areas, landscape, meteorology, global warming;

c) Environmental Pollution – Air pollution, water pollution, soil contamination, bottom sediment, waste, noise and vibration, ground subsidence, offensive odor, visual intrusion.

4.1.1 Social Environment

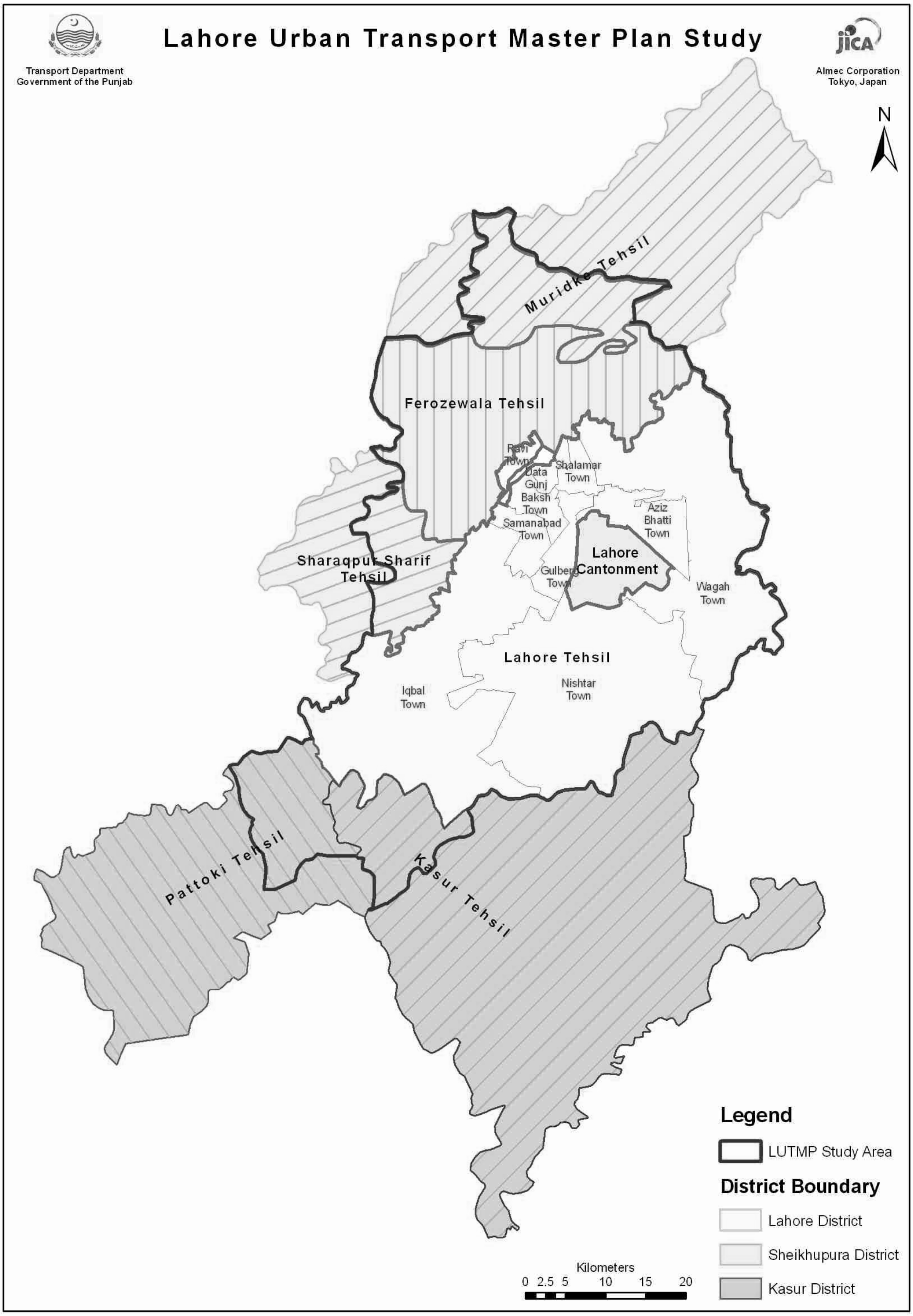
1) Political and Administrative Structure

The Study Area composes of whole of Lahore District, parts of Kasur District, and Sheikhupura Districts as shown in Figure 4.1.1. Tehsil is lower level of administration boundary under district administration in Pakistan. The Study Area includes Lahore District: 2 Tehsils, Lahore and Cantonment; Part of Sheikhupura District: parts of Tehsils of Ferozewala, Muridike, and Sharaqpur; and part of Kasur District: Tehsils Kasur and Pattoki adjoining Lahore District in the South-west and South. Today, Lahore District has spread over 1,772 km^2: over 80 % of the total area is occupied by three towns of Iqbal Town, Nishtar Town and Wagha Town.

The administrative structure has been changed after promulgation of Local Government Ordinance (2001). Districts, City Districts, Tehsils/ Towns and Union Council's Administrations have been created. Lahore was declared as City District and divided into six towns. In 2005, six towns were further divided to create nine towns in CDGL (Figure 4.1.1). Now, Lahore City District comprises of nine towns which are administrated by each Town Municipal Administration (TMA). The Lahore cantonment is separately administered by cantonment board and provision of core facilities is the responsibility of Lahore Cantonment Board.

Local Government Ordinance 2001 changed local administration. Before 2001, in urban areas, local bodies which performed services were metropolitan corporations, municipal corporations, municipal committees and town committees; whereas in rural areas, district and union councils performed these functions. After 2001, major local level services have been transferred to local governments. These include primary education, health, water supply and sanitation. Three tiers of local government have been developed in the form of district/ city district, Tehsil/ Town and union council administration.

Figure 4.1.1 The Study Area



Source JICA Study Team

2) Demographic

(i) Population Characteristics

Urbanization in Lahore has spread beyond its administrative boundaries, although the city continues to be the center of the growing metropolis. The total population of the Study Area is 9.9 million; including: Lahore District population of 8.65 million and 0.37 million of Kasur and 0.9 million of Sheikhupura. However, most of the population is concentrated in the center of Lahore, while the rest of the areas are sparsely developed, and mostly rural except for narrow strips along arterial roads showing a ribbon development.

Most recent population analysis of LUTMP Phase-I is given in the Table 4.1.1. 8.6 million People reside in Lahore District and 82% of which are urban dwellers. The population growth rate of 2.7 % since the 1998 Census is much higher than the national and provincial population growth rates of 2.02 % and 2.03% per annum respectively. The Study Area population accounts for 10.6 % of the total population, and 25.5 % of the urban population of the Punjab Province.

The Lahore Urban Transport Master Plan Study Area is about 42 % larger than Lahore District due to inclusion of parts of Kasur and Sheikhupura districts. Rural populace is still dominant in these two adjoining areas and thus urban residents account for 76 % in the Study Area. The reason of inclusion of these two areas into the Study Area is simply to compare the result with the 1991 JICA Master Plan. The population growth rate of 2.59 % of the Study Area is slightly lower than that of Lahore District.

Table 4.1.1 Demographic Comparison – Study Area Context

Description			Pakistan	Punjab Province	Lahore District	Study Area	LUTMP % of Punjab
1	Area (km^2)	Year	796,096	205,345	1,772	3,044	1.5
2	Population (,000)	Dec-2010	168,258	93,682	8,652	9,928	10.6
3	Urban Population (,000)	Dec-2010	65,330	29,722	7,097	7,572	25.5
4	Urban Population (%)	Dec-2010	39.5	31.7	82	76	-
5	Census Population (,000)	1998 Census	132,352	73,621	6,319	7,307	9.9
6	Annual Growth Rate (% per annum)	1998-2010	2.02	2.03	2.65	2.59	-

Source: Punjab Development Statistics

(ii) Social Migration

According to 1998 Census, 897 thousand migrants in urban Lahore were reported. It constituted 17.4 % of total urban population. There are three main types of migration, i.e., inter-provincial, intra-provincial and international migration. In the census data, 10.1 % came from other provinces, 71.7 % of intra-provincial migrated from other districts and 16.9 % from other countries. In Lahore, primary reasons of migration are better economic opportunities and larger and high-quality educational facilities.

(iii) Religion

As per percentage of population by religion Muslims account for 97.22 %, Christians about 2.31 %, and Ahmadis 0.2 %. While other minorities Sikhs, Hindus and other are very small in numbers. Population by religion is given in Table 4.1.2.

Table 4.1.2 Population by Religion in Punjab Province (1998)

Religion		Total		Urban		Rural	
		1,000 Persons	%	1,000 Persons	%	1,000 Persons	%
	Total	73,621	100	23,019	100	50,602	100
1	Muslim	71,575	97.22	22,156	96.25	49,419	97.67
2	Christian	1,700	2.31	753	3.27	947	1.87
3	Ahmadi	181	0.25	85	0.37	96	0.19
4	Hindu	93	0.13	15	0.07	78	0.15
5	Scheduled Castes	24	0.03	3	0.01	21	0.04
6	Others	48	0.06	7	0.03	41	0.08

Source: Population and Housing Census, 1998

(iv) Ethnic Structure

The main castes and groups of the Lahore District are Arain, Jut, Rajput, Mughal, Sheikh, Komboh, Gujjar, and Pathan. Besides, there are also village artisans, which include Lohars (blacksmith), Tarkhan (carpenter), Kumahrs (potters), Mochis (cobblers), Machhis (water-carries), barbers and weavers etc.

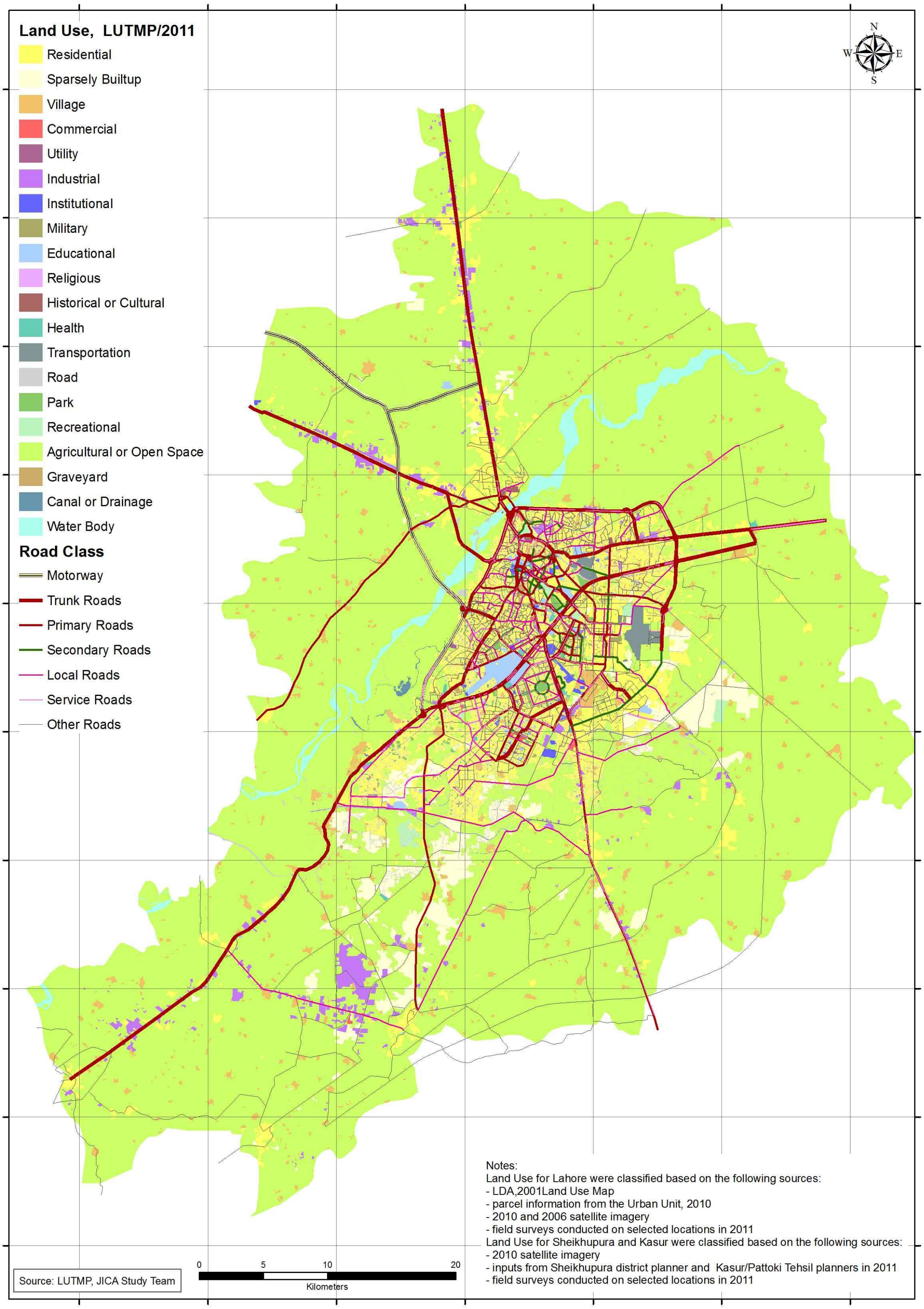
(v) Mother Tongue

As for languages used for communication between parents and their children in any household, Punjabi is predominant (86.2 %), followed by Urdu (10.2 %), Pashto (1.9 %) and Siraiki (0.4 %), and other (0.13 %).

3) The Study Area Land Use

Land in the Study Area is classified as predominantly agricultural use or vacant except residential, commercial, industrial and transport use in the City area as shown in Figure 4.1.2; and in Table 4.1.3.

Figure 4.1.2 Land Use Map of the Study Area



Source: JICA Study Team

(i) Land Use in Lahore Area

In the Study Area, Lahore City area is characterized by the following three concentric zones which represent the generalized built-up form.

(a) Inner or Central Zone

This zone including the historic Walled City is a combination of residential, commercial and small-scale industrial activities. Non-residential uses like retail and wholesale commerce, cottage industry and warehousing are intermingled with historically purely residential neighbourhoods.

(b) Intermediate Zone

This zone is largely planned as a mixture of housing, its related activities and services.

(c) Outer Zone

This zone represents typical urban sprawl characteristics comprising new housing schemes sponsored by public as well as private sector.

The specialized functions and services are, however, concentrated in the inner zone thereby generating a large amount of travel between these zones and thus the need for an efficient public transport system is amply visible.

Land use data of Lahore Area, which was surveyed in 2001 shows that land is mostly covered by vacant or under agricultural use (76.2 %), followed by residential use (9.8 %) and cantonment (4.0 %). Transportation use including network and terminals use cover about 1.9%.

Table 4.1.3 Land Use in Lahore Area* (2001-2002)

Land use		Area (ha)	%
1	Residential	22,715	9.8
2	Commercial	1,737	0.7
3	Educational	1,419	0.6
4	Institutional	998	0.4
5	Industrial	2,455	1.1
6	Graveyards	637	0.3
7	Parks/Recreational	1,608	0.7
8	Vacant/Agricultural	175,854	76.2
9	Transportation (including primary network and terminals)	4,449	1.9
10	Villages	3,820	1.7
11	Water Bodies	5,711	2.5
12	Cantonment	9,267	4.1
Total		**230,670**	**100.0**

Source: Integrated Master Plan for Lahore-2001
***** Note: Area Refers to 2001 Integrated Master Plan Study area.

(ii) Land Use for Agricultural Activity

The agriculture land use is most commonly cultivated in the Study Area are wheat, fodder, cotton, and rice.

4) Socio-economic Structure

(i) Household (HH) Structure:

According to Integrated master Plan for Lahore-2001 household size of Lahore has been progressively growing over past 40 years. In Lahore District, it increased from 5.8 (persons per HH) in 1961 to 7.2 (persons per HH) in 1998. According to LUTMP household survey average household size in the Study Area is 5.6. This shows a considerable decline since 1998 census. These changes in household size can be attributed to the following reasons:

- In the process of urbanization, male member of the family first moves to an urban area and other members join him in due course;
- The house ownership in low income group is very restrictive, joint family system prevails, consequently the household size increases over a period of time;
- For economic reasons and rising cost of living, the people whether having blood relation or not, prefer to live and expend together.

(ii) Household Condition

According to Population Census 1998, about 68 % of total population of Lahore owned a house, 22 % rented a house and the rest stayed free.

Lahore city is facing severe shortage of housing. Although data are limited and not recent, two milestone statistics of 1980 and 1998 showed the situation. Majority of these housing units comprised two to three rooms, with 3 inhabitants per room on average. During this period, the number of inhabitants per unit increased from 6.7 to 7.1. It is an adverse phenomenon not experienced in other countries where household size becomes small as a city grows with economic development. Such household congestion is attributed to high density in urban areas of Lahore.

In addition, the most severely affected segment of the population is the low income group. In urban areas (over 70 % of the annual incremental demand for housing is of low income group who find it extremely difficult to secure developed land plots and construct houses in the schemes by the public sector and cooperative societies.

(iii) Household Income Distribution

Household income distribution in Lahore of 2000-01 is calculated by using base data of household income distribution survey of Punjab (Urban) for the year 1996-97 and is outlined in Table 4.1.4.

Table 4.1.4 Household Income Distribution in Lahore (2000-01)

<table>
<tr><th colspan="2" rowspan="2">Household (%)</th><th>Monthly Household Income (PKR)*</th><th colspan="2">LUTMP (Urban + Rural)</th></tr>
<tr><th>(1996-97)</th><th>% HH</th><th>Income</th></tr>
<tr><td>1</td><td>0.47</td><td>< 1,000</td><td rowspan="3">< 2,000</td><td rowspan="3">0.2</td></tr>
<tr><td>2</td><td>1.26</td><td>1,001-1,500</td></tr>
<tr><td>3</td><td>3.19</td><td>1,501-2,000</td></tr>
<tr><td>4</td><td>5.74</td><td>2,001-2,500</td><td rowspan="4">2,000-4,000</td><td rowspan="4">1.1</td></tr>
<tr><td>5</td><td>6.18</td><td>2,501-3,000</td></tr>
<tr><td>6</td><td>7.68</td><td>3,001-3,500</td></tr>
<tr><td>7</td><td>7.8</td><td>3,501-4,000</td></tr>
<tr><td>8</td><td>15.24</td><td>4,001-5,000</td><td rowspan="2">4,000-6,000</td><td rowspan="2">3.7</td></tr>
<tr><td>9</td><td>12.17</td><td>5,001-6,000</td></tr>
<tr><td>10</td><td>8.48</td><td>6,001-7,000</td><td rowspan="2">> 6,000</td><td rowspan="2">95</td></tr>
<tr><td>11</td><td>31.79</td><td>> 7,000</td></tr>
</table>

Note 1: * Household Integrated Economic Survey, 1996-97
Source: Integrated Master Plan for Lahore-2001

Recent data on the distribution of average household income per annum was reported by Urban Unit Lahore, 2007-08 as given in Table 4.1.5.The table indicates majority of the households (20 %) earn about PKR 200,000 to PKR 300,000, about 19 % earn PKR 100,000 to PKR 150,000 and only less than 2 % earn less than PKR 50,000 per annum. These figures show that most of the people living in Lahore earn reasonable amount of money to support themselves as compared to other cities and rural areas of the Punjab.

Table 4.1.5 Distribution of Household Income in Lahore

Household Income (PKR/year)		% of HH in Lahore	% of HH in the Study Area
1	< 25,000	0.7	0.2
2	25,000 - 50,000	1.4	1.1
3	50,000 - 75,000	5.5	3.7
4	75,000 - 100,000	10.0	7.5
5	100,000 - 150,000	18.9	18.6
6	150,000 - 200,000	15.5	17.4
7	200,000 - 300,000	19.5	17.9
8	300,000 - 500,000	13.0	18.0
9	> 500,000	12.7	15.7
10	Don't know	2.8	0.0
Total		100.0	100.0

Source: The Urban Unit, Lahore, 2007-2008

(iv) Human Development Index

Human Development Index (HDI) is a tool of measuring development by combining indicators of life expectancy at birth, adult literacy rate, mean years of schooling, educational attainment and income as measured by real gross domestic product per capita. The HDI is used as a comparative measure to assess life expectancy, literacy and standards of living with other countries worldwide. It is also a standard means of measuring well-being, especially child welfare and is used to distinguish whether the country is a developed, a developing or in under-developed stage, and also to calculate the impact of economic policies on quality of life. Data for estimating the district HDI has been gathered from 1998 population census, 2004-05 Core Welfare Indicator Questionnaire (CWIQ) and Pakistan demographic survey (1999 and 2003). Three indices (Health, education and income) have been developed, and mean values of these indices have been used to calculate HDI.

As detailed in Table 4.1.6, Lahore District enjoys better human development than other three cities of the Punjab. At the same time it attained the top ten ranking among the cities of Pakistan. According to UNDP categorization of high (more than 0.80), medium (0.50 to 0.80) and low (below 0.50) level of development, Lahore District emerges in medium level and near to high level HDI.

Table 4.1.6 Human Development Index of Lahore District and Other Cities of Punjab

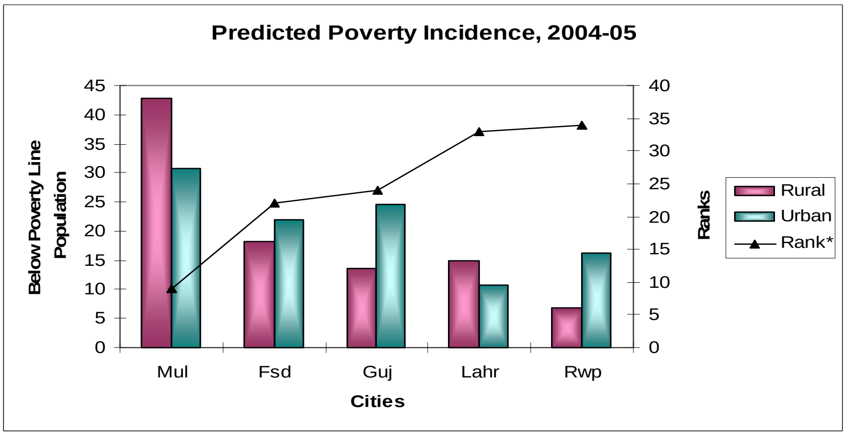
Area		HDI (2005)	HDI (1998)	Annual Rate of Change (% p.a.)
1	Punjab Province	0.620	0.516	2.7
2	Gujranwala	0.696	0.562	3.1
3	Lahore	0.689	0.600	2.0
4	Faisalabad	0.672	0.600	1.7
5	Multan	0.643	0.531	2.8
6	Rawalpindi	0.638	0.600	0.9

Source: Aamir and Haroon (2007)

(v) Poverty Incidence

The poverty incidence is calculated by estimating the percentage of people who live below the poverty line within the district. Among the five major cities of the Punjab, Lahore shows a middle level development but rural population is much poorer than urban population. Lahore as whole is at 33rd rank among the districts of the Punjab indicating that the poverty is lowest in Lahore and Rawalpindi then other districts of Punjab as illustrated in Figure 4.1.3.

Figure 4.1.3 Punjab Estimated Poverty Incidence 2004-05



Source: Social Development in Pakistan, SPDC Annual Review 2006-07

(vi) Industry Profile of Lahore

Land use the Study Area is mostly either vacant or agricultural field as detailed in Table 4.1.7. However, as for industrial activities as well as living conditions Lahore District has a different feature as the second largest financial hub of Pakistan. There has been a steady expansion of industries in and around Lahore since independence. Many large industrial units and modern industrial areas are located. These industrial units consist of textile, leather and rubber footwear, pharmaceutical and other industries.

The 2001Integrated Master Plan for Lahore reported the following features of the industry in 1999:

- About 9,000 cottage and small to large scale manufacturing industries were operating in Lahore. The spectrum of industries extends from organized, large and medium sized industries, and unorganized traditional cottage industries. The latter known as the micro/cottage and small scale industries constitute an important segment of the economy. These provide maximum employment and ensure maximum utilization of local resources, both manpower and materials.
- Large scale manufacturing industries are registered under 77 categories. In 1999, out of 8,468 industrial establishments only 1,239 (about 15 %) are registered. As given in Table 4.1.7, 18.2 % of the total factories belong to metal products, followed by machinery other than electrical (13.8 %), textile products (12.6 %), food manufacturing group (7.2 %).

Table 4.1.7 Registered Factories in Lahore District (1999)

Group		Number	%
1	Food items	89	7.2
2	Beverages	24	1.9
3	Textile	156	12.6
4	Leather, Rubber and Plastic Industry	76	6.1
5	Electric machinery	70	5.6
6	Metal Industry	226	18.2
7	Machinery	171	13.8
8	Printing/Stationery	76	6.1
9	Chemicals	50	4.0
10	Building Materials	28	2.3
11	Pharmaceuticals	52	4.2
12	Transport Equipment	81	6.5
13	Furniture	13	1.0
14	Service Industry	85	6.9
15	Miscellaneous	42	3.4
Total		**1,239**	**100**

Source: Integrated Master Plan for Lahore-2001

Out of 1,239 registered factories in Lahore, 84% have employed up to 50 persons each as shown in Table 4.1.8. In addition, Kasur and Sheikhupura District small and medium size industries of textile and food processing are also located.

Table 4.1.8 Number of Employees in Industry (1999)

Number of Employees		%
1	< 10	24.6
2	10 to 50	59.6
3	51 to100	7.3
4	101 to 250	4.7
5	251 to 500	2.0
6	501 to 1,000	0.8
7	> 1,000	1.0
8	Total	100.0

Source: Integrated Master Plan for Lahore-2001

(vii) Labour Force

In Punjab, labour force (‘working’ plus ‘looking for work’) accounted for 32 % of the provincial population during the period 2006-07. In the urban areas, an unemployment rate of 7.5 % is rather high than that of 4.7 % in the rural areas. Recent provincial statistics do not show district-level labour force. When working population had a share of 29.4 % in the provincial population during the period 2003-04, its share was 22 % in

Lahore District due to the mass of students and other reasons. According to the labour survey done by the Urban Unit during 2007-08, Lahore labour force is characterized as mostly service workers by occupation type, social services, trades and commercial activities by industry type.

(viii) Participation of Labour Force by Occupation

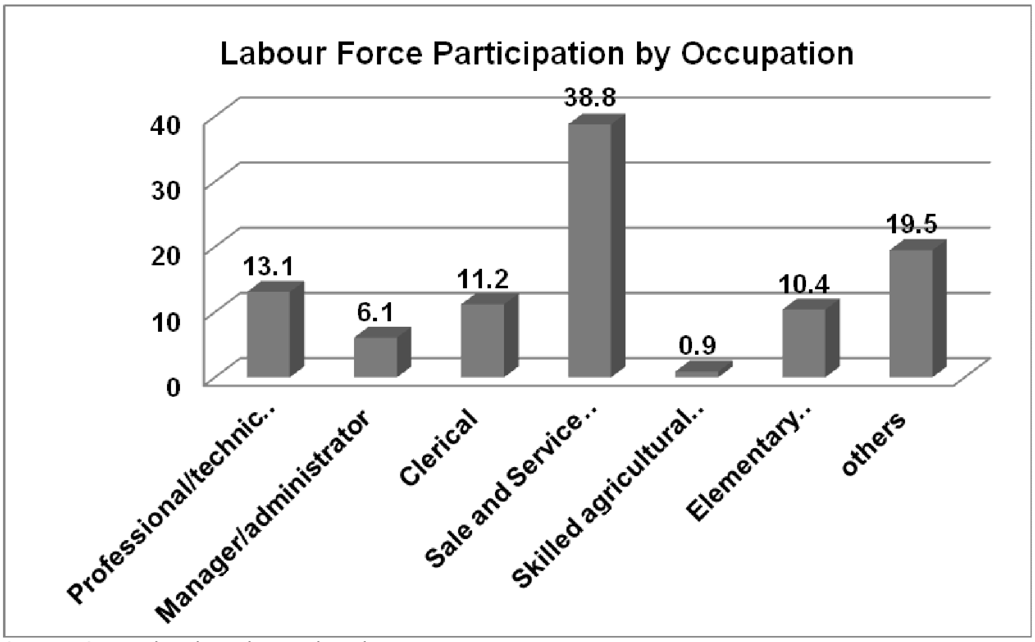
It is clear that 39 % people have been employed in the service sector during 2007-08 in Lahore, which is a significant income from 19 % in 1998. Skilled agricultural people are very low in number and there is no prominent improvement in their ratio from 1998 to 2008. Comparison of occupation in Punjab Province and Lahore District is shown in Table 4.1.9, and Labour Force Participation by Occupation is shown in Figure 4.1.4.

Table 4.1.9 Major Occupation Groups in Punjab Province and Lahore District

Major Occupation Group		Employed Population (%)			
		Punjab Province		Lahore District	
		Jun-05		1998	2007-08
		Total	Urban		
1	Professional/Technician	6.1	11.2	14.5	13.1
2	Manager/Administrator	11.4	21.0	0.8	6.1
3	Clerical	1.2	2.8	4.7	11.2
4	Sale and Service Worker	4.8	8.8	19.2	38.8
5	Skilled agricultural worker	35.8	6.2	2	0.9
6	Elementary occupations	18.8	15.7	43	10.4
7	Others	21.8	34.4	15.8	19.5
Total		**100.0**	**100.0**	**100.0**	**100.0**

Source: Survey by The Urban Unit, Lahore

Figure 4.1.4 Labour Force Participation by Occupation in Lahore District



Source: Survey by The Urban Unit, Lahore

(ix) Distribution of Labour Force by Industry

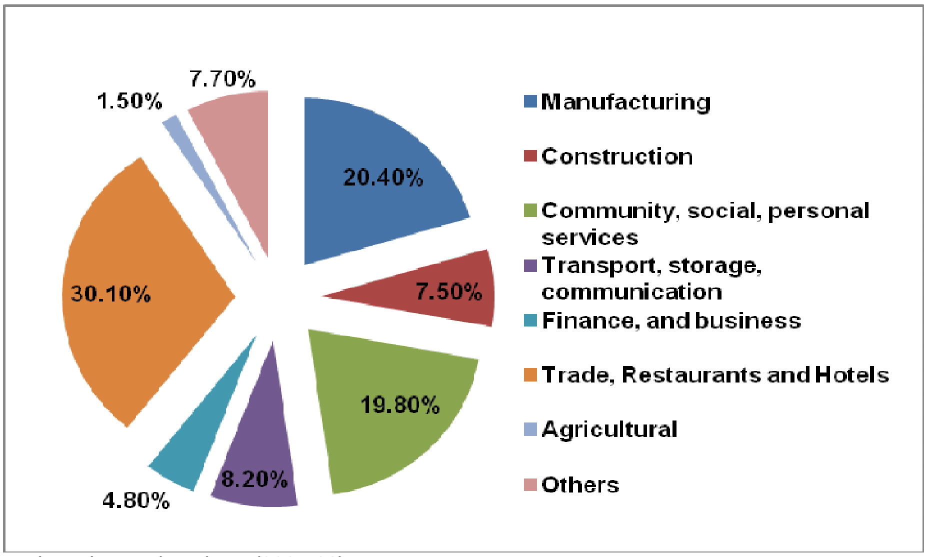
In Lahore majority of people (30 %) works in trade, restaurants and hotels sector followed by (20 %) in manufacturing sector. This is remarkable contrast with that of the Punjab Province as a whole, where agricultural sector was dominant as shown in Table 4.1.10 and Figure 4.1.5.

Table 4.1.10 Labour Force Distribution in Punjab Province and Lahore District

Industry		Employed Population (%)		
		Punjab Province	Lahore District	
		2006-07	1998	2007-08
1	Manufacturing	15.4	10.1	20.4
2	Construction	5.6	27.3	7.5
3	Community, social, personal services	13.7	19.1	19.8
4	Transport, storage, communication	5.3	7.5	8.2
5	Finance and business	1.0	6.6	4.8
6	Trade, restaurants and hotels	14.1	16.9	30.1
7	Agricultural	44.4	2.2	1.5
8	Others	0.6	10.4	7.7
Total		**100.0**	**100.0**	**100.0**

Source: Survey by The Urban Unit, Lahore

Figure 4.1.5 Distribution of Labour Force by Industry



Source: The Urban Unit, Lahore (2007-08)

5) Social Infrastructure and Services

(i) Water Supply

(a) Existing Water Supply Situation

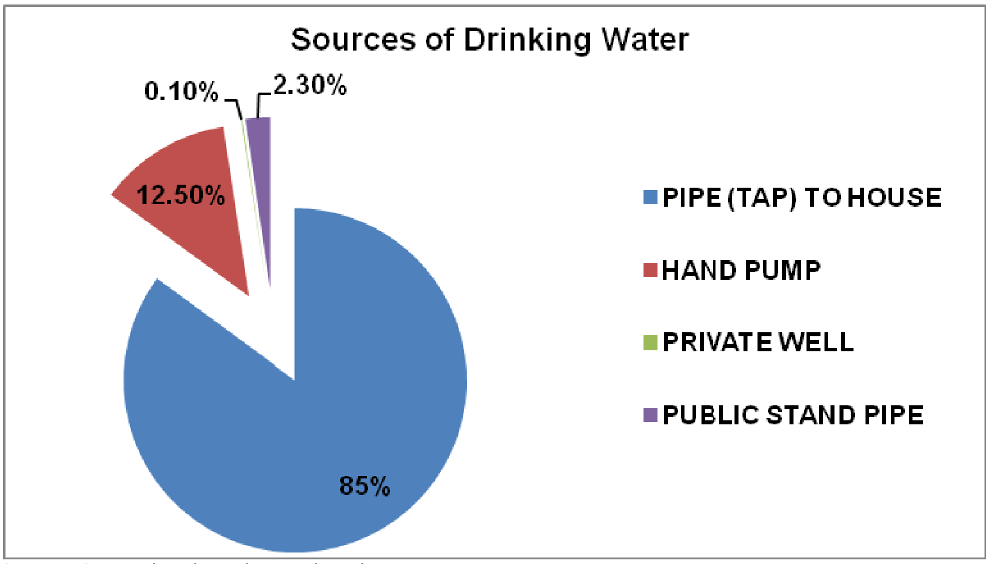
According to Water and Sanitation Agency (WASA), of LDA, water in Lahore City is supplied by WASA for about 85% population of Lahore City, whereas about 11 %

population is supplied by the Lahore Cantonment Board and remaining 4 % population is provided by the others such as Railways Housing Societies or are reliant on own tube well or groundwater pumping (manual) system. WASA and Housing Societies base their water supply on groundwater abstraction within Lahore area. Tube-wells in various locations have been installed for pumping of groundwater, which is generally pumped directly into distribution system of WASA, while the Housing Societies have over-head tanks. Water supply system within Lahore is designed to provide water at an average rate of 363 litres per capita per day as per WASA statistics.

The Household survey of 2007-08 indicates that 85 % people were using potable (tap) water, and the rest 10% people were dependent of their personal hand pumps. These figures are not different from that of 1998, where 10 % population was using hand pumps for drinking water.

The quality of deep groundwater is potable and is adequate for direct consumption without treatment. As shown in Figure 4.1.6, 85 % people use tap water for drinking purpose from groundwater for drinking purpose in 2007-08.

Figure 4.1.6 Distribution of Household by Sources of Drinking Water in Lahore



Source: Survey by The Urban Unit, Lahore

(b) Water Supply Problems

In the Study Area water supply has fairly good situation in both quality and quantity. However, following issues are to be considered:

a) 30 % to 40 % water is being wasted due to leakages in the system, unmetered and illegal connections, incomplete distribution system, etc.

b) Only 70 % houses in WASA service area are provided with water connections.

The remaining houses are either without water connection or they have their own arrangements or illegal connections.

c) There is excessive abstraction of groundwater resulting in depletion of water table at an unsustainable rate.

(ii) Sewerage and Drainage

WASA Lahore provides its sanitation services to very large portion of population, i.e., 80 % of Lahore population over 66 % of the city area. According to WASA Report 2005-06, in Lahore, there are about 405 km of sewer lines and 41km of drainage channels. These were originally designed as separate systems. However, sewer pipes are connected to drains at various points and a large amount of sewage constantly enters storm water drains at various points and is ultimately disposed into the Ravi River.

People are constantly, especially in summer months, complaining about the stench generated from wastewater and raw sewage in open channels, which are also full of sludge and garbage. Flood is attributed to the reduction of flow capacity of sanitary sewers and storm water drainage channels, which are silted up and clogged with solid waste. In addition, pumping stations do not have sufficient drainage capacity to cope with heavy rains in the monsoon season.

(a) Sewerage System

In Lahore WASA is responsible for sewerage system. In 2001 sewerage system in WASA service area catered for about 55 % of the population. The sewerage system consists of 405 km of trunk sewers and 3,205 km of lateral sewers. The sewage is pumped to the storm water cum sludge drains in various sewerage districts of WASA. These drains ultimately dispose of sewage into Ravi River. Presently no wastewater treatment services exist and the raw wastewater is directly discharged into Ravi River thus causing unhygienic condition in the river as well as for the downstream users. The situation is very critical under low flow condition in the river when sufficient dilution is not available and the river almost serves as a sludge carrier. All life form in the River is almost dead due to complete depletion of dissolved oxygen in the water.

(b) Storm Water Drainage

Lahore is comparatively a flat area with a mild slope towards south-western side. There are natural barriers like River Protection Bund along Ravi River, Railway track which divides the city into Northern and Southern parts and the Canal which runs east-west and is situated on the ridge. Therefore, the following five main natural drainage channels run on the lowest contours and finally discharge into Ravi River:

- Upper Chotta Ravi (Northern Area)
- Lower Chotta Ravi (North Western Area)
- SukhNehr (North Eastern Area)
- Mian Mir (Central Area)
- SuttoKatla-Hudiara Drain (Southern Area)

At present urgent rehabilitation project for sewerage and drainage system is in progress in Lahore through technical cooperation with WASA by JICA. Storm water drainage has become a major environmental hazard. The situation becomes worse in the monsoon season which normally extends from July to September.

The storm water drains also function as sludge carriers. Almost all drains are flowing to their full capacity even in the dry weather and after only a light rainfall start to overflow. Encroachment along and over the drains have further deteriorated the situation. The dumping of solid waste in the drainage system is very common. Another bottle neck in the operation is the low head clearance of bridges across the drains, which reduces the waterway of the drains thus affecting their capacities.

(iii) Electricity

According to Population and Housing Census (1998), 97 % people of Lahore and 93 % people of Punjab Province had access to electricity for their common use. In Lahore area (most of the district) electricity is served to about 1.2 million consumers as of December, 2000. Out of these 75 % are residential, 22 % commercial and 3 % industrial consumers. The electricity is supplied through an interconnected 132 kV system comprised thirty-eight 132/ 11 kV grid stations. Water and Power Development Authority (WAPDA) is the agency responsible for installation, operation, maintenance, upgrading and augmentation of the electricity network. LESCO (Lahore Electric Supply Company) is responsible for its distribution, billing and control of leakage.

However, even now scheduled power stoppages are common several times a day due to system break-down and mostly shortage of supply, this causes inconvenience to living activities and are serious impediment to business activities. The existing system of power supply reveals that the network is relegating towards inefficient operational level and there is an imperative need for regular reinforcement and rehabilitation for better services.

(iv) Educational Facilities

In Punjab Province as a whole, various enrolment rates by education stages during 2007-08 were estimated as follows:

- Primary education (5-9 years) – 38.5 %
- Middle education (10-12 years) – 27.0 %
- High school education (13-14 years) – 18.8 %
- Intermediate stage education (15-16 years) – 10.8 %
- Degree level education (17-18 years) – 4.9 %

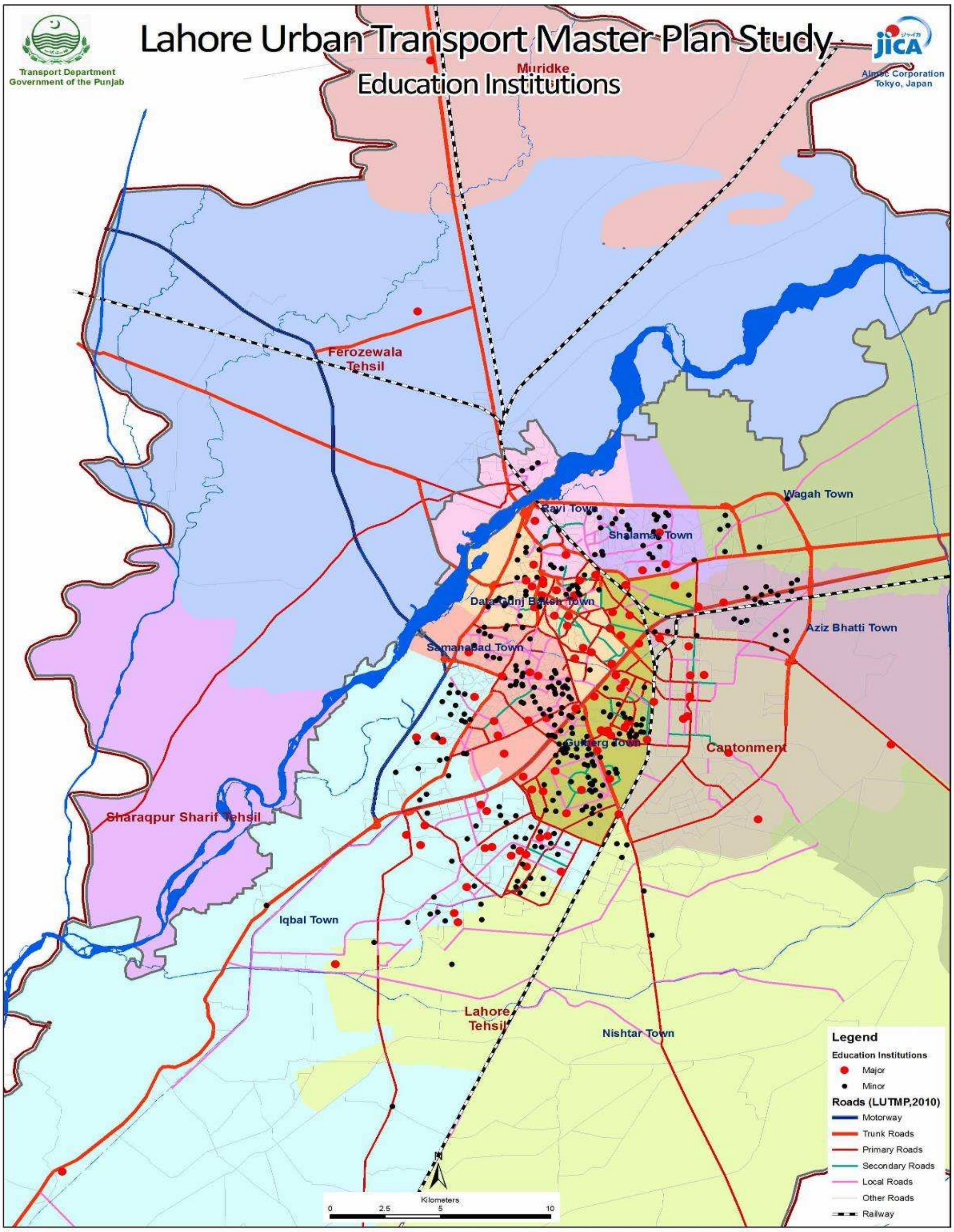
(Source: MICS Survey, Punjab, 2007-2008)

The 1998 Census indicated that the literacy rate of urban dwellers in Lahore District was about 69 % which was slightly higher than that of provincial urban average of 65 %. It is thus supposed that enrolment rates of Lahore by education stages may be higher than the above-mentioned provincial averages.

Lahore is known as an educational hub in the country. High schools and higher educational facilities are concentrated in the city and are shown in Figure 4.1.7. The number of all types of students is estimated at approximately 883 thousand. 651 thousand of which go to high schools or higher education facilities and they mostly need longer trips to the education places than primary and middle school students.

In Lahore, there are 24 universities. 11 universities are relatively new, mostly established after 1990. The largest university is University of the Punjab (30,000 students), followed by the University of Lahore (11,500 students), and University of Engineering and Technology (UET), Lahore (8,865 students).

Figure 4.1.7 Distribution of Educational Facilities in the Study Area



Source: JICA Study Team

(v) Health

(a) Major Diseases

Table 4.1.11 indicates that the total new case of priority diseases reported in the first quarter of year 2001, were just over 80,000 among which about 21,600 cases (27 %) were related to children under the age of 5 years. Seven of the 18 priority diseases, i.e. diarrhoea, dysentery, respiratory infections, malaria, cough, dog bite and scabies accounted for 39 % of the total new cases, during the first three months of the year 2001.In the year 2000, total new cases reported in Lahore were over 671 thousand. Among these 61 % were females and new cases less than 5 years were 20 % of the total.

Table 4.1.11 Priority Diseases in Lahore District (Jan-March, 2001)

Group		Number of Cases (Age)			%
		Under 4	5 and over	Total	
1	Diarrhea	5,926	6,111	12,037	24.6
2	Dysentery	905	1,782	2,687	59.6
3	Acute Respiratory infections	12,616	41,639	54,255	7.3
4	Fever (Clinical Malaria)	735	3,766	4,501	4.7
5	Cough more than 2 weeks	4	522	526	2.0
6	Dog bite	122	218	340	0.8
7	Scabies	1291	4,405	5,696	1.0
8	Total New cases (Priority diseases)	21,599	58,443	80,042	100.0
9	Total New cases (All diseases)	39,395	164,649	204,044	-

Source: Integrated Master Plan for Lahore-2001 (Directorate General Health Services, Punjab)

(b) Health Facilities

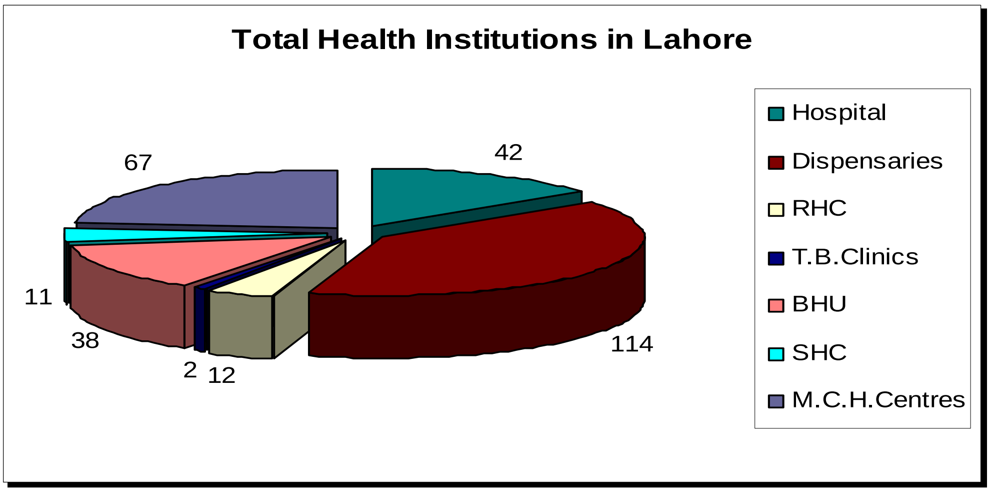
There are 40 hospitals distributed all over Lahore in 2001 as given in Table 4.1.12 and there are 153 dispensaries with 68 beds and 117 Maternity and Child Health Centre (MCH) in Lahore District. In addition to these, there is one Rural Health Centre with 20 beds, a civil dispensary and a MCH Centre in Sheikhupura District. According to Punjab Development Statistics 2008, 42 hospitals, 114 dispensaries, 38 BHUs, 12 SHUs and only 2 TB Clinics are operating in Lahore. These are further illustrated in Figure 4.1.8 below and there locations in the Study Area are shown in Figure 4.1.9.

Table 4.1.12 Number of Hospitals in Lahore

Status		Hospital	Beds	Doctors/Specialists
1	GoPb Hospitals	23	9,235	2,449
2	Federal Government, Autonomous, Semi-autonomous, Local Bodies, Army Hospitals	7	1,903	571
3	Trusts, NGOs, Waqf and other hospitals listed with DGHS	10	1,133	299
Total		**40**	**12,271**	**3,319**

Note: Listed with Director General of Health Services, Lahore
Source: Directorate General Health Services, Punjab

Figure 4.1.8 Health Infrastructure in Lahore



Source: Punjab Development Statistics, 2008

(c) Problems and Inadequate Facilities

In the Study Area the problems being faced by the health sector include:

- inadequate primary health care,
- high rate of population growth,
- prevalence of communicable diseases,
- managerial deficiencies,
- inadequate funding, and
- manpower imbalances.

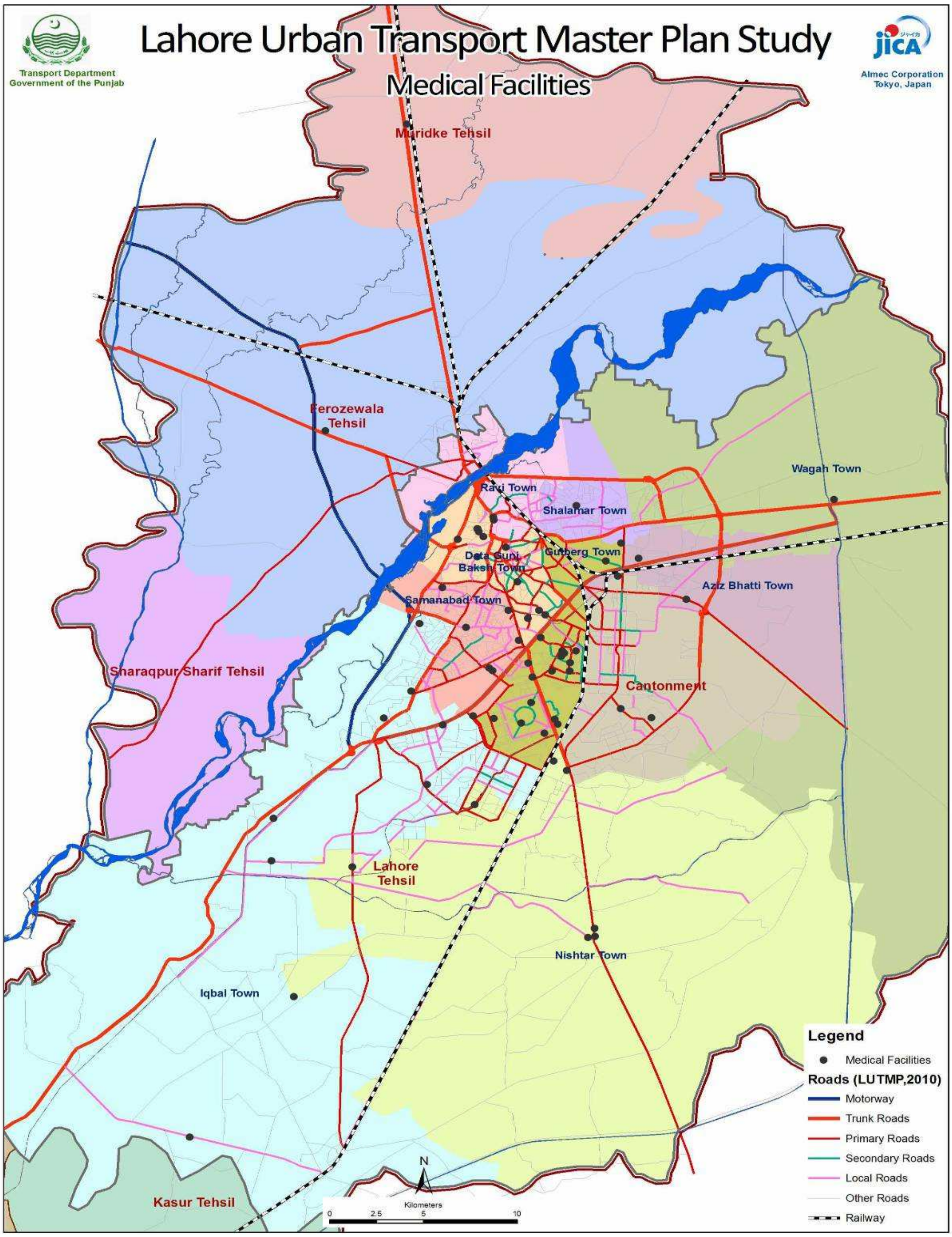
Thus, these lead to the following critical issues:

a) The public sector hospitals, which serve the majority of low and middle income segments of society, are not able to cope with the continuously increasing healthcare needs of the fast growing population.

b) There is an acute shortage of hospital beds, nurses and para-medical staff in the hospitals.

c) Primary health care facilities (dispensaries, NCH etc.) are quite inadequate.

Figure 4.1.9 Distribution of Medical Facilities in the Study Area



Source: JICA Study Team

(vi) Recreational Facilities

Lahore provides numerous recreational and amusement facilities not only to the local population, but also caters for the needs of the adjoining areas. The facilities include cinemas, theatres, parks and open spaces, sports facilities, museums, social and sports clubs and libraries.

(vii) Cultural, Historical and Religious Sites

In the Study Area, especially in Lahore City, various cultural, historical and religious sites can be found. Their locations are depicted in Figure 4.1.10.

(a) World Heritage Sites

Out of six World Heritage sites in Pakistan there are two World Heritage sites in the Study Area. One is the Walled City Area including Lahore Fort and Badshahi Mosque and the other is Shalamar Garden.

(b) Archaeological Sites and Monuments

There are 59 sites in Lahore District and 8 sites in Sheikhupura District as the notified archaeological sites and monuments by the Federal Government

(c) Monuments Declared as “Special Premises” By the GoPb

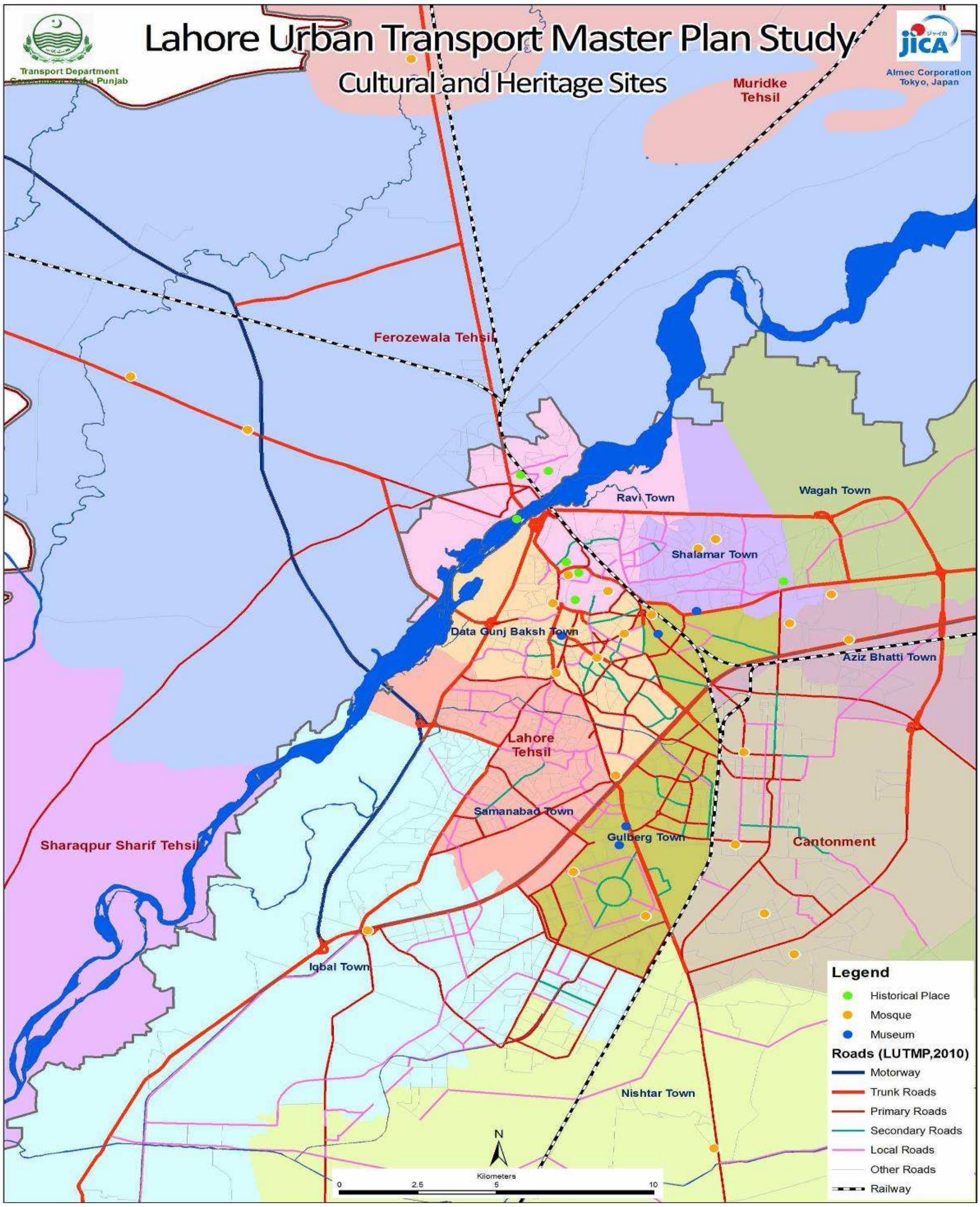
There are 109 sites in Lahore District, 3 sites in Kasur District and 2 sites in Sheikhupura District, which are declared as “special premises” in Punjab Special Premises (Preservation) Ordinance, 1985 by the GoPb.

(d) Religious Buildings in Lahore City

Lahore has a rich heritage of beautiful mosques and shrines of saints. The famous mosques in Lahore include the Badshahi Mosque, Masjid Wazir Khan, Sunehri Masjid, Masjid-e-Shohda, and Mosque of Data Darbar Complex. The maintenance and upkeep of large mosques and shrines is the responsibility of the Provincial Auqaf Department. The shrines are the core of religious gatherings and an integral part of Lahore’s cultural and historical legacy. The famous shrines of saints are those of Pir Makki, Syed Ali Hajveri (Data Ganj Bukhsh), Maadho Lai Hussain, Bibi Pak Daaman, Mian Mir Saheb and Mauj Darya. Almost all shrines include a grand mosque within their premises.

In addition, a number of Cathedrals, Convents and Churches mostly located along the major city roads are the visible and beautiful land marks of the British Colonial rule. These include Cathedral on the Mall, St. Anthony’s Church on Lawrence Road, Don Bosco and Naulakha Churches on Empress Road, and Convent of Jesus and Mary on Durand Road. Quite a few buildings/ structures such as Temples, and Gurdawaras depicting Hindu and Sikh religious faiths can be seen scattered all over the older parts of the city.

Figure 4.1.10 Cultural and Heritage Sites in the Study Areas



Source: JICA Study Team

4.1.2 Present Condition in the Study Area - Natural Environment

1) Geological Location

The Study Area is located on a flat alluvial plain along the bank of Ravi River. Lahore District lies between 31'15" and 31'42" north altitude, 74'01" and 74'39" east longitude. It is bounded on the north and west by Sheikhupura District, on the east by India (international border) and on the south by Kasur District.

2) Climate

(i) Climate data

Climate data average of 30 years (1961-90) of Lahore for the recent 5 years (2006-10) is given in Table 4.1.13 and 4.1.14.

Table 4.1.13 Climate Data in Lahore Average of 1961-90

Month	Temperature (℃)		Precipitation (mm)	Relative Humidity (%)	
	Mean Monthly Max.	Mean Monthly Min.		at 8:00 a.m	at 5:00 p.m
January	19.8	5.9	23.0	83	46
February	22.0	8.9	28.6	75	41
March	27.1	14	41.2	65	37
April	33.9	19.6	19.7	49	27
May	38.6	23.7	22.4	42	22
June	40.4	27.4	36.3	50	29
July	36.1	26.9	202.1	72	54
August	35.0	26.4	163.9	77	60
September	35.0	24.4	61.1	70	49
October	32.9	18.2	12.4	66	40
November	27.4	11.6	4.2	76	47
December	21.6	6.8	13.9	84	52
Year Total	—	—	**628.8**	—	—

Source: Meteorological Center, Lahore

Table 4.1.14 Climate Data in Lahore Average of 2006-10

Month	Temperature (℃)		Precipitation (mm)	Relative Humidity (%)		Wind Speed (Knots)	
	Mean Monthly Max.	Mean Monthly Min.		at 8:00 a.m	at 5:00 p.m	at 8:00 a.m	at 5:00 p.m
January	19.0	8.1	12.7	81	52	0.7	2.5
February	23.0	12.1	30.6	77	48	1.1	3.2
March	28.5	17.3	33.0	68	41	1.3	3.7
April	35.6	22.8	12.1	44	23	2.3	3.9
May	39.0	26.5	18.3	43	25	2.8	3.2
June	38.3	27.7	75.6	54	36	3.0	3.2
July	35.4	27.5	156.8	75	58	2.0	2.6
August	34.5	27.2	149.2	79	65	1.5	2.3
September	33.7	25.2	72.8	76	57	1.2	2.3
October	32.3	21.1	11.0	71	43	0.5	1.8
November	27.0	14.7	4.1	78	48	0.3	0.8
December	21.4	9.4	11.4	83	52	0.3	1.0
Year Total	—	—	**587.6**	—	—	—	—

Source: Meteorological Centre, Lahore

(ii) Temperature

The project area experiences extremes of climate condition. The summer season starts from April and lasts till September. Hottest months are May, June and July. The monthly mean maximum and minimum temperature during these months varies between 27 ℃and above 40 ℃. The winter season lasts from November to March. December, January and February are the coldest months with minimum temperature reaching close to freezing point. Mean minimum and maximum temperatures for the winter period is around 6 ℃ to 22 ℃ respectively. Net temperatures data of recent 5 years (2006 -10) and earlier 30 years (1961 – 90) are given in Tables 4.1.13, 4.1.14 and illustrated in Figure 4.1.11.

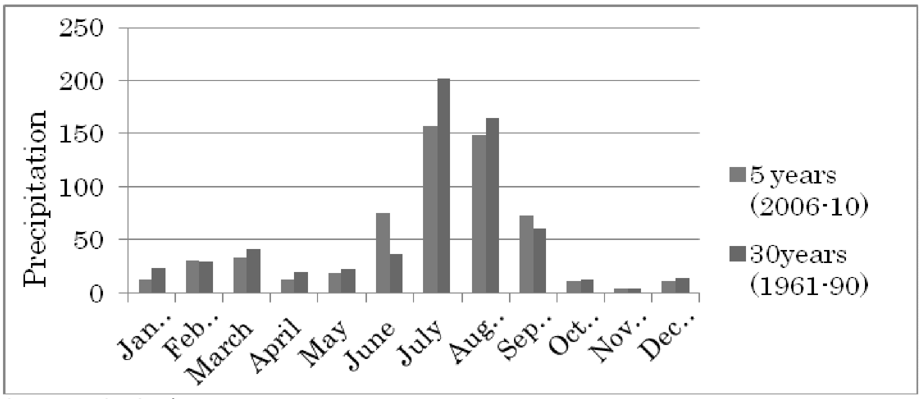
Figure 4.1.11 Monthly Mean Maximum and Minimum Temperature in Lahore

Source: JICA Study Team

(iii) Rainfall

Rainfall varies year to year and also month to month. The Study Area receives rains in all seasons. However, monsoon rain is pronounced and constitutes a definite rainy season between the months of July and September. Data of average monthly precipitation based on recent 5 years (2006-10) and 30 years (1961-90) as given in earlier tables is further compared in Figure 4.1.12. The average annual precipitation is 629 mm for the 30 years and 588 mm for the recent 5 years, respectively indicating a definite reduction in rainfall due to climatic changes, may be attributed to increased carbon emissions and global warming.

Figure 4.1.12 Mean Monthly Rainfall (mm)

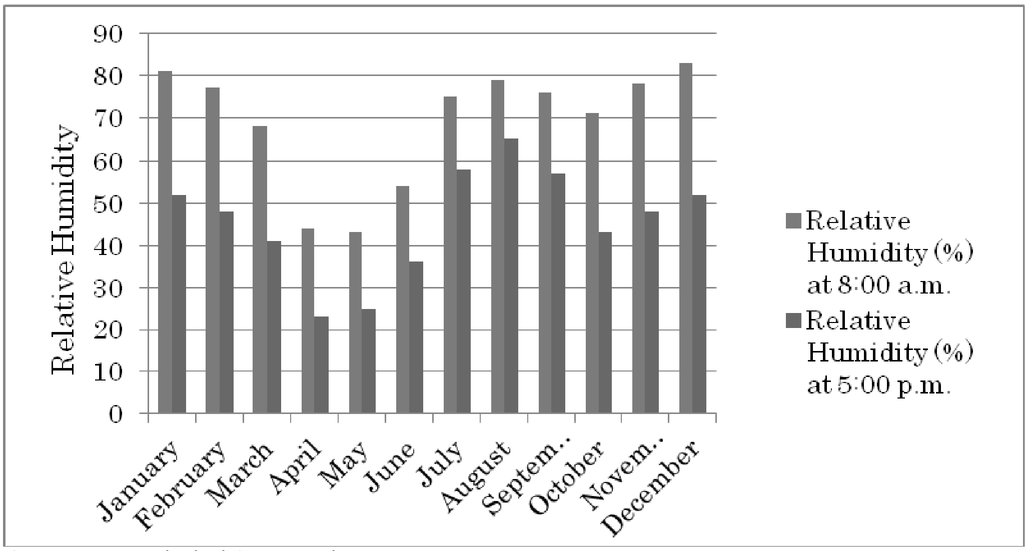


Source: JICA Study Team

(iv) Relative Humidity

Relative humidity throughout the day is higher in winter months than in summer months as compared in Figure 4.1.13. May and June are very hot and dry months during which dust storms occur occasionally.

Figure 4.1.13 Relative Humidity at 8:00 a.m. and at 5:00 p.m. (2006-2010)



Source: Meteorological Centre, Lahore

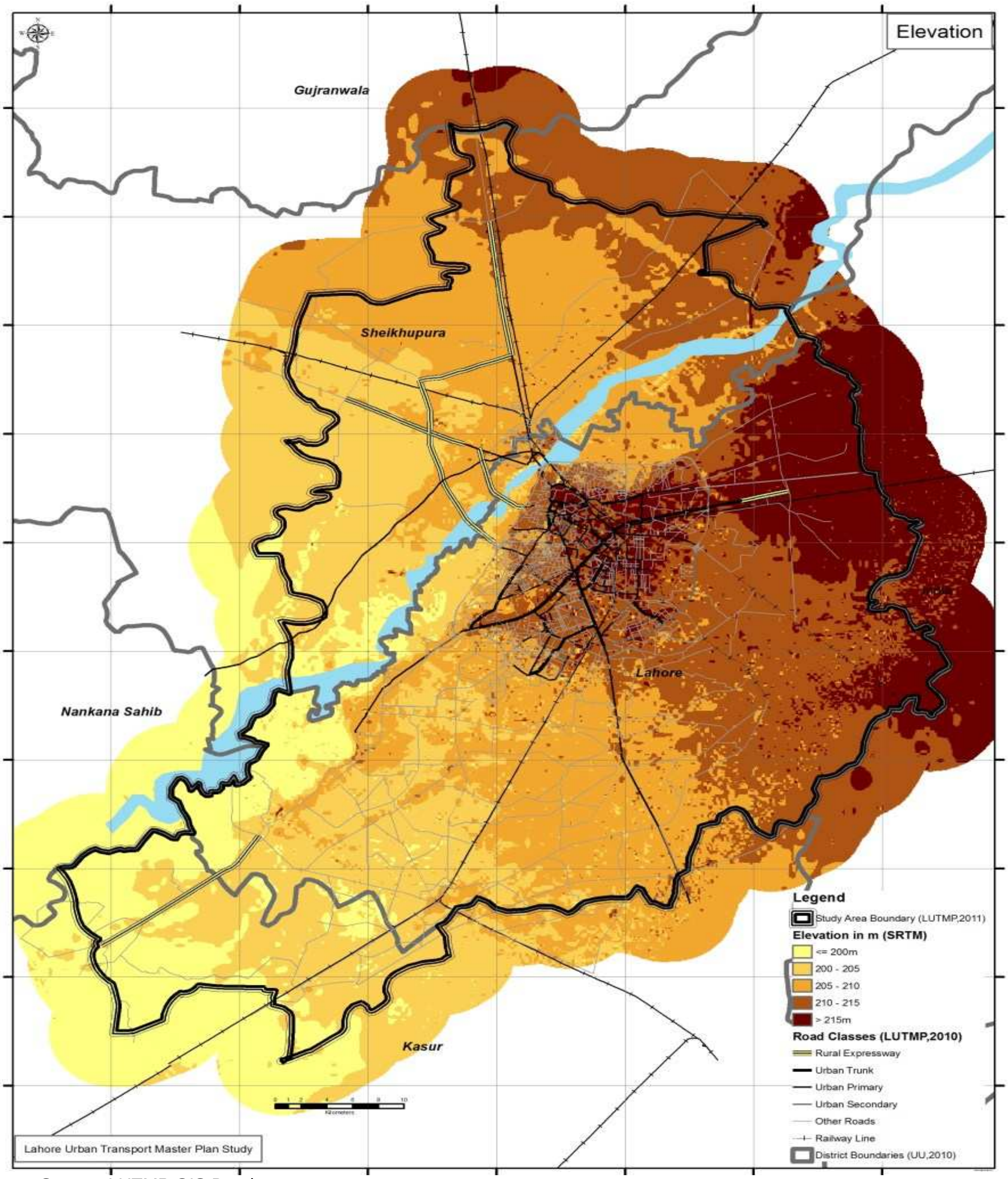
(v) Wind

According to wind data for the year2008, calm winds were observed 56 % of the time with wind speed of 3 m/ sec recorded 15 % of the time. The predominant wind directions are South-east and North-west with speed ranges of 3 to 6 m/ sec. In winter (November to February) the predominant directions are West and North-west, and in summer months (March to June) the predominant direction is South-east, while in Monsoon season (July to October) the predominant direction is South West.

3) Topography, Geology and Soil Conditions

General altitude of the project area is about 208 m to 213 m above sea level. The terrain conditions are generally flat and gently sloping towards south and south-west at an average gradient of 1:3,000.This area may be divided into two parts, the low lying area along Ravi River and the comparatively upland area in the east away from Ravi River. The low lands are generally inundated by the river water during monsoon floods and heavy rain because of poor drainage conditions. The Study Area elevation is depicted in Figure 4.1.14.

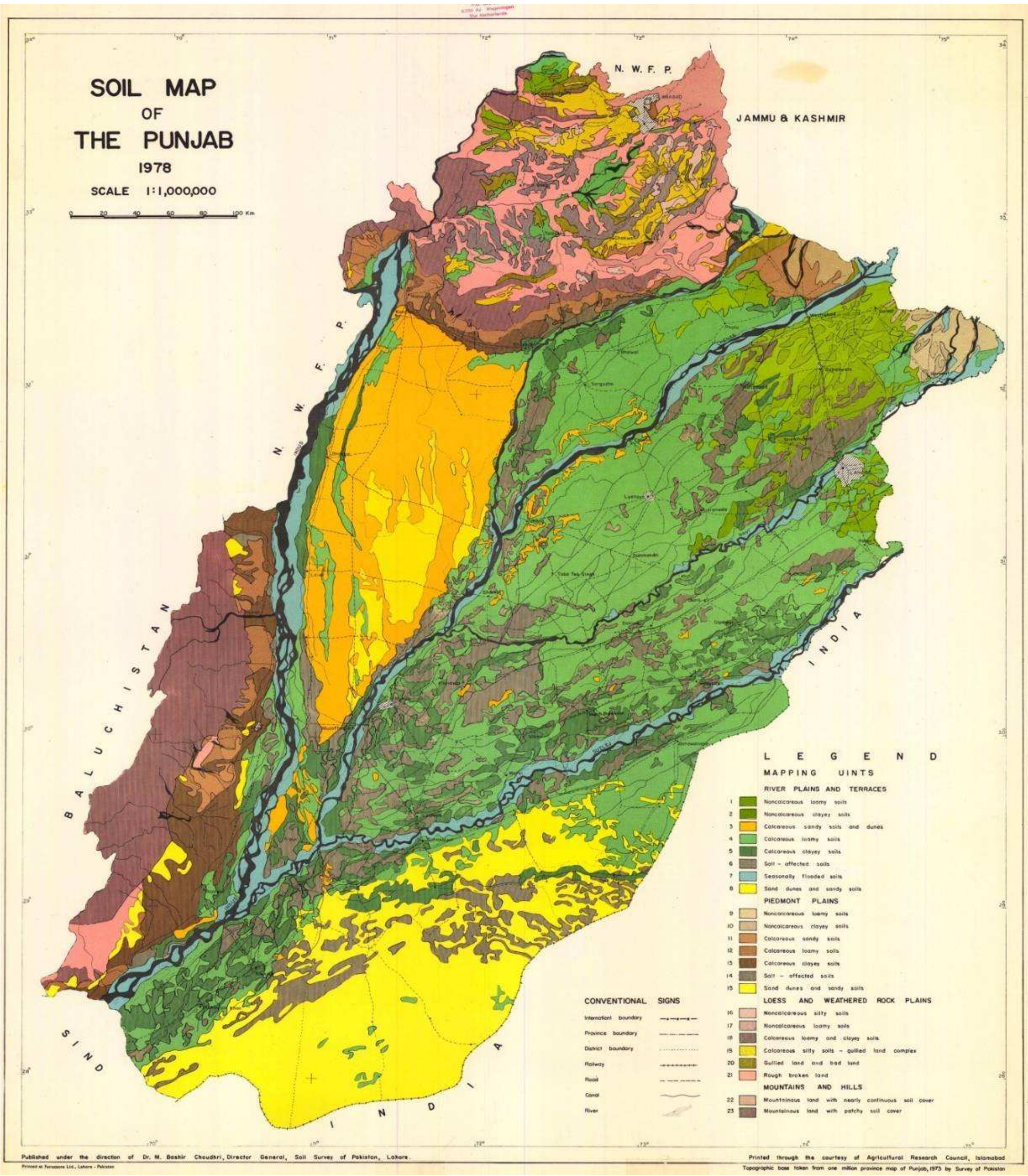
4.1.14 The Study Area Land Elevation



Source: LUTMP GIS Database

The soil of the Study Area is cohesion-less and is of alluvial type deposited by Ravi River. Various soil layers below the ground level includes: silt, silt-clay, silt-sand, poorly graded sand with silt, lean clay etc. According to the soil map of Punjab (Figure 4.1.15), seasonal flooded soil distributes along Ravi River, salt-affected soil is dominant in Sheikhupura District, and non-calcareous and calcareous loamy soil distribute in Kasur District and outside of the Lahore district area.

Figure 4.1.15 Soil Map of Punjab Province



Source: Soil Survey of Pakistan (1978)

4) Water Bodies, Groundwater and Drainage Conditions

(i) River, Canals and Drainages

Water bodies in the Study Area are Ravi River and its tributaries, canals and various drains, as shown in Figure 4.1.16. The Ravi River is a trans-boundary river flowing through North-western India and North-eastern Pakistan. It is one of the six rivers of Indus System in Punjab region. After the partition of Sub-continent in 1947, the waters of the Ravi River, along with other five rivers of the Indus System, i.e. Beas, Sutlej, Ravi, Chenab, Jhelum and Indus, divided Pakistan and India under the Indus Basin Water Treaty.

Ravi River used to be one of the main sources of fishing and recreation for Lahorites till 1960’s, when the river started getting polluted due to the indiscriminate disposal of municipal as well as industrial effluents. During the dry season, this municipal and industrial discharge may exceed the river’s own base flow. As the Ravi River is also one of the sources of recharge to the groundwater aquifer of Lahore, the disposal of untreated effluents including toxic substances into the river may have negative impacts on the groundwater quality of Lahore. In order to assess the pollution status water quality monitoring was started from 1988 for various effluent channels disposing of in Ravi River by Pakistan Environmental Protection Agency.

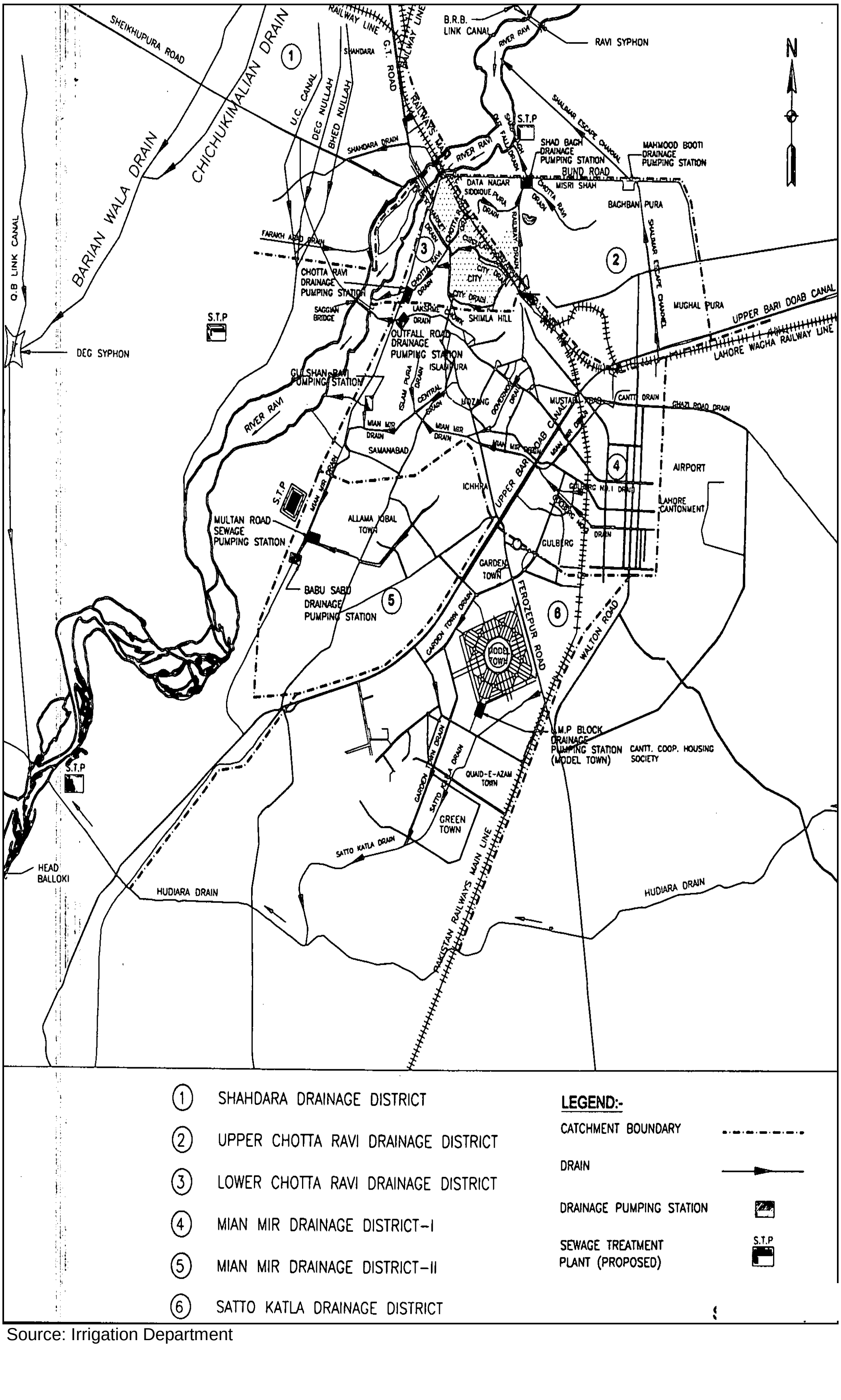
(ii) Groundwater

Project area is blessed with rather good groundwater resource in quality and quantity. Chemical quality of groundwater in the area varies with depth. However, the sweet potable water in a belt five to twenty miles wide paralleling the Ravi River. Groundwater is abstracted form aquifer by means of tube wells located throughout the area and served for drinking water for citizens.

(iii) Floods

Population growth in Lahore with its increasing economic prosperity has led to unauthorized encroachments upon the flood plains of Ravi River. In this river, low to medium floods of less intensity and frequency have created a “false sense of security” among the flood plain dwellers and residents in the adjoining neighbourhoods. The city has seen two catastrophic river floods during 1955 and 1988. The 1988 flood caused unprecedented damages to the city of Lahore and surroundings. All the flood protection facilities were damaged. Some 1,200 ha (3,000 acres) of urban settlements (Shahdara and surroundings) on the right bank got inundated, irrigation system was disrupted, communication links were interrupted and life in the city came to a stand-still for several days.

Figure 4.1.16 Ravi River and Its Tributaries, Canals and Drains



Source: Irrigation Department

(iv) Inundation

According to the Study, inundation disasters in Lahore is basically caused by internal flooding, and flooding from the Ravi River had not happened in the last 15 years, even during the recorded highest daily precipitation in 1996. The latest significant precipitation was recorded as 49.4 mm/ day at the Jail Road Monitoring Point in August, 2009. In recent years, heavy rainfall in June 2007 and in July and August 2008 caused inundation at various sites throughout Lahore for long periods.

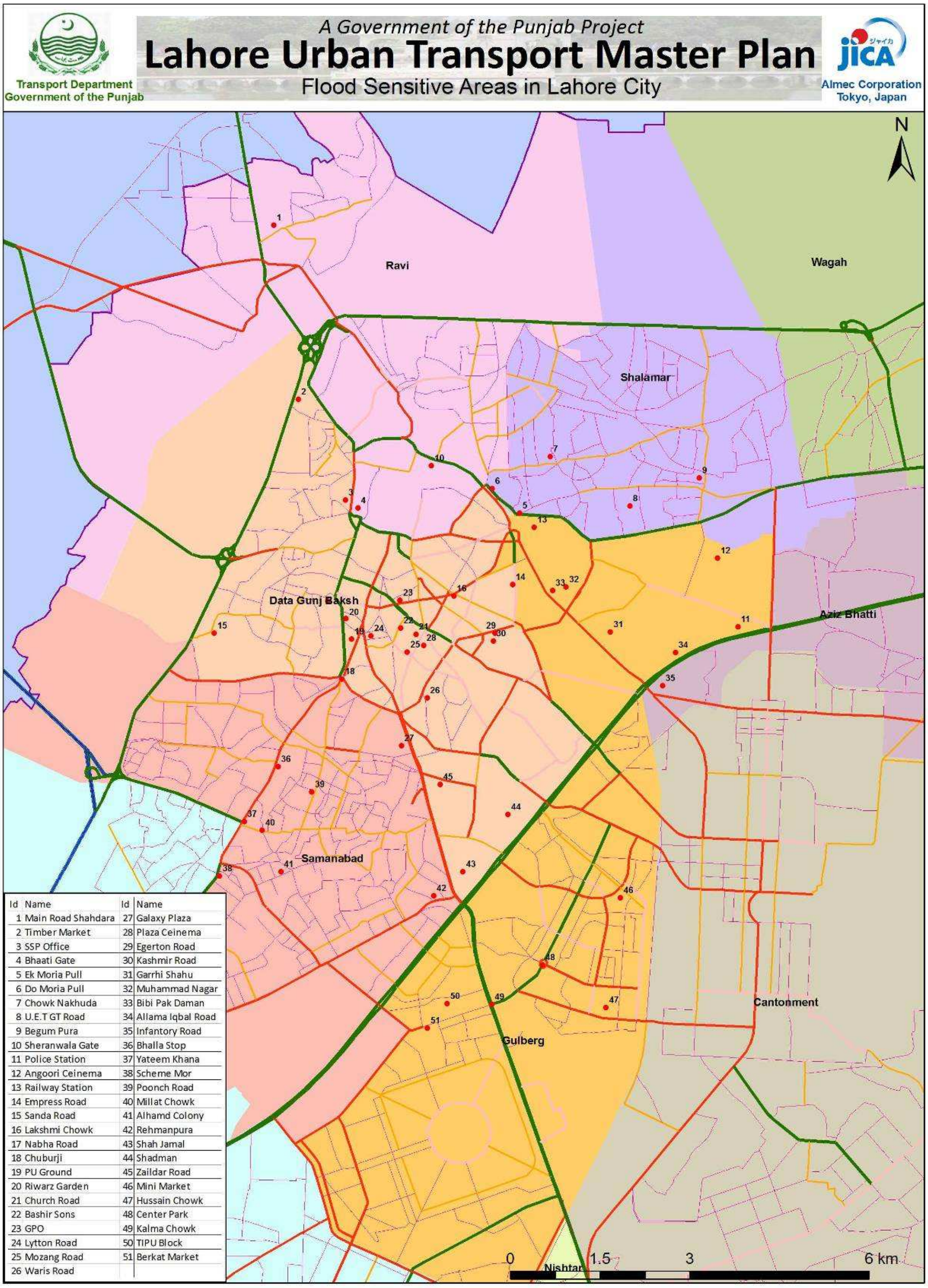
Inundation durations and depths have caused negative impacts not only to road traffic and socioeconomic conditions but also to daily living conditions and sanitation with the accumulation of a mixture of rainwater, domestic wastewater and untreated sewerage in the low-lying areas. These areas are illustrated in Figure 4.1.17. Therefore, improvement of the system together with the procurement and installation of necessary drainage equipment is urgently necessary to resolve and mitigate the negative effects of inundation.

5) Flora, Fauna and Biodiversity

(i) Flora

As climate of Lahore is semi-arid and subtropical, the vegetation of the project area falls under scrub, dry, tropical forest type as per phyto-geographical classification of the area. In addition, over the years Lahore has considerably expanded. However, the ancient monuments, old gardens, trees, graveyards and traditional bungalows having attached gardens, large expanses of lawn and old roadside trees are still found. These green areas and old indigenous trees are home to many resident bird species, as well as many summer, winter and transit migrants. Inventory data of trees and common trees in Lahore are shown in Table 4.1.15 and 4.1.16 respectively.

Figure 4.1.17 Locations Prone to Inundation in Lahore (WASA, 2011)



Source: Based on Data of Water and Sanitation Agency (WASA), Lahore

Table 4.1.15 Inventory of Trees in Lahore District

No.	Common Name	Botanical Name
1	Arjun	*Terminaliaarjuna*
2	Dhak	*Buteafondosa*
3	Mahwa	*Bassialatifola*
4	Bahara	*Terminaliabellerica*
5	Amaltas	*Cassia fistula*
6	Gul-e-nishter	*Erytrinasubrosa*
7	Barringtonia	*Barringtoniaacutengula*
8	Nim	*Meltaindica*
9	Gab	*Diospyoresembryopteris*
10	Berna	*Cratevareligiosa*
11	Khark	*Celtusaustralis*
12	Putajan	*Putranjivaroxburgi*
13	Fiddle wood/KashimirLagotis	*Eithrxyllumrubberratum*
14	Gul-e-mast	*Daliniaindica*
15	Gul-e-mohr	*Poinciana regia*
16	Alstonia	*Alstoniascholaris*
17	Ashoke	*Saracaindica*
18	Sheesham	*Dalbergiasisso*
19	Alata	*Stercoliacolorata*
20	Kenair	*Neriumgrandiflora*
21	Weeping Willow	*Salix babylonica*
22	Keekar	*Parkinsoniaaculeata*
23	Nilem	*Jacaranda mimosfolia*
24	Kechnar	*Bauhinia purpurea*
25	Molsary	*Mimosopelengi*
26	Bel	*Aeglemarmelos*
27	Siris	*Albizialebbek*
28	Tun	*Cedrellatoona*
29	Jamin	*Eugenia jambolana*
30	Moor pankh	*Thujaorientalis*
31	Silkoak	*Grevillearobusta*
32	Sufeda	*Eucalyptus citriodora*
33	Peepal	*Ficusreligiosa*
34	Simbal	*Hiacinthusorientalis*
35	Berri	*Diospyrosmelanoxylon*
36	Sukh chain	*Pongamiagalabra*
37	Poplar	*Populus alba*
38	Alam	*Mangiferaindica*
39	Shehtoot	*Morus alba*

Source: Parks and Horticulture Authority (PHA), Lahore

In the Lahore city area there are a variety of trees, along the roadside, in the lawns of houses, administrative buildings and parks. Major species of common trees are listed in Table 4.1.16. In Lahore Canals provide green space of "linear urban parks" with landscape symmetry and aesthetics along the bank as well as function of waterways. Regarding the vegetation along the Canal Bank from Mustafaabad Bridge to Thokar Niaz Baig dominant species are, Poplar, Weeping Willow, Mango, Eucalyptus and Jaman, and the dominant shrub species are Citrus, Kanair and Marwa according to the study by World Wide Fund (WWF) for nature in Pakistan, 2008.

Table 4.1.16 Common Trees in the City Area

No.	Common Name	Botanical Name
1	Alstonia	*Alstoniascholaris*
2	Eucalyptus	*Eucalyptus camaldulensis*
3	Jaman	*Syzygiumcumini*
4	Shisham	*Dalbergiasissoo*
5	Sirris	*Albizzialebbek*
6	Bakain	*Meliaazedarach*
7	Peepal (Sacred Fig)	*Ficusreligiosa*
8	Banyan	*Ficusbengalensis*
9	Toot (Mulberry)	*Morus alba*
10	Arjan	*Terminaliaarjuna*
11	Molsary	*Mimusopselengi*
12	Bottle Palm	*Cocos species*
13	Bottle Brush	*Callistemon lanceolatus*
14	Palm	*Cocos species*

Source: Parks and Horticulture Authority, Lahore

(ii) Fauna

(a) Mammals

Common mammals found are dogs, cats, house rats and bats. Small Indian Mongoose and Indian Palm Squirrel have also been reported.

(b) Reptiles

Snakes such as cobra, kraits etc. were common in the tract, but now cases of snake bites are very rare.

(c) Birds

Ornithologists of preceding times documented the number of bird species in Lahore. A study conducted in 1965 there were 240 bird species. However, with the unplanned growth of urbanization, number of species as well as population has reduced to 85 including the resident and migratory species. Major species are listed in Table 4.1.17. Along the above mentioned Lahore Canal 44 bird species have been identified according to the study by World Wide Fund for nature in Pakistan, 2008.

Table 4.1.17 List of Bird Species in Lahore

No.	Common Name	Zoological Name
1.	Bank Myna	*Acridotheresginginianus*
2.	Blackbird	*Turdusmerula*
3.	Black Drongo	*Dicrurusmacrocerus*
4.	Rock Pigeon	*Columbia livia*
5.	Common Babbler	*Turdoides caudate*
6.	Common Myna	*Acridotherestristis*
7.	Garden Earbler	*Sylvia borin*
8.	Indian Robin	*Saxicoloides*
9.	White-Rowed wagtail	*Motacillamadraspatensis*
10.	Little Green Bee-Eater	*Meropsorientalis*
11.	Asian Pied Starling	*Sturunus contra*
12.	Red-Vented Bulbul	*Pycnonotuscafer*
13.	Ring-Necked Dove	*Streptopeliacapicola*
14.	Long-Tailed Strike	*Laniusschach*
15.	Great Spotted Woodpecker	*Dendrocopos major*
16.	White/Browed Wagtail	*Motacillamaderaspatensis*
17.	Asian Koel	*Eudynamysscolopacea*
18.	Common Hawk-Cuckoo	*Cuculusvarius*
19.	Common Koel	*Eudynamysscolopacea*
20.	Pied Cuckoo	*Clamatorjacobinus*
21.	Red Turtle Dove	*Streptopeliatranquebarica*
22.	Barbarg Dove	*Streptopeliarisoria*
23.	Rose-Ring Parakeet	*Psittaculakrameri*
24.	White-Backed Vulture	*Gypusafricanus*
25.	White-Breasted Kingfisher	*Halcyon smynensis*

Source: Zoological Office, Lahore

6) Protected Areas

In Pakistan National Parks, Wildlife Sanctuaries and Game Reserves are listedas notified protected ecosystems in order to preserve, conserve and manage fauna and vegetation. In the Punjab Province there are 60 protected ecosystem areas including:

- 2 National Parks, 37 Wildlife Sanctuaries, 20 Game Reserves and 1 Unclassified. There is no site of protected ecosystem located in the Study Area.
- In addition, there are no species reported by Forest and Wildlife Department to be under threat, which are included in the IUCN Red Data Bank for Lahore, Sheikhupura and Kasur.
- Table 4.1.18 shows endangered and prohibited species in Lahore by Forest Department.

Table 4.1.18 Endangered and Prohibited Species in Lahore

No.	Endangered Species
1	*Dalbergiasissoo*
2	*Salvedorapersica*
3	*Ficusbengalensis*
4	*FicusReligiosa (Peepal)*
5	*Ficusenfectoria*
6	*Ficusglomerata*
7	*Albizziaprocera*
8	*Albizzialebbek*
9	*Anogeissusacuminit*
10	*Artocarpusintegrifolia*
11	*Artocarpuslakoocha*
12	*Azadirachtaindica*
13	*Bischofiajavanica*
14	*Berserserrata*
15	*Dilleniaindica*
16	*Meringa Oleifera*
17	*Prosopisspiligera*
18	*Ziziphusmauritania*
19	*Cassia Alata*
20	*Jaguiniaaristata*
21	*Tecomaundalata*
22	*Prosopisjuliflora*
23	*TamyrixArticulate*
24	*Magnolia Grandiflora*
25	*Eucalyptus Species (Molsary)*
26	*Broussonetiamalabarica*
27	*Populasnigra/Alba (Poplar)*
28	*Neriumodorum*
29	*Thevetianerfolia*

Source: Forest Department, Lahore

4.1.3 Environmental Pollution

Lahore, which is also called the “City of Gardens”, has gone through a rapid increase in urban population, encroachments/ unplanned growth as well as increase in vehicle traffic volumes. This caused a continuous, rapid and unchecked deterioration of its environment conditions such as air and water pollution, increase in ambient noise level, indiscriminate disposal of untreated municipal and industrial waste and wastewater into the surface water bodies. In addition, rapid loss of green and open space led to considerable loss of gardens.

1) Air Pollution

(i) Main Sources of Air Pollution

In the Study Area air pollution has a strong impact on daily life, especially in central area of Lahore and along roadside. Motor vehicles are thought to be the major source of air pollution. However, factories and cottage industries also contribute considerably to the air pollution.

Ambient air pollutants may be divided into two types, gases and the suspended particulates. Among these gaseous pollutants Sulphur dioxide (SO_2), Nitrogen Oxides (NO_2 and NO), Carbon Oxides (CO_2 and CO), Ozone (O_3) are the main pollutants as indicators for the ambient air quality. For suspended particles Suspended Particulate Matter Size (PM_{10} – 10 microns) and ($PM_{2.5}$ – 2.5 microns) and amount are the indicators for the quality.

Particulate matters are most common pollutants in dry semiarid zones, industrial and heavy traffic areas. These particulate matters consist of a mixture of primary particles resulting from incomplete combustion of fossil fuels and secondary particles resulting from chemical reactions of some pollutants in the atmosphere. Those produced from combustion, especially diesel fuel combustion such as diesel powered vehicles and thermal electric power stations.

These particles have negative impacts on human health as they cause dangerous respiratory diseases. Their impacts depend on the size of these particles. If they are less than 10 microns (PM_{10}) in size these will be more harmful because these are inhaled easily. In addition, particles less than 2.5 micron ($PM_{2.5}$) are considered to be the most dangerous because breathing defence organs cannot prevent them from reaching deep into lungs and interact with blood stream and other organs of the body.

(ii) Existing Air Pollution Level in Lahore

In Lahore vehicle population has shown a considerable increase over the recent years. Experts consider that 60-70 % cause of urban air quality deterioration is due to road traffic. Table 4.1.19 shows results of air quality monitoring conducted in 2004 by the Punjab Environmental Protection Department. During the monitoring alarming level of suspended particulate matter was found as detailed in Table 4.1.19.

Table 4.1.19 Results of Air Quality Monitoring in Lahore Area (2004)

Air pollutant		Unit	WHO Standards	Monitoring Station			
				Azadi Junction	Qurtaba Junction	Chauburji Junction	Chairing Cross
1	SO_2	ppb	50	29	47	23	41
2	NOx	ppb	—	167	192	195	321
3	NO_2	ppb	107	89	67	71	71
4	CO	ppm	0.9	0.3	0.3	3.1	7.3
6	PM_{10}	μg/m^3	150	882	640	534	963
7	$PM_{2.5}$	μg/m^3	-	-	-	-	-

Source: Punjab Environmental Protection Department

In 2007, Pakistan EPA, in cooperation with JICA, mentioned air quality data in Pakistan and assessed the ambient air quality in Islamabad, Karachi, Lahore, Quetta and Peshawar. Air quality sampling was conducted using fixed stations that measured daily mean concentrations of air pollutants in May and September 2007. The concentrations of $PM_{2.5}$ were found to have greatly exceeded the WHO guideline values in most of the cities. The ambient concentrations of SO_2, NOx (NO, NO_2) and Carbon monoxide (CO) were, on average, found to be within the limits of the WHO guidelines. Table 4.1.20 shows the daily mean values of $PM_{2.5}$, SO_2, CO, NOx in Lahore in 2007.

According to the Punjab EPD reports that air pollution problems in Lahore are linked with the road traffic in the city and high concentration in a few areas due to which the entire city population suffers. In addition, the permissible level of dust particulate matters less than 2.5 microns ($PM_{2.5}$) and PM_{10} has crossed the safe limits in many areas of the city due to mobile and stationary combustion sources and commercial activities in the city. Even in the isolated areas dust particulates $PM_{2.5}$ value has reached 80 μg/m^3 in the non-rainy seasons against the permissible 25 μg/m^3 for 24 hour mean.

Exposure to very high levels of SO_2 can be threatening and is considered immediately dangerous to life and health.

Table 4.1.20 Data of Ambient Air Quality Daily Mean Values in 2007

Measuring Station	Date of Measurement	NO	NO_2	Methane*	Non-Methane Hydrocarbon	CO	SO_2	$PM_{2.5}$
		μg/m^3	μg/m^3	ppb	ppb	ppm	μg/m^3	μg/m^3
Lahore Fixed Station 1	9-May-2007	48.8	83.6	2519.3	1138.4	1.9	41.6	91.8
	20-Sep-2007	6.8	50.4	1732.3	461.0	0.9	46.5	85.5
Lahore Fixed Station 2	9-May-2007	6.9	33.7	1833.8	317.3	0.6	21.5	57.5
	20-Sep-2007	5.0	35.3	3453.1	358.2	1.1	21.4	99.6
Draft PAAQS	-	40	40	-	-	5	80	15

Source: Pakistan EPA in Cooperation with JICA (2007)

*Note: No Methane Standard Exist in Pakistan Ambient Air Quality Standards

(iii) Recent Data of Air Quality Monitoring in Lahore

In Lahore there are three air quality monitoring stations donated by JICA:

1. Commercial site: Town Hall Station is at the Mall Road near Punjab University, an institutional zone.
2. Residential site: Quaid-e-Azam Station is in Township about 3km from Quaid-e-Azam Industrial estate.
3. Mobile Station: Loaded in a truck usually placed at the EPA office near Qaddafi Stadium, which is a recreational area. The mobile unit is also placed at locations like Lower Mall, Gulberg and Township in Lahore.

Table 4.1.21 shows air quality data at Town Hall in 2010. Annual trend shows that ambient air quality deteriorated throughout the year which is detailed below: and further comparisons are illustrated in Figures 4.1.18 to 4.1.20.

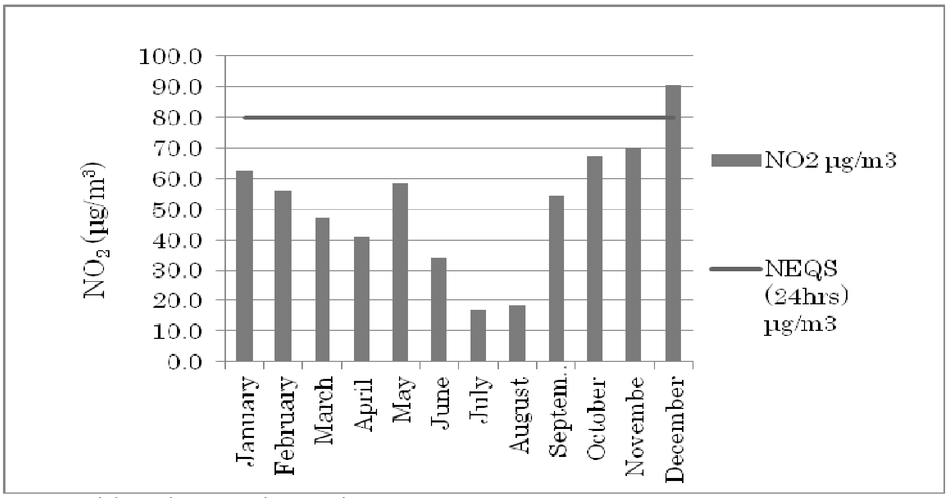
- Inhalable particle ($PM_{2.5}$) was found to be almost five times higher than National Environmental Quality Standard (NEQS).
- Level of oxides of nitrogen in air was found to be twice the permissible level of National Environmental Quality Standard.

Table 4.1.21 Result of Air Quality Monitoring at Town Hall in 2010

Month (2010)	NO	NO_2	NOx	CO	SO_2	O_3	$PM_{2.5}$
	μg/m^3	μg/m^3	μg/m^3	μg/m^3	μg/m^3	μg/m^3	μg/m^3
January	96.9	62.5	159.4	3.2	(-)	23.9	253.9
February	54.7	56.0	110.7	1.6	34.9	30.6	122.2
March	48.2	47.4	95.6	1.4	46.9	38.9	116.6
April	72.5	40.7	113.2	2.2	51.3	40.4	116.2
May	16.9	58.3	75.2	1.2	32.0	62.9	90.9
June	0.8	34.0	34.8	0.7	22.8	101.4	72.6
July	0.6	16.9	17.5	0.6	12.2	77.8	50.8
August	0.7	18.4	19.0	0.7	10.4	59.5	56.8
September	45.3	54.3	99.5	1.1	14.1	68.8	69.8
October	53.3	67.5	120.7	1.7	26.6	85.5	116.1
November	78.3	70.3	148.5	6.4	44.1	62.4	173.9
December	85.9	90.6	176.5	7.3	49.9	(-)	190.7
Annual Average	46.1	51.4	97.5	2.3	31.4	59.3	119.2
NEQS Standard (Annual Average)	40	40	n/a	5	80	130	15

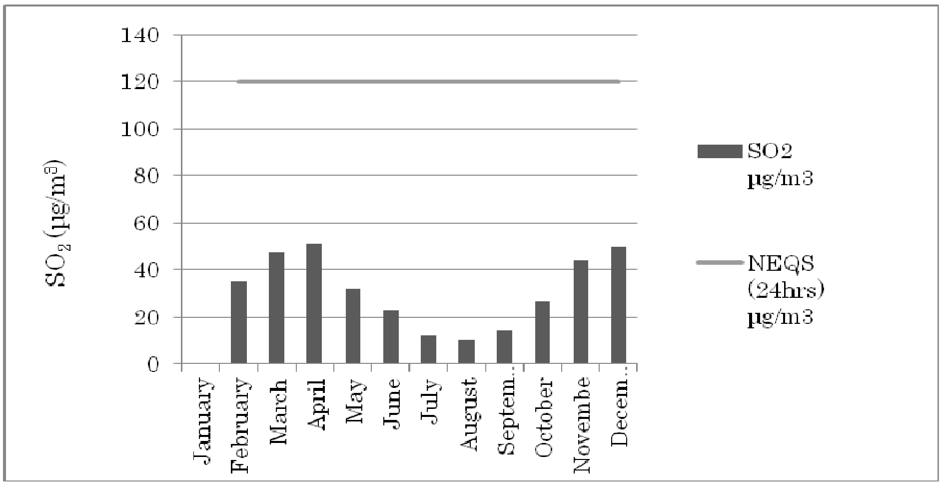
Source: Punjab Environmental Protection Department

Figure 4.1.18 Ambient NO_2 Level at Town Hall Monitoring Station in Lahore (2010)



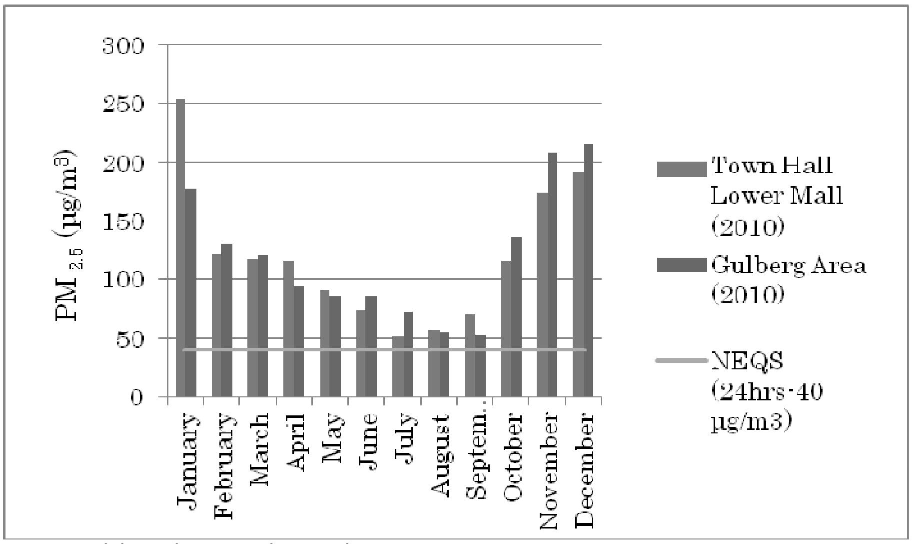
Source: Punjab Environmental Protection Department

Figure 4.1.19 Ambient SO_2Level at Town Hall Monitoring Station in Lahore (2010)



Source: Punjab Environmental Protection Department

Figure 4.1.20 Ambient $PM_{2.5}$ Level at Town Hall and at Gulberg Monitoring Stations in Lahore (2010)



Source: Punjab Environmental protection Department

(iv) Daily-Base Air Quality as Indicated by Air Quality Index (AQI)

In Pakistan Air Quality Index (AQI) is defined as indicator of daily-base air quality. The value of AQI indicates extent of air pollution. The value from 0 to 25 is considered as “pollution free (good)”, 26 to 50 as “moderate pollution”, 51 to 100 as “unhealthy”, 101 to 200 as “severe pollution” and greater than 200 as “hazardous”. Daily-base AQI for Islamabad, the capital city is reported on a website of Pakistan Environmental Protection Agency (http://www.pakepa.org/aqi/).

In Lahore, the data of 29th March, 2010 at Town Hall area shows the that $PM_{2.5}$ concentration was 105 ug/m^3 against the NAAQS of 40 ug/m^3, NO_2 concentration was found to be 101.6 ug/m^3 against the standard of 80 ug/m^3, and SO_2,O_3 and CO concentration were 60 g/m^3, 152 ug/m^3 and 1.51 mg/m^3 respectively. The calculated AQI was 111 which mean that air quality was unhealthy on that day.

(v) Result of Roadside Monitoring

Although the contribution of vehicle traffic to air pollution is widely recognized, relatively few studies have been conducted in Pakistan to estimate the levels of pollutants due to vehicle exhaust emissions. Data shown in Table 4.1.22, indicate the levels of roadside exhaust emissions.

Table 4.1.22 Air Pollutant Concentration at 23 Road Crossings in Lahore

No.	Site	$PM_{2.5}$ or PM_{10} ($\mu g/m^3/hr$)	Vehicle Exhaust Emission (ppm)		
			CO	SO_2	NO_2
	Reference Values (NEQS)	5	25.8	5	25
1	Chauburji	2.76	5	20	0.10
2	Chowk Yaadgar	2.36	8	16	0.08
3	Chungi Amer Sidhu	2.72	6	11	0.15
4	Club Chowk	1.80	5	11	n/a
5	Ghazi Chowk	1.68	6	20	0.13
6	General Bus Stand	3.10	5	17	0.13
7	Kalma Chowk	8.17	5	20	n/a
8	Kanchee Crossing	5.04	8	18	n/a
9	Lahore Hotel Chowk	7.60	7	17	0.17
10	Lakshmi Chowk	1.11	7	12	0.20
11	Liberty Market	2.21	6	12	0.15
12	Lahori Gate	3.42	9	20	0.17
13	Mochi Gate	4.53	5	10	0.10
14	Moon Market Chowk	1.33	9	13	0.18
15	Muslim Town Chowk	1.43	7	15	0.15

No.	Site	$PM_{2.5}$ or PM_{10} (μg/m^3/hr)	Vehicle Exhaust Emission (ppm)		
			CO	SO_2	NO_2
16	Naulakha Chowk	4.52	10	20	0.25
17	Qurtaba Chowk	1.51	7	18	0.20
18	Railway Station	2.89	8	20	0.18
19	Regal Chowk	1.38	9	18	0.20
20	Samanabad Morr	1.93	10	20	0.18
21	Scheme Morr	2.38	11	18	0.22
22	Shadman Chowk	1.04	7	18	0.15
23	Yateem Khana Chowk	3.61	9	15	0.17

Source: Faculty of Environment and Public Health, Institute of Public Health, Lahore

2) Water Pollution

(i) Pollution in Ravi River

Presently no wastewater treatment services exist and the raw sewerage and wastewater is directly discharged into Ravi River, causing unhygienic condition in the river and for the downstream users. The situation is very critical under low flow condition in the river when sufficient dilution is not available and the river almost serves as a sludge carrier. Thus, Ravi River receives almost all the untreated municipal and industrial wastes from the Study Area. The industrial and workshop discharge and household sewage go to Ravi River without any treatment. Thus, its potential value as a recreational water body and breeding place for fish and aquatic life is seriously threatened and almost non-existent due to negligible amount of dissolved oxygen in the water. The sewerage network and facilities are not formally established in the area, even in the Lahore City.

(ii) Water Quality Monitoring of Ravi River

Water quality of Ravi River, canals and drains is monitored by Irrigation Department of the GoPb. As a part of integrated water resources management surface water quality monitoring for drinking water was conducted at two rivers and 18 selected canals by Directorate of Land Reclamation Punjab. Among them results for Ravi River indicate following features as shown in Table 4.1.23.

- Physio-chemical parameters are within permissible limits except turbidity in June 2008;
- Trace Metals/ elements are also within permissible limits – except Ferrous and Lead as found in the sample of June 2008;
- Contaminants – such as nitrates are also within permissible limits;
- Coli forms are reported in the water in both the monitoring runs– indicating microbial contamination – rendering water totally unfit for drinking;

- Biological contamination such as BOD and COD render water unfit for drinking and other purposes, Organic pollutants were not recorded at this site.

Table 4.1.23 Water Quality of Ravi River at Baloki Head Works

No	Parameter	Unit	Reference Value	Sampling Date	
				Sep-07	Jun-08
Physico-Chemical Parameters					
1	pH	(-)	6 - 9	7.81	8.02
2	EC	dS/m	1.5	0.48	0.379
3	Hardness	mg/l	500	190	140
4	Turbidity	mg/l	< 5	< 5	165
5	TDS – Total Dissolved Solids	mg/l	308	308?	281
Trace Metals/ Elements					
6	Cu – Copper	mg/l	2	0.18	Nil
7	Zn – Zinc	mg/l	5	0.1	0.06
8	Cr – Chromium	mg/l	0.05	0.03	Nil
9	Cd – Cadmium	mg/l	0.003	nil	Nil
10	Fe – Iron	mg/l	0.3	0.04	0.44
11	Mn – Manganese	mg/l	0.5	0.1	0.29
12	Pb – Lead	mg/l	0.01	(-)	0.17
13	As – Arsenic	mg/l	0.01	(-)	Nil
14	B – Boron	mg/l	0.3	(-)	0.01
Contaminants					
15	NO_3 – Nitrogen Trioxide	mg/l	50	0.02	(-)
16	S – Sulphate	mg/l	(-)	Nil	Nil
17	F – Fluoride	mg/l	1.5	0.6	Nil
18	CN – Cyanide	mg/l	0.07	None	(-)
Coli forms					
19	Coli forms (*E. Coli*)	-	Nil	Yes	yes
Biological					
20	BOD – Biological Oxygen Demand	mg/l	0	10.2	16.4
21	COD – Chemical Oxygen Demand	mg/l	0	22.6	(-)
22	DO – Dissolved Oxygen	mg/l	7	4.2	6.18
Organic Pollutants					
23	Oil and Grease	n/ a	n/ a	Not Record	
24	Phenolic Compounds	n/ a	n/ a	Not Record	
25	Anionic Detergents	n/ a	n/ a	Not Record	
26	Residual Pesticides	n/ a	n/ a	Not Record	

Source: Monitoring of Surface Water Quality for Drinking Purposes – 2009 (Directorate of Land Reclamation Punjab, Canal Bank Road Mughalpura, Lahore

(iii) Canal Water Quality

CBD Canal water quality was sampled near Muslim Town in Lahore for an EIA study. The results are given below in Table 4.1.24.

Table 4.1.24 Results of Canal Water Quality in Lahore

No.	Parameter	Unit	Result	NEQS
1	Temperature	^oC	18.0	<= 40
2	pH	(-)	7.4	6-9
3	BOD	mg/l	10.0	80.0
4	COD	mg/l	26.0	150.0
5	TSS	mg/l	161.0	200.0
6	Odour	(-)	Odourless	N/A
7	Conductivity	uS	282.00	N/A
8	Turbidity	NTU	108.0	N/A
9	NO_3(Nitrogen Tri-oxide)	mg/l	4.4	N/A
10	Chlorine (Cl)	mg/l	6.7	1,000
11	Fluoride (F)	mg/l	0.12	10.0
12	Sodium (Na)	mg/l	4.7	200.0

Note1: Sampling point is near Muslim Town on 2011.3.15
Source: EIA Report (2011.3) - EIA of Construction of Flyover at Kalma Chowk, Lahore

(iv) Groundwater Quality

According to Groundwater Monitoring Report (2009),there are 55 monitoring points in Lahore District and continuous data for the period 2003-08 was available for only 9 points. Data show that the water quality, at least from salinity point of view and is fresh to marginal and has not shown any considerable change in the last 6 years. Results from a recent, (15th March 2011) test are given in Table 4.1.25. It indicates that water quality is getting worst and many parameter values exceed both the WHO and NEQS recommend maximum permissible values.

Table 4.1.25 Data of Groundwater Quality in Lahore

No.	Parameter	Date (15-Mar-2011)			
		Unit	Result	WHO Guidelines	NEQS
1	Temperature	^oC	26.0	<= 40	(-)
2	pH	(-)	7.3	6.5-8.5	6.5-8.5
3	TDS – Total Dissolved Solids	mg/l	1144.0	1000.0	< 1000
4	Cl – Chlorine	mg/l	61.6	250.0	< 250
5	Hardness	mg/l	274.7	500.0	< 500
6	NO_3 – Nitrogen Trioxide	mg/l	2.69	50.0	<=50
7	Na – Sodium	mg/l	236	200.0	n/ a
8	F – Fluoride	mg/l	0.65	1.5	<=1.5
9	As – Arsenic	mg/l	< 0.01	0.01	<=0.05
10	Pb – Lead	mg/l	< 0.01	0.01	<=0.05
11	Hg – Mercury	mg/l	< 0.001	0.001	<=0.001
12	Fe – Iron	mg/l	0.8	0.3	(-)
13	Total Colony Count	cfu/ml	Too numerous to count	< 500	(-)
14	Total Coliforms	No./ml	64.0	0/100ml	0/100ml
15	Faecal Coliforms *(E. Coli)*	No./ml	18.0	0/100ml	0/100ml

Note1: Sampling point is near the construction camp site at Kalma Chowk on 15-Mar-2011
Source: EIA Report (2011.3) - EIA of Construction of Flyover at Kalma Chowk, Lahore

3) Solid Waste

Solid waste generated includes residential (household), commercial, industrial, hospital, animals and other sources.

(i) Data from Integrated Master Plan for Lahore-2021

Solid waste management study for Lahore carried out in 1997, it was estimated that only 70 % of approximately 3,000 tons of solid waste generated every day (approximately 0.55 kg/ person/ day) was being collected and disposed of by the civic authorities. The uncollected 30 % solid waste found its way into open spaces or vacant plots, sewage system, manholes and storm water channels. The 71 major hospitals and clinics also generate 13.8 tons of solid waste including toxic medical waste. Its disposal process is also not clear.

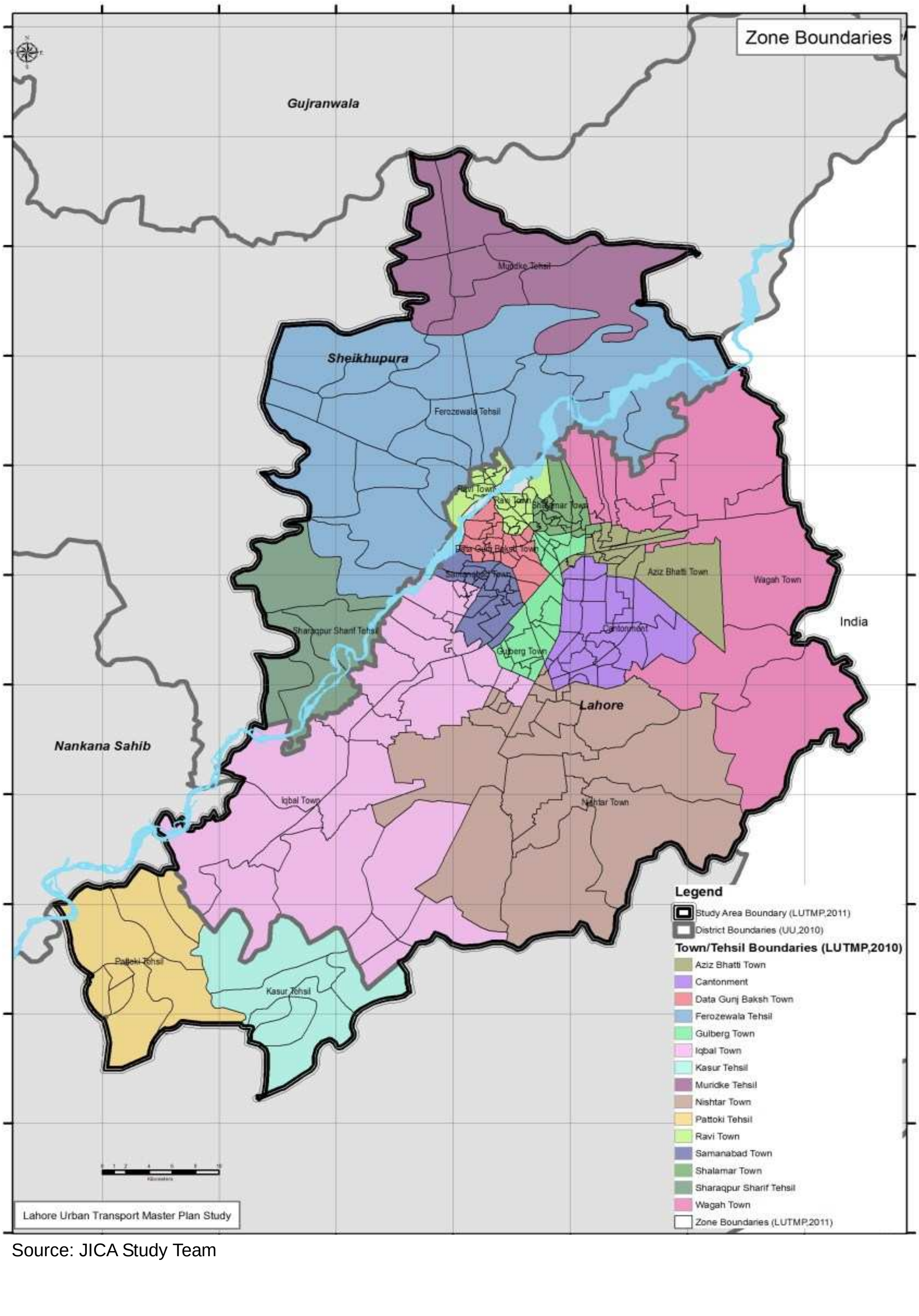
According to a recent report, it is estimated that 5,000 tons of household waste is generated everyday out of which 70 % is disposed properly and remaining is left to spread in the low lying area, open spaces and along the drains and into the wastewater drains. The waste collection services are labour-intensive, i.e. 7,897 workers to serve the vast area of Lahore and thus the division of worker per thousand population is 1:21.

Solid waste is collected from the communal bins placed at various locations in the city and transported to open dumping sites. Among the disposal sites four are existing and two are proposed. Both public and private sectors are involved in managing solid waste. In public sector the City District Government and Lahore Cantonment Board are responsible for collection and disposal. In the private sector, Model Town Society and Lahore Cantonment Cooperative Housing Society are responsible for the collection and disposal from their respective areas. In addition, some NGOs are also involved in the collection of solid waste. However, their activities are generally limited only to collection of solid waste in some parts of the city.

(ii) Data of City District Government, Lahore (CDGL)

Estimated population of Lahore District in 2008 was about 8.65 million with total number of housing units about 1.5 million. For the collection and disposal of solid waste city has been divided into nine towns as shown in Figure 4.1.21 and Table 4.1.26. Waste generation per capita per day is estimated to be 0.65 kg and the total waste is about 5,700 tons/ day. The GDGL solid waste lifting capacity and management is about 4,500 tons/ day (about 78 % of generated waste) and the remaining 1,200 tons/ day waste spreads in the low lying areas, open spaces and along the drains and into the wastewater drains, and finally flows into Ravi River. As a whole the existing solid waste management system is not effective, is getting worst and has many problems to be solved.

Figure 4.1.21 Administrative Zone Map for the Collection of Solid Waste



Source: JICA Study Team

Table 4.1.26 Estimated Solid Waste Generation in CDGL – 2010

No.	Town	Population (,000)	Waste Generated (ton/day)*
1	Ravi	1,007	722
2	Shalimar	854	612
3	Wagha	656	470
4	Aziz Bhatti	667	478
5	Data Ganj Buksh	970	695
6	Samanabad	984	705
7	Gulberg	778	557
8	Allama Iqbal	960	688
9	Nishter	945	677
Total		7,821	5,604

Source: JICA Study Team
Note: * Assumed that waste generation per capita per day is 0.65kg.

4) Noise Pollution

In general there are two types of sources of noise generation. One is stationary sources such as factory machinery, construction work, loud speakers, audio entertainment systems etc. The other is mobile sources due to transportation such as road traffic, railway and aircraft. However, in the city area noise pollution due to road traffic by various types of vehicles is the most dominant and displeasing for human life. In Lahore, there is no ambient noise monitoring system established. However, some data on noise levels is found in EIA reports of road development projects.

(i) Road Traffic Noise

Noise levels at 18 busy places with high traffic volumes in Lahore were measured for a road traffic noise study in 2004 during peak working hours of the day as given in Table 4.1.27. It was found that the daytime average noise level has crossed the permissible limit of 85 dB (A) at 90 % of the busy points in the city. In the study maximum average noise level recorded was 104 dB(A), which was considered to be due to vehicular traffic especially Rickshaws and Qingqis with ineffective silencers and frequent use of the pressure horns by buses, wagons and other vehicles.

Table 4.1.27 Road Traffic Noise Level at Busy Traffic Locations in Lahore

No.	Site/ Location	Predominant Land Use	Density of Traffic	Observed Noise Level dB(A)		
				L_{eq}	Observed	
Reference Value				85	L_{max}	L_{min}
1	Kalma Chowk	Commercial	Heavy	90	100	78
2	PCSIR Main Gate	Main Road	Heavy	87	96	80
3	Muslim Town	Commercial/ Residential	Heavy	91	103	79
4	Shah Jamal	Commercial/ Residential	Heavy	88	98	77
5	Ichhra	Main Road	Heavy	89	102	75
6	Shama	Commercial	Heavy	88	99	76
7	Mozang	Commercial	Heavy	92	104	82
8	Chauburji	Main Road	Heavy	87	101	75
9	Secretariat	Main Road	Heavy	96	101	75
10	Old Anarkali	Commercial/ Residential	Light	92	94	73
11	Mayo Hospital	Commercial	Light	87	99	75
12	Lahori Gate	Commercial	Heavy	83	97	73
13	Delhi Gate	Commercial	Heavy	84	99	72
14	Yaadgar Chowk	Commercial	Heavy	88	102	78
15	New Anarkali	Commercial	Heavy	89	100	77
16	Neela Gumbad	Commercial	Heavy	86	98	78
17	Akbari Mandi	Commercial	Light	98	100	79
18	Crown Adda	Commercial	Heavy	99	104	78

Data Source: Pakistan Council for Scientific and Industrial Research Labs (PCSIR), 2004

(ii) Ambient Noise Level at Sensitive Receptor Sites

The ambient outdoor and indoor noise level, measured at nine sensitive receptors is compared in Table 4.1.28.

Table 4.1.28 Ambient Noise Level Monitoring at Sensitive Receptors

No.	Description	Observed Noise Level dB(A)		
		Leq	Lmax	Lmin
1	Lahore American School, Upper Mall (Outside)	70.3	94.1	61.7
	Lahore American School, Upper Mall (Inside)	64.0	82.4	57.1
2	The Lahore Lyceum Main Branch (Outside)	69.9	85.0	60.3
	The Lahore Lyceum Main Branch (Inside)	65.6	80.1	59.3
3	FC College, Lahore (Outside)	71.3	87.1	63.8
	FC College, Lahore (Inside)	61.5	80.0	56.5
4	University of Central Punjab (Outside)	72.2	86.9	63.5
	University of Central Punjab (Inside)	65.5	80.7	59.3
5	Allama Iqbal Medical College (Outside)	70.8	89.3	61.8
	Allama Iqbal Medical College (Inside)	60.3	76.9	50.6
6	Doctor's Hospital (Outside)	74.9	90.9	62.8
	Doctor's Hospital (Inside)	69.2	85.2	60.7
7	University of Punjab (Outside)	72.9	87.0	61.7
	University of Punjab (Inside)	60.8	72.4	55.4
8	Punjab College of Commerce Campus (Outside)	77.0	87.0	66.7
	Punjab College of Commerce Campus (Inside)	70.0	80.0	62.5
9	Atchison College (Outside)	73.5	80.8	65.6

Source: EIA Study of Canal Bank Road, Lahore, 2006

5) Soil Contamination

At present no relevant data is available.

6) Sediment Contamination

At present no relevant data is available.

7) Ground Subsidence

In general ground subsidence is often observed in case of a large scale groundwater abstraction. However, there is no indication of ground subsidence due to groundwater abstraction in Lahore.

4.2 Summary of Current Policy, Legal and Institutional Framework

4.2.1 Policy Framework

The paramount document for environmental legislation and policy is the Constitution of Islamic Republic of Pakistan, 1973. It safeguards the fundamental rights as to life and health of a citizen. The reference to the environment finds mention in the concurrent list, Item 24 of the Constitution. It provides environment, pollution and ecology, as a concurrent subject that can be legislated by both the Federal Government and the Provinces.

1) National Environmental Policy, 2005

Government of Pakistan launched its National Environmental Policy, in March, 2005 which provides an overarching framework for addressing the environmental issues. Section 5 of the policy commits for integrating environment into development planning as instrument for achieving the objectives of National Environmental Policy. It further states in clause (b) of Subsection 5.1 that EIA related provisions of Environmental Protection Act of 1997 will be diligently enforced for all development projects.

It also provides broad guidelines to the Federal Government, Provincial Governments, Federally Administrative Territories and Local Governments to address their environmental concerns and to ensure effective management of their environmental resources.

2) Other National Policies

The major national policies of Pakistan are listed in Table 4.2.1.

Table 4.2.1 National Policies in Pakistan

No.	National Policy	Year
1	National Conservation Strategy	1992
2	The 8th Five Year Plan (1993-1998)	1993
3	National Forest Policy	2000
4	National Water Policy	2002
5	Education Policy	2001
6	Population Policy	2002
7	National policy for Development and Empowerment of Women	2002
8	National Resettlement Policy	2002
9	Policy for Power Generation Projects	2003
10	National Environment Policy	2005
11	National Sanitation Policy	2006
12	National Drinking Water Policy (Draft)	2007
13	Clean Development Mechanism (CDM) National Operation Strategy	2006
14	National Transport Policy (2005-2015)	2005

Source: Website of Pakistan Environmental Protection Agency

4.2.2 Legal Framework

1) Laws and Legislations Relevant to Environmental Protection

Major Laws and legislations relevant to environment in Pakistan are outlined in Table 4.2.2. Government of Pakistan has promulgated laws/ acts, regulations and standards for protection, conservation, rehabilitation and improvement of the environment. In addition to Laws and Acts, procedures governing development projects have also been developed for environmental impact assessment.

Table 4.2.2 Major Laws and Legislations Relevant to Environment in Pakistan

Purpose Sector	Legislation
Environmental Protection	The Pakistan Penal Code (1880)
	Pakistan Environmental Protection Ordinance, NO.XXVUU of 1997
	Pakistan Environmental Protection Act,1997
Land Use and Land Acquisition	The Land Improvement Loan Act, 1883
	Land Acquisition Act, 1894
	The Punjab Development of Damaged Areas Act, 1962
	The Punjab Soil Reclamation Act, 1952
	The West Pakistan Agricultural Pests Ordinance, 1959 and Rules, 1960.
	The Punjab Development Cities Act, 1976
	Lahore Development Authority Act, 1975
	Lahore Development Authority Land Use (Classification, Reclassification and Redevelopment) Rules, 2009
Water Quality and Wastewater, and Water Resources	The Pakistan Penal Code,1860
	The Canal and Drainage Act, 1873
	The Factories Act, 1934
	On-Farm Water Management and Water User's Associations Ordinance, 1981
	Indus River Apportionment Accord, 1991
	Statutory Notification S. R. R 742, 1993
Air Quality	The Pakistan Penal Code, 1860
	The Factories Act, 1934
	The Motor Vehicles Ordinance, 1965 and Rules, 1969
	The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s), 1979/80
	Statutory Notification S. R. R 742, 1993
	Statutory Notification S. R. R 1023, 1995
Noise	The West Pakistan Regulation and Control of Loud-Speakers and Sound Amplifiers Ordinance, 1965
	The Motor Vehicle Ordinance, 1965 and Rules, 1969
Toxic and Hazardous Substances	The Pakistan Penal Code, 1860
	The Explosives Act, 1884
	The Factories Act, 1934
	The Agricultural Pesticides Ordinance, 1971 and Rules, 1973
Solid Wastes	The Factories Act, 1934
	The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s), 1979/80
	Pakistan Environmental Protection Ordinance, NO.XXVUU of 1997
Marine and Fisheries	The West Pakistan Fisheries Ordinance, 1961
	Balochistan Sea-Fisheries Ordinance,1970 and Rules, 1973

Purpose Sector	Legislation
Marine and Fisheries	The NWFP Fisheries Rules, 1976
	Territorial Waters and Maritime Zones Act, 1976
Forest Conservation	The Punjab Forest (Sale of Timber) Act, 1913
	The Forest Act, 1927
	The NWFP Hazara Forest Act, 1936
	The West Pakistan Firewood and Charcoal (Restrictions) Act, 1964
	The Punjab Plantation and Maintenance of Trees Act, 1974
	The Cutting Trees (Prohibition) Act, 1975
	The NWFP Management 0f Protected Forests Rules, 1975
	The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance(s),1979/80
	The NWFP (Conservation and Exploitation of Certain Forests in Hazara Division) Ordinance, 1980
	The NWFP Forest Development Corporation Ordinance, 1960
Parks and Wildlife Conservation and Protection	The West Pakistan Ordinance, 1959
	The KohatMarszi Control Act, 1954
	The Sindh Wildlife Protection Ordinance, 1972 and Rules, 1972
	The Punjab Wildlife (Protection, Preservation, Conservation and Management) Act,1974 and Rules, 1974
	The Balochistan Wildlife Protection Act, 1974 and Rules, 1975
	The NWFP Wildlife(Protection, Preservation, Conservation and Management) Act, 1975 and Rules, 1976
	The Pakistan Plant Quarantine Act, 1976
	Islamabad Wildlife (Protection, Preservation, Conservation and Management) Ordinance, 1979/80
	The Balochistan, NWFP, Punjab and Sindh Local Government Ordinance, 1979/80
	Export and Control Order, 1982
Mineral Development	The Regulation of Mines and Oil-Fields and Mineral Development (Government Control) Act, 1946
Transport Development	The Provincial Motor Vehicles Ordinance, 1965
	The Provincial Motor Vehicles Rules, 1969
	The Motor Vehicles Act, 1939
	The Fatal Accidents Act, 1855
	The National Highway Safety Ordinance, 2000
Cultural Development	The Antique Act, 1975
	The Punjab Special Premises (Preservation) Ordinance, 1985
Livestock	West Pakistan Goats (Restriction) Ordinance, 1959
	West Pakistan Punjab Animal Slaughter Control Act, 1963
	The Grazing of Cattle in the Protected Forests (Range Lands) Rules, 1978
	Pakistan Animal Quarantine (Import and Export of Animals and Animal Products) Ordinance, 1979/80
	The Balochistan, NWFP, Punjab and Sindh Local government Ordinance(s), 1979/80
Public Health and Safety	The Pakistan Penal Code, 1860
	The Boilers Act, 1923
	The Public Health (Emergency Provisions) Ordinance, 1944
	The West Pakistan Factories Canteen Rules, 1959
	The Balochistan, NWFP, Punjab and Sindh Local government Ordinance(s), 1979/80
	The Western Pakistan Epidemic Diseases Act, 1979/80

Source: Pakistan Environmental Protection Agency, 1997 and JICA Study Team

2) Federal Laws

(i) Pakistan Environmental Protection Act, 1997

The Act was enacted in December 06, 1997 by repealing the Pakistan Environmental Protection Ordinance, 1983. It provides the framework for implementation of PNCS, 1992 establishment of provincial sustainable development funds, protection and conservation of species, conservation of renewable resources, and establishment of Environmental Tribunals, appointment of Environmental Magistrates, Initial Environmental Examination (IEE), and Environmental Impact Assessment (EIA). According to Pakistan Environmental Protection Agency, some portions of Pakistan Environmental Protection Act, 1997 have been proposed to be updated but they were not officially approved. Therefore, the 1997 legislation is effective at present.

(ii) Cutting of Trees (Prohibition) Act, 1975

This Act prohibits cutting or chopping of trees without permission of the Forest Department.

(iii) The Antiquities Act, 1975

Archaeological sites and monuments are specifically protected by this Act.

(iv) Land Acquisition Act, 1894

The Land Acquisition Act (1894) deals with the acquisition of private properties for public purposes including large development projects like major roads terminals, stations etc. There are 55 sections in this Act mainly dealing with area notifications, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions.

(v) Canal and Drainage Act, 1873

This Act entails provisions for the prevention of pollution of natural or man-made water bodies.

(vi) Pakistan Penal Code, 1860

This Act defines the penalties for violations concerning pollution of air, water bodies and land.

(vii) Explosives Act, 1884

Under the Explosives Act, 1884, the project contractors are bound by regulations on handling, transportation and using explosives during quarrying, blasting, and other purposes.

(viii) Highways Safety Ordinance, 2000

This ordinance includes provisions for the licensing and registration of vehicles and construction equipment; maintenance of road vehicles; traffic control devices, offences, penalties and procedures; and the establishment of a police force for motorways and national highways charged with regulating and controlling traffic on roads, and keeping roads and highways clear of encroachments.

(ix) Occupational Health

Construction and operational activities could affect the occupational health of workers. Quantitative national standards with respect to the above aspect are yet to be developed in Pakistan. However, guidance in qualitative terms can be obtained from the Labour Laws (Amended) Ordinance, 1972.

3) Provincial Laws

(i) Punjab Wildlife Act, 1974

This Act defines rules and regulations for the protection, preservation, conservation and management of wildlife in the Province of the Punjab.

(ii) The Punjab Plantation and Maintenance of Tress Act, 1974

This Act defines rules and regulations for plantation and maintenance of trees in the Province of the Punjab.

(iii) The Punjab Soil Reclamation Act, 1952

This Act defines rules and regulations for the speedy reclamation and improvement of the areas damaged by salinity and water logging (for preventing further damage and for maximizing agricultural production).

(iv) Punjab Local Government Ordinance, 2001

Environmental protection is devolved subject under Punjab Local Government Ordinance (LGO), 2001. Notwithstanding any specific provisions, every local government may perform functions conferred by or under the Punjab Local Government Ordinance, 2001 and in performance of such functions may exercise such powers, which are necessary and appropriate. Until different provisions, rules, regulations or byelaws are made, the local governments may exercise such powers as are specified in the Sixth Schedule of Punjab LGO, 2001.

(v) Lahore Development Authority Act, 1975

Lahore Development Authority (LDA) is responsible for new planned development in Lahore. The body acts as regulatory body of permissions which are required for new housing projects, private houses and commercial development in the city areas. LDA was established under the LDA Act, 1975 duly approved by Punjab Legislative Assembly.

(vi) Lahore Land Use (Classification, Reclassification and Redevelopment) Rules, 2009

The GoPb enacted new land use rules in 10th February, 2009 based on the 1975 Lahore Development Authority Act. The Rules intend to determine land use in controlled areas according to land use classification. In Lahore land use plan in any development should be comply with land use classification and sub-classification of the Rules.

(a) New Classification of Land Use in Lahore

In the Lahore Development Authority (LDA) Land Use (Classification, Reclassification and Redevelopment) Rules, 2009 land in the controlled area should be classified into following 6 areas: a) Residential, b) Commercial (including institutional), c) Industrial, d) Per-urban, f) Agricultural, f) Notified.

(b) Sub-classification of land use

The land classified as above are further sub-classified according to the characteristics of the land such as planned, existing notification or established built-up area, size of plots, right of way of roads, corridors, and land use availability (permitted, permissible or prohibited).

4.2.3 Environmental Standards

The Pakistan Environmental Protection Council first approved these standards in1993. These were later revised in 1995 and 2000 as National Environment Quality Standards (NEQS). Subject to the provisions of the PEPA, 1997 and the rules and regulations made there under, no person shall discharge or emit or allow the discharge or emission of any effluent or waste or air pollutant or noise in an amount, concentration or level which is in excess of the National Environmental Quality Standards or, where applicable, the established standards.

The National Environmental Quality Standards (NEQS), 2000 specify the following standards:

- Maximum allowable concentration of pollutants in municipal and liquid industrial effluents discharged into inland waters, sewage treatment facilities, and the sea (three separate sets of numbers).
- Maximum allowable concentration of pollutants (16 parameters) in gaseous emissions from industrial sources.

- Maximum allowable concentration of pollutants (2 parameters) in gaseous exhaust and noise emission from vehicles.

Revised/ new National Environmental Quality Standards for ambient air, drinking water and ambient noise were proposed by Pakistan Environmental Protection Agency and published in the Gazette of Pakistan, Extra, 26th November, 2010. These NEQSs were approved by Pakistan Environmental Protection Council and are now effective.

4.2.4 EIA Regulations

1) Review of IEE/ EIA Regulations, 2000

In 1997, the National Assembly passed the 1997 Pakistan Environmental Protection Act (EPA), which subsumed the 1983 Ordinance. This act requires IEEs and EIAs for all developmental projects. Environmental impact assessment of all development projects whether public or private is a legal requirement under section 12 of PEPA 1997, which became operational in 2001. Project categories, which require an IEE, are listed in Schedule 1 as given in Table 4.2.3. The projects for which an EIA is required are in Schedule 2, and listed in Table 4.2.4. The Pakistan EPA (Review of IEE and EIA) Regulations, 2000 (The 2000 Regulations) prepared under PEPA 1997 define the procedures for IEEs and EIAs, and give legal status to the Pakistan Environmental Assessment Procedures, prepared by the Federal EPA in 1997.

Table 4.2.3 List of Projects Requiring an IEE

Sector	Project Description
A. Agriculture, Livestock and Fisheries	1. Poultry, livestock, stud and fish farms with total cost more than PKR 10 million
	2. Projects involving repacking, formulation or warehousing of agricultural products
B. Energy	1. Hydroelectric power generation less than 50 MW
	2. Thermal power generation less than 200 KW
	3. Transmission lines of less than 11 KV, and large distribution projects
	4. Oil and gas transmission systems
	5. Oil and gas extraction projects including exploration, production, gathering systems, separation and storage
	6. Waste – to - energy generation projects
C. Manufacturing and Processing	1. Ceramics and glass units with total cost more than PKR 50 million
	2. Food processing industries including sugar mills, beverages, milk and dairy products, with total cost less than PKR 100 million
	3. Man-made fibers and resin projects with total cost less than PKR 100 million
	4. Manufacturing apparel, including dyeing and printing, with total cost more than PKR 25 million
	5. Wood products with total cost more than PKR 25million
D. Mining and Mineral Processing	1. Commercial extraction of sand, gravel, limestone, clay, sulphur and other minerals not included in Schedule II with total cost less than PKR 100 million
	2. Crushing, grinding and separation processes
	3. Smelting plants with total cost less than PKR 50 million
E. Transport	1. Federal or Provincial highways (except maintenance, rebuilding or reconstruction of existing metaled roads) with total cost less than PKR 50 million
	2. Ports and harbor development for ships less than 500 gross tons
F. Water Management, Dams, Irrigation and Flood Protections	1. Dams and reservoirs with storage volume less than 50 million cubic meters of surface area less than 8 square kilometers
	2. Irrigation and drainage projects serving less than 15,000 hectares
	3. Small-scale irrigation systems with total cost less than PKR 50 million
G. Water supply and Treatment	Water supply schemes and treatment plants with total cost less than PKR 25 million
H. Waste Disposal	Waste disposal facilities for domestic or industrial wastes, with annual capacity less than 10,000 cubic meters
I. Urban Development and Tourism	1.Housing schemes
	2. Public facilities with significant off-site impacts (e.g., hospital wastes)
	3. Urban development projects
J. Other Projects	Any other projects for which filing of an IEE is required by the Federal Agency under sub-section (2) of Regulation 5

Source: Schedule I of Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations, 2000

Table 4.2.4 List of Projects Requiring an EIA

Sector	Project Description
A. Energy	1. Hydroelectric power generation over 50 MW
	2. Thermal power generation over 200MW
	3. Transmission lines (11 KV and above) and grid stations
	4. Nuclear power plants
	5. Petroleum refineries
B. Manufacturing and Processing	1. Cement plants
	2. Chemical projects
	3. Fertilizer plants
	4. Food processing industries including sugar mills, beverages, milk and dairy products, with total cost of PKR 100 million and above.
	5. Industrial estates (including export processing zones)
	6. Man-made fibers and resin projects with total cost of PKR 100 million and above
	7. Pesticides (manufacture or formulation)
	8. Petrochemicals complex
	9. Synthetic resins, plastics and man-made fibers, paper and paperboard, paper pulping, plastic products, textiles (except apparel), printing and publishing, paints and dyes, oils and fats and vegetable ghee projects, with total cost more than PKR 10 million
	10. Tanning and leather finishing projects
C. Mining and Mineral Processing	1. Mining and processing of coal, gold, copper, sulphur and precious stones
	2. Mining and processing of major non-ferrous metals, iron and steel rolling
	3. Smelting plants with total cost of PKR 50 million and above
D. Transport	1. Airports
	2. Federal or Provincial highways or major roads (except maintenance, rebuilding or reconstruction of existing roads) with total cost of PKR 50 million and above
	3. Ports and harbour development for ships of 500 gross tons and above
	4. Railway works
E. Water Management, Dams, Irrigation and Flood Protection	1. Dams and reservoirs with storage volume of 50 million cubic meters (50 M m3) and above or surface area of 8 square kilometres (8 km2) and above
	2. Irrigation and drainage projects serving 15,000 hectares and above
F. Water Supply and Treatment	Water supply schemes and treatment plants with total cost of PKR 25 million and above
G. Waste Disposal	1. Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital waste)
	2. Waste disposal facilities for domestic or industrial wastes, with annual capacity of more than 10,000 cubic meters (10,000m^3)
H. Urban Development and	1. Land use studies and urban plans (large cities)
	2. Large-scale tourism development projects with total cost more than PKR 50

Sector	Project Description
Tourism	million
I. Environmentally Sensitive Areas	All projects situated in environmentally sensitive areas
J. Other Projects	1. Any other projects for which filing of an EIA is required by the Federal Agency under sub-section (2) of Regulation 5
	2. Any other projects likely to cause an adverse environmental effect

Source: Schedule II of Pakistan Environmental Protection Agency (Review of IEE/EIA) Regulations, 2000

2) EIA Guidelines

Pak-EPA has also published environmental assessment procedures and guidelines in October, 1997. These contain the following sets of information relevant to the proposed project as given in Table 4.2.4.

- Guidelines for Policy and Procedures for Filing, Review and Approval of Environmental Assessment Reports – It describes environmental policy and administrative procedures to be followed for filing of an environmental assessment reports by the proponents and its review and approval by the concerned Environmental Protection Agency/ Department.
- Guidelines for the Preparation and Review of Environmental Reports – These guidelines are developed to facilitate both the proponents and decision makers to prepare reports (inclusive of all the information contained therein) and carry out their review so as to take informed decisions.
- Guidelines for Public Consultation – These guidelines deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures that their concerns are incorporated in any impact assessment study.
- Detailed Sectorial Guidelines – These guidelines embody issues impacts commonly arisen in projects, the mitigations to reduce/ eliminate these impacts and the need for environmental management plan and monitoring plan to protect the environment. These guidelines include major roads, major thermal power stations, major chemical and manufacturing plants, water supply projects, industrial estates, new township development, sewerage schemes, irrigation and drainage, oil and gas exploration etc.
- Guidelines for sensitive and critical areas – These guidelines deal with environmental considerations which should be fully taken into account for the development in sensitive and critical areas in relation both to the natural

environment and cultural aspects.

Table 4.2.6 provides a comprehensive checklist to be followed when planning and proposing a road project as an initial fatal flew analysis due to its environmental impact.

Table 4.2.5 Major Guidelines Relevant to EIA Procedures

Guidelines for EIA Study, Reports and Approval	
1	EIA Guidelines and Overview
2	EIA Graphics Overview
3	Front Sheet
4	Policies and Procedures for Review and Approval
5	Guidelines for Preparation and Review of Environmental Report
6	Guidelines for Public Consultation
7	Guidelines for Sensitive and Critical Areas
8	Pakistan Environnemental Legislation and National Environnemental Quality Standards
9	Sectorial Guidelines for Environmental Reports, Major Thermal Power Stations
10	Sectorial Guidelines for Environmental Reports, Major Chemical and Manufacturing Plants
11	Sectorial Guidelines for Environmental Reports, Housing States and New Town Development
12	Sectorial Guidelines for Environmental Reports, Industrial States
13	Sectorial Guidelines for Environmental Reports, Major Roads Guidelines
14	Sectorial Guidelines for Environmental Reports, Major Thermal Power Stations
15	Sectorial Guidelines for Environmental Reports, Sewage Schemes
16	Sectorial Guidelines for Environmental Reports, Oil and Gas Exploration and Production

Source: Website of Pakistan Environmental Protection Agency (http://www.environment.gov.pk/info.htm)

Table 4.2.6 Checklist of Items and Matters to Be Considered in Initial Site Assessment for Road Development Project

Check Item	Items/ Matters to be Considered
1. Operational Requirements	1) If there is a new road reserve, is the corridor location consistent with any strategic transport plan for the area?
	2) Does the site or corridor provide sufficient land area for present and future requirements?
	3) Is the site efficient in relation to extractive material and other building material sources?
2. Water Issues	1) Are there any site constraints so that on-site water management is difficult?
	2) Are there risks of surface water pollution because of the proximity or pathways to water bodies or wetlands.
	3) Are there risks of groundwater problems because of shallow or rising groundwater tables, or proximity to groundwater recharge areas, or areas with high vulnerability to pollution?
	4) Is the site susceptible to flooding?
3. Flora and Fauna Issues	1) Can clearing of native vegetation be avoided?
	2) Can clearing of vegetation of high significance be avoided e.g. vegetation

Check Item	Items/ Matters to be Considered
3. Flora and Fauna Issues	used for visual screening, riparian vegetation, vegetation used as corridors for the movement of fauna?
	3) Are threatened flora and fauna species, populations and ecological communities or their habitats likely to be affected?
	4) Can areas of native forest be avoided?
4. Geological or Soils Issues	1) Are the local topographic characteristics likely to result in design and management difficulties or the inefficient use of natural resources?
	2) Are there any geological characteristics which will cause difficulties in managing impacts (subsidence, slippage, seismic)?
	3) Is the soil highly erodible? identify any management problems.
	4) Is there any existing soil problems e.g. contamination of soil, acid sulphate or saline soils?
5. Transport issues	1) Does the proposal in this location enhance the efficiency of the transport network including public transport?
	2) Can the standard and capacity of the surrounding road network accommodate traffic likely to be generated directly or indirectly by the proposal?
	3) If inadequacies exist, can the road network or traffic management be changed to minimize any impacts, particularly on residential areas?
6. Community Issues (Land Use, Severance, Pollution, Cultural Property etc.)	1) is the proposal likely compatible with surrounding existing or proposed land uses, any sites of outstanding natural, environmental, agricultural or mineral value?
	2) Does the corridor route avoid necessary dislocation of existing roads, and other infrastructure or utility networks? Can dislocation of residential areas be avoided, particularly severance of communities with strong community identity? Can dislocation of the operation of agriculture, forestry, commercial or industrial activities be avoided?
	3) Is there likely to be a problem with air or water quality, or noise levels due to the proximity and nature of nearby land uses? Is the proposal likely to pose health risks?
	4) Is the proposal likely to affect heritage values or sites of significance?
	5) Is the site highly visible? Can significant visual impacts be avoided?
7. Cumulative Issues	Is the proposal at the proposed location, in concert with other recent and planned road network improvements likely to cause cumulative problems, or contribute to existing problems (air, noise, congestion, economic hardship, social issues and inappropriate land use)?

Source: Pakistan Environmental Protection Agency (1997) Sectorial Guidelines for Environmental Reports, Major Roads Guideline

3) Procedure for Environment Approval

According to the Regulation, 2000 general procedure for Environment Approval is as illustrated in Figure 4.2.1.

(i) Project Requiring an IEE

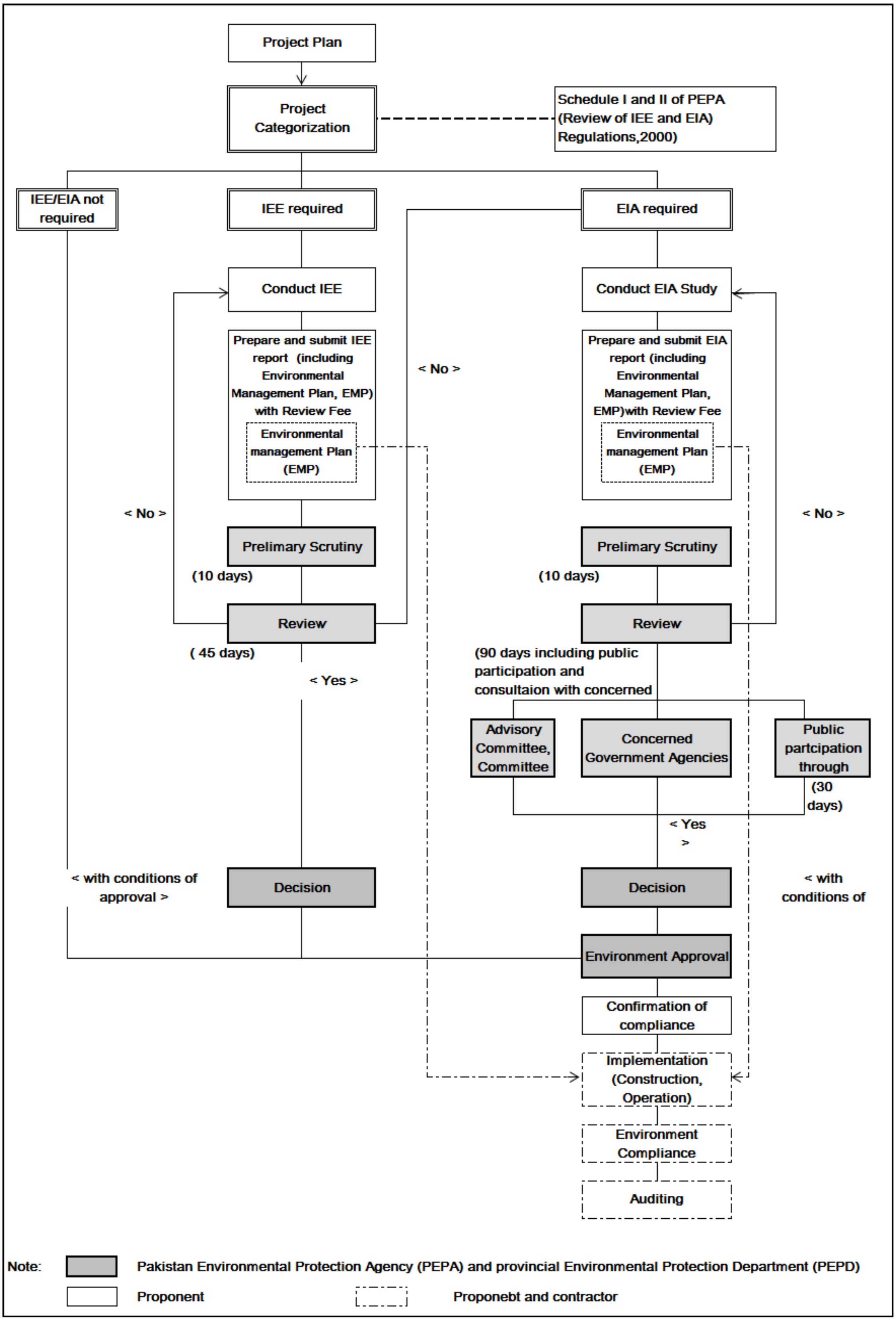
Proponent of a project cannot proceed unless the agency has filed an Initial

Environmental Examination (IEE) with the Federal Agency and received approval. After filing the IEE, the Federal Agency must respond within 10 working days and state if the submission is acceptable or not, or if an EIA is required. If acceptable, the agency is required to review the IEE and approve, within 45 days.

(ii) Project Requiring an EIA

No proponent of a project which is likely to cause adverse environmental effects can proceed unless an EIA has been approved by the Federal Agency. If an EIA is required

Figure 4.2.1 Procedure of Environment Approval in Pakistan



Source: JICA Study Team

The Agency must review the EIA and give approval subject to conditions, within 90 days, require that the EIA be re-submitted after any stipulated modifications, or reject the project. Every review of an EIA must be carried out with public participation but no information will be disclosed during the public participation if it is commercially confidential, unless such disclosure is in the public interest.

(iii) Approval of IEE/ EIA

The Federal Agency must communicate its approval or otherwise within four months from the date the IEE or EIA is first filed. If the submission is complete and complies with procedure, but no response is given, then the IEE or EIA shall be deemed approved. The Federal Government can, at its discretion, extend the four months period if justified due to the nature of the project.

The Federal Agency must maintain separate registers for IEEs and EIAs projects, which contain brief particulars of each project and a summary of decisions taken. These registers are to be open to the public. The IEE and EIA submission and approvals procedure is shown above in figure 4.2.1.

(iv) Environmental Monitoring and Audit

The project proponent will be responsible for ensuring implementation of those environmental mitigation measures which are recommended in the IEE or EIA. The corresponding Environmental Management Plan (EMP) should be prepared during the planning phase of the respective IEE/ EIA. The EMP should include specific mitigation measures, environmental monitoring requirements, institutional arrangements and its corresponding budget.

The EMP is a crucial document that should be prepared during planning phase. After its approval by the EPA, the EMP is to be taken into consideration when defining the contractual obligation to be imposed on the contractor. The implementation of the EMP while performing the corresponding construction works is the responsibility of the contractor. The contractor is responsible for environmental monitoring and reporting activities. The project proponent must ensure that the performance of the contractor is in accordance with EMP. The contractor should submit annually a report on the EMP implementation.

4.2.5 Land Acquisition and Resettlement Issues

1) Definition of Land Acquisition and Resettlement

One of major social issues generated by development is land acquisition and resettlement. Land may be acquired to secure necessary space for various development activities for the public purpose by the government and related organizations. Generally land acquisition contains not only land itself but also assets. On the other hand, international donors such as World Bank, Asian Development Bank and JICA have different definition discussed in this section.

2) Land Acquisition According to Land Acquisition Act, 1894

In Pakistan, a number of laws give and protect the proprietary rights. The Land Acquisition Act, 1894 (LAA) has been the most commonly used law for acquisition of land and other properties for development projects. Process and timeframe for land acquisition is outlined in Table 4.2.7.The process is initiated by a preliminary notice under Section 4 of LAA served by the District Land Acquisition Collector (LAC) expressing the desire to "enter upon" broadly identified private lands for surveying and soil-testing for the specified public purpose. Then under Section 5, marking and measurement of the land is performed and assessments made of compensation. The final declaration for possession is issued under Section 17 of the Act, having issued the award compensation for individual owners.

Under this Act, only legal owners and tenants officially registered with the Land Revenue Department or possessing formal lease agreements, are considered “eligible” for land compensation. Following the Act (Section 5), cash compensation is assessed on the basis of three – five years average registered market rate, and is paid to the landowners for their land being acquired. Land acquisition is to be completed in total 52 weeks (about one year).

Table 4.2.7General Process and Time Frame for Land Acquisition in Pakistan

Step	Land Acquisition Process	Responsible Organization	Timeline (General)
1	Land acquisition proposal to Revenue Department; project description, location, extent of land to be acquired	Pak-EPA	Week 1-2
2	Publication of Notice expressing the intent to acquire the land under Section 4	Revenue Department (each District)	Week 3-4
3	Field survey, inventory of assets under Section 5	Revenue Department (each District)	Week 5-20
4	Declaration for possession under Section 6	Revenue Department (each District)	Week 21-22
5	Compensation assessment and award preparation	Revenue Department (each District)	Week 23-24
6	Dispute/Objections (Grievance Redress)	Aggrieved parties	Week 25-26
7	Possession of land, marking, clearance	Revenue Department (each District)	Week 23-52
8	Disbursement of compensation	Revenue Department (each District)	Week 23-52

Note 1: Land acquisition according to Land Acquisition Act, 1894
Note 2: Land acquisition to be completed in total 52 weeks (about 1 year)
Source: JICA (2006): PTPS Report

Although it comprises 55 Sections pertaining to area notification and surveys, acquisition, compensation and appointment, awards and disputes resolution, penalties and exemptions and lays down detailed procedures for the acquisition of private properties for public purposes and their compensation. The LAA or any other law of the land, does not cover resettlement and rehabilitation of persons in a manner perceived today.

In the absence of a resettlement policy, for development purposes and for those which are adversely affected, the LAA 1894 has been the *'de facto'* policy governing resettlement, and compensation to the project affected persons. Its provisions do not take into account the changed social, cultural, economic and environmental situations in which these operate. From operational point of view, the LAA is a provincial law, and each province has its own version and interpretation of this law, mostly procedural in nature. These differences lead to different dispensations in compensation and resettlement packages for the PAPs.

To achieve long term social benefits of development projects, the people must be consulted, compensated for their losses, and assisted in rebuilding their lost assets and livelihoods to enjoy at least the same standard of living as they had before the project. In addition, very often affected people are poor and vulnerable and therefore unable to either stand up to political or government pressure or to absorb adverse impacts on their lives. Mere payment of cash compensation under the LAA is not enough to restore livelihood and living standards, caused by involuntary resettlement issues.

In 2002 National Resettlement Policy (Draft) was formulated not only to cover the Project Affected Persons (PAPs) under the existing system, but also to ensure an equitable and uniform treatment of resettlement issues all over Pakistan. The Policy is supplemented with Guidelines for planning and implementation of resettlement and project Implementation and Resettlement of Affected Persons Ordinance was planned for enactment by the provincial and local government. However, the Ordinance is not yet enacted.

4.2.6 Donor's Environmental Impact Assessment Procedures and Guidelines

All the development projects, which are funded by the donor agencies, have to abide by the guidelines stipulated by the respective donor agency for the Environmental Impact Assessment purpose.

1) World Bank (WB)

In 1998, the World Bank grouped ten of its key environmental and social policies into a set of "safeguard policies" which together are designed to provide maximum protection to the environment and vulnerable population from negative effects of the Bank financed operations. The World Bank Safeguard Policies establish mandatory standards and procedures that the borrower and the Bank must follow in preparing and implementing the Bank financed projects.

(i) Operational Policy 4th January, 1999: Environmental Assessment

This is the umbrella policy through which potential social and environmental impacts are identified and the mitigation measures are proposed. The assessment process determines whether other safeguard policies apply. This policy provides the World Bank to screen projects in order to identify potential impacts early in the project cycle and categorize projects according to the level of environmental impacts. The categories trigger varying requirements regarding pre-project studies, participation, and information disclosure. The borrower is required to conduct assessment and avoid or minimize the identified impacts of the project and also to examine the project alternatives. The borrower is required to assess not only impacts on immediate project area, but project's "area of influence" (e.g., access roads, power lines, pipelines) as well as unplanned developments (spontaneous settlements, logging, etc.) induced by the project.

(ii) Operational Policy 4th December, 2001: Involuntary Resettlement

This policy establishes standards and procedures for projects that displace people from their homes or cause economic displacement due to loss of land, buildings, or sources of income. The policy insists that involuntary resettlement must be minimized, if not avoided. The displaced persons must be assisted as a minimum in restoring their former living standards, income earning capacity, and production levels. Though not required, the policy speaks of improving living standards of resettled persons. It also provides that the resettlement activities should be conceived and executed as sustainable development programs. The policy applies when a WB financed project causes the loss of land (including buildings), assets, or sources of income. The policy also applies when a project restricts access to parks and protected areas.

2) Asian Development Bank (ADB)

Policy of ADB for Environmental Impact Assessment involves its "safeguard policy" and it is basically the same as that of World Bank. ADB's safeguard policy framework consists of three operational policies on the environment: Indigenous Peoples, and involuntary resettlement. These are accompanied by *Operations Manual* sections on Environmental Considerations in ADB Operations; Involuntary Resettlement; and Indigenous Peoples. *ADB's Handbook on Resettlement* and *Environmental Assessment Guidelines* (2003) provide information on good practice approaches to implementing safeguards. In addition to the three safeguard policies, several sector policies have environmental safeguard elements, for example, those pertaining to water, energy, and forestry.

3) JICA Guidelines for Environmental and Social Considerations (2010)

In JICA Guidelines (Phrase 7 of Appendix 1. Environmental and Social Considerations Required for Intended Projects) regarding involuntary resettlement, required environmental and social considerations are mentioned as follows:

- Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the affected people.
- People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover for land and property), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.
- Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.
- For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

4.2.7 Difference in EIA Policy of Pakistan and Donors

There are some gaps/ differences between EIA policy of Pakistan and donor agencies. Major gaps are found in involuntary resettlement policy as shown in Tables 4.2.8 and 4.2.9. Subsequently, adverse impacts expected by involuntary resettlement such as generation of PAPs are not formally taken into consideration for categorization of project. Therefore, if number of PAPs are expected more than 200 due to the project (According to World Bank and ADB safeguard policy, it is classified as Category A project). It is not clear whether EIA is truly required or not.

However, Pakistan Government already drafted National Resettlement Policy and Resettlement Ordinance, 2003. The draft policy is consistent with the requirements of the World Bank's OP 4.12 on involuntary resettlement. Unfortunately, this policy has yet to be approved and notified by the government.

Table 4.2.8 Entitlement Matrix Proposed by Resettlement Ordinance, 2003 (Draft)

Item	Type of Losses	Entitlement
1	Partial loss of agricultural land, crops and trees by owners and (sharecrop/ lease) tenants	Cash compensation based on current market replacement value plus 15 % Compulsory Acquisition Surcharge (CAS)
		Cash compensation for loss of crops/trees at the market value
		Compensation to tenants at mature crop value crop-share
		Encroachers/squatters are not eligible for compensation for land on Road Right-of-Way but eligible for cash compensation for loss of assets
2	Total/ major loss of agricultural land by owners/ tenants	Financial assistance (grant/loan) and/or job opportunities as the project for an immediate restoration of livelihood. (In addition to the cash compensation paid under Item No.1)
3	Loss of commercial/ other structures/ installations by owners (SBEs, tube-wells, livestock-sheds etc.)	Compensation for loss at full replacement cost on current value/ prices.
		All salvageable materials will be allowed for rebuilding purposes
		Shops/Small Business Enterprise (SBE) owners once paid due compensation will not be allowed to re-establish within the active ROW of the project roads
		Compensation for all other immovable assets on replacement value, plus installation costs (salvageable materials allowed)
		Where necessary, adequate transportation and labour cost will be paid, especially to the most vulnerable persons (poor/women)
4	Loss of business premise by renters/ tenants	One-time cash assistance equivalent to 2 months' rent to the renters for alternative premises for re-establishing of businesses
		If necessary, adequate transportation and labour costs will be paid

Item	Type of Losses	Entitlement
5	Income assistance for loss of business by shops/ SBE owners/ tenants	One-time assistance, a lump sum grants; based on the nature of business and type and size of losses, the following range will apply: (i) small business up to PKR 2,000; (ii) medium business up to PKR 3,500; and (iii) large business up to PKR 10,000.
6	Loss of wages by SBE employees	Wages for 30 to 60 days at local wage rate (or latest wages)
		Family workers in SBEs will not be paid any compensation; they are already covered by income assistance under No.5.
		Special assistance to vulnerable persons, like , the poor, disabled and women-headed household - one-time lump sum grant of PKR 1,000.
7	Loss of cultural/ community structures/ installations	Cash compensation at replacement value to patrons/user group leaders for rehabilitation/rebuilding of the affected part/ whole, including construction/installation costs (salvageable material will be allowed for free for residue in reconstruction/restoration)
		If not feasible, then the project will be rebuild/restore from its own project cost

Source: Pakistan Environment Protection Agency

Table 4.2.9 Comparison of Land Acquisition Policies between Pakistan and International Donors including WB, ADB and JICA

#	Existing Pakistan Land Acquisition Procedure	Donor's Involuntary Resettlement Policy*
1	Land compensation only for titled land owners or holders of customary rights	Lack of title should not be a bar to compensation and/or rehabilitation.
		Non-title holders are to be rehabilitated
2	Crop losses compensation provided only to registered landowners and lease/sharecrop tenants (Non-registered are often deprived).	Crop compensation is provided to landowners and sharecrops/lease tenants according to their shares whether they are registered or not.
3	Tree losses are compensated on the basis of officially fixed rates by the Forest and Horticulture Departments.	Tree losses are compensated according to actual worth of affected trees based on market rates.
4	Land valuation based on the median registered land transfer rate over the previous 3 years.	Land valuation is to be based on current replacement (market) value.
5	Structures valuation based on official rates, with depreciation deduced from the gross value.	Valuation of structures based on current market value/cost of new construction of the structure.
6	Land Acquisition Collector (LAC) is the only pre-litigation final authority to decide disputes and address complaints regarding quantification/compensation for the affected lands and other assets.	Complaints and grievance are resolved informally through community participation in the Grievance Redress Committees (GRC), local governments, NGO and/or local-level community based organizations.

Note:* World Bank, Asian Development Bank and JICA
Source: National Transmission and Dispatch Company (NTDC), Government of Pakistan (2007.11) Pakistan - Power Transmission Enhancement Program MFF Tranche 2.

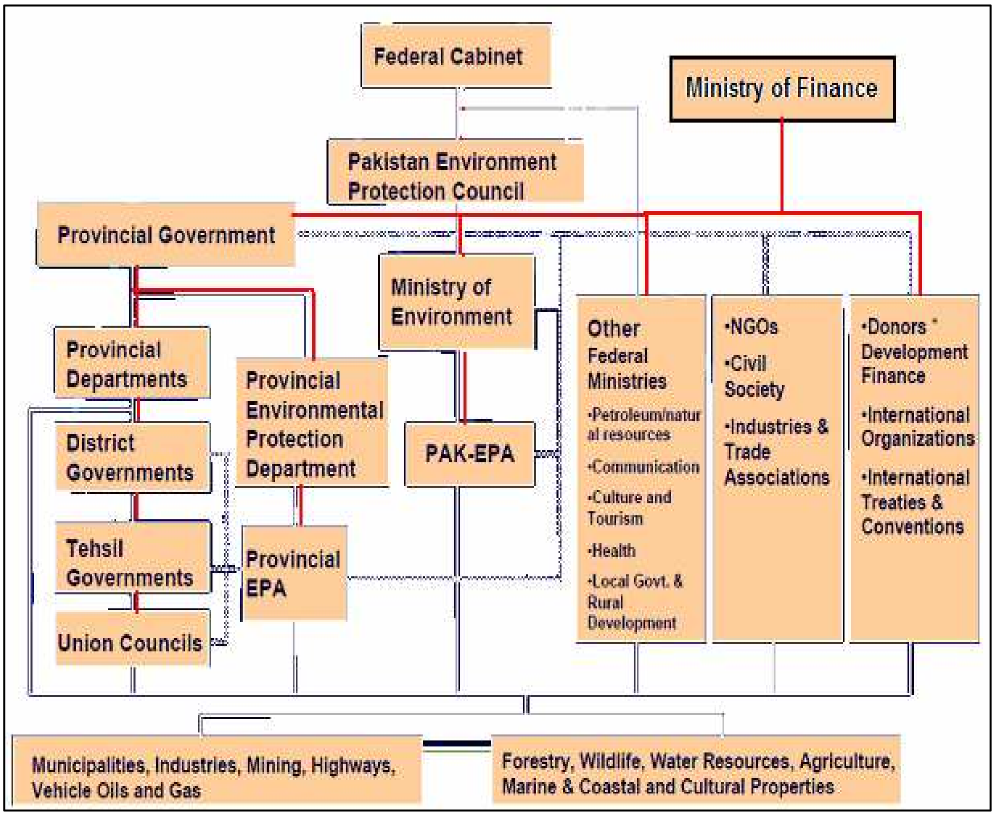
4.2.8 Institutional Framework

1) Pakistan Environmental Protection Council

The Pakistan Environmental Protection Council (PEPC) is the apex institute for environment in Pakistan. The main function of the PEPC is to develop policies and strategies for the enhancement of environment. The PEPC is supported by the Ministry of Environment and Pakistan Environmental Protection Agency. The Planning Commission of Pakistan and provincial planning and development departments have also established environmental sections. These sections are responsible of environmental policy development, identification and development of environmental projects for the five-year plans and annual plans at the federal and provincial levels. To implement Pakistan protection Act 1997 and other regulations, all provincial governments have established Environmental Protection Agencies (EPAs).

Under the framework of the PEPA 1997 and the instruction of Supreme Court of Pakistan, Provincial High Courts have established Environmental Tribunals. Any person in the individual capacity can approach environmental tribunal to register the case against polluters. Figure 4.2.2 shows the organization structure of environmental institutes in Pakistan.

Figure 4.2.2 Relation of Relevant Organizations in Environmental Management



Note: Red lines – flow of resources, Black line – flow of information and decision making processes
Source: PEPA (2009.6): Institutional Analysis of Air Quality management in Urban Pakistan (Draft Report)

4.2.9 Federal Agencies

The Federal Government established the Pakistan Environmental Protection Agency (PEPA) in 1987 to administer the Act, its rules and regulations. PEPA has among its duties:

- Ensure enforcement of the National Environmental Quality Standards; Establish standards for the quality of the ambient air, water and land.
- It may allow different standards for discharge or emission from different sources, and for different areas, but where standards are less stringent than the National Environmental Quality Standards; prior approval of the Council is required.
- PEPA is staffed with 46 regular staff of which 11 are officers and 35 are ancillary staff. It has a Central Laboratory for Environmental Analysis (CLEAN), and a Green Library, which is also a resource center for the Ministry of Environment. In accordance with section 26 (1) of the 1997 Act, the Federal Government has delegated the powers and functions of the Federal EPA to the Provincial Governments, which have set up provincial EPAs. Provincial EPAs can now implement environmental regulations, monitor compliance, inspect environmental performance and take action against violators.

4.2.10 Provincial Agencies

(1) Punjab Environmental Protection Department (PEPD)

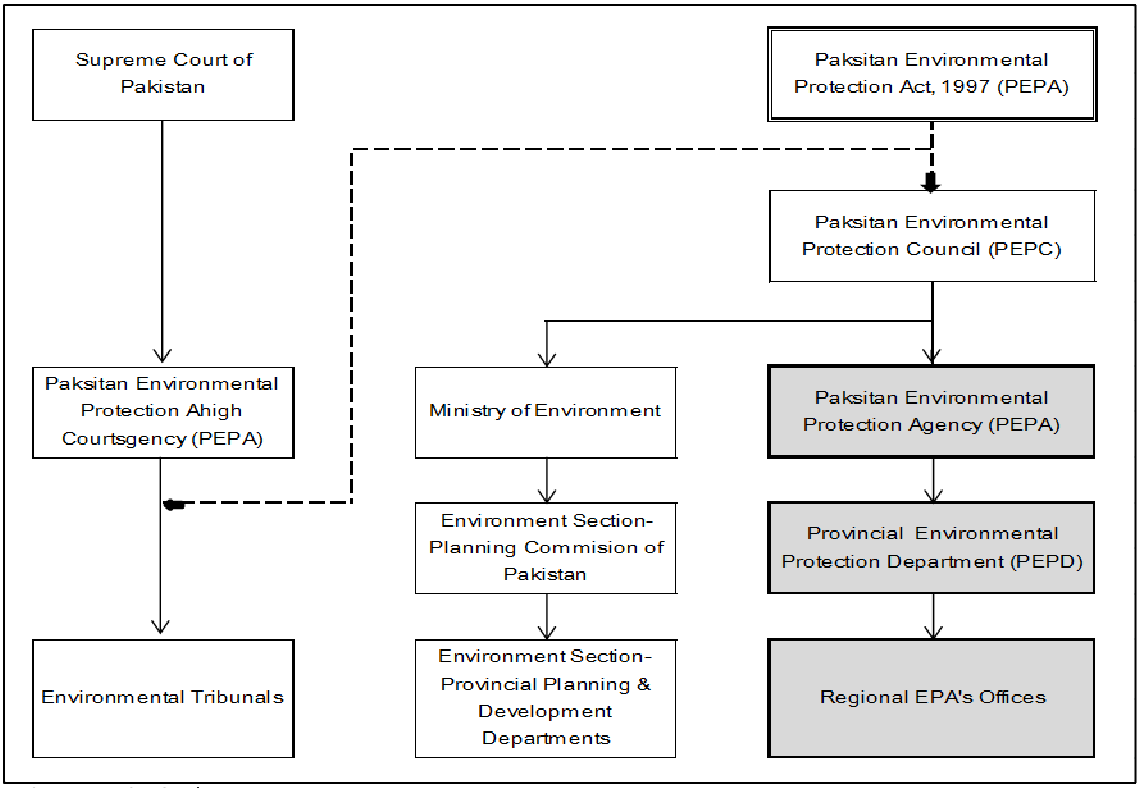
The GoPb has an independent Environment Protection Department headed by a Secretary. The PEPD had offices in the districts, which are headed by Assistant Directors. Under the Punjab Local Government Ordinance, 2001 the PEPD has been devolved, and the officers reassigned at district level. PEPD has 30 officers and 133 ancillary staff, and a laboratory staffed with 5 officers, which generates revenue for the PEPD. The institutional relation slips between various government organizations relevant to environmental protection in Pakistan is illustrated in Figure 4.2.3 and duties, responsibilities as mandated are given in Table 4.2.10.

Table 4.2.10 Responsibilities of Environmental Protection Enforcing Agencies

Organization	Mandate
Ministry of Environment	• Development of Environmental Policy, Drafting and notifying rules and regulations • Focal point for National Policy, plans and programs regarding environmental planning, pollution and ecology, including physical planning and human settlements. • Coordination with other countries and international organizations in the fields of Environment, physical planning and Human Settlements. • Administrative control of Pak EPA, Pak Forest Institute, etc. • Responsible for coordination of implementation of National Conservation Strategy
Pak-EPA and Provincial EPAs	• Regulation of hazardous substances/wastes; • EIA review and introduction of public participation; • Formulation of ambient air standards; • Implementation of national environmental policies; • Establishment of network of environmental laboratories, • Render advice and assistance in environmental matters, • Measures to prevent accidents and disasters causing pollution, • Promote public education and awareness, • Undertake inquiries and investigations into environmental issues., and • Other potential tasks are associated with preparation and processing of legal cases for Environmental Tribunals.
Ministry of Water and Power	Power production to be attuned to safeguarding the environment including air quality
Ministry of Industries	Controlling and correcting industrial discharge of residues and wastes, handling of toxic chemicals, etc. Environmental protection should be one of the key criteria in the selection and development of technology".
Ministry of Transport and Communication	Initiate achievable and phased program for automotive emissions controls by asking local automotive manufacturing industry (Cars, Trucks and Tractors) to comply with EURO Standards for new models.
City Government	• Proper solid waste management system right from collection of solid waste up to its proper disposal; • Measures to prevent accidents and disasters causing pollution, and • Promote public education and awareness

Source: Compiled from Institutional Analysis of Air Quality Management in Urban Pakistanby PEPA,
(Draft Report – June, 2009)

Figure 4.2.3 Institutional Relationship of Organizations Relevant Environmental Protection in Pakistan



Source: JICA Study Team

4.3 Preparation of SEA Procedures

4.3.1 Strategic Environmental Assessment and Planning Process

1) Need and Definition of SEA

The need to address the environmental impact of policy, and plans, and programs is widely acknowledged. Regional and national plans are subject to environmental assessment procedures to identify, at a strategic level, potential environmental impacts likely to arise during implementation of the policy or plan. This level of environmental assessment is often referred to as Strategic Environmental Assessment (SEA). In other word, SEA is a system of incorporating environmental considerations into policies and plans.

In this regards, SEA term of "environment" is used as a wider meaning of description which covers not only natural and social conditions but also economic, and financial engineering (technological) aspects. Currently, SEA is widely accepted in many countries as a tool to integrate environmental and social considerations into a decision-making process. It is generally understood as a process for assessing the environmental impacts caused by a policy, plan and program. SEA should be recognized as a supportive method to conduct appropriate decision-making from the point of view of the environment and sustainable development.

An increasing number of countries and international organizations including World Bank, ADB and JICA have introduced SEA system. However, there are differences in the scope, comprehensiveness, duration in relation to policies, plans and programs. There is no single approach to SEA that can be applied to all cases and no internationally accepted definition of SEA. More importantly the decision making context at the strategic level is different at national versus regional level, at policy versus plan/ program level, etc. SEA should be arranged reflecting differences in each situation of proposed policy, plan and program. The whole SEA process is intended to act as a support to planners and decision-makers, providing them with relevant environmental information on the positive and negative implications of policy, plans and programs.

SEA is a macro-planning tool that identifies the opportunities and constraints that the environment provides for the development process, while EIA focuses on identifying and containing the adverse impacts of the development process on the environment at the micro level. Hence, EIA and SEA are complementary planning tools that enable us to effectively mainstream environmental and social considerations in the development process.

2) SEA Definition According to JICA Guidelines

In JICA Guidelines for Environmental and Social Considerations (Amended April 2010), following definition and explanation are given:

- 1.3 Definitions 7. A "strategic environmental assessment" is an assessment that is implemented at the policy, planning, and program levels, but not at project-level EIA.
- 1.4 Basic Principles Regarding Environmental and Social Considerations. As one of seven principles to be very important, "measures for environmental and social considerations must be implemented from an early stage to a monitoring stage".

JICA applies a Strategic Environmental Assessment when conducting Master Plan Studies and encourages project proponents to ensure environmental and social considerations from an early stage to the monitoring stage. However, there is no further detailed description of SEA in the JICA Guidelines.

3) Role of SEA and Plans for Administrative Decision Level

As mentioned above, SEA can also be applied to formulation of policies, plans and programs at a higher administrative level. Contents and evaluation factors for SEA are somewhat changed depending on the targeted levels of policies, plans and programs such as administrative, spatial and/ or sectarian level. In view of SEA for necessary environmental and social considerations relation of policies and plans with environmental and social considerations are shown in Table 4.3.1.

Table 4.3.1 Development Plan and Strategic Environmental Assessment

No.	Development Plan (Master Plan etc.)		Necessary Environmental and Social Considerations	
	Policy, Strategy, Plan, Project	Example of Development Plan	Examples of SEA/EIA	Tentative Evaluation Factors
1	National Level	National policy/strategy for sector and regional development	National Environmental Policy (NEP)	(1) The Constitution, (2) National Environment Policy, 2005, (3) National Transport Policy
2	Regional (Provincial/District Level	Regional (Provincial/District) level policy/ strategy for development	(1) SEA-Policy level-1, (2) SEA-sector level	(1) NEP, (2) Regional/Governorate Environmental Management Plan (EMP), (3) Pollution loads (NOx, PM, CO_2), (4) Energy consumption, (5) Consistency with land use and land regulation

No.	Development Plan (Master Plan etc.)		Necessary Environmental and Social Considerations	
	Policy, Strategy, Plan, Project	**Example of Development Plan**	**Examples of SEA/EIA**	**Tentative Evaluation Factors**
3	Specific Sector Level	Transport sector (mode and type) development master plan (mode: road, railway, inland waterway, etc., type: passenger, freight)	(1) SEA-policy level-1, (2) SEA-sector level (Transport sector)	(1) NEP, (2) Regional/ Governorate Environmental Management Plan (EMP), (3) Pollution loads (NOx, PM, CO_2), (4) Energy consumption, (5) Consistency with land use and land regulation
4	Selection of Routes/ Areas	Candidate routes and/or areas (sites) for the project	(1) SEA-project level, (2) SEA-sector level	Alternative analysis based on identification of envisioned impacts on natural (including pollution) and social environment (wider range)
5	Implementation of Specific Development Project	Specific project with determined route or site	(1) EIA-specific project, (2) IEE-environmental scoping	(1) Full EIA study or partial EIA study, (2) EIA Form A or B.

Source: JICA Study Team

4.3.2 SEA in Master Plan Study

(1) Basic Approach

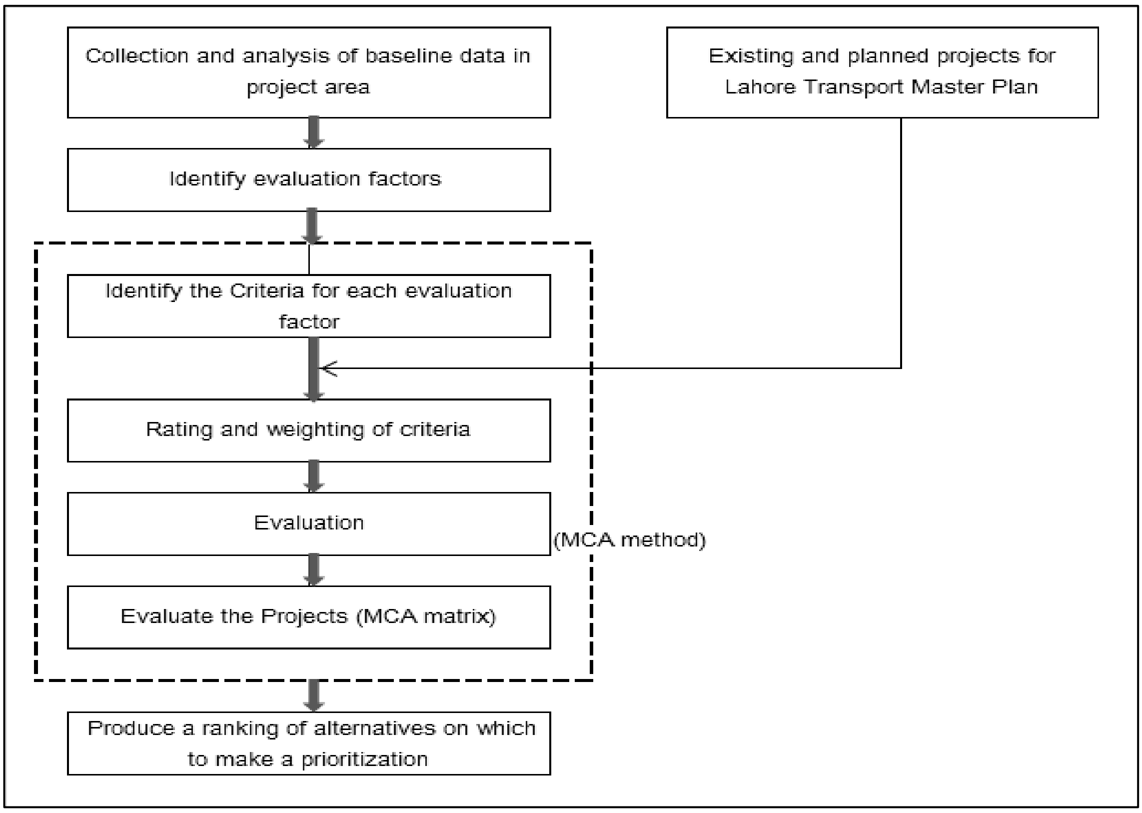
In conducting an environmental evaluation of the Master Plan, a SEA will be applied as a systematic process for comprehensively evaluating, at the earliest appropriate stage in the planning process. Several alternative options for the overall transport development project, thereby ensuring a full integration of the relevant environmental and social considerations as well as economic, engineering and financial aspects of the proposed Master Plan.

In accordance with the SEA concept, environmental considerations are sufficiently incorporated into the Master Plan. While a project-level environmental impact assessment (EIA) will be implemented after specifying the detailed transport development projects such as road and railway construction along designated route alignment in the Master Plan, the SEA introduces early and strategic environmental considerations before the details of plans of route alignments and their specifications are decided. In other words, the SEA method allows the planner to focus on the environmental affects for the optimum formulation of the Master Plan before specific transport development projects are finalized. Thus, in comparison with a project-level EIA, the SEA can take into account a broader range of alternative plans and projects and mitigation measures in the procedures of formulating the Master Plan.

2) Procedure of SEA

The main objective of the SEA method is to conduct a comprehensive impact assessment of the Master Plan by using a SEA methodology. It does not only deal with the negative impacts of the engineering, economic, financial, environmental and social aspects of the Master Plan but also the positive ones. The typical SEA process begins with screening and scoping, and ends up with mitigation measures. Procedure of SEA in a Master Plan is shown in Figure 4.3.1.

Figure 4.3.1 Procedure of SEA in Master Plan



Source: JICA Study Team

(i) Collection of Baseline Data and Information

The collection of the baseline information was carried out to establish benchmarks for natural environmental parameters and their attributes, including the socio-economic conditions in the affected areas. This includes a description of the physical, biological, and socio-economic environments with reference to project location and the proposed activities in the Lahore Urban Transport Master Plan.

(ii) Identification of Evaluation Factors

The details of the tentative primary evaluation items (i.e. engineering items), secondary items (i.e. economic and financial items), and tertiary items (i.e. environmental and social considerations items) are described. Evaluation items will be utilized for both impact assessment and the comparison of alternatives.

(iii) Evaluation of Rating and Impact Assessment

Rating and evaluation of expected impact are designed to identify and assess the potential environmental impacts of proposed alternatives, thereby assisting in the design of appropriate mitigation measures. Impact assessment will be implemented among several alternatives. The results of the impact assessment will be streamlined in the impact assessment matrix.

(iv) Multi-Criteria Analysis (MCA)

The scope of the SEA is not limited to environmental affects alone. The method provides a number of potential links with the socio-economic assessment, recognizing the idea of the SEA's inter-relationships with socio-economic issues or sustainability concerns. The so-called Multi-Criteria Analysis (MCA), which is a useful evaluation method that judges priorities under different development alternatives, is being employed as a key methodology for the overall SEA assessment.[1]

Since a wide range of positive effects and negative impacts are included in the evaluation criteria in the MCA, the methodology allows evaluators to utilize more practical evaluation procedures. The MCA provides a comprehensive evaluation matrix with different weights for each evaluation item, thereby aiding in the selection of alternatives. More concretely, the MCA will be conducted through the following steps:

a) Selection and rating of evaluation items,

b) Fixing evaluation indices and rating evaluation scores,

c) Calculating total weighted evaluation scores,

d) Formulation of an MCA Matrix.

e) Recommendations for mitigation measures; and

f) Information dissemination for mitigation measures,

The above all are elaborated as under:

(a) Selection and Rating of Evaluation Items

The selected evaluation items will be streamlined in the form of a 3 to 5 level evaluation system composed of the following:

[1] In this Study results of MCA for candidate projects of LUTMP are separately described in Volume I Chapter 7.

a) Engineering items related to project conditions,

b) Economic and financial evaluation items related to project benefits and efficiency; and

c) Environmental and social condition items related to project effects and impacts.

(b) Fixing Evaluation Indices and Rating Evaluation Scores

A wide range of indicators explaining the quantitative and qualitative evaluations on the proposed alternatives will be employed. Although it is desirable that evaluation indicators are quantifiable, indicators based on narrative descriptions of the evaluation items are likewise are acceptable whenever difficulties in quantifying indicators arose. In order to obtain clear-cut evaluation results for selecting optimum alternatives, all the evaluation items will be rated through the use of a 3 to 5 grade scoring system.

(c) Calculation of Total Weighted Evaluation Score

To reflect the significance of the evaluations, the weight of each evaluation item is assumed, and the total weighted evaluation score will be calculated taking these weights into account. A five-grade evaluation score will be applied for the evaluation.

(d) Formulation of MCA Matrix

To summarize the results of the evaluation, an MCA matrix, which includes the weights and the scores of each evaluation item, will be prepared. The alternatives will be prioritized in accordance with the total evaluation score in the MCA matrix.

(e) Recommendation for Mitigation Measures

As a preventive tool on a wide range of impacts on the natural environment, mitigation measures will be formulated and incorporated into the SEA process in order to ensure that the environmental deterioration resulting from the Master Plan will be minimized. In accordance with the identified and assessed impacts, a comprehensive mitigation measures will be prepared in a concrete manner.

(f) Information Dissemination and Public Participation

The JICA Guidelines on Environmental Considerations stipulates that in the environmental and social aspects in master planning, a series of stakeholder meetings will be conducted at key stages of the study, i.e. during the preparation of the draft of the scoping items, during the formulation of a rough outline of environmental and social considerations, and during the preparation of the draft final report.

As an integral part of the SEA process, a series of stakeholder meetings will be held involving the representatives of various stakeholders in order to disseminate relevant information on the proposed Master Plan, as well as eliciting responses on possible positive and negative impacts as perceived by the stakeholders. Results will be shared in the SEA process. The main objectives of the public consultation activities for the SEA process are:

- Enhance transparency in decision-making through the provision of information which will allow for the early identification and mitigation of impacts.
- Promote a more comprehensive understanding of the baseline environmental information. Provide stakeholders with relevant information on potential environmental effects at an early stage of the SEA process in order to avoid unnecessary controversies and delays in the decision-making process at latter stages due to public opposition arising from lack of understanding.

Volume-II – Chapter-5

CONDUCT OF CAPACITY DEVELOPMENT FOR TPU

FINAL REPORT

5. CONDUCT OF CAPACITY DEVELOPMENT FOR TPU

5.1 Overall Progress

5.1.1 Program of Capacity Development

TPU had been established in 2010 before the start of the Study. However, no staff was recruited for the first one year, mainly due to financial reasons and difficulty to find qualified persons by the offered conditions. Because of this reason, capacity development program had been suspended during the phase-I of LUTMP (April 2010 – March 2011), even though the capacity development was deemed as an important objectives of the Study.

In April of 2011 when the Phase II of LUMTP started, the Transport Department employed five personnel of TPU, who were all assisting and supportive staff (Assistant Grade) and in July and August additional seven staff including senior researchers were recruited. Soon after the JICA Study Team arrived for the Phase-II of the project, the capacity development program was started for them, through lectures, exercise and On-the Job-Training (OJT).

1) Participants of the Lecture

The first lecture was given on 18th April 2011 at the TPU meeting room. The technical staff of TPU reached eleven by August 2011. At the early stage of the program, Transport Department invited persons who wanted to learn transport planning from transport-related departments and agencies and universities, to the LTUMP lectures. Table 5.1.1 lists the participants who attended the lectures at the capacity development programme.

Table 5.1.1 Participants of the Capacity Development Programme

No.	Name	Position
1	Mr. Tayyab Farid	DS(Planning),Transport Department
2	Mr. Arif Nazir	Quality Manager, TPU
3	Mr. Hamid Khan	Senior Traffic Engineer, TPU
4	Ms. Sadaf Saeed	Urban Planner, TPU
5	Mr. Luqman Haider	GIS and Computing, TPU
6	Ms. Maryam Nawaz	Research Assistant, TPU
7	Mr. Muhammad Waqar Aslam	Research Assistant, TPU
8	Ms. Sara Ambreen	Research Assistant (GIS), TPU
9	Mr. Faisal Hassan	Assistant Demand Modeler, TPU
10	Mr. Muhammad Asif	Data Analyst,TPU
11	Mr. Asif Javed	Research Analyst, TPU
12	Mr. Muhammad Usman Malik	Research Analyst, TPU
13	Mr. Azhar Ali	Research Analyst (GIS), TPU
14	Ms. Sara Khan	Manager Planning, LTC

No.	Name	Position
15	Mr. Mohammad Imran	Deputy Manager Planning, LTC
16	Ms. Azmat Naz	Deputy Director(Tech), EPA
17	Mr. Mohsin Raza	Lecturer Transport Engineering, UET Lahore
18	Ms. Izza Anwar Minhas	Lecturer Transport Engineering, UET Lahore
19	Mr. Wajidullah	Student: City and Regional Planning UET Lahore
20	Mr. Aqeel Younis	Assistant Transport Planner, JICA Study Team
21	Mr. Taimoor Ul Haq	Assistant Transport Planner, JICA Study Team
22	Mr. Nisar Ahmad Sheikh	Assistant Transport Planner, JICA Study Team
23	Mr. Muhammad Usman Akram	Assistant Transport Planner, JICA Study Team
24	Mr. Kazim Khan	Research Associate , The Urban Unit
25	Mr. Abid Ali Chohan	Student (Environmental Sciences), LSE
26	Ms. Isbah Hameed	Student (Environmental Sciences), LSE
27	Ms. Sidrah Inayat Khan	Student (Environmental Sciences), LSE
28	Mr. Jarjaish Hussain	Intern (GIS)

Source: JICA Study Team

As the results of “open door” arrangement, the attendants have widely varied occupations and their experiences and knowledge of transportation planning were also variable. To know the knowledge level, every new attendant to the lecture was requested to fill a questionnaire shown in Figure 5.1.1. This form requests the attendant to describe briefly his/ her working or studying experience in the field of transport planning and to mark on “A”, “B” or “C” according to the level of knowledge of the ten selected technical terms, which are arranged in the ascending order of higher specialty. This is not for examination purpose but to set the level of lecture. Therefore, he/ she is requested to declare the result of self-assessment on each technical term.

Table 5.1.2 shows the result of the declaration individually but anonymously (The order of Table 5.1.1 is randomly shuffled in Table 5.1.2). Out of 22 persons, a few knows 7-8 words well. On the contrary, five persons know almost no words. In average, “A” was marked on 3.7 words, “B” on 2.9 words and “C” on 3.4 words.

On the first hour words which are relatively easy, 56% of participants marked “A” and on the next three words, 38 % marked “A”. On the last three words, relatively difficult words, only 11 % marked “A”, 37 % put “B” and 52 % put “C”.

Considering the original purpose of the LUTMP capacity development programme, technology transfer should focus on training of TPU staff. However, their absorptive capacity seems not at all higher than other attendants’. Therefore, level of the lectures can be duly set focusing upon the average of the attendants.

Table 5.1.2 Survey Results of Knowledge on Transport Planning

No.	Attendant	Knowledge									
		1	2	3	4	5	6	7	8	9	10
1	Mr. A	A	B	B	A	C	A	B	B	C	A
2	Mr. B	A	A	A	A	A	A	A	B	C	A
3	Mr. C	C	C	C	C	C	C	C	B	C	C
4	Ms. D	A	A	A	A	A	C	B	B	C	C
5	Ms. E	A	A	A	A	A	B	A	B	B	A
6	Ms. F	A	A	A	A	A	A	A	-	-	A
7	Mr. G	C	B	B	B	C	C	C	C	C	B
8	Ms. H	A	A	C	B	B	B	B	B	C	C
9	Mr. I	A	A	A	A	B	B	B	B	B	A
10	Ms. J	A	A	A	A	A	B	A	B	B	B
11	Mr. K	A	A	B	A	A	B	B	C	C	C
12	Mr. L	A	A	B	B	A	B	B	B	B	B
13	Mr. M	A	A	A	A	A	B	A	B	B	B
14	Mr. N	B	A	A	A	A	A	B	C	C	B
15	Mr. O	A	A	A	A	A	A	A	B	C	A
16	Mr. P	A	A	-	-	A	A	A	B	B	A
17	Mr. Q	B	A	B	B	C	C	B	C	C	C
18	Ms. R	C	B	C	B	C	C	C	C	C	C
19	Ms. S	C	B	C	B	C	C	C	C	C	C
20	Mr. T	C	C	C	C	B	C	C	C	C	C
21	Mr. U	C	C	C	B	C	C	B	C	C	C

Note: Order is not same as the order of Table 5.1.1. Same staff was not given the test
Source: JICA Study Team

Figure 5.1.1 Questionnaire to the Lecture Attendants

Questionnaire to Attendants to Lesson 1 of LUTMP Course 1 (2011/04/18)

Name: Position:

1. Describe briefly your experiences of working or studying in the transport planning fields.

____

____

____

2. Show your knowledge on the technical terms below by marking X on a box, where

A: Know well.

B: Don't know but have ever heard.

C: Never know and have n

Origin-Destination (OD) Matrix or OD Table [A B C]

(1) Channelization of Carriageway [A B C]

(2) Coordinated Signal Control [A B C]

(3) Light Rail Transit (LRT) [A B C]

----

(4) Cordon Line Survey [A B C]

(5) Internal Rate of Return (IRR) [A B C]

(6) Congestion Tax [A B C]

----

(7) Economic Cost and Shadow Price Rate [A B C]

(8) User Optimum Equilibrium Assignment [A B C]

(9) Exclusive HOV Lane [A B C]

Source: JICA Study Team

2) Lectures and Exercises

Lectures were scheduled twice a week on Tuesday and Friday at 10:00 to 12:00 in the morning in the TPU meeting room. A lecture included an exercise which took 10 to 20 minutes. In the course of the Study, about 50 lectures were planned and these were classified into five courses according to the subjects as outlined in Table 5.1.3. In the original program, these courses were planned to be delivered concurrently with the activities of the Study. In realty, however, the Study has preceded the course programme, and lectures were delivered in more compact schedule than the Study.

Table 5.1.3 Overall Schedule of LUMTP Training Course

Course	Main Subject	Period
1	Transport Surveys and Database Development	Apr – May-11
2	Demand Structure Analysis	May – Jun-11
3	Model Building and Transport Demand Forecast	Jun – Aug-11
4	Transport Network and Project Evaluation	Sep – Oct-11
5	Project Prioritization and Formulation of Implementation Program	Oct – Nov-11

Source: JICA Study Team

Table 5.1.4 gives the schedule of individual lecture, with course number and main contents. By August 5, 2011, actual lectures have been held exactly following the schedule and 24 lessons have been completed.

Both TPU staff and visiting attendants have been very earnest to learn and come to lecturers to ask questions whatever they did not understand well, even after class. Observing their performance of doing exercise, they seemed to understand lecturer's explanation well. Most of them, however, are not good at mathematics.

Unfortunately, core staff of TPU has not been recruited yet and they joined in class later. Consequently, the contents of lectures from 1st to 24th were kept at basic and preparatory level. After the rest of TPU staff joins in, lectures advanced to essential components of planning technologies.

The counterpart team consisting of TPU researchers was assigned a planning project of public transport improvement at Gujarat City in the Punjab Province and all the TPU staff visited the city for one week from 25 to 29 July 2011. During this period, the lectures were suspended; instead, consultative advices were given on the surveys for the public transport improvement project. And one lesson out of the three lost sessions was recovered on 4th August. The other two lessons were carried over to September after EID Holidays. On 5th August 2011, a small test was given.

After one month of break, lectures restarted at the end of June. The first four lessons after restarting had been spent for training of GIS, which is a powerful tool, also useful in transportation planning. Every transport planner should understand what GIS can do for transport planning, even though he/ she could not operate the GIS by him/ her-self. Lectures entered the Course 3 (Transport Demand Forecast) after the GIS.

Table 5.1.4 Schedule of Lectures

No.	Schedule			Lecturers	Course	Subject and Contents
	Month	Date	Day			
1	Apr	18	Mon	Wakui	1	Introduction/ Technical Terms
2	Apr	22	Fri	Wakui/ Horie	1	Home Interview Survey (HIS)
3	Apr	26	Tue	Wakui/ Horie	1& 2	Home Interview Survey (HIS), OD Table
4	Apr	29	Fri	Wakui/ Horie	1& 2	Cordon and Screen Survey
5	May	3	Tue	Wakui	1& 2	Other Transport/ Traffic Surveys, Network Composition and Road Capacity
6	May	6	Fri	Prof. K. K. Mumtaz	Special	Future Urban Structure of Lahore City
7	May	10	Tue	Wakui	1 & 2	Route Search Algorithm (Moore and Dijkstra), Road Network and Transit Network
8	May	13	Fri	Wakui	2	Structure of Master File, Analysis of Transport Demand(1) What we can do using the PT Master File?
9	May	17	Tue	Wakui	2	Structure of Master File, Analysis of Transport Demand(2) Trip Rate, OD table, Trip Chain, Intermodal Point

No.	Schedule			Lecturers	Course	Subject and Contents
	Month	Date	Day			
10	May	27	Fri	Horie	2	Exercise of Present Transport Demand Analysis (1)
11	May	31	Tue	Horie	2	Exercise of Present Transport Demand Analysis (2)
12	June	3	Fri	Horie	2	Exercise of Present Transport Demand Analysis (3)
13	June	7	Tue	Obrien	2 & 3	Network of LUTMP and Structure of LUTMP Network
14	June	28	Tue	Joel CRUZ	2 & 3	GIS(1) Basic Concept of GIS, Database and GIS
15	July	1	Fri	Joel CRUZ	2 & 3	GIS(2) Thematic Map of GIS and Transport Plan
16	July	5	Tue	Joel/ Sara	2 & 3	GIS(3) (Exercise)
17	July	8	Fri	Sara Ambreen	2 & 3	GIS (4) (Exercise)
18	July	11	Mon	Wakui	3	Preparation for model building (Basic knowledge of Statistics)
19	July	15	Fri	Wakui	3	Regression analysis of non-linear equation Model Building (1) Trip Production
20	July	19	Tue	Wakui	3	Model Building (2) Trip Generation and Attraction Model Usage of Adjustment Factor
21	Aug	2	Tue	Wakui	3	Model Building (3) Trip Distribution Model Value of Time
22	Aug	4	Thu	Wakui	3	Model Building (4) Present Pattern Method Iteration Techniques, Opportunity Model
23	Aug	5	Fri	Wakui	3	Model Building (5) Modal Split Model Logit model and its application
24	Sep	6	Tue	Wakui	4	Do Nothing Analysis and Network Evaluation Techniques Overall Evaluation and Corridor Analysis
25	Sep	9	Fri	Wakui	4	Traffic Assignment Method (1) and Incremental and Equilibrium Assignment
26	Sep	13	Tue	Wakui/ Nishikatsu	4	Traffic Assignment Method (2) and Network Improvement
27	Sep	16	Fri	Wakui/ Horie	3&4	Exercise of Network Simulation(1)
28	Sep	30	Fri	Wakui/ Horie	4	Transport Planning and Project Formulation(1) Traffic Management
29	Oct	1	Sat	Wakui/ Horie	4	Transport Planning and Project Formulation(2) Traffic Management
30	Oct	3	Mon	Mazhar Iqbal	4	LRMTS Network Development and Implementation
31	Oct	4	Tue	Takagi	4	Transport Planning and Project Formulation(4) Traffic Management
32	Oct	6	Thu	Horie	4	Transport Planning and Project Formulation Public Transport Development
33	Oct	7	Fri	Horie	4	Transport Planning and Project Formulation Public Transport Development
34	Nov	4	Fri	Wakui	5	Project Evaluation and Prioritization (2); Estimation of Economic Benefit
35	Nov	21	Mon	Wakui	5	Project Evaluation and Prioritization (3) Multi-Criteria Analysis
36	Nov	22	Tue	Wakui	5	Formulation of Implementation Plan (IP)
37	Nov	23	Wed	Wakui	5	Financing Plan and Private Sector Participation (1) Schemes of Private Sector Participation
38	Nov	24	Thu	Wakui	5	Financing Plan and Private Sector Participation (2) Success and Failure of PSP/ PPP Projects
39	Nov	25	Fri	Wakui	Overall	Summary Lecture/ Examination.
40	Nov	28	Tue	Wakui	Overall	Tea Party/ Free Discussion/ Award of Certifcate

Source: JICA Study Team

3) On the Job Training

Planning technologies were transferred to trainees through rotation of lecture, exercise and on-the-job training (OJT). Among three, OJT was the most important one and then maximum time should have been allocated to OJT. This means, the staff of TPU had to work together with the JICA Study Team as counterparts, in order to elaborate and be involved in the Lahore Urban Transport Master Plan.

However, then capacity of TPU was not adequate enough to function to compose a task force with the Study Team and then, a full-scale OJT could not be accomplished, except supportive wok in the field of GIS and land use study. In addition, some analysis of cordon survey data surrounding the old wall city, designated as a world heritage sites, was analysed by the TPU Staff.

5.2 Contents of Lectures

In the period of 26th April to 28th November, 2011, forty (40) lessons were conducted in total. The main topics of each lesson are outlined below. Slides and the handouts used in lectures and exercises are provided in other reports of this study.

5.2.1 Lesson 1 (18 April 2011) by Tetsuo Wakui

The first lecture was given by Tetsuo Wakui, member of JICA Study Team in charge of capacity development. As this is the first time, everybody was requested to make a self-introduction and fill a questionnaire shown in Figure 5.1.1.

The followings were explained in the first lecture:

- Basic policy of LUTMP training programme;
- Procedure for Developing Transport Master Plan;
- Training Schedule;
- Explanation of Selected Technical Terms;
- Calculation of Trip Production Rates;
- How to make traffic Zones (Division of an area, Zone boundary); and
- Exercise: Calculate various trip rates under given conditions.

5.2.2 Lesson 2 (22 April 2011) by Tetsuo Wakui/ Tetsuo Horie

Before stating new topics, about ten minutes are spent for reviewing the previous lesson. Main topics of the second lecture are as follows:

- Four step approach for transport demand analysis;
- Points for Zoning and Examples of Zone System;
- Sample Rate and Confidence Limit;

- Contents of HIS of Person Trips;
- Exercise: Calculate Necessary Sampling Rate under given conditions; and
- Home Work: To Fill the HIS Questionnaire Form.

Figure 5.2.1 View of LUTMP Lecture (26th April)

Source: JICA Study Team

5.2.3 Lesson 3 (26 April 2011) by Tetsuo Wakui/ Tetsuo Horie

Before starting new topics, discussion was held on the homework and review of the previous lesson was made. Main topics of the third lecture are as follows:

- Implementation method of HIS;
- Procedure of Compilation of Trip Master File;
- Structure of O/D Table;
- How to integrate zones in O/D Table;
- Method of Cordon Survey;
- Method of Screenline Survey;
- How to use the result of Cordon Survey; and
- How to use the result of Screenline Survey.

5.2.4 Lesson 4 (29 April 2011) by Tetsuo Wakui/ Tetsuo Horie

Before stating new topics, about twenty minutes are spent for reviewing the previous lesson. Main topics of the fourth lecture are as follows:

- Auxiliary Surveys to HIS of Person Trip Surveys;
- Structure of HIS Database;
- Node and Link Expression of Transport Network;
- General Outline of JICA STRADA;
- Structure of JICA STRADA;
- Main Modules of JICA STRADA;
- Exercise: To draw cordon surrounding Lahore City and make a location plan of survey stations; and

- Exercise: Installation of JICA STRADA.

5.2.5 Lesson 5 (3 May 2011) by Tetsuo Wakui

Before stating new topics, about twenty minutes are spent for reviewing the previous lesson. Main topics of the fifth lecture are as follows:

- Auxiliary Surveys to HIS of Person Trip Surveys;
- Travel Speed Survey;
- Parking Survey;
- Traffic Count Survey;
- Bus Occupancy Survey;
- Road Inventory Survey;
- Basic Knowledge of Transport Network in Computer modeling;
- Travel Speed and Road Capacity; and
- Passenger Car Equivalent Units.

5.2.6 Lesson 6 (6 May 2011) by Prof Kamil Khan Mumtaz

The JICA Study Team invited Professor Kamil Khan Mumtaz of Lahore School of Economics (LSE) and requested him to give a lecture to the attendants of the LUTMP training course. He gave willing consent and gave a lecture under the title of “Retrospect and Prospect of Lahore Urban Transport Master Plan”. Figure 5.2.2 is a handout describing the topics of his lecture prepared by him.

Figure 5.2.2 Topics of Special Lecture by Prof. Kamil Khan Mumtaz

May 5, 2011

Lecture by Prof. Kamil Khan Mumtaz, Lahore School of Economics

1. Man and Environment
   (1) Science, economy, settlement patterns
   (2) "Development" and sustainability
2. Traditional Urban Planning
   (1) Ideal City
      - Mohenjo-Daro, Harappa
      - Axial
      - Bhambore, Mansura, Baghdad
      - Gujrat, Fatehpur Sikri, Satghara
3. Master Plan 1966
   - Twentieth Century Planning
      a. "Road map" and zoning plan
         - Mechanized circulation
         - Segregation
         - High tech
         - Low density
         - High rise
4. LUDS 1980
   (1) Donor driven agendas
      - Development Aid
      - Sites and Services
      - Basic Needs;
      - Poverty Alleviation: sustainable development of the Walled City Project
      - Sustainable Development
   (2) Structural Plan
      - Objectives, policies, strategies
      - Action plan
5. Vision 2020, 2000
   - Incremental development
6. Post Modern
   (1) Project replaces strategic planning
      - Opportunism, instant gratification
      - World Class Cities
      - New Murree, Gwadar, Karachi Waterfront Development Project
      - Canal Road Widening
      - Kalma Chowk
7. Need of the Hour
   - Sustainable economy
      - Global Crisis
      - Conservation of our humanity and our Environment

Source: Prof. Kamil Khan Mumtaz

5.2.7 Lesson 7 (10 May 2011) by Tetsuo Wakui

Main Topics of this lecture are as follows:

- PCU Factors and Vehicle Occupancy;
- Algorithm of Minimum Path Search
- What are the difficulties of traffic assignment procedures
- Method and procedure of traffic assignment
- Exercise: Minimum Route Search manually

5.2.8 Lesson 8 (13 May 2011) by Tetsuo Wakui

Main Topics of the lecture are as follows:

- Traffic Assignment and Transit Assignment
- Daily Fluctuation of Traffic and Peak-hour Ratio/ Factors;
- Information Retrieval from LUTMP Master File; and
- Exercise: To Design a multi-dimension table based on LUTMP Master File.

5.2.9 Lesson 9 (17 May 2011) by Tetsuo Wakui

Main Topics of the lecture are as follows:

- Format of three options of LUTMP Master File;
- Quick review of demand analysis in the LUTMP Interim Report-I; and
- Explanation of LUTMP Training Programme from now on.

5.2.10 Lesson 10 (27 May 2011) by Tetsuo Horie

This lesson was given by Tetsuo Horie, member of JICA Study Team. He explained the structure of the LUTMP database and gave an exercise to make a two-dimensioned table, using a part of the database.

5.2.11 Lesson 11 (31 May 2011) by Tetsuo Horie

This lesson is a continuation of the last lesson. Explanation was given on how to expand the sample data and how to tabulate a two-dimensional matrix, using MS-Excel commands of “COUNTIFS” and “SUMIF”. An exercise was given to four groups comprised of attendants.

5.2.12 Lesson 12 (3 June 2011) by Tetsuo Horie

This is also a continuation of the last lesson. That is an explanation and exercise on data processing using the LUTMP database. As an example of three dimensional tabulation, an O/D tables by trip purpose was made using “COUNTIF”. After developing the O/D tables, an exercise was done to draw a desire line chart using the O/D tables.

In addition, a second small exercise was given to attendants, concerning data processing and tabulation. In this case, the test was announced in advance.

5.2.13 Lesson 13 (7 June 2011) by David O’Brien

These two lessons given by David O’Brien, member of JICA Study Team were concerning Lahore transport network developed and used by LUTMP. Lectures were given on how to develop and how to use the network.

- The Basic Components of a Travel Demand Model Network
  a. What are networks made of?
     i. Nodes, Centroids, Links Centroid Connectors
  b. Building a Network
     i. Data Preparation
     ii. Example
- How a Network is Used
  a. Path Building Examples for Time and Distance
  b. Generalized Costs Theory and Examples
  c. Vehicle Operating Costs (Not something I planned, but we talked about it in response to questions.)
- Building the Lahore UTMP Network
  a. Where the information comes from
  b. Putting it all together

c. Iterative checking process.

5.2.14 Lesson 14 to 17 (28 June to 8 July of 2011) by Joel Cruz and Sara Ambreen

Four lessons from 15 to 18 were introductory lectures and exercises in GIS, which are frequently used for analysis and presentation in transport planning. Lectures were given by Joel Cruz with active assistance of TPU Staff: Ms. Sara Ambreen. Lectures focused on the function and structure of GIS software and how to prepare thematic maps.

5.2.15 Lesson 18 (11 July 2011) by Tetsuo Wakui

Following a quick review of the course one and two given for new participants, basic knowledge and skills of statistics were explained as an introduction to modeling.

- Regression analysis
- Least square error method
- Correlation coefficient
- Estimation of correlation coefficient parameters using excel

5.2.16 Lesson 19 (15 July 2011) by Tetsuo Wakui

After reviewing the regression analysis techniques, trip production as a control total was explained.

- Linear equation and non-linear equation
- Logistic equation
- Transformation to linear equation
- Multiple regression and multi collinearity
- Exercise of regression analysis
- Trip production rate
- Relationship of trip rate to car ownership and household income

5.2.17 Lesson 20 (19 July 2011) by Tetsuo Wakui

Lecture and exercise on regression analysis of logistic equation were given and trip generation and attraction models were explained. As analytical techniques, usage of dummy variables and adjustment factors were also explained.

- How to use dummy variables
- Exercise of fitting of logistic curve
- Application of linear models to trip generation attraction
- Explanatory variables of trip generation and attraction models
- Tentative LUTMP trip generation and attraction models
- How to use adjustment factors

5.2.18 Lesson 21 (2 August 2011) by Tetsuo Wakui

After reviewing the last lesson, value of time and Trip Distribution models were explained. An exercise was conducted on calculation of depreciation both by linear and compound method.

- Value of time in monetary terms
- Value of time of vehicle
- Value of time of trip makers
- Trip Distribution
- Gravity model and its variations
- Problems of Gravity Model

5.2.19 Lesson 22 (4 August 2011) by Tetsuo Wakui

Additional explanation of gravity model was described. And then, internal trip models, iteration techniques, present pattern method and intervening opportunity models were explained. An exercise was done on parameter estimation of a gravity model.

- Internal trip Model
- Adjustment to G & A (Iterative techniques)
- Present Pattern Method
- Intervening Opportunity Model
- Exercise of developing a gravity model

5.2.20 Lesson 23 (5 August 2011) by Tetsuo Wakui

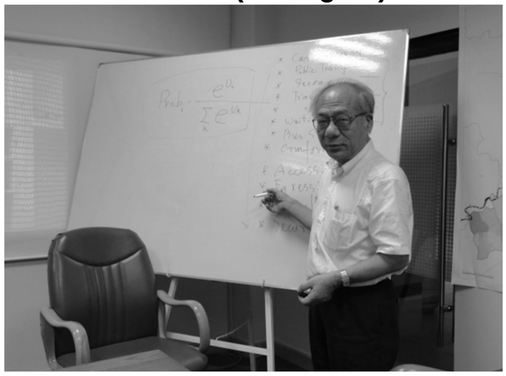
Logit model and its application example were explained as a modal split model.

- Variation of modal split models
- Logit model
- Estimation of Logit model
- Application of Logit model

5.2.21 Lesson 24 (6 September 2011) by Tetsuo Wakui

At the end of Program 2 of “Transport Demand Forecast”, the case of LUTMP was explained, including socio-economic framework, trip generation and attraction, trip distribution, modal split and assigned future demand on the present transport net. In the latter half of the lesson, two exercises were done: one is to draw a desire line chart and the other is to draw a schematic map showing traffic generation and attraction for a model city.

Figure5.2.3 View of LUTMP Lecture and Second Test (5th August)



Source: JICA Study Team

5.2.22 Lesson 25 (9 September 2011) by Frits Olyslager

Frits Olyslager, a JICA Study Team member in charge of bus transportation planning gave a lecture on general bus planning, by presenting advanced bus services in the world, inclusive of the Bus rapid Transit (BRT) system. He also proposed the proceeds pooling system for Lahore.

5.2.23 Lesson 26 (13 September 2011) by Tetsuo Wakui and Yoshiaki Nishikatsu

The JICA-Mission headed by Mr. Kawahara visited and attended this lesson. In the first half of the lesson, an overall review of the past 25 lessons, by checking the participants' understandings on the selected important points. In the latter half, Yoshiaki Nishikatsu, a JICA Study Team member in charge of road planning gave a lecture on road planning in general. Also, he explained the planning issues and directions of road planning for Lahore.

5.2.24 Lesson 27 (16 September 2011) by Tetsuo Wakui and Tetsuo Horie

The method of transport network development was lectured including network simulation cases of "Do nothing" case, "Do something" case and "Do maximum" case, which were usually undertaken in a transport master plan study. Network simulation exercises were scheduled in the latter half of the lesson. However, most of the exercised were carried over to the next lessons due to the time limitation.

5.2.25 Lesson 28 (30 September 2011) by Tetsuo Wakui and Tetsuo Horie

The TPU staff came back from Gujranwala and they were to start a financial analysis on the bus business of the Study City. Therefore, how to make a financial analysis was lectured by changing schedule. It was originally scheduled in November. The lecture covered the followings:

- Definition of Financial Analysis and Economic Analysis
- Evaluation Indicators

- Nominal (Current Price) and Real (Fixed Price) Terms
- Cash Flow of a Project
- Discount Rate
- Calculation of Net Present Value and B/C Ratio
- Estimation of IRR
- Single Year Evaluation

5.2.26 Lesson 29 (1 October 2011) by Tetsuo Wakui and Tetsuo Horie

Traffic assignment method was re-lectured by explanation of the Wardrop's principles and Input/ Output for the JICA STRADA assignment modules. During intermission, Horie explained how to clean PC computers from virus, characteristics of anti-virus software. In the last half of the lesson, exercise of traffic assignment was conducted through a network simulation of "Do-Nothing case", and network improvement by road widening and new road construction. This exercise is a continuation of the exercise of 27th lesson on 13 September.

5.2.27 Lesson 30 (3 October 2011) by Mazhar Iqbal

Mazhar Iqbal, the deputy leader of LUTMP in charge of public transport planning gave a lecture on the Study of Lahore Mass Transit System (LMTS), conducted in 2005-08, covering the LMTS network configuration consisted of four lines, demand forecast, cost estimates, evaluation results, and project status and implementation.

5.2.28 Lesson 31 (4 October 2011) by MichimasaTakagi

Mr. M. Takagi, a Study Team member in charge of traffic management planning gave a lecture on traffic signalization plan in general. At the end of the lecture, an exercise was given to determine the split time under the given conditions of phases and in-flow traffic volumes of each leg and signal phases.

5.2.29 Lesson 32 and 33 (6 and 7October 2011) by Tetsuo Horie

An exercise of network simulation was given as a continuation of the previous exercise, which included tasks of:

(1) To develop a simulation network, by using GIS Converter

(2) To conduct a transit assignment, by using a model city prepared in the JICA STRADA.

5.2.30 Lesson 34 (4 November 2011) by Tetsuo Wakui

A lecture was given on the transport demand management (TDM), covering its historical background, classification and examples of TDM implementation in the world. A homework was given to collect through internet at least one interest TDM example undertaken in some city in the world. The homework shall be reported on 15th of November.

5.2.31 Lesson 35 (21 November 2011) by Tetsuo Wakui

Before entering to the main topic of this lesson, presentations of homework (examples of TDM measures implemented in the world) was made by two participants. This is the first lesson of the economic evaluation. After explanation on economic cost, an exercise was given to convert financial cost to economic cost.

5.2.32 Lesson 36 (22 November 2011) by Tetsuo Wakui

As the second lesson of economic evaluation of a transportation project, the lecture focused on how to define and estimate economic benefit of a project. Another way of demand forecast of a project was explained by using diverted, converted, induced and developed demand, and relationship of those demand and four step approach. Consumer’s surplus, VOC and TTC were also explained.

5.2.33 Lesson 37 (23 November 2011) by Tetsuo Wakui

After making an explanation on the exercise in the previous lesson, continuation of the economic analysis was lectured focusing economic benefit estimation. After finishing the explanation on economic analysis, lecture was given on the structure of the basic three accounting books and how to calculate IRR using these books. Finally, IRRs from other viewpoints than a project were explained, that is, the Equity IRR and Financier’s IRR.

5.2.34 Lesson 38 (24 November 2011) by Tetsuo Wakui

In this lesson, the Multi-Criteria Analysis (MCA) and Public and Private Partnership (PPP) were lectured, explaining the following topics:

MCA

- Procedure of MCA
- Scoring to criteria
- Variations of MCA
- Criteria used in LUTMP
- Exercise of MCA

PPP

- Modality of PPP
- Transport Sector PPP in the World
- PFI Projects in the World

- Role Division for the Public and the Private
- Case Study In Manila of the Philippines
- Main Issues of PPP Scheme
- Fare Setting
- Risk Allocations

5.2.35 Lesson 39 (25 November 2011) by Tetsuo Wakui

As this is the second last lesson, an overall review was given from the course 1 to 5, by asking a question to all the attendants one by one, concerning important technical terms, demand forecast steps and models, zoning and network formulation techniques, road capacities, project evaluation method, and important conditions for success of PPP project.

5.2.36 Lesson 40 (28 November 2011) by Tetsuo Wakui

As this was the final lesson, a test covering the course 1 to 5 was given as shown in Figure 5.3.1. The resultant records were quite satisfactory and the capacity development was regarded successfully achieved.

5.3 Understanding of Lectures

5.3.1 Test at the End of Course 2

At the end of Course 2 of the programme, a small surprise test was given to the attendants, in order to know to what extent they understood the contents of the lectures. There are five questions in the test paper as shown in Figure 5.3.1. These aim at testing the following knowledge.

- **Q1:** Four Steps of Transport Demand Analysis Procedure
- **Q2:** Definition and volume of Road Capacity
- **Q3:** Important matter of Zoning
- **Q4:** Structure of OD Table
- **Q5:** Purpose of Screen Line Survey and Cordon Line Survey

The test was conducted after the lecture on 17th May 2011, by giving time of 20 minutes. Thirteen attendants took the test. The result is shown in Table 5.3.1. The average point is 74.3, which is passable but rather lower than expected. One reason may be that some attendants entered class only recently and did not participate in the early lessons. Actually, two persons attended only two or three lessons.

If observing the average points (in percentage to the full point) by question, Q1, Q2 (1), Q2 (2) and Q5 are comparatively well understood, at the average point of 85 %, 85 %, 77 % and 79 %, respectively. On the contrary, Q2 (3), Q3 and Q4 are poorly understood at 54 %, 62 % and 69 %.

The small test revealed that even very basic knowledge are not necessarily well understood and then repetitive explanation should be given in easier way to understand. In addition, some orientation will be needed to midway attendants by making quick review of lessons prior to their participation.

Figure 5.3.1 Test after Course 1 and 2

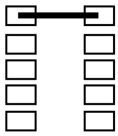
The First Small Test at the end of Course 1 and 2 (17 May 2011)

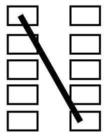
Name:_______________________________

Position:____

1. Four Step Method for Transport Demand Forecast

Show the Four Step Method in order by connecting adjacent squares of correct terms with lines, in the same way as an Exampl example.





Step 0: Production — From where to where? — Trip

Step 1: Traffic Assignment — By which transport mode?

Step 2: Modal Split — Via which route?

Step 3: Trip Distribution — How many trips zone-wise?

Step 4: Trip Generation/ Attraction — How many trips in total?

2. Road Capacity

(1) Based on the definition of three highway capacities of a link, arrange them in descending order (largest at first and smallest at last) by filling the boxes with A, B or C.

A: Practical Capacity
B: Basic Capacity
C: Possible Capacity

☐ > ☐ > ☐

(2) What is an average possible capacity of a lane in a multi-lane road in an urban area?.
_____________________ PCU/Lane/Hour

(3) Convert an hourly road capacity into a daily capacity.
6,000 PCU/Hour = _______________ PCU/Day

Assume the followings:

A) One day = 24 hours.
B) Daytime and Nighttime traffic ratio= 80: 20
C) Peak-hour ratio = 10%
D) Heavier direction traffic ratio = 1.55

3. Zoning

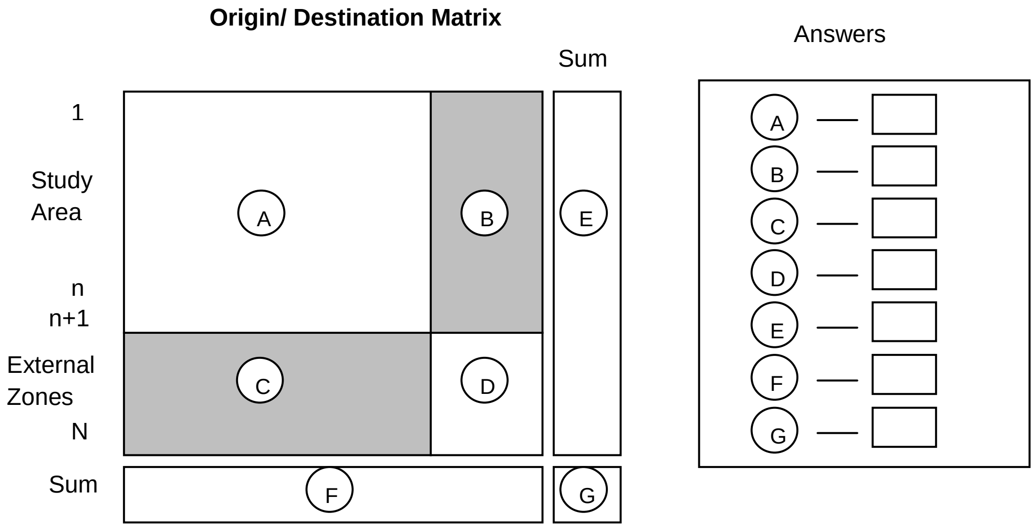
Explain the most important consideration for zoning. (Mention only one.)

____
____

4. OD Table

What are the following A – G of an OD Matrix called in technical terms for transport planning?

Select the correct ones among choices of a-m and fill the boxes with a-m.



Choices

(a) Out-going External Trips	(h) Unlinked Trips
(b) Linked Trips	(i) Through-Trips (External-External Trips)
(c) Inter-modal Trips	(j) Attracted Trips
(d) Non-home based Trips	(k) Home-based Trips
(e) Internal Trips	(l) In-coming External Trips
(f) Triangle Trips	(m) Generated Trips
(g) Produced Trips	

5. Cordon and Screenline Surveys

State briefly on main purposes of Cordon and Screenline Surveys as auxiliary surveys to support HIS Person Trip Survey.

Cordon Line Survey: ______________________________

____

Screen-Line Survey: ______________________________

____

Source: JICA Study Team

Table 5.3.1 Results of Test at the End of Course 1 and 2

Question	1	2(1)	2(2)	2(3)	3	4	5	Total
Full Point	**24**	**6**	**5**	**5**	**10**	**35**	**15**	**100**
Examinee								
A	18	6	5	5	10	35	15	94
B	12	6	5	5	5	10	8	51
C	18	6	5	5	8	35	12	89
D	24	6	5	5	7	35	15	97
E	24	6	0	0	10	10	15	65
F	24	2	5	0	10	35	10	86
G	24	6	5	0	5	15	15	70
H	24	6	5	5	5	35	15	95
I	12	6	5	0	10	30	15	78
J	24	2	5	5	3	15	15	69
K	24	6	5	5	5	35	5	85
L	24	2	0	0	3	10	15	54
M	12	6	0	0	0	15	0	33
Average	**20.3**	**5.1**	**3.8**	**2.7**	**6.2**	**24.2**	**11.9**	**74.3**

Source: JICA Study Team

5.3.2 Test at the End of Course 3

A small test was given to the participants in order to check there understandings. The test included four questions concerning four step approach of demand forecast, calculation of depreciation, linearity of generation and attraction model, characteristics of logistic equation and present pattern, as shown in Figure 5.3.2.

Figure 5.3.2 Test at the End of Course 3

The Second Small Test at the end of Course 3

5August, 2011

Name:________________________________
Position:____

1. Four Step Method for Transport Demand Forecast

State the four steps for transport demand forecast Method in order with very brief explanation of job contents or output of each step.

(Name of Step) (Job Contents or Output of the Step)

Step 0 (example): Trip Production: Total trips generated in the study area

Step 1: ____

Step 2: ____

Step 3: ____

Step 4: ____

2. Depreciation

1) How much is the annual depreciation amount under the following conditions?

- Initial value: PKR150,000
- Scrap Value: 10.0%
- Durable Period (Life): 15 years
- Depreciation Method: Straight Line Depreciation
  Annual Depreciation Amount PKR ___________________________

2) What is the annual depreciation rate under the following conditions?

- Initial value: PKR 10,000
- Scrap Value: 5.0% of the initial value
- Durable Period (Life): 8 years
- Depreciation Method: Compound Depreciation
  Annual Depreciation Rate ____________%

E) **Trip Generation and Attraction Model:** State the reason why a linear model is usually used for the trip generation and attraction model.

____

____

____

3. Logistic Model

Select correct statements about the logistic equation below, using ✓.

$$y = \frac{N}{1 + e^{-ax}}$$

- ☐ The logistic curve is symmetric to the central point (0, N/2).
- ☐ y can take any value even larger than N, if x is enough large.
- ☐ y cannot exceed N. Then, N is called "capacity".
- ☐ Growth rate of y becomes the maximum when x is zero.
- ☐ The logistic equation cannot be transformed to linear equation.
- ☐ Population of a specific area can be shown using the logistic curve.
- ☐ The differential of dy/ dx is proportional to y(N-y).
- ☐ If x is negative, y is also negative.

4. Present Pattern Method

(1) For what purpose is the Present Pattern Method used? Select the correct one with ✓.

- ☐ To estimate the parameters of trip generation and attraction models.
- ☐ To estimate future OD trips using present OD table and future generated and attracted trips
- ☐ To estimate total trip production
- ☐ To make a regression analysis in order to build a logistic model

(2) State one advantage and two disadvantages to use the present pattern method.

Advantage:____

____

Disadvantages:

(1)____

____

(2)____

____

Source: JICA Study Team

The result of the test is shown in Table 5.3.2. All the participants of perfect attendance were marked high scores. Most attendants were judged to understand the lessons well.

Table 5.3.2 Results of Test at the End of Course 3

No.	Question # ⇒	1	2	3	4	5-1	5-2	5-3	Total
	Examinee / Full Point	20.0	20.0	20.0	20.0	5.0	5.0	10.0	100.0
1	A	20.0	20.0	20.0	17.5	5.0	5.0	10.0	97.5
2	B	20.0	20.0	20.0	15.0	5.0	5.0	10.0	95.0
3	C	20.0	20.0	20.0	15.0	5.0	5.0	10.0	95.0
4	D	20.0	20.0	20.0	15.0	5.0	5.0	10.0	95.0
5	E	20.0	20.0	20.0	12.5	5.0	5.0	10.0	92.5
6	F	20.0	20.0	20.0	10.0	5.0	3.0	10.0	88.0
7	G	20.0	20.0	20.0	15.0	5.0	3.0	5.0	88.0
8	H	20.0	20.0	10.0	17.5	5.0	5.0	10.0	87.5
9	I	20.0	20.0	0.0	17.5	5.0	3.0	5.0	70.5
10	J	20.0	10.0	5.0	15.0	5.0	3.0	10.0	68.0

Source: JICA Study Team

5.3.3 Final Test

On the final day of lectures, a small test was given to the participants. The five questions shown in Figure 5.3.3 given in the followeing two pages covered not only the course 5 of project evaluation, but overall coureses 1 to 5 and focused on the most imortant issues which were repeatedly explained and reminded. Moreover, in the second last lesson, overall review was given, touching most part of the test questions. Consequently, the results were much improved comparing the previous two tests, are given in Table 5.3.3. Although there are reasons of the good results, the essenses of transport planning technology were seemingly well understood by most of participants.

Table 5.3.3 Results of the Final Test

No.	Question # ⇒	1	2	3	4	5	Total
	Full Point ⇒	20.0	30.0	15.0	15.0	20.0	100.0
1	A	20.0	30.0	15.0	15.0	20.0	100.0
2	F	20.0	30.0	15.0	15.0	18.0	98.0
3	B	20.0	27.0	15.0	15.0	20.0	97.0
4	G	20.0	27.0	15.0	15.0	20.0	97.0
5	H	20.0	30.0	12.0	15.0	20.0	97.0
6	I	20.0	27.0	15.0	15.0	20.0	97.0
7	J	20.0	27.0	15.0	15.0	20.0	97.0
8	K	20.0	27.0	15.0	15.0	20.0	97.0
9	M	20.0	27.0	15.0	15.0	20.0	97.0
10	C	18.0	30.0	15.0	13.0	20.0	96.0
11	L	20.0	26.0	15.0	15.0	20.0	96.0
12	E	14.0	27.0	15.0	15.0	20.0	91.0
13	D	9.0	21.0	15.0	13.0	16.0	74.0

Source: JICA Study Team

Figure 5.3.3 The Final Test

The Final Test at the end of Capacity Building Program

28 November, 2011

Name:______________________________

Position:____

1. **Put the most suitable technical terms in each box.**
   (1) What comparison is made to estimate economic benefits of a project?
   [ ] **and** [ ] **comparison**
   (2) What is the most popular model for the trip distribution step? [ ] **model**
   (3) What is the most popular model for the modal split step? [ ] **model**
   (4) For conversion of financial cost to economic cost, physical contingency is not excluded and then, what contingency is excluded? [ ] **contingency**
   (5) A network for transport demand assignment is composed of:
   [ ] **and** [ ]
   (6) A conversion rate "SER" represents: [ ]
   (7) A conversion rate "SWR" represents: [ ]
   (8) An important attitude to identify and select economic benefits of a project is to exclude a doubtful one, that is, [ ] **-ism**.
   (9) There are two representative road network patterns: one is "radial and circular" pattern and the other is [ ] **pattern**.
   (10) All types of vehicles are converted into the unit of [ ] when loading on a network.

2. **State briefly the answer of each question.**
   (1) What is the most important condition to success in a PPP project?
   ____
   (2) What are the differences between the financial evaluation and the economic evaluation?
   ____
   ____
   (3) State about "discount rate" (=rate of capital opportunity cost).
   ____
   ____
   (4) What are the three basic accounting books? List-up only the names.
   a)____________________b)________________c)____________________
   (5) State the definition of "internal rate of return" (IRR).
   ____
   ____

3. TDM

Assuming that Lahore had a fine rail transit network for urban transport but people preferred using cars and most roads were congested while the rail transit lines had not enough demand. Under such a situation, recommend three TDM measures in order to shift the demand from private car use to rail transit use.

(1) ____

____

(2) ____

____

(3) ____

____

4. Calculation

(1) Depreciation

Calculate the annual depreciation rate of ten years compound depreciation at the scrap value (salvage value) of 20%. R= _______%

(2) Net Present Value

Calculate the net present value (NPV) in the right Table, assuming the discount rate at 12%.

Year	Cost	Benefit	Discounted at 12%	
			Cost	Benefit
2012	150	-		
2013	10	180		
2014	10	200		

(3) Installment

Calculate the one-time payment amount of fixed amount installment of Rp 250,000 at 10 times installment and interest rate of 12% per annum. **Rp____________ / time**

Formula: $X = i\,(1.0 + i)^n / ((1.0 + i)^n - 1.0)\,A$

5. Select Correct Statement (Put ? in a box)

☐ (1) Logistic curve is transformable into a log-linear equation.

☐ (2) The double-entry bookkeeping is the mainstream in accounting even now.

☐ (3) Trip generation model cannot be a linear equation.

☐ (4) In most case, economic cost of a project is less than financial cost of the same project.

☐ (5) Induced and developed trips are additionally estimated in the 4 step approach.

☐ (6) P/L statement states the assets of an entity at the end of its fiscal year.

☐ (7) The PCU of an animal driven cart is smaller than 1.0

☐ (8) In “do-nothing” analysis, present network is assumed also for the future.

☐ (9) “Linked” trip is counted by mode.

☐ (10) An OD matrix represents distributed trips.

Extra Question

Describe the most impressive matter explained in the course of Lessons which may be kept in your mind for a long time. If there is none, describe “none”.

____

____

Source: JICA Study Team

Volume-II – Chapter-6

LUTMP DATABASE

FINAL REPORT

6. LUTMP DATABASE

LUTMP database has been broadly categorized in to two types; Transport Database, and GIS Database. Transport database includes transport/ traffic surveys. GIS is mainly the processed data related road network, administrative, social, land use, infrastructure, transportation facilities in GIS Arc-View Map environment.

6.1 Transport Database

6.1.1 Introduction

Eleven different types of transport/ traffic surveys have been conducted. These were designed according to data requirement for urban transport planning, and scope of the Study. All types of surveys are described briefly in chapter “Conduct of Transport/ Traffic Surveys” (Volume-II Chapter 1). In addition to these surveys, relevant data was collected from government agencies/ departments related to socio-economic, public transport, administrative, and existing road network and facilities.

Nine surveys have been conducted in LUTMP Phase-I, and two supplementary surveys in Phase-II of the Study. All survey data had been used at different stages of the Study.

Development of comprehensive transport/ traffic surveys database for master planning is essential for its future use in transport planning, strategy development project evaluations, and follow-up feasibility studies by other departments and agencies. LUTMP database has been developed based on the following guidelines:

- It should have clear and simple file structure for user’s ease and understanding;
- It should be transferable from one computer storage media to another through CD-ROM, or external hard drives;
- It should have readable file format which can be ease and understanding accessed/ processed through database, GIS, traffic engineering and transport modeling and planning tools;

6.1.2 Data Classification

Transport/ traffic surveys database is classified according to their use and objective in the Study. Database consists of results of field surveys and other data from like population and administrative boundaries from other sources. Transport database is classified in to six categories as listed below in Table 6.1.1.

Table 6.1.1 Transport Database Classification

Data Category	Source
1 Socio-Economic Data	
a) Population by Age b) Employment by Workplace c) Workers by Residence d) School Attendance e) Income Level f) Vehicle Ownership	Household Interview Survey
2 Transport Demand	
a) Internal O/D Trip Matrices b) External O/D Trip Matrices	Household Interview Survey Cordon Interview Survey
3 Transport Model Calibration	
a) Screenlines Counts and Occupancy b) Traffic Counts	Canal and Rail Screenlines Survey Traffic Count Survey
4 Road Network	
a) Road Network Inventory b) Junctions Characteristics	Road Network Inventory Survey and Junctions Survey
5 Public Transport	
a) Public Transport User Interview b) Bus Occupancy c) Willingness to Pay for Improvements	Public Transport User Interviews Bus Occupancy Survey Willingness to Pay Survey
6 Traffic Management	
a) Parking b) Travel Speed c) Road Junctions Designs and Traffic Signal Operation	Parking Survey Travel Speed Survey Road Junctions and Traffic Signal Survey
OTHER DEPARTMENTS/ AGENCIES	
Population by Union Council Level	Punjab Bureau of Statistics (PDS)
Public Transport Existing HOV and LOV Routes	Lahore Transport Company
Railway Passengers by Station	Pakistan Railway

Source: JICA Study Team

6.1.3 Data Types

The data can be categorized in to three types based on its processing status; primary, secondary and tertiary.

1) Primary Database

It is unprocessed but cleaned data obtained from direct field surveys in standard format without any analysis or computations prepared in LUTMP Phase-I.

This data is held as the base data, and will be useful for the user; if they need raw data for their own specific purpose.

2) Secondary and Territory Database

It is processed data; or analysis of the base data by different transport and traffic field experts according to their own specific requirement to understand the existing situation. Many summary tables, graphs, origin-destination (O/D) trip tables by purpose, mode, time, or activity are proposed. Most importantly this is used to prepare a base for base transport model using the current socio-economic information, O/D trip tables and other surveys for calibration. This data can be used as simple facts without any specific purpose or requirement.

It is the forecast data for future years such as socio-economic framework, road network operational condition, project specific forecasts like BRT or MRT patronage lines. This will be completed at the end of LUTMP Phase-II. This data is scenario specific, and forecast is based on assumptions taken for each scenario. Three alternative urban development scenarios have been considered during the Study, and scenario-II; compact concentric fashion development has been adopted for the master plan development based on its more compatibility and ease of implementation in local condition. This data is not simple facts; so require complete comprehension of socio-economic framework, transport planning and demand modeling before using this for some specific purposes. Detail of primary and secondary data type is given in Table 6.1.2, followed by tertiary data type in Table 6.1.3.

Table 6.1.2: Primary and Secondary Transport Database – LUTMP Phase-I

Data Class	Primary Data (Original Data)	Secondary Data (Processed Data)
Socio-Economic	a) HIS Master File b) Zone System	a) Population by Age b) Employment by Workplace c) Workers by Residence d) School Attendance e) Income Level f) Vehicle Ownership
Transport Demand	a) HIS Master File b) Cordon Survey Master File	a) O/D Matrices
Transport Model Calibration	a) Rail and Canal Screenlines b) Traffic Counts	a) Traffic counts and vehicle occupancy by each crossing b) PCUs summary by each site
Road Network	a) Road Network Inventory b) Junctions Characteristics	a) Road network existing condition analysis through RoW, road width, land use, parking, encroachment b) Overall junction existing condition
Public Transport	a) Public Transport User Interview b) Bus Occupancy c) Willingness to Pay for Improvements	a) Public transport user data summaries and O/D Matrices b) Average occupancy computation by each route c) Value of time
Traffic Management	a) Parking b) Travel Speed c) Road Junction Design and Traffic Signal Operation	a) Parking accumulation and turnover b) Average journey time by each route and delay type analysis c) Junction design and phasing drawing of surveyed junction

Source: JICA Study Team

Table 6.1.3 Tertiary Transport Database – LUTMP Phase-II

Data Class	All Scenarios (2020 and 2030)
Socio-Economic	a) Population b) Employment c) Students d) Income e) GDP f) Vehicle Ownership
Transport Demand	a) O/D Matrices by Mode
Road Network	a) Road Network Capacity b) Network Demand for Proposed Road Network
Public Transport (PT)	a) PT Demand for existing Bus Routes b) PT Demand for proposed public transport improvement projects: BUS, BRT and MRT

Source: JICA Study Team

6.2 GIS Database

6.2.1 Overview and Purpose of GIS Database Development

Geographical Information System (GIS) database is developed using Arc-View environment. This is used to perform geographical analysis based on spatial distribution of socio-economic, other information to see their impact by area type like district, town, union council and traffic zone.

GIS database was developed to understand current conditions of the Study Area covering Lahore and parts of Sheikhupura and Kasur districts, at town and union council levels. The database covers, in varying levels of detail, the administrative, natural, social, land use, infrastructure, public facilities and transport conditions in the Study Area.

6.2.2 LUTMP GIS Database Development

1) Collection of Existing Data

Basic information regarding the administrative boundaries, other information related to socio-economic, land use and road infrastructure were collected from various Punjab Government agencies/ departments. All districts including Lahore, Sheikhupura and Kasur were found to lack GIS system for their administrative and land use control. However, The Urban Unit, GoPb provided GIS based administrative boundaries for Lahore District.

Road network of NESPAK for Lahore Ring Road Study and LRMTS Studies data were considered. Both studies did not cover whole of the Study Area and were specific to their own projects. LRMTS study road network was selected to form base for the Road Network Inventory Survey. Data collected was in digital and hardcopy formats. This data was integrated into the GIS database. Characteristics of the collected data are described below;

(i) Formats

File formats encountered in data collection include

- Microsoft Excel (*.xls)
- Microsoft Office Documents (*.doc)
- Maps (*.jpg, *.pdf)
- AutoCAD (.dwg)
- ESRI Shape files (.shp)
- MapInfo tab files (.dbf)

(ii) Problems Encountered

During assessment and processing of collected data, several problems were encountered; like map data lacked standard coordinate system.

2) LUTMP GIS Data Generated

The JICA Study Team generated a lot of new information regarding the Study Area. The following describes some of the Study developed geographic data attributes.

(i) Satellite Image Map (2010)

Pan-sharpened Advanced Land Observation Satellite (ALOS) imagery at 2.5 m resolution taken from the period March to May, 2010 for the Study Area. This imagery (on loan from JICA) was used to update the various map layers used in the Study such as the road network, built up areas and land use related information. Figure 6.2.1 shows a portion of the pan-sharpened satellite imagery.

Figure 6.2.1 Pan-sharpened ALOS Imagery

Source: JICA Study Team

(ii) Land Use Map (2011)

An updated land use map of the Study Area was prepared by the JICA Study Team. The information used to create the land use map came from the following sources:

a) Lahore District Land Use

- LDA, 2001, Land Use Map

- Partial information from The Urban Unit, 2010
- 2010 and 2006 satellite imagery
- Field surveys conducted in selected areas

b) Sheikhupura and Kasur Land Use

- 2010 satellite imagery
- Inputs from Sheikhupura District, Kasur and Pattoki Tehsil planners
- Field surveys conducted in selected areas

Finalized land use map of the Study Area is depicted in Figure 6.2.2.

3) Data Integration

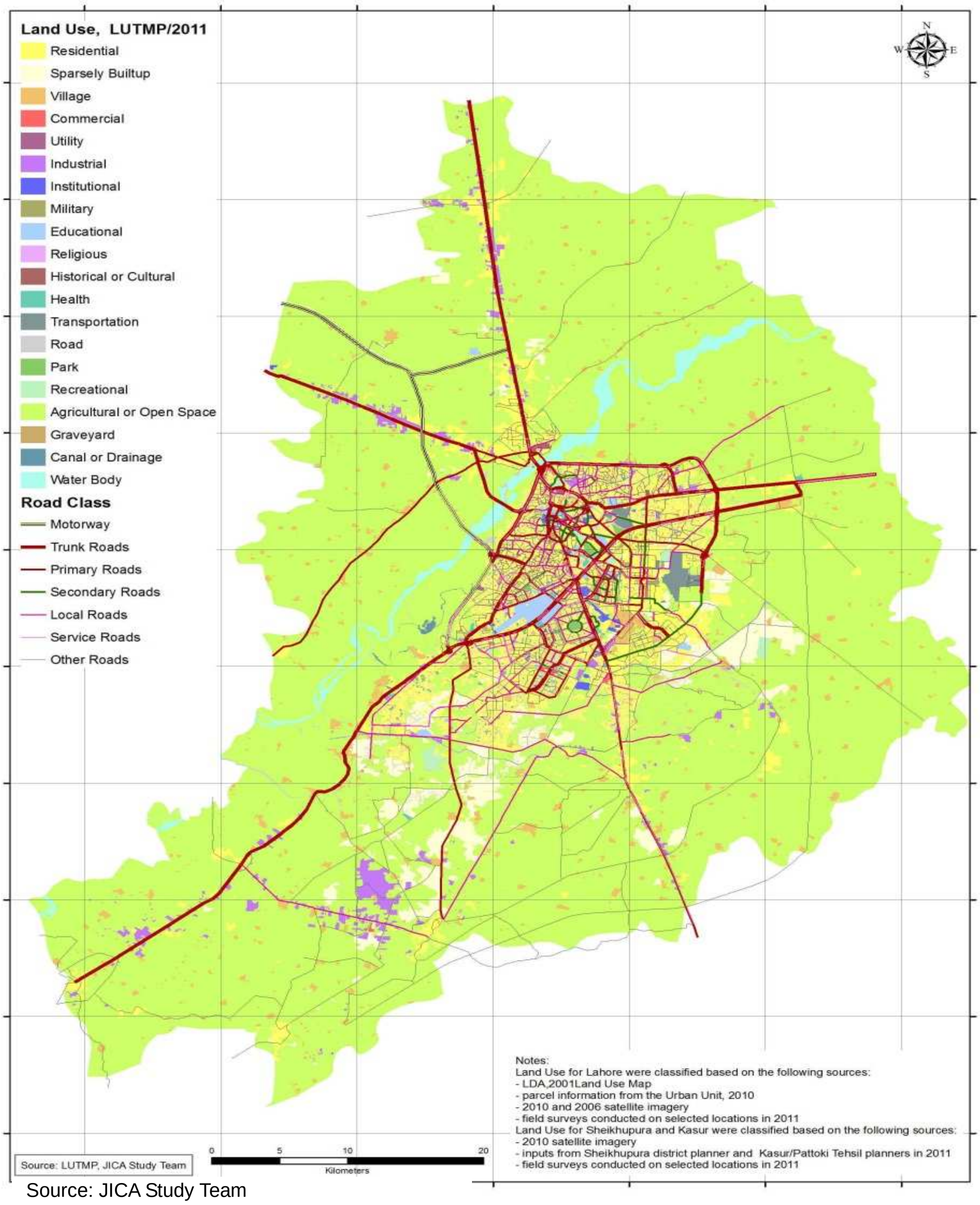
Existing and newly created data was integrated to develop LUTMP GIS database. Data integration consisted of converting hardcopy data to digital form and processing all digital data to conform to standards adopted in the Study. The following are standards adopted in the GIS database.

- The GIS data format is ESRI Shape file format.
- The coordinate system is UTM Zone 43 N.

6.2.3 Current Status

LUTMP GIS Database is finalized, and details are given in Table 6.2.1 with classes of data created during the course of the Study.

Figure 6.2.2 Land Use Map of the Study Area, 2011



Source: JICA Study Team

Table 6.2.1 LUTMP GIS Database

Folder	Shapefile	Description	Coverage	Feature Type	Compilation Scale	Year	Source
T:\10_Databases\10_GIS\00_Administrative							
	A_India_UTM43.shp	India Boder Area	India	Polygon	1:50,000	2010	JST
	A_SA_Backgorund_LUTMP2011_UTM43.shp	Area	SA		approx 1:50,000	2011	JST
	A_SA_District_LUTMPAug2011_UTM43.shp	Study Area District	SA	Polygon	approx 1:50,000	2011	UU/JST
	A_SA_StudyAreaBoundary_LUTMP2011_UTM43.shp	Study Area Boundary	SA	Polygon	approx 1:50,000	2011	LUTMP
	A_SA_Tehsil_LUTMPAug2011_UTM43.shp	Study Area Tehsil	SA	Polygon	approx 1:50,000	2011	UU/JST
	A_SA_TownTehsil_LUTMPAug2011_UTM43.shp	Study Area Town/Tehsil	SA	Polygon	approx 1:50,000	2011	UU/JST
	A_SA_UnionCouncil_LUTMPAug2011_UTM43.shp	Study Area Union Councils	SA	Polygon	approx 1:50,000	2011	UU/JST
	A_SA_ZoneFilled_HIS_LUTMPAug2011_UTM43.shp	Zoning System	SA	Polygon	approx 1:50,000	2011	JST
	A_SA_ZoneSecInd_LUTMP092011_UTM43.shp	Zone Index	SA	Polygon	approx 1:50,000	2011	JST
T:\10_Databases\10_GIS\10_NaturalConditions							
	N_SA_WaterBodies_LUTMPAug2011_UTM43.shp	Water Bodies (River, Canal, Drainages)	SA	Polygon	approx 1:10,000	2011	JST
T:\10_Databases\10_GIS\20_Transportation							
	T_LAH_Airports_UU2010_UTM43.shp	Airport Location	Lahore	Point	1: 10,000	2010	JST
	T_LAH_BusRoutes_UU2010_UTM43.shp	Bus Routes	Lahore	Line	1: 10,000	2010	UU
	T_LAH_BusTerminals_UU2010_UTM43.shp	Bus Terminals	lahore	Point	1: 10,000	2010	JST
	T_LAH_BusTerminal_SPG_Zone_2011_UTM43.shp	Terminal	Lahore	Polygon	1: 10,000	2011	JST
	T_LAH_RailwayStation_SPG_Zone_2011_UTM43.shp	Station	Lahore	Polygon	1: 10,000	2011	JST
	T_LAH_TruckTerminal_SPG_Zone_2011_UTM43.shp	Terminal	Lahore	Polygon	1: 10,000	2011	JST
	T_SA_CordonPoints_LUTMPAug2011_UTM43.shp	Control Points	SA	Point	1: 10,000	2011	JST
	T_SA_RailwayLine_LUTMPAug2011_UTM43.shp	Railway Line	SA	Line	1: 10,000	2011	JST
	T_SA_AccidentData_LUTMP20092011UTM43.shp	Road Accident	SA	Line	1:10,000	2011	JST
	T_LHR_CDGLPrkngStandLUTMP2011_UTM43	City District Govt. Lahore	Lahore	Point	1:10,000	2011	JST
	T_LHR_TrafficSignal_TEPA2010_UTM43	Traffic Signal	Lahore	Point	1:10,000	2011	TEPA
	T_SA_RailwayStation_LUTMP2010_UTM43.shp	Railway Station	SA	Point	1: 10,000	2010	JST
	T_SA_Screenline_PointsLUTMPAug2011_UTM43.shp	Screen line	SA	Point	1: 10,000	2011	JST
T:\10_Databases\10_GIS\30_RoadNetwork							
	R_LHR_BottleneckJuncSurvey_LUTMP2011_UTM43.shp	Bottleneck Junction Survey	Central Lahore	Polygon	1:10,000	2011	JST
	R_LHR_BottleneckJuncSurvey_LUTMP2011_UTM43_line.shp	Bottleneck Junction Survey	Central Lahore	Line	1:10,000	2011	JST
	R_SA_AccessTimesALL_LUTMP2011_UTM43.shp	Access Analysis from City Center	SA	Polygon	1:10,000	2011	JST
	R_SA_JunctionSurvey_LUTMP2011_UTM43.shp	Junction Survey	SA	Point	1:10,000	2011	JST
	R_SA_RoadNetCube_LUTMPAug2011_UTM43.shp	Road Network	SA	Line	1:10,000	2011	JST
T:\10_Databases\10_GIS\40_Infrastructure							
	I_SA_DrainageOpen_Topo50k1994_UTM43.shp	Open Drainage	Lahore	Line	1:10,000	1994	UU
	I_SA_CanalDrain_LUTMPAug2011_UTM43	Canal/Drain	Lahore	Line	1:10,000	2011	JST
T:\10_Databases\10_GIS\50_Landmarks							
	LC_LA_Centers_LUTMP2011_UTM43.shp	(General Post Office)	Lahore	Point	1:10,000	2011	JST
	LC_LA_HistoricalSites_LUTMP2010_UTM43.shp	Historical Sites	Lahore	Polygon	1:10,000	2010	JST
	LC_LA_TouristLandmarks_UU2010_UTM43.shp	Tourist Landmark	Lahore	Point	1:10,000	2010	UU/JST
T:\10_Databases\10_GIS\60_LandConditions							
	LC_SA_BorderMgmtAreas2010_LUTMP2010_UTM43.shp	Border Management Area	SA	Polygon	1:100,000	2010	JST
	LC_SA_LandUse_LUTMPAug2011_UTM43.shp	Landuse for Study Area	SA	Polygon	1:10,000	2011	JST
	LC_SA_NetPopDensity1998_LUTMP2010_UTM43.shp	Net Population Density	SA	Polygon	1:10,000	2010	JST
	LC_SA_NetPopDensity2010_LUTMP2010_UTM43.shp	Net Population Density	SA	Polygon	1:10,000	2010	JST
T:\10_Databases\10_GIS\80_Environment							
	E_LA_Educational_LUTMPAug2011_UTM43.shp	Educational	Lahore	Point	1:10,000	2011	JST
	E_LA_MajorLandmarks_LUTMPAug2011_UTM43.shp	Major Landmark	Lahore	Point	1:10,000	2011	JST
	E_LA_SolidWasteContainer_UU2010_UTM43.shp	Solid Waste Container	Lahore	Point	1:10,000	2010	UU
T:\10_Databases\10_GIS\90_Others							
	O_SA_GPSTracks20110423_LUTMP2011_UTM43N.shp	GPS Tracks	SA	Line		2011	JST
	O_SA_GPSWaypoints20110423_LUTMP2011_UTM43N.shp	GPS waypoints	SA	Point		2011	JST
T:\10_Databases\10_GIS\91_Planning							
	P_SA_UDS_1_LUTMP2011_UTM43.shp	Option Trend	SA	Polygon	1:10,000	2011	JST
	P_SA_UDS2_LUTMP2011_UTM43.shp	Compact Development	SA	Polygon	1:10,000	2011	JST
	P_SA_UDS_3_LUTMP2011_UTM43.shp	Despersed Multicore Development	SA	Polygon	1:10,000	2011	JST
	P_SA_SuitaibilityAnalyses_LUTMP2011_UTM43.img	Results of Suitaibility Analyses	SA	Raster		2011	JST
	P_LHR_TrafficManagementPlanLUTMP2011_UTM43	Traffic Management Plan	SA	Polygon	1:10,000	2011	JST

Source: JICA Study Team

Volume-II – Annex-I

TRAFFIC ZONE SYSTEM

FINAL REPORT

ANNEX 1 – Traffic Zone System

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
1	617	*Int*	Lahore	City	Ravi	1	617	Begum Kot	1
2	83	*Int*	Lahore	City	Ravi	2	83	Kot Mohibbu	2
3	76	*Int*	Lahore	City	Ravi	3	76	Aziz Colony	3
4	42	*Int*	Lahore	City	Ravi	4	42	Faisal Park	4
5	65	*Int*	Lahore	City	Ravi	5	86	Qaiser Town - East	5-E
6	20	*Int*	Lahore	City	Ravi			Qaiser Town - West	5-W
7	201	*Int*	Lahore	City	Ravi	6	201	Dhair	6
8	183	*Int*	Lahore	City	Ravi	7	222	Shahdara - East	7-E
9	40	*Int*	Lahore	City	Ravi			Shahdara - West	7-W
10	256	*Int*	Lahore	City	Ravi	8	256	Jia Musa	8
11	153	*Int*	Lahore	City	Ravi	9	153	Qila Lakshman Singh	9
12	137	*Int*	Lahore	City	Ravi	fxdccvf	137	Fruit Mandi	10
13	317	*Int*	Lahore	City	Ravi	11	317	Siddiquepura	11
14	137	*Int*	Lahore	City	Ravi	12	137	Bangali Bagh	12
15	172	*Int*	Lahore	City	Ravi	13	172	Siddiqia Colony	13
16	510	*Int*	Lahore	City	Ravi	14	510	Bhamman	14
17	75	*Int*	Lahore	City	Ravi	26	75	Farooq Ganj	26
18	53	*Int*	Lahore	City	Ravi	27	53	Dehli Gate	27
19	76	*Int*	Lahore	City	Ravi	28	76	Rang Mahal	28
20	44	*Int*	Lahore	City	Ravi	29	44	Androon Bhaati Gate	29
21	92	*Int*	Lahore	City	Ravi	30	92	Androon Texali Gate	30
22	271	*Int*	Lahore	City	DataGB	67	271	Kasurpura	67
23	82	*Int*	Lahore	City	DataGB	68	82	Ameenpura	68
24	299	*Int*	Lahore	City	DataGB	69	299	Kareem Park	69
25	68	*Int*	Lahore	City	DataGB	70	68	Ganj Kalan	70
26	129	*Int*	Lahore	City	DataGB	71	129	Bilal Gunj	71
27	206	*Int*	Lahore	City	DataGB	72	206	Anarkali	72
28	89	*Int*	Lahore	City	DataGB	73	89	Gawalmandi	73
29	102	*Int*	Lahore	City	DataGB	74	102	Sarai Sultan	74
30	243	*Int*	Lahore	City	DataGB	77	243	Qila Gujjar Singh	77
31	528	*Int*	Lahore	City	DataGB	78	528	Race Course	78
32	145	*Int*	Lahore	City	DataGB	79	145	Mozang	79
33	161	*Int*	Lahore	City	DataGB	80	161	Jinnah Hall	80
34	53	*Int*	Lahore	City	DataGB	81	53	Riwaz Garden	81
35	29	*Int*	Lahore	City	DataGB	82	29	Islampura	82
36	191	*Int*	Lahore	City	DataGB	83	191	Chohan Park	83
37	182	*Int*	Lahore	City	DataGB	85	182	Sanda Kalan	85
38	82	*Int*	Lahore	City	DataGB	86	82	Sanda Khurd	86
39	230	*Int*	Lahore	City	DataGB	94	230	Shadman	94
40	493	*Int*	Lahore	City	Samanabad	84	493	Abu Bakar Siddique Colony	84
41	169	*Int*	Lahore	City	Samanabad	87	169	Sham Nagar	87
42	63	*Int*	Lahore	City	Samanabad	88	63	Gulgasht Colony	88
43	128	*Int*	Lahore	City	Samanabad	89	128	Gulshan-e-Ravi	89

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
44	219	*Int*	Lahore	City	Samanabad	90	219	Babu Sabu	90
45	71	*Int*	Lahore	City	Samanabad	91	71	Rizwan Park	91
46	67	*Int*	Lahore	City	Samanabad	92	67	Sodiwal	92
47	162	*Int*	Lahore	City	Samanabad	93	162	Bahawalpur House	93
48	79	*Int*	Lahore	City	Samanabad	100	79	Ichhra	100
49	36	*Int*	Lahore	City	Samanabad	101	36	New Samanabad	101
50	61	*Int*	Lahore	City	Samanabad	102	61	Shah Kamal	102
51	103	*Int*	Lahore	City	Samanabad	103	103	Pakki Thatti	103
52	230	*Int*	Lahore	City	Samanabad	104	230	Kashmir Block	104
53	123	*Int*	Lahore	City	Samanabad	105	123	Nawan Kot	105
54	159	*Int*	Lahore	City	Samanabad	106	159	Samanabad	106
55	128	*Int*	Lahore	City	Samanabad	107	128	Rehman Pura	107
56	216	*Int*	Lahore	City	Samanabad	108	216	Gulshan-e-Iqbal	108
57	551	*Int*	Lahore	City	Samanabad	109	551	Sikandar Block	109
58	514	*Int*	Lahore	City	Samanabad	115	694	Muslim Town - North	115-N
59	180	*Int*	Lahore	City	Samanabad			Muslim Town - South	115-S
60	60	*Int*	Lahore	City	Shalamar	15	60	Bhaghatpura	15
61	801	*Int*	Lahore	City	Shalamar	16	801	Gujjarpura	16
62	68	*Int*	Lahore	City	Shalamar	17	68	Rehmatpura	17
63	35	*Int*	Lahore	City	Shalamar	18	35	Begumpura	18
64	127	*Int*	Lahore	City	Shalamar	19	127	Chah Miran	19
65	43	*Int*	Lahore	City	Shalamar	20	43	Bilal Park	20
66	58	*Int*	Lahore	City	Shalamar	21	58	Makhanpura	21
67	84	*Int*	Lahore	City	Shalamar	22	84	Kot Khawaja Saeed	22
68	138	*Int*	Lahore	City	Shalamar	23	138	Shad Bagh	23
69	121	*Int*	Lahore	City	Shalamar	24	121	Wassanpura	24
70	52	*Int*	Lahore	City	Shalamar	25	52	Faiz Bagh	25
71	69	*Int*	Lahore	City	Shalamar	33	69	Crown Park	33
72	56	*Int*	Lahore	City	Shalamar	34	56	Madhu Lal Hussain	34
73	478	*Int*	Lahore	City	Shalamar	35	478	Muhammad Colony	35
74	132	*Int*	Lahore	City	Shalamar	36	132	Baghbanpura	36
75	106	*Int*	Lahore	City	Shalamar	46	106	Angori Bagh	46
76	14	*Int*	Lahore	City	Shalamar	47	14	Mujahidabad	47
77	203	*Int*	Lahore	City	Gulberg	31	278	Railway Colony - East	31-E
78	75	*Int*	Lahore	City	Gulberg			Railway Colony - West	31-W
79	379	*Int*	Lahore	City	Gulberg	32	379	Daras Barey Mian	32
80	120	*Int*	Lahore	City	Gulberg	75	120	Bibi Pak Daman	75
81	44	*Int*	Lahore	City	Gulberg	76	115	Garrhi Shahu - East	76-E
82	71	*Int*	Lahore	City	Gulberg			Garrhi Shahu - West	76-W
83	674	*Int*	Lahore	City	Gulberg	95	674	Al-Hamra	95
84	190	*Int*	Lahore	City	Gulberg	96	291	Zaman Park	*96-N*
85	101	*Int*	Lahore	City	Gulberg			Zaman Park	*96-S*
86	359	*Int*	Lahore	City	Gulberg	97	359	Gulberg	97

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
87	191	*Int*	Lahore	City	Gulberg	98	191	Mecca Colony	98
88	326	*Int*	Lahore	City	Gulberg	99	326	Naseerabad	99
89	418	*Int*	Lahore	City	Gulberg	126	418	Garden Town	126
90	621	*Int*	Lahore	City	Gulberg	127	621	Model Town	127
91	216	*Int*	Lahore	City	Gulberg	128	216	Faisal Town	128
92	95	*Int*	Lahore	City	Gulberg	129	95	Liaqatabad	129
93	166	*Int*	Lahore	City	Gulberg	130	166	Kot Lakhpat	130
94	131	*Int*	Lahore	City	Gulberg	131	131	Pindi Rajputan	131
95	311	*Int*	Lahore	City	AzizB	41	606	Harbanspura - North	41-N
96	296	*Int*	Lahore	City	AzizB			Harbanspura - South	41-S
97	144	*Int*	Lahore	City	AzizB	43	144	Rashidpura	43
98	286	*Int*	Lahore	City	AzizB	44	286	Fateh Garh	44
99	140	*Int*	Lahore	City	AzizB	45	140	Nabipura	45
100	126	*Int*	Lahore	City	AzizB	48	126	Mughalpura	48
101	69	*Int*	Lahore	City	AzizB	54	69	Mian Meer	54
102	89	*Int*	Lahore	City	AzizB	55	89	Mustafabad	55
103	73	*Int*	Lahore	City	AzizB	56	73	Ghaziabad	56
104	212	*Int*	Lahore	City	AzizB	57	212	Taj Bagh	57
105	113	*Int*	Lahore	City	AzizB	58	113	Tajpura	58
106	100	*Int*	Lahore	City	AzizB	59	100	Al-Faisal Town	59
107	428	*Int*	Lahore	City	AzizB	60	428	Guldasht Colony	60
108	4,519	*Int*	Lahore	City	AzizB	61	4,519	Bhangali	61
109	1,583	*Int*	Lahore	City	Wagah	37	1,583	Muslimabad	37
110	84	*Int*	Lahore	City	Wagah	38	84	Sultan Mehmood	38
111	869	*Int*	Lahore	City	Wagah	39	869	Shadipura	39
112	798	*Int*	Lahore	City	Wagah	40	798	Salamatpura	40
113	386	*Int*	Lahore	City	Wagah	42	386	Daroghawala	42
114	1,680	*Int*	Lahore	City	Wagah	49	1,680	Lakhodher	49
115	9,966	*Int*	Lahore	City	Wagah	50	9,966	Bhaseen	50
116	1,294	*Int*	Lahore	City	Wagah	51	1,294	Dograi Kalan	51
117	604	*Int*	Lahore	City	Wagah	52	604	Manawan	52
118	9,533	*Int*	Lahore	City	Wagah	53	9,533	Minhala	53
119	5,955	*Int*	Lahore	City	Wagah	62	5,955	Barki	62
120	11,254	*Int*	Lahore	City	Wagah	65	11,254	Hadiara	65
121	4,014	*Int*	Lahore	City	Nishter	63	4,014	Kamahan	63
122	7,363	*Int*	Lahore	City	Nishter	64	7,363	Hair	64
123	8,939	*Int*	Lahore	City	Nishter	66	8,939	Dhaloke	66
124	43	*Int*	Lahore	City	Nishter	134	43	Bostan Colony	134
125	163	*Int*	Lahore	City	Nishter	135	163	Ismail Nagar	135
126	99	*Int*	Lahore	City	Nishter	136	99	Sittara Colony	136
127	251	*Int*	Lahore	City	Nishter	137	251	Farid Colony	137
128	83	*Int*	Lahore	City	Nishter	138	83	Keer Kalan	138
129	113	*Int*	Lahore	City	Nishter	139	113	Green Town	139
130	137	*Int*	Lahore	City	Nishter	140	137	Maryam Colony	140
131	842	*Int*	Lahore	City	Nishter	141	842	Attari Saroba	141
132	1,649	*Int*	Lahore	City	Nishter	142	1,649	Dullo Khurd Kalan	142

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
133	569	*Int*	Lahore	City	Nishter	143	1,239	Chandrai - East	143-E
134	670	*Int*	Lahore	City	Nishter			Chandrai - West	143-W
135	6,310	*Int*	Lahore	City	Nishter	144	6,310	Halloke	144
136	2,825	*Int*	Lahore	City	Nishter	145	2,825	Gajju Matta	145
137	1,741	*Int*	Lahore	City	Nishter	146	1,741	Kahna Nau	146
138	5,953	*Int*	Lahore	City	Nishter	147	5,953	Jia Bagga	147
139	7,961	*Int*	Lahore	City	Nishter	150	7,961	Pandoki	150
140	170	*Int*	Lahore	City	*Iqbal*	110	170	Awan Town	110
141	100	*Int*	Lahore	City	*Iqbal*	111	100	Saidpur	111
142	1,444	*Int*	Lahore	City	*Iqbal*	112	1,444	Sabzazar	112
143	79	*Int*	Lahore	City	*Iqbal*	113	79	Dholanwal	113
144	124	*Int*	Lahore	City	*Iqbal*	114	124	Bakar Mandi	114
145	891	*Int*	Lahore	City	*Iqbal*	116	891	Johar Town	116
146	1,524	*Int*	Lahore	City	*Iqbal*	117	1,524	Hanjarwal	117
147	1,438	*Int*	Lahore	City	*Iqbal*	118	1,438	Niaz Beg	118
148	1,790	*Int*	Lahore	City	*Iqbal*	119	2,537	Shahpur - North	119-N
149	747	*Int*	Lahore	City	*Iqbal*			Shahpur - South	119-S
150	3,427	*Int*	Lahore	City	*Iqbal*	120	3,427	Ali Razabad	120
151	877	*Int*	Lahore	City	*Iqbal*	121	1,899	Chung - North	121-N
152	1,012	*Int*	Lahore	City	*Iqbal*			Chung - South	121-S
153	5,799	*Int*	Lahore	City	*Iqbal*	122	9,129	Maraka - North	122-N
154	3,330	*Int*	Lahore	City	*Iqbal*			Maraka - South	122-S
155	984	*Int*	Lahore	City	*Iqbal*	123	7,266	Shamke Bhattian - North	123-N
156	6,282	*Int*	Lahore	City	*Iqbal*			Shamke Bhattian - South	123-S
157	7,456	*Int*	Lahore	City	*Iqbal*	124	7,456	Sultanke	124
158	3,387	*Int*	Lahore	City	*Iqbal*	125	3,387	Manna	125
159	299	*Int*	Lahore	City	*Iqbal*	132	299	Township	132
160	410	*Int*	Lahore	City	*Iqbal*	133	410	Township-II	133
161	2,328	*Int*	Lahore	City	*Iqbal*	148	8,459	Pajian - East	148-E
162	6,131	*Int*	Lahore	City	*Iqbal*			Pajian - West	148-W
163	932	*Int*	Lahore	City	*Iqbal*	149	1,999	Raiwind - East	149-E
164	1,068	*Int*	Lahore	City	*Iqbal*			Raiwind - West	149-W
165	531	*Int*	Lahore	Cantt	Cantt	152A	531	Cantt Airport	152A
166	309	*Int*	Lahore	Cantt	Cantt	152B	309	Cantt Askari Housing	152B
167	413	*Int*	Lahore	Cantt	Cantt	152C	413	Cantt Aziz Bhatti	152C
168	172	*Int*	Lahore	Cantt	Cantt	152D	172	Cantt Basti Chiragh Shah	152D
169	326	*Int*	Lahore	Cantt	Cantt	152E	326	Cantt CMA Colony	152E
170	786	*Int*	Lahore	Cantt	Cantt	152F	786	Cantt Chung Khurd	152F
171	192	*Int*	Lahore	Cantt	Cantt	152G	192	Cantt DH01a	152G
172	277	*Int*	Lahore	Cantt	Cantt	152H	277	Cantt DH01b	152H
173	373	*Int*	Lahore	Cantt	Cantt	152I	373	Cantt DH03	152I
174	243	*Int*	Lahore	Cantt	Cantt	152J	243	Cantt DH04	152J
175	434	*Int*	Lahore	Cantt	Cantt	152K	434	Cantt DH05	152K

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
176	1,523	*Int*	Lahore	Cantt	Cantt	152L	1,523	Cantt DH08	152L
177	272	*Int*	Lahore	Cantt	Cantt	152M	272	Cantt Dher Pindi	152M
178	157	*Int*	Lahore	Cantt	Cantt	152N	157	Cantt Gulshan1	152N
179	162	*Int*	Lahore	Cantt	Cantt	152O	162	Cantt Gulshan2	152O
180	45	*Int*	Lahore	Cantt	Cantt	152P	45	Cantt Gulshan3	152P
181	672	*Int*	Lahore	Cantt	Cantt	152Q	672	Cantt Iqbal Camp	152Q
182	521	*Int*	Lahore	Cantt	Cantt	152R	521	Cantt Madina	152R
183	259	*Int*	Lahore	Cantt	Cantt	152S	259	Cantt Mian Mir	152S
184	102	*Int*	Lahore	Cantt	Cantt	152T	102	Cantt New Nishtar	152T
185	436	*Int*	Lahore	Cantt	Cantt	152U	436	Cantt Nishat Colony	152U
186	969	*Int*	Lahore	Cantt	Cantt	152V	969	Cantt Park View	152V
187	301	*Int*	Lahore	Cantt	Cantt	152W	301	Cantt Pir Colony	152W
188	302	*Int*	Lahore	Cantt	Cantt	152X	302	Cantt Raza Colony	152X
189	9,961	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF22	9,961	Luban wala	SF22
190	4,287	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF23	4,278	Chak 44	SF23
191	6,939	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF24	6,939	Bharth	SF24
192	2,489	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF26	2,489	Shekhan	SF26
193	1,559	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF27-29	3,334	Ferozewala - East	SF27X-E
194	1,775	*Int*	Sheikhupura	Ferozewala	Ferozewala			Ferozewala - West	SF27X-W
195	1,801	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF30-31	1,801	Wandala Dial Shah	SF30X
196	1,443	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF32	1,443	Dacca	SF32
197	5,151	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF33	5,151	Faizpur Khurd	SF33
198	1,902	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF34-36	1,902	Kot Abdul Malik	SF34X
199	4,948	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF37	4,948	Momanpur	SF37
200	3,707	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF38	3,707	Mandhiali	SF38
201	1,353	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF39	1,353	Kot Pindi Dass	SF39
202	6,002	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF40	6,002	Qila Sattar Shah	SF40
203	1,164	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF41	1,164	Khanpur	SF41
204	3,106	*Int*	Sheikhupura	Ferozewala	Ferozewala	SF42	3,106	Burj Attari	SF42
205	7,851	*Int*	Sheikhupura	Muridke	Muridke	SM11	7,851	Dharor Muslim	SM11
206	2,957	*Int*	Sheikhupura	Muridke	Muridke	SM12	5,510	Nangal Gahdan - East	SM12-E
207	2,554	*Int*	Sheikhupura	Muridke	Muridke			Nangal Gahdan - West	SM12-W
208	4,847	*Int*	Sheikhupura	Muridke	Muridke	SM13	4,847	Nangal Kaswala	SM13
209	1,493	*Int*	Sheikhupura	Muridke	Muridke	SM15-20	1,493	Muridke	SM15X
210	2,679	*Int*	Sheikhupura	Muridke	Muridke	SM21	2,679	Noon	SM21
211	3,798	*Int*	Sheikhupura	Sharaqpur	Sharaqpur	SS43	3,798	Sahjewal	SS43
212	3,251	*Int*	Sheikhupura	Sharaqpur	Sharaqpur	SS44	3,251	Mandian wala	SS44
213	5,199	*Int*	Sheikhupura	Sharaqpur	Sharaqpur	SS45	5,199	Dhamke	SS45
214	1,742	*Int*	Sheikhupura	Sharaqpur	Sharaqpur	SS49	1,742	Sharaqpur	SS49
215	590	*Int*	Kasur	Kasur	Kasur	KK1	590	Kot Radha Kishen 1	KK14
216	1,402	*Int*	Kasur	Kasur	Kasur	KK2	1,402	Kot Radha Kishen 2	KK15
217	3,548	*Int*	Kasur	Kasur	Kasur	KK30	3,548	Zafarke	KK30
218	2,067	*Int*	Kasur	Kasur	Kasur	KK33	2,067	Babilana Otar	KK33

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
219	2,290	*Int*	Kasur	Kasur	Kasur	KK37	2,290	Chak 55	KK37
220	5,130	*Int*	Kasur	Kasur	Kasur	KK38	5,130	Mudke Dhariwal	KK38
221	793	*Int*	Kasur	Patoki	Patoki	KP24	793	Phool Nagar 1	KP24
222	348	*Int*	Kasur	Patoki	Patoki	KP25	348	Phool Nagar 2	KP25
223	446	*Int*	Kasur	Patoki	Patoki	KP26	446	Phool Nagar 3	KP26
224	3,062	*Int*	Kasur	Patoki	Patoki	KP80	3,062	Ghumankey	KP80
225	4,138	*Int*	Kasur	Patoki	Patoki	KP82	4,138	Lambey Jagheer	KP82
226	3,105	*Int*	Kasur	Patoki	Patoki	KP83	3,105	Chak 6 Dina Nath	KP83
227	1,297	*Int*	Kasur	Patoki	Patoki	KP84	1,297	Nathey Kalsey	KP84
228	3,302	*Int*	Kasur	Patoki	Patoki	KP85	3,032	Baghiana Kalan	KP85
229	-	SPG	Lahore	Special Gen.	Air	152A	-	Airport - Passenger ONLY	152A
230	-	SPG	Lahore	Lahore	Ravi Town	9	-	Qila Lakshman Singh	9
231	-	SPG	Lahore	Lahore	Samanabad	92	-	Sodiwal	92
232	-	SPG	Lahore	Lahore	Gulberg	31-W	-	Railway Colony	31-W
233	-	SPG	Lahore	Lahore	DataGB	71	-	Bilal Gunj	71
234	-	SPG	Lahore	Lahore	Ravi Town	2	-	Kot Mohibbu	2
235	-	SPG	Lahore	Cantt	Cantt	152Q	-	Cantt Iqbal Camp	152Q
236	-	SPG	Lahore	Lahore	Iqbal	119W	-	Shahpur	119W
237	-	SPG	Lahore	Lahore	Gulberg	95	-	Al-Hamra	95
238	-	SPG	Lahore	Lahore	Samanabad	91	-	Riawan Park	91
239	-	SPG	Lahore	Lahore	Gulberg	97	-	Gulberg	97
240	-	SPG	Lahore	Lahore	Nishter	*141*	-	Attari Saroba	*141*
241	-	SPG	Lahore	Lahore	Ravi	*7-W*	-	Shahdara	*7-W*
242	-	SPG	Lahore	Lahore	Wagah	*40*	-	Salamatpura	*40*
243	-	SPG	Lahore	Lahore	Iqbal	*120*	-	Ali Razabad	*120*
244	-	SPG	Lahore	Lahore	Bus	*145*	-	*Gajju Matta*	*145*
245	-	SPG	Lahore	Lahore	Ravi	*2*	-	*Kot Mohibbu*	*2*
246	-	SPG	Lahore	Lahore	Iqbal	*119*	-	*Shahpur*	*119*
247	-	SPG	Lahore	Lahore	Nishter	-	-	-	
248	-	SPG	Lahore	Lahore	Gulberg	31	-	Railway Colony	31
249	-	SPG	Lahore	Lahore	Ravi Town	9	-	Qila Lakshman Singh	9
250	-	SPG	Sheikhupura	Ferozewala	Ferozewala	SF27-29	-	Ferozewala	SF27X-W
251	-	SPG	Sheikhupura	Ferozewala	Ferozewala	SF40	-	-	SF40
252	-	SPG	Sheikhupura	Muridke	Muridke	SM15-20	-	Muridke	SM15X
253	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
254	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
255	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
256	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
257	-	SPG	Lahore	Cantt	Cantt	152E	-	Cant CMA Colony	152E
258	-	SPG	Lahore	Cantt	Cantt	152X	-	Cant Raza Colony	152X
259	-	SPG	Lahore	Lahore	Nishter	135	-	Ismail Nagar	135
260	-	SPG	Lahore	Lahore	Nishter	142	-	Dullo Khurd Kalan	142
261	-	SPG	Lahore	Lahore	Iqbal	148E	-	Pajian	148E
262	-	SPG	Kasur	Kasur	Kasur		-	-	-

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
263	-	SPG	Sheikhupura	Ferozewala	Ferozewala	SF27-29	-	Ferozewala	SF27X-W
264	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
265	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
266	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
267	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
268	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
269	-	SPG	Lahore	Lahore	AzizB	-	-	Mustafabad	55
270	-	SPG	Lahore	Lahore	Wagah	-	-	Minhala	53
271	-	SPG	Lahore	Lahore	Wagah	-	-	Minhala	53
272	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
273	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
274	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
275	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
276	-	SPG	Lahore	Special Gen.	Railway	-	-	-	-
277	-	SPG	Lahore	Lahore	AzizB	55	-	Mustafabad	55
278	-	SPG	Lahore	Lahore	Iqbal	118	-	Niaz Beg	118
279	-	SPG	Lahore	Lahore	Ravi	10	-	Fruit Mandi	10
280	-	SPG	Lahore	Lahore	Ravi	28	-	Rang Mahal	28
281	-	SPG	Lahore	Lahore	Ravi	28 & 30	-	Rang Mahal-Andron Taxali Gate	28X
282	-	SPG	Lahore	Lahore	Iqbal	114	-	Bakar Mandi	114
283	-	SPG	Lahore	Lahore	Wagah	40 & 42	-	Salamatpura-Shadipura	40X
284	-	SPG	Sheikhupura	Ferozewala	Ferozewala	26	-	Shekhan	26
285	-	SPG	Lahore	Lahore	Iqbal	119	-	Shahpur	119
286	-	SPG	Lahore	Lahore	Iqbal	135	-	Ismail Nagar	135
287	-	SPG	Lahore	Special Gen.	Truck Terminal	-	-	-	-
288	-	SPG	Lahore	Special Gen.	Truck Terminal	-	-	-	-
289	-	SPG	Lahore	Special Gen.	Truck Terminal	-	-	-	-
290	-	SPG	Lahore	Special Gen.	Truck Terminal	-	-	-	-
291	-	Ext	Sheikhupura	Ferozewala	Ferozewala	-	-	Remainder of Tehsil Ferozewala	-
292	-	Ext	Sheikhupura	Muridke	Muridke	-	-	Remainder of Tehsil Muridke West of GT Road Cordon Point	-
293	-	Ext	Sheikhupura	Muridke	Muridke	-	-	Remainder of Tehsil Muridke East of GT Road Cordon Point	-
294	-	Ext	Sheikhupura	Muridke	Muridke	-	-	Remainder of Tehsil Muridke South-East of GT Road Cordon Point	-
295	-	Ext	Narowal	*District*	-	-	-	-	-
296	-	Ext	Sheikhupura	Sharaqpur	Sharaqpur	-	-	Remainder of Sharaqpur	-
297	-	Ext	Sheikhupura	Sheikhupura	Sheikhupura	-	-	Whole Tehsil & City of Sheikhupura	-

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
298	-	Ext	Nankana Sahib	*District*	-	-	-	-	-
299	-	Ext	Kasur	Kasur	Kasur	-	-	Kasur Tehsil UC's surrounding Cordon Site-5 & Kasur City	-
300	-	Ext	Kasur	Chunia	Chunia	-	-	Tehsil Chunia Surrounding Cordon Point 5	-
301	-	Ext	Kasur	Kasur	Kasur	-	-	Kasur Tehsil UC's surrounding Cordon Site-6	-
302	-	Ext	Kasur	Kasur	Kasur	-	-	Kasur Tehsil UC's surrounding Cordon Site-8	-
303	-	Ext	Kasur	Chunia	Chunia	-	-	Tehsil Chunia Surrounding Cordon Point 5	-
304	-	Ext	Kasur	Patoki	Patoki	-	-	-	-
305	-	Ext	Gujranwala	*Kamoke*	-	-	-	-	-
306	-	Ext	Gujranwala	*Nowshera Virkan*	-	-	-	-	-
307	-	Ext	Gujranwala	*Gujranwala*	City	-	-	-	-
308	-	Ext	Gujranwala	*Wazirabad*	-	-	-	-	-
309	-	Ext	Sialkot	District	-	-	-	-	-
310	-	Ext	Gujrat	District	-	-	-	-	-
311	-	Ext	Jhelum	District	-	-	-	-	-
	-	Ext	Mirpur Has	District	-	-	-	-	-
312	-	Ext	Hafizabad	District	-	-	-	-	-
	-	Ext	Mandi Baha-ud-Din	District	-	-	-	-	-
	-	Ext	Ralwalpindi	District	-	-	-	-	-
	-	Ext	Attock	District	-	-	-	-	-
	-	Ext	Islamabad	District	-	-	-	-	-
	-	Ext	Rest of Azad Kashmir	District	-	-	-	-	-
	-	Ext	FATA		-	-	-	-	-
	-	Ext	Chakwal	District	-	-	-	-	-
313	-	Ext	Layyah	District	-	-	-	-	-
	-	Ext	Faisalabad	District	-	-	-	-	-
	-	Ext	Jhang	District	-	-	-	-	-
	-	Ext	Chiniot	District	-	-	-	-	-
	-	Ext	Toba Tek Singh	District	-	-	-	-	-
	-	Ext	Sargodha	District	-	-	-	-	-
	-	Ext	Bhakkar	District	-	-	-	-	-
	-	Ext	Khushab	District	-	-	-	-	-
	-	Ext	Mianwali	District	-	-	-	-	-
314	-	Ext	Bahawalpur	District	-	-	-	-	-
	-	Ext	Bahawalnagar	District	-	-	-	-	-

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
314	-	Ext	R.Y. Khan	District	-	-	-	-	-
	-	Ext	D.G. Khan	District	-	-	-	-	-
	-	Ext	Muzaffargar h	District	-	-	-	-	-
	-	Ext	Rajanpur	District	-	-	-	-	-
	-	Ext	Multan	District	-	-	-	-	-
	-	Ext	Khanewal	District	-	-	-	-	-
	-	Ext	Lodhran	District	-	-	-	-	-
	-	Ext	Vehari	District	-	-	-	-	-
	-	Ext	Sahiwal	District	-	-	-	-	-
	-	Ext	Okara	District	-	-	-	-	-
	-	Ext	Pakpattan	District	-	-	-	-	-
	-	Ext	Kasur	Patoki	-	-	-	Dholan Chak No.27	-
	-				-	-	-	Bhopay Wall	-
	-				-	-	-	Awan Chak 39	-
	-				-	-	-	Hanjarai Kalan	-
	-				-	-	-	Halla	-
	-				-	-	-	Alpa Kalan	-
	-				-	-	-	Sheikhum	-
	-				-	-	-	Padhana Chak No. 45	-
	-				-	-	-	Jamber Khurd	-
	-				-	-	-	Bharwal Kalan	-
	-				-	-	-	Kot Sardar Kahan Singh	-
	-				-	-	-	Sarai Noshera Rural	-
	-				-	-	-	Khankay Mor	-
	-				-	-	-	Gulzar Jageer	-
	-				-	-	-	Chak No. 66 Dina Nath	-
	-				-	-	-	Nathay Khalsa	-
	-				-	-	-	Wan Radha Ram	-
	-				-	-	-	Bhadian Chak No. 35	-
	-				-	-	-	Wan Adhan	-
	-				-	-	-	Ghumankay	-
	-				-	-	-	Kanween	-
	-				-	-	-	Bhagiana Kalan	-
	-				-	-	-	Phulyani	-
	-				-	-	-	Chak No.7	-
	-	Ext	Kasur	Chunian	-	-	-	Chak No.13	-
315	-	Ext	KPK	*Province*	-	-	-	-	-
	-	Ext	Gilgit Baltistan	*Province*	-	-	-	-	-
316	-	Ext	Sindh	*Province*	-	-	-	-	-
317	-	Ext	Balochistan	*Province*	-	-	-	-	-
318	-	Ext	India	*Special Generator*	Road	-	-	India	-

Zone	Zone Area (ha)	Int/ Ext	District	Tehsil	Town	UC No.	UC Area	Name	Split-UC
319	-	Ext	Afghanistan	*Special Generator*	Road	-	-	Afghanistan	-
320	-	Ext	Rest of the World	*Special Generator*	Air	152A	-	Rest of the World	152A
401	-	Bin	Lahore	Lahore	-	-	-	-	-
402	-	Bin	Lahore	Cantt	-	-	-	-	-
420	-	Bin	Lahore	Lahore	Gulberg	-	-	-	76E-76W
421	-	Bin	Lahore	Lahore	Gulberg	-	-	-	96E-96W