

**ISLAMIC REPUBLIC OF PAKISTAN
BOARD OF INVESTMENT**

**PREPARATORY SURVEY
ON
JICA COOPERATION PROGRAM
FOR
INDUSTRY DEVELOPMENT
(INVESTMENT CLIMATE IMPROVEMENT
IN KARACHI)**

**FINAL REPORT
EXECUTIVE SUMMARY**

SEPTEMBER 2012

**JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)
NIPPON KOEI CO., LTD.**

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ABBREVIATIONS

AASHTO	American Association of State highway and Transportation Official
ADB	Asian Development Bank
APs	Affected Persons
B/C	Benefit/ Cost Ratio
BOI	Board of Investment
BOO	Build Operation and Own
BOT	Build Operation Transfer
BQPS-I	Bin Qashim Power Station - I
BQPS-II	Bin Qashim Power Station - II
BRT	Bus Rapid Transit
CBD	Central Business District
CDGK	City District Government Karachi
CHASHNUP	Chashuma Nuclear Power Plant
CNG	Compressed Natural Gas
CSR	Corporate Social Responsibility
DD	Detail Design
DHA	Defense Housing Authority
DISCOs	Distribution Companies
ECNEC	Executive Committee of National Economic Council
EHS	Environmental Health and Safety
EIA	Environment Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPO	Environmental Protection Order
EPZA	Export Processing Zones Authority
EVTL	Engro Vopak
F/S	Feasibility Study
FDI	Foreign Direct Investment
FESCO	Faisalabad Electric Supply company
FIRR	Financial Internal Rate of Return
FOTCO	Fauji Oil Terminal Company
FTC	Finance & Trade Center
GDP	Gross Domestic Product

GE	General Electric
GENCOs	Generation Companies
GENECO I	Jamshoro TPS, Kotri TPS
GENECO II	Guddu TPS, Quetta TPS
GENECO III	Muzaffargarh TPS, Faisalabad TPS, Multan TPS, Shahadara PP
GENECO IV	Lakhra Coal Power Plant
GEPCO	Gujranwala Electric Power company
GOP	the Government of Pakistan
GPS	Global Positioning System
HESCO	Hyderabad Electric Supply company
HFL	High Flood Level
HFO	Heavy Fuel Oil
HRSR	Heat Recovery Steam Generator
HSE	Health, Safety and Environment
IEE	Initial Environmental Examination
IESCO	Islamabad Electric Supply company
IFC	International Finance Corporation
IMC	Independent Monitoring Consultant
IMF	International Monetary Fund
IPPs	Independent Power Producers
JACI	the Japanese Association of Commerce and Industry
JBIC	Japan Bank for International Cooperation
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
KANUPP	Karachi Nuclear Power Plant
KATI	Korangi Association of Trade and Industry
KCCPP	Korangi Combined Cycle Power Plant
KCR	Karachi Circular Railway
KDA	Karachi Development Authority
KEPZ	Karachi Export Processing Zone
KESC	Karachi Electricity Supply Company
KGTPS-I	Korangi Town Gas Turbine Power Station – I
KGTPS-II	Korangi Town Gas Turbine Power Station – II
KMC	Karachi Metropolitan Corporation
KSDP 2020	Karachi Strategic Development Plan 2020
KTIP	Karachi Transportations Improvement Project

KTPS	Korangi Town Gas Turbine Power Station
KUTC	Karachi Urban Transport Corporation
KUTMP	Karachi Urban Transport Master Plan
KW & SB	Karachi Water & Sewerage Board
LAA	land Acquisition Act
LCT	Liquid Cargo Terminal
LESCO	Lahore Electric Supply company
LFLS	Low Frequency Load Shedding
LIA	Landhi Industrial Area
LNG	Liquid Natural Gas
M-10	Northern Bypass
MDGs	Millennium Development Goals
MEPCO	Mutan Electric Power Company
MES	Military Estate Service
MGD	Mega Gallon per Day
MMCFD	Millions of cubic feet per day
N-25	RCD Highway
N-5	National Highway
N-9	Super Highway
NCS	National Conservation Strategy
NEAP	National Environmental Action Plan
NEPRA	National Electric Power Regulatory Authority
NEQS	National Environmental Quality Standards
NHA	National Highway Authority
NOC	No Objection Certificate
NPV	Net Present Value
NTDC	National Transmission and Dispatch Company
NTRC	National Transport Reserch Center
O&M	Operation & Management
OD	Origin-Destination
ODA	Official Development Assistance
PC	Project Concept Paper
PCU	Passenger Car Unit
PEPA 1997	the Pakistan Environmental Protection Act, 1997
PEPC	Pakistan Environmental Protection Council
PEPCO	Pakistan Electric Power Company

PEPO	Pakistan Environmental Protection Ordinance
PESCO	Peshawar Electric Supply company
PIBT	Pakistan International Bulk Terminal
PPP	Public - Private - Partnership
PQA	Port Qasim Authority
PSM	the Pakistan Steel Mills
PTPS	Pakistan Transport Plan Study
QESCO	Quetta Electric Supply company
QICT	Qasim International Container Terminal
RAP	Resettlement Action Plan
ROW	Right of Way
SADEP	Special Assistance for Development Policy and Project
SEA	Strategic Environmental Assessment
SEPCO	Sukkur Electric Power company
SEZ	Special Economic Zone
SGTPS-I	SITE Gas Turbine Power Station – I
SGTPS-II	SITE Gas Turbine Power Station – II
SITE	Sindh Industrial Trading Estates
STPS	Site Thermal Power Station
TESCO	Tribal Electric Supply company
TMAAs	Tehsil Municipal Administrations
TOR	Terms of Reference
TSR	Transport Sector Report
TTC	Travel Time Cost
UFLS	Under Frequency Load Shedding
UNDP	United Nations Development Program
VOC	Vehicle Operating Costs
WAPDA	Water and Power Development Authority
WB	World Bank
WTP	Willingness to Pay

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CHAPTER 1 INTRODUCTION

1.1 Background of the Study

In response to the request of the Government of Pakistan (GOP), the Japan International Cooperation Agency (hereinafter referred to as “JICA”) decided to dispatch an investment Climate Advisor (hereinafter referred to as “the advisor”) to the Board of Investment (hereinafter referred to as “BOI”). The advisor began his work commencing May 2010.

Under the initiative of the advisor, the report on the “Problem-Analysis and Solution-Action” was submitted to BOI by the Japan Association for Commerce and Industries (JACI), and Japan External Trade Organization (JETRO). A number of suggestions from the Japanese private sector to improve the business climate in Karachi are included in the “Problem-Analysis and Solution-Action” document. Effective implementation of these suggestion is strongly recommended to meet the demand of foreign investors and to attract future investment.

In order to implement these suggestions, the BOI, JICA and the advisor agreed on the necessity of detailed studies by each specialist from various areas/sectors. To respond timely and efficiently to requests from the private sector, BOI, JICA, and the advisor agreed to conduct the “Basic Study on Program for Investment Climate in Karachi”. Accordingly, JICA decided to undertake the Study in close cooperation with BOI.

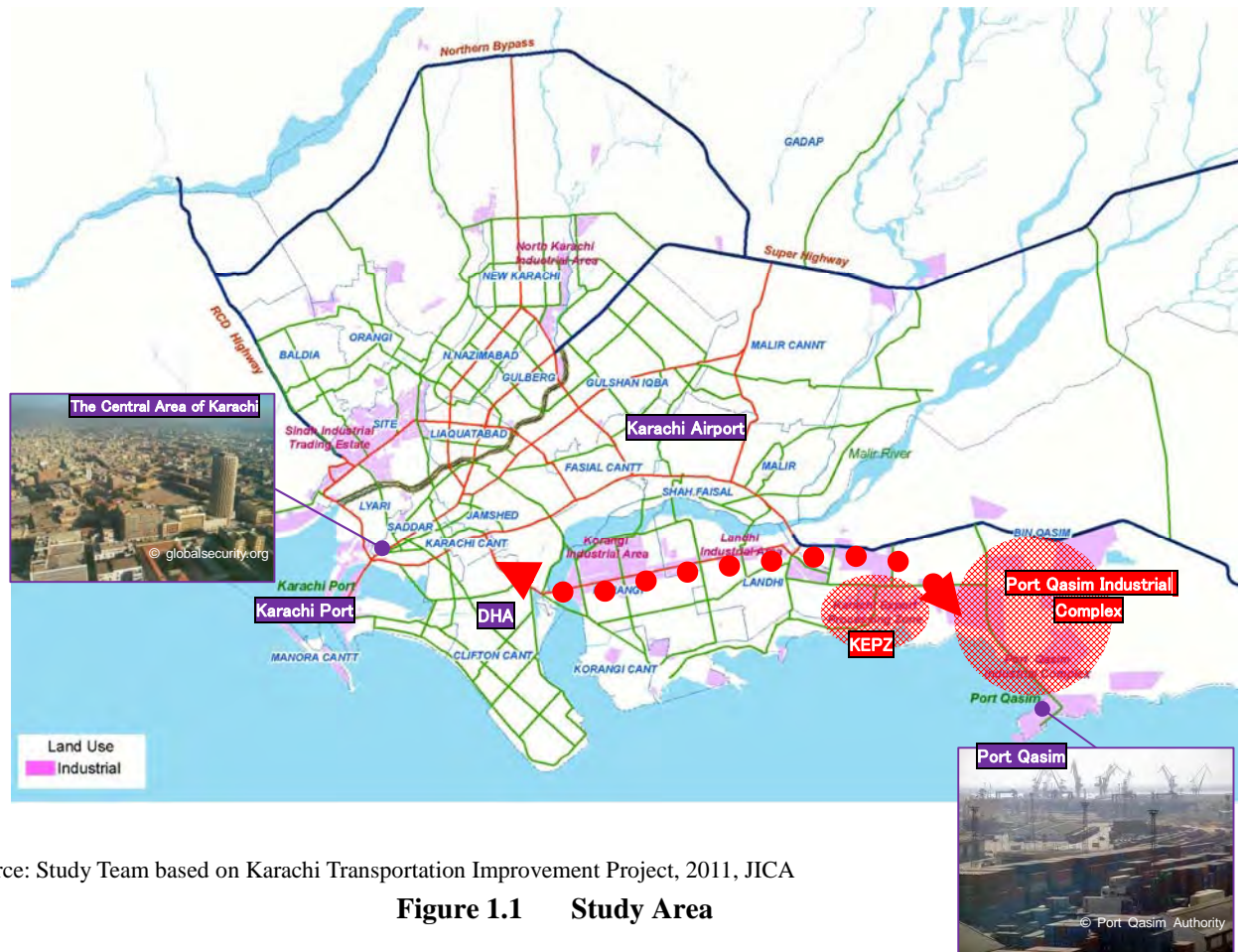
1.2 Objectives of the Study

The study seeks to:

- 1) Clarify the present problems for industrial infrastructure (road and electric sector) in the Study Area from the aspect of improving the overall investment climate;
- 2) Identify candidates for the industrial infrastructure programs/projects; and
- 3) Formulate a priority project.

1.3 Study Area

The Study Area covers the central area of Karachi to Karachi Export Processing Zone (hereinafter referred to as “KEPZ”), Port Qasim Industrial Area, and surrounding areas including access roads to the industrial zones, which are located about 30 km east from the central area of Karachi, (shown in **Figure 1. 1**).



1.4 Scope of Works

The scope of work is shown below.

(1) Interview Survey for Enterprises in Study Area and Pakistan-related Organizations

- 1) The interview survey was carried out for companies in the Study Area, which include Japanese and foreign-affiliated companies, to clarify the present problems of industrial infrastructure.
- 2) The main components to be surveyed include the following:
 - i) Present condition of industrial infrastructure;
 - ii) Level of service;
 - iii) Utilization situation; and
 - iv) Identification of problems and issues.

(2) Specifying Priority Project of Road Sector

- 1) Traffic survey will be conducted.
- 2) Road inventory survey will be conducted.
- 3) Based on the above surveys, about two or three priority projects will be selected.

(3) Specifying Priority Project of Power Sector

- 1) The existing survey, development plan, and feasibility study (F/S) will be reviewed.
- 2) The time and quality of supplied electricity will be confirmed.
- 3) The condition of the plants of the Karachi Electric Supply Company (KESC) for electrical production, transmission, transformation, and distribution will be confirmed.
- 4) Based on the above surveys, about two or three priority projects will be selected.

(4) Preparation of Project Concept Paper Made for Road Sector and Power Sector

- 1) The project concept paper to be prepared will be classified according to the following categories;
 - i) PC-I: The project which F/S or detailed design (D/D) has already completed appropriately.
 - ii) PC-II: The project which is necessary to formulate the implementation plan in the future and F/S is not carried out or additional survey is required.

(5) Pre-feasibility Study for Priority Road Project

- 1) The pre-F/S of a road project with highest priority will be conducted.
- 2) Scope of the pre-F/S includes the following:
 - i) Preliminary design;
 - ii) Cost estimation;
 - iii) Project effects;
 - iv) Project implementation organization;
 - v) Implementation schedule;
 - vi) Management and maintenance system; and
 - vii) Pre-environmental assessment.

CHAPTER 2 CURRENT CONDITIONS FOR INFRASTRUCTURE DEVELOPMENT

2.1 Problem-Analysis and Solution-Action (2011) by JICA Expert

JICA has dispatched an expert to the Board of Investment (BOI) in May 2011 for BOI Empowerment Project. The Problem-Analysis and Solution-Action was prepared to solve the critical issues that include legal and institutional system and infrastructure problems, which are faced by the Japanese investment companies in Karachi. The Problem-Analysis and Solution Action was headed by the JICA Expert in collaboration with JACI and JETRO in Karachi. The document was then submitted to BOI in April 2011.

As for the infrastructure sector in the Problem-Analysis and Solution-Action, the Japanese investment companies requested the GOP to improve the condition of roads leading to factories and enhance the electrical power supply through the following measures as listed below.

a) Road Infrastructure

- Conditions of the inner roads in Landhi Industrial Area surrounding KEPZ are poor due to insufficient road width, which causes abnormal traffic congestions and frequent traffic accidents. Thus, truck operation of factories should solve the serious problem for freight transportation. Consequently, such situation should reflect upon the increase of operation cost.
- Employees to foreign investment companies and factory workers in KEPZ and Port Qasim areas are commuting via Shahrah-e-Faisal and the National Highway. Traffic congestion and accidents usually occur after passing the international airport, due to narrowing road widths of two-lane on one direction, serious traffic jams at intersection, and parking of oil tankers and trailers on road shoulders between Quaid Abad Flyover and Port Qasim.
- Foreign investment companies provide shuttle bus transportation services for factory workers. Delay of commuting seriously impact on the production activities by factory. In addition, stopping along the way due to congestion could increase the risk of getting mugged at gunpoint on the street.

b) Electrical Power Supply

- Constant and stable electrical power supply is the key component in the production activities of factories. However, since this condition is not guaranteed by the power supply company, the manufacturing plant has to purchase and install its own generator.
- Electrical fluctuation affects the production quality, so that factories are forced to pay additional investment in plant and equipment to cope with fluctuation.

One outcome from a dialogue between the Japanese side and BOI is the Mehran Highway Project. The GOP promised to allocate a budget for the construction of Mehran Highway from PMTF Road to Pakistan Steel Mills Road (8.3 km) using Counter Value Fund of the Government of Japan, and then, the project is currently under implementation.

The issues of utility supply such as electricity, water, and gas have been getting serious in recent years. Numerous industrial factories have shifted to India, Sri Lanka, and Bangladesh due to the inconsistent utility supply. The JICA Study Team (hereinafter referred to as "Study Team") conducted the interview survey for a total of 25 companies to station at KEPZ, Port Qasim, Landhi Industrial Area, S.I.T.E. etc. The following are major points from the interview survey

regarding industrial infrastructure:

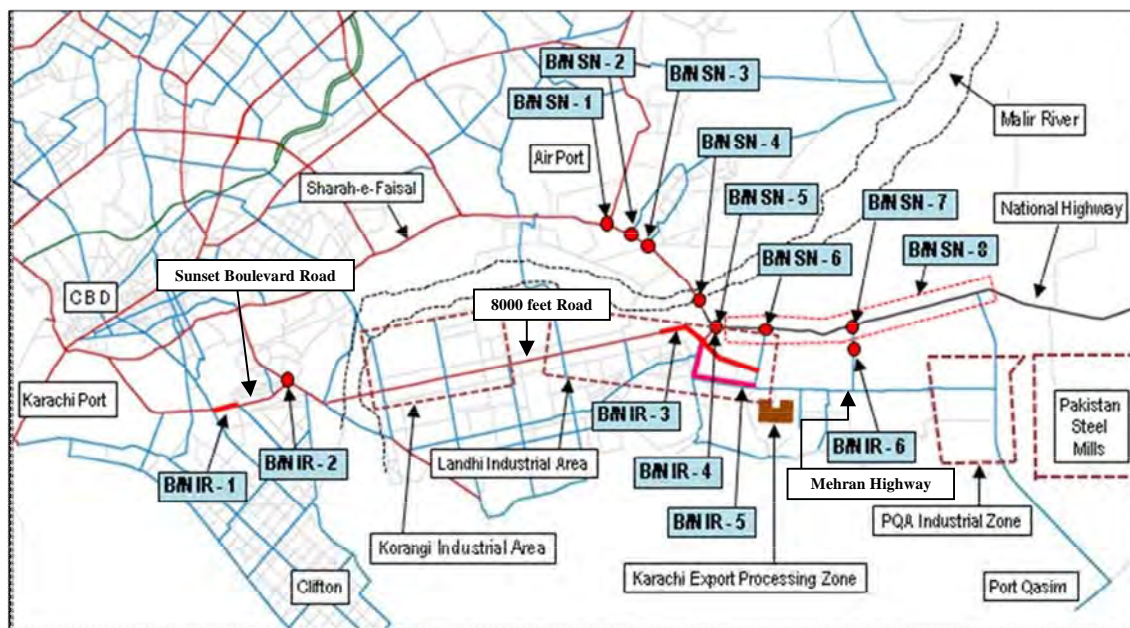
- Consistent electrical power supply is an important premise and be made available continuously at the Industrial Park. However, due to load shedding and breakdown, many companies have shifted toward having their own power generation mainly using the industrial gas supply network.
- Inconsistent supply of industrial gas is also an issue. Depending on industrial gas demand and consumption, the load shedding of gas affects the power generation in the factory.
- Water supply is also a problem. Due to electrical power breakdowns, the water pump in the industrial zone becomes non-functional, which consequently stops water supply.
- The companies to station at KEPZ and Port Qasim complained about the road conditions leading to their factories.

2.2 Current Bottleneck to Access Roads to Industrial Areas

There are two main access routes to the Korangi Industrial Area, Landhi Industrial Area, and Port Qasim from the Central Business District (CBD) and Clifton Residential Area, which are as follows: Sunset Boulevard Road – 8000 feet Road – Mehran Highway Route

- i) Shahrah-e-Faisal – National Highway Route

Figure 2.1 shows the locations of bottlenecks to be identified through site reconnaissance survey of the Study Team.



Source: JICA Study Team

Figure 2.1 Locations of Identified Bottlenecks between the Central Business District and Port Qasim




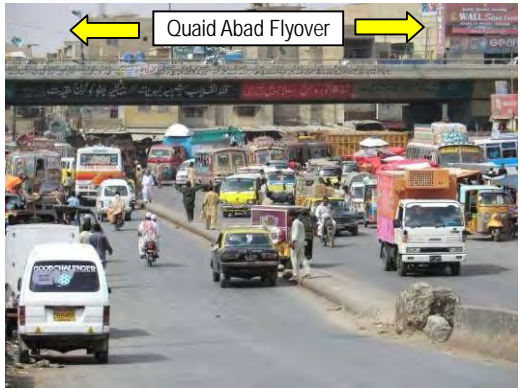
- 1) Sunset Boulevard Road – 8000 feet Road – Mehran Highway Route



Major bottlenecks on the route of Sunset Boulevard Road – 8000 feet Road – Mehran Highway are summarized in **Table 2.1**. Most of the problems of the said route happen at the connectivity of the road sections between Future Colony on 8000 feet Road and Hospital Chowrangi on Mehran Highway. This is due to the narrow and poor road conditions, and that roads run through

residential areas.

Since heavy vehicles such as trailers and tankers contribute to heavy traffic on the said section, it is desirable to separate the main carriageway for these vehicles and the service road for community transportation. However, road widening improvement seems very difficult to implement due to land acquisition along the road. In addition, the accessibility between Landhi Industrial Area and the National Highway must also be improved.

Table 2.1 Bottleneck Conditions for Sunset Boulevard Road – 8000 feet Road Corridor

ID No.	B/N IR - 1	B/N IR - 2
Location	Sunset Boulevard Road at PT Colony	Intersection of Sunset Boulevard Road and Korangi Road
Site Photo		
Condition	<ul style="list-style-type: none"> - Only 0.9 km section has a four-lane carriageway. - Large-scale land acquisition is required to widen it to six-lane with service roads on both sides. 	<ul style="list-style-type: none"> - Two principal arterial roads are intersected by signal control. - Sunset Boulevard Road – Qayyum Abad Flyover direction has main traffic flow.
ID No.	B/N IR – 3	B/N IR - 4
Location	8000 feet Road at Future Colony	Lottery under Quaid Abad Flyover
Site Photo		
Condition	<ul style="list-style-type: none"> - Carriageway has only four lanes. - On-street parking is disturbing the traffic flow on carriageway. 	<ul style="list-style-type: none"> - Lottery has constant traffic congestion due to taxis and buses waiting for passengers on the road.

ID No.	B/N IR - 5	B/N IR - 6
Location	Mehran Highway from Rice Godown to Hospital Chowrangi	Railway Crossing on PMTF Road
Site Photo		
Condition	<ul style="list-style-type: none"> - Road surface condition is very poor. - On-street parking disrupts traffic flow on carriageway. 	<ul style="list-style-type: none"> - Railway crossing section is narrow compared with the anteroposterior of the road section.





Source: JICA Study Team

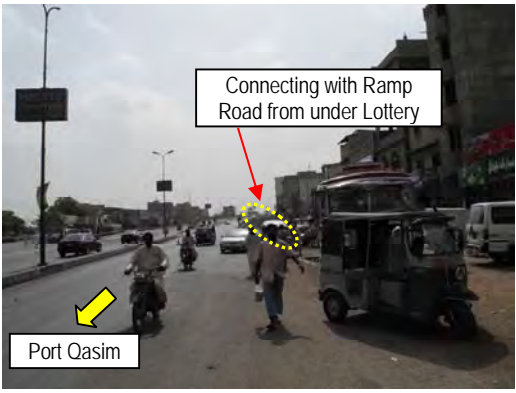
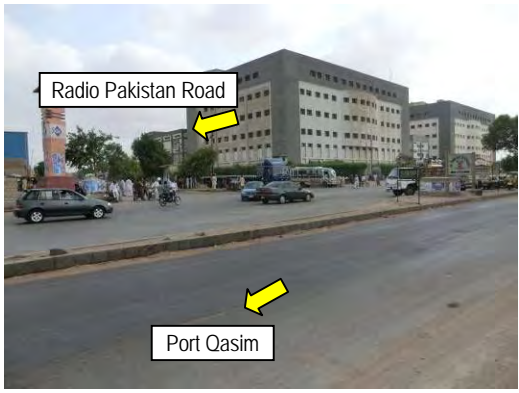


2) Shahrah-e-Faisal – National Highway Route

Table 2.2 shows and describes the major locations of bottlenecks along the road section between Shahrah-e-Faisal and the National Highway to Port Qasim.

The road section of Shahrah-e-Faisal between the Army Settlement Flyover and International Airport has been completed as a signal-free corridor. The road alignment has a minimum of six lanes for the carriageway, with service roads leading to the residential areas so that the smooth traffic may be provided to road users. The road section between the International Airport and Port Qasim has a four-lane carriageway, and intersections with major roads are at-grade. Therefore, such locations at intersections create traffic bottlenecks.

Table 2.2 Bottleneck Conditions on Shahrah-e-Faisal – National Highway

ID No.	B/N SN – 1	B/N IR SN - 2
Location	Intersection of Malir Halt and Shahrah-e-Faisal	Intersection of Begum Khursheed Road and Shahrah-e-Faisal
Site Photo		
Condition	<ul style="list-style-type: none"> - Waiting taxis and stopping buses are disturbing the traffic flow along the carriageway. - Open-air shops along the sides of the ROW space are also disturbing the traffic flow. 	<ul style="list-style-type: none"> - Waiting taxis and stopping buses are disturbing the traffic flow on the carriageway.
ID No.	B/N SN - 3	B/N SN - 4
Location	Intersection of Malir No. 15 and Shahrah-e-Faisal	After Malir River Bridge on National Road (bound for Port Qasim)
Site Photo		
Condition	<ul style="list-style-type: none"> - Two intersections, Abdullah Naseem Road and Marad Memon Goth Road, are close. - Waiting taxis and stopping buses are disturbing the traffic flow on the carriageway. - Open-air shops along the narrow ROW are also disturbing the traffic flow. 	<ul style="list-style-type: none"> - A community road connects with the beginning of the approach of Malir River Bridge. - Parking and stopping vehicles (minibuses and taxis) are disturbing the traffic flow.

ID No.	B/N SN - 5	B/N SN - 6
Location	After Quaid Abad Flyover on National Road (Bound for Port Qasim)	Intersection of Radio Pakistan Road and the National Road (bound for Hospital Chowrangi)
Site Photo		
Condition	<ul style="list-style-type: none"> - A ramp road from the lottery under the flyover connects with the bridge approach without providing the required tapers. - Stopping and parking vehicles on the road shoulder are disturbing the traffic flow. 	<ul style="list-style-type: none"> - Traffic signal system has not been installed at the intersection. - The intersection has high traffic volume of trailers and tankers coming from the direction between Landhi Industrial Area and Port Qasim.
ID No.	B/N SN - 7	B/N SN - 8
Location	Intersection of PMTF Road and the National Highway	Entire section between Quaid Abad Flyover and Port Qasim along the National Highway
Site Photo		
Condition	<ul style="list-style-type: none"> - Traffic signal system has not been installed at the intersection. - The intersection has a high traffic volume of trailers and tankers coming from the direction between Landhi Industrial Area and Port Qasim. 	<ul style="list-style-type: none"> - Parking or stopping of tankers and trailers on road shoulder are disturbing the traffic flow along the carriageway.

Source: JICA Study Team

CHAPTER 3 ELECTRICAL POWER SECTOR DEVELOPMENT PROJECTS

3.1 Actual Status and Background of Electric Power Supply

The Islamic Republic of Pakistan is now facing power shortage crisis, which has not been experienced by the Pakistani people as well as power companies before the last decade. The crisis rose up by the rapid increase of demand and steep rise of oil prices, as well as the gap between power demand and supply capacity grows year-by-year. The shortage of supply capacity has been adjusted by load-shedding, but it has been frustrating people since no fundamental solution was taken to solve the problem.

The power demand exceeded the supply capacity in 2003, but no new generation facility has been built. The demand has increased further, and exceeded 20% of the supply capacity in 2010. The shortage of power has been adjusted only by load-shedding until now.

In such situation, the Study Team started to focus on the improvement of electricity supply circumstances in the KEPZ and Bin Qasim Industrial Area; and seek for projects that will contribute to the improvement of power supply circumstances of the target area, as well as improving the living conditions of the people of Pakistan.

The electric supply condition in Karachi and in other areas of Pakistan is quite different because different power companies supply power.

The Karachi Electric Supply Company (KESC) supplies electricity to Karachi City and its suburbs, while the Water Power Development Authority (WAPDA) group supplies power to other areas of Pakistan. WAPDA is a very large power supply utility that supplies power to areas not covered by KESC, but was unbundled to multi-companies, specializing hydropower, thermal power, transmission, distribution, and administration. WAPDA is not a company that specialized to hydropower. But WAPDA group still used the generic name of the multi-companies after unbundled. KESC was established in 1913 and is considered as a time-honored power company. The GOP instructed KESC to be privatized by transferring KESC's share to the consortium of companies in Saudi Arabia and Kuwait in 2003 to 2005. On the other hand, WAPDA group still consists of government-linked companies. This caused different power supply events between Karachi and the other areas.

The total installed capacity of generators in Pakistan in 2010 was 19,437 MW, and that of KESC was 2,158 MW. Therefore, the facility scale of KESC is more than 10% of the total of Pakistan. Although KESC is privatized, it still monopolize the power supply to the citizens of Karachi City. Karachi citizens cannot receive power from other power companies, unless the National Electric Power Regulatory Authority (NEPRA) gives permission to other companies. The target area of this Study also receives power from KESC, therefore realistic projects will not be proposed by the Study Team unless the team carefully looks into the development policy of KESC.

Although power shortage is serious in the country, GOP instructed the WAPDA group to supply 650 MW to KESC, and such agreement was signed in 2010 effective for five years. As KESC is privatized and becomes profit-making enterprise, priority for power supply is given to industrial consumers from whom revenue collection is ensured. Such government policy makes the rest of the ordinary citizens worry about unequal distribution of power supply.

However, the power shortage in WAPDA group is more serious than KESC. The WAPDA group say the duration of load-shedding is almost double of that in KESC area. This fact creates a feeling of unfairness among nationals. As it is uncertain whether the agreement will be renewed in 2015 or not, the consumers suspects that there would be more serious load-shedding in

Karachi City.

As there is no hydropower site in KESC area, power generation depends on thermal plants. Most the thermal plants are designed with dual-fuel of heavy fuel oil (HFO) and natural gas. As oil price increased, power has been generated by reducing the consumption of HFO but increasing the use of natural gas. Recently, however, as vehicles like trucks have converted the fuel usage from diesel to compact natural gas (CNG), the demand of natural gas has increased rapidly. The GOP issued the “Natural Gas Allocation Management Policy” in 2005, and began to restrict the allocation of natural gas for power generation. In June 2012, only 220 MMcfd (million cubic feet per day) of natural gas is supplied to KESC against the total requirement of 450 MMcfd. To eliminate the circumstance, KESC planned to convert their two out of six units of steam turbine generators at Bin Qasim Power Plant-I from dual-fuel of HFO and natural gas to coal-fired, and has been acting to realize the plan. Furthermore, KESC is seeking power sources not relying on oil or natural gas, such as change the open mode gas turbine to combined cycle mode.

KESC has 220 kV ring transmission lines, which encircles Karachi City, and expanding 132 kV transmission line in radial. The transmission loss was set to 2.5%, which is within the reasonable range at present. This is partly because there are no long-distance lines in Karachi. However, in residential areas, residential consumers are changing to commercial/industrial consumers, and in industrial area, power demand is also increasing. These caused overload on existing facilities. The trip by the overload is the reason for power outage. Therefore, new grid substations and 132 kV transmission lines to connect them are necessary.

The existing conductors for 11 kV and 400 V distribution lines are old. Then, incurred huge distribution loss of 35%. Small conductor induces over-current and voltage-drop. Short circuits, ground faults, and missing phase caused by bare conductor all lead to power outage and poor power quality. Bare conductor also allows many power thefts, which causes financial difficulties of KESC, and lengthens the duration of load-shedding within the area.

The outline of power supply status of KESC is 60% of supply capacity generated by its own facilities, while 40% is bought from IPPs, WAPDA group, and nuclear plants. However, there is a power loss of 35% due to transmission and distribution loss, therefore, the remaining 65% power is available for sale.

The consumers consist of industrial (1%), commercial (22%), and residential consumers (77%). While the ratio of revenue consists of industrial consumers (50%), commercial consumers (18%), and residential consumers (32%). Thus, the 1% of the total consumers consisting of industrial consumers contributes 50% of the total revenue of KESC. The industrial consumers are very important for KESC. According to KESC, load-shedding is not conducted in industrial zones.

As per the interview with numerous industrial consumers in Bin Qasim Industrial Zone, it is confirmed that load-shedding is not applied to the area. However, the fact does not mean that the power is supplied properly. Unannounced power outages occurred for 2 to 8 accumulated hours per month, and such power supply is not suitable for factory operations. In other industrial areas, there were 0 to 20 hours of unannounced power outages recorded. The fault of transmission and distribution facilities are inferred to be the causes of power outages.

The tariffs to the industrial consumers are ranging from Rs11 to Rs13 (US\$0.117 to US\$0.138), and the generation cost of their emergency diesel generators excluding initial cost is around Rs35 (US\$0.372). There are some consumers having gas turbine generators to cover fully or partly their usage. The generation cost of the gas turbine generator is from Rs5 to Rs7.5 (US\$0.053 to US\$0.079). It was found that independent diesel generators costs more than the tariff; but the generation cost of gas turbine is cheaper than the tariff. Therefore, almost all the factories are studying to introduce gas turbine, if the consumption is reasonably large. But as the gas supply

may stop on a particular day of the week, factory owners are worried about the unsteady supply of gas. The industrial consumers expect KESC to supply cheap and steady power.

3.2 Future Plan

The Study Team requested KESC to provide a list showing the projects in the future plan. Projects 1 to 8 in the given list are related to generation. In addition, the Study Team added Projects 9 and 10, for transmission and distribution. These two additional projects are based from plans such as “Karachi Strategic Develop Plan 2020” of the Master Plan Group of Offices under the City District Government Karachi, (at present it is called Karachi Metropolitan Corporation: KMC) after reviewed by the Study Team. Also, the Study Team added Project 11 regarding the industrial zone. **Table 3.1** lists the potential projects related to power supply.

Table 3.1 List of Project Relating to Power Supply

Project No.	Projects	Approx. Cost (US\$ million)	Planned
1	Bin Qasim Power Station-I (BQPS-I) Fuel Conversion to Coal-fired (420 MW)	250	KESC
2	Karachi Waste-to-Energy, Build and Operation (22 MW)	65-70	KESC
3	Thar Coal Thermal Power Plant (300 MW, overall 1,200 MW)	450	KESC
4	Import Overseas LNG, Build and Operation (use for BQPS-II 560 MW)	300-350	KESC
5	Korangi Combined Cycle Power Plant (KCCPP) Convert Open mode unit to combined cycle mode	44	KESC
6	Korangi Gasturbine Power Station-II (KGTPS-II) Add combined mode	24	KESC
7	S.I.T.E Gasturbine Power Station-II (SGTPS-II) Add combined mode	24	KESC
8	Co-generation with Desalination Plant (25 MGD), by BOT	Unknown	PQA
9	Construction of Grid Substations and 132 kV Transmission Lines	130 (*1)	KMC
10	Renovation of Distribution Line	100 (*1)	Study Team
11	Construction of Pakistan Textile City including Power Plant of Max. 250 MW	Unknown	Study Team

Note.*1: This price is based on the tentative scope of the project, which is set by Study Team, and is variable.

Source: JICA Study Team

Projects 1 and 11 for which KESC or other company have almost finalized the fund; Project 2 which has huge operation scheme in its scope; Project 3 which has high costs and not suitable for this Study so that further feasibility study etc. is necessary; Project 4 which includes operation scheme in its scope with huge cost; and Project 8 which implies some risk and subject for further study; are eliminated from the recommended projects as these did not comply to the assistance of international funds. Projects 5, 6, 7, 9 and 10 are subject to further studies.

Projects 5, 6, and 7 are generating plants with combined cycle, by providing heat recovery steam generator (HRSG) and steam turbine to gas turbine, and increase generation capacity without additional fuel consumption. Increase in power generation of 26 MW, 10 MW, and 10 MW are expected from Projects 5, 6, and 7, respectively. Project 5 has four units of 48.4 MW gas turbines, while two units have already been successfully operating with combined cycle mode with 26 MW steam turbine. Project 5 will be for the remaining two units, and, therefore, is an assured project, and a new design for the project is not necessary. Projects 6 and 7 have the same reciprocated engine generators of 32x2.739 MW units. The projects will provide HRSG and steam turbine generator with an expected additional capacity of 10 MW for each plant.

Project 9 is to construct grid substations and to provide overhead or underground transmission

lines to the grid stations. It is impossible to determine the particular points in the populous dense area without detailed study including land acquisition plan. The estimated cost is for the ten new grid substations, though the scale of project is adjustable. Project 10 is to increase the sizes of conductors, change to insulated conductors, and add transformers and capacitors. The project scale is adjustable. The estimated cost is for the 5% of the total existing 11 kV and 400 V conductors. The owner of the both projects 9 and 10 will be KESC.

Projects 5, 6, and 7 are for generation. Investors in the industrial area doubt the reliability of the power supplied by KESC and the WAPDA group, as well as the restriction of using natural gas for generation. The Study Team considered that the projects for generation should have the highest priority, since reserving generation capacity is the fundamental solution. Although additional capacity under these projects is not large, the power is obtained without additional fuel. The projects will contribute to the finance and environment of Pakistan.

Project 9 is for transmission, while Project 10 is for distribution. Both projects will reduce the power outage by decreasing the overload to facilities and improving power quality by use of suitable materials. Among these two projects, Project 10 is prioritized because reducing large distribution loss of 35% has an almost equivalent effect of increasing generation capacity.

Project 11 is under construction already. Booking for the plots in the city is now open. The funds are from the shareholders of the Pakistan Textile City Limited. It looks additional funds from any donor is not necessary. The planned 250 MW generation plant for exclusive use for the city will not contribute to Karachi citizens outside the city.

3.3 Recommended Projects

Four of the recommended projects are shown below in **Table 3.2**.

The same priority is applied to Project 6 and 7, because the existing gas turbines of these two projects are of the same type and were installed in the same year.

Table 3.2 Recommended Projects for Final Selection

Project No.	Projects	Approx. Cost (US\$ million)	Priority
5	Korangi Combined Cycle Power Plant (KCCPP) Convert open mode unit to combined cycle mode	44	1
6	Korangi Gas Turbine Power Station-II (KGTPS-II) Add combined mode	24	2
7	S.I.T.E Gas Turbine Power Station-II(SGTPS-II) Add combined mode	24	2
10	Renovation of Distribution Line	100	3

Note: (*1) The cost of these projects is variable by changing project scale.

Source: JICA Study Team

3.4 Recommendation for GOP's Action

It is recommended that the GOP make the following arrangements to reduce the existing problems as well as expedite the realization of the recommended projects.

Fortunately, Projects 5, 6, and 7 are, basically to construct additional facilities within the premises of the existing power stations. Project 10 is also to install new pole supports and conductors to replace the existing ones, so that land acquisition seems not necessary and even EIA may not be necessary. Only the confirmation by GOP has to be done.

Table 3.3 Recommendation for GOP's Action

No.	Action	Priority
1	Finding funds for recommended four projects KESC is recommended to submit PC-1 for approval for the recommended four projects. Then, GOP is recommended to apply for loans to any possible international funds. If necessary another selection shall be made among those four. Confirmation whether EIA and other formalities are necessary or not, shall be made by GOP.	1
2	Bin Qasim Power Station (BQPS-I) Fuel conversion of BQPS-I to coal-fired, listed as Project 1 in the Study, should be implemented to reduce the present problem because the funding is almost finalized.	2
3	F/S for Renovation of Distribution Line For the renovation of distribution line listed as Project 10 in the Study, an feasibility study including the basic design should be conducted. Establishing the scope of work and design through the F/S can expedite the project implementation.	3

Source: JICA Study Team

CHAPTER 4 TRAFFIC SURVEY IN THE STUDY AREA

4.1 Traffic Survey

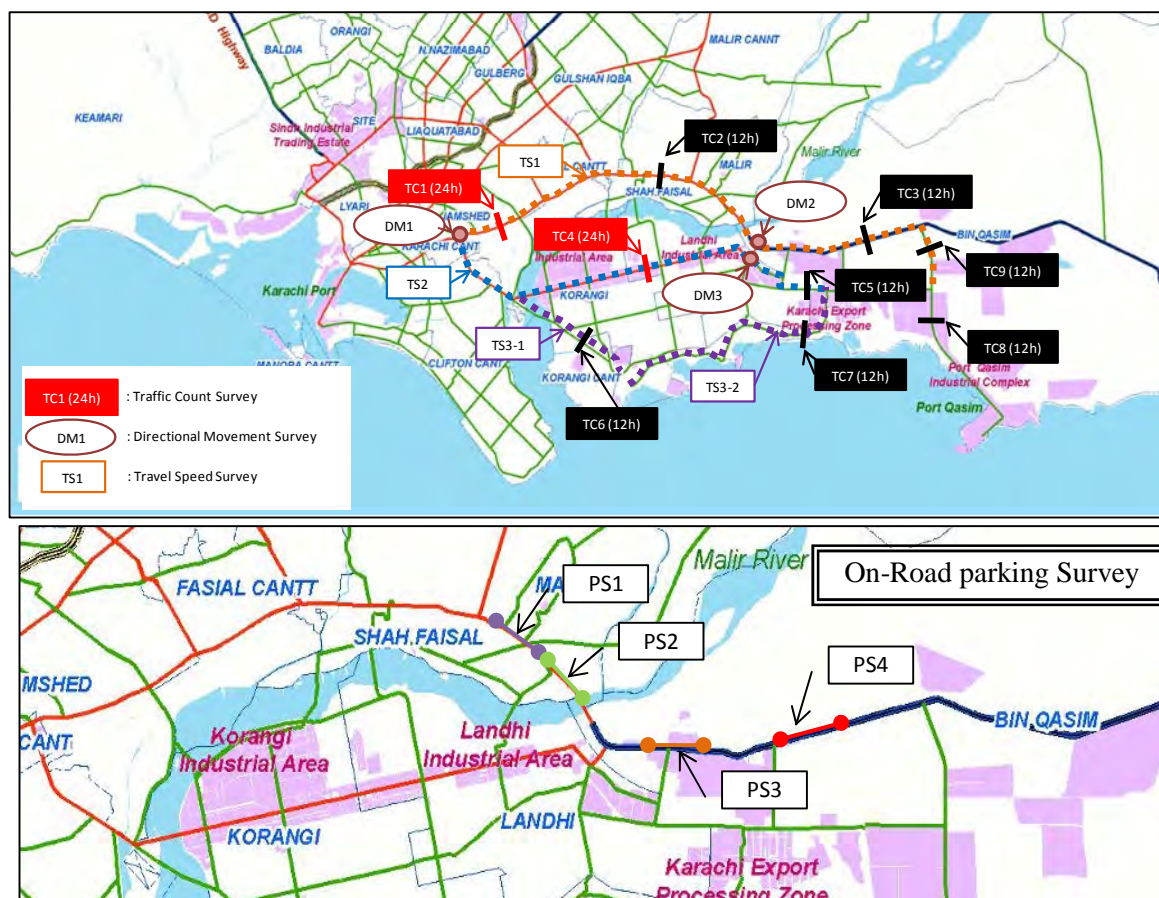
(1) Survey Outline

The traffic survey including the classified traffic count survey (for 12 hour and 24 hour intervals), directional movement survey at intersections, travel speed survey, and on-road parking survey were carried out to grasp the present traffic condition in the Study Area. These survey items are described in **Table 4.1**.

Table 4.1 Survey Outline

Survey	Method	Coverage
1) Classified Traffic Count Survey	• Traffic count (vehicles)	Two (2) locations (24 hrs) Seven (7) locations (12 hrs)
2) Directional Movement Survey at intersections	• Traffic count (vehicles) during peak hours.	Three (3) locations (7:00-10:00, 16:00-19:00)
3) Travel Speed Survey	• Actual driving survey by passenger car. • Three (3) round trips every route for three (3) time zones.	Four (4) routes (7:00-10:00, 10:00-16:00, 16:00-19:00)
4) On-Road Parking Survey	• Counting on-road parked vehicles. • Interviewing the drivers of parked vehicles.	Four (4) sections

Source: JICA Study Team



Source: JICA Study Team

Figure 4.1 Location of the Traffic Survey

4.2 Present Traffic Condition

(1) Traffic Volume and Vehicle Composition

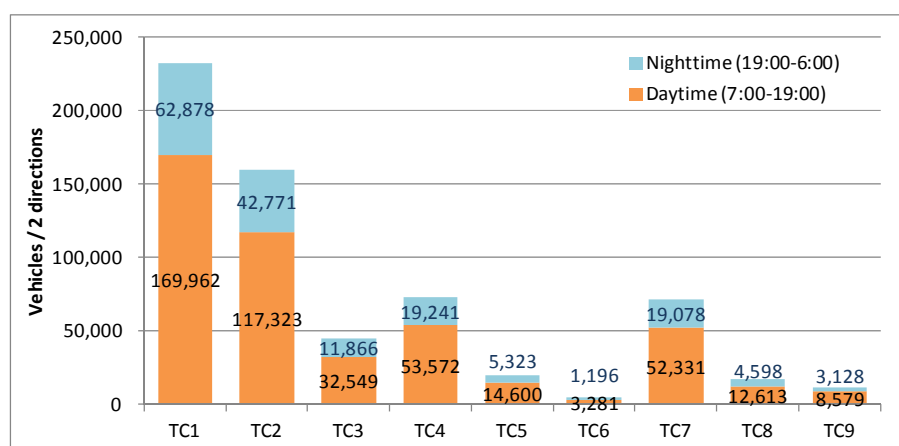
1) Traffic Volume

The detailed data for the 24-hour and 12-hour traffic volumes are shown in **Table 4.2** and **Figure 4.2**. The 12-hour traffic volumes of over 50,000 vehicles were observed at TC1, TC2, TC4, and TC7. These stations are located along Shahrah-e Faisal Road and Korangi Road. The largest traffic volume was observed at TC1 at 169,962 vehicles for 12 hours, and 232,840 vehicles for 24-hours.

Table 4.2 Results of the Classified Traffic Count Survey

Station	Direction		Traffic Volume (Vehicles)		
	From	To	12 hours (7:00 – 19:00)	24 hours (7:00 – 7:00)	Ratio of 24/12 hours
TC1	Airport	FTC	87,735	112,921	1.29
	FTC	Airport	82,227	119,919	1.46
TC2	FTC	PQA	60,552	-	-
	PQA	FTC	56,771	-	-
TC3	PQA	Quaidabad	15,322	-	-
	Quaidabad	PQA	17,227	-	-
TC4	Jam Sadiq Bridge	Dawood Chowranghi(Landhi)	33,471	43,176	1.29
	Dawood Chowranghi(Landhi)	Jam Sadiq Bridge	20,101	29,637	1.47
TC5	PQA	Landhi	5,600	-	-
	Landhi	PQA	9,000	-	-
TC6	Fishery	Korangi crossing	1,609	-	-
	Korangi crossing	Fishery	1,672	-	-
TC7	Hino Chowranghi	Korangi	21,222	-	-
	Korangi	Hino Chowranghi	31,109	-	-
TC8	PQA	N5	5,826	-	-
	N5	PQA	6,787	-	-
TC9	PQA	N5	4,142	-	-
	N5	PQA	4,437	-	-

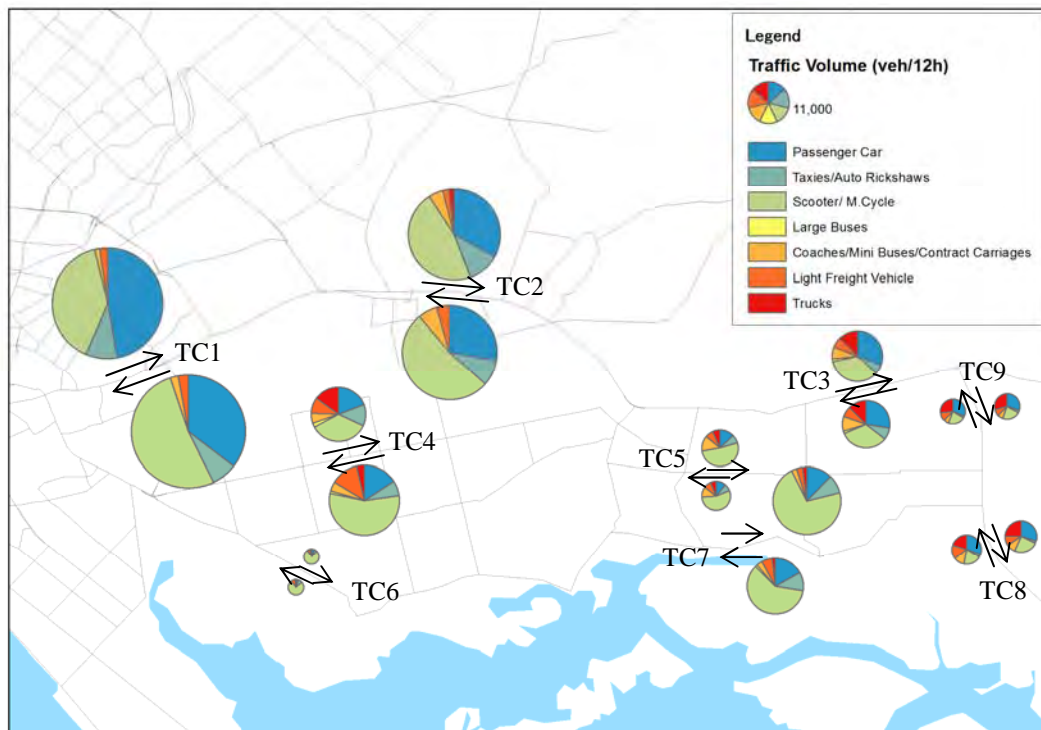
Source: JICA Study Team



Source: JICA Study Team

Figure 4.2 Traffic Volume
(Converted into 24-hour Traffic Volumes based on the Traffic Volume Ratios)

The highest traffic volumes were observed at Shahrah-e-Faisal Road. Passenger car and motorcycles were found to be the majority of vehicles passing in every station. However, the proportion of trucks (from 2–6 axles and more) is more relatively high in TC3, TC4, TC8, and TC9, (average of 17.8%), compared with the others stations (average of 2.6%). It is thought that these roads become access routes for commodity distribution.



	Passenger Cars	Taxis/Auto Rickshaws	Scooter / M.Cycle	Large Buses	Coaches	Light Freight Vehicle	Truck (2~6Axles)
TC1	69,670	13,882	77,963	212	3,198	4,473	564
TC2	35,228	11,586	57,774	457	6,774	3,953	1,551
TC3	9,519	2,283	11,049	504	2,860	2,317	4,017
TC4	9,180	4,873	25,669	807	2,675	6,147	4,221
TC5	1,783	1,133	7,677	25	1,915	1,124	943
TC6	197	244	2,479	0	15	254	92
TC7	7,334	5,081	34,703	485	1,536	2,148	1,044
TC8	3,789	344	2,772	35	1,292	1,494	2,887
TC9	2,621	242	1,889	19	580	822	2,406

Source: JICA Study Team

Figure 4.3 Distribution of Traffic Volume by Vehicle Type

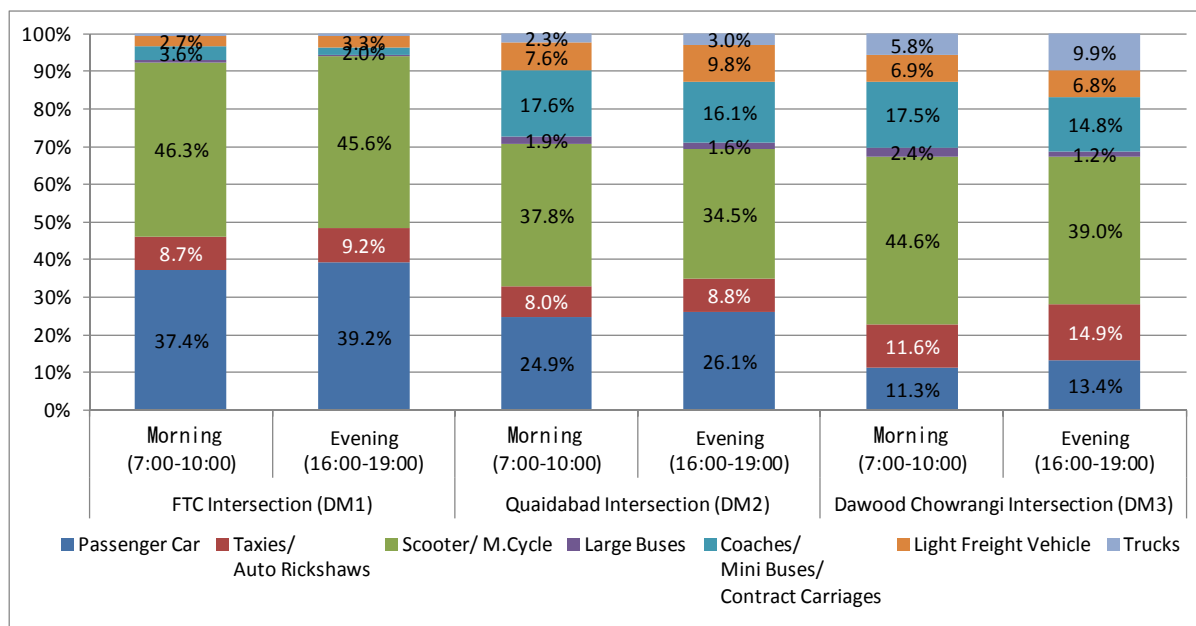
2) Intersection Traffic

The Finance and Trade Center (FTC) intersection, assigned as DM1, has the highest traffic volumes, with the majority of traffic flow coming from westward and eastward. Traffic volume at this intersection in the evening is higher than in the morning. Quidabad intersection, assigned as DM2, is almost the same as the FTC intersection. In Dawood Chowranghi Intersection, assigned as DM3, the majority of traffic flow comes from northward and southward. It is seen that many vehicles pass along Shahrah-e-Faisal. As the composition of vehicle type, Motorcycles were found to be the majority that passes at every intersection. There are many passenger cars in DM1, but there are relatively many coaches, mini buses, contract carriages, and light freight vehicle in DM2 and DM3. And there are relatively many taxis/auto rickshaws and trucks in DM3. Three volume recorded at the three intersection are detailed in **Table 4.3** and **Figure 4.4**.

Table 4.3 Traffic Volume at the Three Intersections

		Passenger Cars	Taxis/Auto Rickshaws	Scooter / M.Cycle	Large Buses	Coaches / Mini Buses/ Contract Carriages	Light Freight Vehicle	Trucks
FTC Intersection (DM1)	Mornig (7:00-10:00)	17,612	4,084	21,813	307	1,714	1,258	291
	Evening (16:00-19:00)	30,978	7,262	36,016	223	1,560	2,601	369
Quaidabad Intersection (DM2)	Mornig (7:00-10:00)	3,576	1,156	5,435	269	2,523	1,090	326
	Evening (16:00-19:00)	4,094	1,383	5,418	256	2,533	1,544	467
Dawood Chowrani Intersection (DM3)	Mornig (7:00-10:00)	1,188	1,223	4,704	257	1,843	726	616
	Evening (16:00-19:00)	1,508	1,669	4,375	137	1,661	764	1,107

Source: JICA Study Team

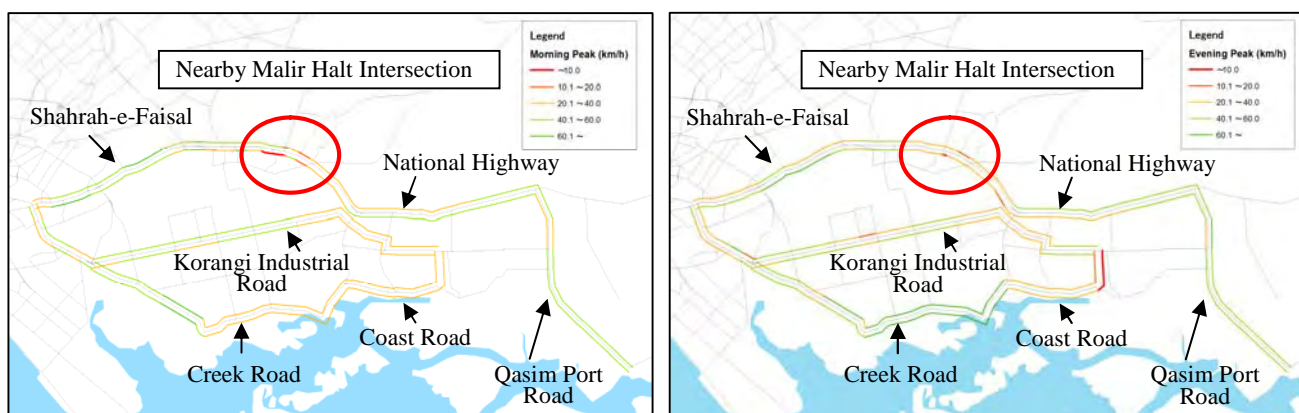


Source: JICA Study Team

Figure 4.4 Traffic Composition at the Three Intersections (Morning and Evening)

3) Travel Speeds on Major Road

The congested sections appear around Malir Halt intersection and the surrounding section. Signalized traffic and concentration of the traffic were found to be the causes of this congestion. **Figure 4.5** illustrates the results of the travel speed survey.



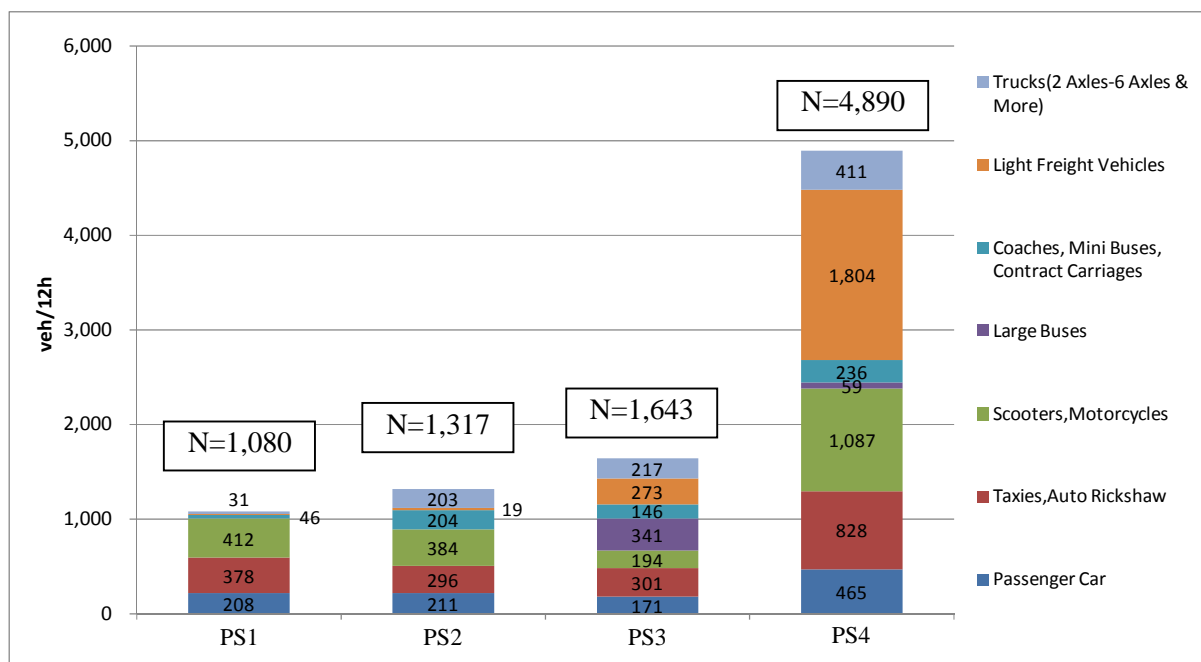
Source: JICA Study Team

Figure 4.5 Result of Travel Speed Survey (Morning Peak and Evening Peak)

4) On-Road Parking

1) Number of On-Road Parking at each Section

Among the four sections surveyed, PS 4 has the highest number of parked vehicles (4890 vehicles/12 hr), with light freight vehicles as the majority. The results of the on-road parking survey is shown in **Figure 4.6**.



Source: JICA Study Team

Figure 4.6 Number of On-Road Parking by Vehicle Type and Section

2) Purpose of Parking

Most of drivers park their vehicles for shopping at PS 1. As for the other sections, vehicles are parked for delivery of goods.

Many road users for business purposes use taxis and auto rickshaws. Shoppers who drive cars and motorcycles are relatively high. Large vehicles, such as light freight vehicles and trucks, comprises the vehicles parked for delivery of goods. **Table 4.4** shows the total number of parked vehicles per purpose at each section.

Table 4.4 Parking Purpose

Parking Purpose	PS 1	PS 2	PS 3	PS 4	Total
Business	29	59	40	32	160
Delivery of goods	25	71	61	72	229
Live nearby	12	12	9	1	34
Service (loading and unloading passengers)	25	26	18	1	70
Shopping	39	25	37	35	136
Work nearby	29	31	13	18	91

Parking Purpose	PS 1	PS 2	PS 3	PS 4	Total
Entertainment/meals/social	15	16	23	9	63

Source: JICA Study Team

(2) Summary of Present Traffic Condition

Based on the above-mentioned condition, Shahrah-e Faisal and Korangi roads experience much traffic as they served as major routes. The proportion of large vehicles increases in Shahrah-e Faisal Road around Qasim Port, making Shahrah-e Faisal Road an important route for logistics.

Although the traffic of the large-size vehicle is regulated on Shahrah-e-Faisal Road, traffic volume of large-size vehicle increases from Dawood Chowrangi intersection without the regulation. The inflows of bus and rickshaw added by the parked vehicles obstruct traffic and reduce vehicle speed. It is necessary to alleviate obstruction of traffic and construct alternative roads because there is much traffic inflow in these bottleneck spots, and road width is narrower due to houses extending within ROW.

CHAPTER 5 PRIORITY ROAD NETWORK DEVELOPMENT PROJECTS

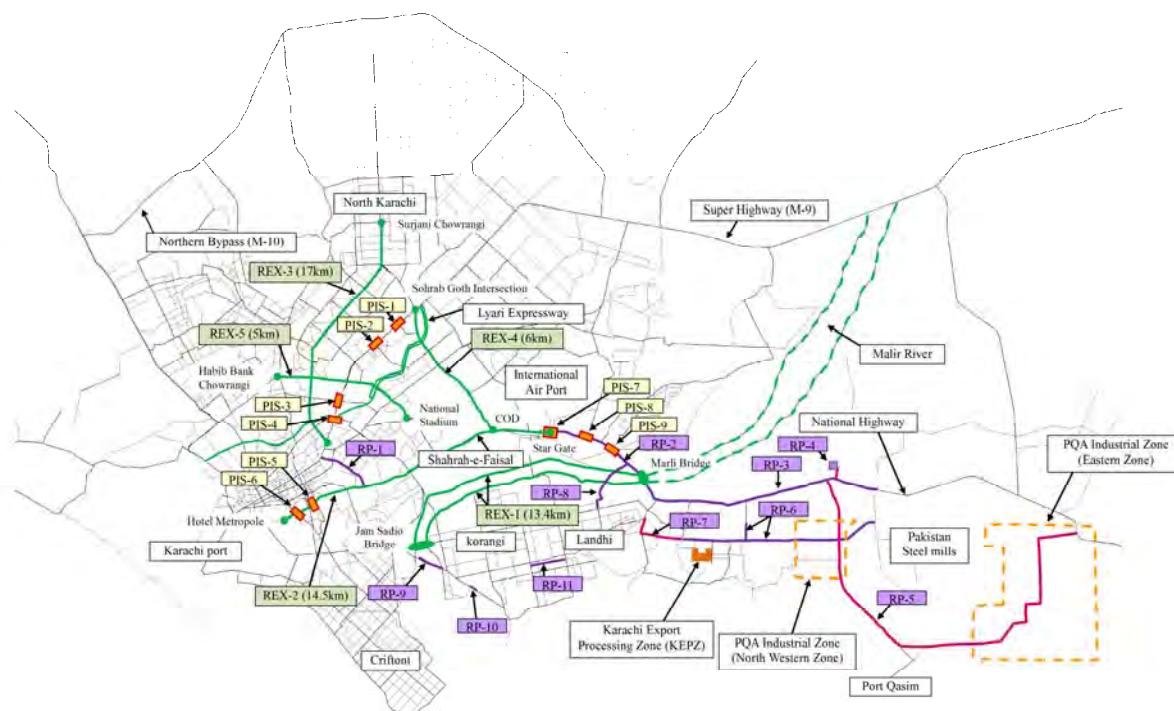
5.1 Road Network Development Project by KMC

(1) Outline of Projects

The Study Team collected project documents such as PC-1 and connection paper for feasibility study and detail design regarding road development projects from the Karachi Municipality Corporation (KMC). These projects may be categorized as follows:

- i) Expressway construction (REX-1 to 5);
- ii) Improving accessibility between CBD area and Super Highway (PIS-1 to 9); and
- iii) Improving connectivity to Korangi and Landhi Industrial Areas and Port Qasim (RP-1 to 11).

The road project in Karachi is shown in **Figure 5.1**.



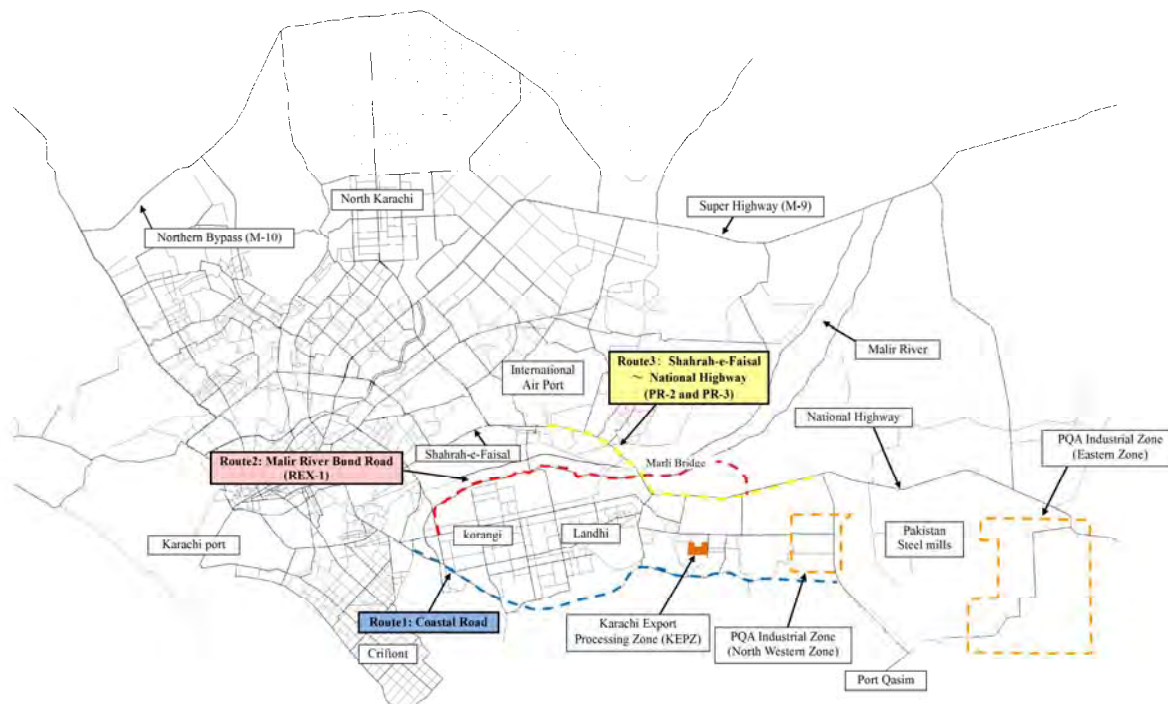
Source: JICA Study Team

Figure 5.1 Road Projects in Karachi

5.2 Formulation of Alternative Route

(1) Setting Alternative Projects

The Study Team selected three alternative routes for road network development project between the central Karachi including Clifton area and the industrial area of east Karachi to contribute in the improvement of investment. The selection of alternative routes considers i) accessibility and connectivity to Port Qasim; ii) order of priority in the road network development plan; and iii) project implementation status by KMC. Proposed Road Project by Study Team is shown in **Figure 5.2**.



Source: JICA Study Team

Figure 5.2 Proposed Road Project by Study Team

Route 1: Construction and Rehabilitation of Coastal Road (L=26.3 km)

- This route may connect with Port Qasim directly, and will perform as an alternative route for Shahrah-e-Faisal and National Highway, and for 8000 feet Road of Korangi and Landhi Towns.
- Coastal Road will be a part of the Outer Ring Road in accordance with KSDP-2020.

Route 2: Construction of Malir River Bund Road (L=21.3 km)

- As a tolling expressway, smoother traffic is expected without traffic congestion at intersection.
- The project is given a higher priority in KSDP-2020.
- A preliminary design has been conducted through the ADB technical assistance program (2009). However, PC-1 has not yet been prepared.

Route 3: Improvement of Shahrah-e-Faisal~National Highway between the International Airport and Port Qasim (L=15.3 km)

- The existing main access route to Port Qasim will be improved.
- JICA Study on the Karachi Transportation Improvement Project (KTIP) recommends implementing the flyover construction as a short-term target (up to 2020).
- KMC has submitted PC-1 for the three locations of the flyover construction project, with one project under construction. Funds for the improvement of road to a six-lane carriageway is being requested by KMC.

The project features and justifications of the selection for each alternative route are summarized in **Table 5.1**.

Table 5.1 Description of Project Features of Alternative Route

Alternative Route 1 Project Name :	Construction and Rehabilitation of Coastal Road
Objective Length	26.3 km Start : Intersection with Creek Avenue on Korangi Road: End : Port Qasim Access Road
Road Classification	Principal Arterial Road
Relevance to the Development Plan	- To formulate a part of Outer Ring Road (R-4) as per KSDP-2020. - To be listed as a middle-term target (up to 2025) as per JICA Study of KTIP.
Description of the Project	- To construct four-lane carriageway road. - In order to ensure functionality of the principal arterial road, and to construct a 2.2 km long bridge at Malir River crossing.
Status of the Project	- Preliminary design has not been conducted by KMC. - KMC has submitted PC-1 for the Malir River Causeway four-lane improvement and box culvert construction near CBM. Only box culvert works are under implementation.
Initial Evaluation in Environmental Issue	- To examine the bypass route at the residential area to minimize resettlement issue. - To provide sidewalk space at road section of the residential area. - To consider the future development of tourism resources along the road.
Alternative Route 2 Project Name	Construction of Malir River Bund Road
Objective Length	21.3 km Start : Intersection of 3000 feet Road and 8000 feet Road; End : National Highway at Goth Juman
Road Classification	Expressway (17.1 km) and Minor Arterial Road (4.2 km)
Relevance to the Development Plan	- KMC gives the highest priority to road network development plan to relate with Education City and DHA City Karachi projects. - To be listed as a long-term target (up to 2030) as per JICA Study of KTIP.
Description of the Project	- To construct a 17.1 km four-lane tolling expressway up to Goth Jam Kand. - Due to serious impact of resettlement issue on the left side of the bund, a four-lane carriageway will be constructed on the left side of the bund. - After expressway on bund of Malir River, to construct a 4.2 km minor arterial road to connect with the National Highway.
Status of the Project	- A preliminary design used left side Bund has been conducted by ADB assistance program in 2009 (project cost: Rs60.479 billion). - At present, KMC has a different alignment plan to use left and right side bund, and preliminary design has not been prepared. - KMC has not prepared PC-1.
Initial Evaluation in Environmental Issue	- To minimize negative impacts on resettlement at Future Colony of Landhi Town due to expressway construction. - To find optimal routes between the end of the expressway and National Highway and to minimize the issues on land acquisition and resettlement. - To minimize negative impacts on flood flow in Malir River by the construction of expressway along the river.

Alternative Route 3 Project Name	Improvement of Shahrah-e-Faisal ~ National Road
Objective Length	L = 15.3 km Start : Entrance Road to International Airport, End : Intersection with Port Qasim Access Road
Road Classification	Principal Arterial Road
Relevance to the Development Plan	<ul style="list-style-type: none"> - KMC has submitted three flyover construction projects on Shahrah-e-Faisal, and the construction of the leading to the International Airport is currently being implemented. KMC has a plan to improve the carriageway to six lanes. - Flyover construction projects on Shahrah-e-Faisal are listed as short-term (2020) target as per JICA Study of KTIP.
Description of the Project	<ul style="list-style-type: none"> - To improve existing four-lane carriageway to a six-lane road. - To provide service road in order to separate community access transporting activities from the main traffic flow. - To improve major intersections by constructing a flyover bridge.
Status of the Project	<ul style="list-style-type: none"> - Plan for the construction of three flyovers along Shahrah-e-Faisal (total cost of Rs1.21 billion) has been submitted. Flyover at the International Airport is under construction. - Regarding road improvement to a six-lane carriageway, the project concept paper on the request approval of project implementation has been prepared by KMC. However, F/S or D/D has not yet commenced.
Initial Evaluation in Environmental Issue	<ul style="list-style-type: none"> - Land acquisition and resettlement issues for road widening and flyover construction.

Source: JICA Study Team

(2) Major Controlled Points for Road Alignment Planning

1) Route 1: Construction and Rehabilitation of Coastal Road

Coastal Road will be constructed and the existing road alignment will be improved. The road sections of Umar Goth (0.8 km) and Landhi Fishing Colony (1.1 km) will be affected by resettlement issues due to road widening (refer to **Figure 5.3**). In order to mitigate the social negative impacts, the bypass route should be planned for the said sections.



Source: JICA Study Team

Figure 5.3 Locations of Resettlement Caused by Road Widening on Coastal Road

2) Route 2: Construction of Malir River Bund Road

a) Resettlement Issue

At the section of Feature Colony in Landhi Town (1 km), the residences are standing too close to the left bund of Malir River, while a graveyard also adjoins the bund in the said section. The road alignment at this section should consider to mitigating the resettlement impacts.

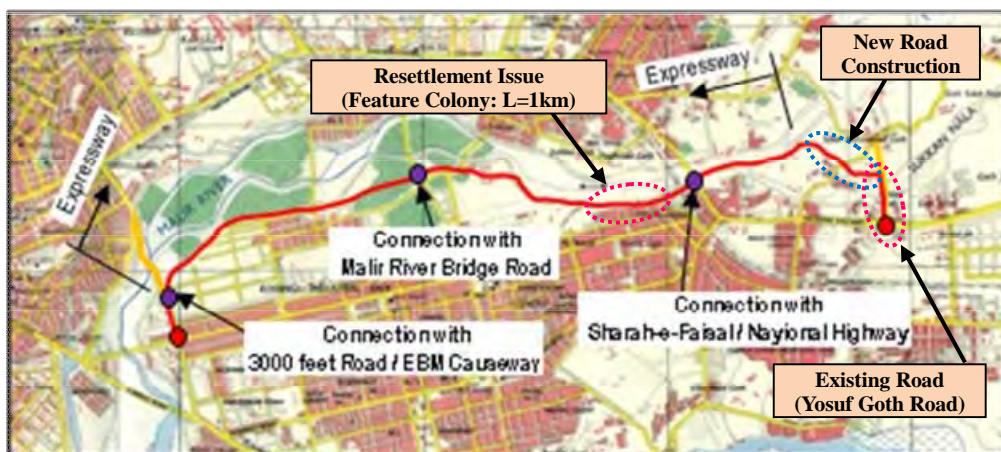
b) Connection with the National Highway (Existing road at Yusuf Goth)

Extending the Malir River Bund Road from Malir Bridge aims to avoid traffic congestion between Malir Bridge and Quaid Abad Flyover along the National Highway. In order to link with the existing road with Yusuf Got, a new 2.5 km road will be constructed to connect both roads.

c) Providing Interchange on Malir River Bund Road

The Study Team proposes to provide three interchanges along the Malir River Bund Road section. The traffic access to the expressway section will be only controlled at the interchanges.

The major controlled points of Route 2 are shown in **Figure 5.4**.

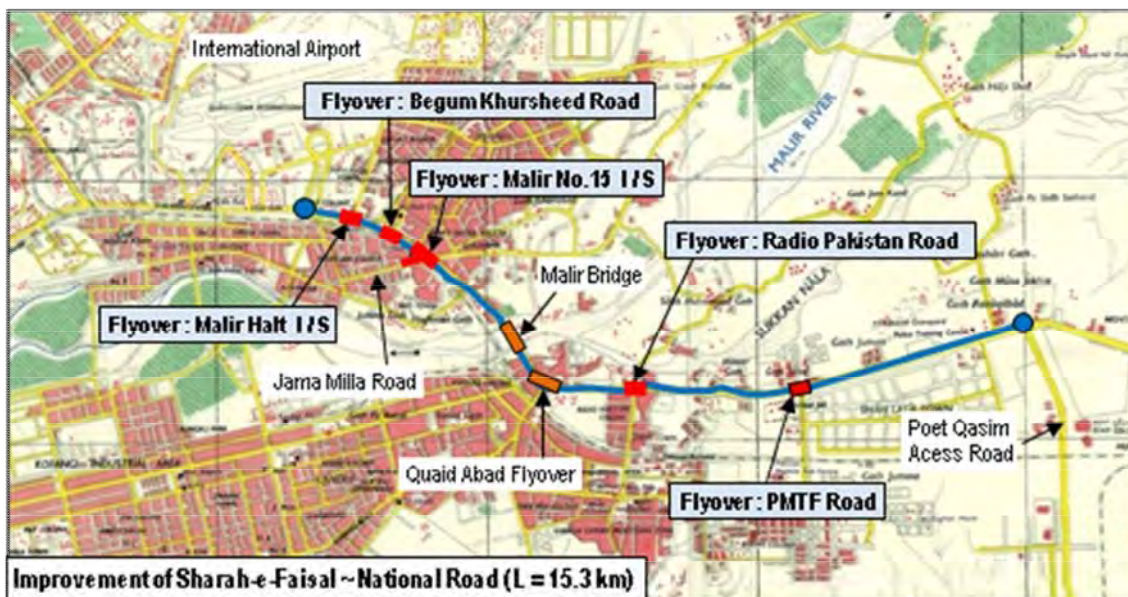


Source: JICA Study Team

Figure 5.4 Major Controlled Points of Route 2

3) Route3: Improvement of Shahrah-e-Faisal ~ National Highway

To solve the congestion at major intersections, flyover bridges will be constructed at five intersections. **Figure 5.5** shows the locations of flyover bridges, and **Table 5.2** describes the features of each flyover.



Source: JICA Study Team

Figure 5.5 Proposed Location of Flyover Bridge of Shahr-e-Faisal ~ National Road

Table 5.2 Number of Carriageway for the Proposed Flyover

Location	Number of Carriageway
Malir Halt Intersection Flyover	Three lanes on one direction (Airport to Port Qasim)
Begum Khursheed Road Intersection Flyover	Three lanes on one direction (Airport to Port Qasim)
Malir No. 15 Intersection Flyover	Three lanes on one direction (Airport to Port Qasim) with a railway flyover from Jama Milla Road
Radio Pakistan Road Intersection Flyover	Six lanes on both directions
RMTF Road Intersection Flyover	Three lanes on one direction (Airport to Port Qasim)

Source: JICA Study Team

5.3 Traffic Demand Forecast

In order to check the accuracy of the developed models that represent the existing transport situation, the model outputs were compared with the existing transport characteristics surveyed. JICA STRADA, a forecasting tool, was used for the present traffic demand analysis. This Study used the results from “the Study for the Karachi Transportation Improvement Project” (KTIP) as a reference, and the forecast flow of KTIP is almost the same as with the present condition. Therefore, KTIP’s data on origin-destination (O-D) and road network were utilized in this Study.

According to KTIP, the growth of the population and employment from 2010 through 2030 is more than 1.5 times, with a 1.67 growth rate of the trip. The modal share of walking decreases while that of bus trips slightly increases. **Table 5.3** shows the growth of population and employment, while **Table 5.4** shows the growth of trip and modal share.

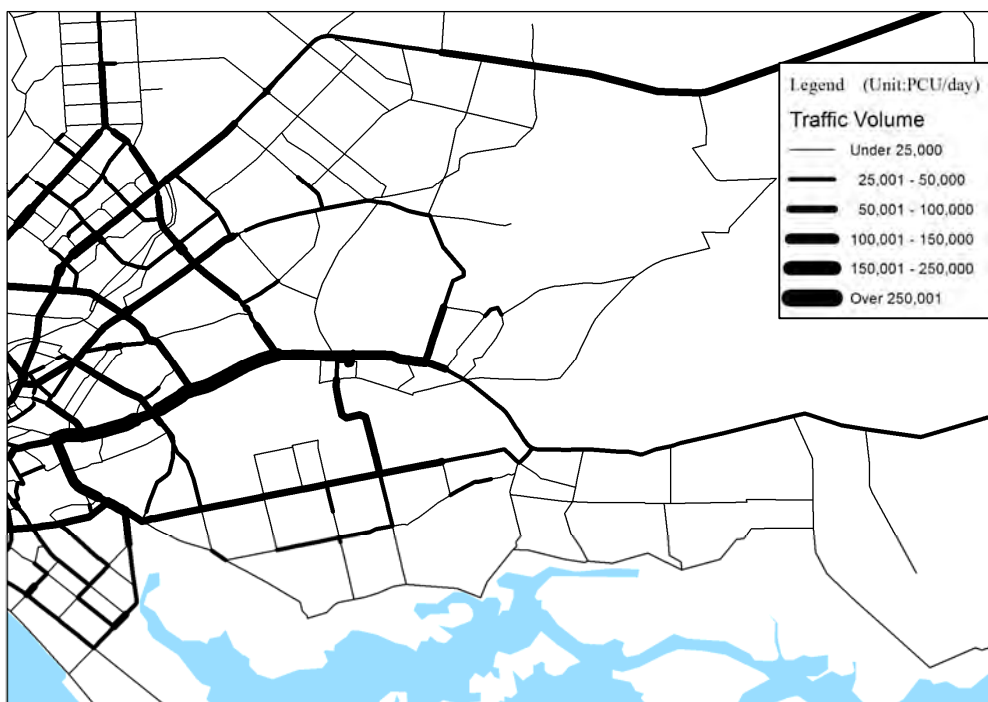
Table 5.3 The Growth of Population and Employment

No.	City/Cantonment	Population (1,000)			Employment (1,000)		
		2010	2020	2030	2010	2020	2030
1	Keamari	761.7	1,913.8	2,290.0	800.2	1,304.3	1,708.2
2	S.I.T.E	853.7	894.5	894.5	620.7	565.9	560.9
3	Baldia	864.4	1,110.1	1,110.1	256.4	285.5	308.7
4	Orangi	1,337.7	1,428.9	1,522.5	182.0	186.6	195.3
5	Lyari	938.6	969.3	969.3	81.2	84.9	89.5
6	Saddar	1,104.3	1,122.7	1,233.0	702.8	861.8	989.4
7	Jamshed	1,397.3	1,559.9	1,713.2	262.2	401.1	508.7
8	Gulshan-E-Iqbal	1,458.3	2,373.4	2,684.4	537.6	686.4	802.9
9	Shah Faisal	601.9	611.9	646.9	73.4	80.9	86.5
10	Landhi	1,353.4	1,822.3	1,822.3	348.8	388.6	430.5
11	Korangi	1,285.5	1,825.6	1,825.6	446.1	390.8	379.7
12	North Nazimabad	917.1	979.5	1,043.6	118.3	129.3	138.8
13	New Karachi	1,226.2	1,246.6	1,328.3	279.7	291.9	307.8
14	Gulberg	838.1	895.2	953.8	144.5	143.3	147.9
15	Liaquatnabad	1,002.0	1,034.9	1,034.9	96.5	163.3	215.0
16	Malir	780.7	907.1	936.9	149.3	165.9	177.9
17	Bin Qasim	517.8	2,031.7	2,697.3	1,098.1	2,591.1	3,293.4
18	Gadap	538.2	3,077.7	5,059.2	556.7	1,577.4	2,029.7
19	Karachi Cantonment	88.4	90.2	96.1	96.6	165.1	220.9
20	Clifton Cantonment	559.0	770.6	821.1	304.9	350.9	386.1
21	Faisal Cantonment	247.5	352.1	362.6	67.1	219.7	335.4
22	Malir Cantt Civil	205.8	400.3	414.4	74.2	69.0	68.9
23	Manora Cantonment	10.0	10.0	10.0	40.3	32.5	30.2
24	Korangi Cantonment	47.5	121.8	129.8	80.6	193.8	276.8
	Total	18,935.1	27,550.2	31,600.0	7,418.0	11,330.0	13,689.0

Source: KTIP

(1) Present Traffic Demand Analysis

In the result of present traffic demand analysis, as shown in **Figure 5.6**, the main traffic flow comes from east-west direction. There are many traffic volumes on Shahrah-e-Faisal and Korangi roads, but the volume capacity ratio is higher. This result duplicated the present traffic situation, and the correlation coefficient was calculated to be 0.97.



Source: JICA Study Team

Figure 5.6 Present Traffic Volume (2010)

(2) Estimation of Future Traffic Demand

1) Demand Forecast Scenario

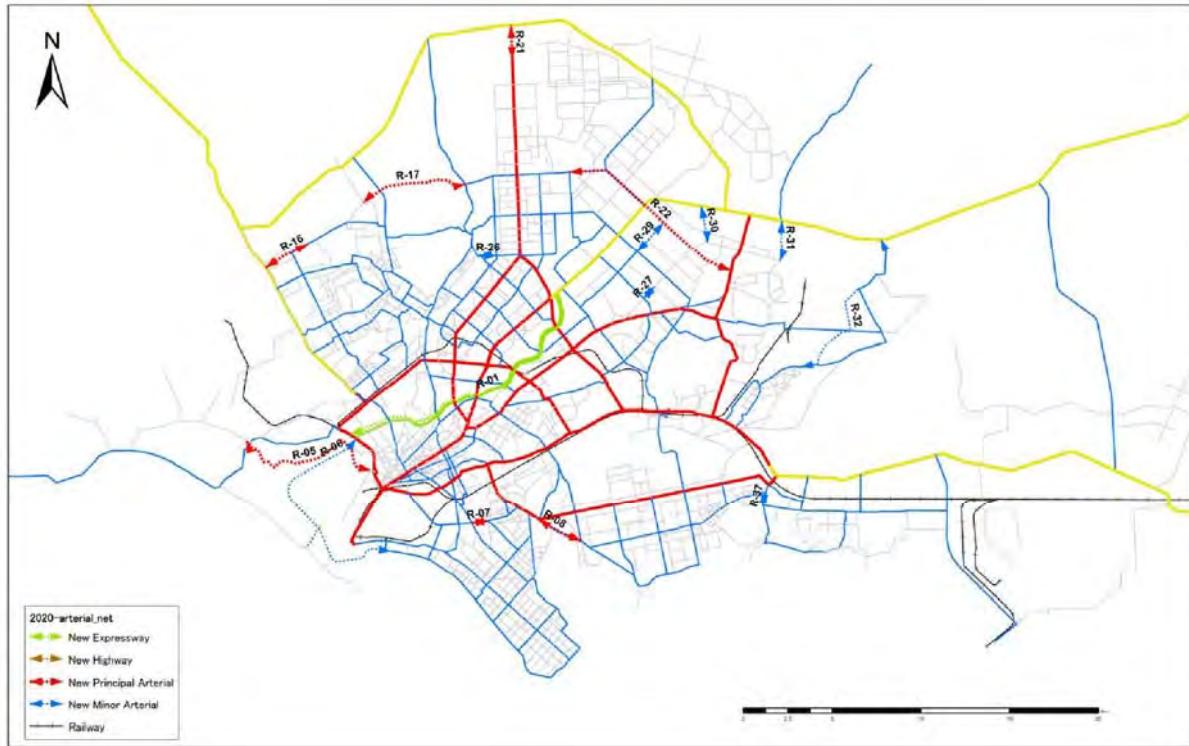
The traffic demand forecast was conducted in order to evaluate the future traffic demand and road network performance with or without priority project. Based on future road network (refer to KTIP), the traffic demand forecast was conducted to evaluate future traffic demand and road network performance with or without priority project. **Table 5.5** shows the analysis on the effects of with and without the priority projects.

Table 5.5 Analysis Case and Road Network Composition

Case No.	Case	Year	Malir River Bund Road	Improvement Shahrah-e-Faisal Road	Coastal Road	Future Road network
1	Without	2020				○
2	Without	2030				○
3	With A	2020	○			○
4	With A	2030	○			○
5	With B	2020		○		○
6	With B	2030		○		○
7	With C	2020			○	○
8	With C	2030			○	○

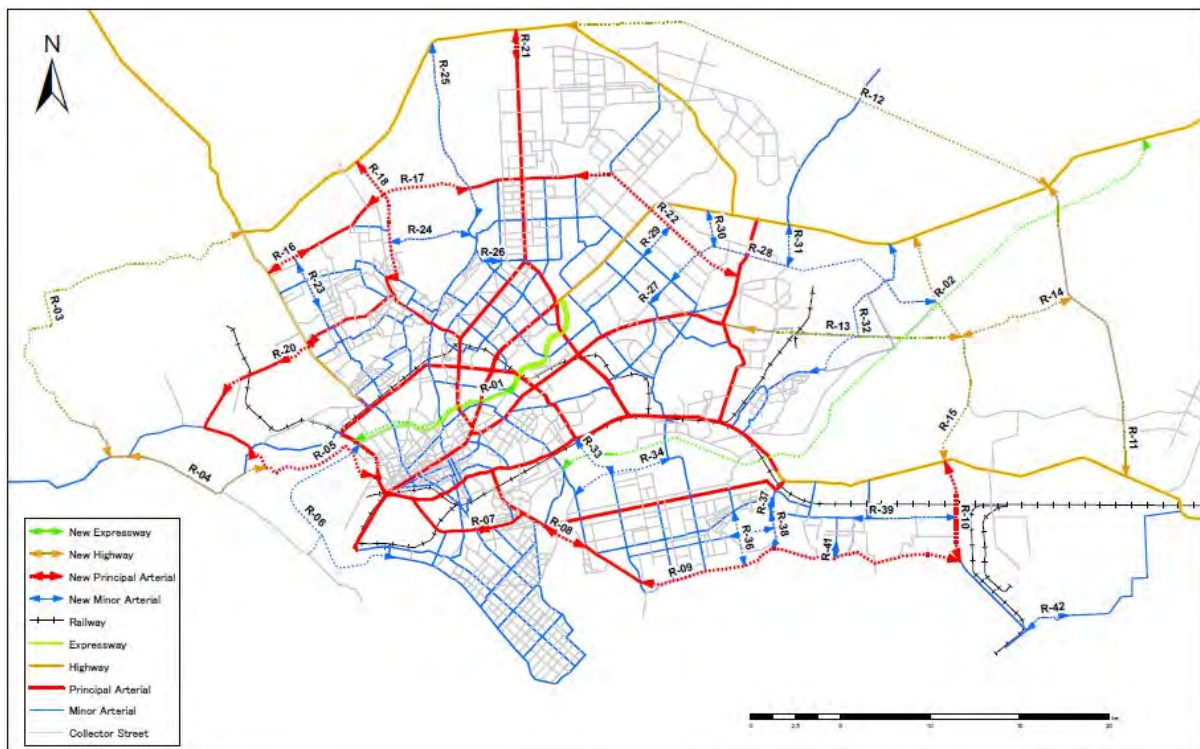
※Note; A: Malir River Bund Road, B: Improvement Shahrah-e-Faisal Road, C: Coastal Road

Source: JICA Study Team



Source: KTIP

Figure 5.7 Future Road Network (2020)



Source: KTIP

Figure 5.8 Future Road Network (2030)

(3) Analysis of Future Traffic Demand

1) Evaluation of Future Traffic Demand

In the “without” case, the average volume capacity ratio in Karachi City is about 1.2, with an average travel speed of about 30 km/h. In the “with” case, the improvement of the congestion degree and travel speed are the highest in the case of the construction of Malir River Bund Road. Although there is high improvement in the total travel distance in the case of construction of Shahrah-e-Faisal Road, the effect is almost the same as that with Malir River Bund Road, and it is thought that Malir River Bund Road is totally effective. In addition, the congestion degree in Malir River Bund Road itself is lower than 1.00. **Table 5.6** shows the result of the traffic demand forecast for each project case while **Table 5.7** shows the evaluation of the forecast.

Table 5.6 Results of the Traffic Demand Forecast

Case No	Case	Year	Average Volume Capacity Ratio	Average Travel Speed (km/h)	Total Travel Distance (PCU·km)	Total Travel Time (PCU·h)
1	Without	2020	1.16	36.8	78,341,211	2,127,338
2	Without	2030	1.22	42.5	90,277,466	2,123,120
3	with A	2020	1.04	40.7	76,218,608	1,871,696
4	with A	2030	1.11	43.7	88,728,471	2,030,494
5	with B	2020	1.10	39.4	75,844,337	1,926,954
6	with B	2030	1.17	42.7	88,570,781	2,073,115
7	with C	2020	1.11	38.0	76,494,018	2,015,207
8	with C	2030	1.17	42.9	88,655,554	2,067,231

※Note; A: Malir River Bund Road, B: Improvement Shahrah-e-Faisal Road, C: Coastal Road

Source: KTIP

Table 5.7 Evaluation of the Demand Forecast Case

Project	VC ratio	Travel Speed	Network Performance	Comprehensive Evaluation
Malir River Bund Road	◎	◎	○	◎
Shahrah-e-Faisal	○	○	◎	○
Coastal Road	△	△	△	△

Source: KTIP

2) Evaluation of Priority Project

According to the results of traffic demand forecast, the Malir River Bund Road project is the most effective project as it has a low volume-capacity (VC) ratio and high travel speed, and there are many traffic demands to change the route. **Table 5.8** shows the evaluation of the three priority projects.

Table 5.8 Evaluation of the Three Priority Projects (2030)

Case No	Priority Project	Traffic Demand to change the route (PCU)	Reference	
			Average Volume Capacity Ratio	Average Travel Speed (km/h)
A	Malir River Bund Road	132,820	0.79	67.1
B	Improvement of Shahrah-e-Faisal / National Highway	94,310	1.39	63.9
C	Coastal Road	53,204	1.34	45.8

Source: JICA Study Team

5.4 Environmental and Social Condition and ROW Status on Alternative Routes

(1) Route 1: Construction and Rehabilitation of Coastal Road

1) ROW Status

Based on the road ROW maps of the “Revised Master Plan of Roads (1964)” to be provided by the Master Plan Department, the existing road from the beginning up to the section of Pak-Arab Limited (PARCO) Oil Tank Terminal before Umar Goth has 300 ft of ROW width. However, the legal document stating that the ROW for the remaining section has not yet been funded during the Study period. It is required to clarify the legal status of ROW for the said section at the further project stage, or during F/S or D/D.

2) Environmental and Social Conditions

a) Affected Scale by Road Construction

It was observed that a large number of natural and manmade features exist along the proposed route, which must be removed during the project execution. These include RCC structures, temporary structures, kiosks, mosques, utility lines, and trees bushes. Removal of these will likely create a lot of environmental and social impacts. It is also worth mentioning that there is a strong political influence in the area, which is likely to be exploited during the project execution stage. **Table 5.9** gives a preliminary account of the various encroachments as seen from Google Earth. A detailed survey is required to be carried out before the execution of project.

Table 5.9 Brief Summary of the Affected Scale by Coastal Road Construction

Station No. (km)	Type of Structure House/Shop			Electric Pole	Industry	Cultivated Land	Other	
	Permanent	Encroached	Hut				Trees/Bushes	Open Plot
0.0 – 2.0	-	-	-	-	-	-	Yes	Mosque
2.0 – 4.0	-	5	-	-	-	-	Yes	6

Station No. (km)	Type of Structure House/Shop			Electric Pole	Industry	Cultivated Land	Other	
	Permanent	Encroached	Hut				Trees/Bushes	Open Plot
4.0 – 6.0	8	10	-	-	-	-	Yes	-
6.0 – 8.0	-	200	-	-	7	-	Yes	-
8.0 – 10.0	-	4	-	-	2	-	Yes	-
10.0 – 12.0	-	6	-	-	-	-	Yes	-
12.0 +14.0	-	10	-	-	7	-	Yes	-
14.0 - 16.0	-	100	-	-	-	-	Yes	-
16.0 – 18.0	-	-	-	-	-	-	Yes	-
18.0 - 20.0	-	-	-	-	-	-	Yes	-
20.0 – 22.0	-	-	-	-	-	-	Yes	-
22.0 – 22.7	-	-	-	-	-	-	Yes	-

Source: JICA Study Team

b) Option of Counter Measurement for Resettlement Issue

The road alignment at sections of Umar Goth and Landhi Fishing Colony are proposed to be provided with bypass road in order to mitigate resettlement impacts. However, the bypass route at Umar Goth must pass through the property of PARCO due to limited open area, as shown in **Figure 5.9**.



Source: JICA Study Team

Figure 5.9 Proposed Bypass Plan at Umar Goth Section

(2) Route 2: Construction of Malir River Bund Road

1) ROW Status

The existing ROW for the Malir River Bund up to Shahrah-e-Faisal is 110 ft (33.5 m) from the center of the river bund. The source for this ROW was taken from the decision given by the Honorable High Court of Sindh of which the orders were issued on 21 October 2010.

However, the legal document stating the ROW after Shahrah-e-Faisal has not been funded during the study period. The legal status of this ROW must be clarified at the further project stage.

2) Environmental and Social Conditions

a) Affected Scale by Road Construction

During the field survey, it was observed that a large number of encroachments are present along the route. The majority of these comprise encroached houses in bulk or in the shape of housing colonies. In addition, few industries and a graveyard also lie along the ROW. A large portion has also been encroached by cultivated lands. **Table 5.10** shows the preliminary account of various encroachments as seen from Google Earth. A more detailed survey must be carried out before the execution of project.

Table 5.10 Brief Summary of Affected Scale by Malir Bund Road Construction

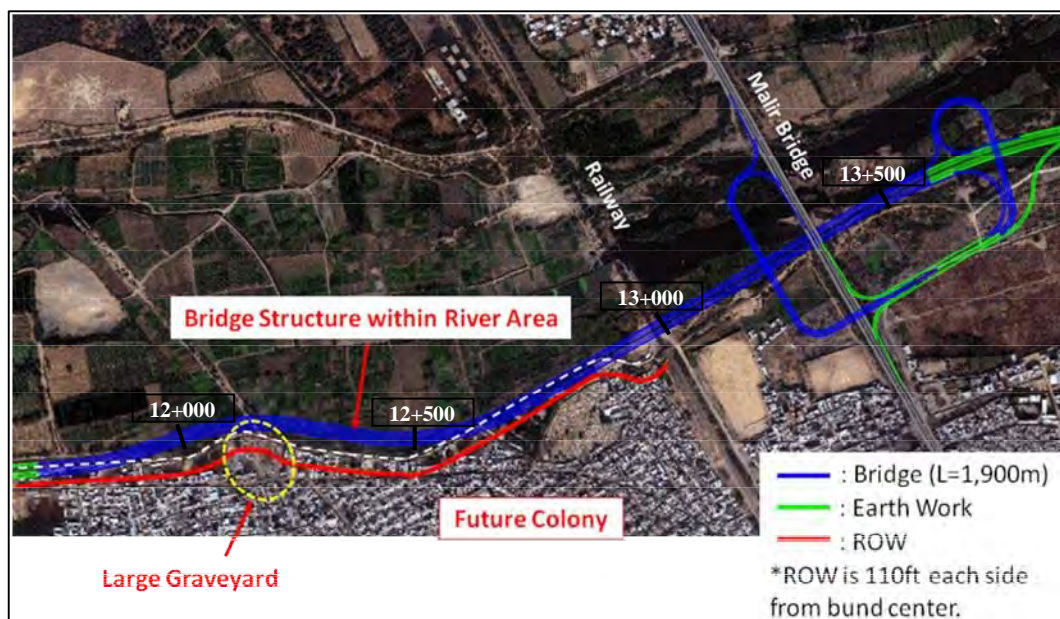
Station No. (km)	Type of Structure House/Shop			Electric Pole	Industry	Cultivated Land	Other	
	Permanent	Encroached	Hut				Trees/ Bushes	Open Plot
0.0 – 2.0	3	43	-	4 H	1	-	-	-
2.0 – 4.0	-	70	-	-	5	-	-	3
4.0 – 6.0	-	56	-	-	1	-	-	6
6.0 – 8.0	-	70	-	-	-	3	-	-
8.0 – 10.0	2	12	-	-	-	7	Yes	-
10.0 – 12.0	-	60	4	-	-	14	-	6
12.0 - 14.0	-	110	5	-	4	8	Yes	2 Graveyard
14.0 - 16.0	-	1	-	-	-	18	Yes	-
16.0 - 18.0	-	10	-	-	-	5	Yes	-
18.0 – 20.0	-	-	-	-	-	-	Yes	-
20.0 – 22.0	-	-	-	-	-	-	Yes	-
22.0 – 24.0	-	-	-	-	-	-	-	-
24.0 – 26.0	-	-	-	-	-	-	-	-

Source: JICA Study Team

b) Option of Counter Measurement for Resettlement Issue

In Future Colony along the proposed route of the Malir River Bund Road, residential houses exist within the ROW (located 110 ft from the center of bund), while a portion of a large graveyard is also intersected by the route, as shown in **Figure 5.10**. The finalized expressway alignment shall be determined after the environmental impact (EIA) and resettlement action plan (RAP) studies are conducted. In order to mitigate the impacts of resettlement, bridge structures

along the expressway will be constructed above river crossings, which would serve as a mitigation measure in the next stage of EIA and RAP studies.



Source: JICA Study Team

Figure 5.10 Mitigation Measures on the Resettlement Issue at Future Colony

(3) Route 3: Improvement of Shahrah-e-Faisal ~ National Highway

1) ROW Status

KMC informed that the existing ROW is 75 ft each side from existing road center between the International Airport and Quaid Abad Flyover. However, the legal document stating the ROW after Quaid Abad Flyover toward Port Qasim has not been funded during the study period. It is then required to clarify the legal status of ROW for the said section at the further project stage. Based on the current location of existing industry building at the said section, the ROW may be seamed as 100 ft from the existing road center.

2) Environmental and Social Conditions

Preliminary survey of the route indicates the presence of RCC structures such as shops and temporary kiosks of various types. In addition, a large number of fruit and vegetable vendors on pushcarts or trolleys also encroach the ROW. Two mosques and a large number of trees are also present along the route. **Table 5.11** shows a preliminary account of various encroachments seen from the Google Earth. A detailed survey must be carried out before the execution of project.

Table 5.11 Brief Summary of Affected Scale by Improvement Project

Station No.	Type of Structure House/Shop			Electric Pole	Industry	Cultivated Land	Other	
	Permanent	Encroached	Hut				Trees/Bushes	Open Plot
0.0 – 2.0	15	-	-	-	-	-	Yes	-
2.0 - 4.0	185	-	-	-	-	-	Yes	Mosque
4.0 – 6.0	90	6	-	-	-	-	Yes	-
6.0 – 8.0	120	-	-	-	2	-	Yes	Mosque

Station No.	Type of Structure House/Shop			Electric Pole	Industry	Cultivated Land	Other	
	Permanent	Encroached	Hut				Trees/Bushes	Open Plot
8.0 – 10.0	40	-	-	-	-	-	Yes	-
10.0 – 12.0	55	-	-	-	-	-	Yes	6
12.0 – 14.0	-	-	-	-	-	8	Yes	-
14.0 – 16.0	-	-	-	-	-	-	-	-

Source: JICA Study Team

5.5 Preliminary Engineering Study for Alternative Road Projects

(1) Route 1: Construction and Rehabilitation of Coastal Road

1) Existing Road Inventory and Utility Conditions

The objective of road inventory survey is to determine the present road conditions and public utilities.

Pavement, roadway, shoulder, median and sidewalk width were measured at points where road width is deemed to change visually. In addition, the number of lanes and presence of service roads and medians were confirmed at site.

The types of pavement were grouped according to asphalt, gravel and earthen, while the pavement condition was classified into three categories (good, fair or bad) based on visual investigation.

The existing underground and overhead public utilities along Route 1 were surveyed, and the information of the detailed locations were identified. The underground utilities were surveyed through site observation and collected relevant documents from the concerned agencies without site excavation, such as maps of existing pipes for water, sewer, and gas.

According to the road survey, the Korangi Road has a 14.6 m wide four-lane asphalt road, a 0.6 m New Jersey Barrier, and 1.7 m wide sidewalks.

The asphalted Creek Road and Coast Road are around 6-7 m wide without any median and sidewalk.

The road pavement considered to be in bad condition accounted for 54%; those considered to be in fair condition was 33%; while those in good condition was 13% overall.

Furthermore, the route will affect 29 high-tension pylons, 41.8 km of telephone and electric cables, 280 telephone and electric posts, 8.83 km of underground electric cables, 7.38 km of gas pipelines, and 136 manholes.

The Study Team considered the present conditions of the existing road, and conducted the preliminary design accordingly.

2) Proposed Project Components

a) Widening and Rehabilitation of the Existing Road

For the six-lane widening with a total length of 24.8 km, the preliminary design was

conducted by the Study Team.

3) Rough Cost Estimation

Total Project Cost: US\$95.18 million (Rs8.614 billion)
Rate: US\$1.00=Rs90.498

(2) Route 2: Construction of Malir River Bund Road

1) Existing Road Inventory and Utility Conditions

The road inventory survey of Route 2 was carried out in the same manner as Route 1.

According to the road survey, the Korangi Industrial Area (3000) Road consists of 14.6 m wide four-lane asphalt roads, with a 7.08 m wide median, and pavement considered to be in fair condition.

In Malir River Bund, the average width of the road is 5 m. The route will affect two high-tension pylons, 3.0 km of telephone and electric cables, 69 telephone and electric posts, 1.134 km of water pipes, 1.082 km of sewerage lines, 865 m of underground electric cables, and 4.55 km of gas pipelines.

The Study Team considered the present condition of existing road plan, profile, and public utilities, and conducted the preliminary design accordingly.

2) Proposed Project Components

a) Widening of the Existing Road

For the Korangi Industrial Area (3000) Road, the Study Team conducted a preliminary design, which widens the road from four to six lanes for a stretch of 1.3 km.

b) Construction of Malir River Bund Road

The Study Team conducted a preliminary design for the 12.2 km road widening to six lanes on the left side of bund. After Malir Bridge, the Study Team conducted a preliminary design for 7.4 km six-lane road that connects with the National Highway.

3) Rough Cost Estimation

Total Project Cost: US\$238.91 million (Rs21.621 billion)
Rate: US\$1.00=Rs90.498

(3) Route-3: Improvement of Shahrah-e-Faisal ~ National Road

1) Existing Road Inventory and Utility Conditions

The road inventory survey of Route 3 was carried out in the same manner as with Routes 1 and 2.

According to the road survey, Route 3 consists of 14-20 m wide asphalt roads with four lanes, an approximately 1.5 m wide median, and some 6.7 m wide service roads.

The condition of the existing road pavement widely varies from the left side (bound for Port Qasim) and right side (bound for the International Airport).

Most roads in left side were in bad condition, which accounted to 72% overall. Those in fair condition accounted to 25%, while those in good condition covered 3% overall.

On the other hand, most roads in the right side were in fair condition, which accounted to 70% overall. Those in good condition accounted to 27%, while those in bad condition covered 3% overall.

The route will affect 55.6 km of telephone and electric cables, 329 telephone and electric posts, 12.79 km of water pipes, 2.92 km of sewerage lines, 26.88 km of underground electric cables 34.12 km of gas pipelines, and 378 manholes.

The Study Team considered the present condition of existing road plan, profile, and public utilities, and conducted the preliminary design accordingly.

2) Proposed Project Components

a) Widening of the Existing Road

The Study Team conducted a preliminary design for the 15.3 road widening to six lanes with a service road.

b) Grade Separation Design

The Study Team conducted a grade separation design for the bridge section.

3) Rough Cost Estimation

Total Project Cost: US\$175.42 million (Rs15.875 billion)

Rate: US\$1.00=Rs90.498

Total Construction cost is US\$122.8 million. The break down is: Bridge 1 US\$62.78 million, Bridge 2 US\$ 9.12 million, Bridge 3 US\$ 9.11 million, 6 Lanes Improvement US\$ 42.94 million.

Bridge 1 is located in Malir Halt Intersection, Begum Khursheed Road Intersection and Malir No.15 Intersection, and its length is 1850m. Bridge 2 is located in Radio Pakistan Road Intersection, and its length is 200m. Bridge 3 is located in RMTF Road Intersection, and its length is 200m.

5.6 Project Evaluation and Selection of Priority Project

(1) Initial Economic Evaluation for Alternative Projects

1) Evaluated Projects

In this Study, the three prioritized alternative road projects were evaluated separately

- Route 1: Construction and Rehabilitation of Coastal Road
- Route 2: Construction of Malir River Bund Road
- Route 3: Improvement of Shahrah-e-Faisal ~ National Road

2) Economic Costs

The main project investment costs consist of construction (or civil works), land acquisition and compensation, consulting services, physical contingency costs, and other related costs. The economic costs were obtained by deducting the transfer costs such as import duties and taxes from the financial costs at market prices. In this evaluation, a factor of 0.90 was applied to convert financial costs to economic costs (only for civil works-related costs) by referring to other

similar road projects in Pakistan.

The maintenance costs consist of the annual and periodic maintenance costs for every five years commencing after the construction and opening for traffic. These costs were also converted into economic costs.

3) Quantification of Economic Benefits

In this evaluation, two kinds of direct benefits were estimated quantitatively, as follows:

- Savings in vehicle operating costs (VOC benefit)
- Savings in passengers travel time costs (TTC benefit)

The accident reduction benefit was not estimated due to the lack of necessary information on the cost and number of accidents per vehicle-km per accident type (fatality, injury, and property damage).

■ “With and Without Project Comparison Method”

The economic benefits were estimated based on the so-called “with and without project comparison method”. The “with Project” situation means that one of the proposed projects will be implemented, while the “without Project” is where none of the three projects are implemented. The assumed future road networks were based on the “Highway Developed Case (2020, 2030)” by KTIP.

The direct economic benefits were calculated as savings in VOC and TTC, which were derived from the difference in total costs of VOC and TTC between the “with” and “without Project” situations.

Unit VOCs (Rs/km) were obtained from the updated values of the “Pakistan Transport Plan Study (PTPS by JICA, 2005)” to 2012 price level. Unit TTCs (Rs/hour/person) were referred to KTIP.

4) Preliminary Economic Evaluation

The cost-benefit cash flow analyses were carried out under the following pre-conditions:

- | | |
|--------------------------------|-----------------------------------|
| 1) Price Level | : 2012 prices |
| 2) Opening Year | : 2018 |
| 3) Evaluation Period | : 20 years after opening |
| 4) Residual Values | : No residual values were counted |
| 5) Opportunity Cost of Capital | : 12% |

Regarding the time savings benefit, as all portions of the saved time are not necessary to be used for productive activities and some portions may be wasted. Under the situation, it is more realistic to assume the utilization factor, or percentage of undertaking productive activities, for saved time. In this evaluation, a factor of 25% was applied.***

[Note ***: Refer to “The Urgent Development Study on Rehabilitation and Reconstruction in Muzaffarabad City (Urgent Rehabilitation Project: West Bank Bypass Design)”(JICA, 2007)]

The following are the summarized results of the economic evaluation:

Route 1: Coastal Road	
- Economic Internal Rate of Return (EIRR)	= 51.9%
- Benefit-Cost Ratio (B/C)	= 5.90
- Net Present Value (NPV)	= 25,664 (Rs millions)
Route 2: Malir River Bund Road	
- Economic Internal Rate of Return (EIRR)	= 31.7%
- Benefit-Cost Ratio (B/C)	= 2.58
- Net Present Value (NPV)	= 24,927 (Rs millions)
Route 3: Shahrah-e-Faisal – National Road	
- Economic Internal Rate of Return (EIRR)	= 47.2%
- Benefit-Cost Ratio (B/C)	= 4.84
- Net Present Value (NPV)	= 32,340 (Rs millions)

The above results indicated that all three alternative projects are economically feasible as the economic rate of return (EIRR) is higher than the opportunity cost of capital ($> 12\%$), benefit-cost ration (B/C) higher than the unity (> 1.0); and net present value (NPV) having positive values (> 0).

Although the Malir River Bund Road will generate the highest total benefit among the three alternatives, it also has the highest project cost. On the other hand, the project cost of the Coastal Road is only less than 1/3 of the Malir River Road, while the cost of the Shahrah-e-Faisal – National Road is about 1/2 only. These cost factors are the main reasons why Route 1 and Route 3 show high values of EIRR (about 50%).

From the aspect of investment climate improvement, it is necessary to take into account not only the direct economic benefits (VOC and TTC savings), but also other factors such as safety measures for commuting through freeways and direct connection with the industrial zones within the Study Area.

At the same time, the top priority project should be selected so as to contribute to the future development of the whole Karachi City keeping consistency with future land use plan.

(2) Selection of Priority Project

Table 5.8 shows the evaluation results from various factors. The Malir River Bund Road Construction may be selected as the highest priority project based from the following reasons:

- i) The project cost of the Malir River Bund Road Construction is highest among the three projects, however, the economical indicators (EIRR = 31.7 %, B/C = 2.58) showed higher level in economical evaluation:
- ii) The traffic demand that will be converted to Malir River Bund Road is highest among the alternative routes. This means that the future traffic impact to the neighboring road networks will be mitigated by the project: and
- iii) From the aspect of implementing resettlement and land acquisition, the required project component of Malir River Bund Road has most the realistic conditions.

Table 5.8 Evaluation Results for the Alternative Routes

Evaluation Item		Coastal Road	Malir River Bund Road	Shahrah-e-Faisal / National Highway
Economic Aspect	Project Cost	US\$95.2 million	US\$238.9 million	US\$175.4 million
	EIRR	51.9%	31.7%	47.2%
	B/C	5.90	2.58	4.84
Traffic Demand to Change Route		53,200 pcu	132,820 pcu	94,310 pcu
Environmental Aspect	Impact by the Project	- Passing residential areas at two locations (2 km).	- Most of the road alignment will be within ROW. - Passing residential area at one location (700 m)	- Houses and shops are standing in 6.5 km length.
	Mitigation Measure	- Bypass road will mitigate impact. - Land acquisition will be difficult at Umar Goth due to PALCO Oil Terminal.	- Constructing bridge carriageway within the river area will mitigate the impacts of resettlement.	- There will be no effective mitigation measures. - Resettlement and land acquisition will be very difficult to implement.
Evaluation		△	◎	X

Source: JICA Study Team

CHAPTER 6 PRE-FEASIBILITY STUDY OF COMMENDED ROAD DEVELOPMENT PROJECT

The Pre-F/S was conducted on the Malir River Bund Road Project. The preliminary design is shown below.

Table 6.1 Outline of Priority Project

Name of Project		Malir River Bund Road		
Length (km)		20.9		
Start Point		Intersection with 3000 feet Road on 8000 feet Road		
End Pint		National Highway (Goth Juman)		
Design Speed (km/h)		80		
Number of Lane		6 lanes on both side		
Road Width (m)		3.65		
Bridge	Location	Sta.1+250~1+350	Sta.4+750~4+850	Sta.6+900~7+400
	Type	T-beam	T-beam	T-beam
	Length (m)	100	100	500
	Location	Sta.10+800~11+100	Sta.11+700~13+600	Sta.19+300~19+550
	Type	T-beam	T-beam	T-beam
	Length (m)	300	1,900	250
Interchange	Location	Sta.1+400	Sta.6+900	Sta.13+700
	Type	Trumpet-type	Double Trumpet-type	Double Trumpet-type
	Structure Length (m)	1,500	5,200	3,700
Public Utilities (Need Relocation)	High-Tension Pylon (2), Cable (Telephone & Electric) (3.0km), Telephone and Telephone Pole (79), Water Line (1,134m), Sewerage Line (1,082m), Gas Pipe (4,545m), Underground Electric Cable (865m)			
Resettlement (No.)		443		

Source: JICA Study Team

6.1 Preliminary Design

(1) Design Standards

The design standards are shown in **Table 6.2**.

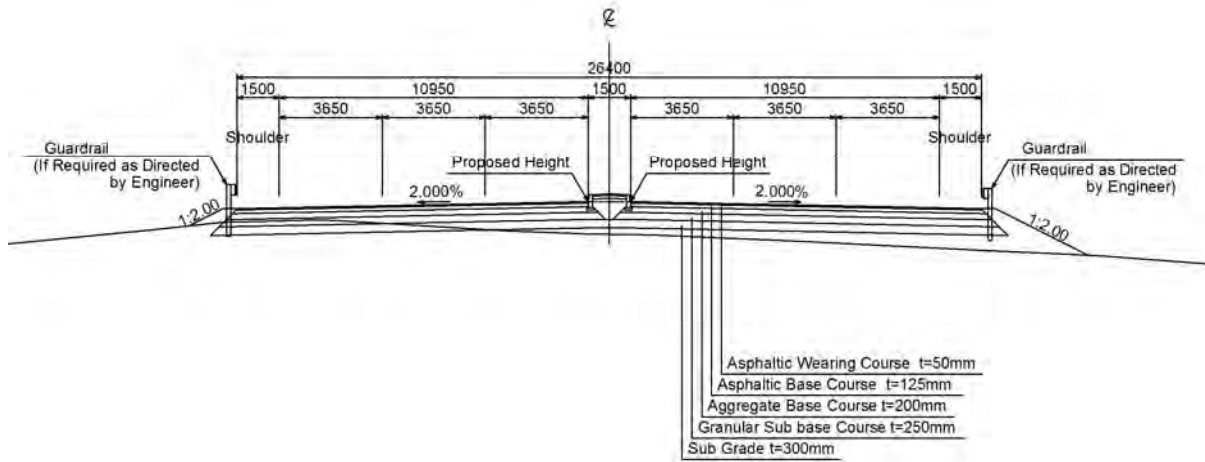
Table 6.2 Design Standards for the Malir River Bund Road Project

Parameters	Design Standard
Design Speed	80 km/h
Lane Width	3.65 m
Number of Lanes (both directions)	6
Outer Shoulder	1.5 m
Median	1.5 m
Shoulder Crossfall	2.0%
Maximum Grade	4.0%
Bridge Type	T-beam
Max Span	40 m
Retaining Wall Type	Reinforced Soil Wall

Source: JICA Study Team

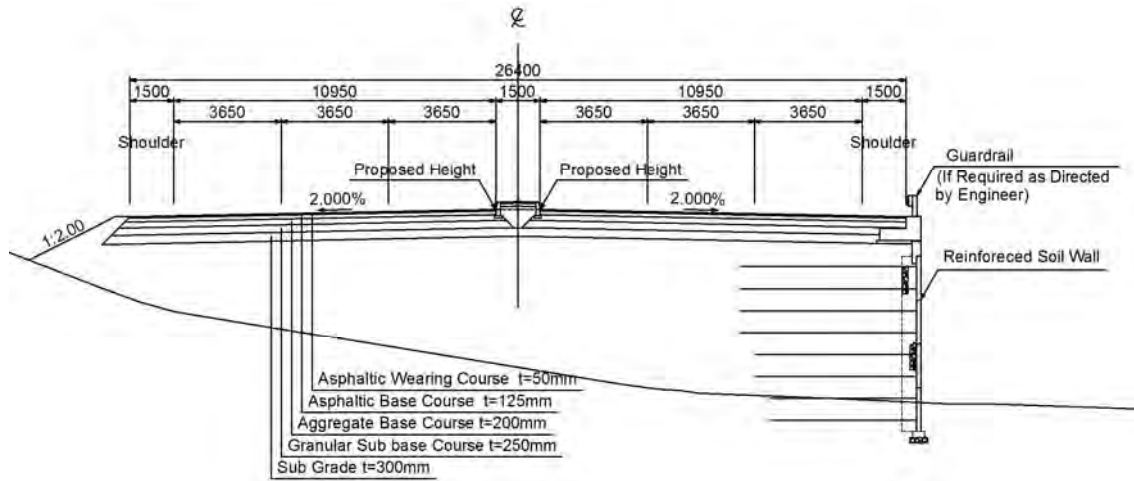
(2) Typical Cross Section

The typical cross section for the various structures of the project is shown in **Figures 6.1 to 6.4**.



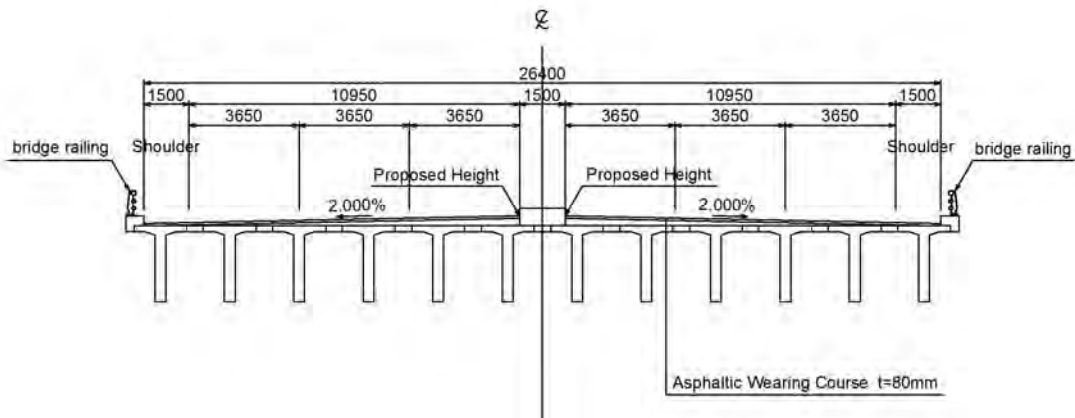
Source: JICA Study Team

Figure 6.1 Typical Cross Section (Earth Works)



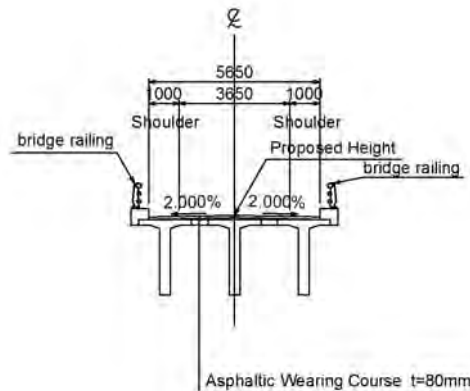
Source: JICA Study Team

Figure 6.2 Typical Cross Section (Retaining Wall)



Source: JICA Study Team

Figure 6.3 Typical Cross Section (Bridge)



Source: JICA Study Team

Figure 6.4 Typical Cross Section (Ramp)

(3) Control Point in Designing Road

1) Top of the Existing Bund

The height of the Malir River Bund Road was determined based on the high flood level (HFL) of the Malir River. The height of Malir River Bund Road is estimated at about 4 ft (1.2 m) above HFL.

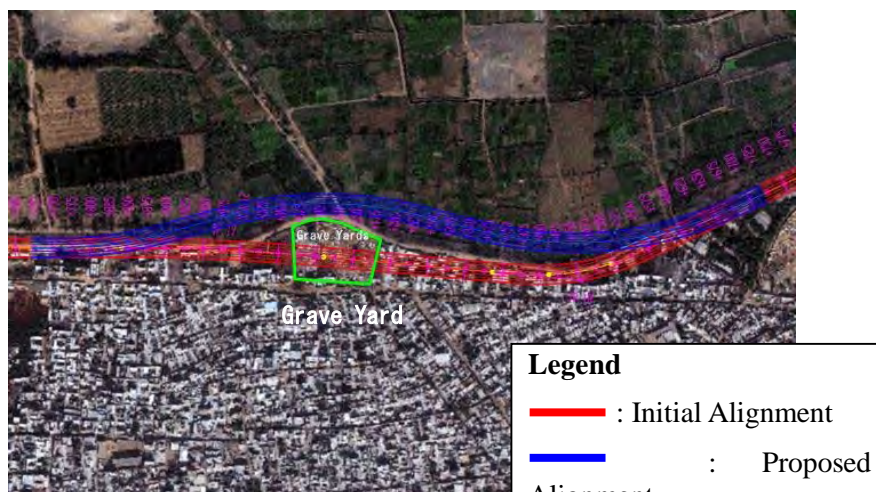
In this Study, the final road level (FRL) was designed on top of the existing bund.

2) Vertical Clearance of Grade Separation

In grade separation, vertical clearance at underpasses will be secured at 5.0 m with an allowance for future resurfacing.

3) Graveyards

Graveyards are located from Sta.12+000 to Sta.12+200 Therefore, the Study Team has planned the alignment to secure these graveyards, as shown in **Figure 6.5**.



Source: JICA Study Team

Figure 6.5 Alignment Securing the Graveyards

4) Profile to Avoid High-Tension Lines (Sta. 6+300)

In Sta. 6+300, high-tension lines are crossing the existing bund. Therefore, the Study Team has followed the same profile.

(4) Right-of-Way ROW

1) Korangi Industrial Area (3000) Road (Sta. 0+000 to Sta. 1+300)

The Karachi Development Authority set the ROW in Korangi Industrial Area (3000) Road at 200 ft (60 m) from the existing road center.

2) Malir River Bund (Sta.1+300 to Sta.13+000)

The Karachi Development Authority set the ROW in Malir River Bund Road at 110 ft (33 m) from the existing bund center.

3) Malir River Bund (Sta.13+000 to Sta.20+925)

The area in this section is owned by the government, therefore, ROW was not established.

(5) Interchange

In this Study, the form of interchange was selected. In this plan, toll gate will be summarized in one place. The selected types of interchanges are as follows:

- Ramp 1 (Around Sta. 1+400): Trumpet-type;
- Ramp 2 (Around Sta. 6+900): Double Trumpet-type; and
- Ramp 3 (Around Sta. 13+700): Double Trumpet-type

6.2 Project Cost Estimation

(1) Unit Cost of Major Construction Items

The unit cost of major construction items were estimated based on NHA CSR 2011 by the Study Team. IMF forecasted that inflation in Pakistan in 2012 will be at 12.00%. The Study Team estimated the unit cost of construction works based on the IMF forecast. The unit cost is shown in **Table 6.3**. Tax is included in the unit cost.

Table 6.3 Unit Cost of Major Construction Items

Work Category	CSR No.	Description	Unit	Unit Cost (Rs)	
				NHA CSR 2011	2012 Estimation
Earth Work	101	Clearing and Grubbing	m ²	21.03	23.76
	104	Compaction of natural Ground	m ²	22.74	25.70
	106	Cutting	m ³	264.14	298.48
	108	Filling	m ³	355.42	401.62
Sub Base and Base	201	Granular Sub Base	m ³	1,028.24	1,161.91
	202	Aggregate Base Course	m ³	1,176.43	1,329.37
	203	Asphaltic Base Course	m ³	14,316.67	16,177.84
	209a	Breaking of Existing Road Pavement Structure	m ³	491.14	554.99
	209b	Scarification / Grooving of	m ²	55.02	62.17

Work Category	CSR No.	Description	Unit	Unit Cost (Rs)	
				NHA CSR 2011	2012 Estimation
		Existing Road Pavement			
Surfacing	302	Prime Coat	m ²	88.57	100.08
	303	Tack Coat	m ²	35.47	40.08
	305	Asphaltic Wearing Course	m ³	15,427.14	17,432.67
Construction Unit Cost		Concrete Bridge Structure	m ²	101,026.00	114,159.38
		Concrete Retaining Wall	m ²	27,147.00	30,676.11

Source: JICA Study Team

(2) Estimated Construction Cost

Table 6.4 shows the estimated construction cost.

Table 6.4 Estimated Construction Cost

Work Category	Cost (US\$)	Cost (Rs)
Earth Work	4,450,000	403,000,000
Sub Base and Base	13,620,000	1,233,000,000
Surfacing	6,530,000	591,000,000
Footpath/Island/Median	460,000	42,000,000
Drainage	8,100,000	733,000,000
Structure	130,410,000	11,802,000,000
Others	63,740,000	5,768,000,000
Construction Cost Total	227,310,000	20,572,000,000

Rate: US\$1.00= Rs90.498

Source: JICA Study Team

(3) Project Cost

Table 6.5 shows the estimated total project cost of the Malir River Bund Road Project.

Table 6.5 Estimated Total Project Cost of the Malir River Bund Road Project

Work Category	Cost (US\$)	Cost (Rs)
Construction Cost	227,310,000	20,572,000,000
Resettlement Cost	6,160,000	557,000,000
Land Acquisition Cost	2,510,000	227,000,000
Relocation Cost	2,930,000	265,000,000
Total Project Cost	238,910,000	21,621,000,000

Rate: US\$1.00= Rs90.498

Source: JICA Study Team

6.3 Project Implementation Plan

(1) Project Implementation Agent

The KMC will be incharge in the entire management of project implementation. KMC will also manage the operation and maintenance (O&M) of the Malir River Bund Road after the completion of construction works.

(2) Implementation Schedule

Table 6.6 shows the project implementation schedule of the Malir River Bund Road Project.

Table 6.6 Project Implementation Schedule of the Malir River Bund Road Project

Item	Year							
	2012	2013	2014	2015	2016	2017	2018	
1. JICA Preparatory Survey (Pre-F/S)	■							
2. Full-Scale F/S		■						
1) Determination of ROW		△						
2) EIA Report Submission		△						
3) RAP Report Submission		△						
4) PC-1 Submission		△						
3. Detailed Engineering Design			■					
1) PQ Document Submission			△					
2) Tender Document Submission			△					
4. Resettlement / Land Acquisition			■	■				
5. Utility Relocation				■				
6. Tendering			■	■				
1) Prequalification (PQ)			□					
2) Bidding				□				
7. Construction Work				■	■	■	■	
8. Road Operation								→

Source: JICA Study Team

6.4 Economic Evaluation

(1) Evaluation of Toll Expressway

In the initial economic evaluation, the Malir River Bund Road Project was evaluated as a toll-free highway. However, the project road is planned as a six-lane motorway, and is completely access controlled with a design speed of 80 km/hr. This kind of high standard road will provide better service level than the general roads. Therefore, being a tolled expressway is more realistic rather than toll-free highway. This section, an economic evaluation was carried out in a case that the Malir River Bund Road is treated as a tolled expressway.

(2) Toll Rate Setting

The toll rates, structure and policy of the expressways should be decided taking into account the factors such as user benefits, willingness to pay, affordability, construction costs including operation and maintenance costs, and general price level.

In general, toll rates are controlled by either the national or local government even if expressways are constructed and operated by the private sector.

In this evaluation, a rate of Rs30 per trip for light vehicles was tentatively applied referring to the existing Lyari Expressway.

(3) Economic and Financial Costs

The project economic and financial costs of the Malir River Bund Road are the same as presented in the initial economic evaluation.

However, as this is a pre-F/S, it will be necessary to cover or supplement the project costs in the next stage of the full-scale F/S so as to include the construction cost of toll gates and collection

costs, and if possible, the intelligent transportation system (ITS) costs.

(4) Economic Evaluation

The cost-benefit cash flow analyses were carried out under the following conditions:

- 1) Price level : 2012
- 2) Opening year : 2018
- 3) Evaluation period : 20 years after opening
- 4) Residual values : No residual values were counted
- 5) Opportunity cost of capital : 12%

The results of the economic evaluation are shown below.

- EIRR = 19.1%
- B/C = 1.56
- NPV = Rs8.73 billion

The above results indicated that the Malir River Bund Road Project is economically feasible with EIRR higher than the opportunity cost of capital ($> 12\%$), B/C higher than unity (> 1.0) and NPV having a positive value (> 0).

In order to check the robustness of the economic feasibility of the Malir River Bund Road Project, sensitivity analyses were carried out by using different cost and benefit values within a probable range against the base case. The prepared cases for the sensitivity analyses are as follows:

- Project costs go up by: +10%, +15% and +20%
- Project benefits go down by: -10%, -15% and -20%
- Different combinations of above changes in costs and benefits

The summarized results of the sensitivity analyses are shown in **Table 6.7**.

Table 6.7 Results of the Sensitivity Analyses (EIRR)

Benefit Cost	Base Case	-10%	-15%	-20%
Base Case	19.1%	17.2%	16.3%	15.1%
+10%	17.4%	15.7%	14.8%	13.8%
+15%	16.7%	15.0%	14.1%	13.2%
+20%	16.0%	14.3%	13.4%	12.5%

Source: JICA Study Team

The results of the sensitivity analyses showed the robustness of economic feasibility of the projects. Even if the project costs increase by 20% and economic benefits decrease by 20%, simultaneously, the project will maintain values of EIRR higher than the opportunity cost of capital ($> 12\%$).

CHAPTER 7 RECOMMENDATION FOR IMPLEMENTATION OF ROAD DEVELOPMENT PROJECT

7.1 GOP's Action for Strengthening Existing Road Network

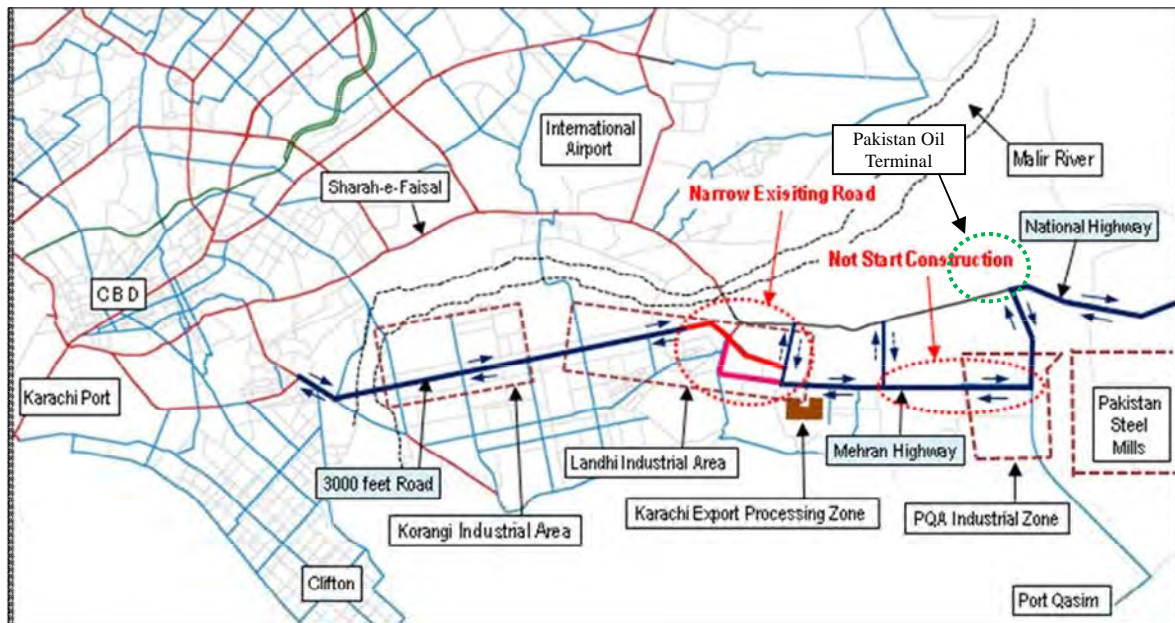
The Study Team recommended to prioritize the construction of the Malir River Bund Road, which will contribute to the improvement of accessibility between Clifton and Port Qasim areas in the aspect of investment climate improvement. Due to the limited traffic capacity, the existing road network should be strengthened to accommodate the increase in traffic year after year, in addition to the construction of the Malir River Bund Road. Moreover, though it takes time to complete the construction works, the Study Team assumed that the Malir River Bund Road may commence operation in 2018.

The GOP must make efforts for the preparation of the Malir River Bund Road Construction Project such as EIA study, RAP formulation and PC-1 preparation. On the other hand, the GOP is recommended to take the following actions in terms of strengthening the existing road network:

- 1) Increasing Traffic Capacity of Shahrah-e-Faisal and the National Highway
 - i) KMC has prepared and submitted the PC-1 for the construction of three flyovers at three locations along Shahrah-e-Faisal. These are at the International Airport, Malir Halt Intersection, and Malir No.5 Intersection. The flyover at the International Airport has commenced construction work. As for the two remaining flyovers, the necessary procedure of budget approval and commencement of construction works should be accelerated.
 - ii) KMC has planned to improve Shahrah-e-Faisal and the National Highway to a six-lane carriageway. However, the status of project is still on the concept paper preparation for budget request to procure survey and design consultants. Since the current traffic volume on Shahrah-e-Faisal and the National Highway between International Airport and Port Qasim has reached the traffic capacity of the existing four-lane carriageway, KMC is recommended to accelerate the internal process of project implementation.
 - iii) On-road parking issues decreases traffic capacity of the carriageway. An oil tanker parking terminal with a capacity of more than 2000 tankers is under construction located behind the Pakistan State Oil Terminal. On-road parking by a huge number of oil tankers is one of main issues along the National Highway section between Quad Abad Flyover and Port Qasim. Therefore, this oil tanker parking terminal construction may mitigate the on-road parking issues.
- 2) Reducing Heavy Traffic Impacts on the National Highway

Due to traffic regulation along Shahrah-e-Faisal, heavy industrial vehicles pass through the 8000 feet Road at Korangi and Landhi Towns. At present, since the Mehran Highway has not yet been completed, industrial vehicles are passing along National Highway, which causes traffic congestion. In order to mitigate traffic impacts by industrial vehicles along National Highway, the following measures are recommended:

- i) The construction of Mehran Highway should be accelerated. After completion of Mehran Highway, heavy industrial vehicles will be controlled to pass along the route of 8000 feet Road – Mehran Highway, as shown in **Figure 7.1**.
- ii) The existing condition of the 3000 feet Road at Future Colony and at the section between Rice Godown and Hospital Chowrangi of Mehran Highway is narrow and poor. Therefore, the road improvement project should be enhanced in order to ensure the transportation conditions for industrial vehicle passing.



Source: JICA Study Team

Figure 7.1 Recommended Transportation Route of Heavy Industrial Vehicles

7.2 Next Stage of Malir River Bund Road Implementation

The Study Team conducted the pre-F/S in this Study, while the full-scale F/S, which includes the RAP study, is recommended to carry out promptly the following scope of works:

1) RAP Study in the Feasibility Study

The usual practices in Pakistan, the ROW is determined at the detailed design stage, while the RAP study is commenced after the completion of the detailed design. Such process causes delay in resettlement and land acquisition, and consequently, the project implementation is delayed. The ROW should be determined in the F/S by raising the precision of engineering study, with the RAP study conducted as a scope of the F/S.

- i) Topographic survey with accuracy of detailed design is carried out. The ROW drawings are prepared on this topographic map.
- ii) Geotechnical investigation for bridge foundation design and hydrological study to confirm the flood elevation are conducted. Then, the plan and profile drawings with detailed design are produced.

2) Financial Study of Tolled Expressway

KMC intends that Malir River Bund Road will be developed as tolling road. However, the preliminary engineering design of Phase 2 Section (Shahrah-e-Faisal to the Super Highway) has not yet been prepared. Therefore, the financial study for the entire Malir River Bund Road has not yet been conducted. To perform the proper financial study, the following should be conducted in the F/S:

- i) Conduct the supplemental traffic survey and demand forecast focusing on the toll road.
- ii) Examine the engineering option of extending the expressway to connect with Clifton DHA area or Karachi Port, and to conduct traffic demand forecast.
- iii) Prepare preliminary engineering design and cost estimation of Phase 2 Section and the above expressway extension to include the location plan of interchanges or ramps.

- iv) Examine the traffic management plan for heavy industrial vehicles. In the pre-F/S, industrial vehicles are not considered in the traffic demand forecast.
- 3) Review for Engineering Design of Pre-F/S
- i) Three interchanges to be located in EBM Causeway, Malir River Bridge, and Shahrah-e-Faisal are planned in the pre-F/S. In accordance with the preliminary design of the Phase 2 Section and extension up to Clifton DHA or Karachi Port, the interchange design should be reviewed.
 - ii) According to the traffic management plan for heavy industrial vehicles, the road geometric design conditions should be reviewed. The preliminary design of the pre-F/S did not consider heavy vehicles along the expressway.