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No. 52

GOVERNMENT OF MALAYSIA
ECONOMIC PLANNING UNIT, PRIME MINISTER'S DEPARTMENT
HIGHWAY PLANNING UNIT, MINISTRY OF WORKS

JAPAN INTERNATIONAL
COOPERATION AGENCY

THE FEASIBILITY STUDY ON KUALA LUMPUR OUTER RING ROAD PROJECT IN MALAYSIA

FINAL REPORT

SUMMARY VOLUME

July 1996

EIGHT-JAPAN ENGINEERING CONSULTANTS INC.
OYO CORPORATION
PACIFIC CONSULTANTS INTERNATIONAL

THE FEASIBILITY STUDY ON KUALA LUMPUR OUTER RING ROAD PROJECT IN MALAYSIA
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FUKUYAMA CONSULTANTS
INTERNATIONAL

PACIFIC CONSULTANTS
INTERNATIONAL

Exchange Rates (Equivalent in Malaysian Ringgit)

Currency Unit	=	Ringgit Malaysia (RM)
RM 1.00	=	US$ 0.40
RM 1.00	=	JY 39.37

(As of August 1995, Ministry of Finance)

PREFACE

In response to a request from the Government of Malaysia, the Government of Japan decided to conduct a Feasibility Study on KUALA LUMPUR OUTER RING ROAD IN MALAYSIA and entrusted the study to Japan International Cooperation Agency (JICA).

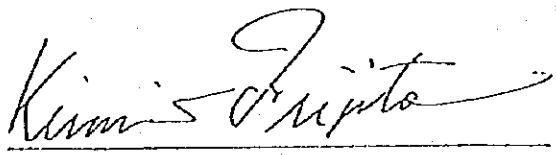
JICA sent a study team to Malaysia between March 1995 and March 1996. The study team was headed by Mr. Hiroo Takeda and comprised members of Fukuyama Consultants International and Pacific Consultants International.

The team held discussions with the officials concerned of the Government of Malaysia and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

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

I wish to express my sincere appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the team.

July 1996



Kimio FUJITA
President
Japan International Cooperation Agency

July 1996

Mr. Kimio FUJITA
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Fujita,

Letter of Transmittal

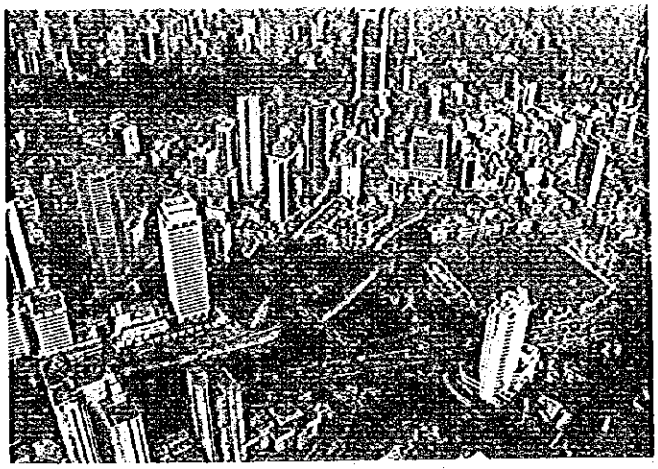
We are pleased to submit you the study report on the Feasibility Study on Kuala Lumpur Outer Ring Road Project in Malaysia. The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the formulation of the above mentioned project. Also included are comments made by the Economic Planning Unit (EPU) of the Prime Minister's department and the Highway Planning Unit (HPU) of Ministry of Works, Malaysia during technical discussions on the draft final report which were held in Kuala Lumpur.

This report presents a scheme for construction of the Kuala Lumpur Outer Ring Road and its possibility of privatization. In view of the urgency of the construction of the said road, we recommend that the Government of Malaysia implement this project as a top priority.

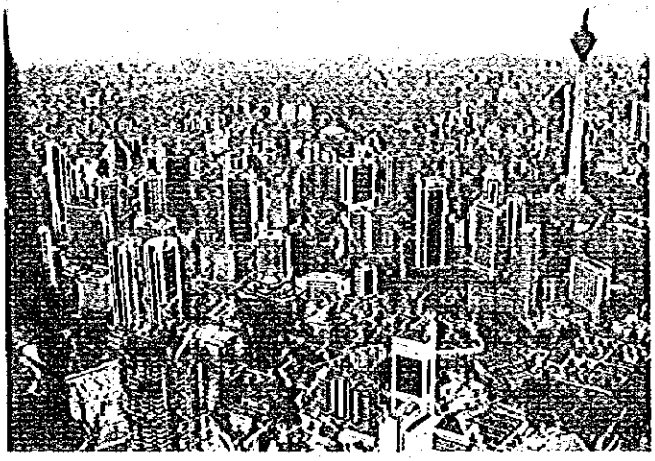
We wish to take this opportunity to express our sincere gratitude to your Agency and the Ministry of Foreign Affairs. We also wish to express our deep gratitude to the officials concerned of the EPU and the HPU of the Malaysian Government, the Japanese Embassy in Malaysia and Malaysia Office of your Agency for the close cooperation and assistance extended to us during our investigation and study.

Very truly yours,

Hiroo Takeda
Team Leader
The Feasibility Study on Kuala Lumpur
Outer Ring Road Project in Malaysia

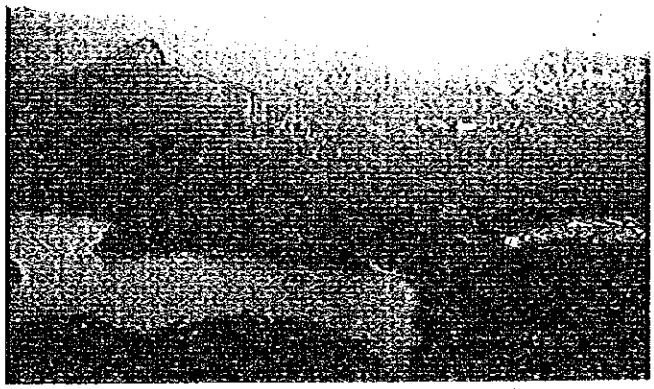


KUALA LUMPUR CENTRAL AREA (1),
MERDEKA SQUARE ON THE RIGHT



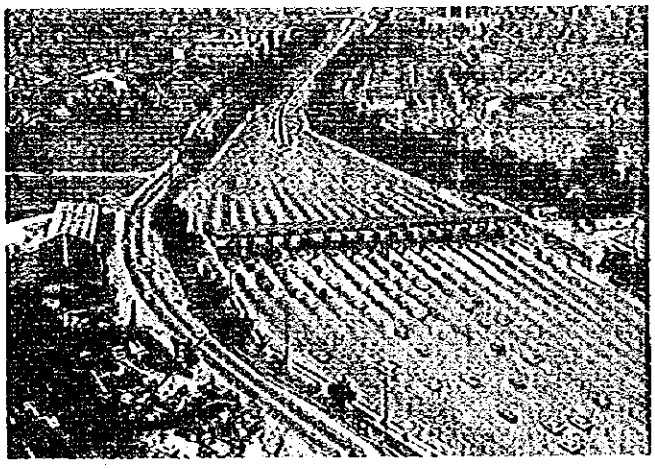
KUALA LUMPUR CENTRAL AREA (2),
KL TOWER ON THE RIGHT

BATU CAVES ON THE FAR SIGHT
AS SEEN FROM SENTUL



QUARTZ RIDGE AND KLANG GATE DAM

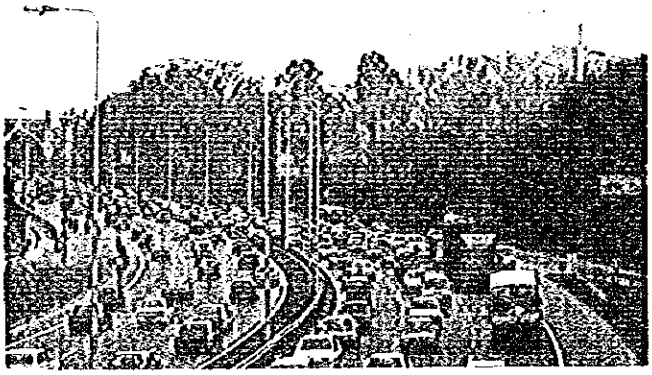
QUARTZ RIDGE AND KL - KARAK HIGHWAY



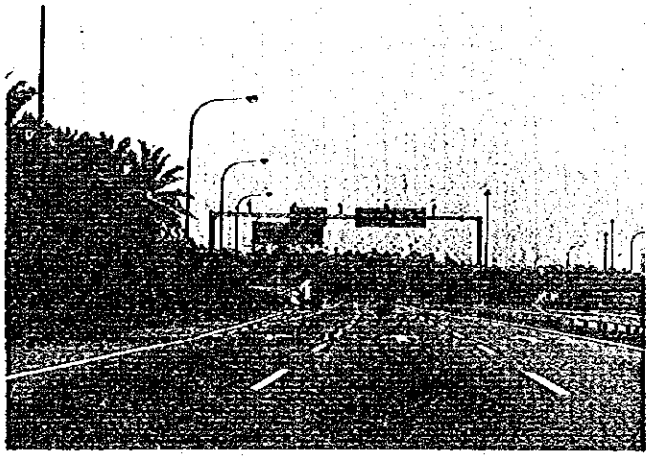
TOLL PLAZA AT JALAN IPOH,
(FEDERAL ROAD 1)

KANCHING FOREST RESERVE

AMPANG FOREST RESERVE

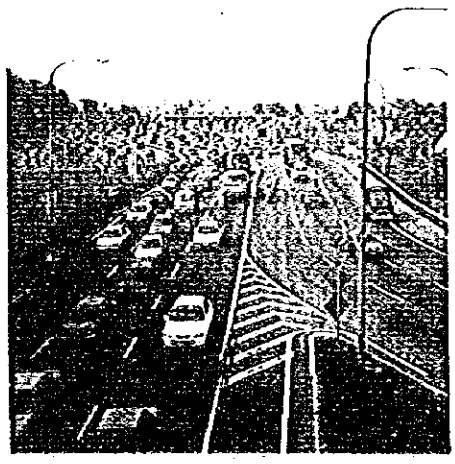


FEDERAL ROAD NO. - 2 NEAR THE BORDER
OF PETALING JAYA AND KL



KL - SEREMBAN EXPRESSWAY

ROAD SIDE INTERVIEW SURVEY



DIVERGING POINT AT SALAK SELATAN

THE FEASIBILITY STUDY ON
KUALA LUMPUR OUTER RING ROAD IN MALAYSIA

FINAL REPORT
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ABBREVIATION

EPU	Economic Planning Unit, Prime Minister's Department
HPU	Highway Planning Unit, Ministry of Works
JKR	Jabatan Kerja Raya (Public Works Department)
JPBD	Jabatan Perancang Bandar Dan Desa (Town and Country Planning Department)
DOE	Department of Environment
RM	Malaysian Ringgit
MC	Malaysian Cen
KLORR	Kuala Lumpur Outer Ring Road
N-SE	North-South Expressway
NKVE	New Klang Valley Expressway
SKVE	South Klang Valley Expressway
HNDP	Highway Network Development Plan
KL	Kuala Lumpur
KLIA	Kuala Lumpur International Airport
GDP	Gross Domestic Products
GRDP	Gross Regional Domestic Products
OD	Origin and Destination
ROW	Right of Way
VOC	Vehicle Operating Cost
LRT	Light Rail Transit
FMP	Fifth Malaysian Plan
SMP	Sixth Malaysian Plan
Jln.	Jalan
Bkt.	Bukit
Tj.	Tanjun
K.	Kuala
Kg.	Kampong

EXECUTIVE SUMMARY

1. The objectives of the study are :
   1) To carry out the feasibility study on the Outer Ring Road for Kuala Lumpur (KLORR) including assessing the financial viability of tolling on this road.
   2) To assess the environmental impacts of the project which will constitute one of the criterions for the selection of preferable alignment.

2. Method of the Study
   The entire study is divided into three major interactive phases as follows:

   1) Stage I (Phase 1) : Formulation of the KLORR Development Concept
   2) Stage II (Phase 2) : Alternative Alignment Study
   3) Stage II (Phase 3) : Preliminary Engineering Study and Evaluation

3. Contents of the Study
   1) The main socio-economic Indicators of Selangor and Kuala Lumpur are found as below

Area	Year	GDP (Million RM at 1978 prices)	Population (x1,000)	Employment at Working Place (x1,000)
Selangor State	1995	24,275	2,689.2	929.4
	2000	37,694	3,282.8	1130.8
	2010	76,255	4,708.0	1640.0
	2020	131,751	5,937.4	2089.9
Kuala Lumpur	1995	15,595	1,329.3	683.9
	2000	22,703	1,590.6	818.3
	2010	38,780	2,021.6	1040.1
	2020	60,895	2,408.5	1239.1

   2) Future Traffic Volume between interchanges are forecasted as below

Year	IC1-IC2	IC2-IC3	IC3-IC4	IC4-IC5	IC5-IC6	IC6-IC7	IC7-IC8	IC8-IC9	IC9-IC10	IC10-IC11	IC11-IC12	IC12-IC13
2000	-	-	-	-	-	-	-	-	11,400	10,900	10,900	10,900
2010	41,800	56,700	46,000	22,000	81,000	93,300	86,000	79,000	76,100	70,000	69,000	69,000
2020	66,600	80,900	71,100	50,600	90,000	11,900	100,900	92,300	93,500	80,800	84,700	84,700

   3) Three alternative routes are established namely A, B and C.
      (1) Alternative Route A : This is the outermost alignment which will provide good services for development projects in the outer area and will have the least social impact.
      (2) Alternative Route B : This is the middle alignment which will have medium impact to both social and natural environments.
      (3) Alternative Route C : This is the innermost alignment, same as route B in section 1. This will provide good services to the inner area with the least effect to natural environment.

      On the basis of various analyses, the alternative route B is selected as the preferred alignment and preliminary design, cost estimates and economic evaluation are carried out for it.

   4) Preliminary Design:
   The summary of the KLORR Project is as follows:

Section	Unit	Section 1	Section 2	Section 3	Total
Length	m	22,830	37,580	28,500	88,910
(Cut and Embankment)	m	13,220	22,580	22,390	58,190
(Bridges and Viaduct)	m	6,050	9,270	6,110	21,430
(Tunnels)	m	3,560	5,730	-	9,290
Number of Lanes	Lane	6	6	6	6

5) Project Cost Estimation

The various costs of the project are found as follows:

Unit : Million RM

Section	Construction	Land Acquisition	Engineering	Environment	Total
1	1,207.4	99.2	60.4	12.1	1,379.1
2	1,647.9	226.6	82.4	16.5	1,973.4
3	1,089.3	138.7	54.5	10.9	1,293.4
Total	3,944.6	464.5	197.3	39.5	4,645.9

4. Project Evaluation

1) Economic Evaluation for the Whole Length

On the basis of the economic evaluation parameter for the whole length of the KLORR which are found as below, the project is highly economically feasible.

Benefit-cost Ratio (B/C)	3.05
Net Present Value (NPV) (RM Million)	5,498.5
Internal Rate of Return (IRR) (%)	22.7

2) Financial evaluation reveals that to make the project feasible some measures such as application of higher toll rate will be needed.

5. Conclusion and Recommendation

1) Necessity of the Project Road

The Klang Valley Region including Kuala Lumpur has played a significant role as the administrative and economic growth pole. Rapid economic expansion followed by the urbanization and motorization in the region justify the necessity of the KLORR expressway to form a favorable highway network configuration for both inter and intra region.

2) Implementation Schedule

The implementation schedule of the project is proposed as follows:

	Total Length (km)	No. of Lanes	Project Cost (RM million)	1997	1998	1999	2000	2001	2002	2003	2004	2005
Section 3 Segment 2 North South Expressway at South-N-S Central Link	18.30	6	864.9									
Section 3 Segment 1 Federal Route 1 at South-North South Expressway	10.20	6	428.5									
Section 2 Segment 2 Hulu Langat Road-Federal Route 1 at South	14.58	6	684.3									
Section 1 Segment 1 and 2 North South Expressway at North-KL-Karak Highway	22.83	6	1,379.1									
Section 2 Segment 1 KL-Karak Highway-Hulu Langat Road	23.00	6	1,289.1									
TOTAL	88.91	6	4,645.9	120.3	445.2	807.0	643.1	537.0	546.2	645.1	351.0	351.0

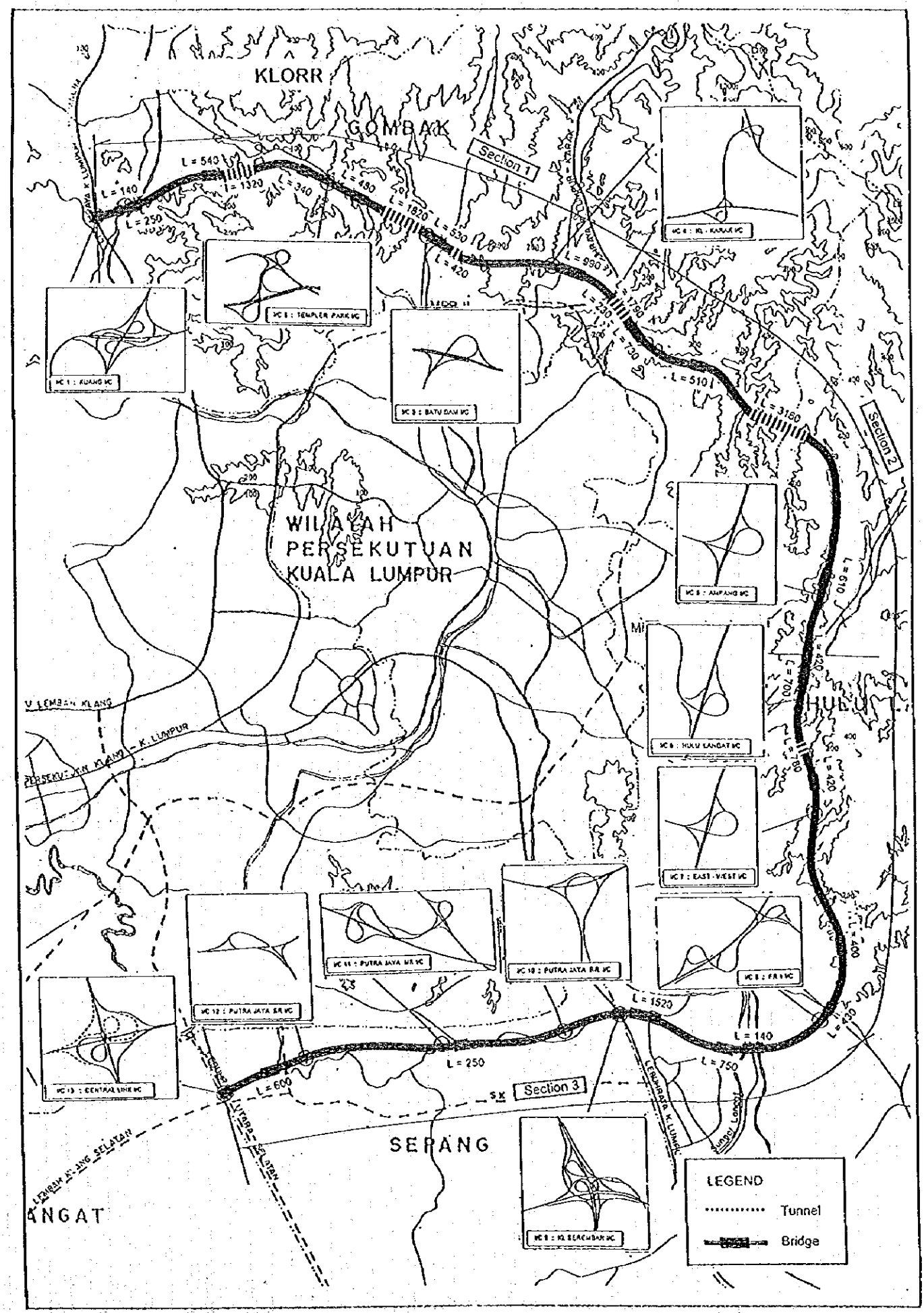
Note : E-W Link Extension is scheduled to be completed in 2001.
Among Elevated Bypass is scheduled to be completed by 2005.

Detail Engineering
Land Acquisition
Construction

3) Financial Plan

Toll rate is proposed to be MC18.9/km with 6% increase per 10 years. The financial plan is proposed as follows:

Financing Resources	Share
Equity	20%
Commercial Loan	60%
Government Loan	20%
Total	100%


KLORR
GOMBAK
Section 1
Section 2
Section 3
WILAYAH
PERSEKUTUAN
KUALA LUMPUR
SERANG
L = 540
L = 140
L = 1320
L = 340
L = 490
L = 1820
L = 530
L = 420
L = 890
L = 1190
L = 230
L = 730
L = 5101
L = 3160
L = 610
L = 700
L = 420
L = 180
L = 400
L = 1520
L = 140
L = 250
L = 600
L = 750
IC 1 : KUANG IC
IC 2 : TEMPLER PARK IC
IC 3 : BATU DAM IC
IC 4 : KL - KAPAR IC
IC 5 : AMPANG IC
IC 6 : HULU KLANG IC
IC 7 : EAST - WEST IC
IC 8 : FRI IC
IC 9 : KL SEACOM IC
IC 10 : PUTRA JAYA BR IC
IC 11 : PUTRA JAYA BR IC
IC 12 : PUTRA JAYA BR IC
IC 13 : CENTRAL LINK IC
LEBUHRAYA KLANG - K. LUMPUR
LEBUHRAYA KLANG SELATAN
LEBUHRAYA KLANG
LEBUHRAYA KLUANG
LEGEND
Tunnel
Bridge

Chapter 1 INTRODUCTION

1.1 Study Background

In response to the request of the Government of Malaysia, the Government of Japan has decided to conduct Feasibility Study on Kuala Lumpur Outer Ring Road (hereinafter referred to as "the Study"), in accordance with the relevant laws and regulations in force in Japan and Malaysia.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation program of the Government of Japan, undertook the Study in close cooperation with the relevant authorities of Malaysia. The Study started in Malaysia in March 1995 and ended in March 1996.

1.2 Study Objectives

1) To carry out the feasibility study including assessing the financial viability of tolling on the Kuala Lumpur Outer Ring Road (KLORR) ; and
2) To assess the environmental impact of the project which will constitute one of the criterias for the selection of the preferable alignment.

1.3 Study Area

The Study area is shown in Figure 1-1. The KLORR is planned as an expressway encircling the Kuala Lumpur Metropolitan Area beyond the on-going Middle Ring Road II.

The KLORR is approximately 80 km in length from the interchange with the North-South Expressway near Rawang/Serendah to the North-South Central Link Expressway in a clockwise arc.

1.4 Study Framework and Report Composition

1) Overall Study Framework

The overall Framework of the Study is shown in Figure 1-2. The study is implemented in two stages and three phases as follows :

Stage I (Phase 1) : Formulation of the KLORR Development Concept
This stage of the Study intends to formulate a preferable development concept for the KLORR based on review of the HNDP study, traffic demand, and the environmental impact on the proposed corridor.

Stage II (Phase 2) : Alternative Alignment Study
This phase is to determine an optimum route alignment for the KLORR, as evaluated from the environmental, engineering and economic view points. A Preliminary Environmental Impact Assessment (PEIA) Report is prepared.

Stage II (Phase 3) : Preliminary Engineering Study and Evaluation
The preliminary engineering study is to be conducted on the preferable route alignment using 1/5,000 topographic map and economic and financial viability of the project is to be evaluated. Implementation strategies and programme including privatization as an option is also proposed.

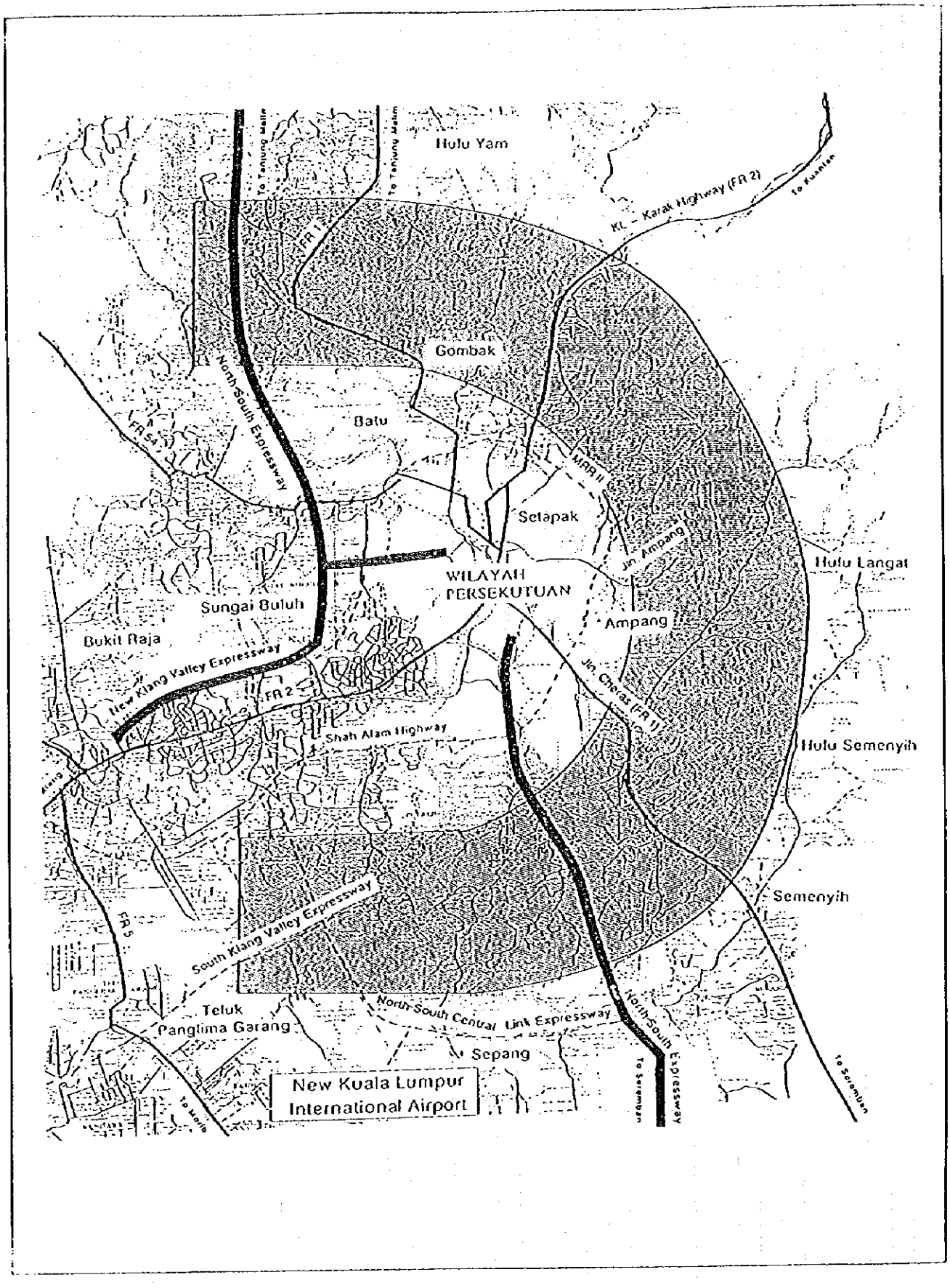


Figure 1-1 : Study Area for the Kuala Lumpur Outer Ring Road

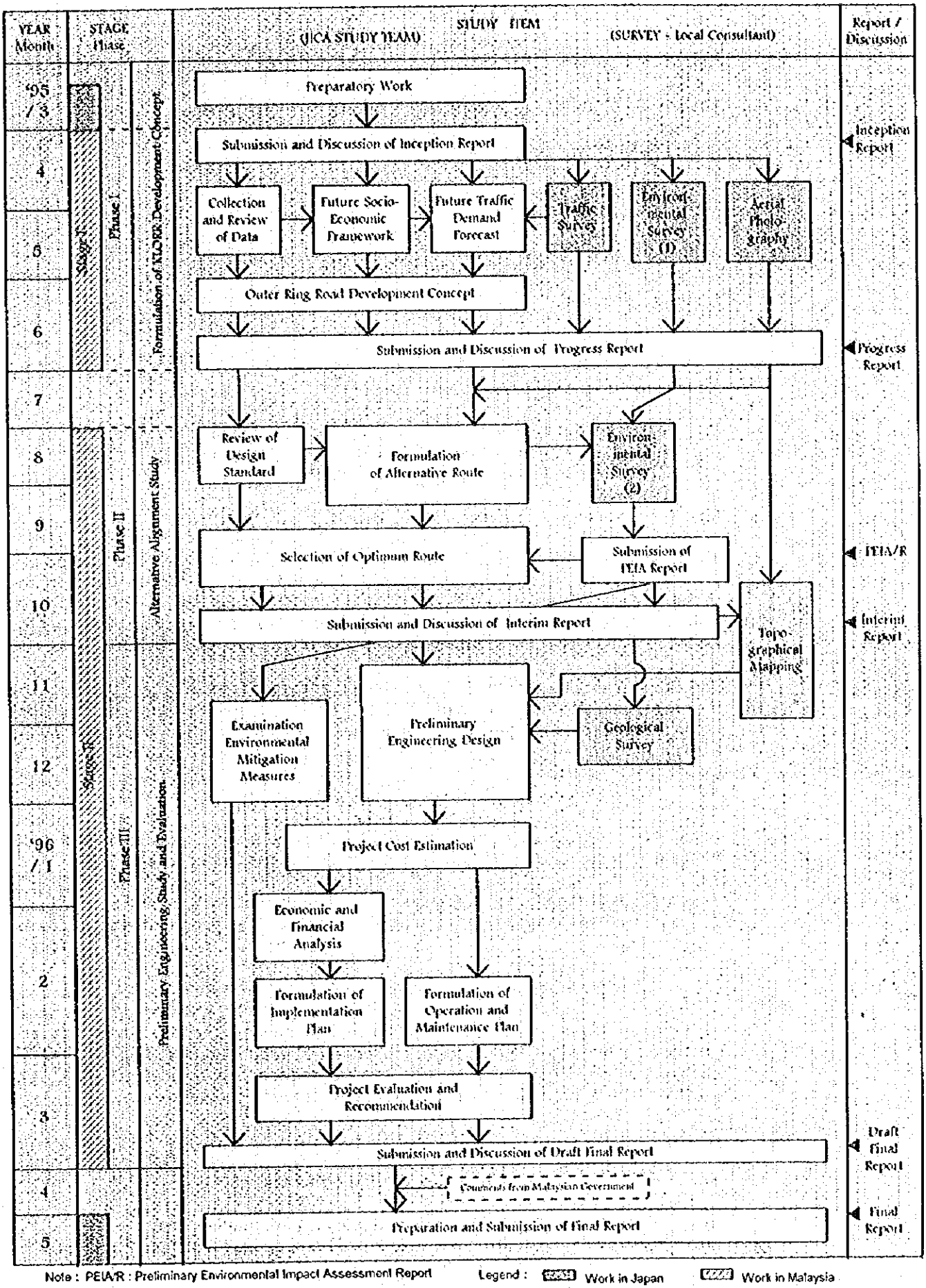


Figure 1- 2 : Overall Framework of the Study

2) Report Composition

The results of the Study are embodied in the following reports :

a. Summary
b. Main Volume
c. Technical Report
d. Drawings

1.5 Major Activities Undertaken

1) Surveys

(i) Traffic Survey

The following Traffic Surveys were conducted.

(1)	Traffic Count Survey	: 30 Stations (16 hours, 24 hours)
(2)	Roadside Interview Survey	: 10 Stations (16 hours)
(3)	Travel Speed Survey	: 10 routes

(ii) Environmental Survey

The PEIA (Preliminary Environmental Impact Assessment) study was conducted in 2 phases. The objectives of Phase 1 is to describe the existing baseline condition and to highlight areas that are environmentally and ecologically sensitive in the Study Area. The phase 1 survey covered an area of approximately 165,000 ha and included the District of Hulu Selangor, Gombak, Petaling and Sepang.

The Phase 2 Environmental Survey identified and assessed all potential impacts on the proposed alternative routes of the KLORR and prepared PEIA report. The PEIA report was submitted to the DOE (Department of Environment) and accepted by the PEIA committee.

(iii) Aerial Photography and Topographical Mapping

Aerial photographs of the Study Area were taken. And an uncontrolled photo-mosaic of scale 1:10,000 and the following topographical maps were prepared.

Topographical mapping 1:5,000 scale :	Approximately 8,000 ha
Topographical mapping 1:2,500 scale :	For interchanges and major structures; 6 locations, approximately 1,200 ha

(vi) Geological Survey

The main purpose of the geotechnical investigation was to clarify the general and detailed geotechnical conditions for the design of major structures on the KLORR, such as bridges, slopes, etc. The geotechnical investigation included 30 locations of machine boring, laboratory tests and a reconnaissance survey.

2) Study

The major components of the study are briefed as follows ;

(i) Collection and review of data and relevant information.
(ii) Socio-economic Framework such as Population, Employment and GDP by traffic zone to the year 2020 were estimated for forecasting the traffic demand at an interval of 5 years.

(iii) Future Traffic Demand on the KLORR was forecasted up to the year 2020 based on the data from the traffic survey and the socio-economic indicators mentioned above.

(iv) Formulation of the KLORR Development Concept was examined in terms of future regional development, highway network configuration and traffic demand.

(v) Review of Design Standards - Geometric design standards and typical cross sections for the KLORR have been established based on the Malaysian Design Standard.

(vi) Three alternative routes for the KLORR were formulated, taking into consideration of the engineering, environmental and geological aspects. Then, an optimum route alignment was selected.

(vii) Preliminary Engineering Study was conducted on the 1/5,000 topographic map for the plan, profile and structures and on 1/2,500 map for the major interchanges and major structures.

(viii) Future Environment and Monitoring - To provide better urban environmental conditions along the project corridor, environmental management programme and roadside development concept were examined.

(ix) Maintenance and Operation - Maintenance and operation plans were prepared to assure the smooth traffic flows, safety and users' comfort,.

(x) Project Cost Estimation including construction cost, land acquisition and compensation cost, maintenance and operation cost as well as environmental monitoring cost were estimated.

(xi) The economic and financial analysis including the sensitivity analysis were conducted to examine the project viability in terms of the socio-economic view point and business opportunity as a privatization project.

(xii) Implementation Plan - Based on the analysis for determining the section priority and assessing the financial viability, the implementation schedule of the projects was proposed.

(xiii) Conclusion and Recommendation - Based on the financial analysis and implementation plan, the most preferable plan was recommended.

3) Technology Transfer

(i) Meeting With Counterpart Team

Meetings were held between the JICA Study Team and Counterpart Team. Key issues related to the study were discussed. The main topics were as follows:

- Discussion of Inception Report, Progress Report, Interim Report and Draft Final Report
- Estimation of Socio-economic indicators
- PEIA Report
- Route Selection and Interchange Plan

(ii) Counterpart Training in Japan

Ir. Mohd Fozi Matori of Highway Planning Unit visited Japan from 20th November to 12th December in 1995 for the JICA Counterpart Training in the field of highway and bridge engineering.

Mr. See Ah Sing of Economic Planning Unit visited Japan from 3rd June to 20th June in 1996 for the JICA Counterpart Training in the field of project evaluation.

(iii) Workshop for Traffic demand forecasting with EMME2 programme

The workshop was held for 6 days from 8th January to 13th January in 1996. Total of 28 engineers and planners from HPU, Malaya University and other organizations

participated in the workshop.

The major themes were as follows :

- Introduction to Transportation Modelling with EMME/2
- Demonstration and Basic Concepts of EMME/2
- Introduction to Graphics
- Building Base Network
- Function/Scenario Manipulation
- Matrices
- Assignment, etc

(iv) Technical Reports

Detail methodologies, analyses, calculation process, etc are indicated in the Technical Reports.

Chapter 2 EXISTING ROAD NETWORK AND TRAFFIC CONDITIONS

2.1 Existing Road Network

The major roads forming the existing road network in Selangor State as shown in Figure 2-1 can be briefly explained as follows:

1) North-South Expressway

This expressway, with fully access controlled toll operated, runs from Bukit (Bkt) Kayu Hitam near the border of Malaysia and Thailand in the north to Johor Baharu near the border of Singapore in the south. The total length of this road is 847.7 km. It is the backbone of the road network in the western corridor of Peninsular Malaysia.
This road traverses the middle of Selangor State parallel to the Federal Road 1 from Tanjong Malim in the north to Bangi in the south, linking Hulu Selangor, Gombak, Petaling, Klang, Hulu Langat and Sepang districts.

2) New Klang Valley Expressway (NKVE)

This is part of North-South Expressway which links Kuala Lumpur to Klang, traversing east-west through the central region of the state. The starting point is Jalan Duta Toll Plaza in Kuala Lumpur and the ending point is Bkt Raja Toll Plaza in Klang.

3) Kuala Lumpur - Seremban Expressway

This is also part of North-South Expressway which links Kuala Lumpur to Seremban. It continues further to the south in the north-south direction to Johor Baharu.

4) Federal Road 1 (FR 1)

This is a major highway traversing north - south in the state. It connects the major towns and cities. This Federal Road starts from Tanjong Malim in the north to Beranang in the south, linking the district centers and major towns such as Kuala Kubu Baharu, Serendah, Rawang, Cheras, Kajang, Semenyih and Beranang.

5) Federal Road 5 (FR 5)

This road traverses north - south along the west coast of the state. It is the most important road in the west corridor of the state. This road links all the districts in the western part of the state, connecting the cities, towns and district centers such as Klang, Sungai Besar, Kuala Selangor, Sepang etc.

6) Federal Road 2 (FR 2)

This is the major artery connecting the Federal Road 1 and 5 in the central part of the state. It links major cities like Klang, Shah Alam, Subang Jaya and Petaling Jaya to the capital Kuala Lumpur. This is a dual carriage 6-lane road and a very important part of the east-west road network in the central region of the state.

7) Kuala Lumpur - Karak Highway

This is a toll highway connecting Kuala Lumpur to Karak in Pahang State. It was constructed as a bypass of Federal Road 68. It starts at the Gombak Toll Plaza near the border of Kuala Lumpur and Selangor. Due to increased traffic demand, it is being upgraded to a 4-lane dual carriage highway.

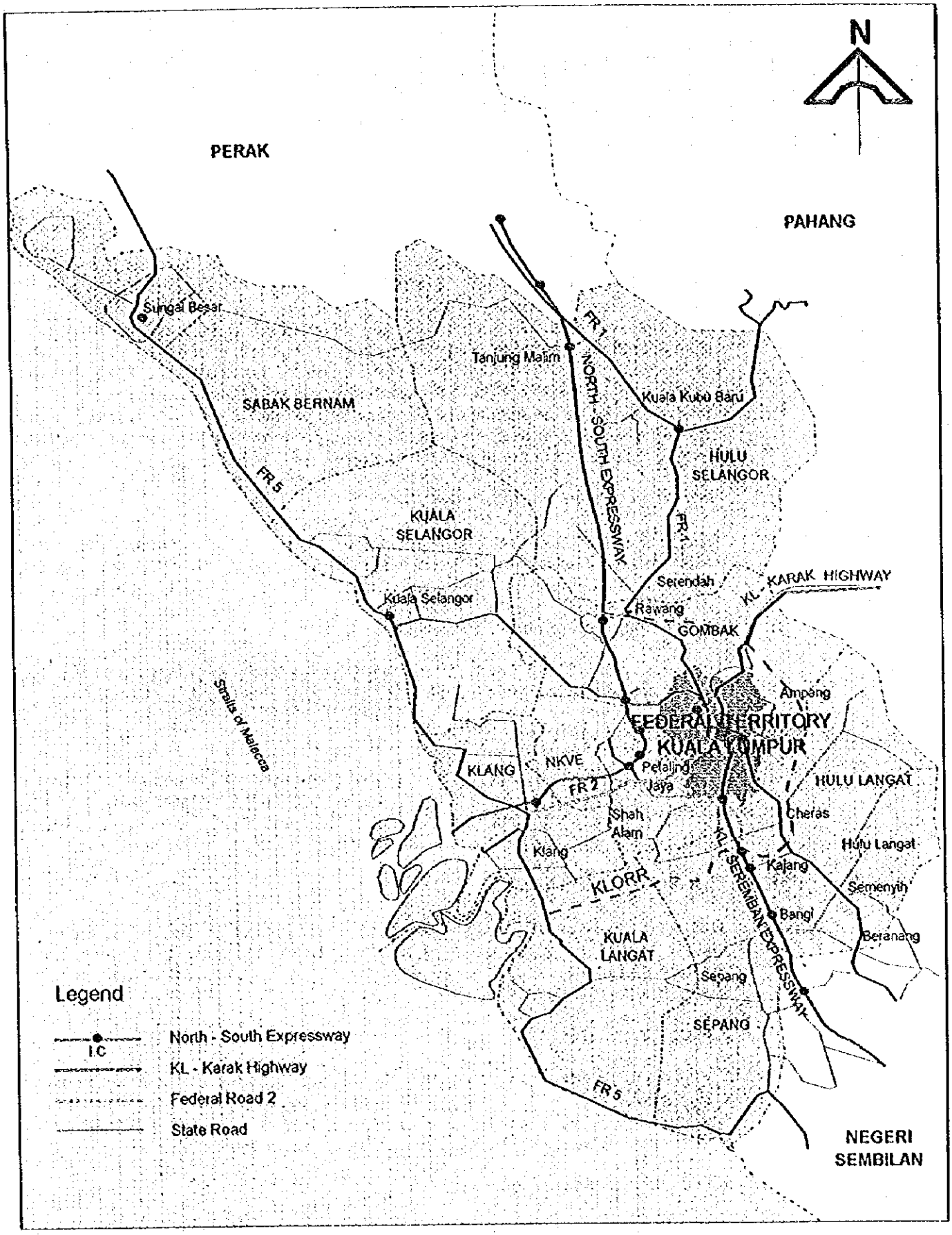


Figure 2 - 1 : Road Network in Selangor State

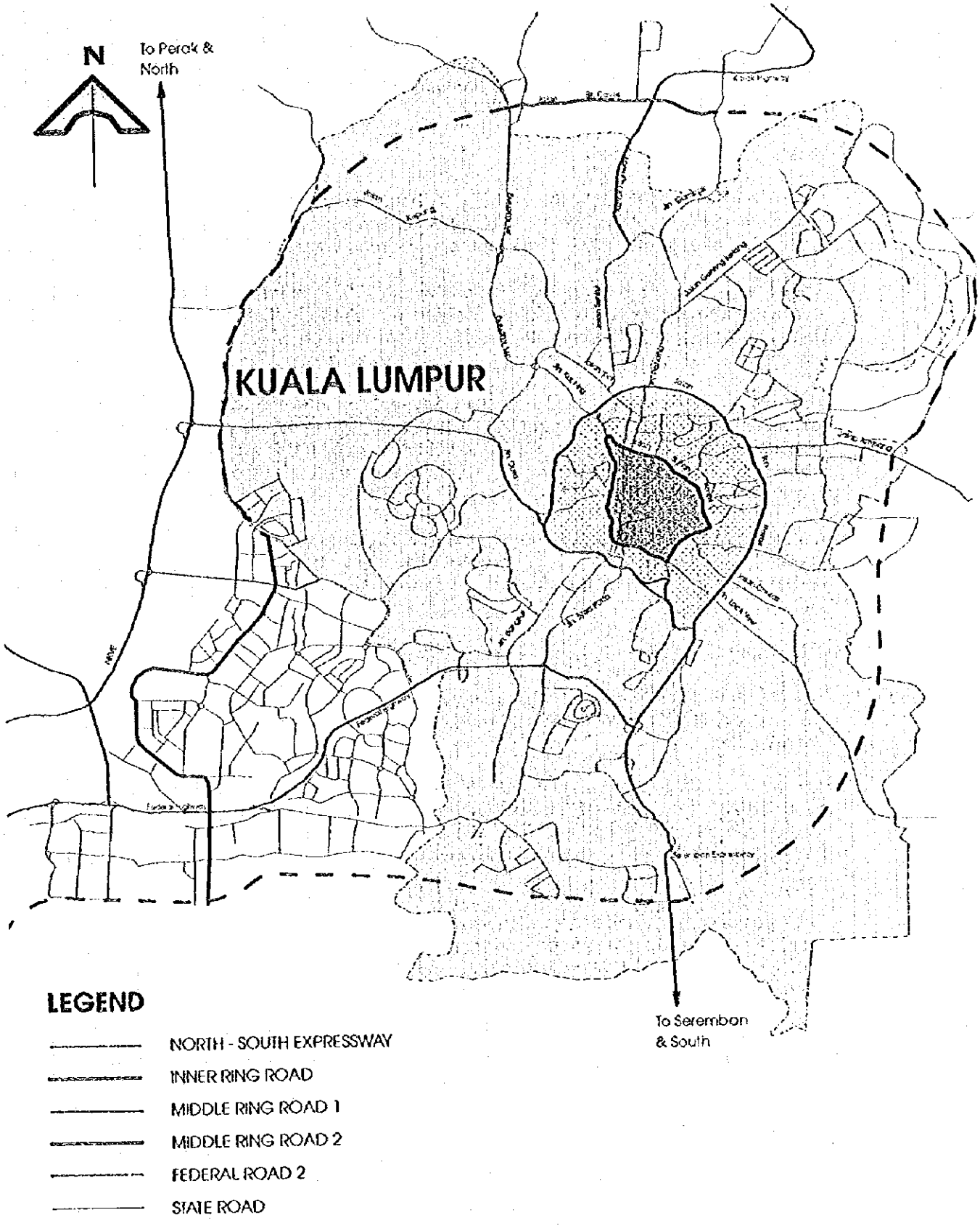


Figure 2 - 2 : Road Network in Kuala Lumpur

The present road network in the Federal Territory of Kuala Lumpur consists of mainly two types of roads. Firstly, urban arterial road such as Expressways, Highways and Federal Roads. Secondly, ring roads which are circumferential to the city. The road network in Kuala Lumpur is shown in Figure 2-2.

2.2 Existing Traffic Condition

According to the HPU data the highest 16 hour traffic volume of 355,700 vehicles was observed on the Kuala Lumpur - Petaling Jaya Section of Federal Road 2. The average annual growth rate of traffic volume on the major road was 6.48%.

Since the opening of the North-South Expressway in 1993, the traffic volume on this road has increased tremendously. The highest daily traffic volume in the northern section is on the Damansara - Subang section, with 70,200 veh/day in 1994, which is 32% up from the 1993 volume.

The traffic survey was conducted in April 1995 to realize the traffic volume on cordon lines for Kuala Lumpur as well as the Klang Valley. The traffic volume inbound to Kuala Lumpur was 587,000 veh/day, whereas, the outbound volume was 621,100 veh/day. The traffic volume inbound to Klang Valley was 92,300 veh./day, whereas, the outbound volume was 97,100 veh/day.

According to the traffic survey, the highest traffic volume was observed on Federal Road 2 between Kuala Lumpur and Petaling Jaya with 448,900 veh/day, followed by 138,500 veh/day on Damansara Road near the stadium. The daily traffic volume on major roads is shown in Table 2-1.

2.3 Trip Characteristics

Trip characteristics of the existing traffic demand, especially those crossing Kuala Lumpur city boundary and Klang Valley Region boundary were examined with the Roadside Interview Survey data.

The average vehicle occupancy rate for Passenger Cars was 1.7(passenger per vehicle, henceforth the same) and 21.5 for buses . Table 2-2 shows the average vehicle occupancy rate on the all survey stations. The average vehicle occupancy rate for Passenger Cars traveling on the North-South Expressway was 1.1. Their trip purposes are shown in Figure 2-3.

The types of commodities and their loading conditions are shown in Figure 2-4 and Figure 2-5 respectively. Both Consumer goods and Mining/Minerals comprised 18%, whereas Agriculture, Fishery & Livestock Products and Metal Products/Machineries comprised 13% each.

More than half of the lorries, that is 57%, were loaded. Among the loaded lorries, 31% were fully loaded, 7% were three quarters loaded, 11% were half loaded and 8% were a quarter loaded.

Table 2-1 : The Daily Traffic Volume on Major Roads

Sta. No.	Name of Road	Location	Traffic Volume		
			Dir. 1	Dir. 2	Total
		Stations along KL Federal Territory Cordon Line			
F4	FR - 2	Boundary of F.T. and Petaling Jaya	214,669	234,262	448,931
F5	Damansara Road	Near Stadium	67,872	70,660	138,532
F8	FR - 1	Near Batu Cave	45,221	45,432	90,653
F1	KL-Seremban EW	Sungai Besi Toll Plaza	43,981	41,597	85,578
F11	FR - 1	Near Junct. of FR-1 & SR B-52	41,524	40,591	82,115
F3	SR - B14	Near Junction of SR B11 and B14	39,163	38,025	77,188
F7	FR - 54	East of Sg. Buloh	26,620	27,647	54,267
F6B	North Klang Valley EW	BT. Lanjan I.C., Location B	27,685	17,336	45,021
F10	SR - B21	Near Junct. of SR B-21 & B-36	19,105	25,620	44,725
F6A	North Klang Valley EW	BT. Lanjan I.C., Location A	12,815	27,768	40,583
F12	SR - B13	Near Junct. of SR B-13 & B-16	15,998	15,676	31,674
F6C	North Klang Valley EW	BT. Lanjan I.C., Location C	13,815	17,401	31,216
F9	KL - Karak Highway	Gombak Toll Plaza	9,793	11,025	20,818
F2	SR - B11	Lombong Bijih Timah Kucai	8,781	8,085	16,866
		Sub-Total	587,042	621,125	1,208,167
		Stations along Klang Valley Cordon Line			
12	KL - Seremban EW	South of Bangi I.C.	28,909	30,598	59,507
3	North - South EW	Near Ladang K. Garing	9,897	10,515	20,412
16	FR - 5	Pandamaran	9,586	10,680	20,266
4	FR - 1	Near Bt. Rawang Jaya Housing	9,358	9,653	19,011
1	FR - 5	Near Kg. Tambak Jawa	8,671	8,801	17,472
7	KL - Karak Highway	Border of Selangor	6,230	7,419	13,649
14	SR - B11	West of B11 & B13 Junction	5,015	5,032	10,047
2	FR - 54	Kg. Merban Sempak	4,874	4,803	9,677
11	FR - 1	Beranang	4,365	5,013	9,378
13	SR - B18	Near KL-Seremban EW	3,798	3,363	7,161
6	SR - B23	Hulu Gombak .	1,208	888	2,096
8	SR - B32	Genting Peres	389	357	746
		Sub-Total	92,300	97,122	189,422
		Other Stations			
17	FR - 2	Subang Jaya	73,919	56,810	130,729
F13	North Klang Valley EW	Jln. Duta Toll Plaza	41,723	34,612	76,335
10	FR - 1	Cheras	19,556	27,394	46,950
5	SR - B27	East of Rawang IC	12,033	13,617	25,650
15	SR - B11/16	Near Selangor Garden Center	9,528	9,285	18,813
9	SR - B62	Hulu Langat	2,561	1,704	4,265
		Sub-Total	159,320	143,422	302,742
		Grand Total	838,662	861,669	1,700,331

Note:

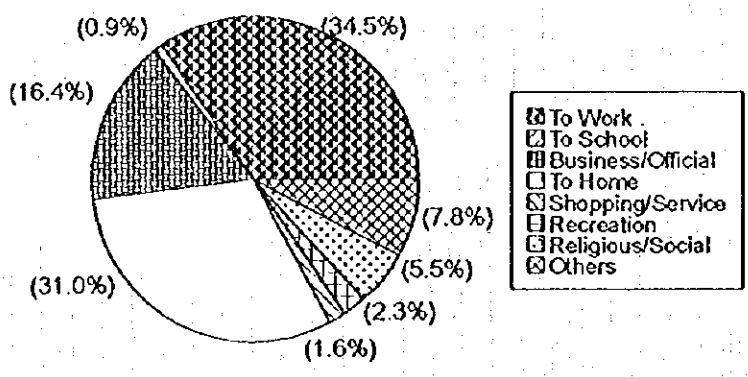
EW - Expressway
FR - Federal Road
SR - State Road
IC - Interchange
Dir. 1 - Towards Kuala Lumpur
Dir. 2 - Away from Kuala Lumpur

Table 2-2 : Average Vehicle Occupancy Rate

Station No.	Location	Vehicle Occupancy Rate	
		P. Car	Bus
2	FR 54, Kg. Merban Sempak	2.1	21.11
4	FR 1, Rawang	1.9	19.16
5	SR 827, Rawang	1.6	21.08
9	SR B62, Hulu Langat	1.72	20.85
10	FR 1, Cheras	1.45	27
15	SR B11/16, Near Selangor Garden	1.94	18
16	FR 5, Pandamaran	2.1	20.4
F1	NSE, Sg. Besi Toll Plaza	1.05	21.56
F9	Kuala Lumpur - Karak Highway, Gombak Toll Plaza	1.9	25.8
F13	NSE, Jln. Duta Toll Plaza	1.15	19.89
Average		1.69	21.49

Note : FR - Federal Road, NSE - North-South Expressway, SR - State Road

Figure 2-3 : Traffic Demand by Trip Purposes



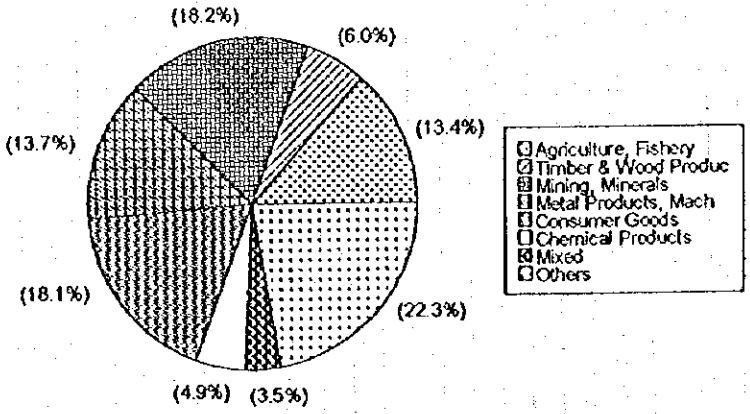


Figure 2-4 : Commodities Carried by Lorries

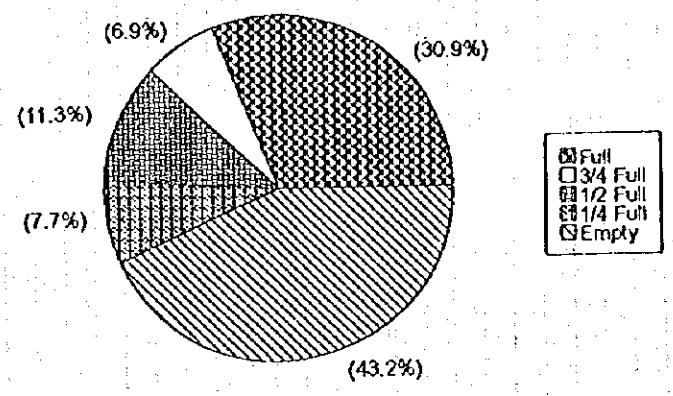


Figure 2-5 : Loading Condition of Lorries in the Study Area

Chapter 3 SOCIO-ECONOMIC FRAMEWORK

The objectives of socio-economic study for the KLORR project are as follows :-

i) Examination of the spatial development trend in the study area,
ii) Estimation of the socio-economic indicators for traffic demand forecasting.

The spatial development examinations are indispensable to formulate a development plan of the KLORR and also provide essential information estimating socio-economic indicators, especially for traffic zones.

3.1 Spatial Development Pattern

Most urban development in the existing spatial development pattern of the study area is concentrated in the Klang Valley Region stretching from Kuala Lumpur to Klang.

The strategy in the Klang Valley Perspective Plan (Review) to disperse development to the new growth areas of Sg. Buloh, Bandar Baru Selayang and Bangi is slowly gaining momentum. Most of the other urban centers outside the Klang Valley are local centers serving the commercial and service needs of the local residents. Many of them are unable to provide goods and services in higher order in competition with the polarized Klang Valley Urban Metropolitan Area. Even district capitals such as Kuala Selangor, Sabak Bernam, Kuala Kubu Baru, Banting and Salak Tinggi are merely small towns serving the needs of agricultural communities.

By 2010, it is predicted that Selangor will have achieved developed state status. Urbanization levels will rise with increased establishment of urban growth centers. The urbanization level which was 34.2% in 1980, increased sharply to 75.3% in 1991 and is expected to exceed 80% by 2010.

As outlined in the State Development Strategy, a functional hierarchy of centers will be established, with most of the urban development to occur outside the Klang Valley Region.

Much of the urban development will occur in Putra Jaya and KLIA Region (Sepang- Kuala Langat). It is also predicted that industrial development in the next decade will be promoted along Industrial Corridors, as opposed to dispersed industrial estates which is the current strategy.

When trying to strike a balance between urban development and the loss of 'green areas' the State should:

(i) Gazette and conserve all existing Forest Reserve and Swamp Forest areas.
(ii) Only promote urban development within the development area of the towns shown in the Structure / Local Plans. Urban development should not be allowed to leap-frog, as is currently the practice.
(iii) Prepare local plans for all major towns in Selangor.
(iv) Not indiscriminately convert estate land for urban development, unless they fall within the growth area identified in the Development Plans.

Figure 3-1 shows a Conceptual Spatial Development Strategy for Selangor State.

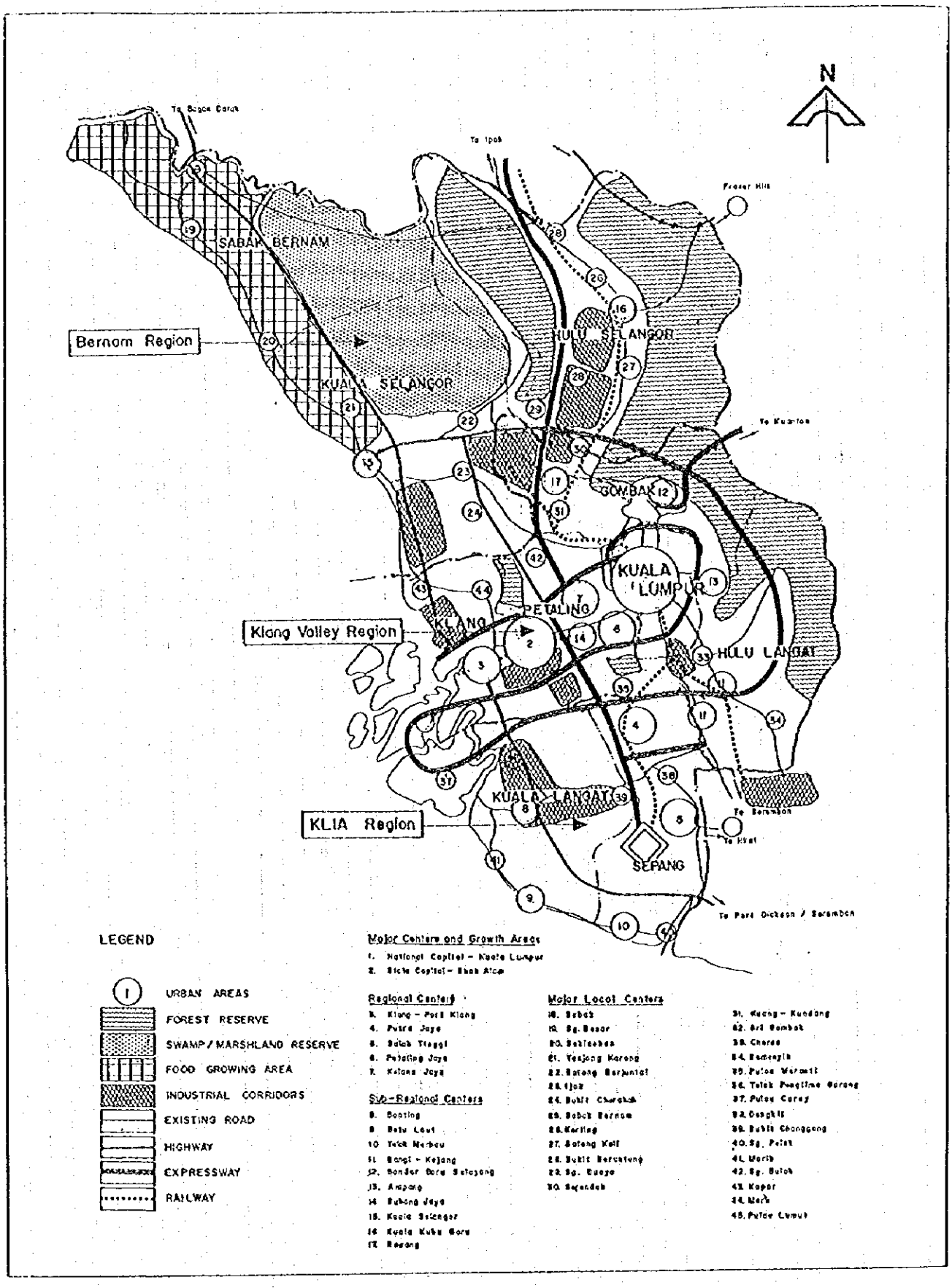


Figure 3-1 : Conceptual Spatial Development Strategy for Selangor

3.2 Socio-Economic Framework

For estimating and forecasting traffic demand by traffic zones, two types of explanatory variables are required : variables which represent existing and future activities of people and commodities at generation areas of traffic ("Residential Area Base"), and variables which represent its activities at attraction areas of traffic ("Working Area Base").

Based on the availability of indicators and the above requirements, the following indicators with observed/measured areas are employed.

Table 3-1 : Type of Socio-Economic Indicators

Estimated/Projected Indicators	Observed/Measured Areas
Population	- Residential Area
Labour Force	- Residential Area
GDP	- Working Place
Employment	- Working Place and Residential

There are two GDP growth rate figures for Selangor State. One is based upon the existing economic trend, the other is based upon the national economic development policy. The existing economic trend indicates a higher annual average GDP growth rate of 7.8% from 1995 to 2020, compared with 7.0% in the policy case.

In the Study the national policy case was applied as shown in Table 3-2 agreed with the Macro-Economic Division of EPU. The Study, however, takes into account the higher growth rate case for the sensitivity analysis. This macro socio-economic indicators was broken down into mukim and further into the traffic zones up to the year 2020 at 5 years intervals.

Table 3-2 : Key Socio-Economic Indicators in Selangor and Kuala Lumpur

Area		Year	GDP*1 (million RM)	Population (Person)	Employment *2 (1000 employee)
Selangor State	Indicators	1995	24,275	2,698,220	929.4
		2000	27,694	3,282,800	1,130.8
		2010	76,255	4,708,010	1,640.0
		2020	131,751	5,937,440	2,089.9
	Increasing Rate	1995 ~ 2000	9.0	4.0	4.0
		2000 ~ 2010	7.3	3.7	3.8
		2010 ~ 2020	5.6	2.3	2.5
		1995 ~ 2020	7.0	3.2	3.3
Kuala Lumpur	Indicators	1995	15,595	1,329,300	683.9
		2000	22,703	1590,560	818.3
		2010	38,780	2,021,630	1,040.1
		2020	60,895	2,408,490	1,239.1
	Increasing Rate	1995 ~ 2000	7.8	3.7	3.7
		2000 ~ 2010	5.5	2.4	2.4
		2010 ~ 2020	4.6	1.8	1.8
		1995 ~ 2020	5.6	2.4	2.4

Note : *1 - GDP before adjustment by imputed Bank Services Charge and import duty at 1978 prices
*2 - Employment on a working place basis

Chapter 4 TRAFFIC DEMAND ANALYSIS

The traffic demand analysis of the Study followed the traditional travel demand forecasting process consisting of Trip Generation, Trip Distribution and Trip Assignment. The modal usage is an important factor for urban transportation system. Generally, the modal usage is analyzed in the stage of Trip Distribution with necessary data and information of people and goods movement. In this study, however, due to the lack of available data and information, the modal usage was examined in the Trip Generation stage with some assumptions.

The traffic demand analysis was carried out using computer software packages such as EMME/2 (transportation planning system software package), Lotus programme and some FORTRAN programmes.

4.1 Existing OD Traffic Demand

The 1995 OD traffic demand is estimated using the results of the roadside traffic count and interview surveys conducted in the Study.

Figure 4-1 shows the trip generation by district in 1995. The present OD distributions pattern was obtained from the results of the roadside interview survey. The distribution of some of the OD pairs which could not be obtained from the survey, such as internal trips within the Klang Valley, were assumed referring to the HNDP distribution patterns.

Figure 4-2 illustrates the results of OD distribution patterns in 1995 for Selangor State and Kuala Lumpur. Huge traffic demand is observed within the Klang Valley area, while the demand is still small in other areas at present.

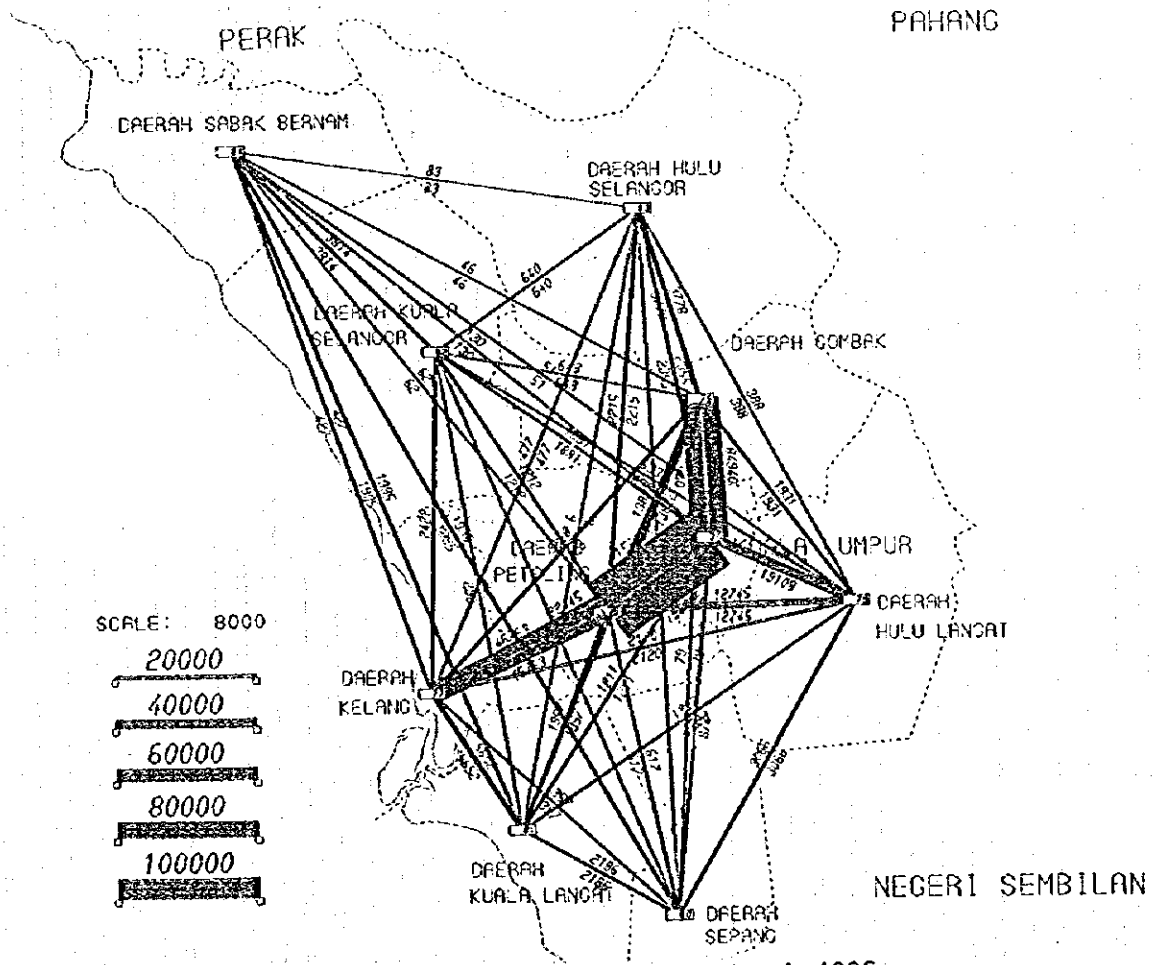


Figure 4-2 : OD Distribution Pattern in 1995

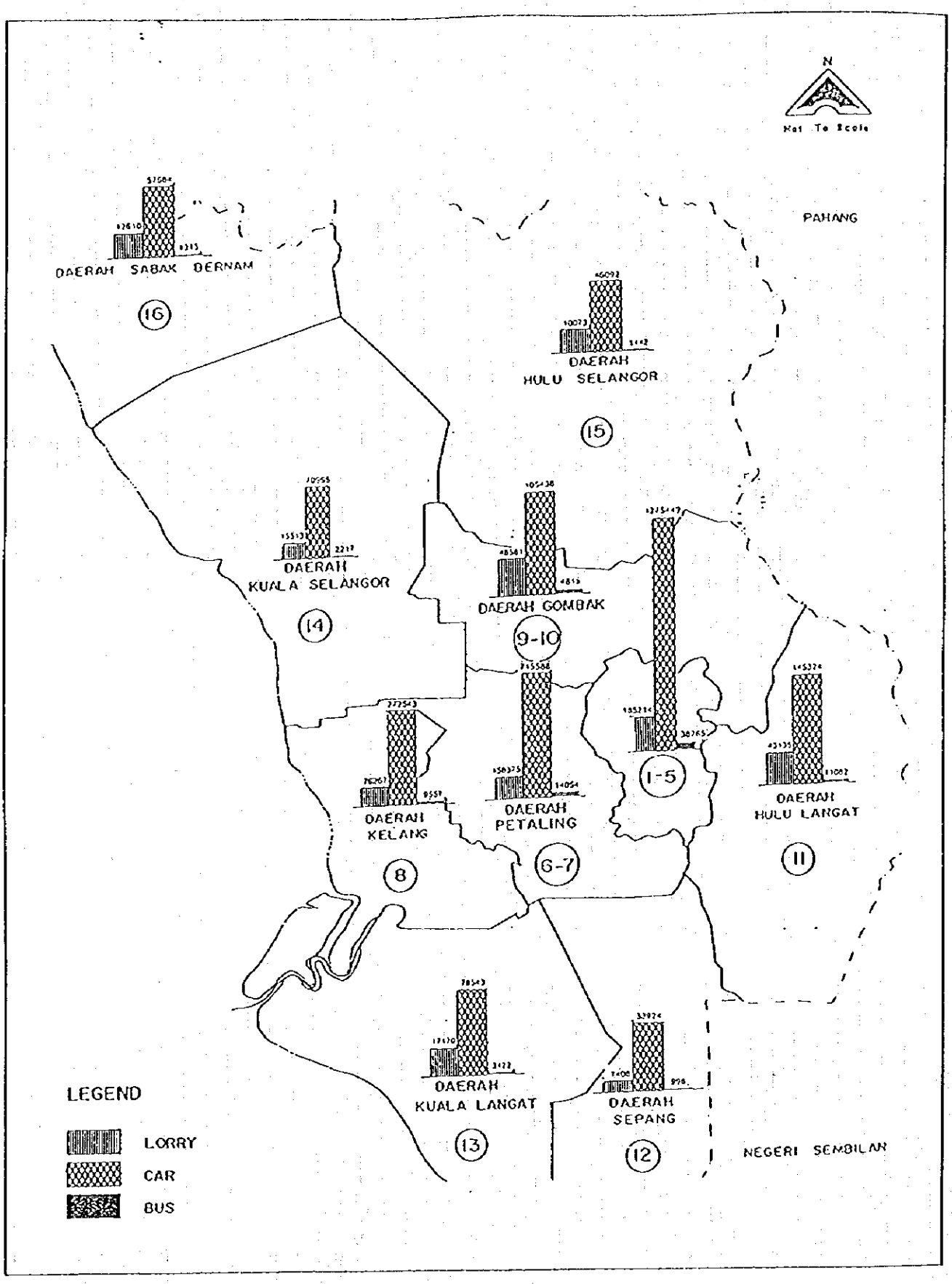


Figure 4-1 : Trip Generation by District in 1995

4.2 Future Traffic Demand

4.2.1 Number of Vehicles

Future number of vehicles registration as shown in Table 4-1 were forecasted using linear regression models and time series-vehicle ownership models. Figure 4-3 illustrates the ownership model for passenger cars and shows the existing conditions in the Selangor and Kuala Lumpur area.

Vehicle ownership in Malaysia in 1995 is 125 (vehicles per thousand people, henceforth the same), while Kuala Lumpur and Selangor are far ahead. For example, ownership rates for Kuala Lumpur in 1995 are equal to that of the year 2035 for the peninsular Malaysia. Selangor in 1995 is equal to year 2005 for Malaysia. The biggest gap observed between Kuala Lumpur and Malaysia is nearly 40 years. The ownership rate 322 recorded in Kuala Lumpur indicates an almost saturated situation.

Table 4-1 : Future Number of Vehicles Registration

(Unit Vehicle)

Area	year	P.Car	Bus	Lorry	Total
Selangor	1995	477469	5726	110527	595717
	2000	594610	7149	142279	746038
	2010	880199	11236	229354	1122799
	2020	1126557	17119	341217	1486913
Kuala Lumpur	1995	422159	5530	63394	493078
	2000	530674	7571	85302	625547
	2010	724067	12453	131507	870037
	2020	901546	18810	180564	1102940

Note : 1995 numbers are based on the models

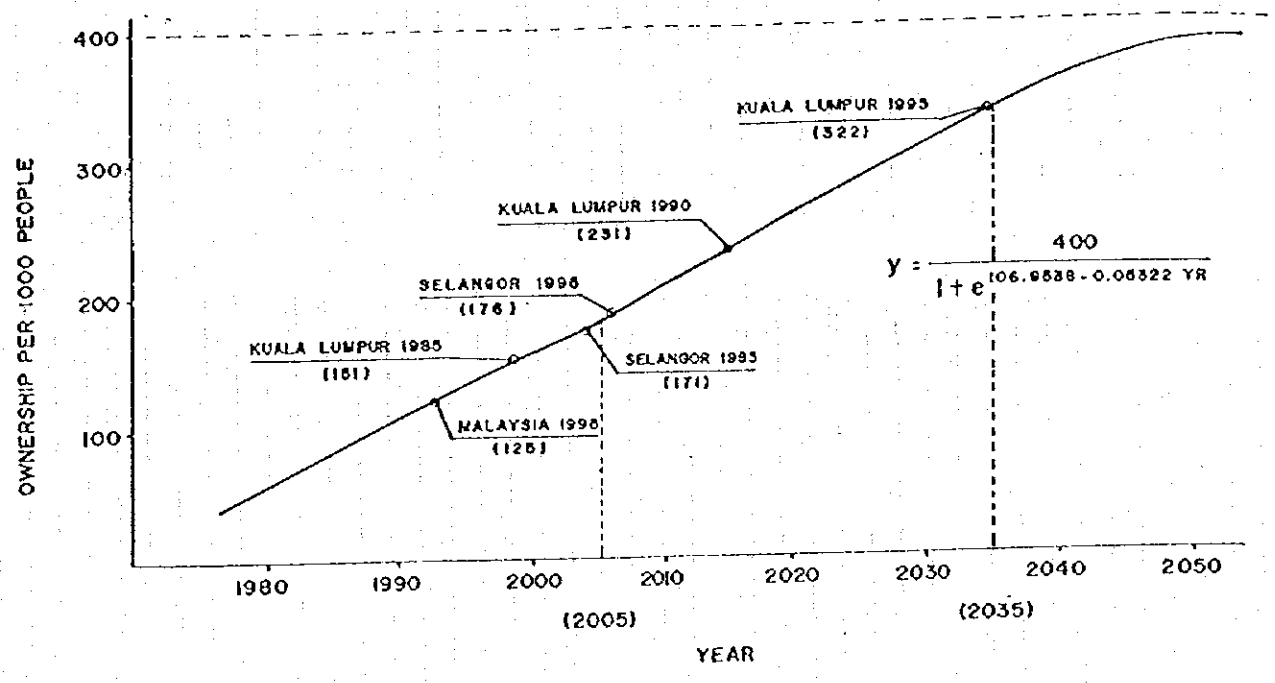


Figure 4-3 : Passenger Car Ownership Model and its rate in Selangor and Kuala Lumpur

4.2.2 Future Total Trip Generation

Trip rate analysis was applied for forecasting total trip generation for Selangor State and Kuala Lumpur. Future trip generation rate for each vehicle type differs from the existing one. As shown in Table 4-2, the rate for passenger cars have a tendency to decrease following the expansion of the ownership. Buses also have shown the same tendency, possibly caused by traffic congestion on roads. On the other hand, lorries have increased in contrast to the others.

To improve the heavily congested traffic conditions in the metropolitan area, the government of Malaysia is enhancing the development of public transport systems introducing KTM commuter service, LRT system and so on. Future traffic demand analysis for the KLORR, therefore, was conducted taking into account of the government policy. Table 4-3 shows the share of transport modal usage applied to the analysis. Although the government plans are targeting the ratio of Passenger Car to Public Transport System equals 40 to 60, it is difficult to use this ratio in the modal split step. Therefore, it was assumed to be 50 to 50 based on the Klang Valley Transportation Study (1987 JICA).

Table 4-2 : Future Trip Generation Rate

Area	Year	P.Car	Bus	Lorry
Selangor	1995	3.10	8.40	3.50
	2000	3.00	8.00	3.60
	2010	2.90	7.50	3.80
	2020	2.80	7.00	4.00
Kuala Lumpur	2995	2.80	6.90	3.00
	2000	2.70	6.00	3.10
	2010	2.60	5.00	3.30
	2020	2.50	4.50	3.50

Table 4-3 : Transport Modal Usage

Unit : %

Year	P.car	Public Transport			Total
		Bus	Rail	Total	
1995	67	33	-	33	100
2000	60	33	7	40	100
2010	55	35	10	45	100
2020	50	35	15	50	100

Table 4-4 shows estimation of the future trip generation. Due to the rapid economic expansion and motorization, the vehicle trip generation will increase tremendously.

Table 4-4 : Future Total Trip Generation After Adjustment*

	Year	P.Car	Bus	Lorry
Selangor	1995	1,480,154	48,098	386,845
	2000	1,686,994	57,192	515,124
	2010	2,288,616	84,290	876,265
	2020	2,886,256	119,833	1,371,719
	(Target)	(2,473,900)	(132,532)	
Kuala Lumpur	1995	1,182,045	38,157	190,182
	2000	1,348,305	45,426	264,435
	2010	1,713,720	62,265	433,972
	2020	1,880,475	84,645	631,974
	(Target)	(1,343,200)	(87,308)	
Total	1995	2,662,199	86,255	577,027
	2000	3,035,299	102,618	779,559
	2010	4,002,337	146,555	1,310,237
	2020	4,766,731	204,478	2,003,693

Note : *Adjustment from - Modal Usage

4.2.3 Future Trip Distribution

Figure 4-4 shows the desire lines of Future OD in 2020. The majority of the demand will be still within the Klang Valley Region. Substantial increases are noted for the trips between Sepang District and Klang Valley as a result of KLIA and Putra Jaya projects.

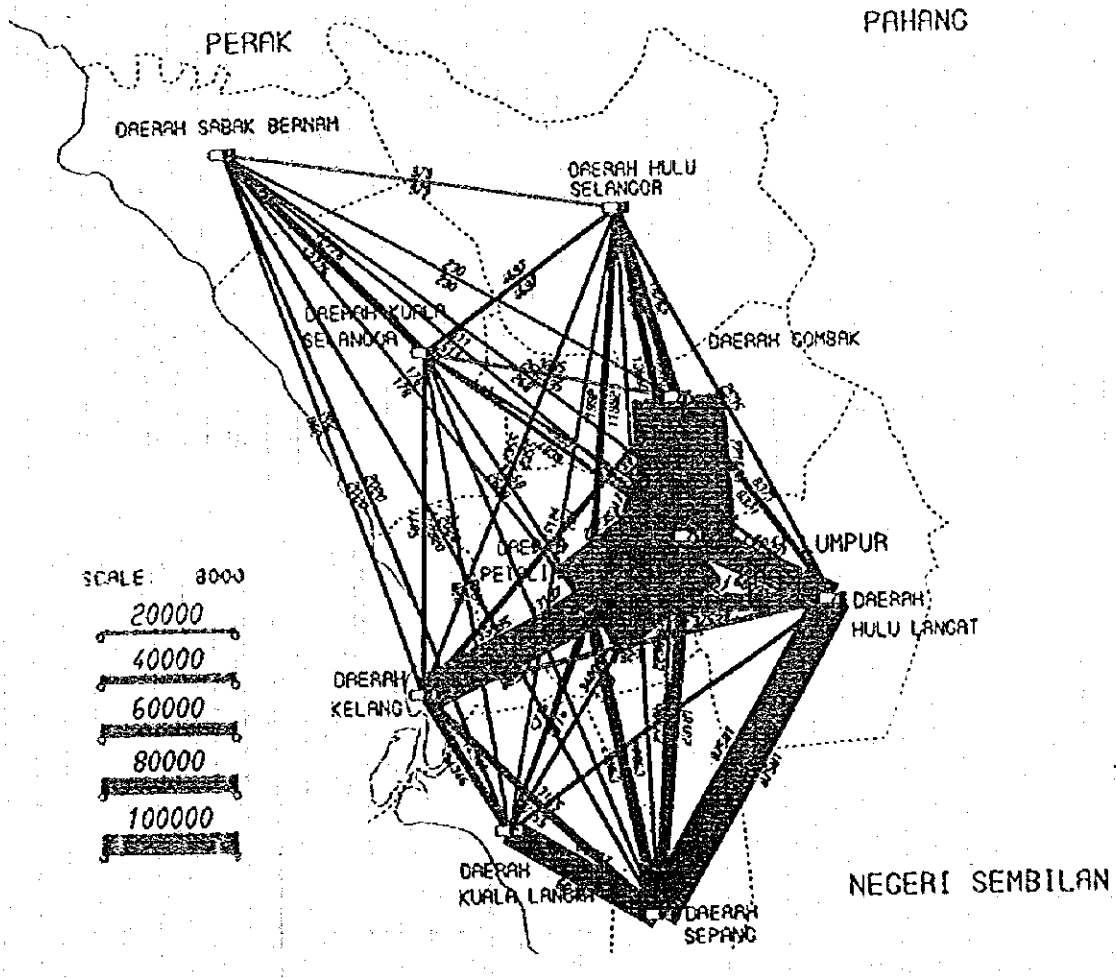


Figure 4-4 : Desire Lines of OD in 2020

Table 4-4 : Future Total Trip Generation After Adjustment*

	Year	PCar	Bus	Lorry
Selangor	1995	1,480,184	48,008	360,845
	2000	1,889,084	67,192	515,124
	2010	2,288,016	84,230	870,275
	2020	2,836,256	113,833	1,371,719
	(Target)	(2,473,900)	(113,833)	
Kuala Lumpur	1995	1,162,045	33,157	100,182
	2000	1,345,305	43,436	264,435
	2010	1,713,720	62,295	433,902
	2020	1,850,475	84,055	631,974
	(Target)	(1,343,200)	(67,303)	
Total	1995	2,642,150	86,265	577,027
	2000	3,234,389	122,618	779,559
	2010	4,002,337	146,555	1,310,297
	2020	4,790,731	204,478	2,003,653

Note : *Adjustment from - Modal Usage

4.2.3 Future Trip Distribution

Figure 4-4 shows the desire lines of Future OD in 2020. The majority of the demand will be still within the Klang Valley Region. Substantial increases are noted for the trips between Sepang District and Klang Valley as a result of KLIA and Putra Jaya projects.

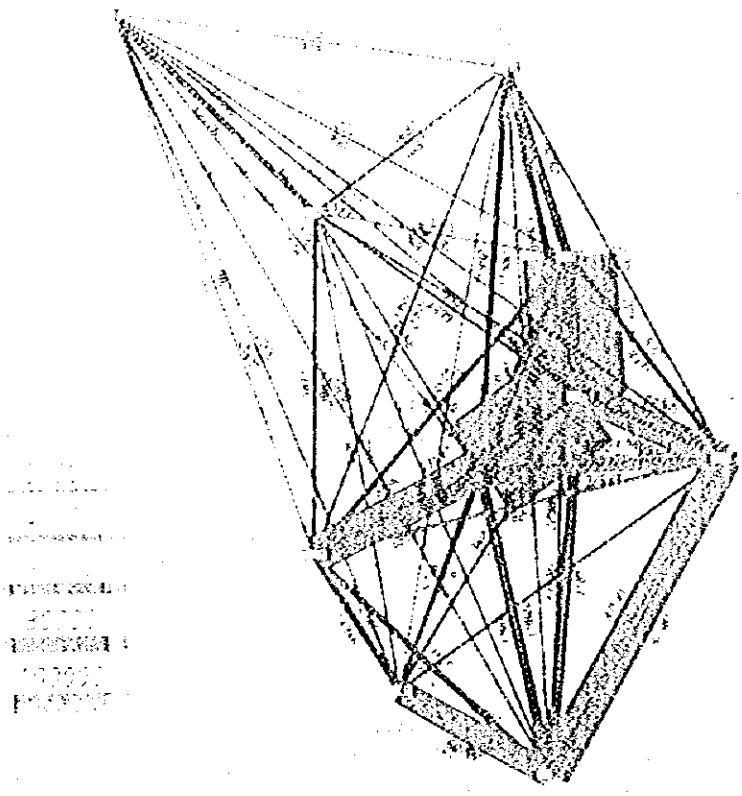


Figure 4-4 : Desire Lines of OD in 2020

Chapter 5 FORMULATION OF KLORR DEVELOPMENT CONCEPT

5.1 Spatial Development Trend and Existing Highway Framework

The present capital region of Klang Valley has played the most significant role as the growth center in national economic development during the last decade. Expansion of the economy has developed this region rapidly, and it will be fully developed in near future.

The national economy is expected to expand further, targeting "Vision 2020". Based on the economic growth, the pressure of development has started to over flow from Klang Valley to the region north and south outside. The present development trend is illustrated in Figure 5-1.

New national development projects, such as Putra Jaya, KLIA and 2nd National Car Project will stimulate this trend and will form a new capital region, namely, the Greater Klang Valley Region. Existing road network and traffic conditions are described in Chapter 2. The basic network configuration shown in Figure 5-2 for the existing urban area of Klang Valley including Kuala Lumpur will be completed with the on-going projects such as MRRII, Shah Alam Expressway and North-South Central Link Expressway.

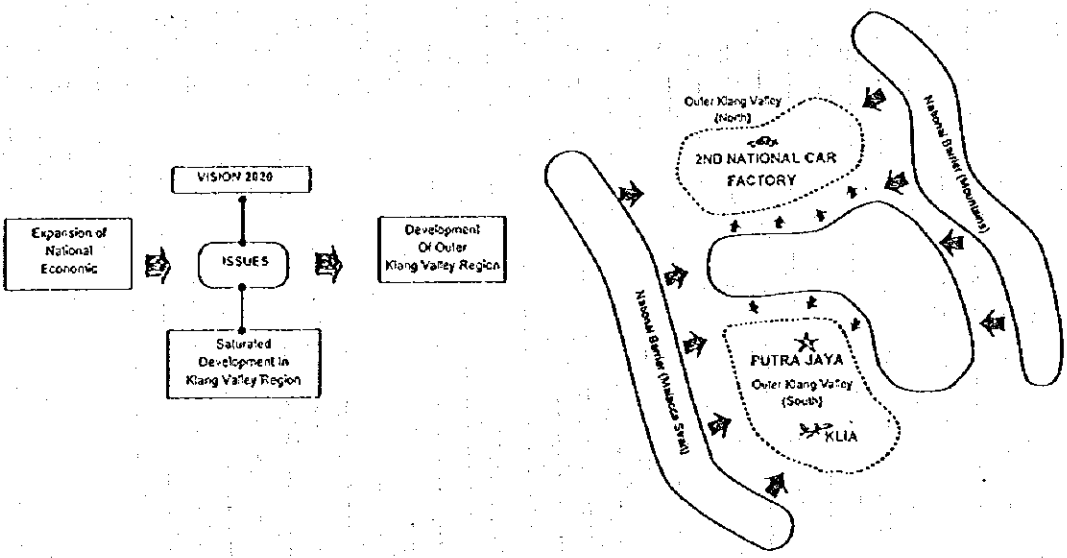


Figure 5-1 : Present Development Trend

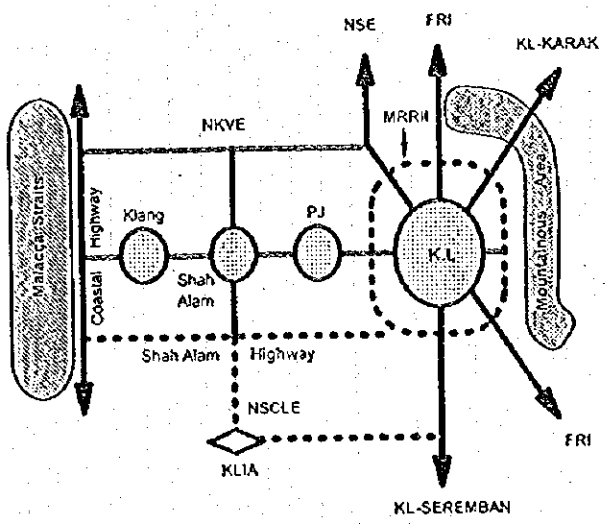


Figure 5-2 Road Framework in the Study Area

5.2 The KLORR Development Concept

In the recent trend of urbanization and motorization, the KLORR is an element of urban infrastructure development, especially in metropolitan areas. The basic function of the outer ring road is to distribute population and traffic in order to improve the urban environment.

The KLORR development concept is based on this basic function and on the needs identified in previous sections. The development concept is illustrated in Figure 5-3 and interpreted into the following Goals and Development Objectives.

Goal 1 : To encourage balanced urbanization in the Greater Klang Valley Region in order to sustain the rapid growth of the national economy of Vision 2020, taking into account of harmonization with the natural environment.

Goal 2 : To provide efficient, reliable and safe transport of goods and people in the capital region, and to minimize wasteful problems such as traffic congestion, road bottle-necks, air and noise pollution.

In pursuit of these goals, the KLORR shall employ the following objectives.

(1) To provide an outer ring road in the strategic areas based on the expansion of urbanization and the regional development trend.

(2) To provide functional linkage between urban centers in line with urban hierarchy in an effort to avoid over concentration on the urban functions in Kuala Lumpur, and to ensure an equitable distribution of acceptable levels of urban services.

(3) To provide better access to the national development projects, such as KLIA, Putra Jaya and 2nd National Car Projects.

(4) To link up major inter-state highways leading to the Capital Region Klang Valley in order to distribute external traffic.

(5) To formulate a total highway network configuration, with a clear functional hierarchy of road types, capacity and design capable of covering the Greater Klang Valley Region.

(6) To provide sufficient road infrastructure so as to meet future traffic demand.

(7) To provide an environment-friendly highway, in order to minimize environmental destructions.

(8) To prepare a roadside (corridor) development concept aiming toward preservation of natural and living environments.

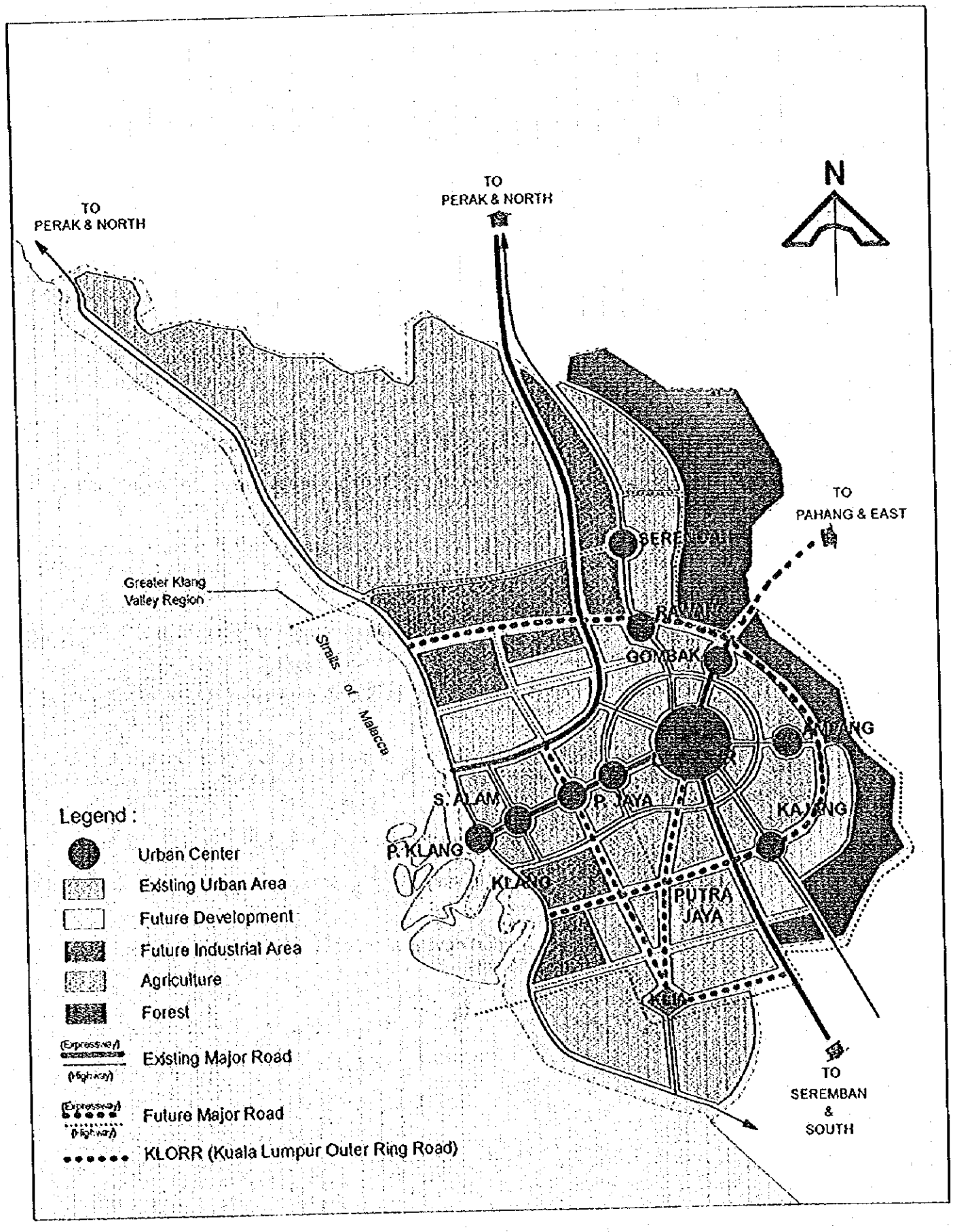


Figure 5-3 : Development Concept of the KLORR

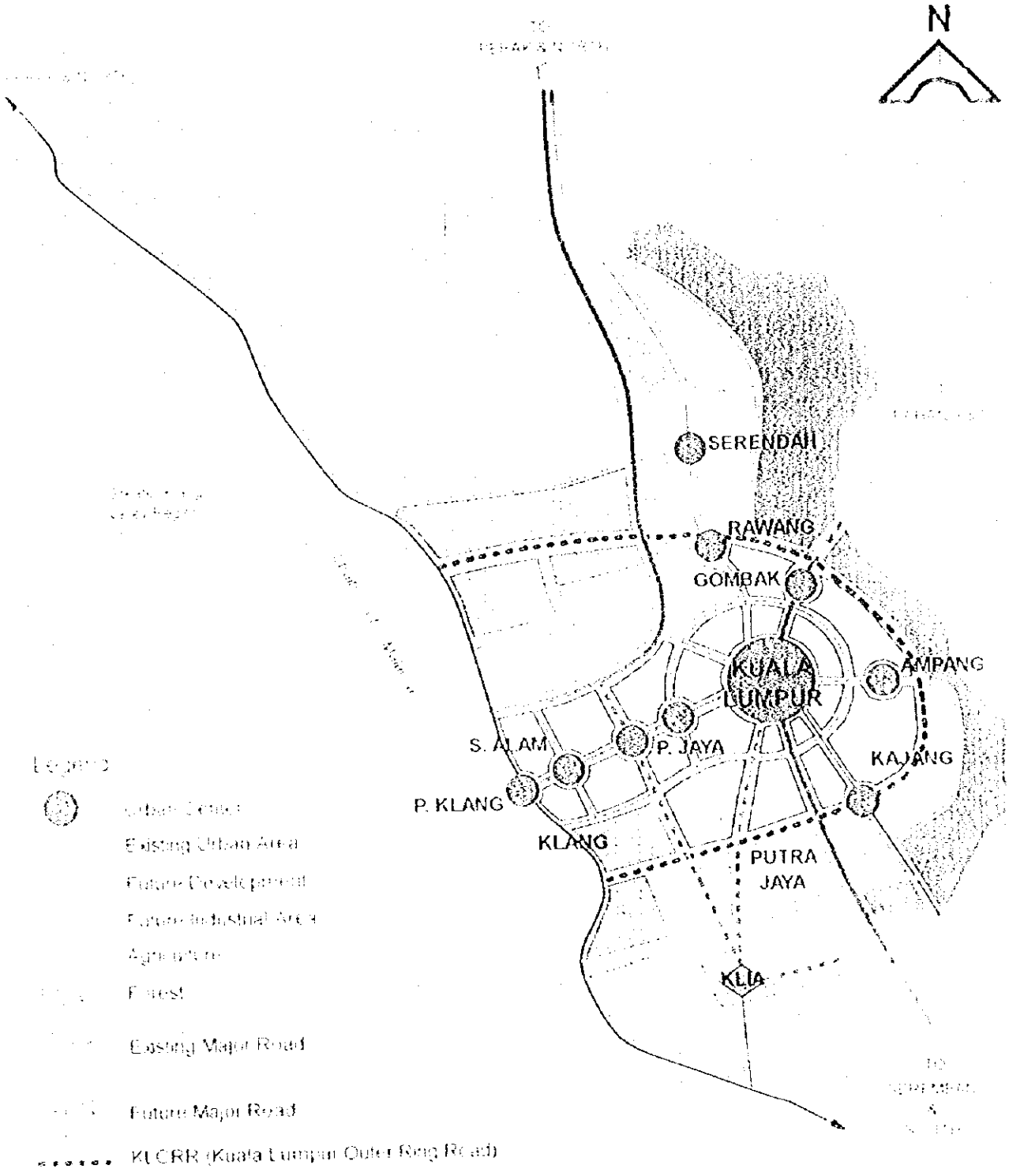


Figure 5-3 : Development Concept of the KLORR

Chapter 6 ENVIRONMENTAL ASSESSMENT FOR THE PROJECT CORRIDOR

6.1 Existing Environmental Conditions and Sensitive Areas

The environmental study area covers an area of approximately 165,000 ha (407,340 acres) including Hulu Selangor, Gombak, Petaling, and Sepang Districts. The KLORR corridor bypasses the Kuala Lumpur Federal Territory and passes through several outside major towns. The existing land use pattern in the Study corridor are shown in Figure 6-1.

The environmentally sensitive sites in this Study Area are water catchment areas, water intake points, reservoirs, high-risk erosion areas, forest reserves, virgin jungle recreational parks, wildlife reserves, squatters, Orang Asli settlements, monuments and archaeological sites and universities.

The location of the sensitive sites in the Study Area are shown in Figure 6-2.

A. Physical Environment

(1) Water Catchment Area : There are five water catchment areas identified in the Study Area. Two of them are situated in Sg. Langat while the rest are located in Sg. Batu, Sg. Kelang and Sg. Ampang.

(2) Water Intake Points : The eleven water intake points in the Study Area are situated in Sg. Langat, Sg. Batu and Sg. Kelang.

(3) Reservoir : There are also four reservoirs in the Study Area. Two of them are located in Sg. Langat while the other two are located in Sg. Batu and Sg. Kelang.

B. Biological Environment

There are eleven forest reserves, four virgin jungle forest reserves, six recreational parks and two wildlife reserves situated in the Study Area.

C. Sociological Environment

The two main aspects in the sociological environment that need to be highlighted are the squatters and Orang Asli settlements.

(1) Squatter Areas : There are a total of 129 squatter settlements in the Study Area, most of them are located in the District of Gombak, Hulu Langat and Petaling. Based on the data obtained, industrial and agricultural squatters constitute 2.8% (609) while dwellings amounted to 97.2% (21,189). Squatters located in the Study Area are mainly situated near big towns due to migration from out of town areas.

(2) Orang Asli Settlements : The Orang Asli in the Study Area, belonging only to the Temuan sub-tribe, has a total population of 4,776 with the Hulu Selangor District having the highest population of 1,526, followed by Hulu Langat District with 1,133. There are a total of 35 Orang Asli kampongs in the Study Area.

(3) Others : There are also three monumental sites identified within the Study Area while five archaeological areas are found in Bukit Melawati and Hulu Kelang.

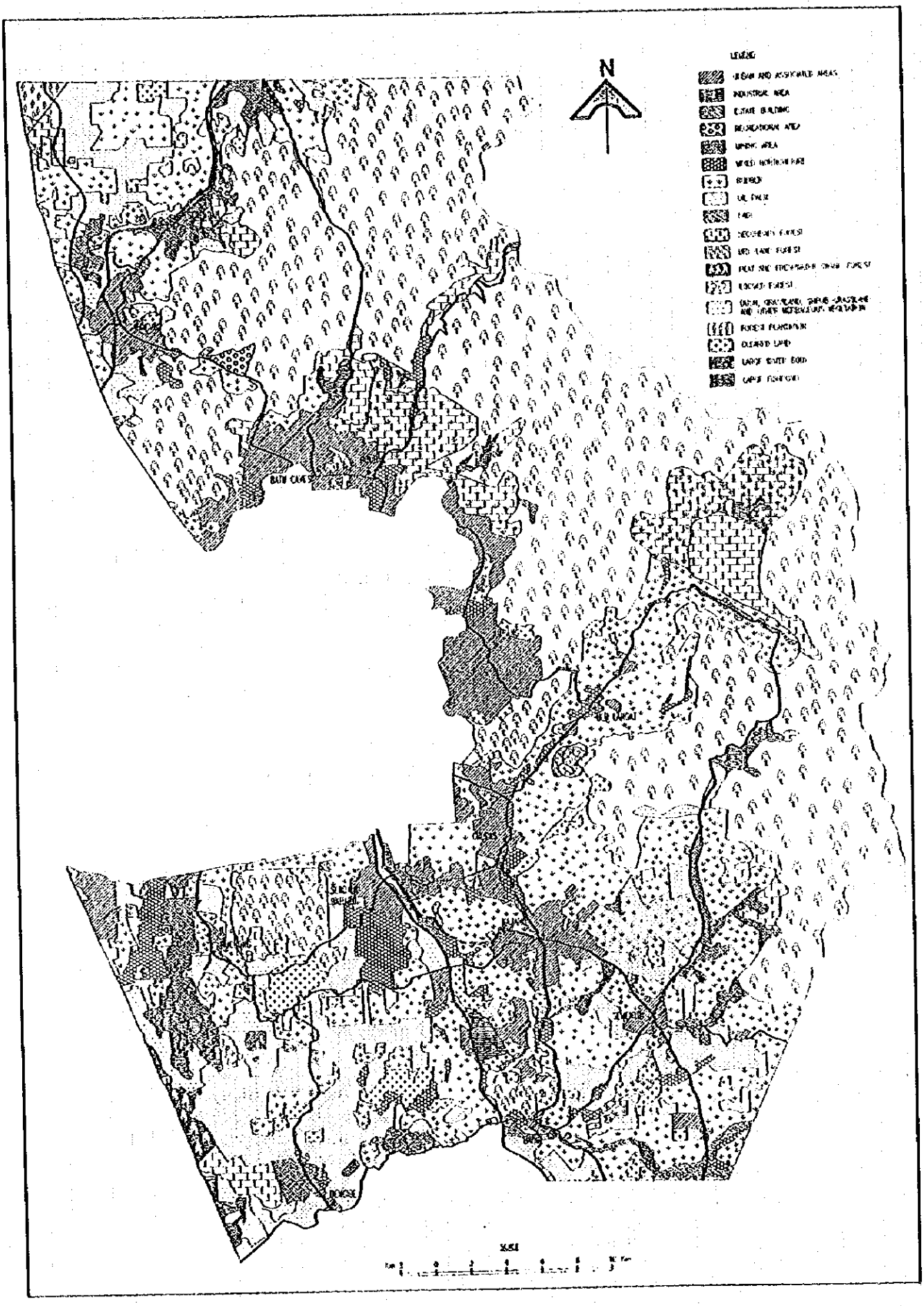


Figure 6-1 : Land Use Pattern

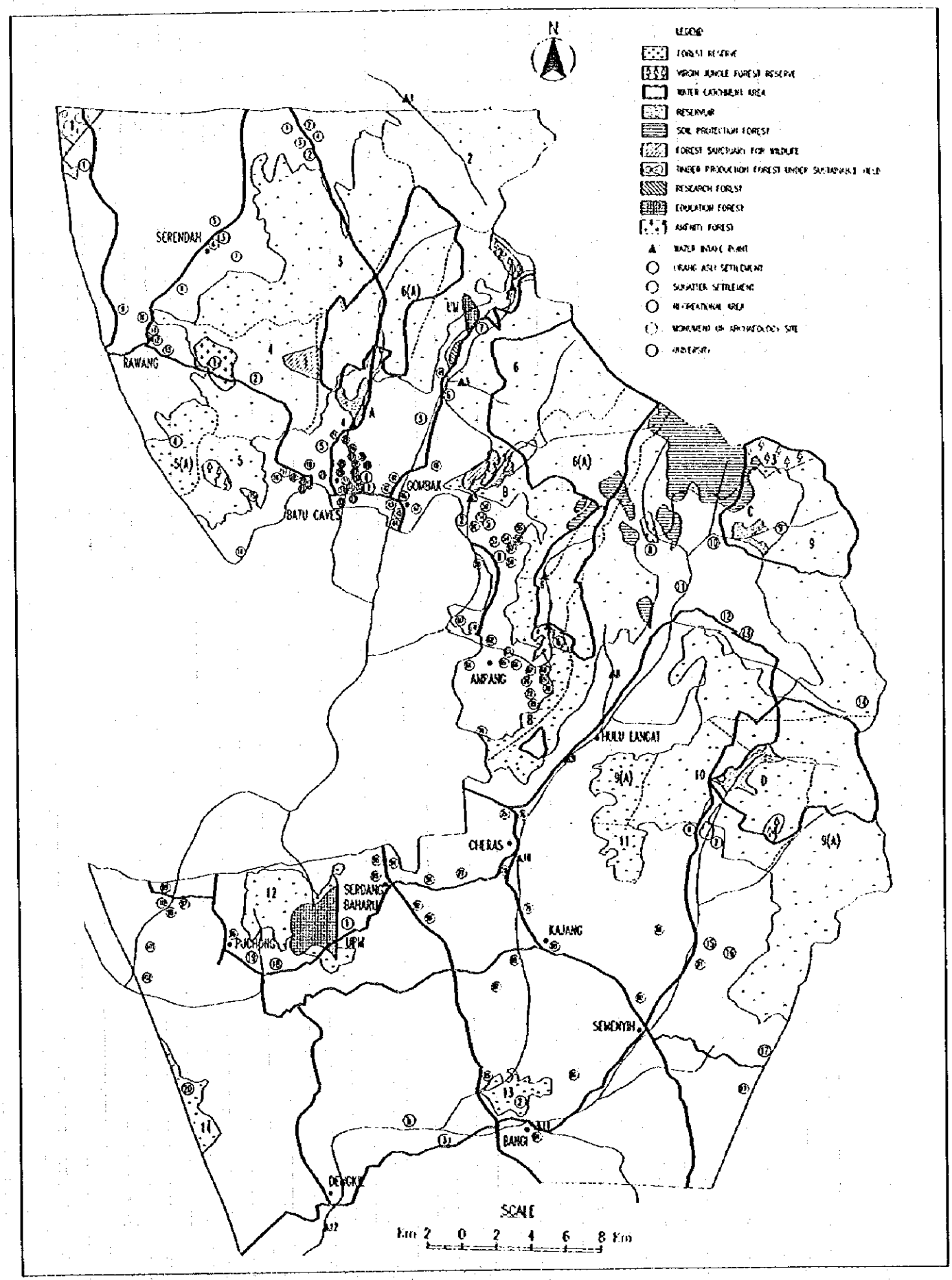


Figure 6-2 : Sensitive Sites in the Study Area

6.2 Identification of Environmental Impacts

Table 6-1 shows a matrix of potential impacts which may arise with the implementation of the Project.

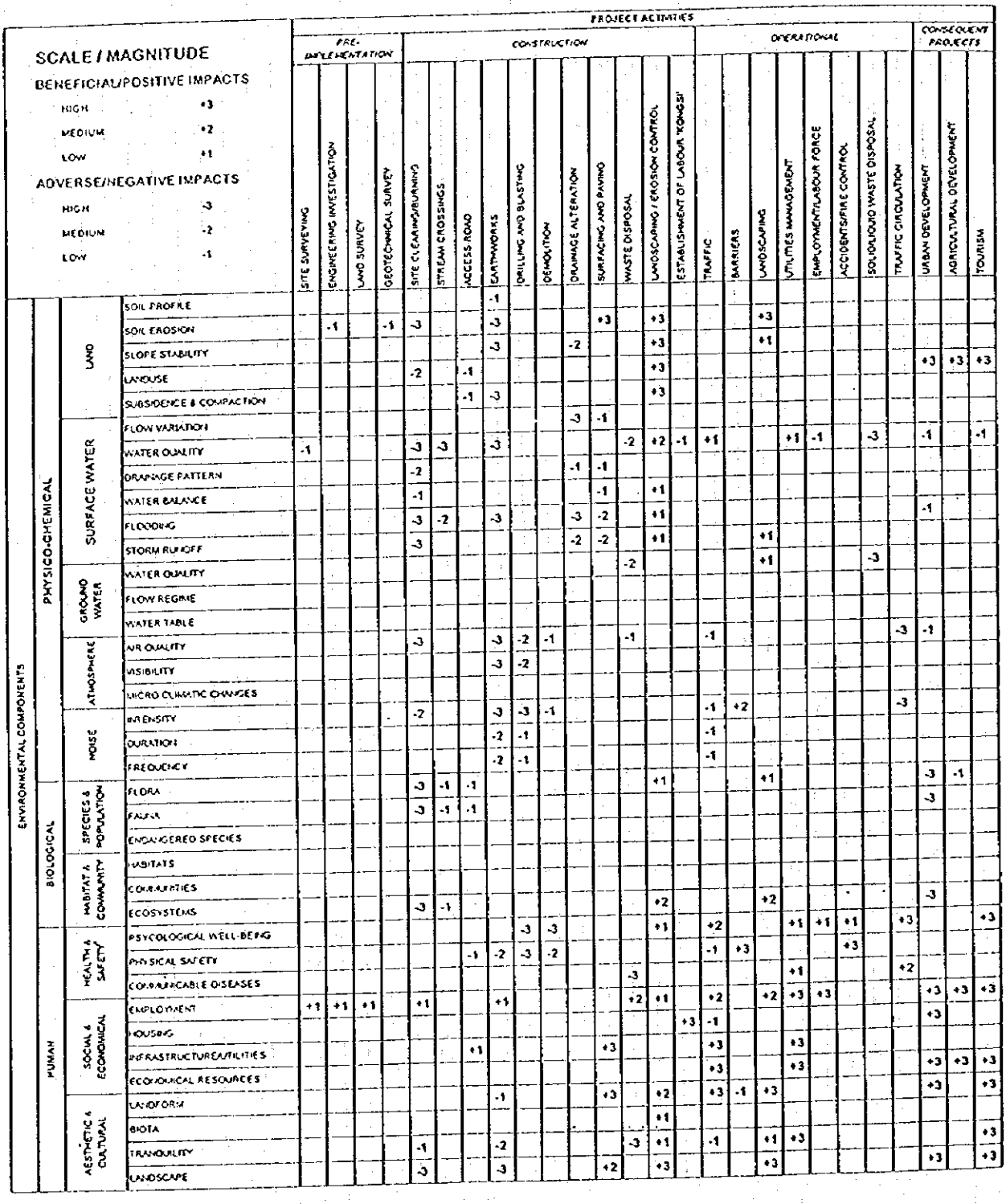


Table 6-1 : Matrix of the Potential Impacts which may arise from the Project Development

6.3 Potential Environmental Impacts and Assessment

Various activities will be carried out during investigation, construction and operational phases of the Project. These activities will have a potentially significant impact on the natural environment as well as the social environment.

The activities involved in the pre-implementation phase are ground inspection, geotechnical and soil investigation and sociological survey. These activities will not cause any significant negative impact to the environment.

Activities in the development and construction phase of the Project will significantly affect the existing environment, especially soil erosion generated from activities such as site clearing and earthwork.

The major impact of the operational phase of the KLORR is the improvement of traffic flow. Existing road users will be able to avoid traffic congestion in the Kuala Lumpur region and save time through a shortening of the travel time and distance. The KLORR will provide better accessibility and linkage between the new development areas in the outskirts of Kuala Lumpur, such as the PERODUA project in the northern part and Putra Jaya in the southern part. Besides this, economic activities in the area will increase significantly. There will also be an increase in employment opportunities and business activities. Therefore, with the increase of human activity and traffic volume in the area, noise and air pollution will arise.

Spill-over projects are hoped to be initiated by the proposed development. These projects may be urban (commercial/industrial) development, recreational and residential development. In other words, new townships will be developed. When development starts to take place, various environmental and social changes will follow.

The Project will facilitate new township development in the Project corridor. This will enhance economic growth in the outskirts of Kuala Lumpur as well as increase services and amenities for rural folks.

The proposed alignment of the KLORR would wind up its way through some thickly forested mountain regions of Malaysia. Therefore, breath-taking scenic views would be offered by the rich natural surroundings. Such view points would become good recreational areas for weary road users. Other scenic spots with a good natural environmental setting may be developed into various resort / tourism spots.

The proposed Project would create new settlements around consequential development. However, unplanned settlements might result with adverse impact due to inadequate services and amenities.

Chapter 7 ALTERNATIVE ROUTE ALIGNMENT STUDY

7.1 Basic Consideration for Alternative Routes

In this section, the basic consideration and control points which should be taken into account on the examination of the alternative routes are discussed.

For the selection of the alternative routes, the control points were identified with area issues as shown in Figure 7-1. The corridor for the KLORR has been identified from Rawang/Serendah in the north to the North - South Central Link in the south, passing through the eastern area of Kuala Lumpur. This corridor can be divided into three areas: Northern, Eastern and Southern. The major issues in the three areas are represented with the key words as follows:

Northern area	:	Key word - "Topography, Engineering, Environment"
Eastern area	:	Key word - "Environment, Development, Road Network"
Southern area	:	Key word - "Development"

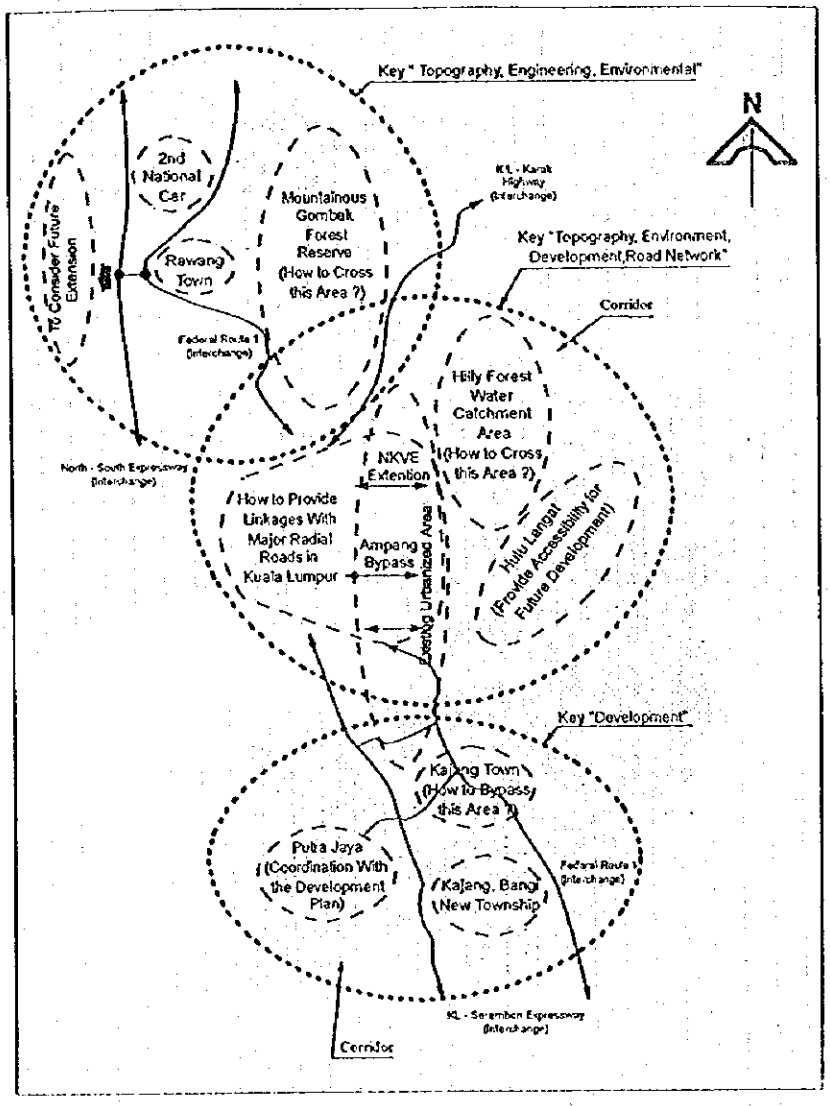


Figure 7-1 : Area Wide Control Points for the Alternative Routes

7.2 Proposed Alternative Route Alignment

Three alternative routes are established, namely A, B and C as shown in Figure 7-2.

1) Alternative Route A : This is the outermost alignment which will provide good services for development projects in the outer area and will have the least social impact.

2) Alternative Route B : This is middle alignment which will have medium impact to both social and natural environments.

3) Alternative Route C : This is innermost alignment, same as route B in section 1. This will provide good services to the inner area and affect the least to natural environment.

A preliminary engineering study was made on the three alternative alignments and summarized engineering features are shown in Table 7-1.

Table 7-1 : Summary on Comparison of the Three Alternative Routes

	A	B	C
1) Highway Type	Expressway with full access control		
2) Design Speed	100 km/hr	100 km/hr	100 km/hr
3) No. of Lanes	6	6	6
4) Concept of Alignment	• Outermost Alignment • Min. Social Impact • Max. Natural Environmental Impact	• Middle Alignment • Section 1: Same as C • Section 2: Middle of A and C • Section 3: Same as C	• Innermost Alignment • Max. Social Impact • Min. Natural Environmental Impact
5) Total Length	93,300m	87,700m	77,000m
6) Land Use Length a) Forest b) Agriculture c) Ex Tin Mine d) Urban	45,800 m 35,900 m 5,400 m 6,200 m	36,400 m 42,200 m 2,000 m 7,100 m	28,300 m 39,000 m 500 m 9,100 m
7) Structure Type Length a) Earth Work b) Bridge c) Tunnel	55,540m 22,210m 15,600m	58,850m 19,360m 9,580m	43,890m 18,360m 14,640m
8) Number of Interchanges (including Junctions)	13	13	13
9) Project Cost a) Construction Cost b) Land Acquisition Cost	RM4,580 million RM298 million	RM3,650 million RM335 million	RM3,924 million RM398 million
c) Total	RM4,878 million	RM4,185 million	RM4,322 million
10) Traffic Volume (2000) Traffic Volume (2020) Total Veh-km (2020) Total Veh-hr (2020)	24,300 veh/day 79,600 veh/day 97.3 million veh.km 4373.2 thousand veh.hr	27,100 veh/day 81,000 veh/day 96.9 million veh.km 4297.5 thousand veh.hr	34,700 veh/day 84,500 veh/day 95.5 million veh.km 4292 thousand veh.hr
11) Major Issues Section 1	• JCT with N-S Exp. is close to Service Area • Long Slope in Section 1 • Many tunnel sections incl. 3.8km long in Sec.1 • Construction problem due to fault line	• JCT with N-S Exp. is close to Rawang IC • Close to Housing Development at the South of Batu Dam	• JCT with N-S Exp. is close to Rawang IC • Close to Housing Development at the South of Batu Dam
Section 2	• Long Span Bridge with high pier • Affect water catchment area for Klang Gate dam • Long tunnel (4.7 km) • Crossing Malay Reserve	• Tunnel under quartz ridge • Crossing Taman Melawati • Long tunnel (4.47km) • Crossing Malay Reserve	• Tunnel under quartz ridge • Crossing Taman Melawati • Affecting squatters at Ulu Kelang and Ampang • Crossing Malay Reserve • Long tunnel (3.8 km)
Section 3	• Crossing Putra Jaya • Long Viaduct on swamp area	• Long Viaduct on swamp area	• Squatter at Kajang area • Long viaduct on swamp area

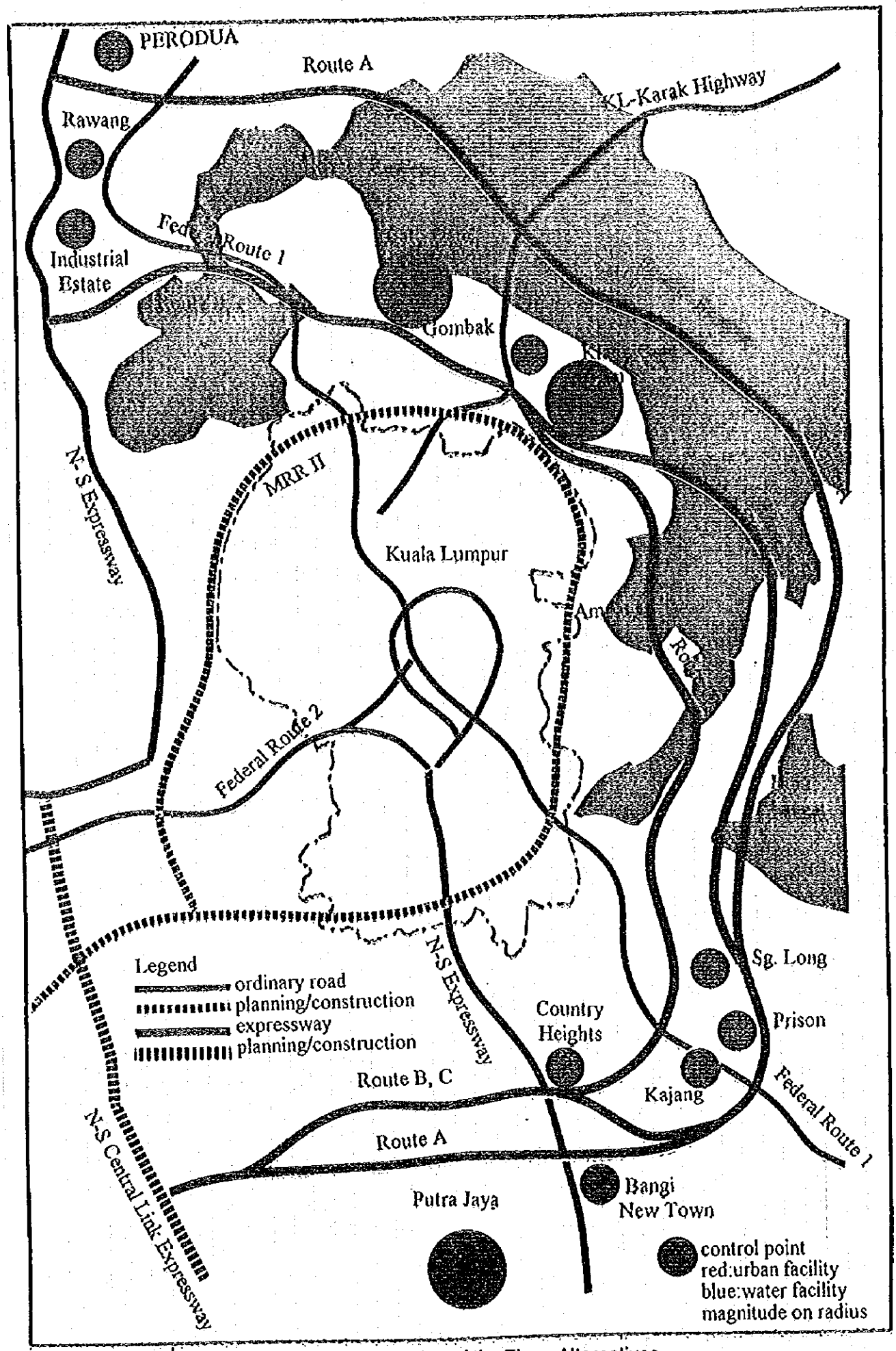


Figure 7-2 : Location of the Three Alternatives

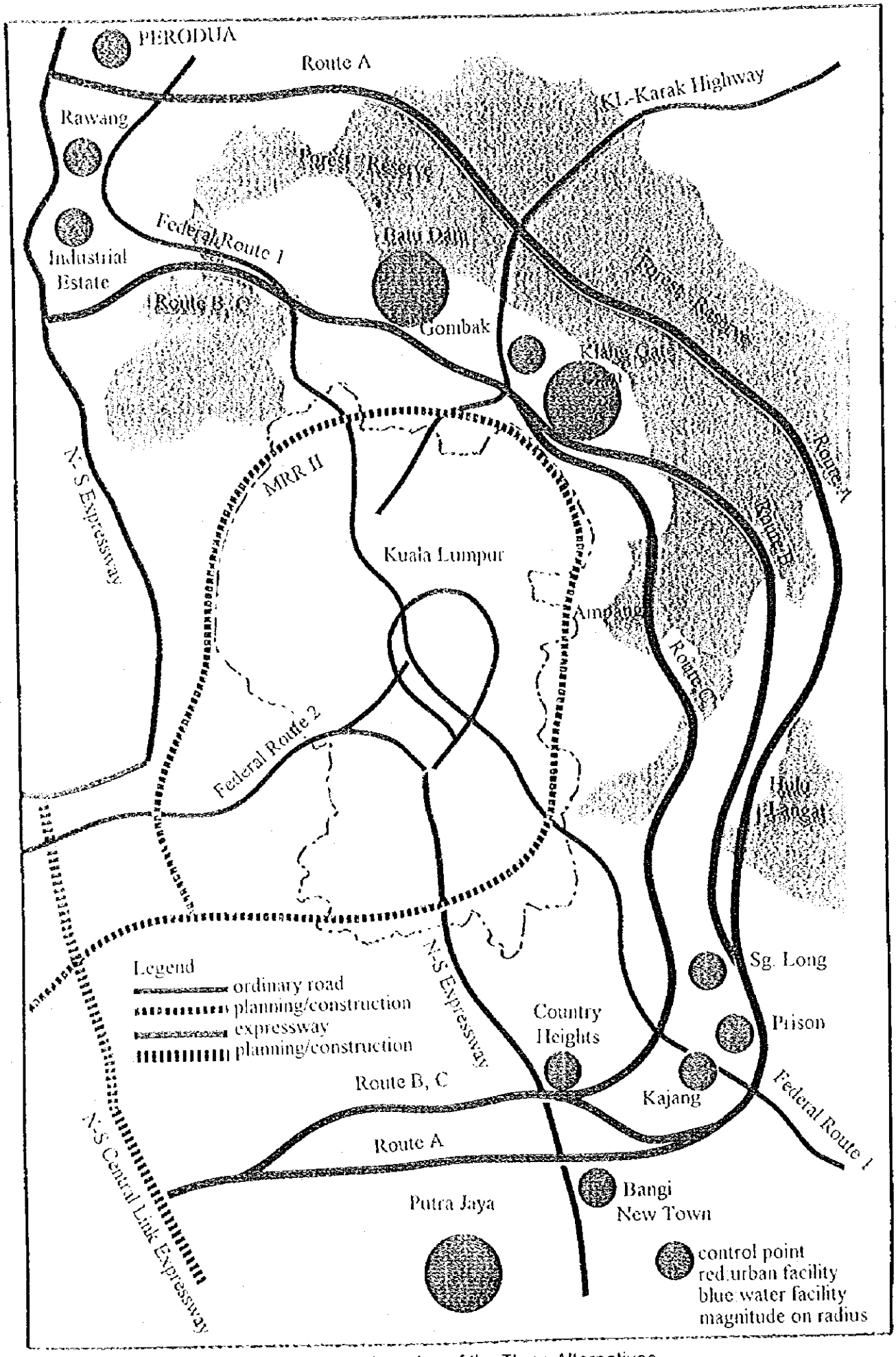


Figure 7-2 : Location of the Three Alternatives

7.3 Evaluation of the Alternative Routes

Table 7-2 shows the scores of evaluation of the three alternatives from the view points of engineering, environment and economic aspects.

Since the route A is located at the outermost area, the impact to the natural environment will be most serious, particularly where it encroaches the water catchment area of Klang Gate Dam. In addition, there are many tunnel sections, including the 4.7 km long tunnel, together with long fault lines running parallel to the route will make construction difficult. As the total length of structures is the longest, the cost benefit analysis indicates that it is less advantageous than the other alternatives.

The route B is located at the middle, therefore, the environmental impact is not extreme, but modest, although there are some negative impacts to the natural as well as social environment. They will not be so serious if relevant countermeasures are provided. The total structure length is the shortest among the three alternatives. This suggests that the route which is aligned with better topographic conditions, possibly results in relatively less construction costs than the other alternatives.

As the route C is located nearest to the urbanized area, impact to the social environment will be serious. Particularly it will affect the communities and squatters settlements at Ampang, Cheras, Kajang and Ulu Klang, where also public nuisance is expected.

As the consequences, Route B was selected as the most prefarable route.

Table 7-2 : Scores of Evaluation of the Three Alternatives

Aspect	Alternatives			Remarks (Indicator for Scoring)
	A	B	C	
1. Engineering				
a) Geology	Bad (-1)	Fair (0)	Fair(0)	Refer to Table 7-13
b) Topography	Bad (-1)	Fair (0)	Fair (0)	Refer to Table 7-13
c) Construction	Bad (-1)	Fair(0)	Fair(0)	Refer to Table 7-13
d) Land Acquisition	Fair (0)	Fair(0)	Bad (-1)	Length of Urban Land
e) Project Cost	Fair (0)	Fair(0)	Fair (0)	Project Cost
2. Environment				
a) Natural Environment	Bad (-1)	Fair(0)	Good (+1)	Refer to Table 7-13
b) Social Environment	Good (+1)	Fair(0)	Bad (-1)	Refer to Table 7-13
c) Public Nuisance	Good (+1)	Fair(0)	Bad (-1)	Refer to Table 7-13
d) Regional Development	Good (+1)	Good (+1)	Fair (0)	Refer to Table 7-13
3. Economic Aspect				
a) Traffic Demand	Fair (0)	Fair (0)	Fair (0)	Traffic Volume (2020)
b) Accessibility	Good (+1)	Good (+1)	Good (+1)	Refer to Table 7-13
c) Cost-benefit Analysis	Fair (0)	Good (+1)	Good (+1)	IRR
Total	0	+3	0	-

Note : If indicators are noted in the column "Remarks", the above scoring criteria (I) is applied. In other cases, the above criteria (2) is applied.
Score : Good : +1, Fair : 0, Bad : -1