Technical Volume

Chapter 3
TRAFFIC DEMAND FORECASTING

CHAPTER 3 TRAFFIC DEMAND FORECASTING

3.1 TRAFFIC ZONING SYSTEM

3.1.1 General

For the traffic demand analysis, the Study area is divided into several appropriate traffic zones that can link information about activities, travel and transportation to physical location in the Study area.

The zones vary in size depending on the density or nature of urban development, but also the objectives of the study. Number of criteria will be taken into account for the planning of the zoning system, for example:

a) Ability to capture the overall traffic pattern

A zoning system should consider the ability to capture the overall travel demand and pattern. If the zone area is too big, for instance, inter zonal trips captured will be few. In case of the number of intra zonal trips are large, the true traffic pattern cannot be clearly understood. Nevertheless, if zones are too small, the work load increase tremendously as more samples will be needed.

Usually, zonal definition should be inversely proportional to trip generation or attraction rates. Zones for highly urbanized area, for example, will be small compared with the sparsely inhabited outskirts.

The specialized areas, such as ports, air ports, will be considered as separate zones to capture the specific stream of traffic generated and attracted to these areas.

b) Availability of data

Zoning should coincide with the definition of the population records or vehicle records from which the samples are to be drawn. This is for the obvious reason for expanding the surveyed data and for future projection. Some form of administrative boundaries, therefore, will be employed.

C) Compatible with other zoning system

Sometimes, it is required that a zoning system be compatible with some existing or past system such as Highway Network Development Plan Study (HNDP).

3.1.2 Zoning System for KLORR

To determine KLORR zoning system, some important points should be taken into account. They are:

- Enable to use HNDP data.
- Availability of socioeconomic indicators.
- Reliability on traffic surveys, especially Roadside Interview Survey.
- Reliability on traffic assignment for the project road.

Traffic demand analysis for the KLORR will be started from updating the demand in the HNDP study. Therefore, the zoning systems should be based on the HNDP zoning system that

divides Peninsular Malaysia into 97 traffic zones with three external zones. There are 14 zones for Selangor and 5 zones for Kuala Lumpur as shown in Figure 3-1.

Study areas for the KLORR traffic demand analysis should cover wider areas of the Study corridor to examine the traffic flow likely related to the project road, and to determine socioeconomic frameworks. The State of Selangor and adjacent districts in Perak, Pahang and Negeri Sembilan will be included in the study area. Additionally, the zones in Selangor are defined as "internal zones" and the ones outside Selangor state are "external zones."

Basic ideas for setting up the KLORR zoning system are as follows:

a. Three types of zoning systems will be prepared to access to the HNDP OD table, to examine socioeconomic frameworks and to carry out traffic assignment on several road network scenarios, namely A zones, B zones and C zones.

b. On the A zones system, internal zones will follow HNDP zones' boundaries (district boundaries). For external zones, HNDP zones will be aggregated by directions of the road network.

c. B zones' system will correspond with the availability of socioeconomic data. This study will zoom in up to Mukim level from view points of limitation of the projection.

d. However the Mukim level zoning system (B zones) is too big to simulate traffic flows on a road network through traffic assignment procedure.
A smaller zone system (C zones) will be provided for the project road corridor. C zones' system will be prepared from subdividing the B zones taking into consideration the Enumeration Block in the Population Census in 1991.

Table 3-1 shows traffic zoning system for this study, whereas, Table 3-2 shows the zone codes. Besides, the traffic zones are shown in Figure 3-2.

Table 3-1 : Traffic Zoning System for KLORR

	A zones	B zones	C zones
Internal	15	47	58
External	9	9	9
Total	24	56	67

Table 3-2 : Traffic Zone Code

A zone	HNOP Zone No.	State	District	B Zone	C Zone	Name of Areas
1	32	Kuala Lumpur	CPA	1	1	Bandar K. Lumpur / Kg. Baru
2	31		Kepong	2	2	Taman Duta
				3	3	Bangsar
				4	4	Damansara
				5	5	Batu
				6	6	Segambut
				7	7	Jinjang
3	30		Setapak	8	8	Sentul
				9	9	Setapak
				10	10	Wangsa Maju
4	33		Cheras	11	11	Taman Maluri
				12	12	Bandar Tun Razak
				13	13	Taman Bukit Cheras
5	34		Damansara	14	14	Salak Selatan
				15	15	Kelang Lama
				16	16	Sri Petaling
6	42	Selangor (Klang Valley)	Petaling	17	17	Bandar Petaling Jaya
				18	18	Petaling
				19	19	Damansara
7	43			20	20	Bukit Raja
				21	21	Sg. Buluh
8	35,46,48		Klang	22	22	Bandar Klang
				23	23	Kapar
				24	24	Klang
9	37,44		Gombak	25	25 26	Rawang
				26	27 28	Batu
			Setapak	27	29	Setapak
				28	30 31	Hulu Klang
10	40	Selangor (Klang Valley)	Hulu Langat	29	32 33 34 35	Ampang
				30	36	Hulu Langat
				31	37	Cheras
				32	38 39	Kajang
				33	40	Hulu Semenyih
				34	41	Semenyih

A zone	HNDP Zone No.	State	District	B Zone	C Zone	Name of Areas
11	45	Selangor (Outer Klang Valley)	Sepang	35	42 43	Dengkil
				36	44 45	Sepang Labu
12	36		Kuala Langat	37	46 47	Tanjung Dua Belas
				38	48	Teluk Panglima Garang , Jugra, Banelar
				39	49	Morib, Kelanang, Batu
13	38		Kuala Selangor	40	50	Batang Berjuntai, Ijok
				41	51	Pasangan, Ujong Permatang, Api-api, K. Selangor, Jeram
				42	52	Tg. Karang, Ulu Tinggi
14	41		Hulu Selangor	43	53 54	Serendah
				44	55	Batang Kali, Rasa, Ulu Yam
				45	56	Kalumpang, K.Kalumpang, Kerling, Peretak, Ampang Pecah, Buloh Telor, Sg. Gumut
				46	57	Ulu Bernam, Sg. Tinggi
15	39		Sabak Bernam	47	58	Bagan Nakhoda Omar, Panchang Bendera, Sg. Panjar, Sabak, Sg. Panjang
16	53	Negeri Sembilan	Seremban	48	59	
17	51		Port Dickson	49	60	
18	49,50, 52, 54, 55		Others Area	50	61	
19	1~18, 21~25, 27, 28, 99	Perak and North	Ipoh and Others	51	62	
20	19		Batang Padang	52	63	
21	20, 26, 29		Hilir Perak/ Dindings	53	64	
22	70~74,75 76~81, 99, 100	Pahang East	Kuantan and Others	54	65	
23	69		Bentong	55	66	
24	56 ~ 68,98	Johor / Melaka		56	67	

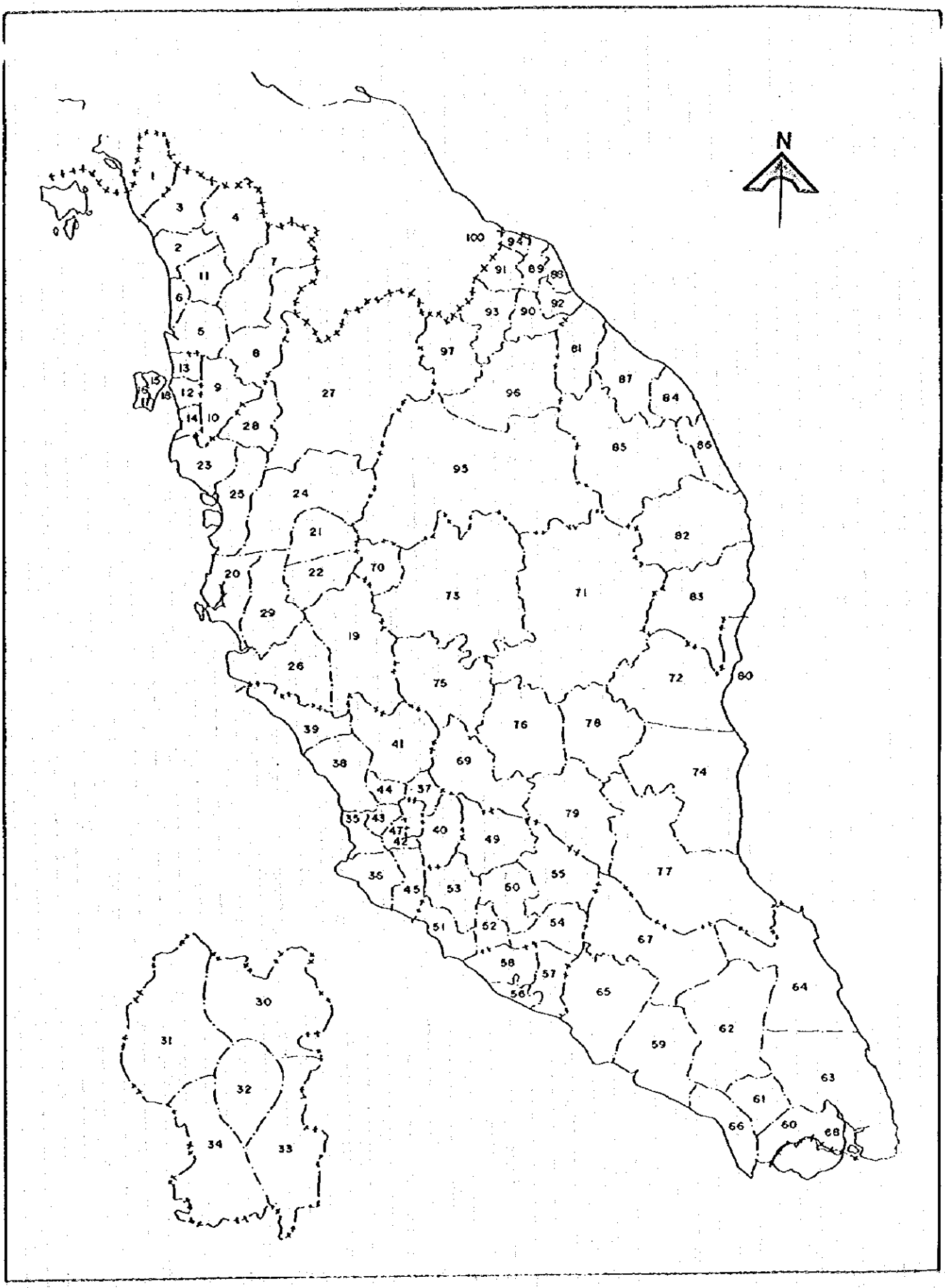


Figure 3-1 : HNDP Traffic Zones (A zones)

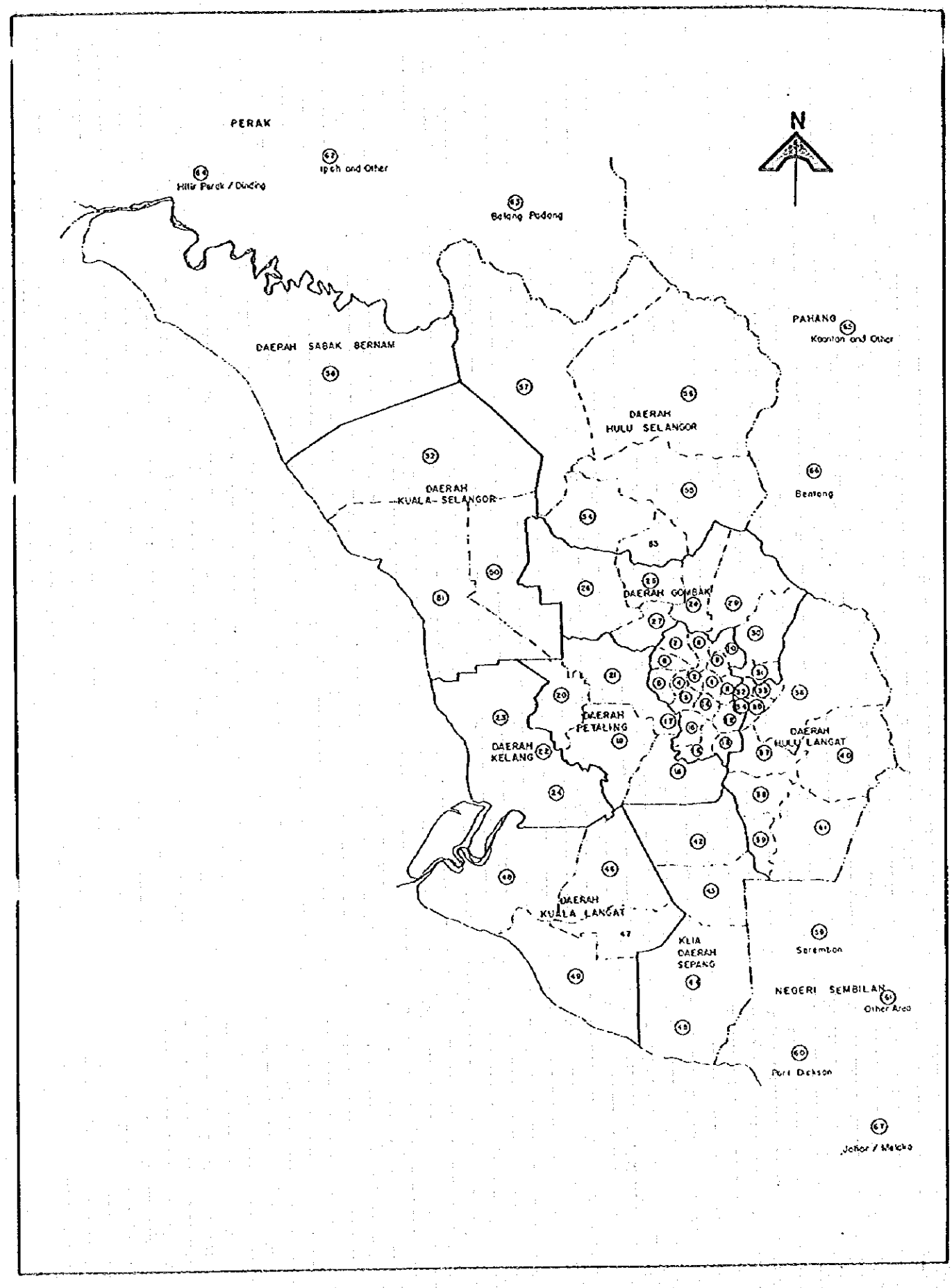


Figure 3-2 : KLORR Traffic Zones (C zones)

3. 2 SOCIO-ECONOMIC INDICATORS BY TRAFFIC ZONE

Table 3-3 : Socio-Economic Indicators by Traffic Zone for the Year 1995 - 2005

Year	1995			2000			2005		
B zone	Population Person	Employment Employee	DGP Million RM 1978	Population Person	Employment Employee	DGP Million RM 1978	Population Person	Employment Employee	DGP Million RM 1978
1	117,160	166,380	3,825.92	131,299	229,124	5,063.52	142,964	244,575	6,463.39
2	10,490	7,647	128.90	12,081	12,275	271.26	13,393	13,939	371.53
3	61,090	29,538	666.03	76,534	27,185	600.78	89,275	32,399	869.11
4	18,100	8,631	171.19	31,345	11,134	246.06	42,272	15,362	419.21
5	27,550	13,041	301.58	51,087	18,142	400.94	70,504	25,643	701.62
6	40,150	17,794	365.68	64,685	23,003	508.35	84,926	30,867	839.79
7	162,240	81,761	1,948.00	186,411	66,239	1,463.86	206,352	74,792	1,992.12
8	127,380	45,266	1,033.63	138,840	49,340	1,090.40	148,295	53,718	1,423.61
9	88,250	40,930	910.92	91,071	57,281	1,265.88	93,398	65,044	1,733.80
10	156,500	54,183	1,250.51	176,814	62,848	1,388.91	193,573	70,154	1,865.67
11	64,700	26,321	560.80	75,489	49,098	1,085.04	84,390	55,752	1,486.11
12	147,920	55,781	1,233.89	166,508	59,175	1,307.73	181,843	65,897	1,751.88
13	37,230	31,940	884.54	66,998	23,794	525.84	91,557	33,273	909.34
14	36,910	16,250	333.92	48,630	32,732	723.36	58,299	37,168	990.74
15	157,570	59,061	1,334.51	169,810	60,362	1,333.96	179,908	65,187	1,725.58
16	76,060	29,276	644.99	102,958	36,567	808.12	125,149	45,432	1,225.04
17	71,020	74,930	2,756.00	79,030	108,150	4,254.60	89,890	115,080	5,599.65
18	177,600	32,570	758.40	197,610	33,270	968.50	270,855	45,900	1,610.75
19	283,940	201,420	6,495.60	315,930	251,880	9,621.10	359,350	297,340	14,331.95
20	29,600	5,870	101.10	32,930	5,300	137.30	37,455	6,160	192.20
21	183,550	23,620	777.10	204,230	37,160	1,081.30	232,295	42,665	1,492.00
22	22,700	7,060	141.00	27,020	3,830	100.50	30,735	4,495	142.10
23	172,640	52,350	1,179.30	205,510	64,640	1,762.80	233,755	63,800	2,546.30
24	271,150	98,020	2,665.80	322,790	119,350	4,168.70	367,150	139,735	6,095.10
25	67,440	21,350	511.50	82,050	22,720	726.70	131,200	34,345	1,383.15
26	223,840	45,680	1,079.20	272,340	52,741	1,659.90	307,570	59,906	2,217.35
27	61,630	12,600	252.00	74,980	11,100	297.50	91,255	13,880	428.40
28	92,630	21,060	454.00	112,700	20,750	611.50	129,710	24,025	852.30
29	238,220	43,260	991.10	263,400	47,510	1,396.90	263,400	49,155	1,738.05
30	26,580	5,720	141.80	31,520	5,900	183.40	38,350	7,145	254.15
31	69,580	28,730	651.20	90,770	28,060	947.00	125,650	37,430	1,572.50
32	142,420	53,740	1,459.60	192,540	69,500	2,425.30	264,685	91,760	3,999.35
33	2,880	1,330	22.50	3,500	1,160	28.50	4,260	1,330	39.75
34	42,480	16,170	330.50	53,550	14,420	437.60	80,350	19,045	696.05
35	34,730	9,620	217.40	86,270	23,300	662.00	165,690	66,435	2,377.20
36	26,440	9,640	167.00	65,690	57,500	1,553.90	79,950	66,415	2,203.05
37	58,720	15,240	335.40	79,570	23,520	677.40	96,840	28,555	1,002.20
38	49,940	29,900	721.50	60,760	31,600	1,091.40	73,950	37,315	1,611.65
39	33,110	8,280	147.20	44,400	9,320	234.90	54,040	11,890	384.05
40	28,050	9,420	212.60	34,130	9,760	286.90	46,300	12,240	436.60
41	65,930	26,970	507.90	87,300	22,490	1,227.40	108,880	27,215	1,240.65
42	34,110	7,530	134.90	34,410	7,070	178.60	34,490	7,360	221.15
43	12,240	5,190	83.60	18,000	11,040	384.10	21,905	17,315	825.65
44	20,080	7,040	127.40	23,710	6,340	176.40	28,860	7,525	256.90
45	22,860	9,370	178.10	27,230	5,540	145.10	33,030	6,640	209.90
46	27,990	9,650	167.40	32,250	8,970	221.00	39,370	10,440	313.50
47	104,030	26,870	927.50	126,680	26,930	685.30	154,175	32,870	1,018.75
Seremban	289,490	102,600	2,674.30	328,130	116,760	3,593.80	376,400	134,155	5,141.80
Batang Padang	169,420	44,480	982.10	186,120	49,390	1,256.80	206,785	54,950	1,670.55
Bentong	88,850	30,290	618.80	95,040	32,370	778.60	102,390	34,875	1,011.00
total	4,575,190	1,781,570	44,565.81	5,482,650	2,147,640	62,046.71	6,487,078	2,538,593	89,884.24

Table 3-4 : Socio-Economic Indicators by Traffic Zone for the Year 2010 - 2020

Year	2010			2015			2020		
8 zone	Population	Employment	DGP	Population	Employment	DGP	Population	Employment	DGP
	Person	Employee	Million RM 1978	Person	Employee	Million RM 1978	Person	Employee	Million RM 1978
1	154,628	260,025	7,863.25	165,097	272,509	9,783.17	175,565	284,993	11,703.09
2	14,705	15,602	471.80	15,883	17,095	617.53	17,060	18,587	763.25
3	102,016	37,613	1,137.43	113,451	42,592	1,545.45	124,885	47,571	1,953.47
4	53,199	19,589	592.36	63,006	23,635	864.53	72,812	27,681	1,136.70
5	89,921	33,144	1,002.29	107,347	40,312	1,476.00	124,773	47,479	1,949.71
6	105,166	38,730	1,171.22	123,331	46,267	1,690.32	141,495	53,804	2,209.42
7	226,293	83,344	2,520.37	244,189	91,535	3,307.76	262,085	99,725	4,095.14
8	157,749	58,095	1,756.82	166,234	62,274	2,242.83	174,718	66,452	2,728.84
9	95,725	72,807	2,201.71	97,814	76,675	2,754.56	99,902	80,542	3,307.40
10	210,332	77,460	2,342.43	225,372	84,468	3,049.41	240,412	91,475	3,756.39
11	93,291	62,406	1,887.18	101,279	68,376	2,470.08	109,267	74,346	3,052.98
12	197,177	72,619	2,196.03	210,939	79,068	2,853.88	224,700	85,517	3,511.73
13	116,115	42,752	1,292.84	138,155	51,853	1,897.92	160,195	60,953	2,503.00
14	67,968	41,604	1,258.12	76,645	45,584	1,646.72	85,322	49,564	2,035.32
15	190,006	70,012	2,117.20	199,069	74,603	2,684.61	208,131	79,193	3,252.02
16	147,339	54,297	1,641.95	167,254	62,758	2,283.26	187,168	71,219	2,924.56
17	100,750	122,010	6,944.70	113,905	111,275	7,140.10	127,060	100,540	7,335.50
18	344,100	58,530	2,253.00	389,030	75,605	3,817.10	433,960	92,680	5,381.20
19	402,770	342,800	19,042.80	455,360	381,705	24,903.60	507,950	420,610	30,764.40
20	41,980	7,020	247.10	47,460	7,720	329.25	52,940	8,420	411.40
21	260,360	48,170	1,902.70	294,355	52,025	2,362.20	328,350	55,880	2,821.70
22	34,450	5,160	183.70	38,950	5,820	251.10	43,450	6,480	318.50
23	262,000	72,960	3,329.80	292,575	82,265	4,514.50	323,150	91,570	5,699.20
24	411,510	160,120	8,021.50	462,415	183,945	11,010.70	513,320	207,770	13,999.90
25	180,350	45,970	2,039.60	251,635	65,125	3,596.05	322,920	84,280	5,152.50
26	342,800	67,070	2,774.80	342,800	65,060	3,117.00	342,800	63,050	3,459.20
27	107,530	16,660	559.30	121,570	18,640	789.70	135,610	20,620	1,020.10
28	146,720	27,300	1,093.10	146,720	26,605	1,239.75	146,720	25,910	1,386.40
29	263,400	50,800	2,079.20	263,400	49,350	2,342.30	263,400	47,900	2,605.40
30	45,200	8,390	324.90	46,705	8,385	381.05	48,210	8,380	437.20
31	160,530	46,800	2,198.00	190,080	56,365	3,197.40	219,630	65,930	4,196.80
32	336,830	114,020	5,573.40	380,810	133,320	7,834.35	424,790	152,620	10,095.30
33	5,020	1,500	51.00	5,675	1,495	60.85	6,330	1,490	70.70
34	107,150	23,670	954.50	125,335	25,390	1,194.95	143,520	27,110	1,435.40
35	245,110	109,570	4,092.40	280,960	115,100	5,152.80	316,810	120,630	6,213.20
36	94,210	75,330	2,852.20	110,025	78,100	3,567.80	125,840	80,870	4,283.40
37	114,110	33,590	1,327.00	124,670	42,495	2,235.10	135,230	51,400	3,143.20
38	87,140	43,030	2,131.90	95,675	51,800	3,159.10	104,210	60,570	4,186.30
39	63,660	14,460	533.20	71,995	16,110	639.35	80,310	17,760	545.50
40	58,470	14,720	586.30	65,950	18,900	1,002.50	73,430	23,080	1,418.70
41	130,460	31,940	1,253.90	144,145	35,740	1,752.40	157,830	39,540	2,250.90
42	34,570	7,650	263.70	34,640	7,310	298.80	34,710	6,970	333.90
43	25,810	23,590	1,267.20	35,390	48,170	3,367.55	44,970	72,750	5,467.90
44	34,010	8,710	337.40	41,780	15,735	927.45	49,550	22,760	1,517.50
45	38,830	7,740	274.70	48,290	10,175	484.85	57,750	12,610	695.00
46	46,490	11,910	406.00	59,455	13,135	547.55	72,420	14,360	689.10
47	181,670	38,810	1,352.20	240,970	62,085	2,683.90	300,270	85,360	4,015.60
Seremban	424,670	151,550	6,669.80	489,325	174,765	9,619.85	553,980	197,980	12,549.90
Batang Padang	227,450	60,510	2,084.30	254,545	67,600	2,792.85	281,640	74,690	3,501.40
Bentong	109,740	37,380	1,243.40	118,990	40,595	1,627.25	128,240	43,810	2,011.10
total	7,491,500	2,929,539	117,721.70	8,400,650	3,287,514	159,009.08	9,309,790	3,645,481	200,296.42

3.3 ORIGIN-DESTINATION (OD) TRAFFIC DEMAND FORECASTING METHODOLOGY

3.3.1 Overall Methodology

In this section how to prepare year 1995 present and future OD traffic matrices from the KLORR data base and HNDP data base is discussed.

HNDP data base contains:

- 1991 OD traffic matrices by vehicle type in Peninsular Malaysia and Sabah and Sarawak.
- Future OD traffic matrices (in 1995,2000,2050 and 2010) by vehicle type and by areas.
- Socioeconomic Framework by zones (District level) in 1991 and 2010.
- Traffic Survey Data (Owner Interview Survey, Road Side Interview Survey, Traffic Count Survey).

KLORR data base will be completed through this Study. Before processing the traffic demand analysis, traffic survey data (Roadside Interview Survey and Traffic Count Survey) and socio economic data have been installed.

The traffic demand analysis will be carried out using computer software packages such as emme2 (transportation planning system software package) and Lotus programme, and some FORTRAN programmes.

The traffic demand analysis will follow 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 traffic movement. In this study, however, due to the lack of the data and information, the modal usage will be taken into account in the Trip Generation stage with some assumptions.

General procedure for traffic demand analysis is illustrated in Figure 3-3.

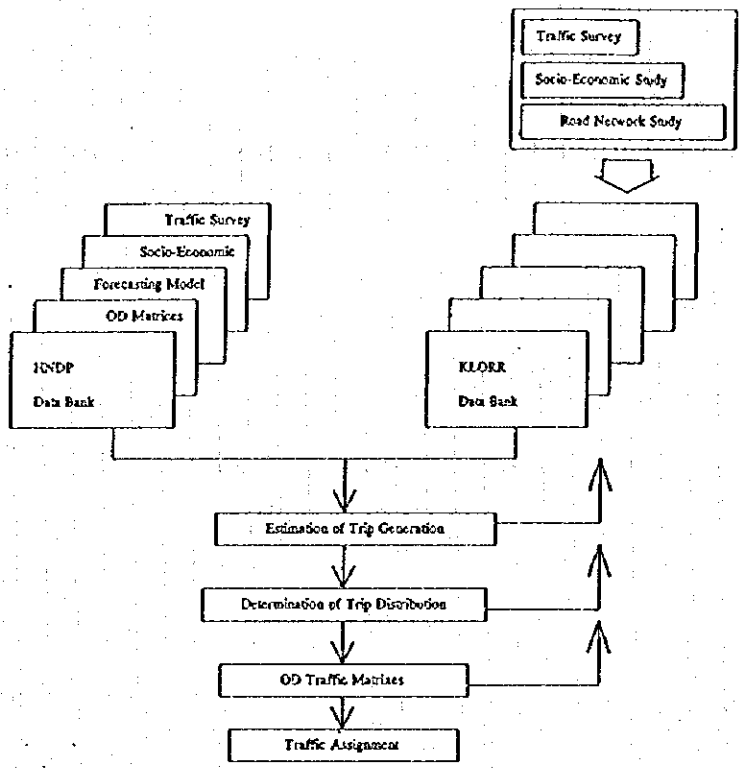


Figure 3-3 : General Procedure for Traffic Demand Analysis

3.3.2 Preparation of 1995 Present OD Traffic Matrices

For the preparation of 1995 present OD traffic matrices, Selangor state will be divided into three(3) areas. One is Klang Valley area and the others are north and south of Klang Valley so called Outer Klang Valley.

Roadside Interview Survey (RIS) was conducted at the stations along the Klang Valley boundary. From this survey, the OD trips crossing the boundary have been obtained. (See Figure 3-4) The remaining areas where data cannot be obtained from RIS are as follows:

a. Within Klang Valley area
b. Within North and South of Outer Klang Valley areas
c. External trips between Outer Klang Valley zones and external zones except the trips crossing Klang Valley Boundary.
d. Through traffic without crossing the boundary

The internal trips distribution in the areas a. and b. will be prepared from updating HNDP OD matrices with a total trip generation in 1995 as a control total value. For the external trips including the through traffic, the trips will be adjusted by the '95 traffic volume (HPU traffic censuses) on the state boundary.

The OD traffic volume estimated by the respective procedure will be compiled in one file and be completed as a 1995 present OD matrix. This process will be carried out on the A zones level. Those procedures are illustrated in Figure 3-5.

Based on the A zone OD tables, B zone OD tables will be estimated using Mukim socioeconomic indicators. C zone OD tables for the traffic assignment will be prepared from subdividing B zones with simple indicators such as population.

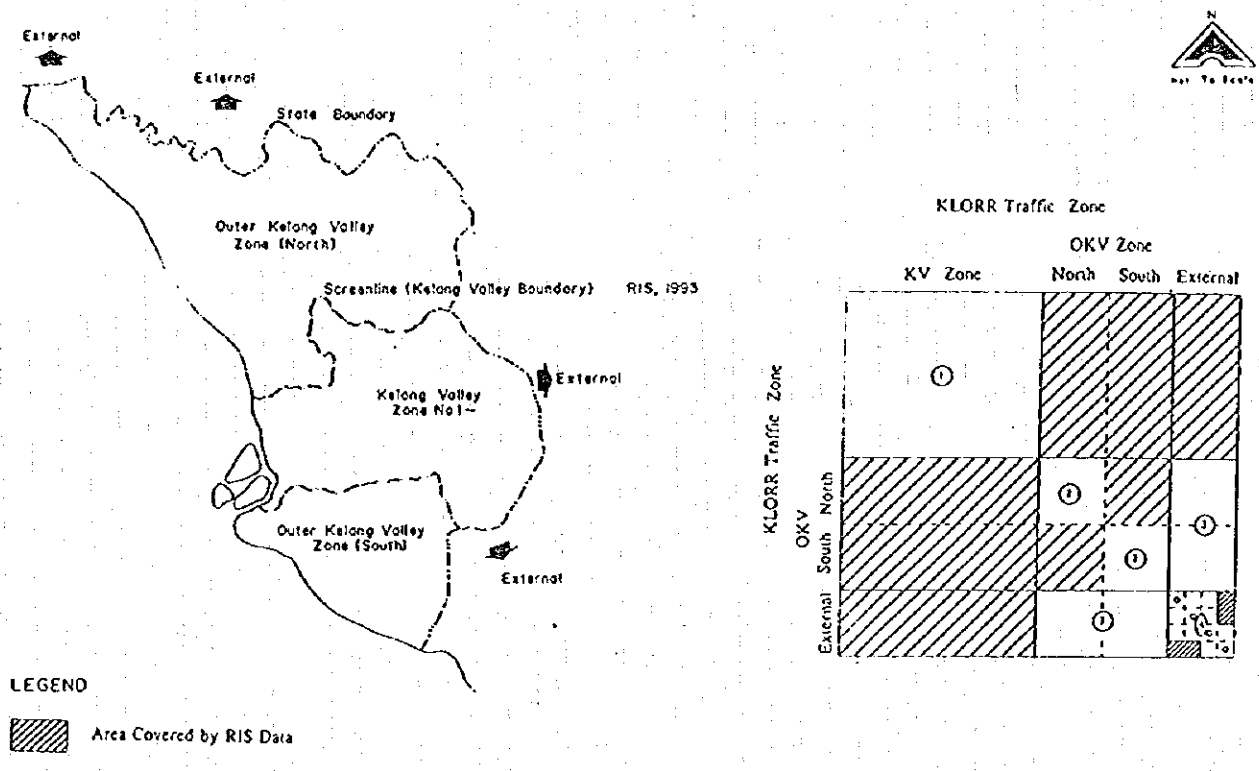


Figure 3-4 : Data Input Area from RIS (Roadside Interview Survey)

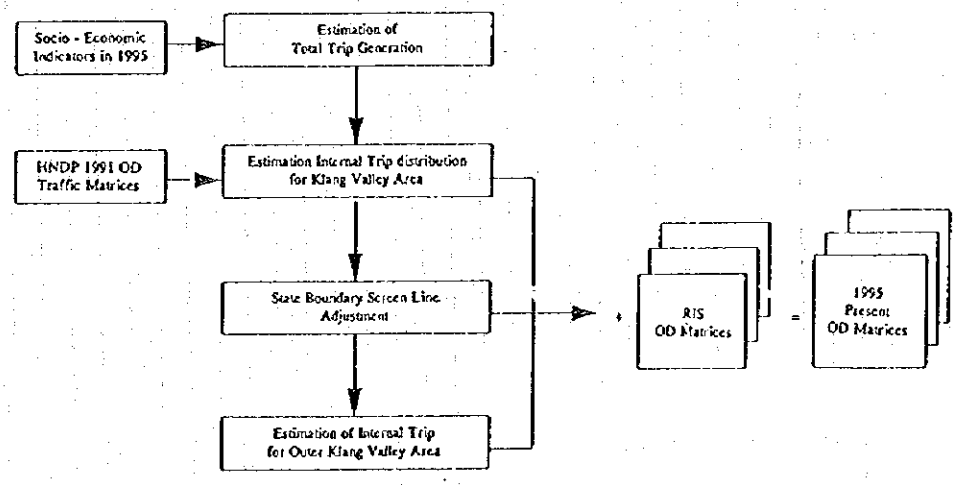


Figure 3-5 : Procedure for Preparation of the Present OD Matrices in 1995

3.3.3 Preparation of Future OD Traffic Matrices

The future traffic demand will be projected up to the year 2020 at 5 year intervals. The process of the forecasting is shown in Figure 3-6. It is started from estimating of the total trip generation in order to reduce forecasting errors that may occur from estimated socio-economic indicators and traffic models, etc.

Traffic forecasting models such as total trip generations (trip production) model and trip generation and attraction model will be referred to the HNDP study. However trip distribution model will be examined based on the 1995 OD matrices.

An issue on the preparation of future OD matrices is how to determine the future external traffic demand. They will be deliberated from not only socio-economic activities in the study area but also from the activities in other areas. Individual projects normally do not include the projection outside study areas and many cases refer to available statutory plans or studies. KLORR study, therefore will be estimated from updating or extending HNDP future OD matrices.

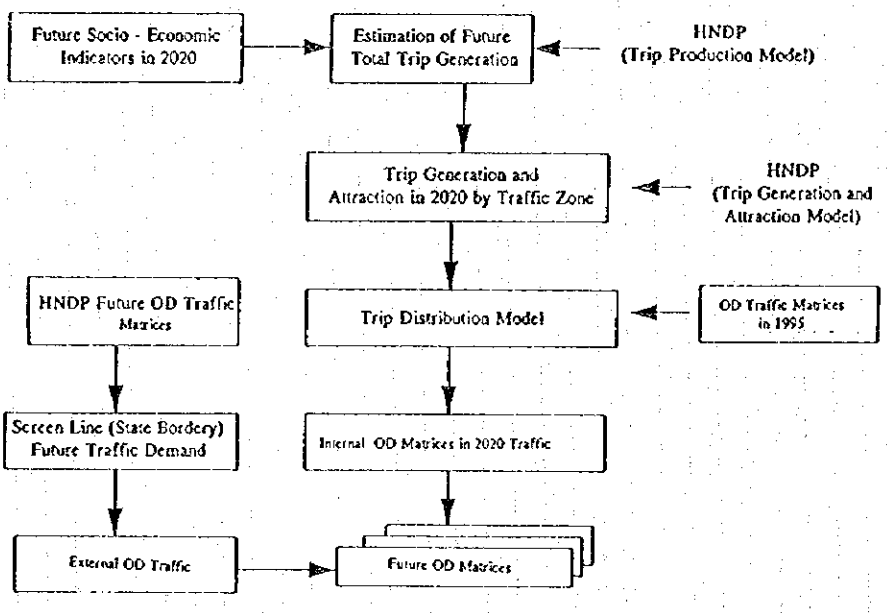
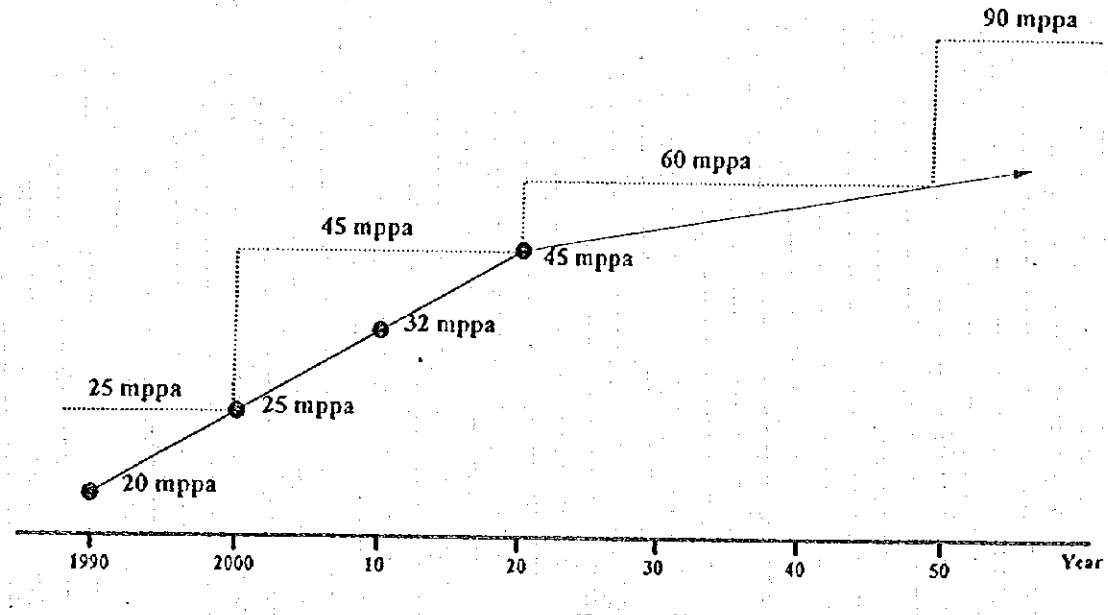


Figure 3-6 : Procedure for Future Traffic Demand Forecasting

3.4 TRAFFIC DEMAND FROM KUALA LUMPUR INTERNATIONAL AIRPORT (KLIA)

The projection of trips are assumed for the traffic demand forecasting from KLIA as follows :

Figure 3-7 show the projection of air passenger from KLIA over a time period of 50 years



(Source : Kuala Lumpur International Airport Berhad)

Figure 3-7 : Projection of Air Passenger from KLIA

(1) Air Passenger 20 mppa - 66,440 pax/day
25 mppa - (83,050 pax/day)
32 mppa - 104,250 pax/day
45 mppa - (146,650 pax/day)

(2) Miscellaneous Trip 20 mppa - 11,400 pax/day
25 mppa - (14,250 pax/day)
32 mppa - 17,070 pax/day
45 mppa - (22,700 pax/day)

(3) Cargo Trips 20 mppa - 2,920 two way daily trips
25 mppa - (3,650 two way daily trips)
32 mppa - 4,720 two way daily trips
45 mppa - (6,850 two way daily trips)

TRIP GENERATION AND ATTRACTION FROM KLIA

AIR PASSENGERS	2000	20 mppa	66,440 pax/day
	2005	25 mppa	83,050 pax/day
	2010	32 mppa	104,250 pax/day
	2020	45 mppa	146,650 pax/day
MISCELLANEOUS TRIP	2000	20 mppa	11,400 trips/day
	2005	25 mppa	14,250 trips/day
	2010	32 mppa	17,070 trips/day
	2020	45 mppa	22,700 trips/day
CARGO TRIP	2000	20 mppa	2,920 two way daily trip
	2005	25 mppa	3,650 two way daily trip
	2010	32 mppa	4,720 two way daily trip
	2020	45 mppa	6,850 two way daily trip

AIR PASSENGERS

MODAL CHOICE

	P.CAR	TAXI	BUS	LORRY
2000	45%	35%	20%	
2005	45%	35%	20%	
2010	45%	35%	20%	
2020	45%	35%	20%	

OCCUPANCIES

	P.CAR	TAXI	BUS	LORRY
2000	1.68	1.4	10	
2005	1.68	1.4	10	
2010	1.68	1.4	10	
2020	1.68	1.4	10	

TRIP GENERATION AND ATTRACTION

	P.CAR	TAXI	BUS
2000	17796	16610	1329
2005	22246	20763	1661
2010	27924	26063	2085
2020	39281	36663	733

TRIP GENERATION AND ATTRACTION

	P.CAR	BUS
2000	34406	1329
2005	43009	1661
2010	53987	2085
2020	75944	733

MISCELLANEOUS

MODAL CHOICE

	P.CAR	TAXI	BUS	LORRY
2000	53%	12%	30%	
2005	53%	12%	30%	
2010	53%	12%	30%	
2020	45%	11%	21%	

OCCUPANCIES

	P.CAR	TAXI	BUS	LORRY
2000	1.25	0.7	15	
2005	1.25	0.7	15	
2010	1.25	0.7	15	
2020	1.25	0.7	15	

TRIP GENERATION

	P.CAR	TAXI	BUS
2000	28171	11390	1329
2005	35213	14237	1661
2010	44202	17871	2085
2020	52794	23045	2053

TRIP GENERATION

	P.CAR	BUS
2000	39561	1329
2005	49450	1661
2010	62073	2085
2020	75839	2053

TRIP GENERATION

	P.CAR	BUS
2000	56,764	2,658
2005	70,955	3,322
2010	89,067	4,170
2020	113,811	2,786

3.5 TRAFFIC DEMAND ON THE ALTERNATIVE SOCIO-ECONOMIC INDICATORS AND MODAL SPLIT

3.5.1 Traffic Demand in the High Economic Growth Case

Two cases of the future economic condition have been examined as described in the Main Volume Chapter 3 and Appendix B. The future traffic demand for the evaluation of the project applied the volume from the low economic case based on the discussion with Macro Economic Section in EPU (Economic Planning Unit) and Technical Committee Meeting. However, the present economic development trend in the study area expects a higher economic growth. This section will estimate future traffic demand in the high growth case for the project evaluation - Sensitivity Analysis.

The forecasting methodology employed herein will be the same as in the low economic growth case. The socio-economic condition in the high economic growth is indicated in Appendix B. A result of the case is shown in Table 3-5 for the Future Number of Vehicles and Future Total Trip Generation respectively. In addition, the total volume is adjusted by the future modal split expected.

The traffic demand in Kuala Lumpur is no change from the low case, because the vehicle ownership will already be saturated in the low case. The demand in Selangor State will increase around 21% from the low case. Total volume including both Kuala Lumpur and Selangor State will be expected to increase around 12%.

3.5.2 Traffic Demand on the Target Modal Split Case

Based on the present serious traffic congestion in the study area, Government of Malaysia is encouraging the usage of public transport system. The future modal split will be 40% for P.Car and 60% for public transport system such as KTM commuter service, LRT system, Monorail and so on.

However, this study employs 50%:50% of the share in 2020, because some issues such as future public transport development and how to control the usage of P.Car and so forth, are not clear to justify the modal transfer from the present modal split of 70%:30% to 40%:60%. Moreover, if the government wants to achieve the target, it will require to develop the public transport system intensively such as Tokyo or major cities in Japan which are less than 50% share for the public transport.

Traffic demand on the target modal split case is estimated for the project evaluation as shown in Table 3-6. Comparing the traffic demand of both cases, the demand of the 40:60 case will reduce around 20% of the 50:50.

		LOW ECONOMIC GROWTH 7.0 % (A)				HIGH ECONOMIC GROWTH 7.8 %(B)				(B) / (A)			
FUTURE NUMBER OF VEHECLES													
		P.CAR	BUS	LORRY	TOTAL	P.CAR	BUS	LORRY	TOTAL	P.CAR	BUS	LORRY	TOTAL
SELANGOR	1995	477,469	5,726	110,527	593,722	477,469	5,726	110,527	593,722	1.00	1.00	1.00	1.00
	2000	594,610	7,149	142,279	744,038	619,060	7,297	146,593	772,950	1.04	1.02	1.03	1.04
	2010	880,199	11,236	229,354	1,120,789	933,659	11,694	240,865	1,186,218	1.06	1.04	1.05	1.06
	2020	1,126,557	17,119	341,217	1,484,893	1,367,920	19,555	405,163	1,793,038	1.21	1.17	1.19	1.21
K. LUMPUR	1995	422,159	5,530	63,394	491,083	422,159	5,530	63,394	491,083	1.00	1.00	1.00	1.00
	2000	530,674	7,571	85,302	623,547	530,674	7,571	85,302	623,547	1.00	1.00	1.00	1.00
	2010	724,067	12,453	131,507	868,027	724,067	12,453	131,507	868,027	1.00	1.00	1.00	1.00
	2020	901,546	18,810	180,564	1,100,920	901,546	18,810	180,564	1,100,920	1.00	1.00	1.00	1.00
TOTAL	1995	899,628	11,256	173,921	1,084,805	899,628	11,256	173,921	1,084,805	1.00	1.00	1.00	1.00
	2000	1,125,284	14,720	227,581	1,367,585	1,149,734	14,868	231,895	1,396,497	1.02	1.01	1.02	1.02
	2010	1,604,266	23,689	360,861	1,988,816	1,657,726	24,147	372,372	2,054,245	1.03	1.02	1.03	1.03
	2020	2,028,103	35,929	521,781	2,585,813	2,269,466	38,765	585,727	2,893,958	1.12	1.08	1.12	1.12
FUTURE TOTAL TRIP GENERATION													
SELANGOR	1995	1,480,154	48,098	386,845	1,915,097	1,480,154	48,098	386,845	1,915,097	1.00	1.00	1.00	1.00
	2000	1,686,994	57,192	512,204	2,256,390	1,749,699	58,376	527,735	2,335,810	1.04	1.02	1.03	1.04
	2010	2,288,616	84,270	871,545	3,244,431	2,418,306	87,705	915,287	3,421,299	1.06	1.04	1.05	1.05
	2020	2,886,256	119,833	1,364,868	4,370,957	3,471,777	139,685	1,620,652	5,232,114	1.20	1.17	1.19	1.20
K. LUMPUR	1995	1,182,045	38,157	190,182	1,410,384	1,182,045	38,157	190,182	1,410,384	1.00	1.00	1.00	1.00
	2000	1,348,305	45,426	264,436	1,658,167	1,360,860	45,426	264,436	1,670,722	1.01	1.00	1.00	1.01
	2010	1,713,720	62,265	433,973	2,209,958	1,729,682	62,265	433,973	2,225,920	1.01	1.00	1.00	1.01
	2020	1,880,475	84,645	631,974	2,597,094	1,877,078	84,645	631,974	2,593,697	1.00	1.00	1.00	1.00
TOTAL	1995	2,662,199	86,255	577,027	3,325,481	2,662,199	86,255	577,027	3,325,481	1.00	1.00	1.00	1.00
	2000	3,035,299	102,618	776,640	3,914,557	3,110,559	103,802	792,171	4,006,532	1.02	1.01	1.02	1.02
	2010	4,002,336	146,535	1,305,518	5,454,389	4,147,988	149,970	1,349,260	5,647,218	1.04	1.02	1.03	1.04
	2020	4,766,731	204,478	1,996,842	6,968,051	5,348,855	224,330	2,252,626	7,825,811	1.12	1.10	1.13	1.12

Table 3-5 : Future Number of Vehicles and Traffic Demand on the Alternative Socio-Economic Indicators

		P.CAR : PUBLIC = 50 : 50 (A)				P.CAR : PUBLIC = 40 : 60 (B)				(B) / (A)			
LOW ECONOMIC GROWTH 7.0 %													
		P.CAR	BUS	LORRY	TOTAL	P.CAR	BUS	LORRY	TOTAL	P.CAR	BUS	LORRY	TOTAL
SELANGOR	1995	1,480,154	48,098	386,845	1,915,097	1,480,154	48,098	386,845	1,915,097	1.00	1.00	1.00	1.00
	2000	1,686,994	57,192	512,204	2,256,390	1,686,994	58,621	512,204	2,257,819	1.00	1.02	1.00	1.00
	2010	2,288,616	84,270	871,545	3,244,431	2,157,838	92,479	871,545	3,121,862	0.94	1.10	1.00	0.96
	2020	2,886,256	119,833	1,364,868	4,370,957	2,144,076	153,737	1,364,868	3,662,681	0.74	1.28	1.00	0.84
K. LUMPUR	1995	1,182,045	38,157	190,182	1,410,384	1,182,045	38,157	190,182	1,410,384	1.00	1.00	1.00	1.00
	2000	1,348,305	45,426	264,436	1,658,167	1,348,305	46,126	264,436	1,658,867	1.00	1.02	1.00	1.00
	2010	1,578,426	62,265	433,973	2,074,664	1,488,231	64,490	433,973	1,986,694	0.94	1.04	1.00	0.96
	2020	1,880,475	84,645	631,974	2,597,094	1,343,196	104,769	631,974	2,079,939	0.71	1.24	1.00	0.80
TOTAL	1995	2,662,199	86,255	577,027	3,325,481	2,662,199	86,255	577,027	3,325,481	1.00	1.00	1.00	1.00
	2000	3,035,299	102,618	776,640	3,914,557	3,035,299	104,747	776,640	3,916,686	1.00	1.02	1.00	1.00
	2010	3,867,042	146,535	1,305,518	5,319,095	3,646,069	156,969	1,305,518	5,108,556	0.94	1.07	1.00	0.96
	2020	4,766,731	204,478	1,996,842	6,968,051	3,487,272	258,506	1,996,842	5,742,620	0.73	1.26	1.00	0.82
HIGH ECONOMIC GROWTH 7.8 %													
SELANGOR	1995	1,480,154	48,098	386,845	1,915,097	1,480,154	48,098	386,845	1,915,097	1.00	1.00	1.00	1.00
	2000	1,749,699	58,376	527,735	2,335,810	1,749,699	60,800	527,735	2,338,234	1.00	1.04	1.00	1.00
	2010	2,418,306	87,705	915,287	3,421,298	2,280,117	97,719	915,287	3,293,123	0.94	1.11	1.00	0.96
	2020	3,471,777	139,685	1,620,652	5,232,114	2,975,808	159,418	1,620,652	4,755,878	0.86	1.14	1.00	0.91
K. LUMPUR	1995	1,182,045	38,157	190,182	1,410,384	1,182,045	38,157	190,182	1,410,384	1.00	1.00	1.00	1.00
	2000	1,360,860	45,426	264,436	1,670,722	1,360,860	46,556	264,436	1,671,852	1.00	1.02	1.00	1.00
	2010	1,729,682	62,265	433,973	2,225,920	1,502,092	65,091	433,973	2,001,156	0.87	1.05	1.00	0.90
	2020	1,877,078	84,645	631,974	2,593,697	1,340,771	87,150	631,974	2,059,895	0.71	1.03	1.00	0.79
TOTAL	1995	2,662,199	86,255	577,027	3,325,481	2,662,199	86,255	577,027	3,325,481	1.00	1.00	1.00	1.00
	2000	3,110,559	103,802	792,171	4,006,532	3,110,559	107,356	792,171	4,010,086	1.00	1.03	1.00	1.00
	2010	4,147,988	149,970	1,349,260	5,647,218	3,782,209	162,810	1,349,260	5,294,279	0.91	1.09	1.00	0.94
	2020	5,348,855	224,330	2,252,626	7,825,811	4,316,579	246,568	2,252,626	6,815,773	0.81	1.10	1.00	0.87

Table 3-6 : Traffic Demand Comparison between Alternative Modal Splits

3.6 Origin and Destination Matrix

Table 3-7 : OD Traffic Matrix (Whole Vehicles) with B Zone system in 1995

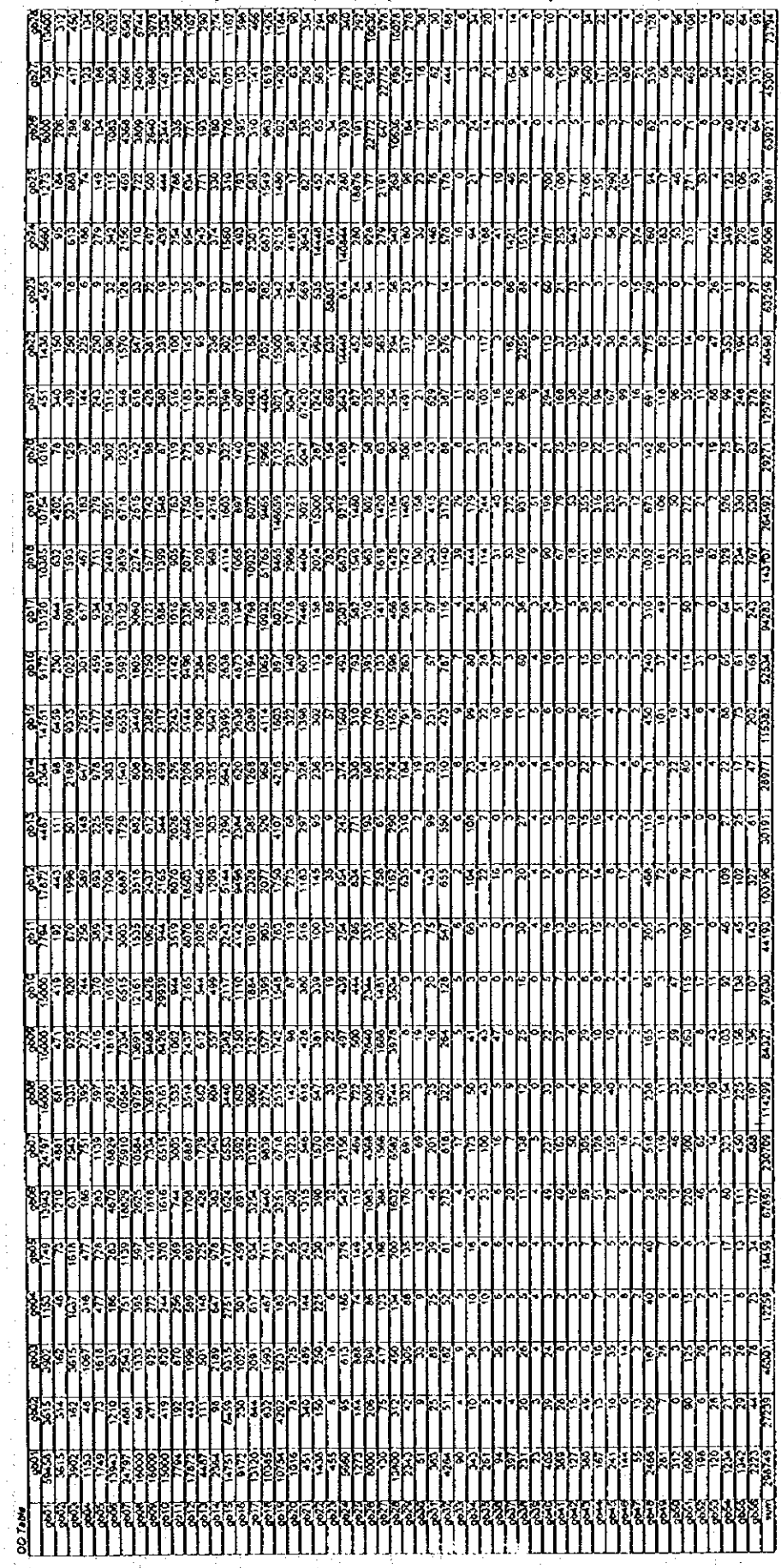


Table 3-7 : OD Traffic Matrix (Whole Vehicles) with B Zone system in 1995 (continued)

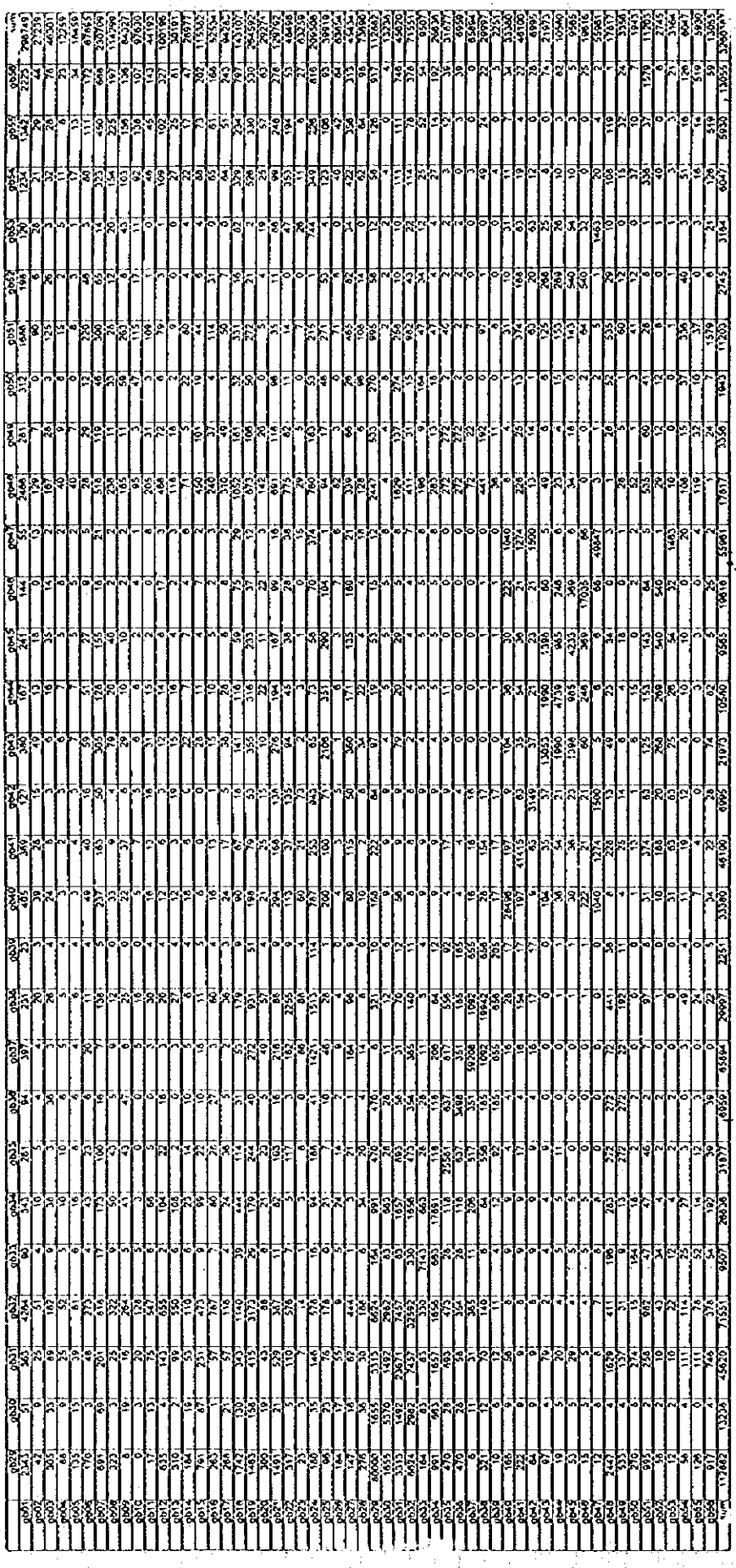


Table 3-8 : OD Traffic Matrix (Whole Vehicles) with B Zone system in 2020

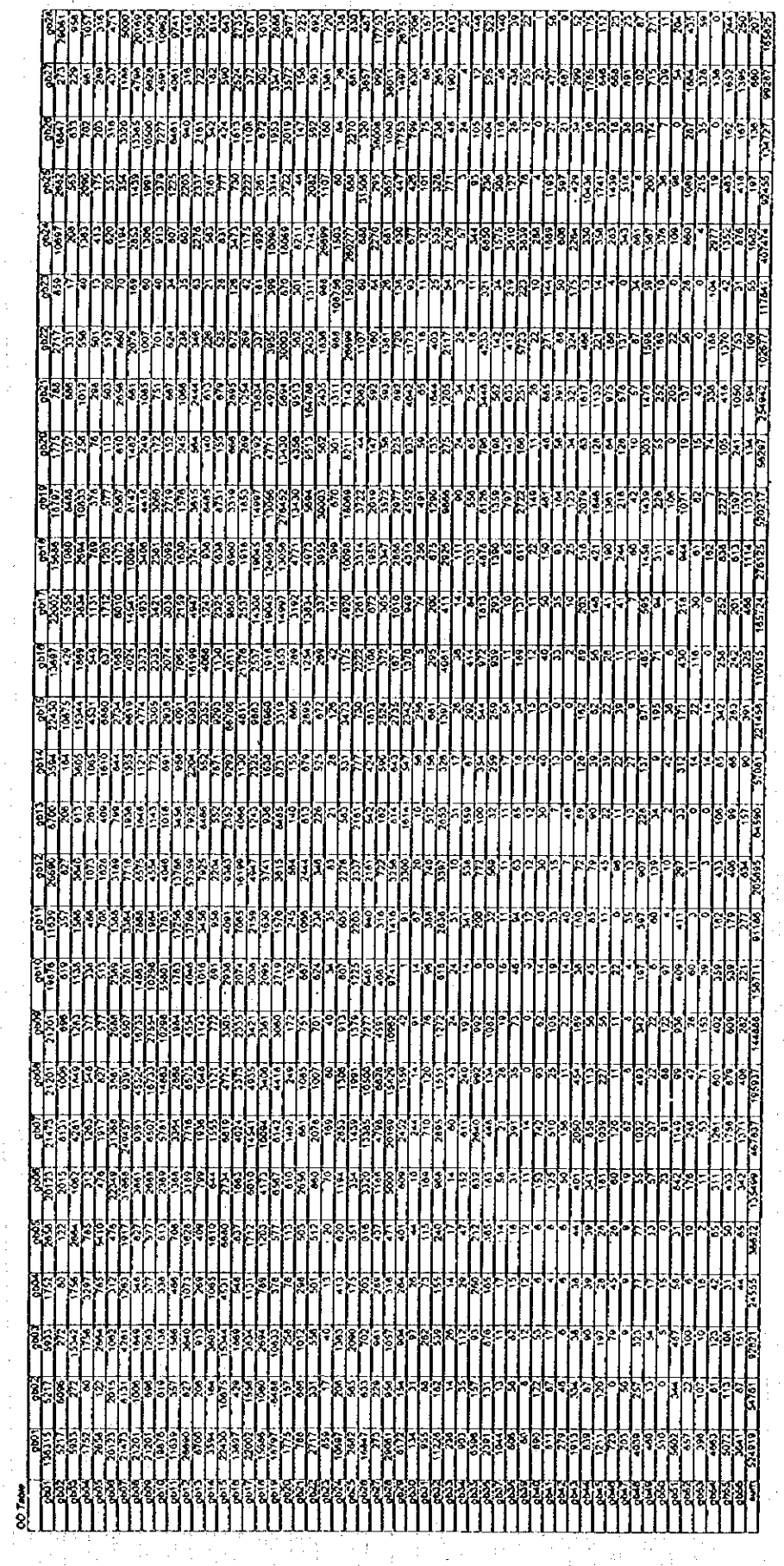
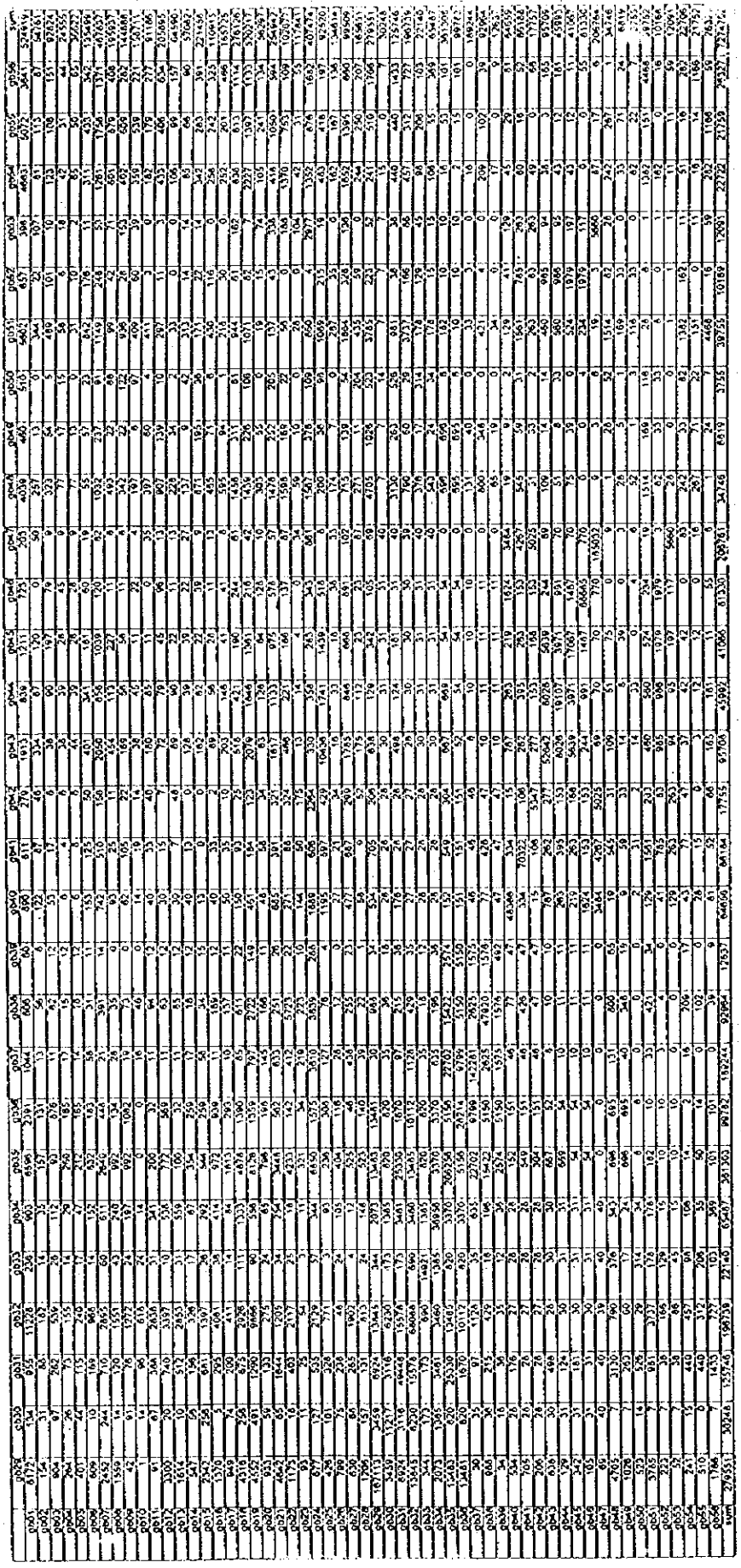


Table 3-8 : OD Traffic Matrix (Whole Vehicles) with B Zone system in 2020 (continued)



Technical Volume

Chapter **4**

ALTERNATIVE ALIGNMENT STUDY

CHAPTER 4 ALTERNATIVE ALIGNMENT STUDY

4.1 Preparation of Alternative Alignment

4.1.1 Basic Consideration

(1) Natural Barrier

Natural barrier is the primary condition that governs alignment of the CLAIR. High mountain and water reservoirs are avoided to pass through.

(2) Control Point

There are some sensitive areas which the KLORR will seriously affect such as virgin jungle FR, Orang Asli settlements, water reservoir and geological legacy. Also there are some newly developed areas both housing and industrial. In designing the alignment of the KLORR not to encroach to those area was considered as the first rank control points.

Those facilities which will be very difficult to relocate such as graveyard, hospital and school are considered also important control points.

(3) Harmonize with environment

Highway alignment can be itself a beautiful structure in the natural condition. To harmonize with natural condition also one of consideration to design alignment. To avoid the place where too high cutting too deep embankment is primary consideration. To avoid forest is also considered.

(4) Gentle alignment

Alignment was designed as gentle as possible, although there area some sections where control points and natural condition became obstacles to do so. The smallest curve to be used is 600 to 800 meters.

Clothoid curve is used as a transient curve. And its length is so designed to be longer than that is required to runoff superelevation. It make the alignment more gently.

In designing vertical alignment , usage of steep slope was avoided as much as possible. Especially in tunnel section, the effort was made not to use steep gradient. Longer vertical curves than minimum requirement are used. It is very important to use longer vertical curve to make the alignment gentle to the drivers.

4.1.2 Alterative Route and their Control Points

The alternative routes are examined by dividing the route into three sections.

North Section	--	from N-S Expressway to Kuala Lumpur-Karak highway
Eastern Section	--	from Kuala Lumpur-Karak highway to Federal Route No.1
South Section	--	from Federal Route No.1 to N-S Central Link

(1) North Section

Natural Barrier

Natural barrier of this section is mountain range of Bukit Ulu Gombak (698m), Bukit Ulu Kalong (695m) and Bukit Lagong (575m). How to pass through these mountain ranges is one of main concern to design the alternatives in this section.

Control Points

a. highway/expressway
There is a new interchange in Bt.Beruntung in N-S Expressway expected to be complete in middle 1995.
Rawang Bypass to bypass Rawang town and to improve alignment of FHR1 was planned.

b. development project
"PERODUA" project of "KANCIL" car plant in operating in S.Choh and Bt. Sentosa industrial park is developed in Serendah.

c. Orang Asli
There is Kg. Melaka Serendah Orang Asli settlement east of Serendah town.

d. other facility
Addict rehabilitation center near Orang Asli settlement in Serendah and cemetery in hilly area in Serendah.
Selayang New Town along S.Gambak

e. forest reserve
Serendah FR. Lagong FR and Kanching amenity FR, wildlife reserve at northern part of Templer Park.

f. water catchment area
Batu Dam water catchment area

Route A:

It starts from N-S Expressway between Rawang and new Bkt. Beruntung IC at Serendah and crosses the railway line and crosses FHR1. Then it runs eastward at the south of Serendah town. Then it follows Sang Serendah valley and climbs by 3% grade as far as possible, then by tunnels it crosses below the mountain range, then crosses valley of Sang Liam and also crosses Jalan Ulu Yam Baharu (B23).
Then it follows valley of Sang Gajah Mati and Sang Pisang one of tributary of Sang Gombak to KL-Karak highway.

Route B and C:

It starts at the southern section of existing Rawang Interchange, as far as enough spacing in traffic control view point between two interchanges. Then it runs between FHR1 and Bukit Lagong FR and crosses FHR1 near Templer Park. Then it runs hills by tunnels at foot of Batu Dam and back side of Batu Caves to K L-Karak highway.

(2) East Section

Natural barrier

Natural barrier of this section is huge mountain rage which spread up stream of Klang Gate Dam, and water catchment area of which will be sensitive for the alternatives. And there are Hulu Gombak and Impinge FR. Southern part of this section is Hulu Langa of gently sloping hilly area which will not be natural barrier for route location.

Control points

a. highway/expressway

KL-Karak highway (FHR2) is under widening from 2 lane to 4 lane divided highway.
There are three possible connection ie, NKVE eastern extension, Impinge elevated highway and Jalan Impinge.
Also a connection is considered in Cheras area such as E-W link extension.

b. New Development
Hi-Tech Center S. Long
Bangi New Town

b. Orang Asli
There are Orang Asli settlements along KL-Karak highway named Pusat Pembangunan Orang Asli, Kg. Batu 16 Gambak. And Kg. Perdik in Hulu Klang.

c. forest reserve
Hulu Gombak (Extension), Impinge, Bt. Sang Puteh (north and south), Hulu Langa and Sugei Jeloh.
S. Chongkak recreation park
Wildlife reserve in Klang Dam reservoir.

d. water intakes
in S. Gambak along KL-Karak highway
in Impinge FR.
in S. Langa

e. other facility

International Islamic University campus construction site
National Zoo
Bandar Hussein Onn
S. Long
Saujana Impian
Cheras Jaya
Country Heights

Route A:

It follows Sang Rumput and traverses catchment area of Klang Gate Dam. Then it crosses by tunnel below the mountain rage near Bukit Cenuang 820 m high, then follows Sang Chongkak and Sang Peredek both of them tributary of Sang Hulu Langa.
Then crosses Jalan Hulu Langa then traverses southern area of Jalan Hulu Langa in hilly area of S. Long and S. Jeloh then turn to west by large radius bypassing

Kajang town. Then it to crosses FHR1 and its Kajang Bypass at planning stage.

Route B:

It is obliged to turn south to the Bt. Batu Tabor (quartz ridge) after crossing KL-Karak highway, because there are International Islamic University campus construction site north of the quartz ridge and wildlife reserve in Klang Dam reservoir. It passes through by tunnel under the ridge and cross Melawati area by high pier bridge. Then it runs to mountain side of developed area of Impinge and traverses Impinge FR, and by tunnel it crosses below mountain rage, then follow the valley of Sang Semungkis to Hulu Langa Area. It runs to southward then merge to Route A.

Route C:

It starts from Route B in North Section, then crosses the quartz ridge by tunnel same as route B. Then it passes the area between already built up area and Impinge FR of hilly side of Hulu Klang passing by Kemensah, Bukit Jerlang and Sang Seriang. Then turns to the east under the mountain rage of S. Puteh by tunnel to Hulu Langa. Then it runs southward in hilly area of S. Long in Cheras. Then it turns to the west by large radius crossing northern area of Kajang town and crosses FHR1 and its Kajang Bypass.

(3). Southern Section

Natural Barrier

There is not natural condition which can be natural barrier in this area, but, some high hill must be detoured so that cutting depth will not be so high.

Control Points

a. highway/expressway
There are many expressway projects in this area related to Putra Jaya and KLIA project:
- KL-Seremban Expressway (open to traffic)
- N-S Central Link
- KLIA Expressway
- South Klang Valley Expressway
- Dedicated Highway
- Damansara Highway

b. railway
electrification of existing railway for commuter service for KL-Seremban
New Express Rail Link

c. development
Putra Jaya - new administrative center
KLIA - new international airport
Bangi New Town

c. forest reserve
Air Hitam

d. Orang Asli
Kg. Bukit Baja

Route A

It turns to west bypassing Kajang town in its southern area, the it cross Bangi New Town area. Then it crosses KL-Seremban Expressway and a major interchange will be planned here.

It traverses hilly area of Denkil proposed Putra Jaya area. Then it runs toward south-west to avoid many mining ponds. Then it crosses N-S Central Link at north of Bt. Baja, a major interchange with it will be planned.

Route B & C

After crossing FHR1 it follows alignment of State highway B11, south of country heights. Then it traverses hilly area of Denkil following B11, then turns to south-west to avoid many mining ponds then merges to Route A.

These alternative route and their control points are shown in Figure 4-1-1.

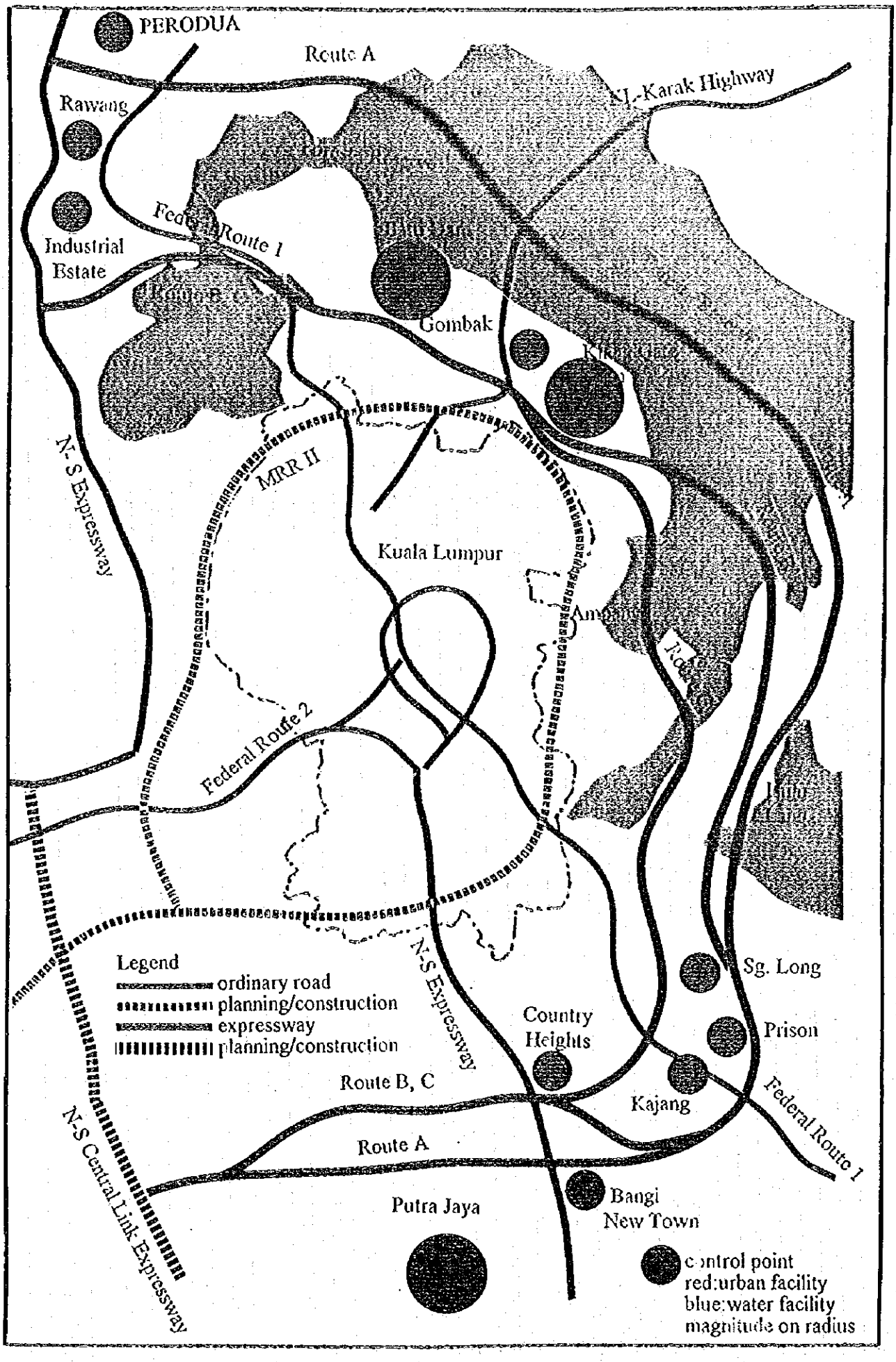


Figure 4-1-1 Alternative Route and Control Points

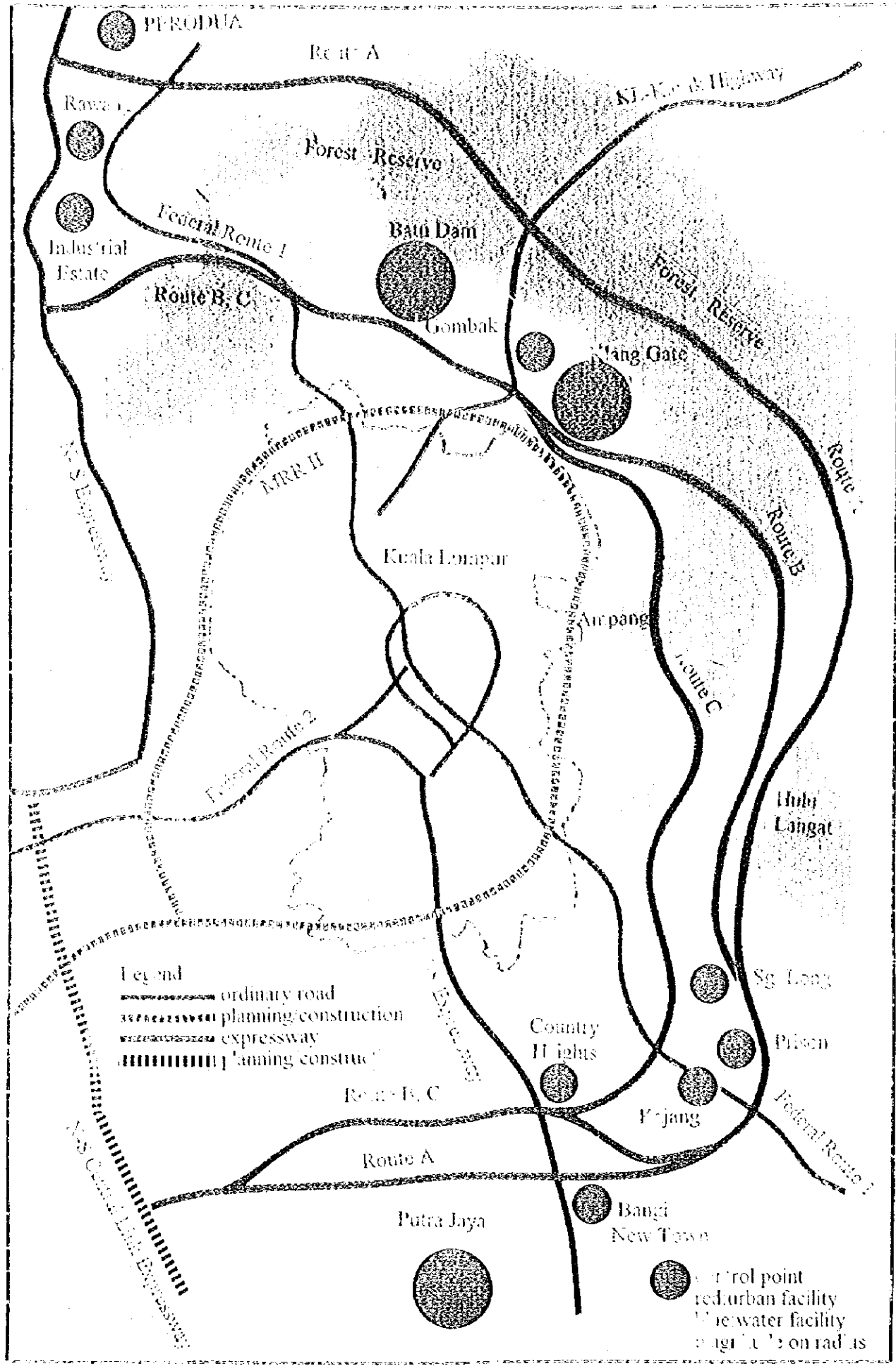


Figure 4-1-1 Alternative Route and Control Points

4.2 Landuse

4.2.1 Forest Reserve

There are eleven forest reserve, in the study corridor, and four virgin jungle forest. The alignment encroach some of the former but, the latter are located rather far from the alignment.

They are illustrated in Figure 4-2-1. In alignment designing consideration was give not to encroach FR, but they are so vastly spreading, there are no places other than to encroach them in some places. The traversing length of the FR by the alternatives is shown in Table 4-2-1.

Table 4-2-1 Forest Reserve Traversing Length

Unit : km

Route	Section 1	Section 2	Section 3
Alternative A	10.0	12.0	-
Alternative B	1.7	8.0	-
Alternative C	1.7	9.0	-

4.2.2 Malay Reservation

There are many Malay Reserve (MR) in the study corridor. The largest one is Ulu Langa MR. They are illustrated in Figure 4-2-2. In alignment designing consideration was give not to encroach MR, but, in some places alignment pass through MR. Especially the places where present landuse is plantation. The traversing length of the MR by the alternatives is shown in Table 4-2-2

Table 4-2-2 Malay Reserve Traversing Length

Unit : km

Route	Section 1	Section 2	Section 3
Alternative A	-	14.0	1.6
Alternative B	2.3	13.3	0.6
Alternative C	2.3	8.1	1.5

4.2.3 Development Projects

There are many development projects already on going or committed. Although the detail of the committed projects are not known some of the projects already implemented are shown in the figure 4-2-3.

PERODUA
Rawan Industrial Complex
Sg. Long
Bangi
Putra Jaya

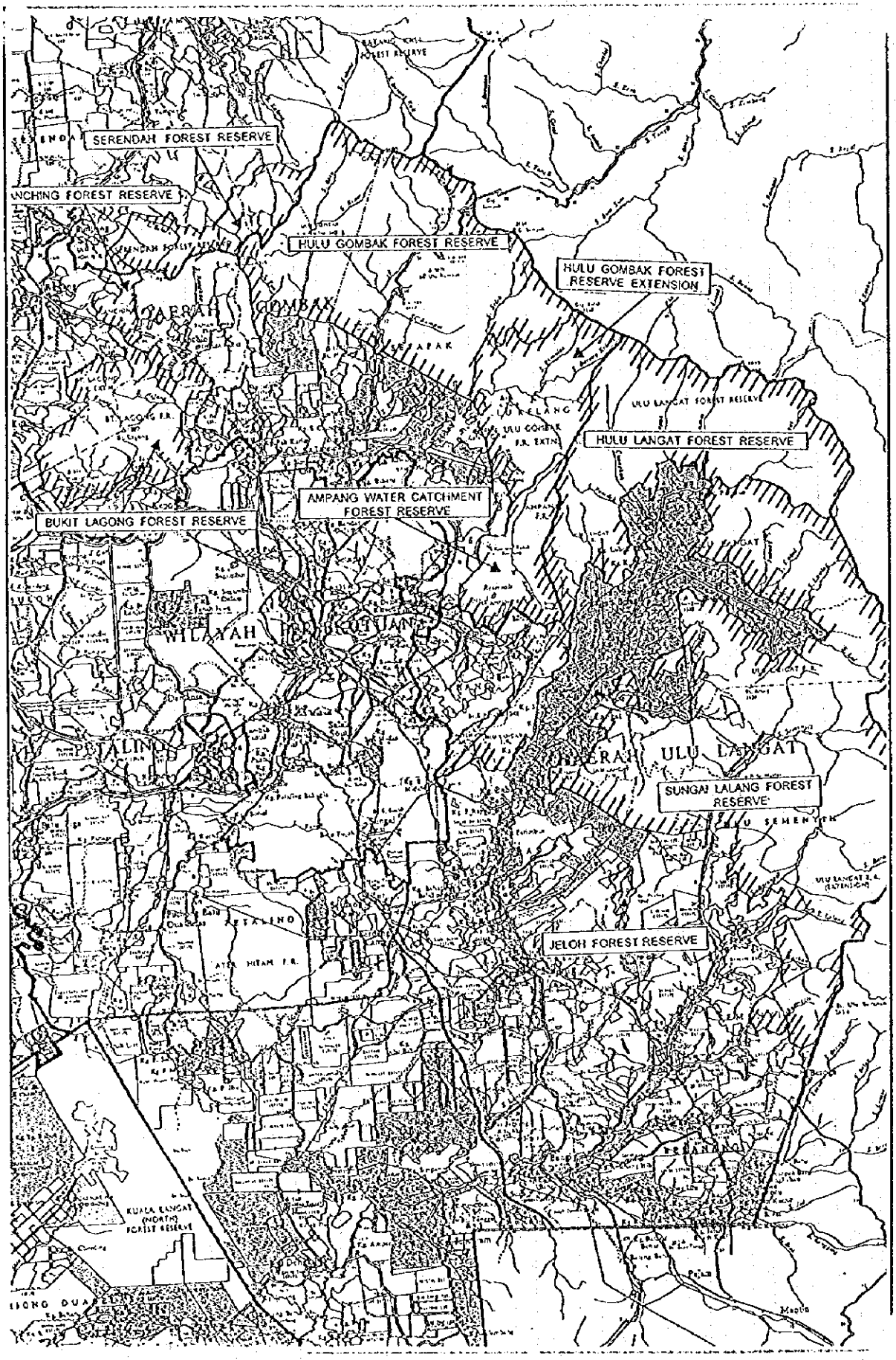


Figure 4-2-1 Forest Reserve

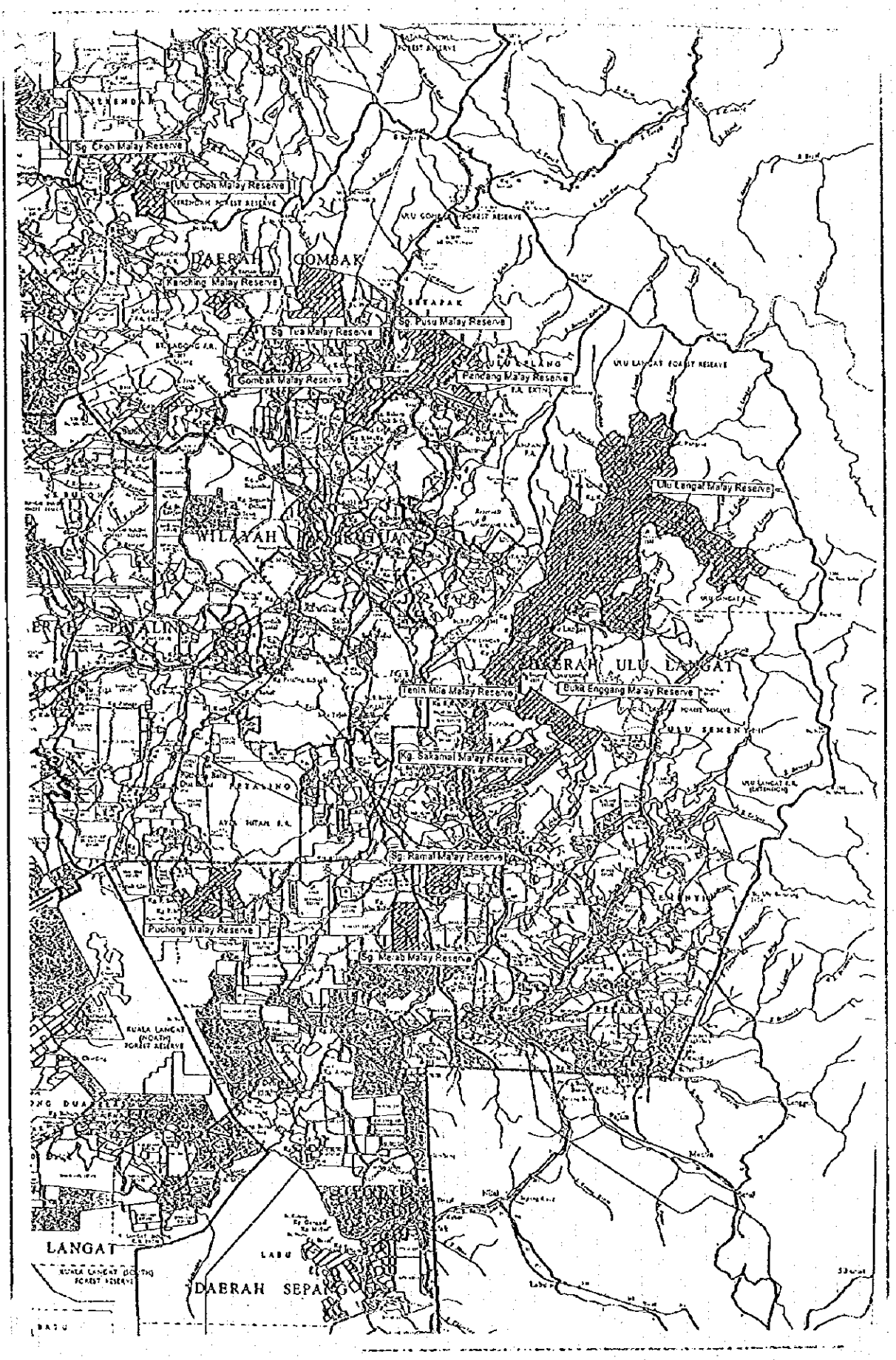


Figure 4-2-2 Malay Reserve

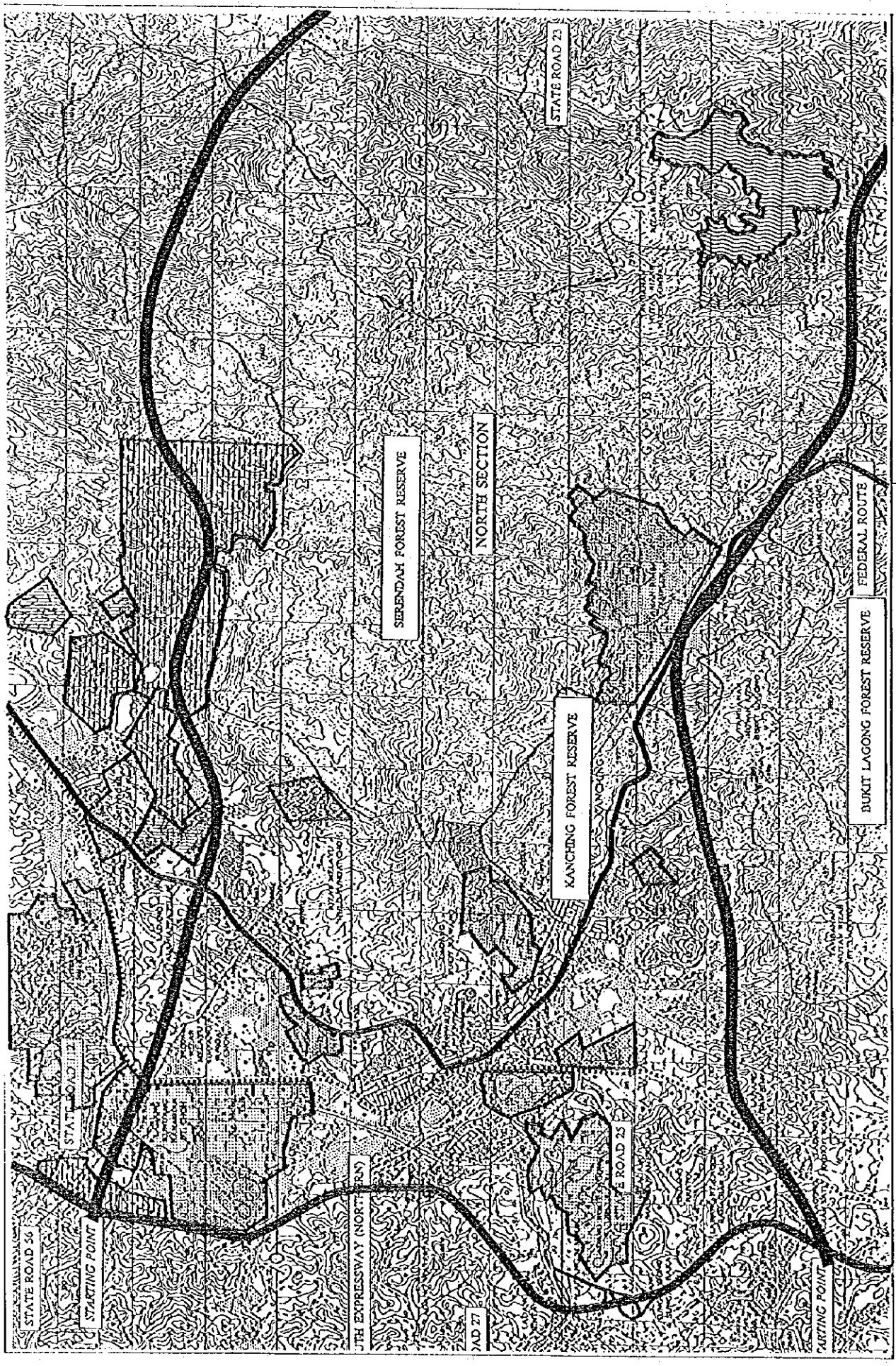


Figure 4-2-3 Control Points in the Study Area

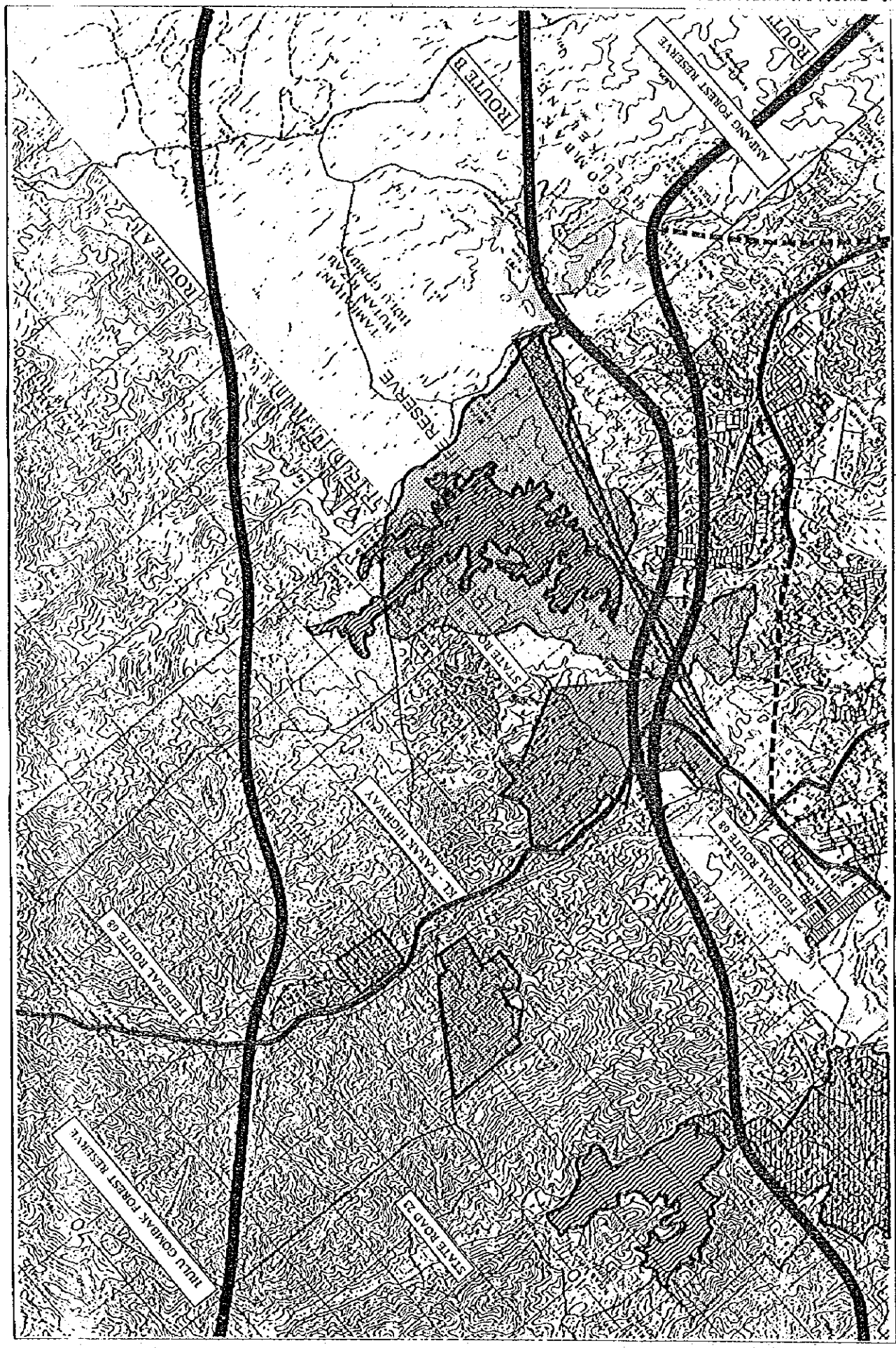


Figure 4-2-3 Control Points in the Study Area (Continued)

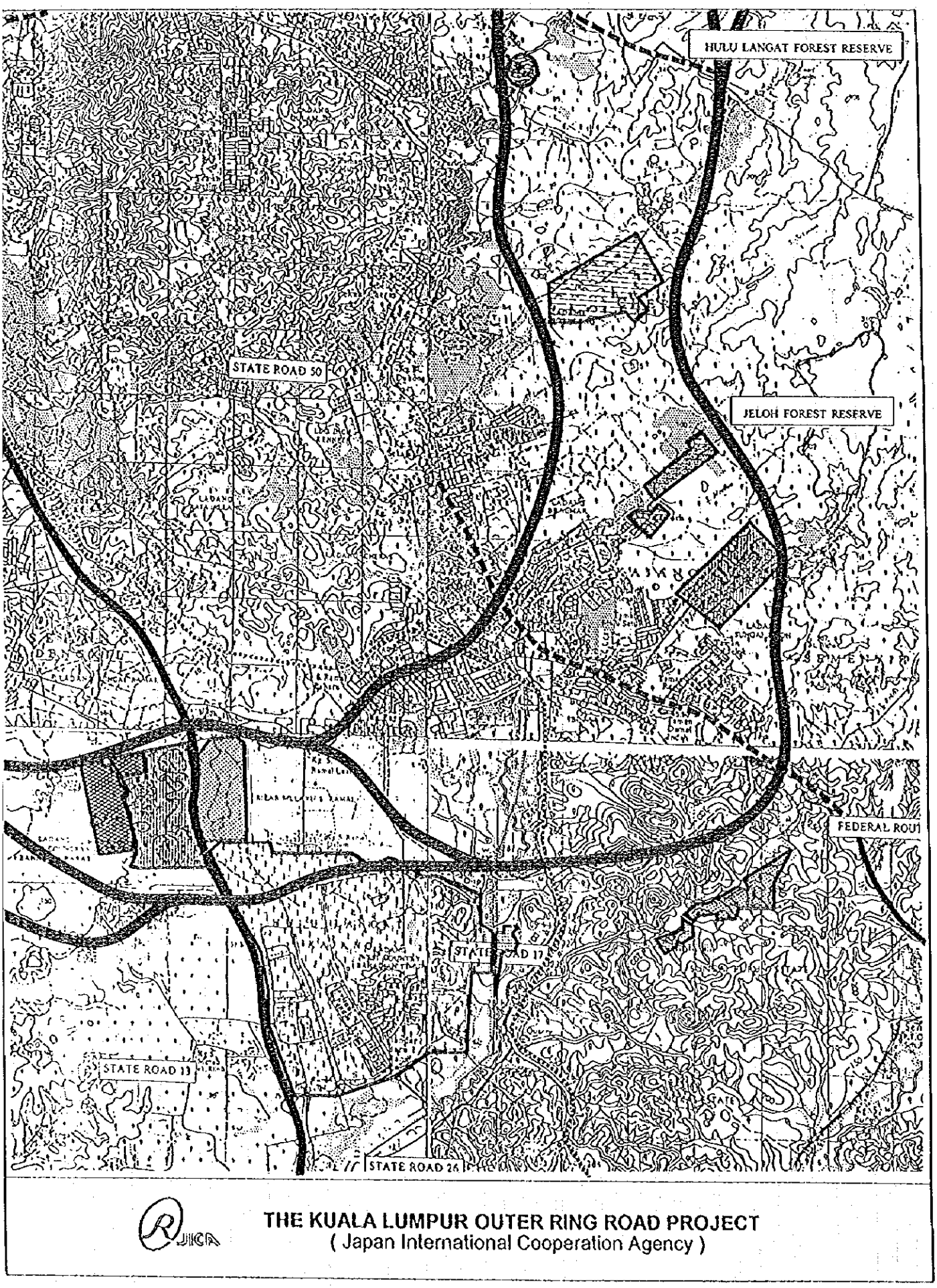


Figure 4-2-3 Control Points in the Study Area (Continued) 4-12

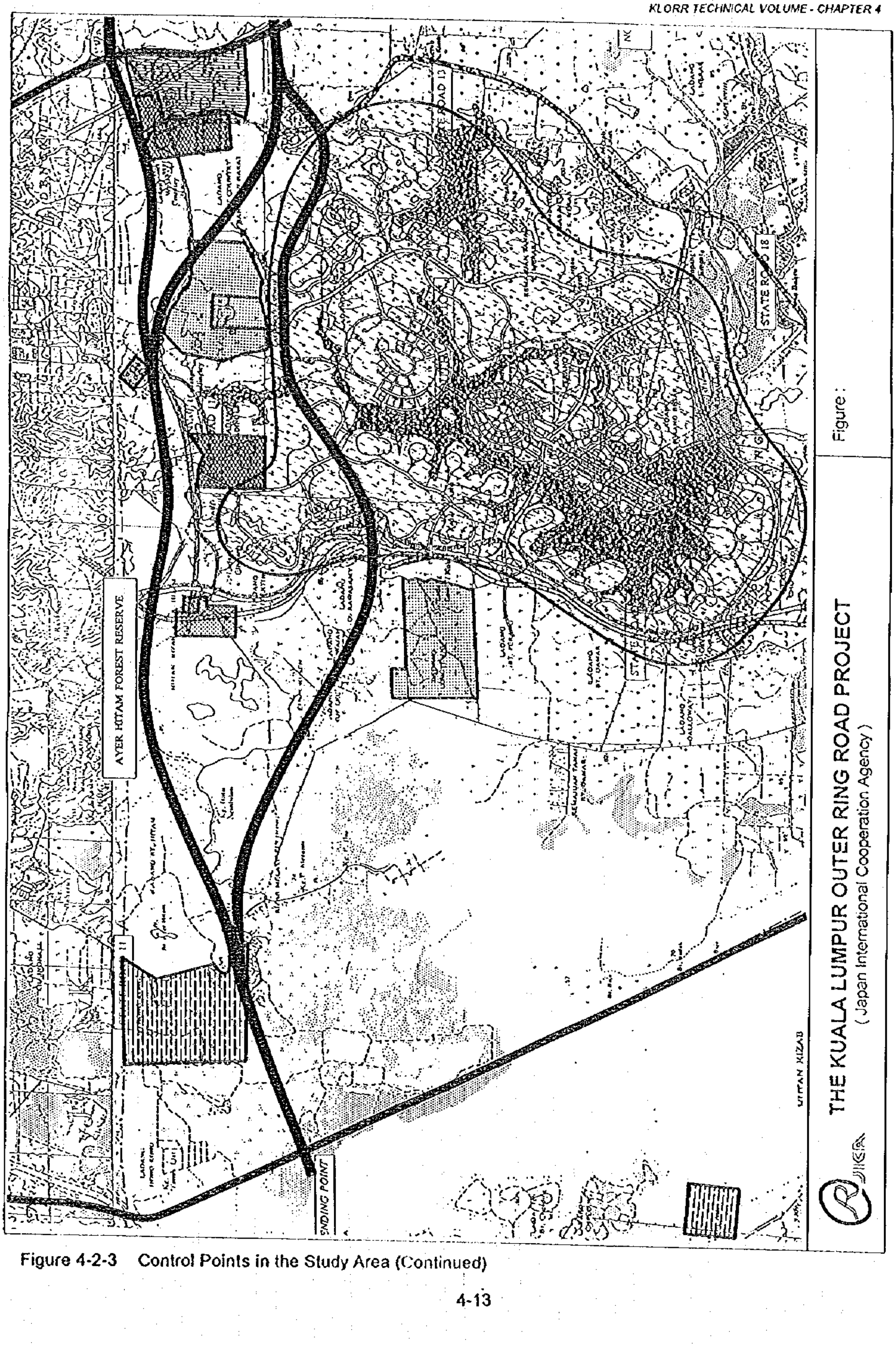


Figure 4-2-3 Control Points in the Study Area (Continued)

4.3 Examination of Possible Connection Route B to Serendah

1). General Condition

(1) Topography

Bt. Unyang situated at the boundary of Gombak and Serendah is quite high -- 720 m --. It creates many waterfall especially southern slope covering Templer Park and Kanching recreational forest.

2) Development

Federal Route 1 changes its direction from north-west to north-east at Rawang town, population of 67,000 (1995, estimation). There are so many housing and industrial projects already going on such as Bt. Rawang Jaya, Taman Setia Rawang.

3) Possible Route

(1) Main consideration

control point :Kanching Forest Reserve (FR)
:On going development projects

There are two possible routes, as shown Figure 4-3-1 and Figure 4-3-2:

Route 1:

Alignment follows along eastern and northern boundary of Kanting FR. As height of the boundary is considerably high (about 300 to 400 m) highway structure will be tunnel (length is 4500m). Then crosses Hulu Sg. Choh Malay Reserve then merge to Alternative Route A at northern side of Kg. Sg. Choh.

Route 2:

Alignment follows west boundary between Kanching FR and new development, but encroach a little to Kanching FR, because foundation work already finished for Taman Setia Rawang development project. And it passes through north side of Kg. Melayu Batu Enam Belas and Kg.Sepakat. As the mountain is not so high, it can pass through by cut and fill method. The it merge Route 1.

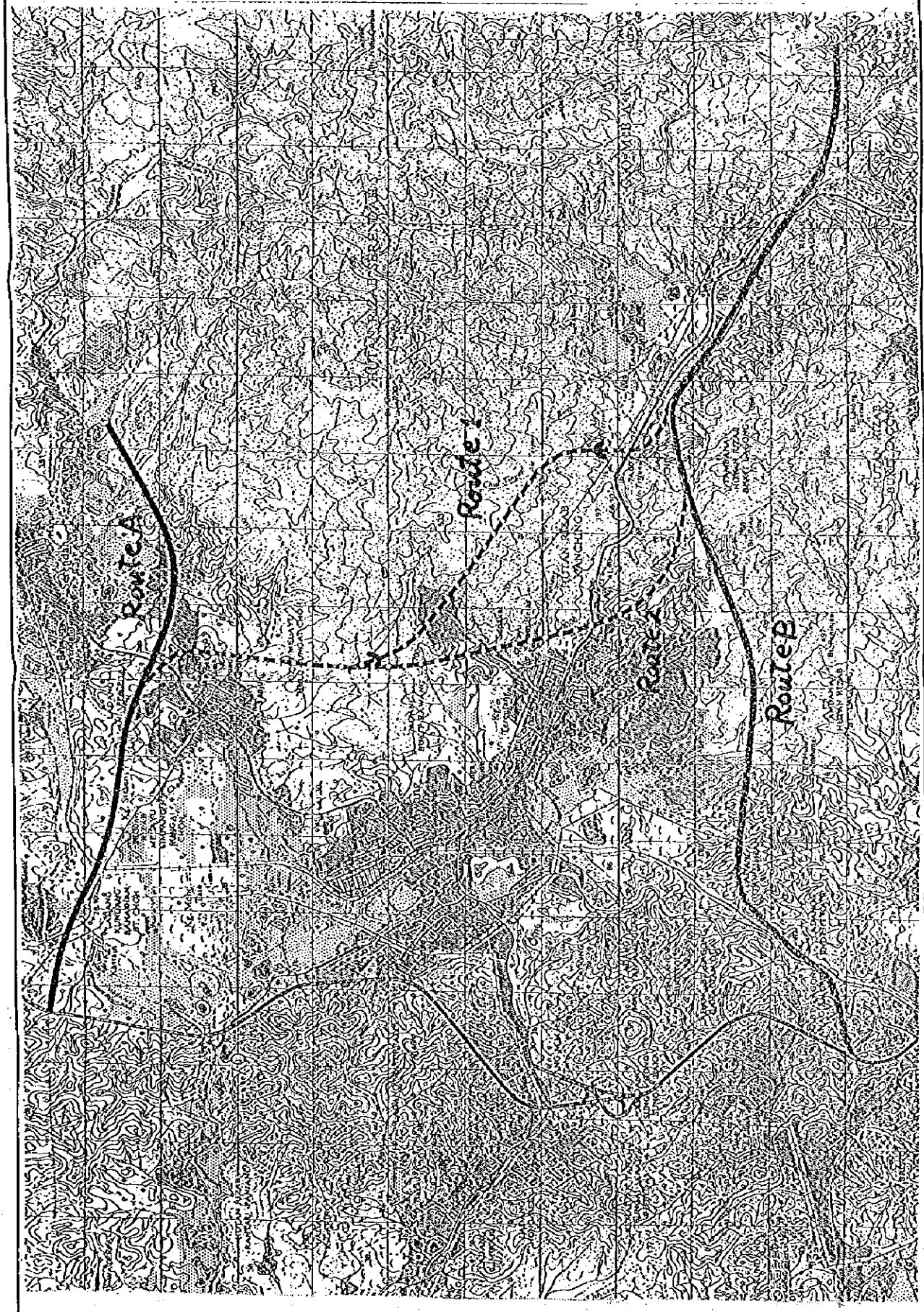
4) Inherent Problem of Alternative Route A

(1) Development Project

There are so many development projects already committed by JPBD. Especially in Kg. Stesen and Sg. Choh MR area.

(2) New interchange

New interchange Sg. Buaya and Sg. Choh is already



THE KUALA LUMPUR OUTER RING ROAD PROJECT
(Japan International Cooperation Agency)

Figure

Figure 4-3-1 Possible Connection Route to Serendah from Route B (Plan)

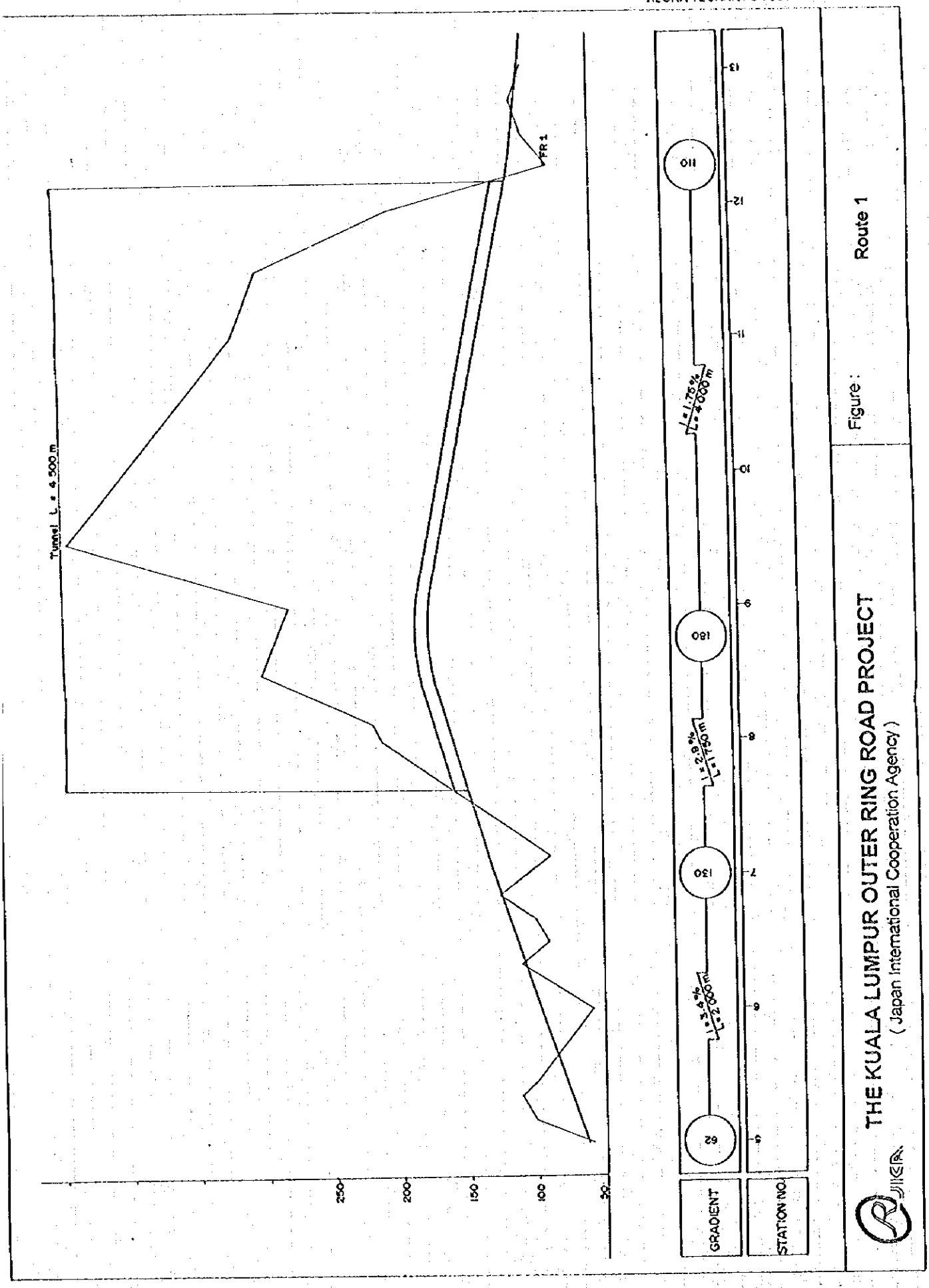


Figure 4-3-2 Possible Connection Route to Serendah from Route B
Route 1 (Profile)

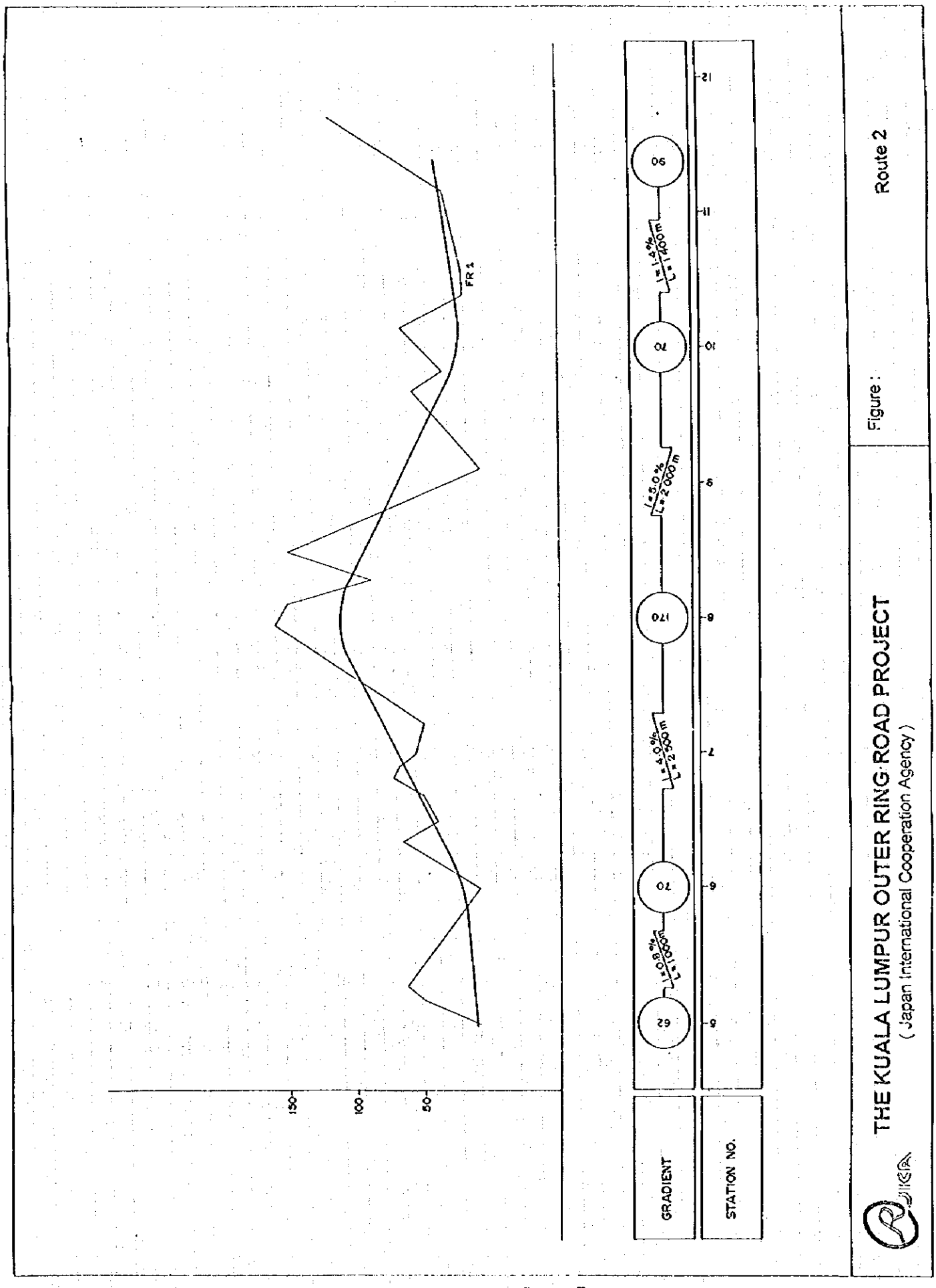


Figure 4-3-2 Possible Connection Route to Serendah from Route B
Route 2 (Profile)

4.4 Spatial Relationship of The KLORR and MRR II at Melawati

The alignment of The KLORR runs closer to MRR II at Melawati in Setapak. This is to clarify the spatial relationship of The KLORR and MRR at Melawati. The conditions which control the alignment here are:

- water reservoir and catchment area of Klang Gate Dam
- State wildlife reserve
- Klang Gate Dam
- Quartz ridge (Bt. Tabor).

Three alternatives are considered to pass through this area as shown Figure 4-4-1. But, due to these conditions alignments of The KLORR are obliged to run either farther mountain side or below the Klang Gate Dam consequently closer to MRR II. To pass through over the reservoir could be one of alternatives.

Alternative A:

It pass through as upper as possible to the water reservoir. It crosses upper stream of some of tributary by bridge. And it passes through mountain of Bt. Cenuang by tunnel.

Alternative B:

It crosses the water reservoir by long span and high pier bridge father north of northern boundary of the wildlife reserve. Then runs to Ampang FR.

Alternative C:

It crosses under Bt. Tabor by tunnel and Taman Melawati by viaduct.

The problem of Alternative- B is most serious. Because, the water reservoir is the most sensitive area for expressway route location. To pass through the reservoir by long span bridge, the problem of pollution during construction has to be solved. In the operation phase, expressway surface water has to be drained outside of catchment area. Moreover, the adverse impact of lorry accident loading poisonous liquid is very difficult to solve.

The problem of Alternative-A also serious. As there is space between expressway alignment and the water reservoir, the impact to the water reservoir will not be so direct. Some facility could be installed to store polluted water, so that adverse impact will be mitigated. But, effective way of mitigation in case of accidents is also very difficult to solve.

Alternative-C is the last option and the possible solution. It passes under the quartz ridge (Bt. Tabor) by tunnel, then pass through Taman Melawati by viaduct. Consequently it runs closer to MRR II, the distance is about 1 km.

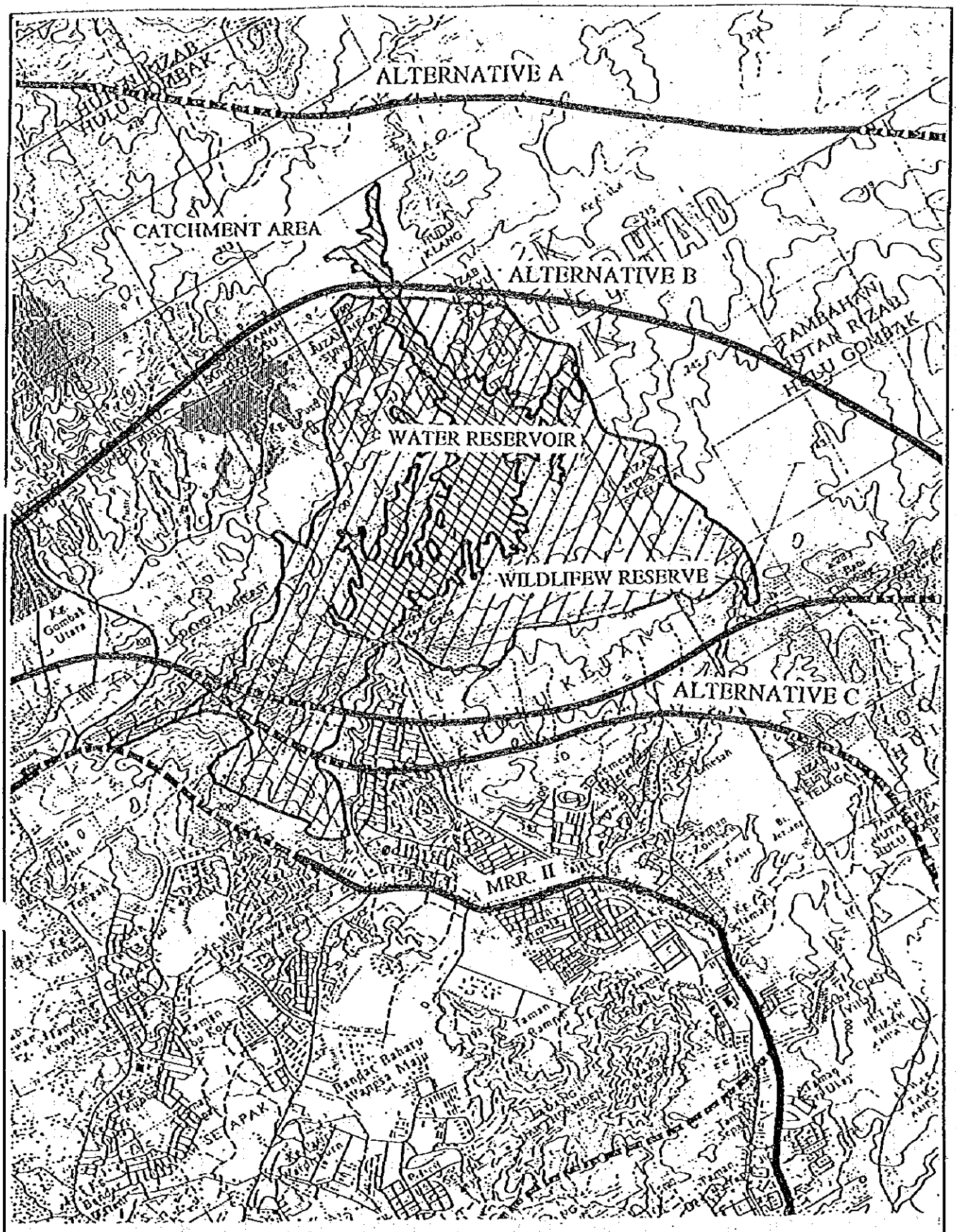


Figure 4-4-1 Alternative Route Around Klang Gate Dam