3.5 Micro Socio-Economic Indicators

The forecasting process for micro (Mukim Level) socio-economic indicators in the Study Area until the year 2020 is shown in Technical Report. When forecasting the micro indicators, the following issues are taken into consideration :

i) The forecasted macro socio-economic frame,
ii) Essential characteristics of production activities of industry and population,
iii) The three National Projects,
iv) The existing spatial Development Plans in the Area,
v) The requirements for Socio-Economic Development in the Area,

The forecasted macro frame presented in the previous section is used as the "Control Totals" of the micro indicators, which are forecasted based on factors particular to a certain mukim. The factors are induced from the above mentioned issues.

In this forecast, it is assumed that there are limitations on productivity per unit land of Agriculture and Manufacturing industries as well as the dwelling capacity per unit land of the residents. Therefore, some assumptions are examined for the prediction, which were presented in the Technical Report. These essential characteristics are reflected in the forecast.

The following three National Projects affected the forecast :

- Project of Movement of the Central Government Office from Kuala Lumpur to Putra Jaya in Mukim Dengkil of District Sepang,
- Project of Movement of the existing International Airport from Mukim Damansara of District Petaling to Mukim Labu and Sepang of District Sepang (KLIA),
- Construction project of the "Second National Car" production facilities at Mukim Serendah of District Hulu Selangor.

These Projects affect the GDP of industry, employment and population of Mukims. The existing spatial Development Plans, which were reviewed in Section 3.3, offer basic information on developing Mukims where future industrial activities and population are allocated.

Finally, the requirements for Socio-Economic Development provide basic information on the distribution of industrial activities and population along, as do the existing spatial Development Plans. They are utilized for the estimation of the carrying capacity of industrial activities and dwelling capacities of residents by Mukim and the concrete ways of allocation of overflowed portions from Mukims concerned.

The following situations do not allow the adoption of a simple forecasting method like the econometric model to forecast the socio economic indicators by Mukim :

(1) Reflection of the above mentioned issues ii) ~ v),

(2) Lack of more concrete data for forecasting the indicators by Mukim,

(3) Peculiarity of smallness of the forecasting zone of "Mukim"

To overcome the problem, the Study Team devised a "Capacity-Overflow" Method for forecasting the indicators at micro-level. This method regards Mukim as a container which accommodates industrial activities and population.

The carrying capacity of industrial activities (Agriculture and Manufacturing) and dwelling capacity of residents limit accommodations in each Mukim. Volume/value will grow to the upper limits parallel with the corresponding average growth rate at State level, including those affected by the National Projects. Once the volume/value exceeds the upper limits, the volume/value in the Mukim concerned is set at the upper limit, and the excess is distributed to appropriate Mukims in accordance with distribution rules, which are established based on these issues iv) and v).

Table 3-10 : Population by Mukim / Traffic Zone until the year 2020 (Summary)

(Unit : Person)

Mukim/ Traffic/Zone	Year				Annual Average Increasing Rate (%)			
	1995	2000	2010	2020	1995-2000	2000-2010	2010-2020	1995-2020
Selangor	2,698,220	3,282,800	4,708,010	5,937,440	4.0	3.7	2.3	3.2
Gombak	445,540	542,070	777,400	948,050	4.0	3.7	2.0	3.1
Batu	223,840	272,340	342,800	342,800	4.0	2.3	0.0	1.7
Rawang	67,440	82,050	180,350	322,920	4.0	8.2	6.0	6.5
Setapak	61,630	74,980	107,530	135,610	4.0	3.7	2.3	3.2
Ulu Klang	92,630	112,700	146,720	146,720	4.0	2.7	0.0	1.9
Klang	466,490	555,320	707,960	879,920	3.5	2.5	2.2	2.6
Kapar	172,640	205,510	262,000	323,150	3.5	2.5	2.1	2.5
Klang	271,150	322,790	411,510	513,320	3.5	2.5	2.2	2.6
Bandar Klang	22,700	27,020	34,450	43,450	3.5	2.5	2.3	2.6
Kuala Langat	141,770	184,730	264,930	319,750	5.4	3.7	1.9	3.3
Bandar	8,630	10,500	15,060	18,990	4.0	3.7	2.3	3.2
Batu	16,460	22,310	32,000	40,360	6.3	3.7	2.3	3.7
Kelanang	13,180	17,870	25,630	32,320	6.3	3.7	2.3	3.7
Morib	3,470	4,220	6,050	7,630	4.0	3.7	2.3	3.2
Tanjong Dua Belas	58,720	79,570	114,110	135,230	6.3	3.7	1.7	3.4
Telok Panglima Garang	34,150	41,550	59,590	75,150	4.0	3.7	2.3	3.2
Jugra	7,160	8,710	12,490	10,070	4.0	3.7	-2.1	1.4
Kuala Selangor	128,090	155,840	223,500	265,970	4.0	3.7	1.8	3.0
Api-Api	13,140	19,150	27,460	34,630	7.8	3.7	2.3	4.0
Batang Berjuntai	14,950	18,190	35,610	44,910	4.0	6.9	2.3	4.5
Ijok	13,100	15,940	22,860	28,520	4.0	3.7	2.2	3.2
Jeram	27,190	33,080	47,440	58,630	4.0	3.7	2.1	3.1
Kuala Selangor	9,310	13,560	19,360	19,360	7.8	3.6	0.0	3.0
Pasangan	7,020	10,230	20,020	27,390	7.8	6.9	3.2	5.6
Tanjung Karang	33,810	34,050	34,050	34,050	0.1	0.0	0.0	0.0
Ujong Permatang	9,270	11,260	16,180	17,820	4.0	3.7	1.0	2.6
Ulu Tinggi	300	360	520	660	3.7	3.7	2.4	3.2
Petaling	745,710	829,730	1,149,960	1,450,260	2.2	3.3	2.3	2.7
Bukit Raja	29,600	32,930	41,980	52,940	2.2	2.5	2.3	2.4
Damansara	283,940	315,930	402,770	507,950	2.2	2.5	2.3	2.4
Petaling	177,600	197,610	344,100	433,960	2.2	5.7	2.3	3.6
Sungai Buloh	183,550	204,230	260,360	328,350	2.2	2.5	2.3	2.4
Bandar Petaling Jaya	71,020	79,030	100,750	127,060	2.2	2.5	2.3	2.4
Sabak Bernam	104,120	126,680	181,670	300,270	4.0	3.7	5.2	4.3
Bagan Nakhoda Omar	9,640	11,730	12,870	12,870	4.0	0.9	0.0	1.2
Panchor Bedena	38,390	49,430	70,890	86,850	5.2	3.7	2.1	3.3
Pasir Panjang	23,230	23,320	23,320	23,320	0.0	0.0	0.0	0.0
Sabak	23,650	30,450	43,670	63,540	5.2	3.7	3.8	4.0
Sungai Panjang	9,120	11,750	30,920	113,690	5.2	10.2	13.9	10.6
Sepang	61,170	151,960	339,320	442,650	20.0	8.4	2.7	8.2
Dengkil	34,730	86,270	245,110	316,810	20.0	11.0	2.6	9.2
Labu	5,770	14,340	20,570	32,430	20.0	3.7	4.7	7.1
Sepang	20,670	51,350	73,640	93,410	20.0	3.7	2.4	6.2
Ulu Langat	522,160	635,280	918,130	1,105,880	4.0	3.8	1.9	3.0
Ampang	238,220	263,400	263,400	263,400	2.0	0.0	0.0	0.4
Beranang	12,320	15,530	52,620	66,360	4.7	13.0	2.3	7.0
Cheras	69,580	90,770	160,530	219,630	5.5	5.9	3.2	4.7
Kajang	142,420	192,540	336,830	424,790	6.2	5.8	2.3	4.5
Semenyih	30,160	38,020	54,530	77,160	4.7	3.7	3.5	3.8
Ulu Langat	26,580	31,520	45,200	48,210	3.5	3.7	0.6	2.4
Ulu Semenyih	2,880	3,500	5,020	6,330	4.0	3.7	2.3	3.2
Ulu Selangor	83,170	101,190	145,140	224,690	4.0	3.7	4.5	4.1
Ampang Pechah	12,810	15,590	22,360	28,200	4.0	3.7	2.3	3.2
Batang Kali	7,860	9,560	13,710	23,950	4.0	3.7	5.7	4.6
Buloh Telor	180	220	320	400	4.1	3.8	2.3	3.2
Kalumpang	3,270	3,720	5,100	5,100	2.6	3.2	0.0	1.8
Kerling	4,290	4,890	7,010	13,770	2.7	3.7	7.0	4.8
Kuala Kalumpang	1,600	1,950	2,800	8,710	4.0	3.7	12.0	7.0
Peretak	150	180	260	330	3.7	3.7	2.4	3.2
Rasa	3,040	3,700	5,310	6,700	4.0	3.7	2.4	3.2
Serendah	12,240	18,000	25,810	44,970	8.0	3.7	5.7	5.3
Sungai Gumut	560	680	980	1,240	4.0	3.7	2.4	3.2
Sungai Tinggi	4,940	6,010	8,620	10,870	4.0	3.7	2.3	3.2
Ulu Bernam	23,050	26,240	37,870	61,550	2.6	3.7	5.0	4.0
Ulu Yam	9,180	10,450	14,990	18,900	2.6	3.7	2.3	2.9

Table 3-10 : Population by Mukim / Traffic Zone until the year 2020 (continued).

(Unit : Person)

Mukim/ Traffic/Zone	Year				Annual Average Increasing Rate (%)			
	1995	2000	2010	2020	1995-2000	2000-2010	2010-2020	1995-2020
Kuala Lumpur F.T	1,329,300	1,590,560	2,021,630	2,408,490	3.7	2.4	1.8	2.4
Zone 100	117,160	131,299	154,628	175,565	3.7	2.4	1.8	2.4
Zone 201	10,490	12,081	14,705	17,060	3.7	2.4	1.8	2.4
Zone 202	61,090	76,534	102,016	124,885	3.7	2.4	1.8	2.4
Zone 203	18,100	31,345	53,199	72,812	3.7	2.4	1.8	2.4
Zone 204	27,550	51,087	89,921	124,773	3.7	2.4	1.8	2.4
Zone 301	40,150	64,685	105,166	141,495	3.7	2.4	1.8	2.4
Zone 302	162,240	186,411	226,293	262,085	3.7	2.4	1.8	2.4
Zone 401	127,380	138,840	157,749	174,718	3.7	2.4	1.8	2.4
Zone 402	88,250	91,071	95,725	99,902	3.7	2.4	1.8	2.4
Zone 403	156,500	75,489	210,332	240,412	3.7	2.4	1.8	2.4
Zone 500	64,700	166,508	93,291	109,267	3.7	2.4	1.8	2.4
Zone 601	147,920	66,998	197,177	224,700	3.7	2.4	1.8	2.4
Zone 602	37,230	48,630	116,115	160,195	3.7	2.4	1.8	2.4
Zone 701	36,910	169,810	67,968	85,322	3.7	2.4	1.8	2.4
Zone 702	157,570	102,958	190,006	208,131	3.7	2.4	1.8	2.4
Zone 703	76,060	91,010	147,339	187,168	3.7	2.4	1.8	2.4
Pahang								
Bentong	88,850	95,040	109,740	128,240	1.4	1.4	1.6	1.5
Bentong	16,760	50,020	57,760	67,500	1.4	1.4	1.6	1.5
Pelangai	18,280	19,550	22,570	26,370	1.4	1.4	1.6	1.5
Sabai	23,810	25,470	29,410	34,370	1.4	1.4	1.6	1.5
Negeri Sembilan								
Seremban	289,490	328,130	424,670	553,980	2.5	2.6	2.7	2.6
Ampangan	61,630	69,860	90,410	98,850	2.5	2.6	0.9	1.9
Labu	29,800	33,780	43,720	63,320	2.5	2.6	3.8	3.1
Lenggeng	9,820	11,130	14,410	18,800	2.5	2.6	2.7	2.6
Pantai	3,250	3,680	4,760	6,210	2.5	2.6	2.7	2.6
Rantau	30,830	34,950	45,230	64,610	2.5	2.6	3.6	3.0
Rasah	36,820	41,730	54,010	73,920	2.5	2.6	3.2	2.8
Seremban	17,020	19,290	24,970	32,570	2.5	2.6	2.7	2.6
Setul	16,320	18,500	23,940	34,960	2.5	2.6	3.9	3.1
Bandar Seremban	84,000	95,210	123,220	160,740	2.5	2.6	2.7	2.6
Perak								
Batang Padang	169,420	186,120	227,450	281,640	1.9	2.0	2.2	2.1
Batang Padang	30,370	33,360	40,770	50,480	1.9	2.0	2.2	2.1
Bidor	30,730	33,760	41,260	51,090	1.9	2.0	2.2	2.1
Chendering	20,470	22,490	27,480	34,030	1.9	2.0	2.2	2.1
Slim	25,430	27,946	34,140	42,270	1.9	2.0	2.2	2.1
Sungkai	36,530	40,130	49,040	60,730	1.9	2.0	2.2	2.1
Ulu Bernam Timur	25,890	28,440	34,760	43,040	1.9	2.0	2.2	2.1

Table 3-11 : GDP by Mukim / Traffic Zone until the year 2020 (Summary)

(Unit : Million RM at 1978 prices)

Mukim/ Traffic/Zone	Year				Annual Average Increasing Rate (%)			
	1995	2000	2010	2020	1995-2000	2000-2010	2010-2020	1995-2020
Selangor	24,275.0	37,694.0	76,255.0	131,751.0	9.2	7.3	5.6	7.0
Gombak	2,296.7	3,245.6	6,506.8	11,018.2	7.2	7.2	5.4	6.5
Batu	1,079.2	1,659.9	2,774.8	3,459.2	9.0	5.3	2.2	4.8
Rawang	511.5	726.7	2,039.6	5,152.5	7.3	10.9	2.2	9.7
Setapak	252.0	297.5	559.3	1,020.1	3.4	7.3	9.7	5.8
Ulu Klang	454.0	611.5	1,093.1	1,386.4	6.1	6.0	5.5	4.6
Klang	3,986.1	6,032.0	11,535.0	20,017.6	8.6	6.7	2.4	6.7
Kapar	1,179.3	1,762.8	3,329.8	5,699.2	8.4	6.6	5.7	6.5
Klang	2,665.8	4,168.7	8,021.5	13,999.9	9.4	6.8	5.5	6.9
Bandar Klang	141.0	100.5	183.7	318.5	-6.5	6.2	5.7	3.3
Kuala Langat	1,204.1	2,003.7	3,956.1	8,175.0	10.7	7.0	7.5	8.0
Bandar	37.1	52.9	102.1	160.9	7.4	6.8	4.7	6.0
Batu	71.6	117.0	283.5	421.1	10.3	9.3	4.0	7.3
Kelanang	57.3	92.7	196.1	33.7	10.1	7.8	5.5	7.3
Morib	18.3	25.2	53.6	90.7	6.6	7.8	5.4	6.6
Tanjong Dua Belas	335.4	677.4	1,327.0	3,143.2	15.1	7.0	9.0	9.4
Telok Panglima Garang	623.1	954.3	1,882.2	3,870.7	8.9	7.0	7.5	7.6
Jugra	61.3	84.2	147.6	154.7	6.6	5.8	0.5	3.8
Kuala Selangor	855.4	1,100.9	2,103.9	4,003.5	5.2	6.7	6.6	6.4
Api-Api	92.3	104.5	247.4	540.9	2.5	9.0	8.1	7.3
Batang Berjuntai	123.7	179.4	389.0	901.2	7.7	8.0	8.8	8.3
Ijok	88.9	107.5	197.3	517.5	3.9	6.3	10.1	7.3
Jeram	142.9	221.4	427.1	953.3	9.2	6.8	8.4	7.9
Kuala Selangor	170.1	160.5	281.1	319.8	-1.1	5.8	1.3	2.6
Pasangan	58.2	83.3	174.8	269.0	7.4	7.7	4.4	6.3
Tanjung Karang	130.0	174.4	256.3	324.4	6.1	3.9	2.4	3.7
Ujong Permatang	44.4	657.7	123.5	167.9	8.1	6.5	3.1	5.5
Ulu Tinggi	4.9	4.2	7.4	9.5	-3.1	5.8	2.5	2.7
Petaling	10,888.1	16,063.3	30,390.3	46,814.2	8.1	6.6	4.4	6.0
Bukit Raja	101.1	137.3	247.1	411.4	6.3	6.1	5.2	5.8
Damansara	6,495.6	9,621.1	19,042.8	30,764.4	8.2	7.1	4.9	6.4
Petaling	758.4	968.5	2,253.0	5,381.2	5.0	8.8	9.1	8.2
Sungai Buloh	777.1	1,081.3	1,902.7	2,821.7	6.8	5.8	4.4	5.4
Bandar Petaling Jaya	2,756.0	4,254.6	6,944.7	7,335.5	9.1	5.0	0.5	4.0
Sabak Bernam	507.4	685.3	1,352.2	4,015.6	6.2	7.0	11.5	8.6
Bagan Nakhoda Omar	466.6	67.4	112.6	342.2	7.7	5.3	11.8	8.3
Panchor Bedena	181.6	241.8	483.6	1,183.4	5.9	7.2	9.4	7.8
Pasir Panjang	118.1	127.5	188.7	235.7	1.6	4.0	2.2	2.8
Sabak	113.9	177.0	350.8	1,129.9	9.2	7.1	12.4	9.6
Sungai Panjang	47.3	71.6	216.5	1,124.4	8.7	11.7	17.9	13.5
Sepang	384.3	2,217.9	6,944.6	10,496.6	42.0	12.1	4.2	14.1
Dengkil	217.4	662.0	4,092.4	6,213.2	25.0	20.0	4.3	14.4
Labu	50.5	682.7	1,248.0	1,869.1	68.4	6.2	4.1	15.5
Sepang	116.5	871.2	1,604.2	2,414.3	49.5	6.3	4.2	12.9
Ulu Langat	3,596.6	5,418.7	11,181.0	18,840.8	8.5	7.5	5.4	6.8
Ampang	991.1	1,396.9	2,079.2	2,605.4	7.1	4.1	2.3	3.9
Beranang	97.2	149.6	428.0	634.0	9.0	11.1	4.0	1.8
Cheras	651.2	947.0	2,198.0	4,196.8	7.8	8.8	6.7	7.7
Kajang	1,459.6	2,425.3	5,573.4	10,095.3	10.7	8.7	6.1	8.0
Semenyih	233.3	288.0	526.5	801.4	4.3	6.2	4.3	5.1
Ulu Langat	141.8	183.4	324.9	437.2	5.3	5.9	3.0	4.6
Ulu Semenyih	22.5	28.5	51.0	70.7	4.9	6.0	3.3	4.7
Ulu Selangor	556.3	926.6	2,285.1	8,369.5	10.7	9.4	13.9	11.5
Ampang Pechah	103.5	66.7	134.1	425.2	-8.4	7.2	12.2	5.8
Batang Kali	55.3	84.3	161.5	626.8	8.8	6.7	14.5	10.2
Buloh Telor	3.3	1.8	3.2	4.6	-11.6	5.9	3.7	1.3
Kalumpang	10.9	14.7	28.6	38.7	6.3	6.9	3.1	5.2
Kerling	24.7	32.5	59.9	123.4	5.7	6.3	7.5	6.7
Kuala Kalumpang	19.8	14.5	26.1	75.2	-6.1	6.1	11.2	5.5
Peretak	7.7	5.1	6.2	7.4	-7.8	2.0	1.8	-0.1
Rasa	24.5	34.9	67.4	427.3	7.4	6.8	20.3	12.1
Serendah	83.6	384.1	1,267.2	5,467.9	35.6	12.7	15.7	18.2
Sungai Gumut	8.2	9.8	16.6	20.5	3.6	5.4	2.1	3.7
Sungai Tinggi	43.1	48.7	87.1	120.8	2.5	6.0	3.3	4.2
Ulu Bernam	124.3	172.3	318.9	568.3	6.7	6.3	5.9	6.3
Ulu Yam	47.6	57.2	108.5	463.4	3.8	6.6	15.6	9.5

Table 3-11 : GDP by Mukim / Traffic Zone until the year 2020 (continued)

(Unit : Million RM at 1978 prices)

Mukim/ Traffic/Zone	Year				Annual Average Increasing Rate (%)			
	1995	2000	2010	2020	1995-2000	2000-2010	2010-2020	1995-2020
Kuala Lumpur F.T	15,595.00	22,703.00	38,780.00	60,895.00	7.8	5.5	4.6	5.6
Zone 100	1,258.8	1,830.7	3,154.8	5,016.8	7.8	5.6	4.7	5.7
Zone 201	151.1	161.2	278.3	443.4	1.3	5.6	4.8	4.4
Zone 202	795.5	1,142.2	1,935.6	3,003.3	7.5	5.4	4.5	5.5
Zone 203	209.5	277.9	479.7	764.9	5.8	5.6	4.8	5.3
Zone 204	359.8	511.3	866.8	1,346.4	7.3	5.4	4.5	5.4
Zone 301	450.7	617.7	1,065.4	1,697.5	6.5	5.6	4.8	5.4
Zone 302	2,291.3	3,367.3	5,658.0	8,665.9	8.0	5.3	4.4	5.5
Zone 401	1,303.2	1,957.6	3,377.7	5,380.9	8.5	5.6	4.8	5.8
Zone 402	1,097.8	1,576.3	2,682.3	4,189.3	7.5	5.5	4.6	5.5
Zone 403	1,581.7	2,402.1	4,147.1	6,611.7	8.7	5.6	4.8	5.9
Zone 500	697.9	993.0	1,714.3	2,733.3	7.3	5.6	4.8	5.6
Zone 601	1,547.1	2,286.4	3,944.5	6,282.3	8.1	5.6	4.8	5.8
Zone 602	964.6	1,354.7	2,196.9	3,184.5	7.0	5.0	3.8	4.9
Zone 701	412.2	566.7	978.3	1,559.7	6.6	5.6	4.8	5.5
Zone 702	1,668.0	2,486.4	4,280.6	6,797.3	8.3	5.6	4.7	5.8
Zone 703	808.0	1,171.5	2,019.7	3,217.8	7.8	5.6	4.8	5.7
Pahang								
Bentong	618.8	778.6	1,243.4	2,011.1	4.7	4.8	4.9	4.8
Bentong	364.5	433.0	690.3	1,114.3	3.5	4.8	4.9	4.6
Pelangai	96.1	132.5	215.1	353.6	6.6	5.0	5.1	5.3
Sabai	158.2	213.1	338.0	543.2	6.1	4.7	4.9	5.1
Negeri Sembilan								
Seremban	2,674.3	3,593.8	6,689.8	12,549.9	6.1	6.4	6.5	6.4
Ampangan	211.4	286.7	501.6	3,783.1	6.3	5.8	22.4	12.2
Labu	724.3	961.5	435.8	556.7	5.8	-7.6	2.5	-1.0
Lenggeng	48.9	66.3	109.5	182.9	6.3	5.1	5.3	5.4
Pantai	18.2	23.8	38.7	64.0	5.5	5.0	5.2	5.2
Rantau	148.4	189.5	317.6	578.9	5.0	5.3	6.2	5.6
Rasah	944.2	1,322.3	2,563.7	5,005.1	7.0	6.8	6.9	6.9
Seremban	87.4	91.5	153.7	262.9	0.9	5.3	5.5	4.5
Setul	144.5	138.0	230.5	420.7	-0.9	5.3	6.2	4.4
Bandar Seremban	347.0	482.5	883.9	1,622.3	6.8	6.2	6.3	6.4
Perak								
Batang Padang	982.1	1,256.8	2,084.3	3,501.4	5.1	5.2	5.3	5.2
Batang Padang	212.1	229.3	379.7	636.2	1.6	5.2	5.3	4.5
Bidor	185.9	207.1	336.7	559.7	2.2	5.0	5.2	4.5
Chendering	103.7	153.4	245.9	404.4	8.2	4.8	5.1	5.6
Slim	110.8	178.3	301.8	513.9	10.0	5.4	5.5	6.3
Sungkai	183.9	282.0	471.1	794.6	8.9	5.3	5.4	6.0
Ulu Bernam Timur	185.6	206.7	349.1	592.6	2.2	5.4	5.4	4.8

Table 3-12 : Forecast of Employment on Warking Place Basis by Mukim/Traffic Zone until the year 2020

(Unit : Employee)

Mukim/ Traffic/Zone	Year				Annual Average Increasing Rate (%)			
	1995	2000	2010	2020	1995-2000	2000-2010	2010-2020	1995-2020
Selangor	929,400	1,130,800	1,640,000	2,089,900	4.0	3.8	2.5	3.3
Gombak	100,690	107,310	157,000	193,860	1.3	3.9	2.1	2.7
Batu	45,680	52,741	67,070	63,050	2.9	2.4	-0.6	1.3
Rawang	21,350	22,720	45,970	84,280	1.3	7.3	6.2	5.6
Setapak	12,600	11,100	16,660	20,620	-2.5	4.1	2.2	2.0
Ulu Klang	21,060	20,750	27,300	25,910	-0.3	2.8	-0.5	0.8
Klang	157,430	177,820	238,240	305,820	2.5	3.0	2.5	2.7
Kapar	52,350	54,640	72,960	91,570	0.9	2.9	2.3	2.4
Klang	98,020	119,350	160,120	207,770	4.0	3.0	2.6	3.1
Bandar Klang	7,060	3,830	5,160	6,480	-11.5	3.0	2.3	-0.3
Kuala Langat	53,420	64,440	91,080	129,730	3.8	3.5	3.6	3.6
Bandar	2,150	2,100	2,940	3,310	-0.5	3.4	1.2	1.7
Batu	3,980	4,640	7,190	8,840	3.1	4.5	2.1	3.2
Kelanang	3,220	3,670	5,700	7,000	2.7	4.5	2.1	3.2
Morib	1,080	1,010	1,570	1,920	-1.3	4.5	2.0	2.3
Tanjong Dua Belas	15,240	23,520	33,590	51,400	9.1	3.6	4.3	5.0
Telok Panglima Garang	24,290	26,010	35,690	53,940	1.4	3.2	4.2	3.2
Jugra	3,460	3,490	4,400	3,320	0.2	2.3	-2.8	-0.2
Kuala Selangor	43,920	39,320	54,310	69,590	-2.2	3.3	2.5	1.9
Api-Api	5,210	3,900	6,250	9,120	-5.6	4.8	3.9	2.3
Batang Berjuntai	4,480	5,400	8,940	14,160	3.8	5.2	4.7	4.7
Ijok	4,940	4,360	5,780	8,920	-2.5	2.9	4.4	2.4
Jeram	8,230	8,030	11,150	16,170	-0.5	3.3	3.8	2.7
Kuala Selangor	8,070	4,690	5,960	5,220	-10.3	2.4	-1.3	-1.7
Pasangan	2,990	3,240	4,990	5,530	1.6	4.4	1.0	2.5
Tanjung Karang	7,190	6,890	7,430	6,770	-0.8	0.8	-0.9	-0.2
Ujong Permatang	2,470	2,630	3,590	3,500	1.3	3.2	-0.3	1.4
Ulu Tinggi	340	180	220	200	-11.9	2.0	-0.9	-2.1
Petaling	347,410	435,760	578,530	678,130	4.6	2.9	1.6	2.7
Bukit Raja	5,870	5,300	7,020	8,420	-2.0	2.9	1.8	1.5
Damansara	201,420	251,880	342,800	420,610	4.6	3.1	2.1	3.0
Petaling	32,570	33,270	58,530	92,680	0.4	5.8	4.7	4.3
Sungai Buloh	23,620	37,160	48,170	55,880	2.6	2.6	1.5	2.2
Bandar Petaling Jaya	74,930	108,150	122,010	100,540	7.6	1.2	-1.9	1.2
Sabak Bernam	27,070	26,930	38,810	85,360	-0.1	3.7	8.2	4.7
Bagan Nakhoda Omar	2,610	2,700	3,300	7,500	0.7	2.0	8.6	4.3
Panchor Bedena	9,280	9,400	13,780	25,170	0.3	3.9	6.2	4.1
Pasir Panjang	6,300	4,870	5,260	4,770	-5.0	0.8	-1.0	-1.1
Sabak	6,250	7,080	10,230	24,420	2.5	3.7	9.1	5.6
Sungai Panjang	2,630	2,880	6,240	23,500	1.8	8.0	14.2	9.2
Sepang	19,260	80,780	184,900	201,500	33.2	8.6	0.9	9.8
Dengkil	9,620	23,300	109,570	120,630	19.4	16.7	1.0	10.6
Labu	3,120	25,000	32,580	35,000	51.6	2.7	0.7	10.2
Sepang	6,520	32,500	42,750	45,870	37.9	2.8	0.7	8.1
Ulu Langat	148,950	166,550	245,180	303,430	2.3	3.9	2.2	2.9
Ampang	43,260	47,510	50,800	47,900	1.9	0.7	-0.6	0.4
Beranang	4,370	4,880	10,880	12,130	2.2	8.3	1.1	4.2
Cheras	28,730	28,060	46,800	65,930	-0.5	5.2	3.5	3.4
Kajang	53,740	69,500	114,020	152,620	5.3	5.1	3.0	4.3
Semenyih	11,800	9,540	12,790	14,980	-4.2	3.0	1.6	1.0
Ulu Langat	5,720	5,900	8,390	8,380	0.6	3.6	-0.0	1.5
Ulu Semenyih	1,330	1,160	1,500	1,490	-2.7	2.6	-0.1	0.5
Ulu Selangor	31,250	31,890	51,950	122,480	0.4	5.0	9.0	5.6
Ampang Pechah	4,810	2,520	3,740	7,080	-12.1	4.0	6.6	1.6
Batang Kali	2,880	2,900	3,960	9,600	0.1	3.2	9.3	4.9
Buloh Telor	250	90	90	90	-18.5	0.0	0.0	-4.0
Kalumpang	670	560	800	790	-3.5	3.6	-0.1	0.7
Kerling	1,450	1,310	1,760	2,550	-2.0	3.0	3.8	2.3
Kuala Kalumpang	1,420	580	770	1,560	-16.4	2.9	7.3	0.4
Peretak	250	70	80	90	-22.5	1.3	1.2	-4.0
Rasa	1,240	1,160	1,610	5,930	-1.3	3.3	13.9	6.5
Serendah	5,190	11,040	23,590	72,750	16.3	7.9	11.9	11.1
Sungai Gumut	520	410	500	450	-4.6	2.0	-1.0	-0.6
Sungai Tinggi	2,730	2,000	2,580	2,540	-6.0	2.6	-0.2	-0.3
Ulu Bernam	6,920	6,970	9,330	11,820	0.1	3.0	2.4	2.2
Ulu Yam	2,920	2,280	3,140	7,230	-4.8	3.3	8.7	3.7

Table 3-12 : Forecasts of Employment at Working Place by Mukim / Traffic Zone until the year 2020

(Unit : Employee)

Mukim/ Traffic/Zone	Year				Annual Average Increasing Rate (%)			
	1995	2000	2010	2020	1995-2000	2000-2010	2010-2020	1995-2020
Kuala Lumpur F.T.	683,800	818,300	1,040,100	1,239,100	3.7	2.4	1.8	2.4
Zone 100	56,760	66,410	84,740	102,030	3.2	2.5	1.9	2.4
Zone 201	8,600	5,860	7480	9,010	-7.4	2.5	1.9	0.2
Zone 202	35,060	40,960	51,860	61,160	3.2	2.4	1.7	2.3
Zone 203	10,270	10,090	12,690	15,550	-0.4	2.5	1.9	1.7
Zone 204	15,530	18,330	23,230	27,420	3.4	2.4	1.7	2.3
Zone 301	21,420	22,400	28,600	34,500	0.9	2.5	1.9	1.9
Zone 302	96,420	120,030	151,400	176,570	4.5	2.3	1.5	2.4
Zone 401	56,780	71,030	90,700	109,440	4.6	2.5	1.9	2.7
Zone 402	48,910	56,680	71,920	85,240	3.0	2.4	1.7	2.2
Zone 403	68,330	87,240	111,430	134,450	5.0	2.5	1.9	2.7
Zone 500	32,170	36,070	46,060	55,590	2.3	2.5	1.9	2.2
Zone 601	69,150	83,010	105,970	127,770	3.7	2.5	1.9	2.5
Zone 602	35,360	47,030	58,360	65,010	5.9	2.2	1.1	2.5
Zone 701	19,590	20,590	26,290	31,720	1.0	2.5	1.9	1.9
Zone 702	73,300	90,140	114,970	138,250	4.2	2.5	1.9	2.6
Zone 703	36,150	42,430	54,200	65,390	3.3	2.5	1.9	2.4
Pahang								
Bentong	30,290	32,370	37,380	43,810	1.3	1.4	1.6	1.5
Bentong	16,420	17,290	20,270	24,020	1.0	1.6	1.7	1.5
Pelangai	5,270	5,780	6,650	7,800	1.9	1.2	1.6	1.6
Sabai	8,600	9,300	10,460	11,990	1.6	1.4	1.4	1.3
Negeri Sembilan								
Seremban	102,800	116,760	151,550	197,980	2.6	2.6	2.7	2.7
Ampangan	10,600	11,560	14,720	15,830	1.7	2.4	0.7	1.6
Labu	23,920	29,140	38,290	51,640	4.0	2.8	3.0	3.1
Lenggeng	2,770	2,870	3,360	3,990	0.7	1.6	1.7	1.5
Pantai	1,060	1,040	1,190	1,400	-0.4	1.4	1.6	1.1
Rantau	8,250	8,060	9,600	12,480	-0.5	1.8	2.7	1.7
Rasah	33,710	37,450	50,390	68,450	2.1	3.0	3.1	2.9
Seremban	3,340	3,400	4,270	5,390	0.4	2.3	2.4	1.9
Setul	5,610	5,060	6,090	8,020	-2.0	1.9	2.8	1.4
Bandar Seremban	13,540	18,180	23,640	30,780	6.1	2.7	2.7	3.3
Perak								
Batang Padang	44,480	49,390	60,510	74,690	2.1	2.1	2.1	2.1
Batang Padang	9,170	9,040	11,110	13,780	-0.3	2.1	2.2	1.6
Bidor	7,150	7,360	9,170	11,470	0.6	2.2	2.3	1.9
Chendering	4,170	5,290	6,510	8,080	4.9	2.1	2.2	2.7
Slim	5,730	7,440	9,140	11,320	5.4	2.1	2.2	2.8
Sungkai	9,150	11,450	13,920	17,020	4.6	2.0	2.0	2.5
Ulu Bernam Timur	9,110	8,810	10,660	13,020	-0.7	1.9	2.0	1.4

Chapter 4

TRAFFIC DEMAND ANALYSIS

CHAPTER 4 TRAFFIC DEMAND ANALYSIS

4.1 Existing OD Traffic Demand

4.1.1 Total Trip Generation

Trip generation is the process by which various socioeconomic activity are converted into number of trips. Several methodologies for forecasting the trip generation could be considered.

Trip generation could be estimated in the unit of person trips (for people movement) and tonnage (for goods movement) and sometimes in vehicular units depending on the purposes of the study. In this study, it will concentrate on the movement of vehicular unit. The trip production, therefore, is estimated in vehicular units.

Two types of methodology for the analysis, namely multiple linear regression analysis and trip-rate analysis are compared. Table 4-1 shows multiple linear regression models in the HNDP study.

Table 4-1 : Trip Generation Models (Linear regression)

Type of Vehicle		Formula	Correlation Coefficient
P.Car	GEN	75.84 POP + 962.18 EMP	0.857
	ATT	75.84 POP + 962.15 EMP	0.857
Bus	GEN	4.18 POP + 1.49 GDP	0.797
	ATT	4.19 POP + 1.49 GDP	0.797
Lorry	GEN	48.09 POP + 166.52 EMP	0.779
	ATT	48.10 POP + 166.49 EMP	0.779

(Source : HNDP Study)

Note : GEN : Generation
ATT : Attraction
POP : Population ('000)
EMP : Employment ('000)
GDP : Gross Domestic Product (million)

The trip-rate method estimates trip production from the number of vehicles and trip generation rate by vehicle type. Table 4-2 shows statistical data for the number of registered vehicles in Selangor state and Kuala Lumpur. Table 4-3 shows an average daily trip generation rate obtained from HNDP study.

Table 4-2 : Statistic of Number of Registered Vehicles in Selangor and Kuala Lumpur

	Cars	Taxies	Hire Cars	Buses	Lorries & Van	Trailers	Motorcycles	Others	Total
Selangor									
1985	284,704	5,294	656	4,125	62,811	6,583	379,291	13,504	756,958
1986	292,276	5,343	625	4,265	66,686	6,667	391,971	14,026	781,836
1987	301,041	5,414	625	4,370	67,972	6,666	399,486	14,233	799,834
1988	313,629	5,491	663	4,423	69,623	6,666	408,766	14,786	824,047
1989	331,764	5,570	666	4,512	72,878	6,666	426,222	15,736	864,014
1990	354,283	5,911	694	4,629	78,447	6,667	451,375	17,485	919,491
1991	380,255	6,215	739	4,800	84,363	6,675	479,015	18,889	980,951
1992	403,761	6,481	765	5,055	89,258	6,800	507,430	20,398	1,039,948
1993	422,847	6,576	795	5,217	92,583	6,878	531,256	21,277	1,087,429
1994	465,970	7,151	849	5,614	99,921	6,800	571,720	23,075	1,181,100
1995	468,978	7,181	859	5,635	100,453	6,800	575,265	23,195	1,188,366
Kuala Lumpur									
1985	146,750	2,660	918	1,920	18,118	2,655	126,027	28,534	327,602
1986	156,508	2,841	1,070	2,258	20,099	2,656	135,145	29,521	350,098
1987	167,175	2,965	1,190	2,457	21,352	2,654	140,776	30,163	368,732
1988	183,231	3,125	1,399	2,670	23,257	2,661	148,028	31,031	395,402
1989	209,765	3,357	1,657	2,947	26,803	2,672	162,845	33,756	443,802
1990	247,677	4,353	2,151	3,282	32,089	2,673	184,515	37,582	514,322
1991	290,917	5,355	2,391	3,747	39,355	2,679	210,021	42,240	596,705
1992	324,601	5,893	2,755	4,300	45,425	2,904	236,451	46,638	668,967
1993	361,008	6,403	3,166	4,852	50,147	2,968	264,056	47,378	739,978
1994	407,939	8,029	5,625	5,323	56,941	2,904	306,345	55,643	848,749
1995	414,059	8,156	5,883	5,389	57,495	2,904	310,848	56,067	860,801

(Source : HPU Data)

Table 4-3 : Average Daily Trip Production Rates by Vehicle Type by State in Malaysia

State	P.Car	Goods Veh.	Bus	Taxi	All Vehicle
Perlis	3.9	4.5	7.8	7.4	4.2
Kedah	3.5	3.6	7.2	6.9	3.7
P.Pinang	3.5	3.7	6.8	9.2	3.6
Perak	3.8	4.6	5.7	8.2	4.0
K.L.	2.8	3.0	6.9	6.8	2.9
Selangor	3.1	3.5	8.4	5.1	3.3
N. Sembilan	3.6	3.2	9.2	5.8	3.6
Melaka	3.0	2.9	5.6	4.1	3.0
Johor	3.7	3.8	7.1	5.8	3.8
Pahang	3.7	3.7	6.5	4.4	3.8
Terengganu	3.6	3.3	5.3	4.5	3.5
Kelantan	3.7	3.9	4.6	5.7	3.8
P. Malaysia	3.4	3.6	7.1	6.1	3.5

(Source : HNDP Study; OIS Survey 1991)

The results obtained from those methods and data are summarized in Table 4-4 and compared with year 1991's data from the HNDP study.

Big differences between the results of the regression model and trip-rate method are observed. By the regression analysis it is projected to be less than the 1991 figures. Several reasons could be considered. One is over estimation of the HNDP socio-economic indicators in 1991. The other is continuous rapid growth of the Malaysian economy which could not be explained by regression models. The models might be influenced by low economic growth in the early 1980's, although high economic growth in the last third of the 1980's was attained,

Comparing the results of the trip - rate analysis and the 1991 figures, trip generation for passenger cars and buses has increased in line with the increment of the number of vehicles. However, contrary to the above results, lorry trip is smaller than the 1991 trip. Employment in 1991 could be a reason for the contradiction.

In conclusion, total trip generation in 1995 is determined by the trip-rate analysis. Figure 4-1 shows Trip Generation by Districts in Selangor and Kuala Lumpur.

Table 4-4 : Comparison of Total Trip Generation

KLORR		Kuala Lumpur		Selangor	
Socio-Economic Indicators (1995)	Population ('000)	1,329.3		2,698.2	
	Employment ('000)	556.4		1,054.9	
	GDP (Million '78)	15,595.0		24,275.0	
Total Trip Generation	Type of Model	Regression	Trip-Rate	Regression	Trip-Rate
	P.Car	636,152	1,254.830	831,929	1,494.836
	Bus	28,793	37,184	43,569	47.234
	Lorry	156,574	181,197	204,981	375,386
HNDP Study (1991 Traffic Demand)					
Socio-Economic Indicators (1991)	Population ('000)	1,334.9		2,292.3	
	Employment ('000)	662.3		896.7	
	GDP (Million '78)	10,980.6		16,106.3	
Total Trip Generation	P.Car	857,118		1,024.809	
	Bus	20,190		39,241	
	Lorry	206,265		319,490	

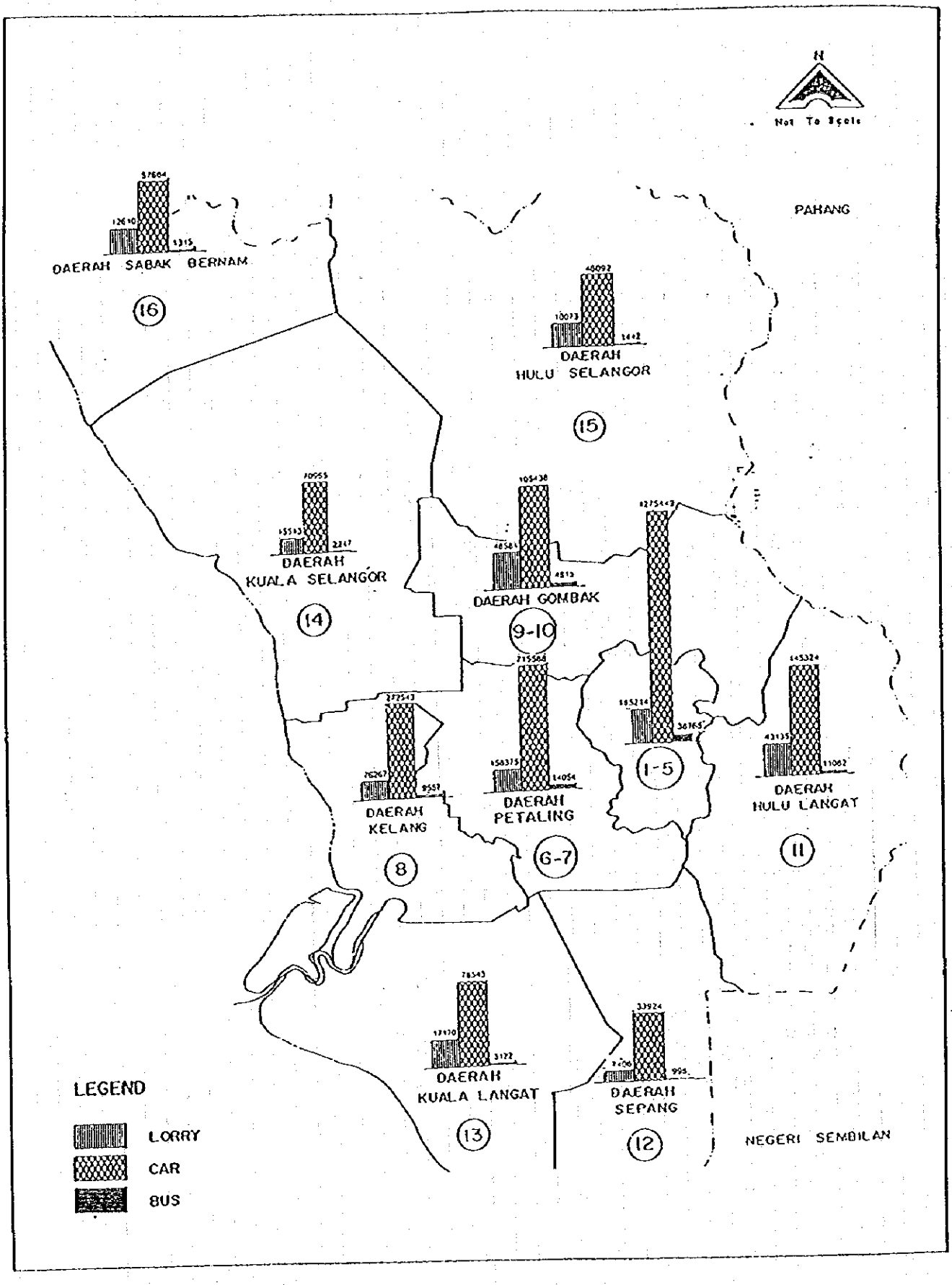


Figure 4-1 : Trip Generation by District in 1995

4.1.2 Trip Distribution

Trip Distribution determines where the trips produced in each zone will go, i.e : how they can be distributed among all other zones in the study area.

The present OD distributions in 1995 have been obtained from the results of the roadside interview survey. The distribution of some of the OD pairs which could not been obtained from the survey, such as internal trips within the Klang Valley, were assumed referring to the HNDP distribution patterns. Table 4-5 depicts the OD matrix for 1995.

Figure 4-3 illustrates the result 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 in other areas is still small at present.

4.1.3 Network Model Validation

The 1995 OD Matrices are assigned to the 1995 network model developed on the EMME/2 software programme. Figure 4-4 shows the assignment results for the 1995 network model. The assignment results are then compared with observed traffic counts carried out by the Study Team and other available traffic census data. Figure 4-2 shows that the model results are able to replicate the Observed flows with reasonable accuracy, i.e. $R^2 = 0.81$, thereby validating the network model for use in further analysis.

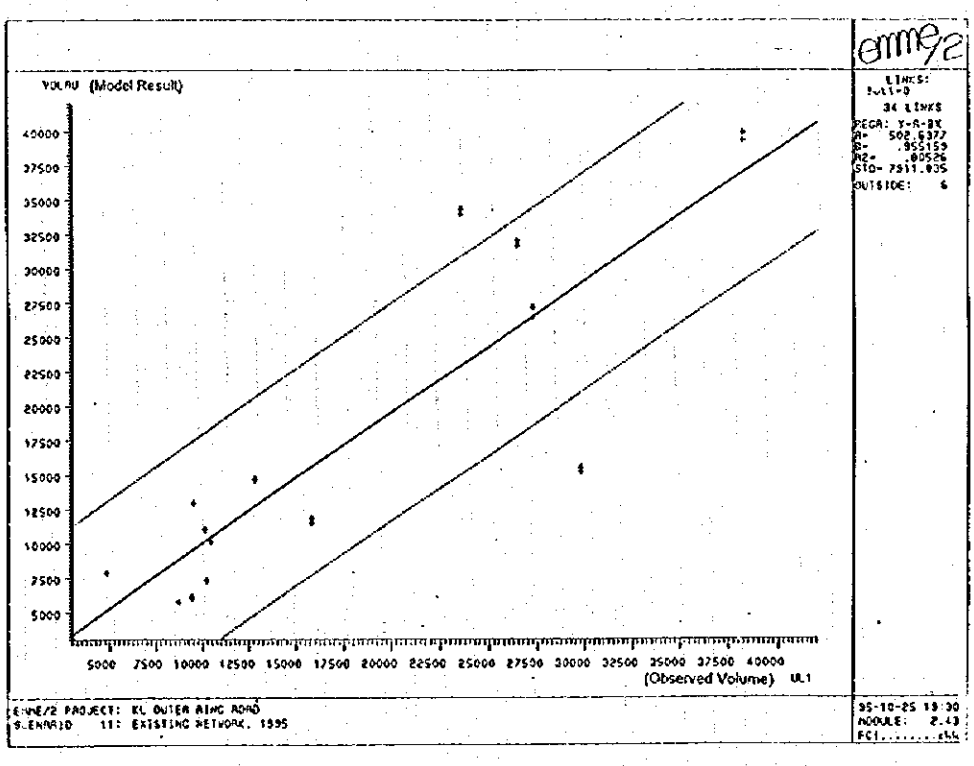


Figure 4-2 : Comparative Analysis Between Model Results and Observed Flows

Table 4-5 : OD Matrix (All vehicles) in 1995

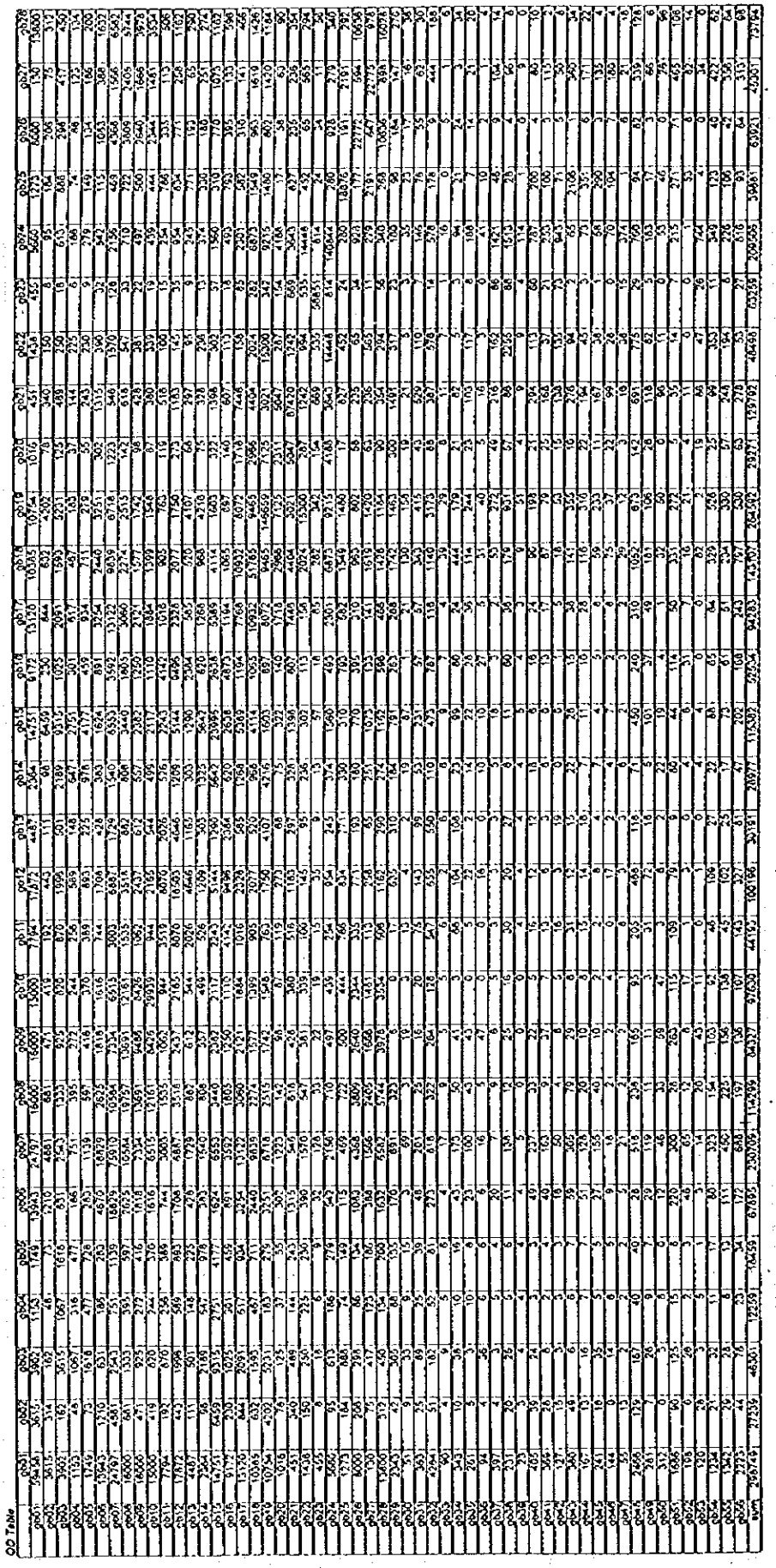


Table 4-5 : OD Matrix (All vehicles) in 1995

	qb29	qb30	qb31	qb32	qb33	qb34	qb35	qb36	qb37	qb38	qb39	qb40	qb41	qb42	qb43	qb44	qb45	qb46	qb47	qb48	qb49	qb50	qb51	qb52	qb53	qb54	qb55	qb56	sum
qb01	2343	51	363	4264	90	343	261	94	397	231	23	405	389	127	360	167	241	144	55	2468	261	312	1886	198	120	1234	1342	2223	2467491
qb02	42	9	25	51	4	10	5	4	4	20	3	29	26	15	49	13	18	0	13	129	7	0	90	6	26	211	29	44	27239
qb03	305	33	89	182	9	38	3	36	31	20	4	24	6	31	6	16	35	14	2	167	28	3	125	26	3	32	26	78	46301
qb04	66	9	25	52	5	10	10	6	5	5	4	3	2	3	6	7	5	6	2	40	9	8	15	2	5	11	8	23	12259
qb05	135	15	39	81	6	18	8	6	4	6	4	3	4	3	7	7	5	5	2	40	7	0	8	3	1	17	13	34	10459
qb06	170	31	68	273	4	40	23	6	20	11	4	49	40	16	59	51	27	9	6	28	29	12	220	46	3	80	111	172	67685
qb07	691	89	261	818	17	173	100	18	7	136	5	237	163	50	305	128	155	16	21	516	119	46	300	65	14	323	450	688	230169
qb08	323	3	25	322	9	50	43	5	9	12	0	30	9	4	79	20	40	2	2	236	11	33	28	12	20	154	225	197	112799
qb09	8	19	16	264	5	41	43	47	6	25	0	22	37	6	29	10	10	2	2	165	11	59	263	8	43	103	155	158	84327
qb10	0	3	20	128	5	3	0	0	5	16	0	5	7	5	0	0	2	4	1	95	3	47	115	17	11	92	138	107	97630
qb11	17	10	75	547	6	88	51	0	3	30	4	16	13	16	31	15	2	0	8	205	31	3	109	11	0	46	45	145	44193
qb12	635	4	143	655	2	104	22	16	3	20	4	12	8	3	12	14	8	17	3	468	72	8	76	3	1	108	102	327	100198
qb13	318	2	98	5501	8	108	2	0	3	27	4	12	3	19	15	16	4	2	3	118	16	2	9	0	0	27	25	61	30191
qb14	184	19	53	110	8	23	14	10	5	6	4	18	8	0	22	7	7	4	6	71	5	22	80	4	4	22	17	41	26977
qb15	791	87	231	475	8	99	22	10	18	11	5	8	0	0	26	11	4	7	2	450	101	19	44	6	4	88	75	202	115382
qb16	263	1	57	787	7	80	26	27	3	80	4	16	13	1	15	10	5	2	3	240	37	4	114	31	0	65	61	188	82534
qb17	268	21	57	118	4	24	36	51	2	36	3	24	17	5	38	28	8	6	2	310	49	1	50	7	0	84	51	243	94263
qb18	1742	130	345	1140	39	444	114	31	53	179	9	90	67	18	141	116	59	75	29	1052	181	22	331	16	82	329	234	797	145107
qb19	1483	156	415	3173	29	176	244	40	272	931	61	198	79	53	355	316	230	37	12	873	109	60	272	21	2	528	330	530	264592
qb20	300	19	42	66	8	21	23	5	49	57	4	21	25	15	10	22	11	22	3	142	29	0	5	4	19	25	57	65	29271
qb21	1491	21	529	367	111	62	103	16	216	66	9	294	168	136	276	194	187	99	16	991	116	96	35	11	86	98	248	276	129792
qb22	317	5	110	576	7	51	117	3	182	2255	9	113	37	135	94	45	38	28	36	775	82	11	14	0	47	353	194	53	48498
qb23	23	3	7	14	1	3	8	0	66	66	4	60	21	73	2	3	11	0	15	29	5	0	7	0	26	11	6	27	63259
qb24	160	35	146	376	16	94	166	41	1421	1513	114	787	253	943	65	73	58	70	374	760	183	53	215	1	744	349	226	616	709506
qb25	95	23	76	176	0	21	7	10	46	26	1	200	100	71	2106	351	290	104	1	94	17	46	271	53	4	123	106	93	39919
qb26	164	17	65	9	5	24	14	21	9	4	0	4	3	5	1	8	3	7	8	82	3	0	71	6	0	40	42	64	63854
qb27	147	16	62	444	1	3	21	1	164	96	9	80	115	50	360	171	135	180	21	339	66	26	465	82	34	422	356	313	45434
qb28	276	36	30	168	6	34	20	4	14	8	01	10	2	8	34	22	4	4	18	128	6	96	198	14	0	62	64	98	75690
qb29	60000	1655	3313	8624	164	991	470	470	8	321	101	166	222	64	97	19	83	15	17	2447	533	279	995	58	12	56	126	917	112682
qb30	1655	5070	1492	2962	63	660	28	26	11	12	6	9	9	9	4	5	5	5	6	4	4	8	7	2	2	4	0	4	13239
qb31	33131	1492	23871	7457	63	1657	893	50	31	70	12	56	9	9	79	20	29	5	6	1629	137	274	256	10	10	111	111	748	45020
qb32	8624	2962	7457	32592	330	1858	473	354	365	140	11	6	6	8	2	4	4	4	7	411	31	15	982	43	22	114	76	378	71551
qb33	164	63	63	330	7143	660	28	28	11	6	4	9	9	9	4	5	5	5	6	198	9	164	47	34	12	75	52	54	9507
qb34	991	693	16577	1858	6801	17691	118	118	208	64	12	9	9	9	4	5	5	5	6	263	15	15	47	4	4	27	14	192	28838
qb35	470	78	6931	473	28	118	25561	837	817	558	82	4	17	9	9	11	0	0	0	272	272	2	46	2	2	5	12	39	31877
qb36	470	78	58	354	28	118	837	3498	351	185	185	4	4	4	0	0	0	0	0	272	272	2	46	2	2	5	1	39	8959
qb37	6	11	31	345	11	206	617	351	59208	1092	555	16	16	16	0	0	0	0	0	72	22	0	7	0	0	3	0	0	65694
qb38	321	12	70	140	8	84	556	185	1092	19942	858	26	134	17	0	1	1	1	0	441	192	0	97	1	0	49	24	22	29997
qb39	10	6	17	11	4	12	92	185	655	858	205	17	17	17	0	1	1	1	0	56	11	0	6	0	0	4	0	5	2251
qb40	158	9	56	8	9	9	4	4	16	28	17	28496	197	9	104	36	30	222	1040	8	4	1	31	10	51	11	7	34	33360
qb41	222	9	9	8	9	9	17	4	15	154	17	197	61615	83	35	34	36	21	1274	228	25	13	374	188	63	19	4	22	46100
qb42	64	9	8	8	9	9	9	4	16	17	17	9	83	3149	37	21	23	21	1500	13	14	1	83	20	63	12	0	28	6595
qb43	97	4	79	2	4	4	9	0	0	0	0	104	35	37	13055	1990	1398	60	5	49	6	6	125	266	25	8	6	74	21973
qb44	19	5	20	4	5	5	11	0	0	1	1	36	54	21	1990	4709	985	246	6	23	4	15	193	269	26	10	31	62	10560
qb45	53	5	29	4	5	5	0	0	0	1	1	30	36	23	1398	985	4233	389	6	34	18	0	143	540	34	10	3	5	9565
qb46	151	5	5	4	5	5	0	0	0	1	1	222	21	21	60	246	389	17035	86	0	0	2	84	540	32	0	0	25	19919
qb47	12	6	8	7	6	6	0	0	0	0	01	1040	1274	1500	5	6	6	86	49647	3	1	2	5	1	1463	70	4	2	55961
qb48	2447	4	1829	411	196	283	272	272	72	441	56	8	236	131	49	23	34	0	3	1	28	52	535	29	10	106	119	1	17617
qb49	553	4	137	311	9	13	272	272	22	192	11	4	25	14	6	4	16	0	1	28	5	1	60	12	0	15	32	24	3358
qb50	270	6	274	15	164	161	2	2	0	0	0	1	13	1	4	15	0	2	2	52	11	3	41	12	0	37	10	7	1943
qb51	995	2	258	962	47	471	46	2	7	97	8	31	374	83	125	1593	143	64	5	535	60	41	26	8	1	336	37	1579	11203
qb52	58	2	10	43	34	4	2	2	0	1	0	10	166	20	268	269	540	540	1	29	15	12	6	0	1	40	0	6	2745
qb53	12	2	10	22	12	4	2	2	0	0	0	31	83	83	25	26	54	32	1463	10	01	0	1	1	1	3	3	21	3184
qb54	58	4	111	114	25	27	3	0	3	49	4	11	19	12	8	10	10	0	20	108	15	37	338	40	3	51	16	125	6047
qb55	126	0	111	76	52	16	12	3	0	24	0	7	4	0	0	3	3	0	4	119	32	10	37	0	3	16	14	519	5930
qb56	917	4	746	376	34	192	39	39	0	22	5	34	22	28	74	62	51	25	2	1	24	7	1579	6	21	126	519	56	13055
sum	112882	13238	45620	71551	9507	26636	31877	8959	65694	29997	2251	33360	46100	8995	21973	10560	9565	19616	55961	17617	3358	1943	11203	2745	3184	6047	5930	13055	2260387

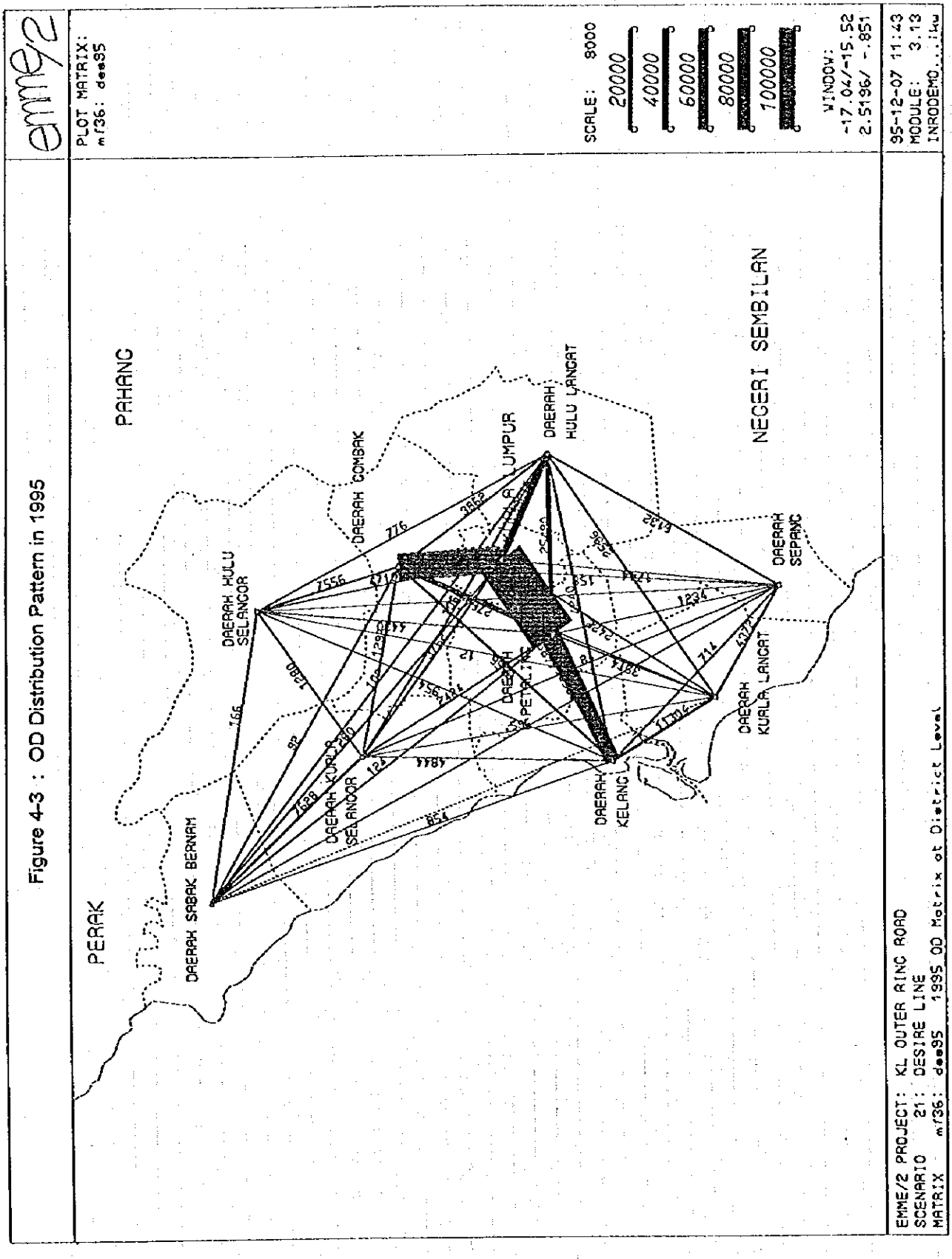


Figure 4-3 : OD Distribution Pattern in 1995

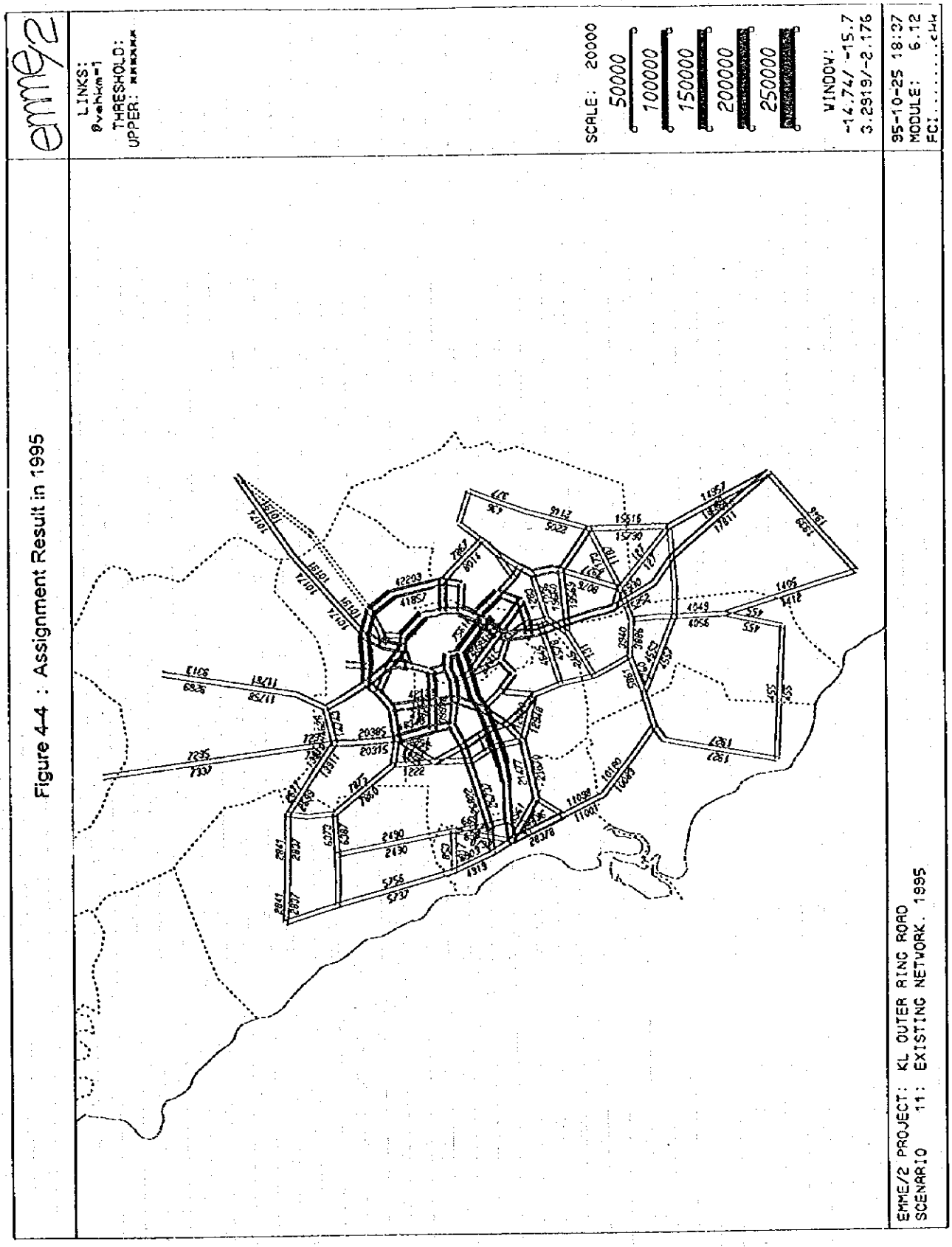


Figure 4-4 : Assignment Result in 1995

4.2 Future Traffic Demand

4.2.1 Forecasting the Number of Registered Vehicles

The number of registered vehicles is an important factor in forecasting vehicular traffic demand. There are two types of forecasting methods:

(1) Structural model (linear regression model),
(2) Time series vehicle forecasting model.

To determine the future number of vehicles in Selangor and Kuala Lumpur, these methods are used for comparison analysis.

The regression analysis was carried out with the number of registered vehicles and socioeconomic indicators from 1985 to 1995. Linear regression models obtained are shown in Table 4-6. Most models bare high correlation coefficients.

Table 4-6 : Linear Regression Model for Forecasting Number of Registered Vehicles

Area	Vehicle Type	Formula		Correlation Coefficient
Selangor	P. Car	(1)	200.384 POP - 63211	0.975
		(2)	13.869 GDP + 159276	0.990
		(3)	12.927 POP + 12.988 GDP +144721	0.99
	Bus	(4)	1.535 POP + 1450	0.966
		(5)	0.106 GDP + 3153	0.982
	Lorry	(6)	16.372 POP + 1.653 GDP + 26225	0.988
		(7)	2.769 GDP + 44660	0.985
Kuala Lumpur	P.Car	(8)	952.018 POP - 776011	0.984
		(9)	38.146 GDP - 134871	0.985
	Bus	(10)	11.064 POP -8975	0.986
		(11)	0.456 GDP - 1307	0.988
	Lorry	(12)	81.157 POP + 2.168 GDP - 76757	0.981
		(13)	5.500 GDP - 20355	0.979

Note POP : Population ('000)
GDP : Gross Domestic Product (million MR)

For the time series vehicle forecasting analysis, trend type models with the saturation rate of vehicle ownership is used. The equation of the model is shown below:-

$$Y = \frac{K}{1 + e^{A1-A2\,YR}}$$

Where; Y = Vehicle ownership (vehicles per 1000 population)
K = Saturation rate of vehicle ownership
A1, A2 = Parameters
YR = Year

Table 4-7 shows trend type vehicle ownership forecasting models from the HNDP study. The models assume the saturation rate of 400, 25 and 100 for passenger cars, buses and lorries, respectively. These saturation rates were determined based on the data from developed countries.

Table 4-7 : Vehicle Ownership Forecasting Models

Type of Vehicle	Formula	Coefficient
Car	$\frac{400}{1 + e^{106.9538 - 0.05322\,YR}}$	0.962
Bus	$\frac{25}{1 + e^{68.2757 - 0.03292\,YR}}$	0.988
Lorry	$\frac{100}{1 + e^{95.5106 - 0.04759\,YR}}$	0.949

Source: HNDP study

Figure 4-8 illustrates the model for passenger cars and shows the existing conditions in the Selangor and Kuala Lumpur area as well as in Malaysia. Vehicle ownership in Malaysia in 1995 is 125 (ownerships per thousand people), while Kuala Lumpur and Selangor are far ahead of Malaysia in terms of ownership. For example, ownership rate for Kuala Lumpur in 1995 equals to the year 2035 for Malaysia. And for Selangor in 1995 equals to year 2005 for Malaysia. The biggest gap observed between Kuala Lumpur and Malaysia is nearly 40 years. The ownership rate of 322 vehicles recorded in Kuala Lumpur indicates an almost saturated situation.

The results for the future number of vehicles in 2020 obtained from each model or method are shown in Table 4-7. For the trend type model, imaginary years are used for parameter YR as a basic year, for example 1995 will be 2035 for Kuala Lumpur. Comparing these results carefully, the forecasting model for each vehicle type and area has been determined. The models for Selangor have been chosen from a regression analysis which means that the number of vehicles in Selangor will continue to increase following the growth of development. On the other hand, the growth rates for Kuala Lumpur will be reduced because of the already high rate of ownership and limited development areas.

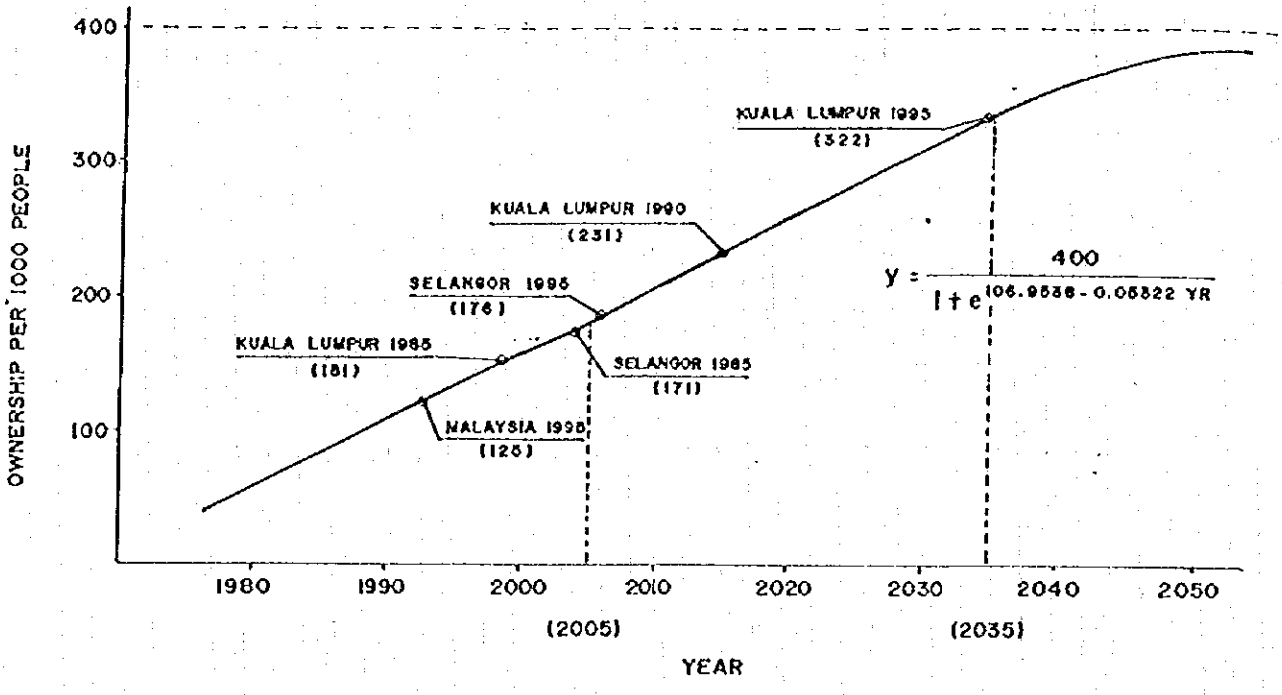


Figure 4-5 : Passenger Car Ownership Model and its Rate in Selangor and Kuala Lumpur

Table 4-8 shows the future number of registered vehicles in 2000, 2010 and 2020 for Selangor and Kuala Lumpur.

Table 4-8 : Future Number of Registered Vehicles

(Unit Vehicle)

		P.Car	Bus	Lorry
Selangor	1995	477,469	5,726	110,527
	2000	594,610	7,149	142,279
	2010	880,199	11,236	229,354
	2020	1,126,557	17,119	341,217
Kuala Lumpur	1995	422,159	5,530	63,394
	2000	530,674	7,571	85,302
	2010	724,067	12,453	131,507
	2020	901,546	18,810	180,564

Note : 1995 numbers are based on the models

Table 4-9 : Comparisons of Vehicle Number Forecasting Models

Area	Vehicle Type	Multiple Regression Model			Trend Type Model		'95 Ownership
		No.	No of Vehicle	Ownership	No of Vehicle	Ownership	
Selangor	P.Car	(1)	1.126,557	190	2135.428	299	176
		(2)	2,357,626	330			
		(3)	2.295,667	321			
	Bus	(4)	12.416	1.74	33,995	4.76	2.09
		(5)	17,119	2.80			
	Lorry	(6)	341,217	56.7	535,643	75.0	39.7
		(7)	483,562	67.7			
Kuala Lumpur	P.Car	(8)	1,447,825	602	901.498	374	322
		(9)	2,183,778	908			
	Bus	(10)	17,623	7.33	33,719	9.67	4.06
		(11)	26,428	11.0			
	Lorry	(12)	250,127	104	180,637	92.6	45,4
		(13)	313,986	131			

Input : Socio Economic Indicators in 2020
Base Year for the Trend Type Model
Selangor : 2005 (2020 → 2045)
Kuala Lumpur : 2035 (2020 → 2060)
Note : Ownership means "Vehicle per 1000 population"

4.2.2 Future Total Trip Generation

Trip rate analysis has been applied for forecasting total trip generation for Selangor and Kuala Lumpur. As mentioned earlier, the regression model is useful for estimating trips from each traffic zone, but it is not adequate for estimating the total generation.

Future trip generation rate for each vehicle type will differ from the existing rates. The rates will decrease or increase depending on the type of vehicle. According to the experience in developed countries, the rate for passenger cars shows a tendency to decrease following the expansion of ownership. Buses have also shown the same tendencies, possibly caused by traffic congestion on roads. On the other hand, goods vehicles have increase in contrast to the others.

Expansion of the economy will encourage people and goods transport, as well as urbanization and motorization. However, the urban transportation system, especially the road system, cannot always accommodate the rapidly increasing traffic. Traffic congestion will occur everywhere, so that people, especially commuters will switch from private cars to public transport in order to avoid road traffic congestion.

While for goods transport, there is only a limited modal choice besides road transport. They have to find a more efficient mode of transport, such as containerization, improvement of delivery system and so on. Even so, it will be needed to make more trips to meet the increased demand.

Based on the mechanism encompassed in the relationship between expansion of the economy and vehicle trips, future trip generation rates for each vehicle type are determined as shown in Table 4-9.

Table 4-9 : Future Trip Generation Rate

		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	1995	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

Traffic congestion in Kuala Lumpur is getting more serious. The government of Malaysia, therefore, is enhancing the development of public transport system introducing KTM commuter service, LRT system and so on. In the traffic demand forecasting, the further development of public transport systems should be considered.

The traffic demand forecasting procedure applied in this study is a car based method, using HNDP car base models. In order to adjust the values obtained from HNDP models with a future development of public transport system, the following steps have been taken.

Step 1 : To estimate total number of person trips
Step 2 : To estimate person trips by P. Car and Bus respectively and assume the share of modal usage.
(Mode : P.Car, Public (Bus, Rail),
Step 3 : To set a future modal split. (Table 4-10)
The modal split is set up as a target value based on the Klang Valley Transportation Study (JICA).
Although the Malaysian government plans to setup a modal usage target of 40 (P.Car) : 60 (Public), it is not practical to achieve by 2020 based on the present public transport system development.
Step 4 : To adjust the trip generation for the zones in the Klang Valley and KL - KLIA corridor where rail mode public transport system will be introduced.

Table 4-11 : Transport Modal Split

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
(Target)	(40)	(40)	(20)	(60)	(100)

Table 4-11 shows the future total trip generation after the adjustment of the modal split. The trip generation is estimated using the future socio-economic indicators mentioned in Chapter 3. The demand estimation in high economic growth case and traffic from KLIA passenger and cargo are referred to Appendix.

Table 4-12 : Future Total Trip Generation after Adjustment*

		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 4-6 shows the desire lines of Future OD in 2020. The majority of the demand is 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.

Table 4-12 depicts the forecasted OD matrix for 2020.

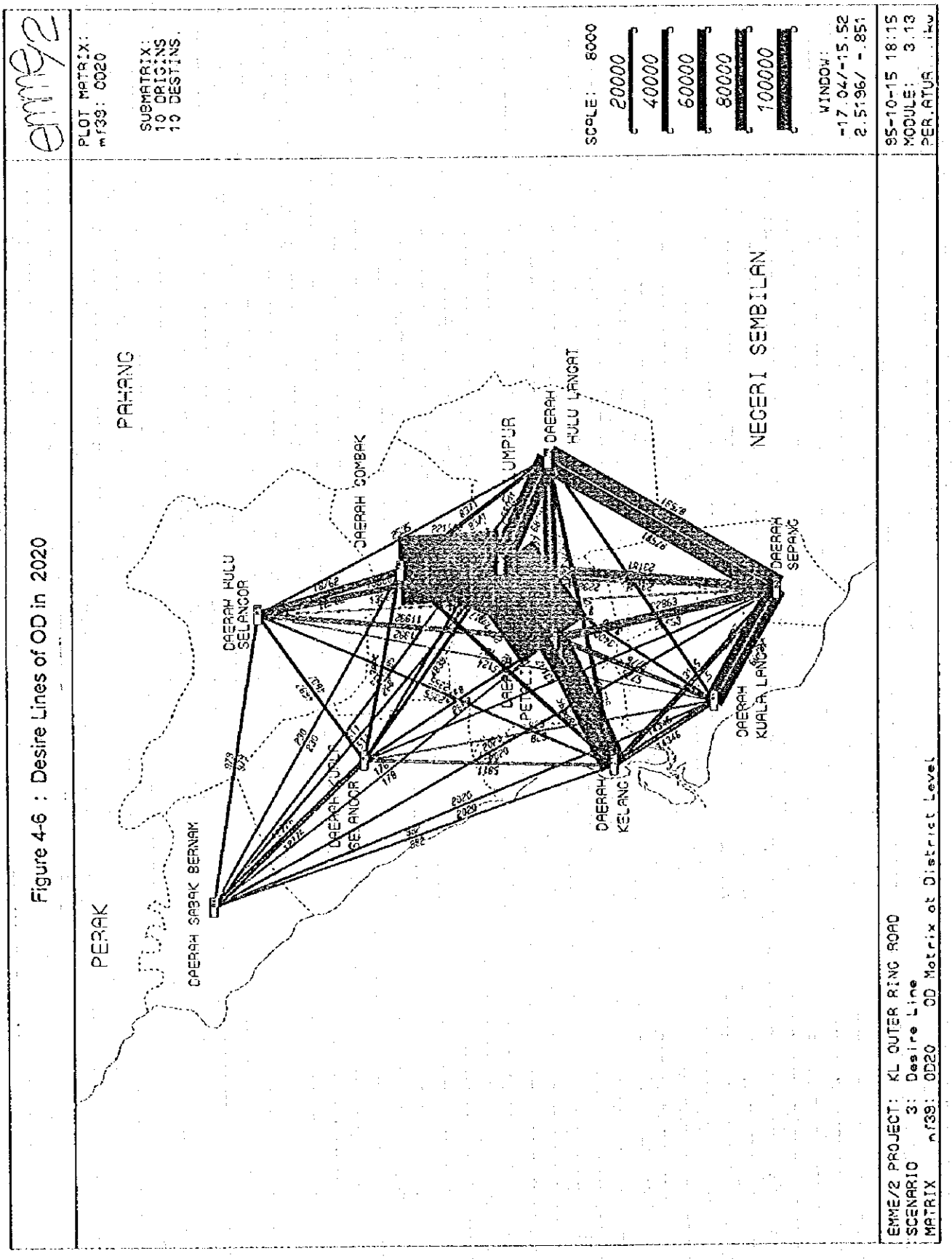


Figure 4-6 : Desire Lines of OD in 2020

Table 4-13 : OD Matrix (All vehicles) in 2020

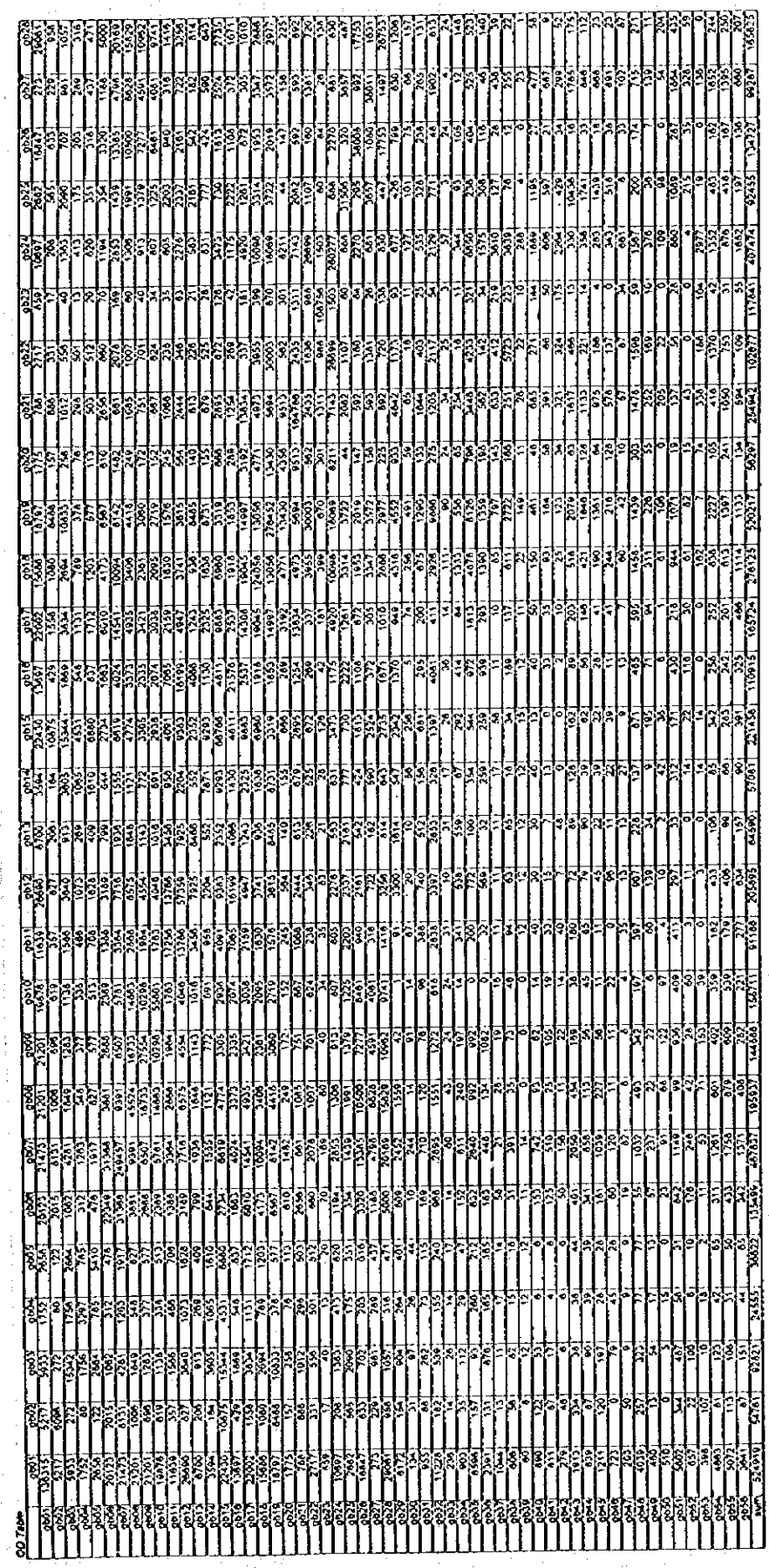


Table 4-13 : OD Matrix (All vehicles) in 2020

	gb29	gb30	gb31	gb32	gb33	gb34	gb35	gb36	gb37	gb38
gb01	8172	134	955	11228	236	903	8504	2301	1044	605
gb02	134	31	88	162	14	35	157	131	13	56
gb03	904	97	262	539	26	112	93	876	11	82
gb04	284	26	73	155	14	29	260	185	17	15
gb05	401	44	115	240	17	47	212	105	14	16
gb06	609	10	169	988	14	152	632	183	58	31
gb07	2452	244	710	2695	80	611	2640	448	21	391
gb08	1559	14	120	1551	43	240	992	134	28	35
gb09	42	91	78	1272	24	197	992	1062	19	73
gb10	1	14	98	618	24	14	0	0	16	46
gb11	91	67	388	2638	31	341	200	32	11	94
gb12	3309	20	740	3397	10	558	772	569	11	63
gb13	1614	10	512	2853	31	559	100	32	11	85
gb14	547	56	156	326	17	67	354	259	17	18
gb15	2342	256	851	1397	76	292	544	259	58	34
gb16	1370	5	295	4081	36	414	972	939	11	169
gb17	949	74	200	411	14	84	1613	293	10	137
gb18	4318	256	675	2928	111	1333	4878	1390	85	611
gb19	4552	491	1290	9888	90	554	8126	1359	797	2722
gb20	933	59	133	275	24	85	798	198	145	166
gb21	4642	85	1644	1265	34	254	3448	582	833	251
gb22	1173	16	403	2117	25	18	4233	142	412	5723
gb23	93	11	25	54	3	11	321	34	219	223
gb24	877	127	535	2129	57	344	9850	1575	3610	3639
gb25	426	101	326	771	3	93	236	308	127	76
gb26	799	73	236	48	24	105	404	118	28	12
gb27	830	86	265	1902	4	12	325	48	438	255
gb28	1208	157	131	813	24	148	523	140	39	22
gb29	187113	3459	6924	13845	344	2073	13483	13481	30	966
gb30	3459	11217	3118	6230	473	1365	820	820	35	36
gb31	6924	3118	49448	15578	173	3481	25330	1870	97	215
gb32	13845	6230	15576	88088	690	3460	13465	10112	1128	429
gb33	344	173	173	690	14821	1365	820	820	35	18
gb34	2073	1365	3461	3460	1365	58658	3370	3370	835	195
gb35	13483	820	25330	13465	820	3370	206256	5156	22702	15422
gb36	13481	820	1870	10112	820	3370	5156	28214	9799	5150
gb37	30	35	97	1128	35	835	22702	9799	142261	2625
gb38	968	36	215	429	18	198	15422	5150	2625	47920
gb39	34	16	36	35	12	36	2574	5150	1575	1576
gb40	534	26	176	27	26	26	152	151	46	77
gb41	705	26	28	27	28	28	549	151	48	426
gb42	206	28	28	27	26	28	304	151	46	47
gb43	838	30	496	28	30	30	867	52	8	10
gb44	129	31	124	30	31	31	869	54	10	11
gb45	342	31	181	30	31	31	54	54	10	11
gb46	105	31	31	30	31	31	54	54	10	11
gb47	89	40	40	39	40	40	0	0	0	0
gb48	4705	7	3130	790	378	543	898	695	131	800
gb49	1025	7	283	60	17	24	695	695	40	348
gb50	523	14	528	29	314	34	8	8	0	0
gb51	3785	7	981	3737	178	178	182	10	33	421
gb52	223	7	34	166	129	15	10	10	3	4
gb53	52	7	36	66	45	15	10	10	0	0
gb54	241	15	440	457	98	106	14	2	18	209
gb55	510	0	440	312	208	55	50	14	0	102
gb56	1768	7	1433	727	103	369	101	101	0	39
sum	279551	30246	125746	196739	22140	85487	381303	99782	189244	62964

	gb39	gb40	gb41	gb42	gb43	gb44	gb45	gb46	gb47	gb48
gb01	60	890	811	276	1913	839	1211	723	203	4036
gb02	8	122	87	46	334	87	120	0	50	257
gb03	12	53	17	0	38	90	197	79	9	323
gb04	12	6	4	6	38	39	28	45	9	77
gb05	12	6	8	6	44	39	28	28	9	77
gb06	11	153	125	50	401	341	161	60	19	55
gb07	14	742	510	156	2050	658	1039	120	82	1032
gb08	0	93	25	11	454	113	227	11	8	493
gb09	0	62	105	22	169	58	58	11	8	342
gb10	0	14	19	14	36	45	11	22	4	197
gb11	12	40	33	40	180	85	11	0	35	397
gb12	12	30	15	7	72	79	45	96	13	907
gb13	12	30	7	48	86	90	22	11	13	228
gb14	12	40	13	0	128	39	39	22	27	137
gb15	15	13	0	0	162	62	22	39	9	871
gb16	12	40	33	2	69	56	26	11	13	465
gb17	11	30	35	10	203	146	41	41	8	595
gb18	22	130	93	25	518	421	190	244	61	1458
gb19	149	481	184	123	2079	1846	1361	216	42	1439
gb20	11	48	56	34	63	128	64	128	10	303
gb21	28	685	391	321	1817	1133	975	578	57	1478
gb22	22	271	66	324	466	221	166	137	87	1598
gb23	10	144	50	175	13	14	4	0	34	59
gb24	288	1689	606	2264	330	358	263	343	881	1567
gb25	4	1195	597	429	10436	1741	1439	518	8	200
gb26	0	27	21	34	16	33	18	38	33	174
gb27	23	477	687	299	1785	848	688	891	102	715
gb28	1	54	9	52	175	112	23	23	87	271
gb29	34	534	705	206	838	129	342	105	89	4705
gb30	18	26	28	28	30	31	31	31	40	7
gb31	36	176	28	28	496	124	181	31	40	3130
gb32	35	27	27	27	28	30	30	30	39	790
gb33	12	28	28	28	30	31	31	31	40	378
gb34	38	28	28	28	30	31	31	31	40	543
gb35	2574	152	549	304	867	889	54	54	0	898
gb36	5150	151	151	151	52	54	54	54	0	695
gb37	1575	46	46	46	8	10	10	10	0	131
gb38	1578	77	426	47	10	11	11	11	0	800
gb39	492	47	47	47	10	11	11	11	0	65
gb40	47	48586	334	15	787	283	219	1624	3484	19
gb41	47	334	70322	106	282	395	283	153	4267	545
gb42	47	15	106	5347	277	153	188	153	5025	31
gb43	10	787	262	277	52642	8026	5639	244	89	109
gb44	11	283	395	133	8026	19107	3971	991	70	51
gb45	11	219	283	188	5639	3971	17087	1487	70	75
gb46	11	1624	153	153	244	991	1487	68885	770	0
gb47	0	3484	4267	5025	89	70	70	770	185032	6
gb48	65	19	545	31	109	51	75	0	9	1
gb49	19	9	59	33	14	8	39	0	3	26
gb50	0	2	31	2	14	33	0	4	6	52
gb51	34	129	1561	263	460	560	524	234	19	1514
gb52	0	41	765	83	985	986	1976	1979	3	82
gb53	0	129	263	263	94	95	197	117	5660	28
gb54	17	45	77	47	37	42	42	0	83	242
gb55	0	28	15	0	3	12	12	0	18	287
gb56	9	81	52	66	185	181	11	55	6	1
sum	12637	64656	68164	17735	95708	45992	41066	81330	209781	34748

	gb49	gb50	gb51	gb52	gb53	gb54	gb55	gb56	sum
gb01	460	610	6602	657	398	4663	5072	3641	524919
gb02	13	0	344	22	107	81	113	87	54781
gb03	54	5	469	101	10	123	108	151	92824
gb04	17	15	58	8	18	42	31	44	24555
gb05	13	0	31	10	2	65	50	65	30622
gb06	57	23	842	176	11	311	433	342	135499
gb07	237	91	1149	240	53	1261	1758	1371	487837
gb08	22	88	99	42	71	601	679	408	195937
gb09	22	122	936	26	153	402	609	282	144886
gb10	8	97	409	60	39	359	539	221	150711
gb11	60	4	411	3	0	162	179	277	91186
gb12	139	10	297	11	3	433	466	634	205695
gb13	34	2	33	0	0	108	99	157	84590
gb14	9	42	313	14	14	85	66	90	57082
gb15	195	38	171	22	14	342	263	391	221458
gb16	71	6	430	116	0	258	242	325	110915
gb17	94	1	218	30	0	252	201	469	165725
gb18	311	81	944	61	162	836	813	1114	278128
gb19	226	106	1071	62	7	2227	1397	1133	520217
gb20	55	0	19	15	74	105	241	134	58297
gb21	252	205	137	43	338	418	1050	594	254942
gb22	189	22	58	0	168	1370	733	109	102677
gb23	10	0	28	0	104	42	31	55	117641
gb24	378	109	880	4	2977	1352	876	1682	407474
gb25	38	98	1069	215	19	463	418	197	92520
gb26	7	0	267	35	0	162	167	136	134614
gb27	139	54	1664	328	136	1852	1395	860	95509
gb28	11	204	435	59	0	244	250	207	185651
gb29	1026	523	3785	223	52	241	510	1768	279551
gb30	7	14	7	7	7	15	0	7	30248
gb31	283	528	981	34	36	440	440	1433	125746
gb32	60	29	3737	166	66	457	312	727	196739
gb33	17	314	178	129	45	98	208	103	22140
gb34	24	34	178	15	15	106	55	369	85487
gb35	898	8	182	10	10	16	53	101	381306
gb36	695	8	10	10	10	2	15	101	99783
gb37	40	0	33	3	0	18	0	0	189244
gb38	348	0	421	4	0	209	102	39	92964
gb39	19	0	34	0	0	17	0	9	12637
gb40	9	2	129	41	129	45	29	81	64659
gb41	59	31	1561	765	263	66	16	52	68186
gb42	33	2	263	83	263	49	0	66	17757
gb43	14	14	460	985	94	38	3	165	95709
gb44	8	33	560	986	95	43	12	181	45993
gb45	39	0	524	1979	197	43	12	11	41067
gb46	0	4	234	1979	117	0	0	55	81330
gb47	3	6	19	3	5660	87	17	8	206764
gb48	26	52	1514	82	26	242	287	1	34746
gb49	5	1	189	33	0	33	71	24	6819
gb50	1	3	118	33	0	62	22	7	3755
gb51	189	118	28	8	1	1382	151	4466	39752
gb52	33	33	8	0	1	162	0	16	10188
gb53	0	0	1	1	1	11	11	59	12091
gb54	33	62	1342	162	11	51	16	262	22708
gb55	71	22	151	0	11	16	14	1168	21752
gb56	24	7	4466	16	59	262	1168	59	28327
sum	6819	3755	39755	10189	12091	22722	21759	28327	7274702

Chapter 5

FORMULATION OF KLORR DEVELOPMENT CONCEPT

CHAPTER 5 FORMULATION OF KLORR DEVELOPMENT CONCEPT

5.1 Review of HNDP Study

The HNDP (Highway Network Development Plan) Study was conducted from May 1991 to February 1993 with the technical cooperation from the Government of Japan (JICA - Japan International Cooperation Agency)

The HNDP Study targeted the following two objectives covering the whole of Malaysia (Peninsular Malaysia, Sabah and Sarawak).

a) To formulate a development plan of the national highway network up to the year 2010,

b) To prioritize new and improved linkages in the planned network with respect to technical and economic consideration, and to formulate a road development program.

The highway network development plan was approved by the Cabinet and incorporated as the basic guidelines for the future development of highways in the Mid-Term Review of the Sixth Malaysian Plan.

Figure 5-1 shows the Conceptual Future Highway Network in Peninsular Malaysia established by the HNDP Study. The concept has proposed that the expressway network be extended to the east from Kuala Lumpur and in the east coast corridor from North to South.

A sustainable economic growth targeted in the Vision 2020 is expected to encourage industrial developments and urbanization in the east coast regions. Based on economic expansion, the traffic demand will increase tremendously, not only in the Number of Vehicular trips but also longer travel distance.

Selangor state will play the most prominent role in the expansion of economy in Malaysia as mentioned in Chapter 3. Figure 5-3 shows the conceptual highway network configuration for the Central Region from the HNDP Study. The highway network configuration aims at the dispersal of traffic converging in Kuala Lumpur and the Klang Valley; and to provide smooth linkages to region-wide highways and expressways.

As mentioned earlier, the inter-state traffic demand will increase according to the economic expansion. Figure 5-2 shows external traffic demand for Selangor State in 1995 and 2010. The future traffic demand on the state boundaries is forecasted to increase two to four times the existing (1995) traffic demand. The highest growth is indicated on the boundary between Selangor state and the eastern states. The KLORR will disperse the external traffic on the outer side of Kuala Lumpur.

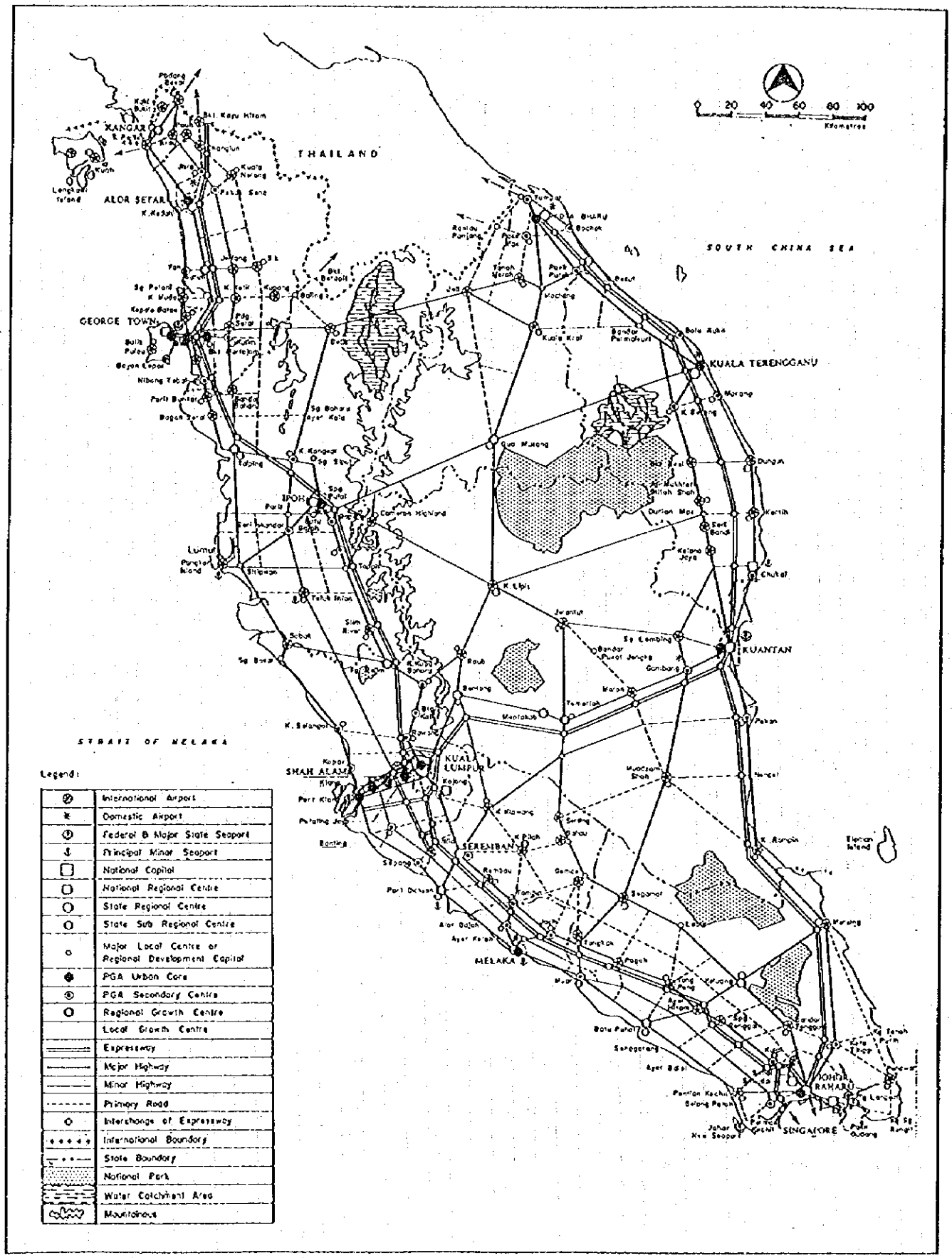


Figure 5-1 : Conceptual Future Highway Network in Peninsular Malaysia
(By Functional Classification)

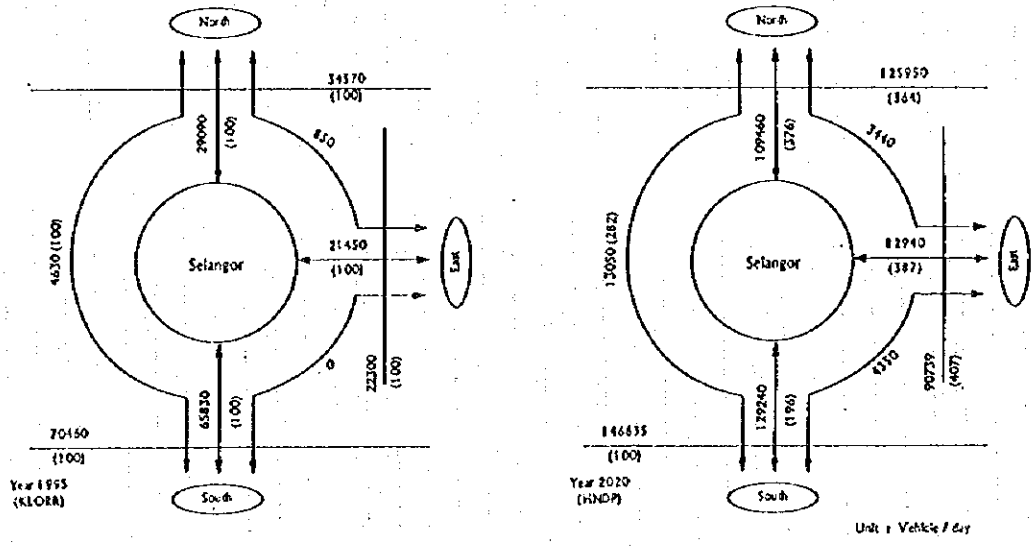


Figure 5-2 : External Traffic Demand for Selangor State

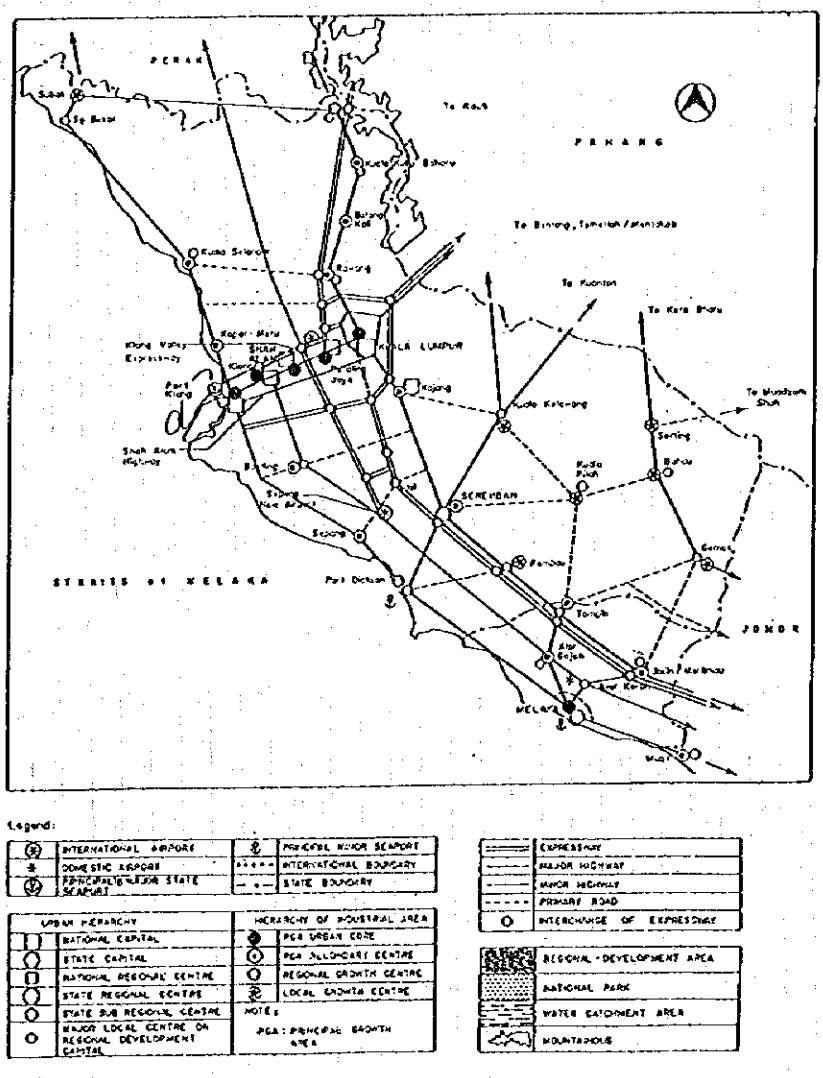


Figure 5-3 : Conceptual Regional Highway Configuration for Central Region in Peninsular Malaysia

5.2 Development Trend and Issues

The development plan for Selangor State is discussed in detail in Chapter 3. In this section, effort will be made to identify the development trend and issues necessary to base the KLORR development concept, especially outside of Klang Valley Region.

The present capital region of Klang Valley has played the most significant role as the growth pole 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 economic growth, the development trend has started to over flow from Klang Valley to the north and south regions. The present development trend is illustrated in Figure 5-4.

New national development projects, such as Putra Jaya, KLIA and 2nd National Car Project, will encourage this trend and will form a new capital region, the Greater Klang Valley Region.

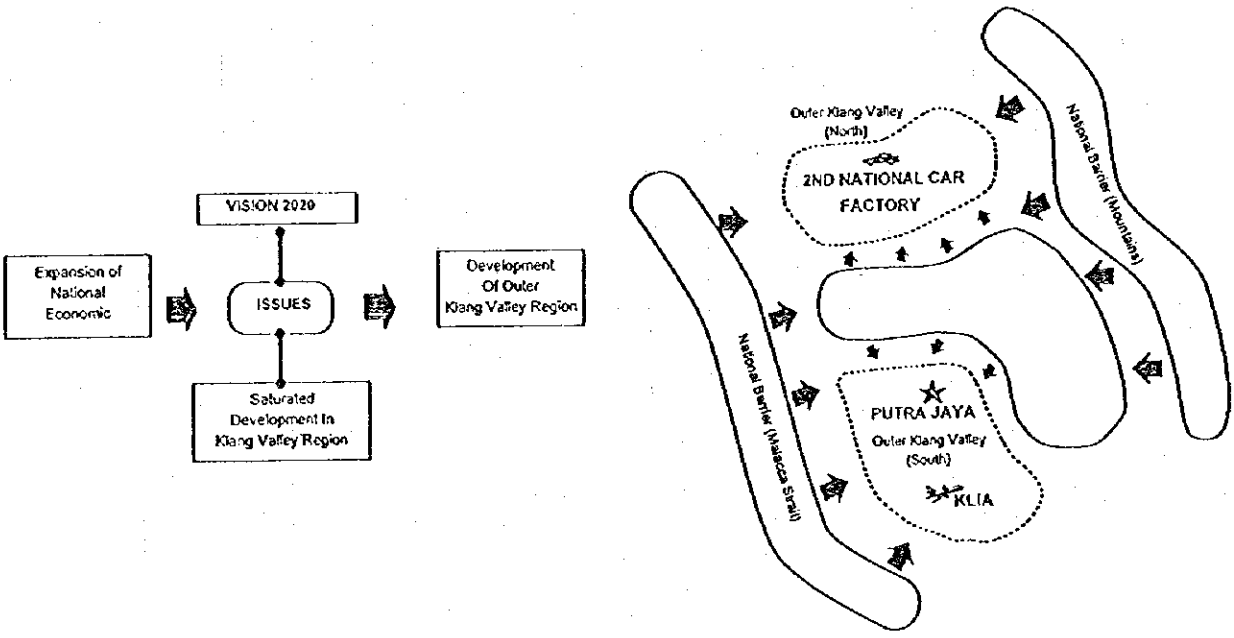


Figure 5-4 : Expansion of the Capital Region - Klang Valley

Figure 5-5 and Figure 5-6 show future economic growth by district in terms of GDP and Population . The rapid growth of GDP can be observed in the district Gombak and Hulu Selangor in the North, and Sepang and Kuala Langat in the South. Sepang district will expand rapidly, due to impact from Putra Jaya and KLIA projects. The distribution of population indicates same growth patterns as the GDP.

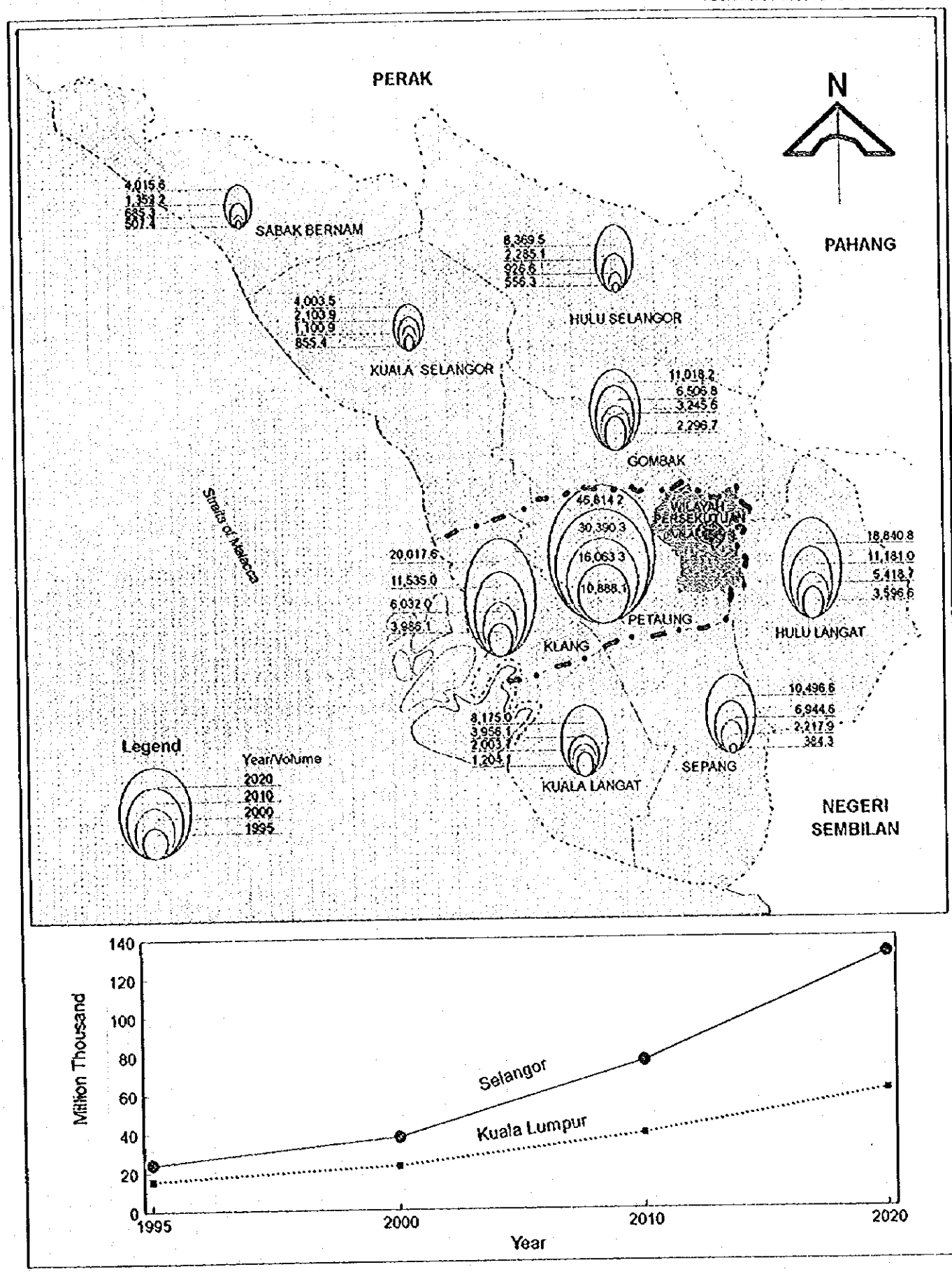


Figure 5-5 : Growth Domestic Product in Selangor

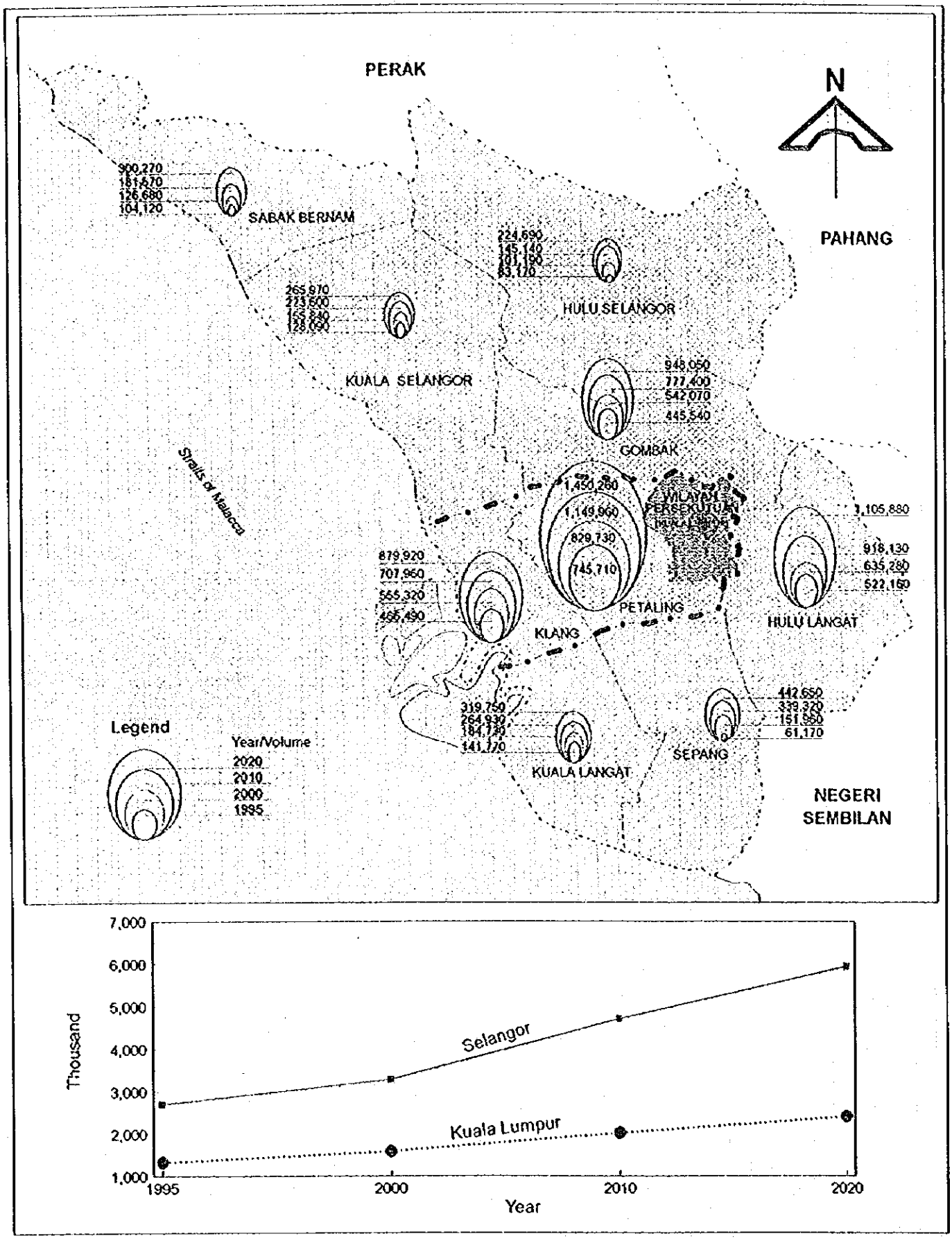


Figure 5-6 : Population Growth in Selangor

5.3 Development of Network Configuration

Existing road network and traffic conditions are described in Chapter 2. The basic frame work of the network configuration for the existing urban area, Klang Valley including Kuala Lumpur, will be completed with the existing on-going, projects such as MRRII, Shah Alam Highway and North-South Central Link Expressway, as illustrated in Figure 5-7.

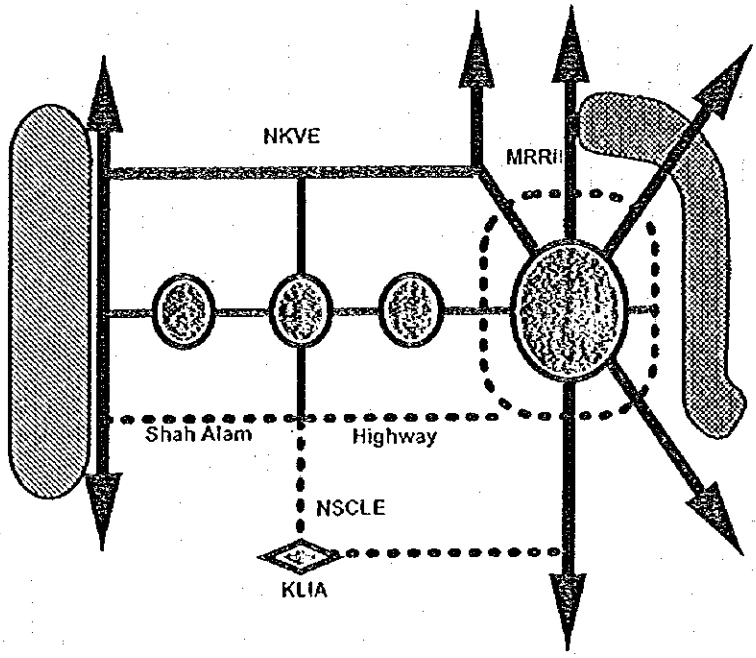


Figure 5-7 : Framework of Existing Urban Road Network

Future road network development for the existing urban area will be in the improvement of road network density based on the framework, which should be examined with other studies.

The other consideration is of the network configuration in Kuala Lumpur. Figure 5-8 shows the expansion of urban areas and road networks in Kuala Lumpur, which resulted in the urban road network forming a typical Radial-Circumferential configuration.

The major functions of the circumferential road are to disperse traffic and to provide a bypass route for through traffic. The necessity of a further outside circumferential road will be justified by the expansion of the urban area and present traffic conditions on the outer ring road (Middle Ring Road II - MRRII).

From view point of the expansion of the urban area, the KLORR can be justified in the north and south, because of the potentiality of rapid urbanization out side Klang Valley in the north and south. However, in the eastern side of Kuala Lumpur, urban expansion is controlled by the natural barriers of mountains. The justification of this link will be examined from the traffic congestion on the MRRII.

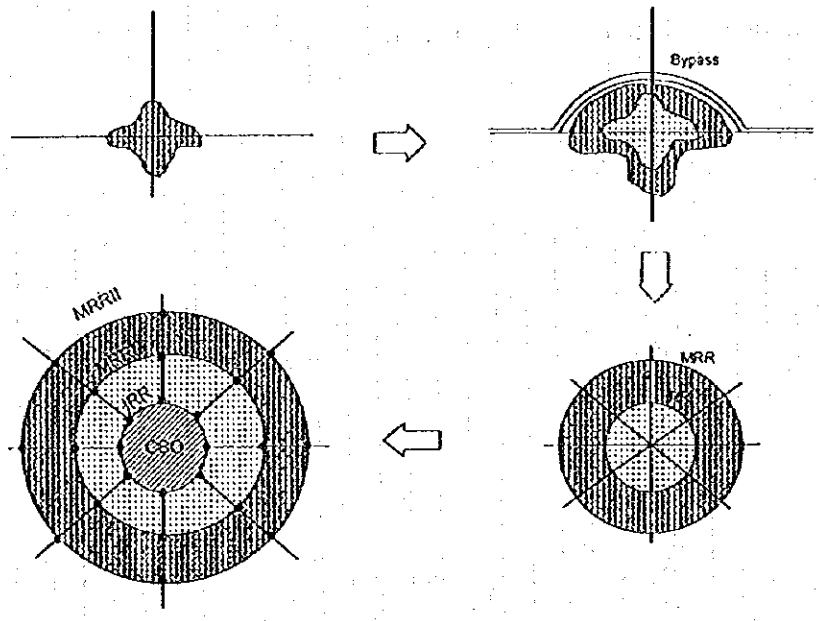


Figure 5-8 Expansion of Urbanization and Road Network

Figure 5-9 shows the result of traffic assignment with and without KLORR in year 2020 for the Study Area. Figure 5-9 also shows that the future traffic volume on the MRR II in the eastern sector is expected to decrease by 21%~25%, as compared with and without the KLORR. The traffic volume on MRRII without the KLORR is expected to be 133,300 veh/day; with the KLORR it is expected to be 102,000 veh/day by the year 2020. The volume/capacity ratio, considering the capacity to be 120,000 veh/day (6- lane) without the KLORR, will be 1.11, whereas, with KLORR it will be 0.85.

Based on the traffic assignment, MRRII will play an important role early on in traffic dispersal as an outer ring road. However, it will be selected based on the huge volume of regional traffic that will be generated from new urban areas.

The next question in building a network configuration is how to connect to the existing road network with interchanges. The KLORR will encounter major radial roads such as Federal Route 1, Kuala Lumpur - Karak Highway, Kuala Lumpur - Seremban Expressway, etc. Besides these major inter-state roads, it is important to provide linkages to major urban roads in Kuala Lumpur to ensure desirable configuration. They are Jalan Ampang, East - West Link and Middle Ring Road II as shown in Figure 5-10.

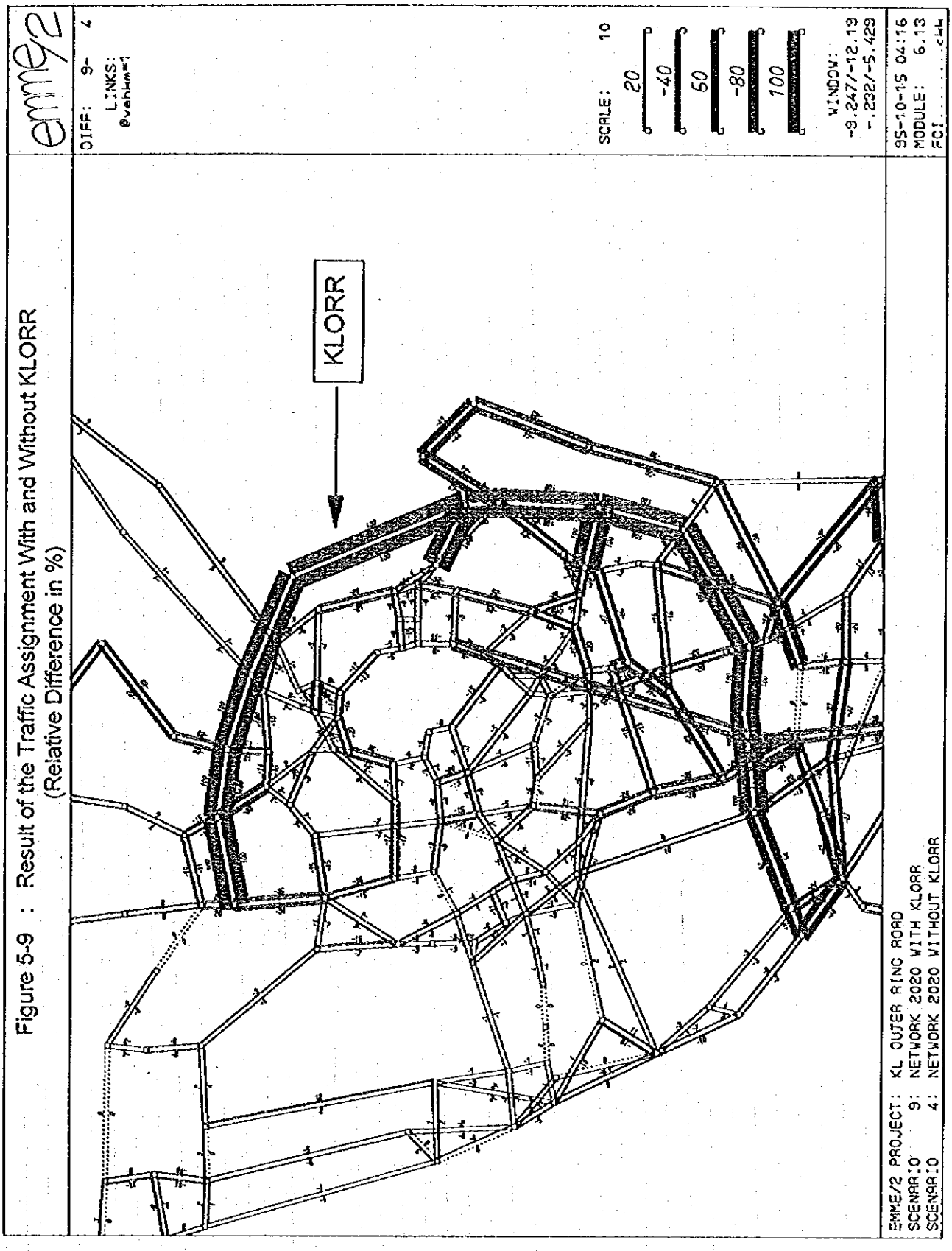


Figure 5-9 : Result of the Traffic Assignment With and Without KLORR (Relative Difference in %)

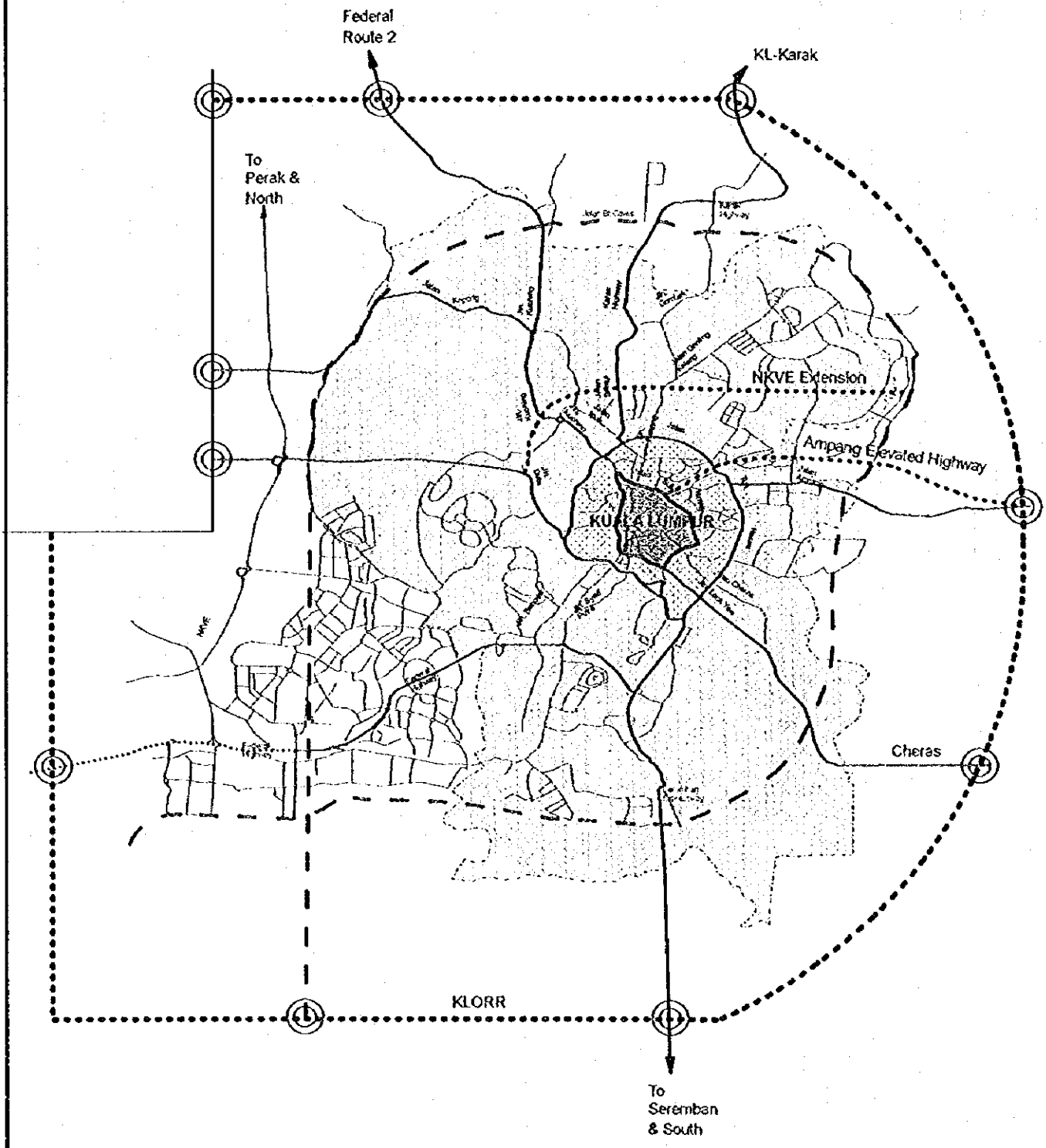


Figure 5-10 : Configuration Showing Linkage To Urban Road in Kuala Lumpur

5.4 KLORR Development Concept

In the recent trend of urbanization and motorization, the outer ring road is an element of 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 the needs are identified in previous sections. The development concept is illustrated in Figure 5-11 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 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 urban areas 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 roads 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 to meet future traffic demand.

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

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

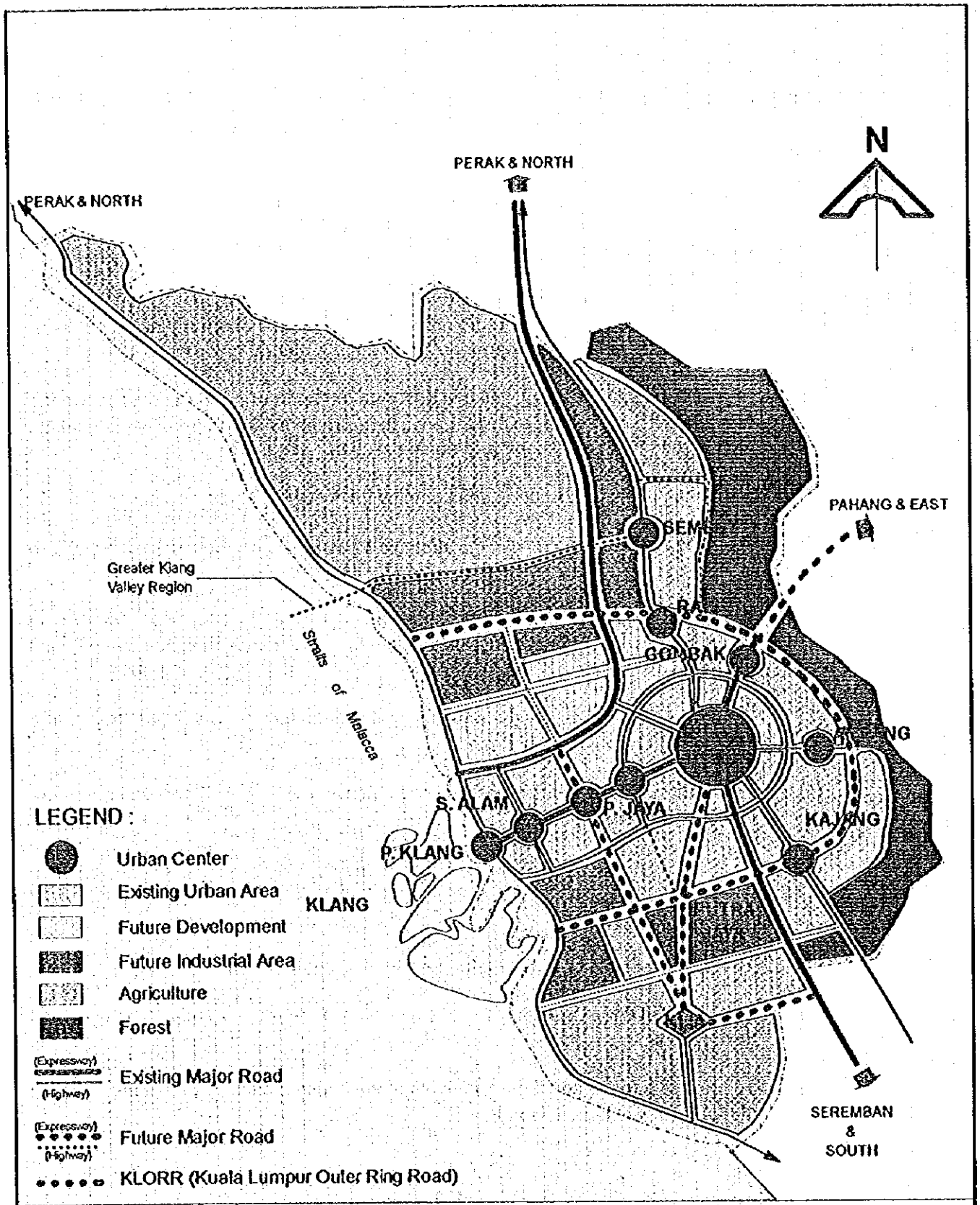


Figure 5-11 : Development Concept of KLORR

THE KUALA LUMPUR OUTER RING ROAD PROJECT

(Japan International Cooperation Agency)

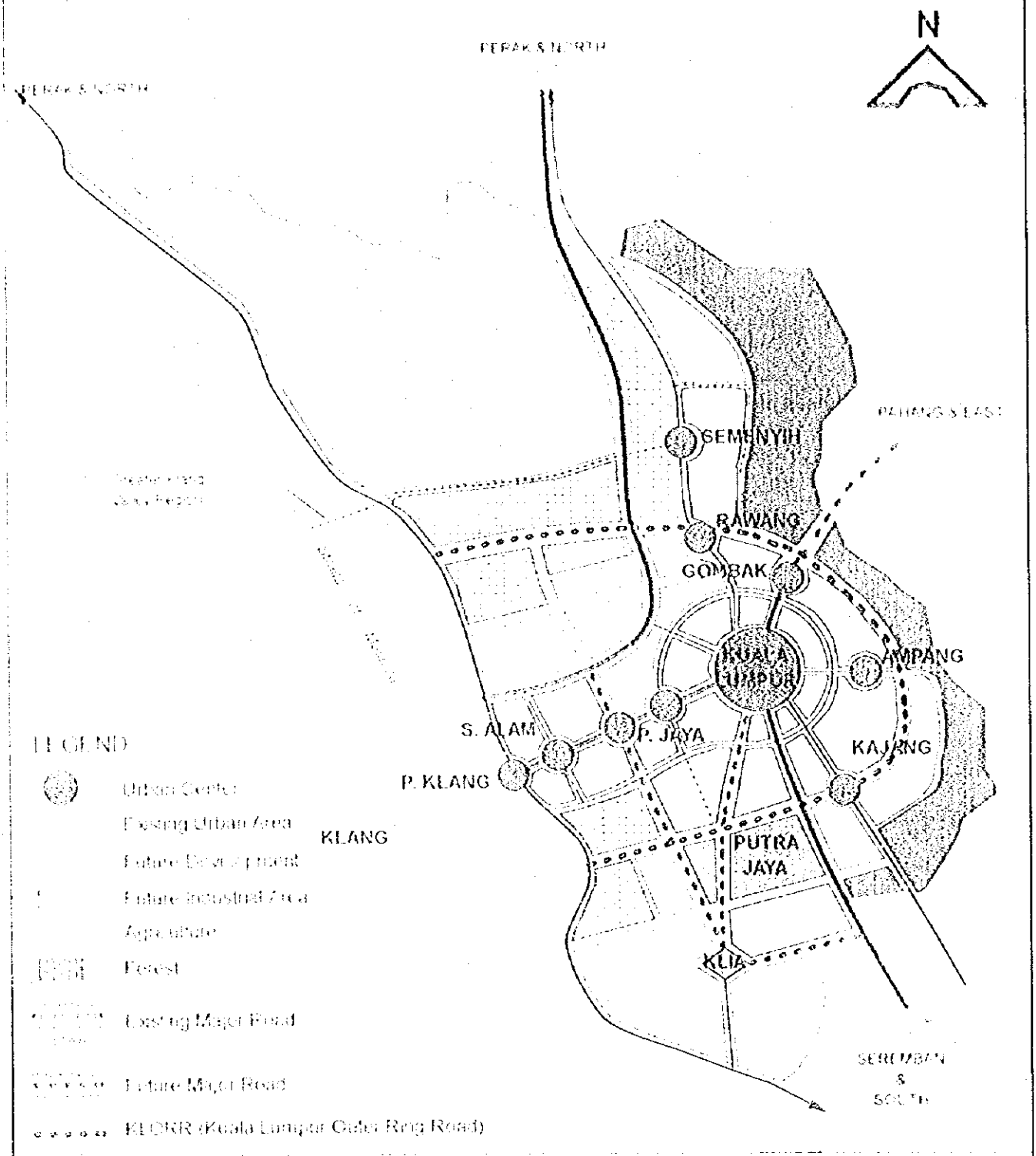


Figure 5-11 : Development Concept of KLORR

THE KUALA LUMPUR OUTER RING ROAD PROJECT

(Japan International Cooperation Agency)

Based on the above strategies, the study envisions the outer ring road as a ring encircling the Klang Valley Region, which eventually connects with the coastal highway (Federal Route 5). The objectives (1), (2) and (3), which are related to the urban developments are basically in the northern and southern links. Presently in those areas, there is no-proper road infrastructure. The KLORR, therefore, will provide the first proper road access to the areas. Comparing the development pressure between the north and south areas, the south area has more development pressure because of the Putra Jaya and KLIA projects.

From the view point of the efficiency of the infrastructure investment, the construction of the highway should be implemented with urban development projects which provide most significant impacts for the KLORR projects. The question is which project will raise the efficiency of the KLORR project. Putra Jaya Development Project can be seen as such project for two reasons. Firstly, the function of Putra Jaya as the main administrative center and secondly, its short distance from Kuala Lumpur. On the other hand, KLIA is a transport terminal and far from Kuala Lumpur with 40 km distance. It is important to provide sufficient access to the transport terminal. In addition to providing a link to the administration center, it is equally important to link other urban centers with the priority of building a functional urban hierarchy.

The next point involves spacing these areas from an existing (including committed projects) outer most highway, New Klang Valley Expressway in the north and Shah Alam Highway in the south. It is important to provide sufficient space between major highways for proper urban development and strategic expansion of urban areas, as well as to formulate the network configuration mentioned in the strategy (5). The other issues concerned are network configuration and environmental preservation.

The objectives (4) and (5) aim toward the dispersal of traffic, and the objectives (7) and (8) are environmental considerations. There should be careful investigation of environmental conditions, in the eastern section of the KLORR.

The mountainous area in the eastern part of Klang Valley is an important green area which forms a favorable urban environment. The area, therefore, should be preserved as much as possible.

Chapter 6

ENVIRONMENTAL ASSESSMENT FOR THE PROJECT CORRIDOR

CHAPTER 6 ENVIRONMENTAL ASSESSMENT FOR THE PROJECT CORRIDOR

This chapter summarizes existing environmental conditions and potential impacts based on the Preliminary Environmental Assessment Study report submitted to the DOE (Department of Environment). The PEIA study basically was conducted for the three alternative alignment indicated in the following chapter. The results of the assessment are referred to the PEIA report and also Appendix Volume.

6.1 The Existing Environmental Conditions

The Environmental Study Area covers an area of approximately 165,000 ha (407,340 acres) and includes Hulu Selangor, Gombak, Petaling, and Sepang Districts. The KLORR corridor bypasses the Kuala Lumpur Federal Territory region and passes through several major towns such as Serendah, Rawang, Batu Caves, Ampang, Gombak, Hulu Langat, Cheras, Kajang, Semenyih, Serdang, Puchong and Bangi. The existing environmental conditions in the Study area are as follows :

A. Physical Environment

1) Topography

Its outline ranges from low-lying plains with isolated hills in the south-western part of the area to undulating plain, whereas hills and mountains stand in the north and the east. The Main Range stretches from north to east with Gunung Hulu Kali (1,772m/5,814ft) as the highest point.

Only the catchment areas of Sungai Selangor, Sungai Kelang and Sungai Langat are confined within the boundaries of the Study Area. The northern part of the Study Area is drained by Sungai Selangor. Its middle part is saved by Sungai Kelang and Sungai Ampang whilst southern part of the Study Area is drained by Sungai Langat.

2) Geology

The general geology of the Study Area consists of various lithology from igneous, sedimentary to metamorphic rocks. The main mountain range consists of extensive masses of granite where original sedimentary cover has been removed by weathering and erosion. The low-lying areas mark the margin between granite and stratified rocks.

3) Climate

The Study Area is located in an equatorial climate region characterized by uniform temperatures and high humidity throughout the year. Low negative water balance was recorded in the months of January, June, July, August and October. There is an even distribution of wind direction. The Monsoons , however, have some effect on the surface wind direction. The north-eastern winds are dominant during the

months of December to March, whereas the southerly winds are dominant during the months of June till August.

4) Water and Air Quality

The water of the nine rivers coursing the Study Area show satisfactory pH level. The water quality near water intake points are good. The BOD levels were lower than standard. The COD levels, however, exceed the standard at some point. The high COD levels may be due to non-biodegradable substances such as industrial wastes.

Overall air quality of the Study Area is satisfactory.

5) Noise Level

Noise levels near highway are rather high such as in Kajang, Karak Highway, Serendah and Templer Park reflecting daily traffic fluctuation. In Hulu Langat it is still low.

B. Biological Environment

1) The Flora and Vegetation

There are fourteen (14) Forest Reserves and four (4) virgin jungle Forest Reserves in the Study Area. The flora and vegetation are classified as follows:

i) Lowland dipterocarp forests --- logged over and virgin stand
ii) Hill dipterocarp forests
iii) Logged over hill dipterocarp forests
iv) Quartzite ridge vegetation
v) Limestone hills
vi) Peat swamp forest

2) Fauna

The contiguous nature of the Forest Reserve within the State as well as with those of the neighbouring State offers a degree of mobility for many of the birds and animal. In general, it is observed that because of the contiguity, many of these forest reserves contain animal species that are common to each other.

C. The Socio-Economic Environment

The socio-economic and traffic condition of the study area are mentioned in Chapter 3 and Chapter 4 respectively. Only land use is mentioned here.

1) Land use

Information on existing Land use in the Study Area is derived mainly from the 1994 Malaysia Center for Remote Sensing Map based on satellite imagery of 1991. Land use details are presented in Table 6-1 and the spatial distribution of the Land use

The Study Area is divided into 3 zones of Land use : Hulu Selangor and Gombak District represent the Northern Zone; Hulu Langat District represents the Middle Zone while the parts of the Districts of Sepang and Petaling represent the Southern Zone.

(1) Northern zone
Most of the forested land is located in the western portion of this zone, which covers 62% of this zone. Most of the forested area are forest reserves. Agricultural Land use accounts for 19% of this zone with rubber and oil palm

Table 6-1 : Land use of the Study Area

	Northern Zone		Middle Zone		Southern Zone		Total	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Urban land								
Urban and Associated Areas	5193.6	8.2	6325.6	8.6	977.6	3.5	12496.8	7.6
Industrial Area	-	0.0	323.2	0.4	-	0.0	132.2	0.2
Estate Building	9.8	0.0	-	0.0	9.8	0.0	19.6	0.0
Recreational Area	312.8	0.5	-	0.0	-	0.0	312.8	0.2
Mining Area	1304.8	2.1	1667.2	2.30	1912.8	6.9	4884.8	3.0
Sub-total	6821.0	10.7	8316.0	11.3	2900.2	10.4	18037.2	11.0
Cultivated Land								
Mixed Horticulture	1038.4	1.6	1854.4	2.5	2617.6	9.4	5510.4	3.3
Rubber	9694.0	15.2	22037.0	30.0	5639.2	20.3	37370.2	22.7
Oil Palm	3354.0	5.3	4964.0	6.8	8489.2	30.5	16807.2	10.2
Forest Plantation	323.2	0.5	-	0.0	-	0.0	323.2	0.2
Paddy	-	0.0	342.8	0.5	-	0.0	342.8	0.2
Sub-total	14409.6	22.7	29198.2	39.8	16746.0	60.2	60353.8	36.6
Non-Cultivated Land								
Natural/Semi-Natural Vegetation	37782.4	59.4	29782.4	40.6	3980.4	14.3	71545.2	43.4
Dry Land Forest	-	0.0	-	0.0	368.4	1.3	368.4	0.2
Peat and Freshwater Swamp Forest	-	0.0	98.0	0.1	19.6	0.1	117.6	0.1
Logged Forest	1661.2	2.6	2826.0	3.8	580.8	2.1	5068.0	3.1
Secondary Forest	1528.8	2.4	959.6	1.3	724.8	2.6	3213.2	1.9
Bush, Grassland, Scrubrass land								
Sub-total	40972.4	64.4	33666.0	45.9	5674.0	20.4	80312.4	48.7
Non-Cultivated Land, Non Vegetated	597.6	0.9	1404.0	1.9	1616.8	5.8	3618.4	2.2
Cleared Land								
Sub-total	597.6	0.9	1404.0	1.9	1616.8	5.8	3618.4	2.2
Water								
Large Water Body	793.2	1.2	832.8	1.1	871.6	3.1	2497.6	1.5
Large Fishpond	-	0.0	-	0.0	19.6	0.1	19.6	0.0
Sub-total	793.2	1.2	832.8	1.1	891.2	3.2	2517.2	1.5
Total	63593.8	100.0	73417.0	100.0	27828.2	100.0	164839.0	100.0

Source : Land Cover Map (1994), MACRES

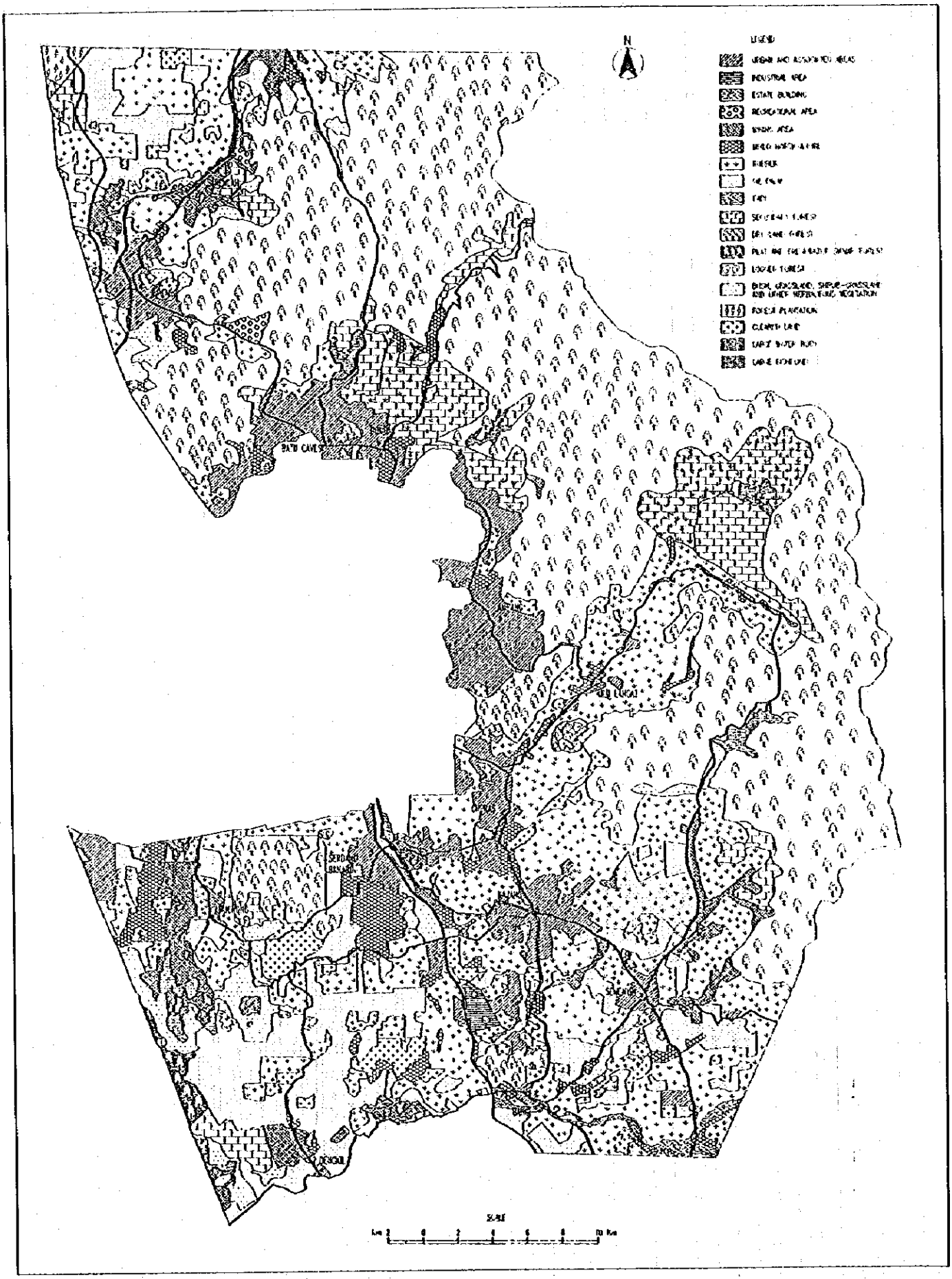


Figure 6 - 1 : Landuse Pattern

(2) Middle zone

The forested land use account for the biggest Land use category of 53% in this zone. Agriculture land is the second biggest Land use contributing 28% of the zone. A big stretch of rubber plantation is located at Hulu Langat. The urban area contributes to 15% of the zone. Most of these areas are located at peripheral of Kuala Lumpur such as Ampang and Cheras.

(3) Southern zone

Agriculture is the biggest Land use category in this zone, accounting 47% of the zone. The major crops are oil palm and rubber. The urban area covers 29% of the zone stretching from Cheras towards Kajang and further southwards to Bangi.

6.2 Identification of Environmentally Sensitive Areas

The environmentally sensitive areas 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 sensitive areas 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.

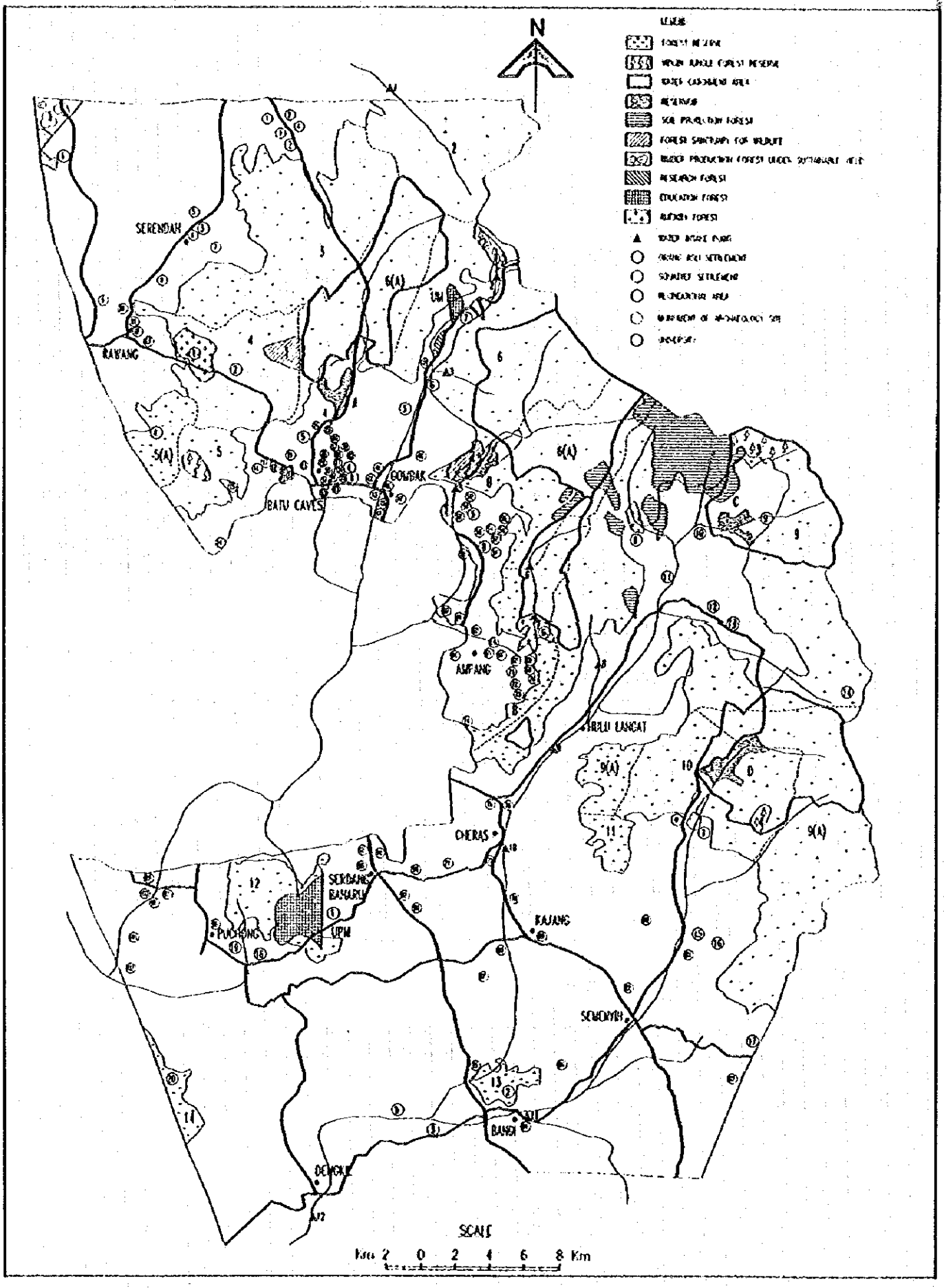


Figure 6-2 : Sensitive Sites in the Study Area

LOCATION OF SENSITIVE SITES IN THE STUDY AREA

FOREST RESERVE

1 Rantau Panjang
2 Batang Kali
3 Serendah
4 Kanching
5(A) Bukit Lagong (Extended)
6(A) Hulu Gombak (Extended)
7 Ampang
8(N) Bukit Sungai Puteh (North)
8(S) Bukit Sungai Puteh (South)
9(A) Hulu Langat (Extended)
10 Sungai Lalang
11 Sungai Jeloh
12 Air Hitam
13 Bangi
14 Kuala Langat (North)

VIRGIN JUNGLE FOREST RESERVE

1 Bukit Lagong
2 Hulu Gombak
3 Hulu Langat
4 Sungai Lalang

WATER INTAKE POINT

1 Sg. Batang Kali
2 Sg. Gombak
3 Sg. Rumput
4 Sg. Batu
5 Sg. Kelang
6 Sg. Ampang
7 Sg. Ampang
8 Sg. Gahal
9 Sg. Langat
10 Sg. Langat
11 Sg. Beranang
12 Sg. Langat

RESERVOIR

1 Batu Dam
2 Kelang Gate Dam
3 Sg. Langat Dam
4 Semenyih Dam

FOREST SANCTUARY FOR WILDLIFE

1 Templer Park
2 Kelang Gate

ORANG ASLI SETTLEMENT

HULU SELANGOR DISTRICT

1 Kg. Bukit Manchong
2 Kg. Gurney
3 Kg. Melaka Serendah

GOMBAK DISTRICT

4 Kg. Hulu Kuang
5 Kg. Sg. Tua
6 Pusat Pembangunan Orang Asli (Hosp)
7 Kg. Batu 16, Gombak
8 Kg. Hulu Kelang

HULU LANGAT DISTRICT

9 Kg. Dunglai Baru
10 Kg. Kuala Pansun
11 Kg. Padang/Perdik
12 Kg. Sg. Lui
13 Kg. Gabai
14 Kg. Genting Peras
15 Kg. Sg. Lalang
16 Kg. Kachau
17 Kg. Beroga

PETALING DISTRICT

18 Kg. Sg. Rasau Hulu
19 Kg. Sg. Rasau

SEPANG DISTRICT

20 Kg. Bukit Baja
a. Kemajuan Tanah Sungai Lalang Orang Asli (FELCRA)
b. Sakai Reserve

SQUATTER SETTLEMENT

HULU SELANGOR DISTRICT

Mukim Hulu Yam

1 Hulu Yam Baru
2 Hulu Kalong
3 Kg. Sg. Chik
4 Kg. Gurney

Mukim Serendah

5 Maccau Street
6 Kg. Melaka
7 Kg. Tok Pinanag
8 Kg. Sg. Choh

GOMBAK DISTRICT

Mukim Rawang

9 Rawang Tin
10 Kg. Rajah
11 Bt. 18 & Bt. 19
12 Kg. Kenanga, Bt. 17
13 Bt. 16 Rawang

Mukim Batu

14 Desa Aman, Bt. 11
15 FRI Kepong
16 Selayang Tin
17 Lembah Selayang
18 Seri Cendana
19 Jalan Bt. 50, Selayang Baru
20 Seri Wira Damai
21 Seri Temenggung
22 Selayang Bahagia
23 Jalan Besar Selayang Baru
24 Kg. Mahkota
25 Jalan Sg. Tua
26 Kg. Nakhoda
27 Kg Bendahara
28 Kg. Bahtera
29 Kebun Sireh
30 Kg. Kannesion
31 Kg. Baru Batu Caves
32 Kg. Melayu Batu Caves
33 Lembah Indah
34 Kg. Laksamana
35 Air Jernih
36 Kg. Jaya
37 Kg. Laksamana Jaya
38 Bukit Perwira
39 Kg. Benggali
40 Kg. Sentosa
41 Seri Gombak Indah
42 Gombak Jaya
43 Taman Selasi
44 Kok Doh II
45 Lembah Mutiara
46 Lorong Muhibbah

LOCATION OF SENSITIVE SITES IN THE STUDY AREA

Mukim Setapak

47 Kg. Tengah, Gombak
48 Kg. Desa Mukmi
49 Bt. 10-12, Gombak

Mukim Hulu Kelang

50 Sg. Kelang
51 Suk Hulu Kelang
52 Batu 8
53 Bukit Permai
54 Kg. Kemeseh
55 Bukit Baru
56 Bukit Baru
57 Kg. Pasir Tambahan
58 Lembah Keramat
59 Kg. Selamat
60 Kg. Berembang
61 Kuala Ampang
62 Ampang Jaya

HULU LANGAT DISTRICT

Mukim Ampang

63 Kg. Seri Melor
64 Kg. Pandan Jaya
65 Kg. Baru Ampang
66 Kg. Seri Ampang
67 Kg. Tengah
68 Taman Risab Rida
69 Kg. Lembah Jaya Utama
70 Kg. Ampang Indah
71 Kg. Ampang Campuran
72 Kg. Tasik Permai
73 Kg. Tasik Campuran
74 Kg. Cheras Baru

Mukim Cheras

75 Kg Taman Nasir
76 Kg. Sg. Raya
77 Kg. Baru Balakong
78 Kg. Indah
79 Kg. Lombong

Mukim Semenyih

80 Kg. Sg. Pening
81 Kg. Jalan Sg. Lalang
82 Batu 3
83 Kg. Baru Tarun

Mukim Kajang

84 Kg. Masjid Bangi
85 Kg. Teras Jernang
86 Kg. Sg Tangkas
87 Sg. Ramal
88 Kg. Sg Chua
89 Sg. Kantan

PETALING DISTRICT

Mukim Petaling

90 Kg. Serdang Lama
91 Bel. Klinik Serdang
92 Kg. Taman Aman
93 Kg. Serdang Jaya
94 Lombong Sungai Besi
95 Simpanan Sg. Kuyoh
96 Batu 14 Puchong
97 Kg. Tun Razak
98 Kg. Bersatu
99 Kg. Kenangan
100 Kg. Seri Puchong
101 Kg. Pulas

SEPANG DISTRICT

Mukim Dengkil

102 Kg. Tanah Liat

RECREATIONAL AREA

1 Kanching Forest Reserve Recreation Park
2 Templer Park
3 Mimaland
4 Batu Caves
5 Natioanal Zoo
6 Ampang Forest Reserve Recreation Park
7 Sungai Lalang Forest Reserve Rereation Park
8 Sungai Chongkak Recreation Park

MONUMENT OR ARCHAEOLOGY SITE

1 Batu Caves
2 Bukit Melawati, Ulu Kelang
3 Bukit Piatu, Jenderam Hilir

UNIVERSITY

1 University Pertanian Malaysia
2 University Kebangsaan Malaysia

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

Among Orang Asli in the Study Area, 93% of them belong to the Temuan sub-tribe, with a total population of 4,776. Hulu Selangor District has the highest population of 1,526 followed by Hulu Langat District with 1,133. There are a total of 35 Orang Asli kampungs in the Study Area.

(3) Others

There are also three monumental sites identified within the Study Area, whereas five archaeological areas are found in Bukit Melawati and Hulu Klang.

6.3 Potential Environmental Impacts and Assessment

6.3.1 Identification of Potential Environmental Impacts

Various activities will be carried out during the investigation, construction and operational phases of the Project. These activities will have a potentially significant impact on the natural as well as 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 by shortening of the traveling distance. The highway 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, economic activities in the area should 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 rise.

Table 6-2 : Matrix of the Potential Impacts which may arise from the Project Development

SCALE / MAGNITUDE

BENEFICIAL/POSITIVE IMPACTS

HIGH	+3
MEDIUM	+2
LOW	+1

ADVERSE/NEGATIVE IMPACTS

HIGH	-3
MEDIUM	-2
LOW	-1

ENVIRONMENTAL COMPONENTS				PROJECT ACTIVITIES: PRE-IMPLEMENTATION				CONSTRUCTION												OPERATIONAL								CONSEQUENT PROJECTS		
				SITE SURVEYING	ENGINEERING INVESTIGATION	LAND SURVEY	GEOTECHNICAL SURVEY	SITE CLEARING/BURNING	STREAM CROSSINGS	ACCESS ROAD	EARTHWORKS	DRILLING AND BLASTING	DEMOLITION	DRAINAGE ALTERATION	SURFACING AND PAVING	WASTE DISPOSAL	LANDSCAPING / EROSION CONTROL	ESTABLISHMENT OF LABOUR "KONGSI"	TRAFFIC	BARRIERS	LANDSCAPING	UTILITIES MANAGEMENT	EMPLOYMENT/LABOUR FORCE	ACCIDENTS/FIRE CONTROL	SOLID/LIQUID WASTE DISPOSAL	TRAFFIC CIRCULATION	URBAN DEVELOPMENT	AGRICULTURAL DEVELOPMENT	TOURISM
PHYSICO-CHEMICAL	LAND	SOIL PROFILE									-1																		
		SOIL EROSION			-1		-1	-3			-3				+3		+3				+3								
		SLOPE STABILITY									-3			-2			+3				+1								
		LANDUSE						-2		-1							+3										+3	+3	+3
		SUBSIDENCE & COMPACTION								-1	-3						+3												
	SURFACE WATER	FLOW VARIATION												-3	-1														
		WATER QUALITY	-1					-3	-3		-3					-2	+2	-1	+1			+1	-1		-3		-1		-1
		DRAINAGE PATTERN						-2						-1	-1														
		WATER BALANCE						-1							-1		+1												
		FLOODING						-3	-2		-3			-3	-2		+1										-1		
		STORM RUNOFF						-3						-2	-2		+1				+1								
	GROUND WATER	WATER QUALITY														-2					+1				-3				
		FLOW REGIME																											
		WATER TABLE																											
	ATMOSPHERE	AIR QUALITY						-3			-3	-2	-1			-1			-1							-3	-1		
		VISIBILITY									-3	-2																	
		MICRO CLIMATIC CHANGES																											
	NOISE	INTENSITY						-2			-3	-3	-1						-1	+2						-3			
		DURATION									-2	-1							-1										
		FREQUENCY									-2	-1							-1										
BIOLOGICAL	SPECIES & POPULATION	FLORA						-3	-1	-1							+1				+1						-3	-1	
		FAUNA						-3	-1	-1																	-3		
		ENDANGERED SPECIES																											
	HABITAT & COMMUNITY	HABITATS																											
		COMMUNITIES																											
		ECOSYSTEMS						-3	-1								+2				+2						-3		
HUMAN	HEALTH & SAFETY	PSYCOLOGICAL WELL-BEING										-3	-3				+1		+2			+1	+1	+1		+3			+3
		PHYSICAL SAFETY								-1	-2	-3	-2						-1	+3				+3						
		COMMUNICABLE DISEASES														-3						+1				+2			
	SOCIAL & ECONOMICAL	EMPLOYMENT	+1	+1	+1		+1				+1					+2	+1		+2		+2	+3	+3				+3	+3	+3
		HOUSING																+3	-1								+3		
		INFRASTRUCTURE/UTILITIES								+1					+3				+3			+3							
		ECONOMICAL RESOURCES																	+3			+3					+3	+3	+3
	AESTHETIC & CULTURAL	LANDFORM									-1				+3		+2		+3	-1	+3						+3		+3
		BIOTA															+1												
		TRANQUILITY						-1			-2					-3	+1		-1		+1	+3							+3
		LANDSCAPE						-3			-3				+2		+3				+3						+3		+3

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 increases services and amenities for rural folks.

The proposed alignment of the highway would wind its way through some thickly forested mountain regions of Malaysia. Therefore, breath-taking scenic views would be offered by the rich natural surroundings. Such viewing points would be 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 any consequential development. However, unplanned settlements might result with adverse impact due to inadequate services and amenities. Table 6-2 shows a matrix of potential consequence which may arise with the implementation of the Project.

6.3.2 Potential Significant Impact

(1) Impact on the Physical Environment

The potential significant consequences on the physical environment include soil erosion, changes in hydrological regime, water pollution, noise pollution and solid waste disposal.

Soil Erosion

There are two types of soil erosion, namely geological erosion and accelerated erosion. Geological erosion is a natural process, governed by the action of water, wind, climate and vegetation and generally the rate is low. Accelerated erosion is due to human activities such as land clearing and earthworks. It generally causes an adverse impact on the environment because of nutrient loss and sediment output.

Soil erosion analysis was carried out for the existing environment. During the construction phase, the high risk erosion areas are mostly in the northern and eastern section. About 6.5 % of the Project Site is classified as high risk erosion areas with an erosion rate more than 1000 tones/ha/yr. Figure 6-3 shows an overlay of the topography with the high risk erosion areas on the proposed routes. In order to reduce soil erosion during site clearing, slopes should be contour cut and turfed immediately.

Impact on the Slope Stability

Landslides normally occur on soil or highly weathered rocks with increased stress due to the high angles of slope cutting and increasing weight of mass especially after

a heavy down pour.

If slope cutting is parallel to the dip of the sedimentary strata or schist foliation (Kenny Hill Formation, Kajang Formation, Dinding and Hawthornden Schist), failures will happen between beds, and the situation would worsen with the occurrence of joints. With a proper drainage system, water normally seeps through these joints or discontinuities of strata, thus weathering the rock surface, accompanied by the formation of clay minerals, which act as a trigger mechanism to slope failures.

Exposed granite rocks without proper mitigation measures will enhance slope failure such as rockfall. The angle of slope cutting on solid granite without discontinuities can be as high as 80°, but for granite with joints and fractures, slope angle cuts should be reduced to less than 45° . If cutting of granite is impossible under such circumstances, anchoring, rock bolt, concrete and shotcrete are recommended (Sower, 1979).

Hydrology and Flooding

Hydrology of the environment is governed by the distribution of vegetation, rainfall and evapo-transpiration rate. Any variation in this dynamic equilibrium will cause changes in the hydrology of the area.

The proposed Project which involves forest clearing, construction of embankments, bridges and tunnels along the stretch would cause short term hydrological impacts. The results could be manifested in a variety of ways:

(i) Reduction in infiltration rate due to loss of vegetation cover leading to a reduction in the recharge ability of the water catchment.

(ii) Increase in surface runoff as a result of land clearing. The removal of vegetation cover will increase the surface area subject to surface runoff and therefore, erosive force.

(iii) Removal of vegetation will result in a reduction of rainfall interception which would have negative impacts on the availability of water supply at the abstraction points.

(iv) Blocking of existing streams for bridge construction may cause some short-term localized flooding at upstream.

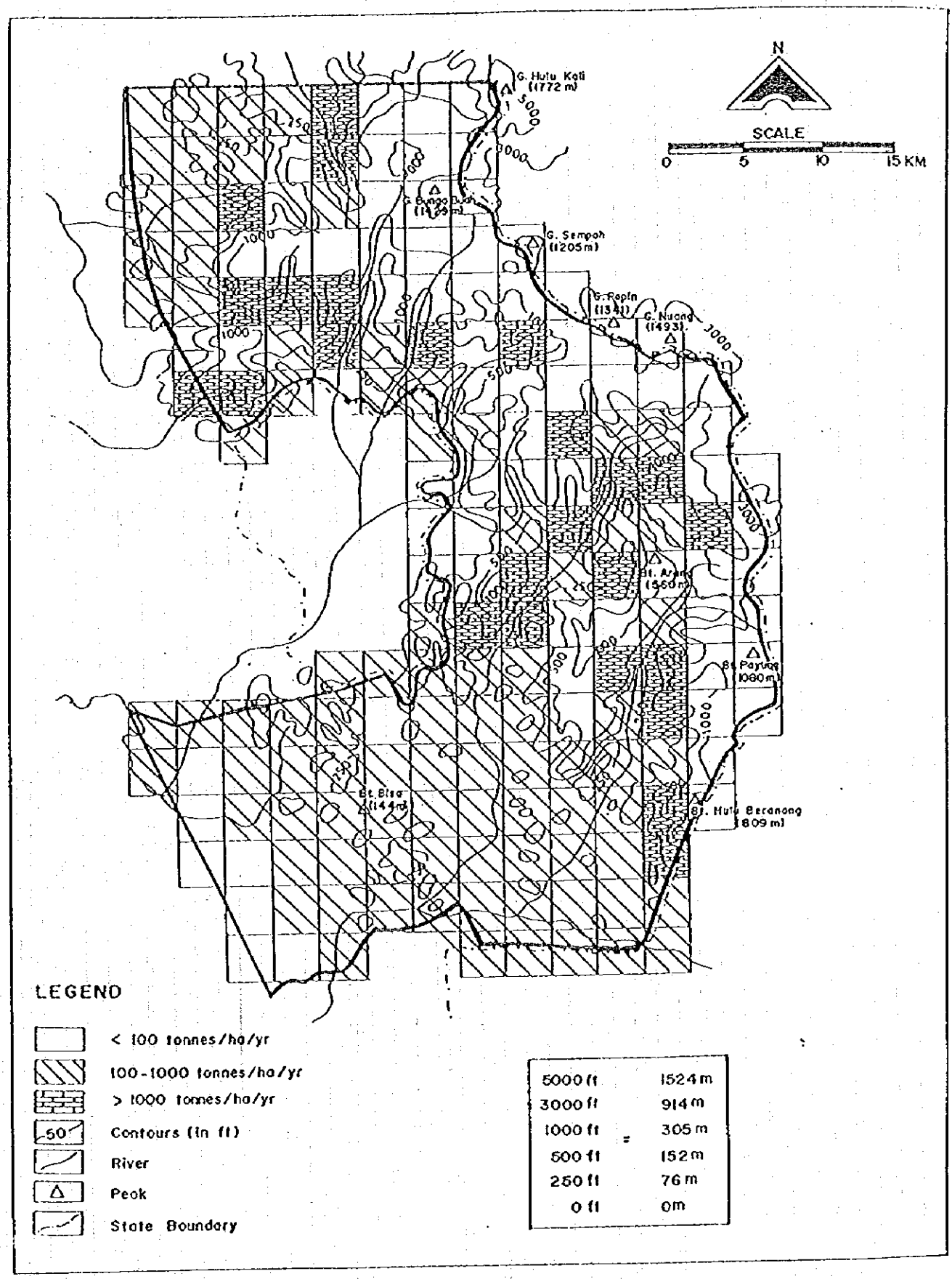
(v) Construction of tunnels would alter the drainage pattern of the area.

For the proposed highway this impact will be more severe in the northern and middle sections where the proposed road alignments pass through the water catchment areas of Hulu Gombak Forest Reserve and Ampang Forest Reserve.

Water Pollution

Water pollution will be significant during the construction phase. Sedimentation is

Figure 6-3 : High-risk Erosion Areas Identified in the Study Area



the main pollutant. During the construction phase, activities such as site clearing and earthwork will result in soil erosion and sedimentation of the waterways. The sediments will impact negatively on the downstream water quality especially where there are municipal water intake points or settlements which depend on the rivers for their water needs. The increase in suspended solids will raise the cost of treating drinking water at the water intake points. However, this impact will be for short-term.

Indiscriminate waste disposal is another source of water pollution during the construction phase. The waste generated from various earthwork and land clearing activities will need to be disposed. If this is not managed appropriately, it will pollute the bodies of water. Air pollution will be significant during the construction and operational phases of the Project.

Among all types of air pollutants, dust particles should be given particular attention during construction phase. Its source is mainly construction activities and earthworks. Typical particle concentration can be as high as 200 $\mu g/m^3$ if such activities are carried out without proper mitigation measures in place.

Emission from vehicles would cause substantial air pollution during operational phase. The toxicity of air pollutants varied accordingly from those of primary to secondary in nature.

For the proposed highway, the total suspended solids (TSP) level is expected to be below 200 $\mu g/m^3$. As a comparison, the existing TSP level on Karak Highway is 173 $\mu g/m^3$, which is well below the Recommended Malaysian Guidelines.

Noise Pollution

Noise pollution is expected to be significant during the construction and operational phase of the Project.

Table 6-3 : Noise Pollution, by Different Moving Vehicle

Source of Noise	% Contribution to the Noise			
	Light Vehicles		Heavy Vehicles	
	Town	Open Road	Town	Open Road
Air intake inlet, exhaust outlet	15 - 35		15 - 60	
Exhaust pipe assembly	15 - 30			
Engine block	20 - 30	20 - 70		40 - 80
Gear box and transmission	5 - 30		30 - 80	
Cooling fan	-		10 - 50	
Type-road surface contact	5 - 10			
		30 - 80	5	20 - 60

Source : Saenz and Stephens, 1986

During the construction phase, noise will be generated by activities such as land clearing, stripping, grading excavation, transportation and mechanical plants. The impact by the noise pollution, during the construction phase on the environment, is dependent on the distance from the source of pollution. As expected, it decreases with the distance from the noise pollution source.

Traffic noise would be one of the main consequences of this Project in the long run. It is caused by moving vehicles.

The estimated daily noise level L_{eq} (day night equivalent) for each zone of the highway range from 70 dBA to 73 dBA or specified by WHO's Recommended Noise Exposure Limits. Therefore the proposed Project would not cause significant hearing damage as the exposure time is less than 8 hours per day. However, particular attention should be paid to noise levels during daytime, especially in the southern zone where the estimated noise levels exceed the recommended noise exposure limits.

Generally, high traffic noise levels are expected along the northern and southern zones. This is mainly due to high traffic volume along these stretches of the highway.

Table 6-4 : Estimated Daily Leq Levels During the Operational Phase

L_{eq} Levels (dBA)	Northern Zone		Middle Zone			Southern Zone		
	A1	B1/C1	A2/ A2B2	B2/ A2 B2	C2	A3B3/ A3/ A3B3C3	A3B3/B3/ B3C3/ A3B3C3	C3/ B3C3/ A3B3C3
Daytime	75.43	75.62	73.37	74.86	77.11	77.83	77.13	76.96
Night-time	67.64	67.84	65.59	67.08	69.32	69.60	69.35	69.17
Average	71.54	71.73	69.48	70.97	73.22	73.49	73.24	73.07
Daily Traffic Volume	23,900	25,000	14,900	21,000	35,200	37,500	35,400	34,000

Solid Waste Disposal

Solid waste disposal would not be an important issue if proper disposal areas were identified for the purpose.

(2) Impacts on the Biological Environment

Under the National Forest Policy, the forest reserves are gazetted as permanent forest estates. Depending on their use, parts of the reserves can be gazetted for different purposes: soil and water conservation, water catchment areas, sustainable timber and other forest produce, balancing the ecosystem, preventing soil erosion, moderating the harmful effects of droughts and torrential rains (which can result in

crop flooding and failures), research, recreation and education. The continued supply of water to reservoirs and hydro-electric dams to a great extent is dependent on the protective roles the forests in conserving the land surface surrounding the dams. The forested land is also the natural habitat for diverse animal wildlife including birds. Currently, sections of Ampang FR, Hulu Gombak FR, Hulu Langat FR, Kanching F.R and Sg. Lalang have been designated as water catchment areas. Many of these forests still harbour rare and endangered plant and animal species. Any disturbances on forest reserves would definitely affect their vital roles.

The development during the construction phase will have a negative effect on the flora and fauna in the Project area and its vicinity. The construction of roads in new areas, especially through forest reserves would open up new economic potential for logging as well as other developments, which may adversely affect the existing status of the forest and its inhabitants.

Impact on Forest Vegetation

During the construction phase, site clearing, trimming of slopes and other earthwork will result in the removal and destruction of vegetation along the road alignment. On sites that have been cleared of vegetation, secondary growth will appear. This normally include common secondary plant species comprising various *grasses, Melastoma, Macaranga, Mallatos etc.* Clearance of the forest will cause a significant impact directly or indirectly on the environment.

Direct impact on the environment includes :

(a) Permanent loss of good hill dipterocarp forests

This will be significant as the project area traverses hill dipterocarp forests. The forest areas affected will be greater in the Northern and Middle zones compared with those in the southern zones. Nevertheless, the area to be cleared will be small as the width of road will be 20 m. Therefore, in terms of quantity, the number of trees to be felled will be few, if they are cut selectively.

(b) Permanent loss of genetic resources or species of scientific interest

Along with the loss of forest is the loss of genetic resources found within the forest. The forest traversed by the proposed routes contains a large number of species.

(c) Disturbance of ecologically sensitive areas

Areas such as the quartz ridge at the Klang Gates and some limestone hills are sensitive areas with unique vegetation. If disturbed this vegetation will be permanently lost. Route A will skim through south of the quartz ridge.

Indirect impact from the loss of forest will create a pattern of deterioration on the existing environment due to the disruption of the vital roles played by the forests.

Indirect impact includes:

(a) Loss of wildlife habitat

The forest is the home for wildlife. A high population of various fauna is harbored in the forests including those which are endangered or protected. The animals depend a lot on the forest as it is their habitat. Due to a delicate and complex ecosystem in existence, any removal of forest causes loss of habitat for wildlife. This is especially true in the sanctuaries. There are two wildlife sanctuaries located in the impact Area, i.e., Templer's Park in Northern zone and Klang Gates in the Middle zone.

(b) Erosion due to removal of vegetation cover

A direct effect of forest removal is soil erosion. The clearance of vegetation cover will expose land to various erosive agents, especially water. Soil erosion will then occur. A few parts in the Hulu Gombak Forest Reserve have been gazetted as the Soil Protection Forests so that a tunnel can be built to minimize cutting and therefore minimizing the risk of erosion.

(c) Change in hydrology regime

Forest cover plays a major role in maintaining the hydrology regime. Loss of forest cover will increase surface runoff due to the lowered infiltration rate. Increased surface runoff increases the possibility of floods. All three proposed routes will pass through many of the forest reserves which are gazetted as water catchment areas. Nevertheless, as the cleared working area will not be large, the impact will be minimal.

The subsequent development that will occur in tandem with the proposed Project will aggravate the above mentioned consequences. Therefore, controlled development is necessary.

Impact on Fauna

As mentioned above, the forest is home to wildlife. The forest reserves traversed by the proposed routes is home to many species of endangered and rare birds and animals. The main impact on fauna will be loss of habitat.

Clearance of vegetation for highway construction will drive most of the wildlife species further into the forest, including forest edge browsers such as cadging, rusa and pelanduk.

During the forest clearance, some large mammals (tigers, leopards, tapirs and wild boars) may move to other forests and may encroach into the neighbouring ecosystems. They may face death due to inter-species competition for established territories. Smaller mammals (rats, squirrels), reptiles and amphibians may face death earlier during forest clearance. The reduction in their numbers is significant even though a relatively small area is affected. Bird life will also be adversely

affected except for aerial feeding species such as swifts and swallows and the occasional bare soil feeders such as pipits and mynahs.

Waterways will be polluted by silt/clay from the road construction as bridges will be constructed over the rivers. The bare soil and its compaction will cause more surface runoff leading to more severe erosion of the river banks. The sediment load and turbidity of the river will increase, thus affecting the fish and other aquatic life adversely (especially in steep areas). Heavily silted rivers will affect respiration of adult and larvae fish and aquatic insects and also reduce their breeding capacity. The effects are expected to be temporary.

Many of the existing forest reserves will be accessible after the completion of the highway. The forests will therefore be exposed to logging and hunting activities. The flora and fauna will again be threatened.

(3) Socio-Economic Environment

Affected Human Settlement/Community

Table 6-5 : Affected Human Settlement in the Impact Area

Section	Human settlements	Impact
A1	Kg Melaka (Orang Asli) - 0.3km away	Public Safety
B1C1	New housing estate south of Batu Dam	Air & Noise, Public Safety Split of community, Relocation
A2/A2B2	Kg Padang/Perdik (Orang Asli) - 0.5km away Pekan Bt Lapan Belas.	Air & Noise, Public Safety
B2/A2B2	Taman Melawati Kg. Rantau Panjang	Air & Noise, Public Safety Split of Community, Relocation
C2	Taman Melawati, Kg Kemesah, Kemesah Height, Kg Muhibbah, Lembah Jaya Selatan in Ampang Area	Air & Noise, Public Safety Split of community, Relocation - Minimal Impact
A3B3/A3/A3B3C3	-	-
A3B3/B3/B3C3	Bandar Baru Bangi	Minimal Impact
A3B3C3	-	-
C3/B3C3/A3B3C3	Pekan Sg Chua	Air & Noise, Public Safety Split of community, Relocation

(a) Relocation of Population

Relocation of people is a major impact. Many of the affected households may be relocated in order to make way for the Project. It was found from the sociological survey that the affected squatter population generally agree to relocation if compensation is reasonable.

(b) Public Nuisance

Population residing near the highway will be affected by an increase in air and noise pollution as a result of higher traffic volume along the highway. Long exposure to these pollutants would cause various negative health effects.

(c) Public Safety

The population in the vicinity of the Project would face various safety problems. During the construction phase, the tranquility and peace in the area would be disturbed by the immigration of workers (some of them may be foreign workers). Traffic safety will be a major problem during the operational phase. Road crossings and road accidents along highway may directly or indirectly affect the safety of people living in the area.

(d) Split of Community

This problem may arise when the road alignment traverses through human settlements. Communication difficulties in the bisected settlements may arise.

Land use

The proposed Ring Road, which has an average length of 80 km and 20 m in width would not have significant impact on the land use pattern there. This impact would be negligible as the Project covers only about 0.32-0.34 % of the Impact Area.

Overall, the Project covers an area of about 1.53 - 1.83km². It traverses several stretches of forested land, rubber and oil palm plantation, horticultural land, mining land and some associated urban areas.

The resulting urbanization of the vicinity will cause significant changes on land use, especially for agricultural and forest land at present. This phenomenon is verified by the emergence of various new townships along the North-South Expressway. The land value of the adjacent land parcels will be appreciated in tandem.

Business and Employment Opportunities

In the long term, the Project will further promote more business and employment opportunities in Kuala Lumpur, the Klang Valley and its catchment. The enhanced business environment would take place both during the construction and operational phases.

Traffic Impact

The construction of the highway will affect the traffic pattern of the surrounding region. The high traffic volume in central Kuala Lumpur is expected to be dispersed through the KLORR. Thus, the traffic congestion in the city centre would be reduced.

6.4 PEIA Report and DOE Comments

The PEIA report was submitted to the DOE (Department of Environment) and discussed in the EIA Committee meeting. The Committee basically approved the PEIA report. However, some sensitive issues were commented. They are :

i) Detail geological and geotechnical study are required in the mountainous areas identified as prone to high risk soil erosions and slope failures.

ii) Land developments should follow the Development Guidelines for the hilly areas prepared by Town and Country Planning Department.

iii) The project implementation may cause soil erosion followed by some short-term localized flooding at the upstream of existing stream.

iv) The proposed highway will pass through five forest reserves and park areas namely Bkt. Lagong, Kanching, Hulu Gombak, Ampang, Hulu Langat and Templer Park. The indirect impacts of the loss of forest will create a chain of deterioration on the existing environment, especially flora and fauna, due to the disruption of vital role played by the forests. An action plan to preserve the flora and fauna should be prepared.

v) The proposed road alignment passes through the water catchment areas namely Sungai Gahal, Sungai Langat(2), Sungai Batu and Sungai Klang and crosses some rivers and streams where there are municipal water intake points. Proper mitigation measures including monitoring system should be prepared.

vi) The project implementation will involve relocation and resettlement of the people including Orang Asli. The resettlement should be done with the related authorities.

vii) Vibration generated by the tunneling work will affect the stabilization of structures such as Batu Dam and other surrounding buildings. Detail impacts and countermeasures should be examined and prepared.

These issues are taken into account in the preliminary engineering design for the optimum alignment discussed in the Chapter 8.

Introduction of tunnels and bridges can reduce the negative impacts on the forest reserves and water catchment areas and also minimize the effects to the flora and fauna, as well as soil erosion and slope failures in the mountainous sections.

For the open cut sections in the mountainous terrain, harmonization with natural environment will be given a special attention.

Although the preliminary engineering study is conducted based on the environmental considerations, some sensitive issues will require a detail study on the detail engineering stage, such as the detail geological and geotechnical study for the slope stability and tunnel construction method, etc.