After the careful examination of these alternatives, Alternative III is considered to be the most likely development pattern for the following reasons:-

1. The alternative pattern III takes into serious consideration the current government's policies of promoting rural development in line with the aims of the New Economic Policy.
2. It also takes into account the current development trends and in particular current approved and other projects in J.B.-P.G. corridor area.
3. It seeks to maximise the utelization of resources of the rich rural hinterland.
4. The alternative pattern III is considered to be in line with the policies of the State Town and Country Planning Department and the State Economic Planning Unit.

4 Land Use Pattern in 2000

(1) Urban Land Distribution Pattern

The total urban area is expected to increase by 11,000 ha. during next two decades of which 77% will be concentrated in the Johor Bahru District and 67% in the metropolitan area.

Residential area in the Johor Bahru District will constitute almost 75% of the total increase of the residential area which is estimated at 6,306 ha.; the District's industrial area will account for 86% of the total increase of industrial area, and the District's commercial area will be 84% of the total increase of commercial area. (Refer to Table 2.12)

Table 2.12 Urban Land Use Pattern by 2000

			Existing Urban Area (ha) 1980	Residential (ha) 1980–2000	Industry (ha) 1980–2000	Commerce (ha) 1980–2000	Other Land Use (ha) 1980–2000	Total Urban Area Increment (ha) 1980–2000	Future Urban Area (ha) 2000
Primary Area	Johor Bahru	MPJB	7,502	2,458	465	262	956	4,141	11,643
		Plentong	2,796	1,262	689	136	626	2,713	5,509
		Senai-Kulai	1,117	312	98	20	129	559	1,676
		Other Area	1,827	677	176	14	260	1,127	2,954
		Sub Total	13,242	4,709	1,428	432	1,971	8,540	21,782
	Kota Tinggi	Kota Tinggi	462	313	20	7	102	442	904
		Others	30	47	13	3	19	82	112
		Sub Total	492	360	33	10	121	524	1,016
		Total	13,734	5,069	1,463	442	2,090	9,064	22,798
Secondary Area	Pontian	Pontian Kecil	167	607	61	17	206	891	1,058
		Others	498	347	108	39	148	642	1,140
		Sub Total	665	954	169	56	354	1,533	2,198
	Tanjong Penggerang		1,172	283	24	14	96	417	1,589
		Total	1,837	1,237	193	70	450	1,950	3,787
Study Area Grand Total			15,571	6,306	1,656	512	2,540	11,014	26,585

Source: The Study Team Estimate (1981).

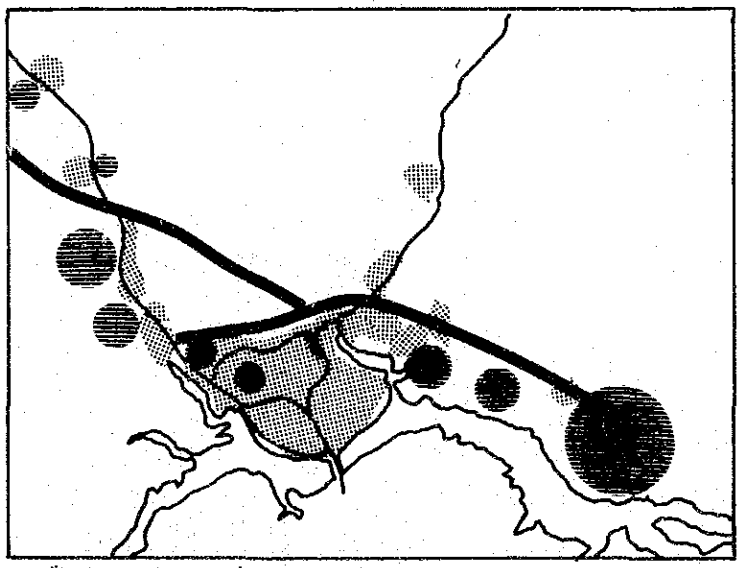
(2) Principle Location Policies for Land Use Plan

The land use development pattern conforms to the guideline of the conceptual development plan. The pattern shows the possible locations of housing developments, commercial centres and nature reserves.

Housing Development

Two types of housing development pattern can be considered, the estate type of development which is now popular in the Johor Bahru metropolitan area and small-scale developments which expand into the open space and the outskirts of existing town areas. Many high-rise housing projects will be built in MPJB as urban renewal and squatter resettlement projects, (See Fig. 2.7).

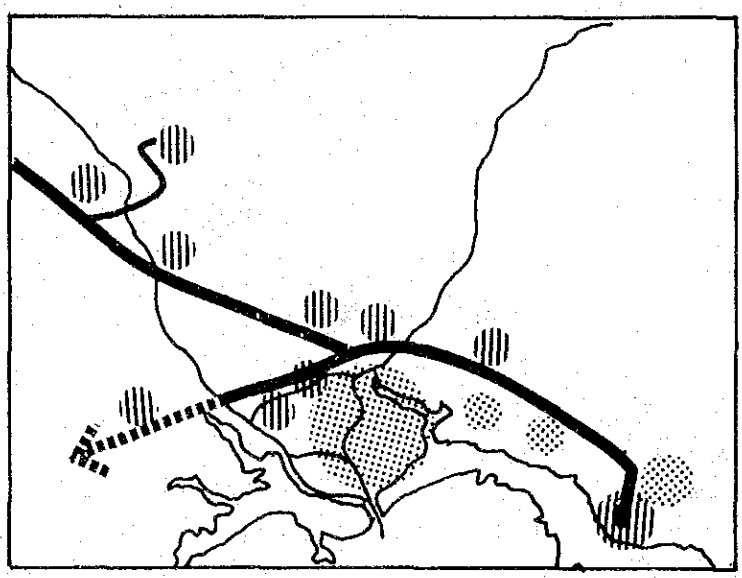
Fig. 2.7 Housing Development Pattern



Industrial Development

The pattern of industrial development will also be of the estate type and the small-scale type. Preferably the estate type of development will be located along the Port Access Road which has better linkage with Johor Port, Senai Airport and the other regional and national centres. The small-scale type will be scattered in the existing urban area and in some of the housing estates. (See Fig. 2.8)

Fig. 2.8 Industrial Site Distribution

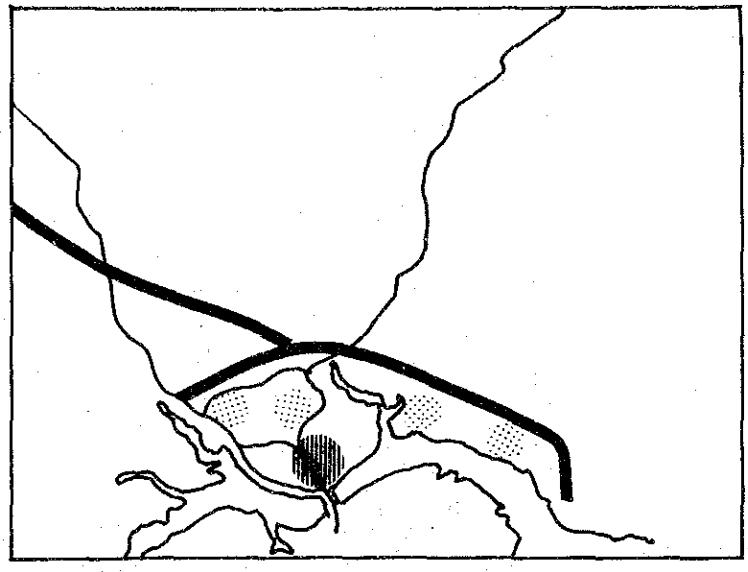


Commercial Centre

In the future Johor Bahru will require a central business district in order to facilitate regional, national and to some extend international commerce and business activities in the metropolitan region. This requires a comprehensive development program for the CBD in Johor Bahru, which should include planning for pedestrians

and beautification of the urban environment. Other commercial centres will be planned in conjunction with housing estate developments and the Pasir Gudang project. (See Fig. 2.9)

Fig. 2.9 Future Location of C.B.D.



Nature Conservation

It is important that long-term planning include a plan for conserving nature and open space for the people's physical and psychological well-being. An environmental infrastructure of coastal green and parks, and a buffer green for the expressway should be planned. (See Fig. 2.10)

Fig. 2.10 Coastal and Buffer Green to be Conserved

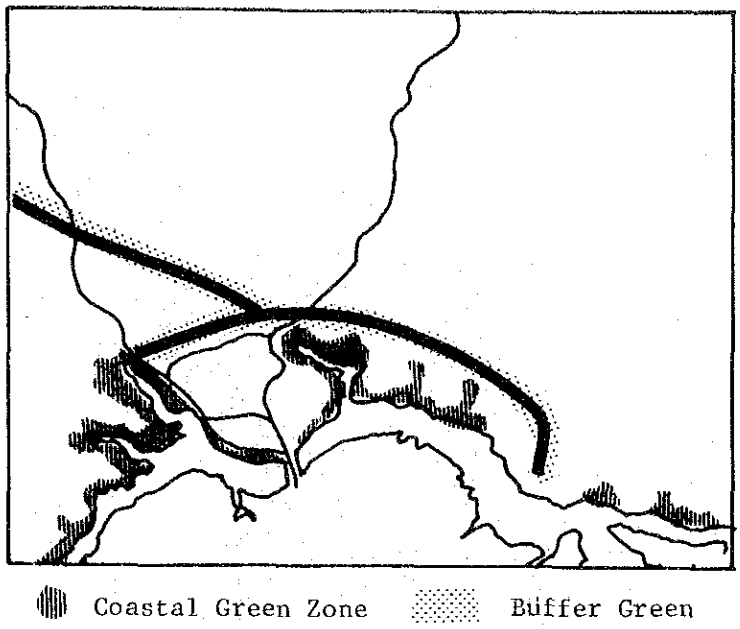
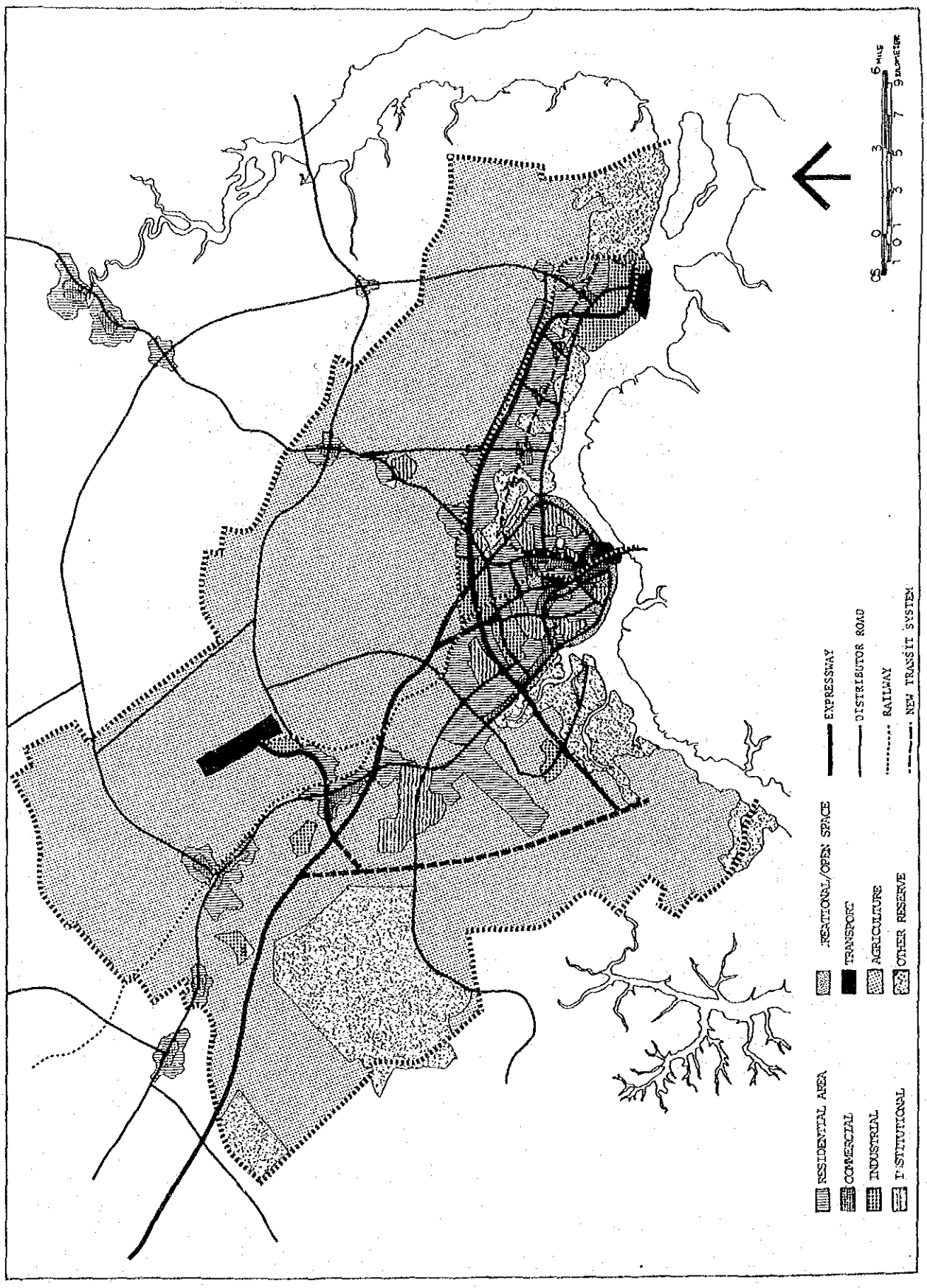


Fig. 2.11 Land Use Pattern in 2000 Metropolitan Johor Bahru



2–4 Population and Employment Distribution Plans

1 Future Population Distribution

The future spetial patterns of urbanization and population distribution are, to a large extent, being shaped by the forces of large-scale residential developments in the Study Area for which commitment has been made. In particular, to the east of the Study Area lies the Pasir Gudang New Town and Industrial Complex development where a total population target of approximately 235,000 is expected to be achieved by the year 2000. Another major concentration of population due to commitments to develop residential areas lies to the northwest of MPJB, namely the Senai/Kulai - Johor Bahru corridor where a population of about 245,000 is expected. With the establishment of this broad population distribution framework, the population of MPJB in 2000 can be calculated to be approximately 520,000, given the target population of 1 million planned for the entire Johor Bahru district (See Fig. 2.12).

Thus, the future population in the Mukims of MPJB and Plentong is expected to be 520,000 and 235,000 by 2000. The population distribution in the other mukims is similarly obtained by taking into account committed residential developments within the mukim in question. The population distribution by mukims is shown in Table 2.13.

The major determinant in population growth in the Study Area is residential developments which incidentally are also largely private enterprises. Notwithstanding the fact that these developments are committed and can 'proceed', there are still strong manipulative forces of the market mechanism at play that may slightly alter the future pattern of urbanization. It would not be surprising if some committed schemes fail to immediately materialize or if some are scaled down due to intervening factors such as the location of a scheme,

Fig. 2.12 Population Hierarchy by Mukims, in 2000

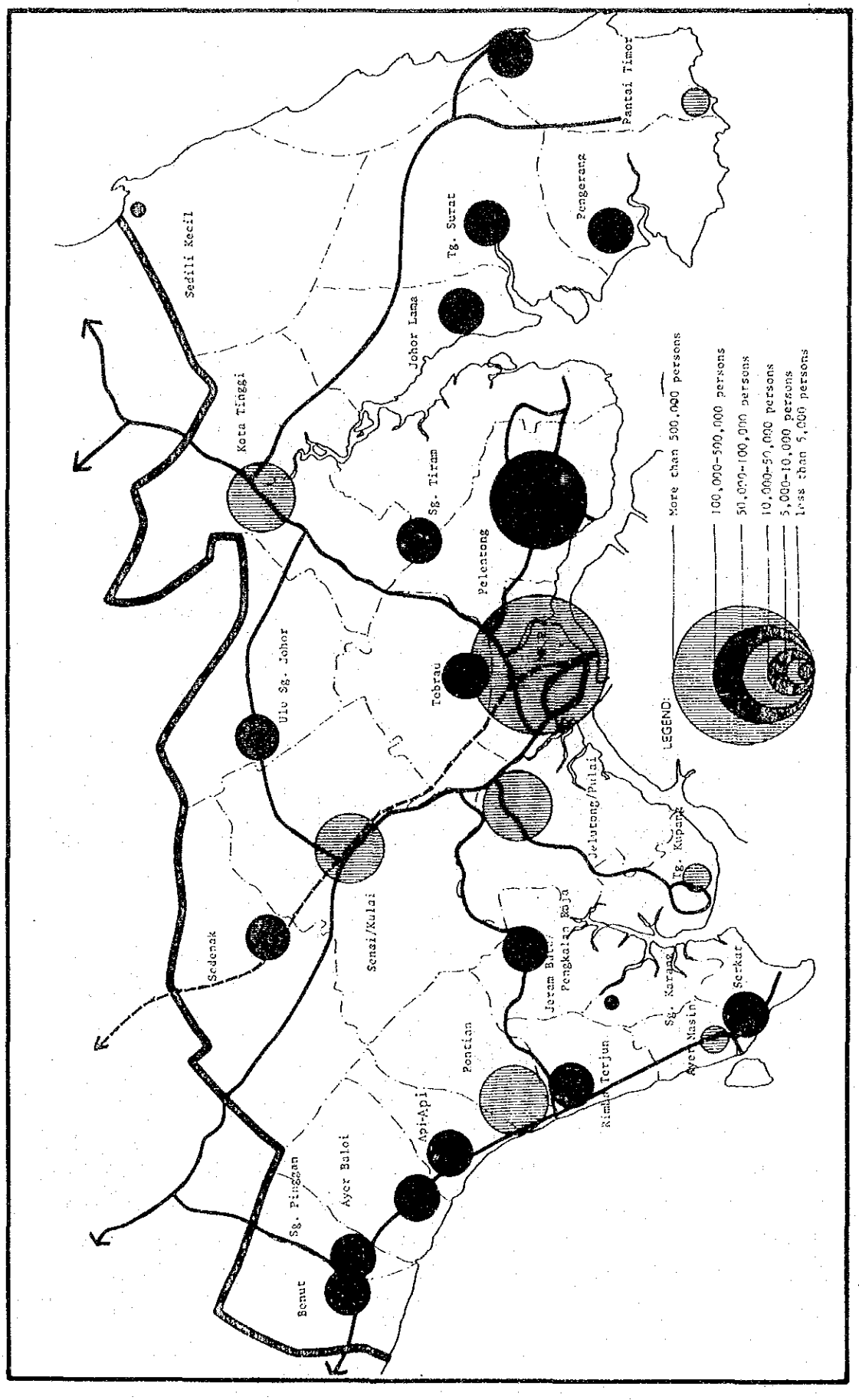


Table 2.13 Future Population Distribution by Mukims in the Study Area, 1970–2000

(in thousand person)

District	Mukims	1970		1980		1990		2000		Average Annual Growth %		
										70-80	80-90	90-2000
JOHOR BAHRU	MPJB	150.8	275.5	247.0	417.42	398.5	654.8	520.0	1,000.0	5.1	4.9	2.7
	Jelutong/Pulai	19.8		23.7		51.7		94.7		1.8	8.1	6.2
	Pelentong	22.1		37.7		81.6		235.0		5.5	8.0	11.2
	Sedenak	18.1		22.6		24.4		28.9		2.2	0.8	0.7
	Senai/Kulai	36.3		52.1		62.0		79.9		3.7	3.0	2.6
	Sg. Tiram	8.3		9.1		10.2		11.4		0.9	1.1	1.0
	Tg. Kupang	4.5		4.7		5.1		5.6		0.4	0.8	0.9
	Tebrau	15.6		17.6		21.3		24.5		1.2	1.9	1.4
KOTA TINGGI	Kota Tinggi	23.2	50.6	30.8	80.5	39.8	109.1	50.5	148.5	2.9	2.6	2.5
	Ulu Sg. Johor	8.4		10.7		13.4		16.4		2.4	2.3	2.0
	Primary Area	307.1		458.9		708.0		1,066.9		4.1	4.4	4.2
	Johor Lama	4.3		7.3		12.7		22.3		5.4	5.7	5.8
	Pantai Timur	5.1		5.4		6.1		7.1		0.6	1.2	1.5
	Pengerang	7.2		6.6		8.4		10.7		-0.9	2.4	2.5
	Sedili Kechil	0.4		0.5		0.7		0.9		2.3	3.4	2.5
	Tg. Surat	2.0		19.2		28.0		40.5		25.4	3.8	3.7
PONTIAN	Api - Api	12.3	117.8	12.3	121.7	14.7	164.7	17.7	201.9	0	1.8	1.9
	Ayer Baloi	12.0		11.6		13.7		16.1		-0.3	1.7	1.6
	Ayer Masin	5.2		5.2		5.9		6.7		0	1.3	1.2
	Benut	16.0		15.7		18.1		21.3		-0.2	1.4	1.6
	Jeram Batu/P. Raja	13.2		15.4		19.4		25.2		1.6	2.3	2.5
	Pontian	16.0		25.5		48.9		62.3		4.8	6.7	2.5
	Rimba Terjun	24.9		19.8		23.7		28.2		-2.3	1.8	1.7
	Serkat	7.6		7.1		9.0		11.0		-0.7	2.4	2.0
	Sg. Karang	3.0		2.0		2.3		2.8		-4.0	1.8	1.6
	Sg. Pinggan	7.6		7.1		8.9		10.6		-0.7	2.3	1.8
	Secondary Area	136.8		160.7		220.6		283.5		1.6	3.2	2.5
	Total Study Area	443.9		619.6		928.6		1,350.4		3.4	4.1	3.8

Note: (1) Targets estimated by Unit Pelan Struktur 1981.
(2) Population by mukims do not add up to that by district due to 2,880 navy personnel from Woodlands, Singapore.

Source: Urban Transport Study Team Estimates 1981.

the quality of construction, prices of houses in relation to the effective housing demand of potential owners and availability of credit and loan facilities.

A rapid succession of housing developments and the natural increase in population will tend to concentrate future population within MPJB as can be seen by the increase in gross density from 20.7 persons per hectare in 1980 to 52.3 persons per hectare (See Table 3.14). Based on SPU's standard classification*, MPJB can be considered a low-density area which will develop into a medium-density region. All other mukims can be expected to remain low-density areas even in 2000.

In terms of net residential density, MPJB has an existing density of 97.3 persons per hectare, and this will increase to approximately 127.4 persons per hectare by 2000.

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* Low Density: 27-40 persons/ha
Medium Density: 45-67 persons/ha
Medium High Density: 72-148 persons/ha
High Density: 151 persons/ha

Table 2.14 Future Gross Distribution by Mukims in the Study Area, 1970–2000

(Persons/hectare)

District	Mukim	1970		1980		1990		2000	
JOHOR BAHRU	MPJB	12.63		20.69		33.38		52.33	
	Jelutong/Pulai	0.93		1.12		2.44		4.42	
	Pelentong	1.09		1.86		4.02		11.59	
	Sedenak	0.57	1.55	0.72	2.34	0.77	3.67	0.91	5.61
	Senai/Kulai	0.84		1.20		1.43		1.85	
	Sg. Tiram	0.34		0.38		0.42		0.47	
	Tg. Kupang	0.55		0.58		0.63		0.68	
	Tebrau	0.89		1.00		1.21		1.38	
KOTA TINGGI	Kota Tinggi	0.59		0.79		1.02		1.29	
	Ulu Sg. Johor	0.27		0.34		0.43		0.53	
	Primary Area	1.24		1.85		2.85		4.29	
	Johor Lama	0.22	0.26	0.37	0.41	0.65	0.56	1.14	0.76
	Pantai Timur	0.22		0.23		0.26		0.31	
	Pengerang	0.39		0.36		0.46		0.59	
	Sedili Kechil	0.01		0.02		0.02		0.03	
	Tg. Surat	0.06		0.60		0.87		1.26	
PONTIAN	Api - Api	1.40		1.40		1.67		2.01	
	Ayer Baloi	0.80		0.77		0.92		1.08	
	Ayer Masin	1.40		1.40		1.59		1.80	
	Benut	1.11		1.09		1.25		1.48	
	Jeram Batu/P. Raja	1.17		1.37		1.72		2.24	
	Pontian	1.25	1.21	2.00	1.25	3.83	1.70	4.88	2.08
	Rimba Terjun	2.67		2.12		2.54		3.03	
	Serkat	1.25		1.17		1.48		1.81	
	Sg. Karang	0.46		0.31		0.37		0.43	
	Sg. Pinggan	1.06		0.99		1.24		1.48	
	Secondary Area	0.62		0.73		1.00		1.28	
	Total Study Area	0.94		1.32		1.97		2.87	

2 Future Employment Distribution

The plan for employment distribution is made on the basis of the land use plan and the total employment projection made in this study.

Classification of employment used in distribution is as follows:

Primary	:	Agriculture, Fishing, Forestry and Mining
Secondary	:	Manufacturing and Construction
Tertiary	:	Commerce, Financing, Transportation and Communication and Services

There are no available data for employment by work place in the population census. However, the data from the Home Interview Survey conducted for this study are available, and these form the basis for the estimate of the existing employment distribution.

1) Primary Industries

The Scale of employment in primary industries is expected to increase slightly in the future. The amount of land used for agriculture will drastically descrease in urbanized areas, but on the other hand such land will be developed in rural areas.

2) Secondary Industries

The projections for these industries are calculated in the following manner:

(Future industrial area) x (Employment density)

The following employment densities are assumed:

a. 125 workers/ha (Pasir Gudang free trade zone)
b. 100 workers/ha (MPJB and Pasir Gudang area)
c. 75 workers/ha (the rest)

The sizes of future industrial areas are based on the land use study.

3) Tertiary Industries

The projections for these industries are calculated in the same manner as with secondary industries.

(Future commercial and institutional area) x (Employment density)

The following employment densities are assumed:

1. Commercial Area

   a. 600 workers/ha (C.B.D. in MPJB)
   b. 200 workers/ha (Neighbourhood shopping centre)
   c. 100 workers/ha (Inside of Jalan Tampoi in MPJB excluding the above-mentioned area)
   d. 80 workers/ha (Outside of Jalan Tampoi in MPJB)

2. Institutional Area

   a. 50 workers/ha (C.B.D. in MPJB)
   b. 20 workers/ha (Inside of Jalan Tampoi in MPJB)
   c. 10 workers/ha (Outside of Jalan Tampoi in MPJB)

The employment figures for the Pasir Gudang Area used in the Conceptual Plan for Pasir Gudang New Town were calculated by Nikken Sekkei.

The results of the distribution by mukims are shown in Table 2.15 for the year 1981 and in Table 2.16 for the year 2000.

Table 2.15 Employment Distribution by Mukims in 1981

(person)

	Primary	Secondary	Tertiary	Total
Johor Bahru District	43,430	49,700	51,910	145,040
MPJB	1,460	23,560	41,870	66,890
Plentong	6,880	19,490	1,980	28,380
Pulai	7,316	816	1,407	9,539
Senai/Kulai	8,000	5,260	4,570	17,830
Sedenak	7,602	96	890	8,588
Tebrau	6,457	332	813	7,602
Sg. Tiram	5,715	146	380	6,241
Kota Tinggi	10,780	1,482	2,226	14,488
Kota Tinggi	5,654	1,335	2,013	9,002
Ulu Sg. Johor	5,126	147	213	5,486
Primary Area	54,210	51,182	54,136	159,528
The Rest in Kota Tinggi	13,180	1,698	1,574	16,452
Pontian District	29,300	6,110	7,290	42,700
Secondary Area	42,480	7,808	8,864	59,152
Total Study Area	96,690	58,990	63,000	218,680

Source: Total Employments in 1980 are broken down using 1981 Home Interview Survey Data.

Table 2.16 Future Employment Distribution by Mukims in Study Area in 2000

(Person)

	Primary	Secondary	Tertiary	Total
Johor Bahru District	46,590	217,040	131,560	395,190
MPJB	590	102,300	89,950	192,340
Plentong	6,520	85,580	25,760	117,860
Pulai	8,980	13,590	6,610	29,180
Senai/Kulai	8,480	11,960	7,330	27,780
Sedenak	8,330	1,300	640	10,270
Tebrau	7,920	1,920	790	10,630
Sg. Tiram	58,770	390	480	6,640
Kota Tinggi	13,210	4,930	4,020	21,960
Kota Tinggi	6,930	4,540	3,660	15,130
Ulu Sg. Johor	6,280	190	360	6,830
Primary Area	59,800	221,770	135,580	417,150
The Rest in Kota Tinggi	29,430	4,060	4,000	37,490
Pontian District	34,370	19,590	15,370	69,330
Secondary Area	63,800	23,650	19,370	106,820
Total Study Area	123,600	245,330	154,950	523,970

Source: Study Team Estimates 1981.

Chapter 3 FORECAST OF FUTURE TRAFFIC DEMAND UNDER BASE SITUATION

3-1 General

The forecasts of future traffic demand for vehicles and bus passengers are made separately in this chapter.

The future traffic demand will vary depending on Government policy; for example, if a strategy to encourage the development of public transport is carried out, private vehicle traffic demand may decrease.

First, future demand in the case no strategy for reducing traffic demand is carried out is estimated in this study. This case is defined as the base situation in this report.

After examining the future transport problems which may arise in the base situation, other cases will be studied in order to assess the effectiveness of the specific strategies.

Although the estimation of vehicle trips is made by type of vehicles, the final figures are expressed by using the following passenger car unit.

Table 3.1 Passenger Car Unit

	Car	Van	Med. Lorry	Heavy Lorry	Bus	Motorcycle
P.C.U.	1.0	1.0	2.0	3.0	3.0	0.75

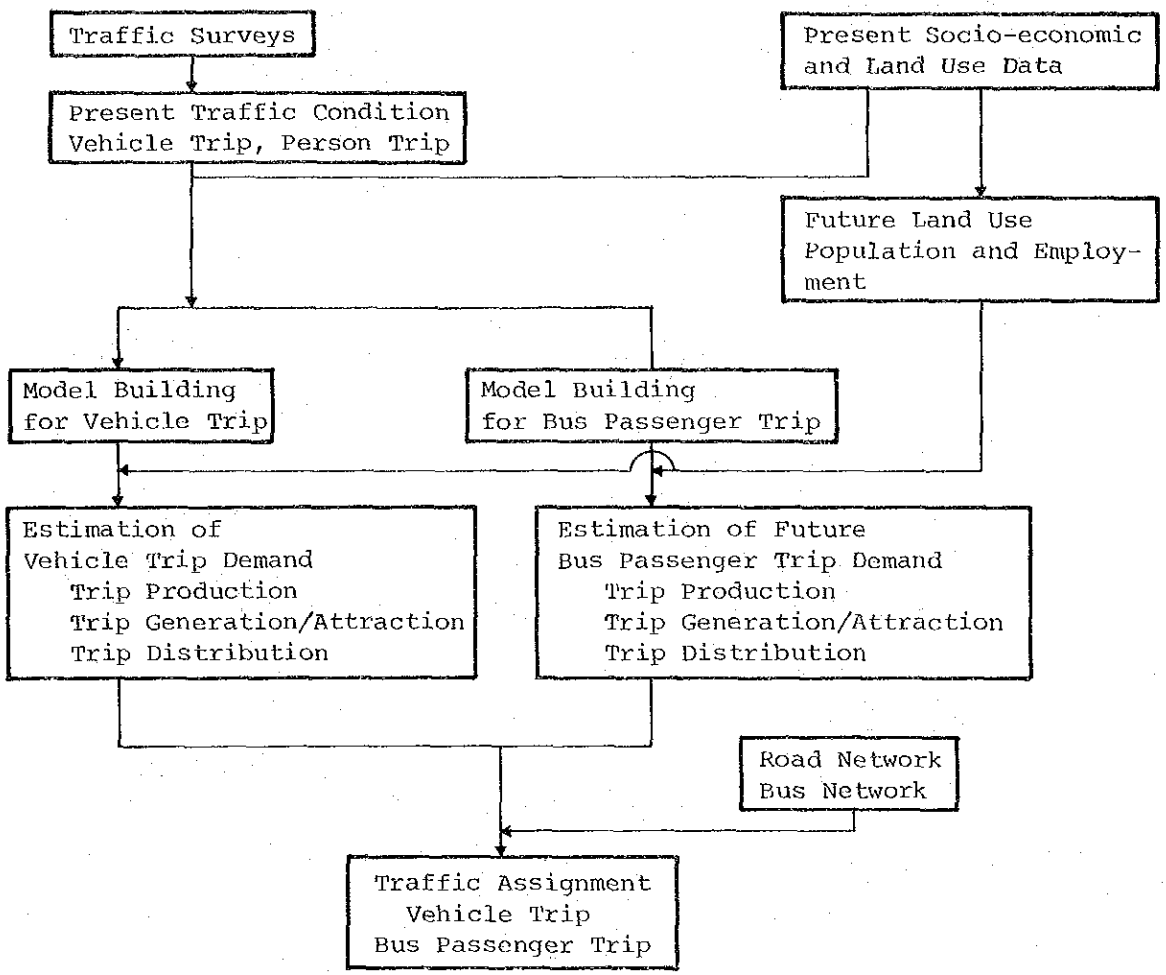
Procedure

The procedure for predicting future traffic demand is shown in Fig. 3.1.

First, the future demand for vehicle trips is estimated based on the analysis of existing conditions derived from traffic surveys.

The models for the estimation of traffic demand are established by analysing the relationships between existing traffic demand and socio-economic data.

Fig. 3.1 Procedure for Traffic Projection under the Base Situation



Based on the future socio-economic framework of the Study Area, trip production, trip generation and attraction and trip distribution are predicted by using the traffic model as shown above.

Finally, the future traffic demand in terms of O-D volumes is allocated to the road network to obtain the traffic volume on each road link. The traffic assignment is made for several alternative road networks in order to find the effects of proposed road projects.

The base case of the alternative networks consists of the existing network and the road projects for which commitment has been made under the Fourth Malaysia Plan.

Bus passenger demand is predicted in the same way as vehicle trips.

3-2 Prediction of Vehicle Traffic Demand

1 Model Formulation

(1) Trip Production

Generally trips are classified according to the following four types; i.e. internal trip, external trip, through trip and trip from specific terminal facilities.

The specific terminal facilities in the Study Area are the port at Pasir Gudang and the airport at Senai.

a) Internal Trip

The internal trip production is estimated by multiplying the number of vehicles by unit trip production, which can be derived from the Car Owner Interview Survey conducted by the Study Team.

As already stated, the ownership rates for private cars and motorcycles are expected to increase in the future.

It has been proven empirically in major cities that the unit trip production has a tendency to decrease as ownership rises; i.e. the number of trips per car decreases as the number of cars per person increaes.

Therefore, the future unit trip production was estimated by using the relationship between the number of trips per car and the ownership rate by traffic zone, which was also obtained from the Car Owner Interview Survey.

b) External and Through Trips

The growth rate of external and through trips

is dependent on the growth of social, economic activities in the external area as well as the internal area.

The estimate was made on the assumption that in the case of cars, motorcycles and buses, the increase of trips is closely related to the increase in the number of vehicles and population, and that the increase of trips for lorries is related to the GRP growth.

c) Trip Production from Specific Terminal Facilities
Trip production from the Johor Port is estimated on the basis of its handling cargo volume by each commodity type, and trip production from the airport at Senai is based on the number of passengers arriving and departing. The expansion plans of the terminal facilities and related projects such as the construction of new railway branch line to Johor Port were also taken into consideration.

(2) Trip Generation and Attraction

For estimating trip generation and attraction, a regression model was employed. The general formula is as follows:-

$$Y = a + bx_1 + cx_2 + dx_3$$

where Y : trip generation or trip attraction by zone

x_1, x_2, x_3 : explanatory variables by zone such as population, employment etc.

a, b, c, d : constants

After examining various formulae by changing the combination of explanatory variables, the formula was calibrated by type of vehicle by generation and attraction.

(3) Trip Distribution

For estimating trip distribution, two methods are representative. One is the present pattern method and the other is the model method.

The former is used for short-term estimation, while the latter is for long-term. In the Study Area, rapid urbanization as well as various projects for infrastructural and industrial development many alter the pattern of traffic flow. Accordingly the model method was selected, and a gravity-type model, one of the most common models, was employed in this study. The formula is as follows:-

$$Tij = K.Gi^{a}.Aj^{b}.Dij^{-r}$$

where tij : number of trips between zone i and j

Gi : total number of trip generation in zone i

Aj : total number of trip attraction in zone j

Dij : distance between zone i and j

K : constant

a, b, r: exponential factor

(4) Traffic Assignment

When there exist several alternative routes for travel, the driver chooses one according to his decision criteria. The criteria may differ for individuals, but the main factors are travel time and vehicle-operating cost. Most drivers tend to choose the best route so as to minimize travel time and operating cost. In order to express these factors as an indicator, the concept named "Impedance" is introduced. Impedance of a link is expressed by the following formula:-

$$I_i = C_t.T_i + C_d.D_i \quad \text{(for non-toll links)}$$

$$I_i = C_t.T_i + C.D_i \quad \text{(for toll links)}$$

where I_i : the impedance of link i

C_t : time coefficient in impedance per hour

T_i : the link's time in hour (non-toll links)

the average service time at the toll booth (toll links)

C_d : distance coefficient in impedance per km

D_i : the link's distance (non-toll links)

the link's toll(toll links)

C : toll coefficient in impedance per dollar of toll

The coefficient C_t and C_d are determined by using time value and vehicle operating cost.

Hence, the traffic demand of each O-D pair is to be assigned so as to minimize the total impedance of the route.

The time cost of each trip is estimated by multiplying the unit time value of passengers by the average occupancy rate by type of vehicle. The unit time value is calculated by using the monthly household income and the monthly working hours, taking into account differences among car owners, motorcycle owners and non-vehicle owners. The calculation results are shown as follows:-

Table 3.2 Time Value by Vehicle Type

(in 1981 prices)

	Value of Vehicles (M$/hour/car)	Value of Passengers (M$/hour/person)
Cars	2.74	1.52
Buses	20.70	0.69
Motorcycles	0.93	0.77

Note : The average occupancy rate is as follows: -
Passenger Car : 1.8
Motorcycle : 1.2
Buses : 30

Source : Study Team Estimate

The vehicle operating cost is composed of running cost, which increases proportionately with mileage, and fixed vehicle cost, which depends on time. The unit running cost at the optimum speed and the fixed vehicle cost are estimated as shown in Table 3.3.

Table 3.3 Unit Running Cost and Fixed Vehicle Cost

(in 1981 prices)

	Unit Running Cost ¢/km	Fixed Cost M$/vehicle/hour
1. Passenger Cars	14.0	0.74
2. Taxis	12.3	3.38
3. Lorries	33.8	3.75
4. Buses	33.4	7.39
5. Motorcycle	5.0	-

Source : Study Team Estimate

The running cost also varies according to travel speed on the roads. Therefore, the relationship between the unit running cost and travel speed is established.

The travel time of a link varies according to the traffic volumes on the link. This relationship is taken into account by using the following formula.

$$T = T_o + a . T_o . (\frac{V}{C})^b$$

where T : estimated travel time of the link at volume V

T_o : free flow link time

C : link capacity

a, b : coefficients determined by emirical data

2 Results of Traffic Forecast

(1) Trip Production

The average daily number of trips in the Primary Study Area was projected by type of trip on the basis of the results of traffic surveys and vehicle ownership projection.

As shown in Table 3.4, the daily trip production in terms of passenger car unit (P.C.U.) will grow from 462,000 in 1981 to 1,424,700 in 2000 with an annual growth rate of 6.1%.

Table 3.4 Trip Production

(in 1000 P.C.U.)

	1981	2000	Annual Growth Rate (%)
Internal trips	411.9	1,263.9	6.1
External and Through Trips	50.1	160.8	6.3
Total	462.0	1,424.7	6.1

Both types of trips are expected to increase at almost the same growth rate during the coming two decades.

Table 3.5 shows trip production by type of vehicle. The numbers of trips by cars and lorries grow at a higher rate than other vehicles, reflecting the higher growth of vehicle ownership.

Table 3.5 Trip Production in the Primary Study Area

(in 1000 P.C.U/day)

Type of Vehicle		1981	2000	Annual Growth Rate (%)
Car	Work and School	67.3	171.2	5.0
	Business Trip	26.6	99.2	7.2
	Private Trip	48.9	180.2	7.1
	Going Home	89.4	332.8	7.2
	Total	232.2 (49.2%)	783.4 (53.2%)	6.6
Taxi		0.6 (0.1%)	1.5 (0.1%)	4.9
Bus		18.3 (3.9%)	46.8 (3.2%)	5.1
Lorry		108.5 (23.0%)	383.9 (26.1%)	6.9
Motorcycle		112.0 (23.8%)	257.4 (17.5%)	4.5

Note : Percentage in bracket

(2) Trip Generation and Attraction

Future trip generation and attraction were calculated by using the future population and employment distribution. Fig. 3.2 shows the average daily trip generation by zone. A high rise in trip generation can be found in Pelentong and the peripheral area of MPJB, while the growth in the C.B.D. area and the surrounding rural area of Johor Bahru - Pasir Gudang Corridor remains at a relatively low level, reflecting their respective population growths.

(3) Trip Distribution

The O-D table of future trips is estimated by applying the future trip generation and attraction to the gravity model mentioned above.

Table 3.6 shows the O-D volumes in 1981 and in 2000. It is noted that the trips related to

Pelentong, particularly the trips between Johor Bahru and Pelentong and within Pelentong increase remarkably due to industrial and housing development projects in the Pasir Gudang area.

Although the growth rate of intra-urban trip within MPJB is moderate, the absolute number of i incremental trips is significantly large; approximately 450,000 P.C.U. will be additionally generated by 2000.

Table 3.6 Vehicle O–D Table

(in 1000 P.C.U/day)

O \ D	Year	MPJB	Pelentong	Other Area within Internal Area	External Area	Total
MPJB	1981	265.7	5.2	13.2	11.6	295.7
	2000	712.9	61.7	68.8	38.2	881.5
Pelentong	1981	5.2	9.8	1.8	1.7	18.5
	2000	59.9	188.1	11.5	7.0	266.5
Other Area within Internal Area	1981	13.2	2.2	45.6	6.9	117.9
	2000	57.1	9.9	94.1	19.4	180.5
External Area	1981	12.0	2.2	7.3	8.4	29.9
	2000	37.2	8.7	22.3	28.0	96.2
Total	1981	296.1	19.4	117.9	28.6	462.0
	2000	867.1	268.4	196.6	92.6	1,424.7

Source : Study Team Estimate

Table 3.7 Traffic Volume and Road Capacity at the Boundary of MPJB

(in 1000 P.C.U./day)

	Year	Traffic Demand (a)	Road Capacity (b)	Traffic Demand Capacity (a)/(b)
Johor Bahru – Senai	1981	24.6	16.0	1.34
	2000	130.5	168.0	0.78
Johor Bahru – Kota Tinggi	1981	21.7	16.0	1.36
	2000	43.9	16.0	2.74
Johor Bahru – Pasir Gudang	1981	21.3	27.0	0.79
	2000	155.0	85.0	1.82
Johor Bahru – Singapore	1981	25.5	81.0	0.31
	2000	83.3	81.0	1.03
Johor Bahru – Pulai	1981	10.9	9.0	1.21
	2000	46.6	9.0	5.18
Total	1981	104.0	149.0	0.70
	2000	459.3	359.0	1.28

Note : Road capacity in 2000 shows the total capacity of the existing roads and the project roads committed under the Fourth Malaysia Plan.

Source: Study Team Estimate

Fig. 3.2 Vehicle Trip Generation by Zone

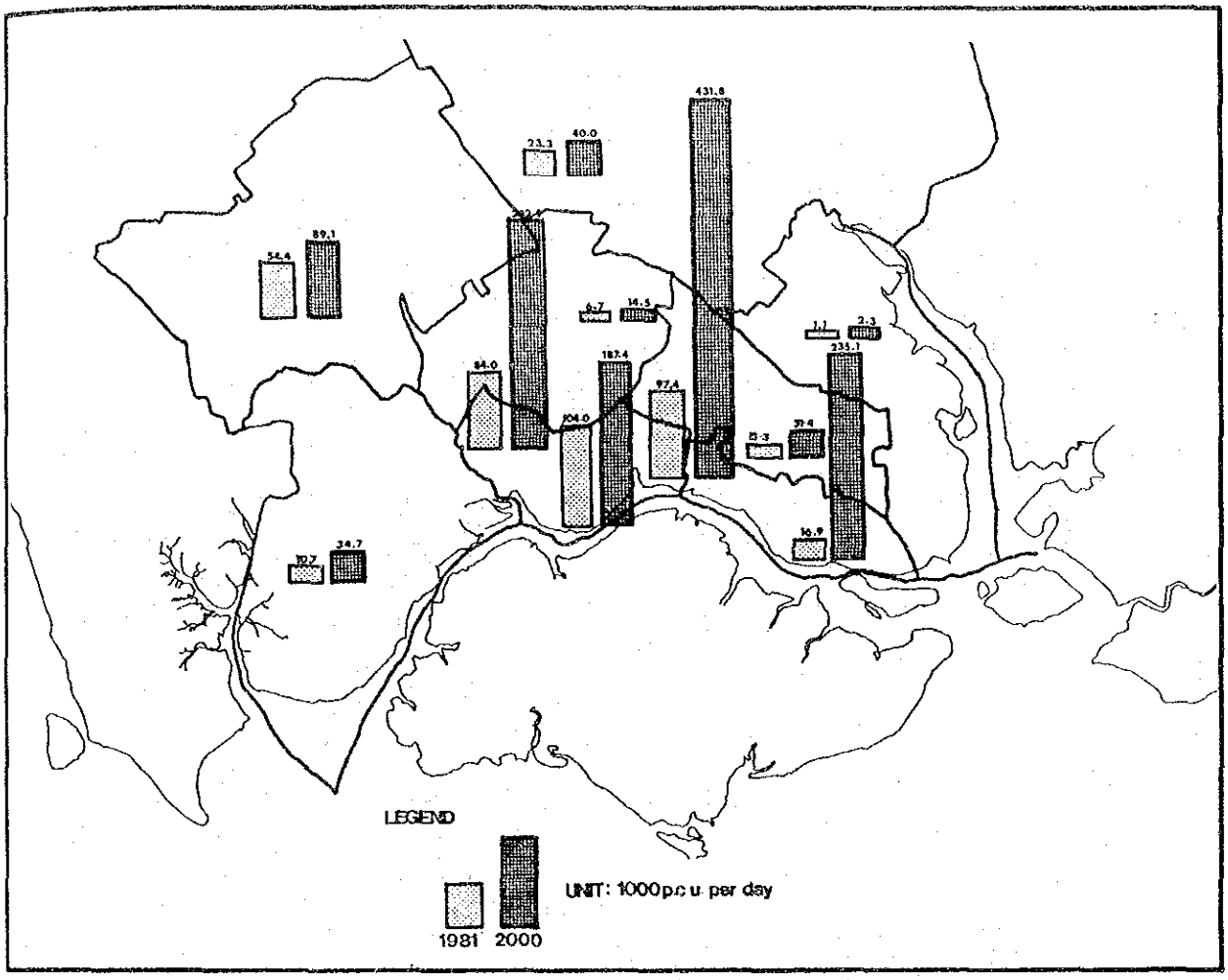


Fig. 3.3 Present Traffic Volume on Traffic Lines

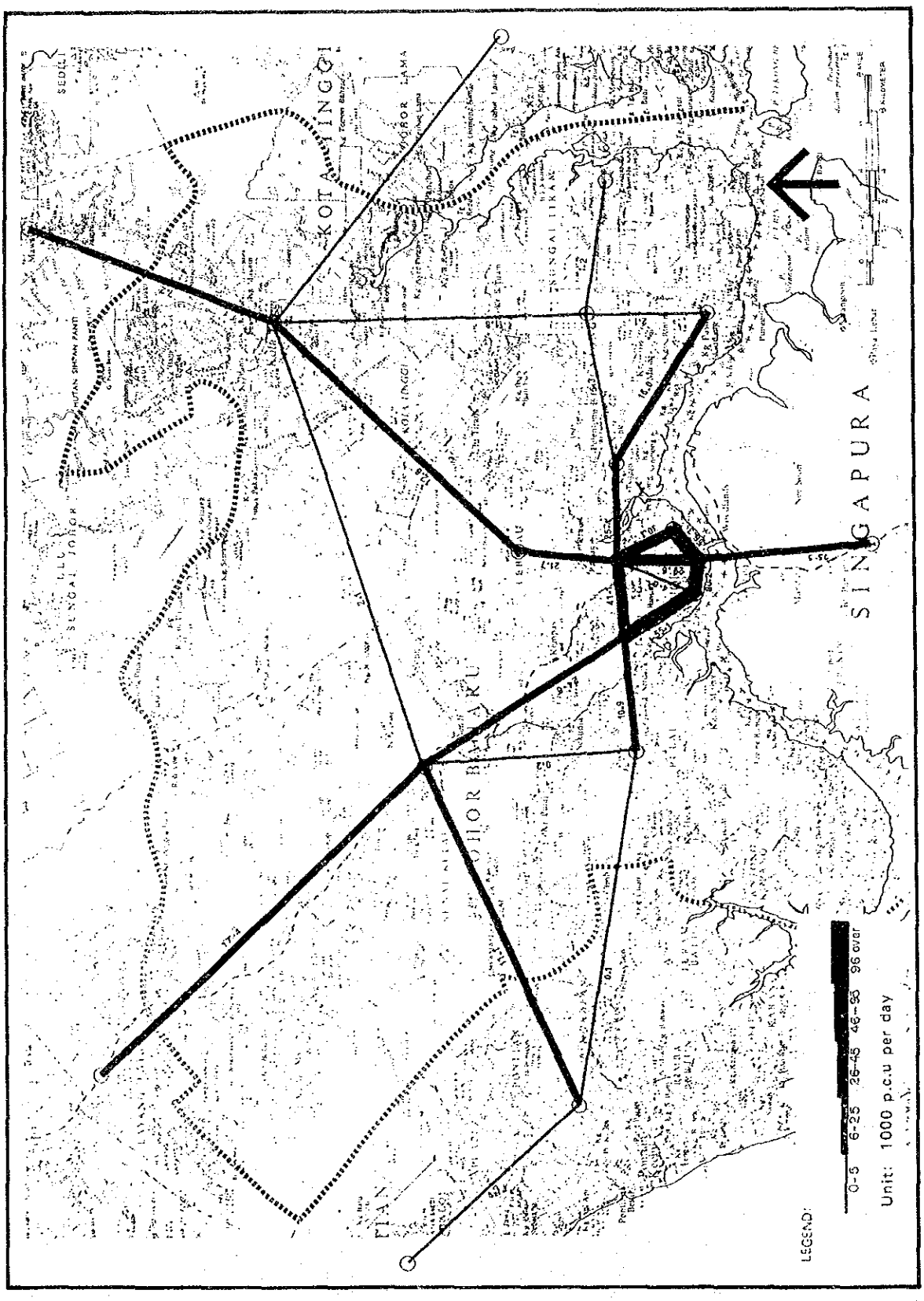
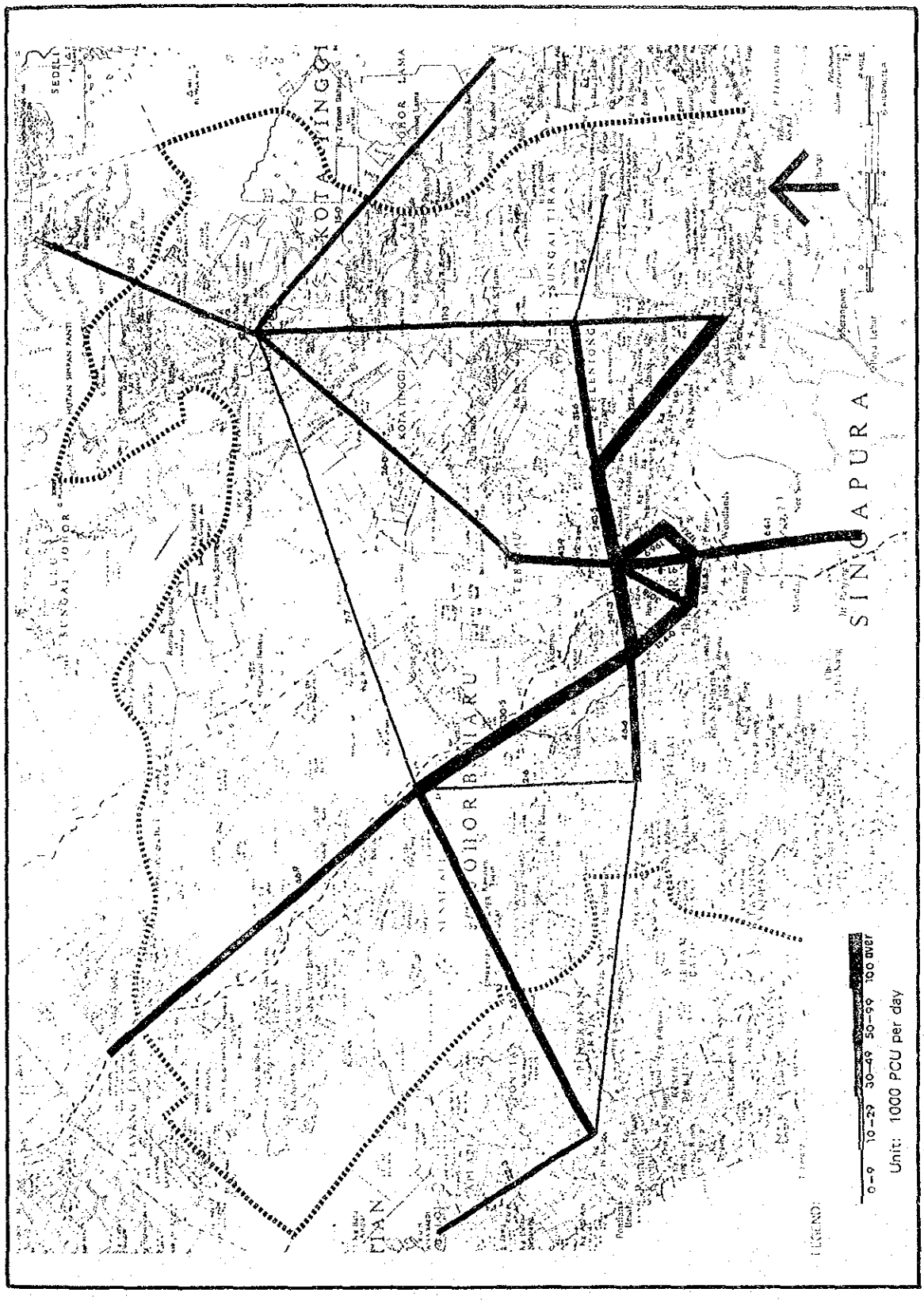


Fig. 3.4 Projected Traffic Volume on Traffic Lines in 2000



In Table 3.7, capacity represents the total capacity of roads in the corresponding direction.

For example in the case of Johor Bahru - Senai, the present capacity is only that of Federal Route One which has 2 lanes as of 1981, while the capacity in the year 2000 is counted as the total capacity of the expanded Federal Route One and the Toll Expressway.

At present, road capacity is roughly sufficient except for the section Johor Bahru - Kota Tinggi, since in the case of Johor Bahru - Senai, capacity is now being expanded.

However, in the year 2000, traffic demand will exceed capacity in many sections, particularly in sections such as Johor Bahru - Pasir Gudang and Johor Bahru - Pulai.

3 Traffic Volume on Traffic Lines

Figs. 3.3 and 3.4 show the daily traffic volume on traffic lines in the year 1981 and 2000 respectively. In comparing traffic volume on traffic lines in 2000 with that in 1981, the following findings can be noted.

(1) Traffic Volume on C.B.D. Cordon Line on Johor Bahru

The daily traffic volume on the C.B.D. cordon line is as follows:

Table 3.8 Traffic Volume on C.B.D Cordon Line

	Daily Traffic Volume	Percent Increase
1981	201.6 thousand P.C.U.	226%
2000	454.8 thousand P.C.U.	

The results indicated that if the existing service level on the road is to be maintained, it will be necessary to increase traffic capacity

2.3 times th e present level by the year 2000.

(2) Traffic Volume on the Boundary of Johor Bahru

Table 3.7 shows a comparison of traffic demand and road capacity at the boundary of MPJB.

Traffic demand will grow about 4.4 times the present level in the coming two decades.

3-3 Estimate of Bus Passenger Demand

1 Total Demand of Bus Passengers

Based on the results of the Home Interview Survey in 1981, the total demand of bus passengers in the future was estimated as shown in Table 3.9.

Table 3.9 Total Number of Bus Passenger in the Primary Study Area

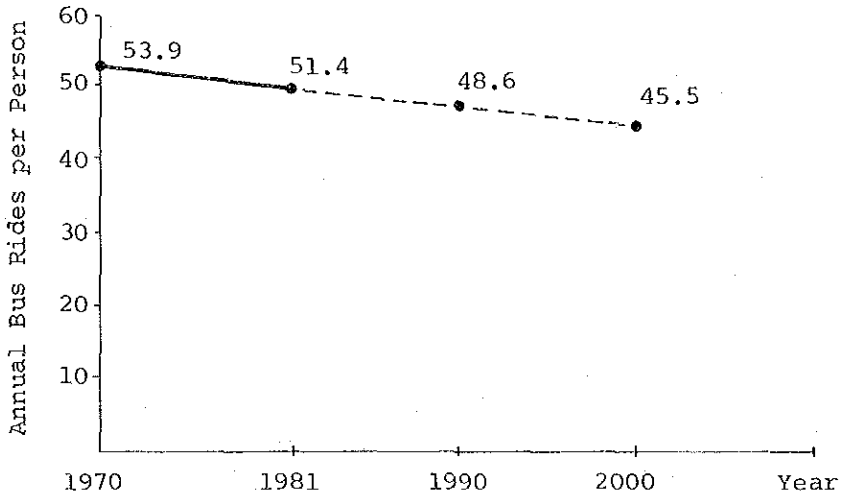
(Person/day)

Purpose	1981	2000	Growth Rate
Work	20,685	31,206	1.51
School	57,674	130,746	2.27
Business	727	1,410	1.94
Private	10,394	21,327	2.05
Home	82,857	186,147	2.25
Total	172,337	370,836	2.15

Note : The figures are the total passengers for scheduled buses, factory buses and school buses.

Although the ratio of bus passengers to population (rides per capita) will decrease as shown in Fig. 3.5, the total number of bus passengers will grow more than double the existing level, reflecting the population and employment growth in the Study Area.

Fig. 3.5 Trend of Per Capita Bus Rides



2 Trip Generation and Attraction

Future trip generation and attraction bus passengers were estimated by using the same type of regression model as with vehicle trips.

The result is shown in Fig. 3.6 together with the existing trip generation. As can be seen, the growth of trip generation in the peripheral areas of MPJB is extremely high, reflecting the high population growth.

3-4 Total Person Trip Production and Modal Split

As described above, the prediction of vehicle traffic demand and that of bus passengers were made separately.

By combining both estimates, the total person trip production was calculated in this section to examine whether these estimates were relevant or not as a whole.

Converting the vehicle trip production to person trip production by taking into account the average occupancy by vehicle type and by trip purpose, the total trip production is obtained. According to this calculation unit trip production per person will grow from 1.55 in 1981 to 1.80 in 2000 as shown in Table 3.10.

Fig. 3.6 Bus Passenger Trip Generation 1981 & 2000

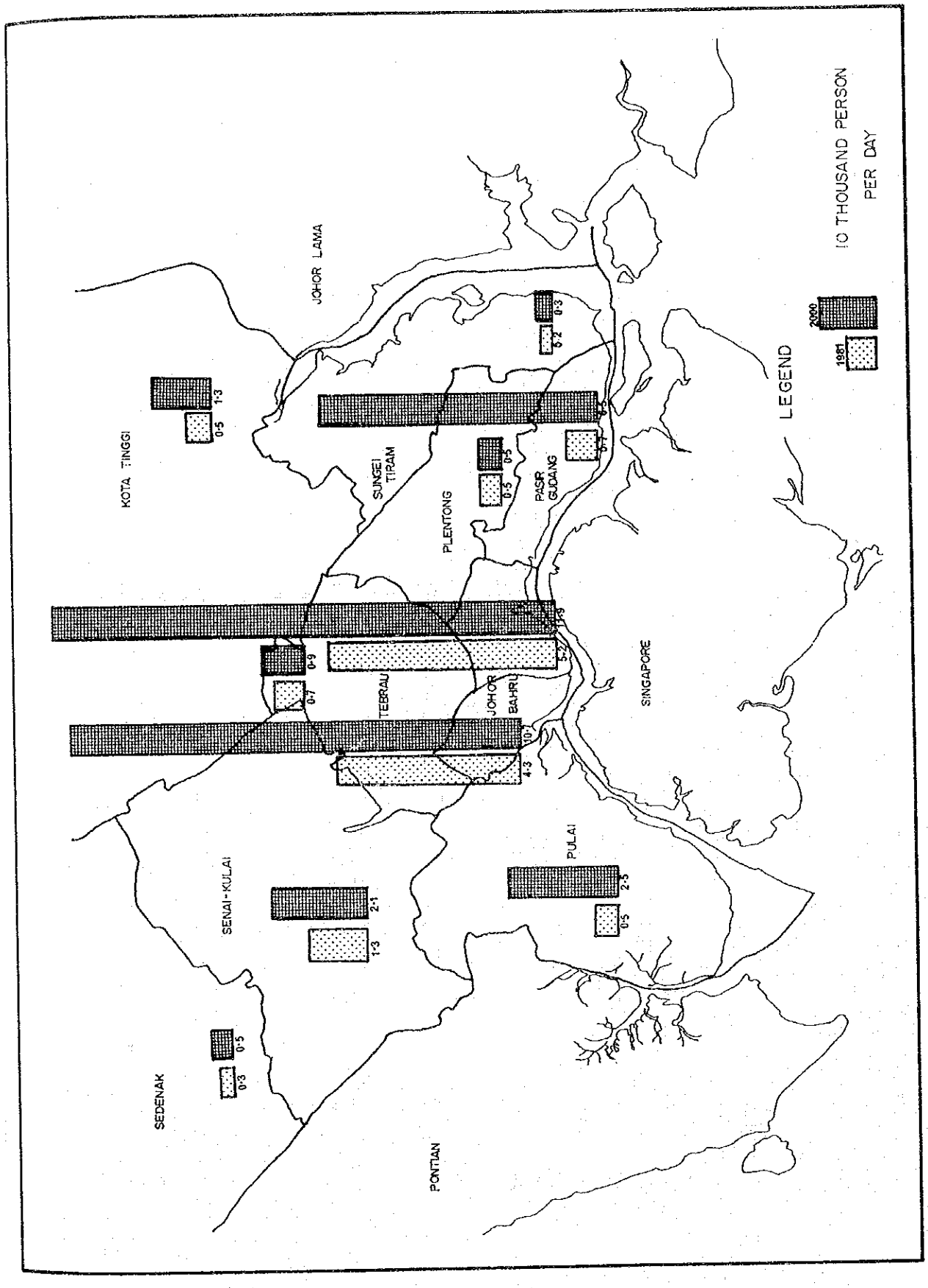


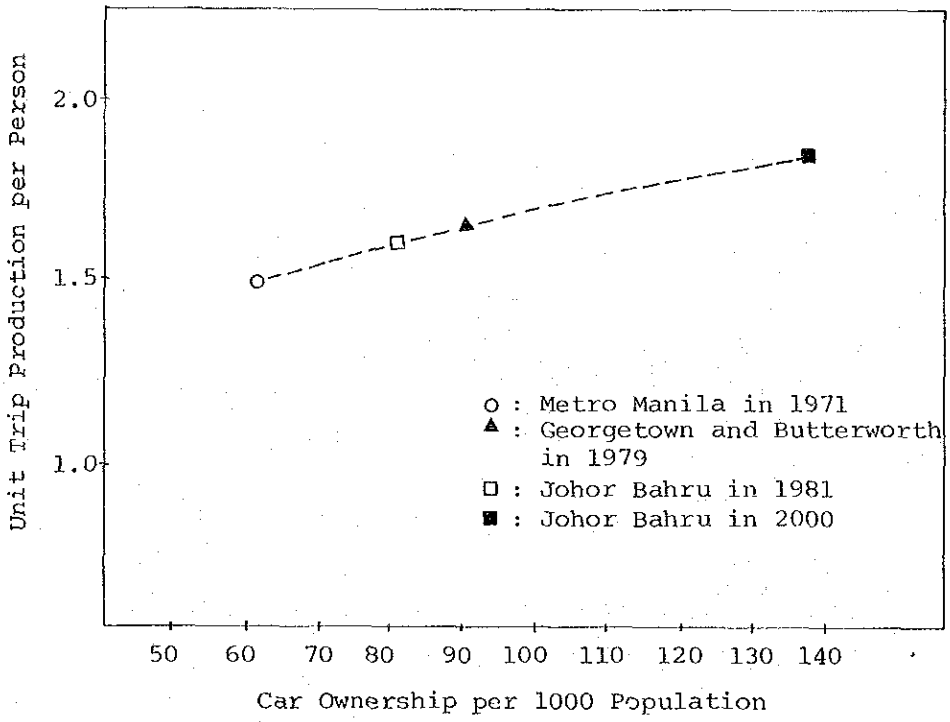
Table 3.10 Unit Trip Production per Person

	1981	2000
Total Person Trips	713,000	1,917,000
Population	459,000	1,067,000
Unit Trip Production per Person	1.55	1.80

Note : Excluding the trips on foot, bicycles, taxis and lorries

To compare the unit trip production per person with that in other cities, the relationship between unit trip production per person and car ownership is plotted as shown in Fig. 3.7.

Fig. 3.7 Comparison of Unit Trip Production per Person



The estimates in this study are found to conform to the growth curve of unit production per person.

Table 3.11 presents the person trip production

in the Primary Study Area by mode and by trip purpose.

Notably, the percentage share of bus use will decrease for all trip purposes, reflecting car ownership growth.

This tendency is acceptable considering the past trend observed in other cities.

As a result, it can be said that the estimates of future traffic demand for both vehicles and bus passengers are reasonable and are neither overestimated nor underestimated.

Table 3.11 Total Person Trip Production by Mode by Purpose

(in 1000 persons trips)

Trip Purpose		1981			2000		
		Private Vehicles	Buses	Total	Private Vehicles	Buses	Total
Work	No. of Trips	124.2	20.7	144.9	288.7	31.2	319.9
	%	(83.0)	(17.0)	(100.0)	(90.2)	(9.8)	(100.0)
School	No. of Trips	25.8	57.7	83.5	83.0	130.7	213.7
	%	(30.9)	(69.1)	(100.0)	(38.8)	(61.2)	(100.0)
Business	No. of Trips	45.4	0.7	46.1	160.9	1.4	162.3
	%	(98.5)	(1.5)	(100.0)	(99.1)	(0.9)	(100.0)
Private	No. of Trips	129.4	10.4	139.8	438.2	21.3	459.5
	%	(92.6)	(7.4)	(100.0)	(95.4)	(4.6)	(100.0)
Home	No. of Trips	213.4	82.9	296.3	575.4	186.1	761.5
	%	(72.0)	(28.0)	(100.0)	(75.6)	(24.4)	(100.0)
Total	No. of Trips	540.7	172.3	713.0	1,546.2	370.8	1,917.0
	%	(75.8)	(24.2)	(100.0)	(80.7)	(19.3)	(100.0)

Note : Private Vehicles: Passenger Car and Motorcycle

Buses : Scheduled bus, school bus, factory bus

Source: Study Team Estimate

3-5 Foreseeable Problems

(1) With a rapid population growth and a steady increase in household income, the number of cars will increase tremendously in the Study Area.

Accordingly, a serious problem in terms of road and parking capacity can be expected both within MPJB and its surrounding area.

(2) Within MPJB, the growth rate of traffic demand is relatively speaking not so high — about 2.7 times the existing level — however, the increase of trips between 1981 - 2000 is huge; i.e. about 450 thousand P.C.U/day. In particular, on the C.B.D. cordon line, the increase in volume will be more than 250 thousand P.C.U/day. These traffic demands require a vast amount of investment to expand the road and parking capacity; otherwise, chronic traffic congestion cannot be avoided.

(3) A similar problem is expected on the roads on the outskirts of MPJB. By the year 2000, the traffic demand on the boundary of MPJB will increase about 4.4 times the present demand. The road capacity, therefore, will fall short of meeting the future traffic demand, particularly on the sections between Johor Bahru and Pasir Gudang, and between Johor Bahru and Pulai.

In addition, the construction of the Toll Expressway is expected to be completed by the year 1986. When it is open to traffic, there will be a large inflow of vehicles into Johor Bahru. Unless an adequate approach road is provided, the roads around the exit of the Toll Expressway will suffer serious congestion.

Chapter 4 ALTERNATIVE TRANSPORT PLANS

4–1 Planning Target

1 Background

By the year 2000, the population will have increased from 0.6 million to 1.4 million and about 11,000 hectares of land will be developed for urban activities in the Study Area. The economic development will result in a large increase in transport demand: 3.2 times the present vehicular travel demand. In addition, the basic transport structure in the Study Area will change with the completion of the Toll Expressway and the Pasir Gudang industrial and port developments. Thus, the development of the transport network is urgently needed to meet increased travel demand and to promote further economic development.

2 Objectives for the Development of the Transport System

The following are the objectives in creating a better urban transport system:

a. to maximize the benefits to the urban economy;
b. to ensure mobility of the residents;
c. to minimize resource consumption;
d. to provide a safer means of transport;
e. to create and maintain a high quality of urban environment;
f. to maintain social equity for transportation of the urban poor.

4–2 Choice of Solutions

1 General

The alternative transport solutions will be discused in this section with the planning target in mind.

A distinction can be made between the problems of built-up areas and those of less developed areas where

future growth and expansion are expected. In the former, which lie mainly inside Jalan Tampoi, expanding the road network extensively will be difficult without large expenditures and large-scale replacement of established buildings and activities. In the latter, the road network is deficient in many places and must be extended if the expected future developments are to materialise, but because these are largely undeveloped areas. There is sufficient space to do this at relatively low cost without creating major disturbances. The analysis therefore deals separately with the urban area inside Jalan Tampoi and the outer areas lying outside Jalan Tampoi.

In the urban area, it is not always feasible or desirable to provide the transport capacity to meet future demand for whatever mode. A more appropriate objective is to meet the demand by a combination of methods, that will not only include road construction but also measures that will make more effective use of the transport space available.

These strategic measures are summarized below:

1. effective use of existing transport facilities;
2. effective use of passenger car;
3. improvement and/or expansion of transport system;
4. introduction of innovational bus and/or public transport system;
5. traffic restraints;
6. traffic engineering and management;
7. road improvement and construction.

For establishment of transport solutions, five (5) corridors within MPJB and four (4) outside MPJB are defined:

They are as follows:

1) Within MPJB

a. C.B.D.
b. Eastern Corridor

c. Western Corridor
d. Proposed inner ring corridor
e. Jalan Tampoi corridor

2) Outside MPJB

a. Johor Bahru - Pasir Gudang corridor
b. Johor Bahru - Kota Tinggi corridor
c. Johor Bahru - Senai/Kulai corridor
d. Johor Bahru - Pulai corridor

Strategic measures adopted for each of the corridors are summarized in Table 4.1. In the C.B.D. of MPJB, a combination of measures including the effective use of existing transport facilities, traffic restraints and traffic engineering and management and so forth may be necessary. On the other hand, in the Johor Bahru - Pasir Gudang corridor, it may be necessary to prepare the infrastructure as by road improvement and construction and introduction of an innovative bus and other public transport systems.

Table 4.2 shows the inter-relationship of these strategic measures and the timing of their implementation. For the short-term transport plan, the following strategic measures may be adopted.

a. Effective use of existing transport facilities.
b. Effective use of passenger car.
c. Improvement and/or expansion of bus transport system.
d. Traffic engineering and management.

For the longer-term plan, the following measures are the most vital.

a. Road construction and improvement.
b. Introduction of innovative bus and other public transport systems.
c. Traffic restraints.

2 Control Factors

In the search for transport solutions, there are five (5) major factors to be considered: demand, cost, external effects, effectiveness and institutional effects.

1) Demand

The future traffic demand of the base situation has already been described in detail in Chapter 4.

2) Cost

Various programmes and projects will be implemented to achieve the New Economic Policy (NEP). The Federal Government has allocated about 2,700 million for Johor State under the FMP and about 23 per cent of this budget is allocated for infrastructure development including transport, communication and public utilities.

The other cost factor is whether Johoreans can afford transport services. It is necessary to provide adequate service for residents who are willing to pay the cost.

3) External Effects

Any transport system may have external effects including environmental and social effects. These can be important and need to be carefully examined in the evaluation process.

4) Effectiveness

It must be understood that a proposed transport plan, whatever its theoretical potentials, has to be effective. A new transport system, if introduced, is of little use if people will not employ it. The effectiveness of each solution in meeting demand and minimising undesirable external effects must be balanced against the cost of the solution.