4-6 STUDY ON CAUSEWAY TRAFFIC DISPERSAL SCHEME

4-6-1 Introduction

(1) Background

As the Causeway Immigration and Custom Complex, which serves the Causeway traffic except laden lorries, is located at the southern end of the CBD of Johor Bahru, while the Causeway Lorry Custom Complex is located at Tanjong Putri at the eastern side of the railway, traffic going to and coming out of the Causeway is the main source of traffic congestion in the town of Johor Bahru, especially in the CBD area.

The CBD is also a pivot for the MPJB road network since major roads start here.

Therefore, most of the traffic problems in MPJB is manifested in the CBD and its peripheral area. Concerted effort has long been made to mitigate the problems. Some examples of the major measures taken until now can be cited as follows:

a. Construction of the interchange of Jalan Larkin and Jalan Tebrau,
b. Widening of Jalan Tun Abdul Razak,
c. One-way designation of Jalan Wong Ah Fook,
d. Traffic interchange facility with grade-separation and Custom Complex.

However, some problems still exist such as:

a. Congestion at the roundabout of interchange in front of the Causeway Immigration and Custom Complex,
b. Long queues of cars awaiting Immigration Clearance,
c. Congestion and confusion along Jalan Wong Ah Fook in the evening peak hour,
d. Adverse effects of inadequate road conditions along the designated lorry route to the Custom Complex thus raising complaints.

In order to solve these problems, the Causeway Traffic Dispersal Scheme was therefore proposed in the Masterplan Study. Following the proposal, further investigation has been conducted in the Feasibility Study.

(2) Objective

This Study mainly aims at formulating the Traffic Dispersal Plans of the Causeway traffic on a long-term as well as short-term basis.

The Traffic Dispersal Plan will be a comprehensive Traffic Dispersal Plan for the Causeway traffic including the CBD traffic.

(3) General Procedure Adopted

The procedure adopted for the formulation of the Causeway Traffic Dispersal Scheme is illustrated in Fig. 4-23.

(4) Study Area

The Study Area, as illustrated in Fig. 4-24 covers the Central Area of Johor Bahru which includes the Central Business District, its peripheral area within the proposed Inner Ring Road and the entry and exit points of the Causeway Immigration and Custom Complex.

As far as signal installation design is concerned, the Study will cover an area outside the above defined Study Area if required.

(5) Road Network to be Studied

The road network to be studied, as illustrated in Fig. 4-25, covers primary distributors, district distributors and major circulation roads in the Central Area of Johor Bahru.

(6) Target Year

Since the target year of the Urban Transport Masterplan Study has been formulated as the year 2000, that of the Causeway Traffic Dispersal Scheme should be set up towards the year 2000. However, the Causeway Traffic Dispersal Scheme includes a long-Term Plan as well as Short-Term Actions and the Short-Term Action focuses mainly around the year 1990 and the Long-Term Plan focuses after the year 1990 towards the year 2000.

(7) Premises

The formulation of the Causeway Traffic Dispersal Scheme will be based on the following premises:

1. Widening of Jalan Tebrau

The widening of Jalan Tebrau into six (6) lanes is expected to be implemented under the mid-term review of the Fourth Malaysia Plan.

2. Causeway Renovation Plan

The Causeway Renovation Plan, which aims at reducing traffic congestion at the Entry and Exit Points, was formulated by the JEEP Committee and its implementation will be completed in 1983.

3. Preliminary Causeway Layout Plan

Two (2) out of the four (4) concept plans proposed for the Preliminary Causeway Layout Plan, which are based on the estimated traffic demand in 2000, were selected by the Steering Committee held in March, 1983. They are:

a. Concept A: Horizontal Expansion Concept.

b. Concept B: Site Relocation Concept.

The Inner Ring Road and Lorry Route, the Feasibility Study for which is being conducted separately, will much affect the formulation of the Causeway Traffic Dispersal Scheme, though they are not considered as premises.

Therefore, they are included, according to the anticipated progress of their implementation, in the alternative road networks for which the traffic projection is made to enable their feasibility to be assessed from the viewpoint of the Causeway Traffic Dispersal.

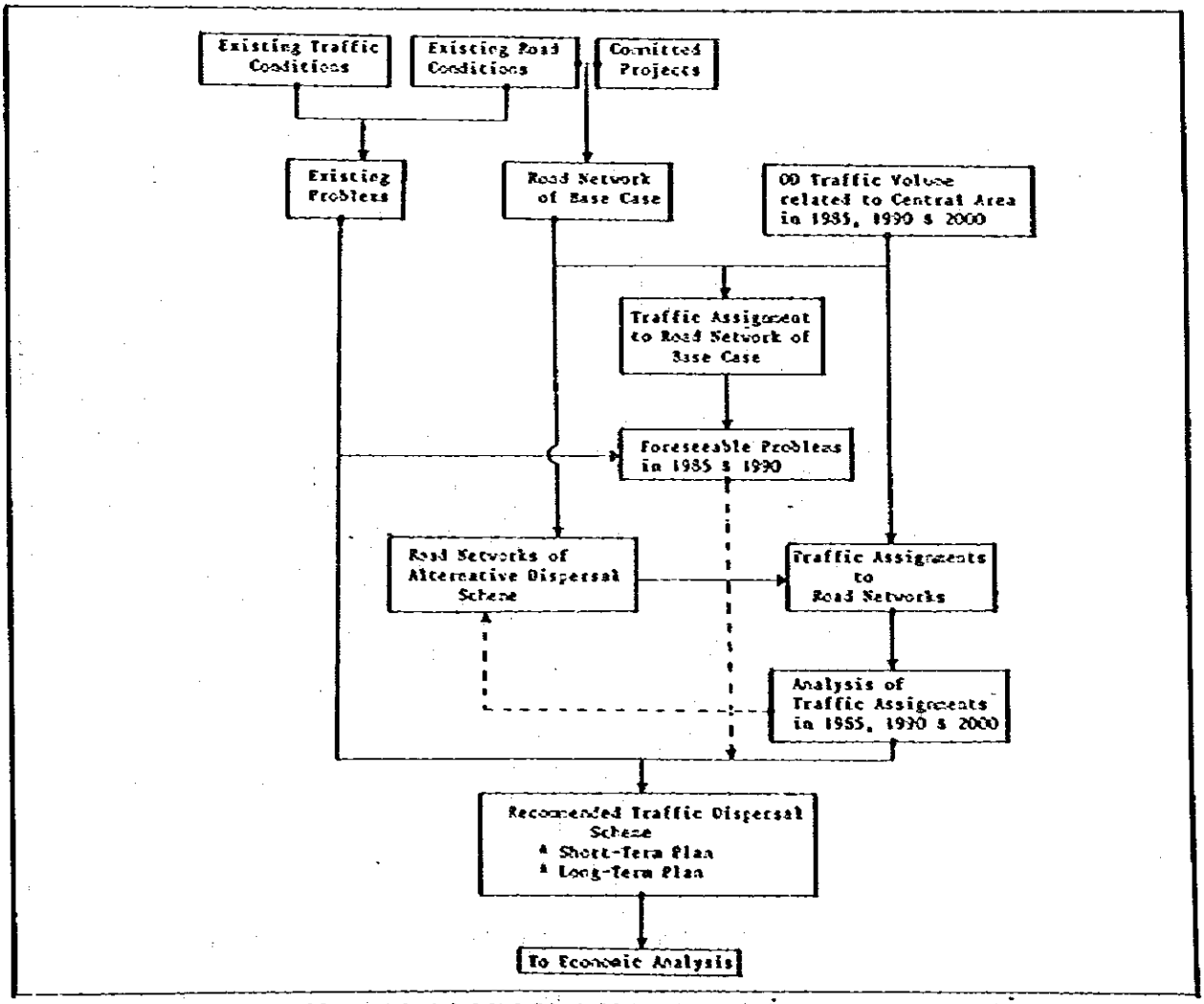


FIG. 4-23 PROCEDURE FOR FORMULATION ON THE CAUSEWAY

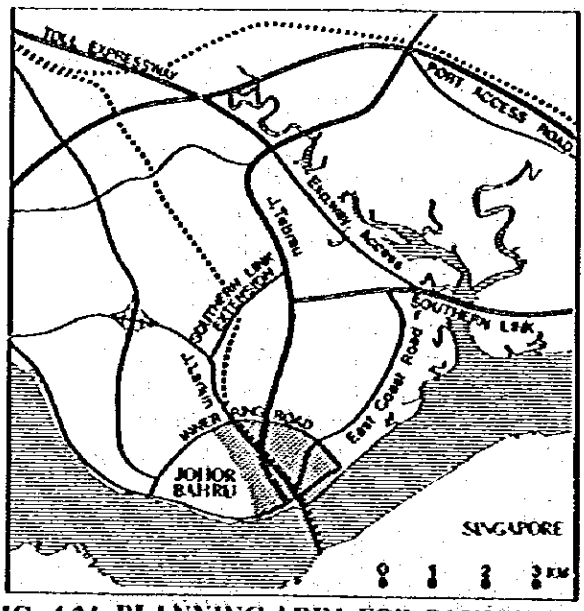


FIG. 4-24 PLANNING AREA FOR CAUSEWAY TRAFFIC DISPERSAL SCHEME

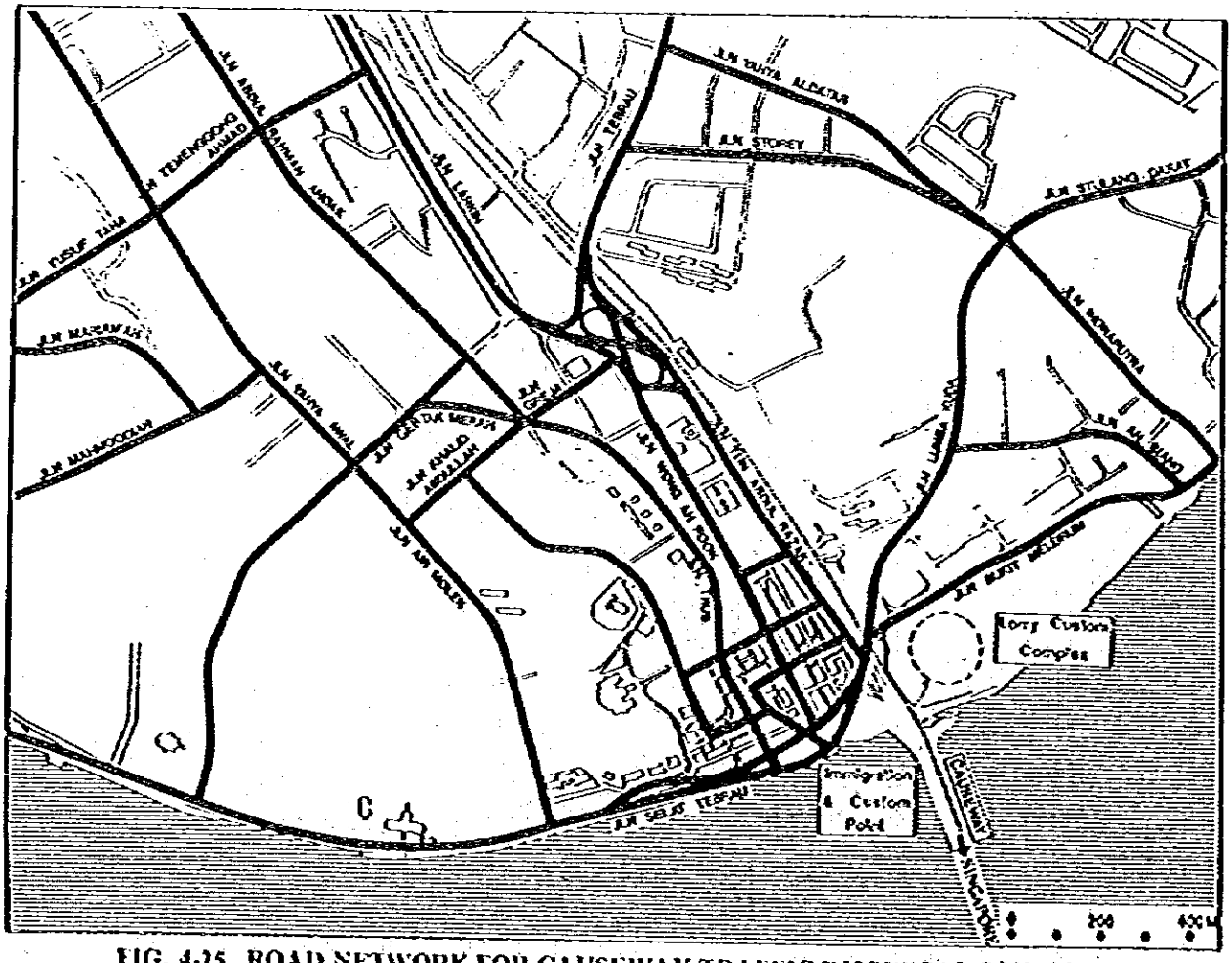


FIG. 4-25 ROAD NETWORK FOR CAUSEWAY TRAFFIC DISPERSAL SCHEME

4-6-2 Existing and Foreseeable Problems

(1) Existing Problems

Figs. 4-26 and 4-27 show the daily traffic volume, (the data for which was obtained from the traffic surveys conducted), and its congestion on the road network. From these figures, the following problems now existing are summarrized in Table 4-14 and displayed in Fig. 4-28.

They are as follows:

1. Traffic Congestion on Roads

a. Congestion and conflict on Jalan Wong Ah Fook between Jalan Station and Tebrau Interchange with a congestion degree of 1.07,
b. Congestion on Jalan Tebrau between Jalan Storey and Jalan Yahya Aldatar with a congestion degree of 1.43.

2. Traffic Congestion at Intersections

a. Long queue of right turning vehicles at the station intersection of Jalan Tun Abdul Razak is a common sight in the morning peak hours. However, this problem has already been solved by the Traffic Signal Renovation Plan implemented by JICA.
b. The congestion and conflict at the intersection of Jalan Wong Ah Fook with Jalan Station is a pressing problem. This is mainly due to conflicting traffic between east-northbound and south-eastbound traffic.
c. There was congestion at the intersection of Jalan Wong Ah Fook with Jalan Segget but this too has been solved through the Traffic Signal Renovation Plan implemented by JICA.

3. Weaving Problems

Improper road design resulting in poor traffic weaving is a hindrance to the smooth flow of traffic. Such problem is found at several location in Johor Bahru.

They are:

a. Congestion and conflict along Jalan Wong Ah Fook near Tebrau Interchange owing to weaving and merging traffic.
b. Congestion along Jalan Sawmill near the roundabout in front of the Causeway Immigration and Custom Complex due to the heavy weaving traffic between Jalan Lumba Kuda and Jalan Ibrahim.
c. Congestion along Jalan Ibrahim owing to weaving and merging traffic.
d. Conflict along Jalan Selat Tebrau between Jalan T. Duke and the Causeway Immigration and Custom Complex due to weaving and merging traffic between Jalan Selat Tebrau and the Causeway traffic.
e. Conflict along Jalan Tebrau between the interchange and Jalan Storey due to weaving traffic.

4. Merging Problems

A conspicuous traffic merging problem exists at the two (2)-lane section of Jalan Tun Abdul Razak southbound roadway near the merging points of the two (2) ramps from Jalan Tebrau and Jalan Larkin.

5. Specific Problems

Other traffic problem found in Johor Bahru are:

a. Long queues on Jalan Tun Abdul Razak formed by cars awaiting Immigration Clearance.
b. Long queue on Jalan Bukit Meldrum formed by lorries awaiting Lorry Custom Clearance.
c. Adverse effects due to inadequate road provisions along designated lorry route.

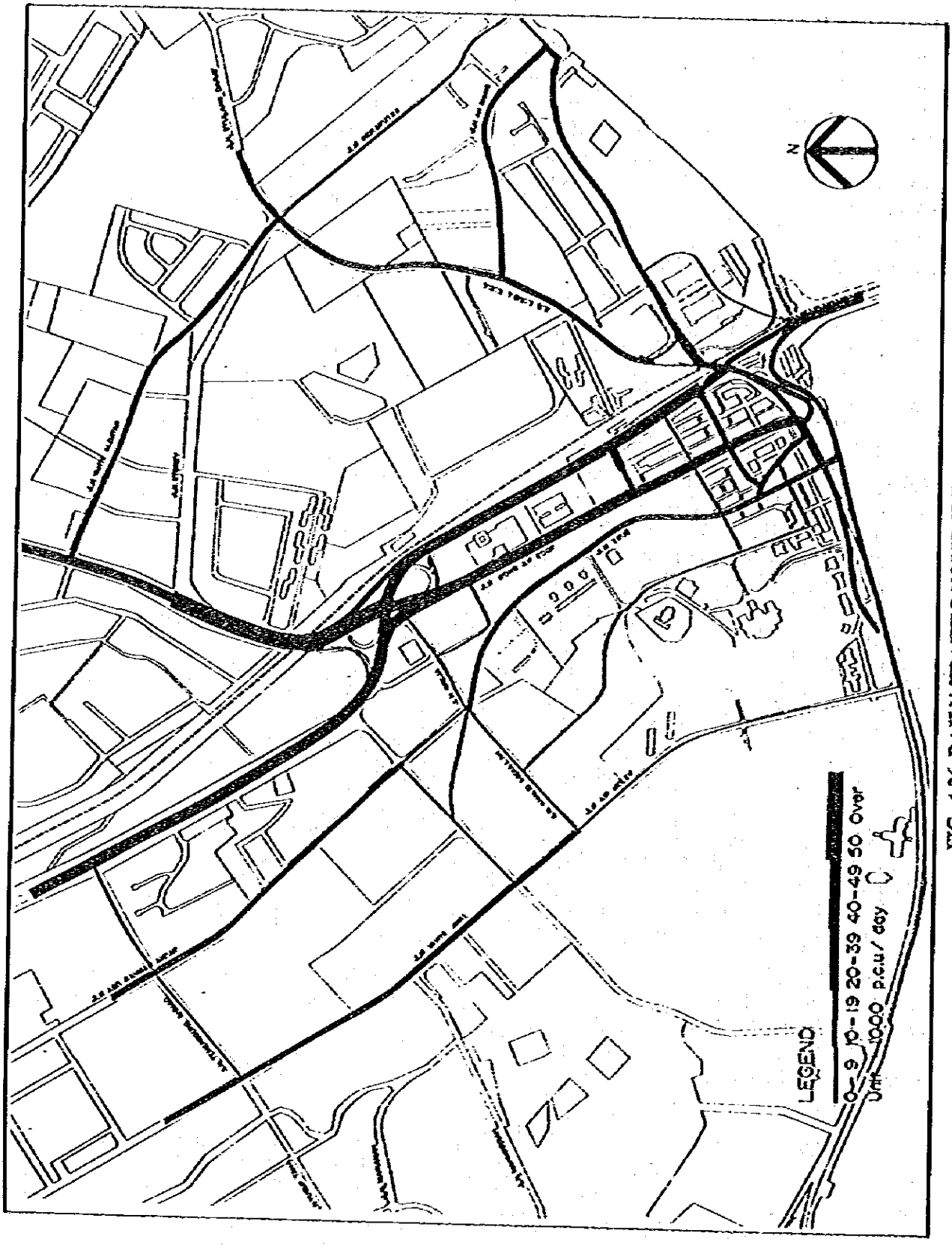


FIG. 4-26 DAILY TRAFFIC VOLUME IN 1981

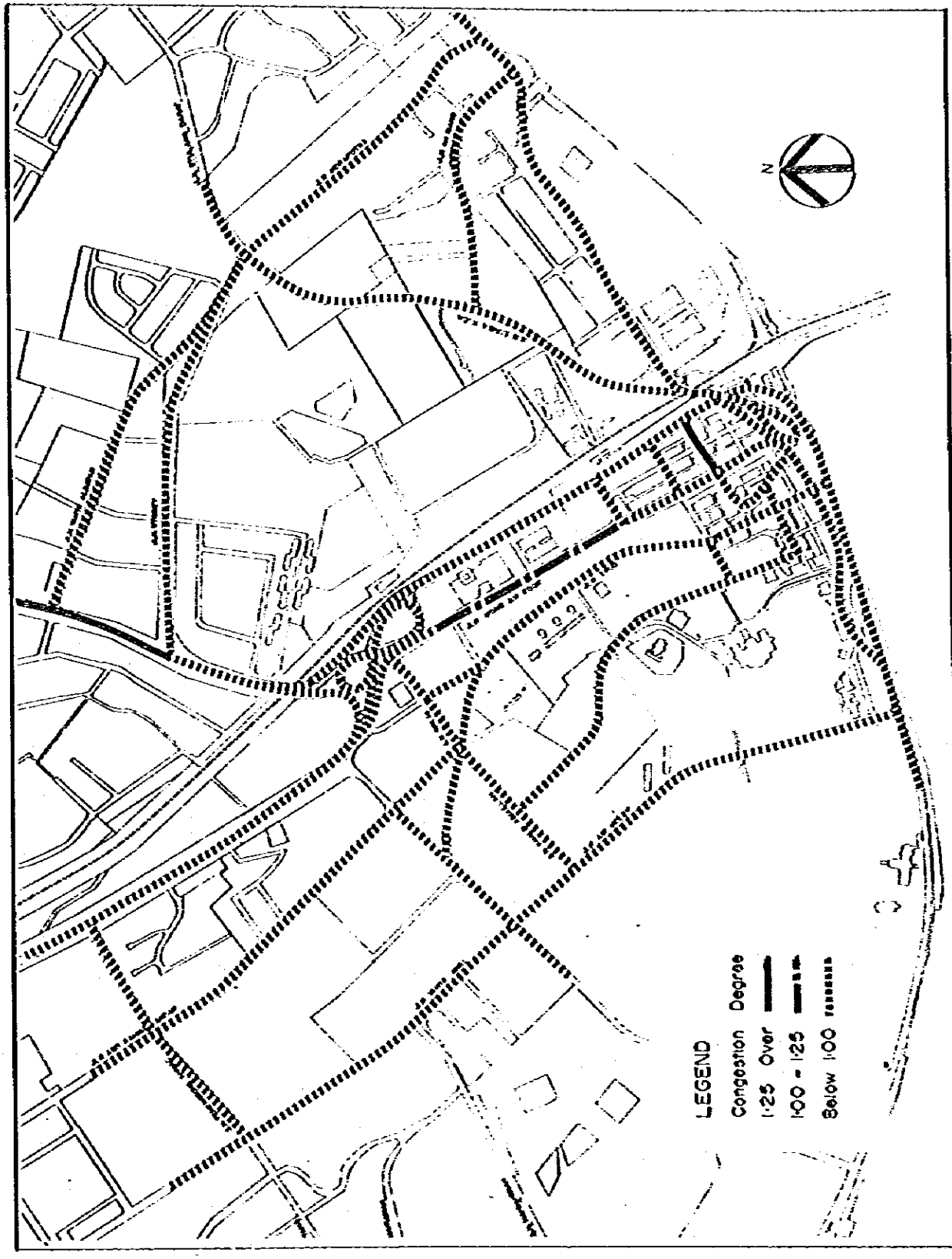


FIG. 4-27 TRAFFIC CONGESTION DEGREE ON ROADS IN 1981

TABLE 4-14 EXISTING TRAFFIC PROBLEMS

Categories of Problem	Problem Sections/Intersections
1 Traffic Congestion on Roads	a. Jalan Wong Ah Fook, between Jalan Station and Tebrau Interchange with a congestion degree of 1.27
	b. Jalan Tebrau between Jalan Yahya Aldatar and Jalan Storey with a congestion degree of 1.38
2 Traffic Congestion at Intersections	a. Intersection of Jalan Tun Abdul Razak with Jalan Station
	b. Intersection of Jalan Wong Ah Fook with Jalan Station with a congestion degree of 1.08
	c. Intersection of Jalan Wong Ah Fook with Jalan Segget
3 Weaving Problems	a. Jalan Selat Tebrau between Causeway Entry Point and Jalan T. Duke.
	b. Jalan Ibrahim between Jalan T. Duke and Jalan Wong Ah Fook
	c. Jalan Sawmill, around the roundabout
	d. Jalan Wong Ah Fook near Tebrau Interchange
	e. Jalan Tebrau between Tebrau Interchange and Jalan Storey
4 Merging Problems	a. Jalan Tun Abdul Razak from Jalan Larkin and Jalan Tebrau.
5 Specific Problems	a. Awaiting vehicles to exit point on Jalan Tun Abdul Razak
	b. Awaiting vehicles to Lorry Custom on Jalan Bukit Meldrum
	c. Adverse effects on Jalan Lumba Kuba and Jalan Ah Siang along the Lorry Route

Notes:

1) Congestion Degree on Roads = Traffic Volume/Road Capacity
2) Congestion Degree on Intersections = Turning Movement of Traffic Volume/Intersection Capacity

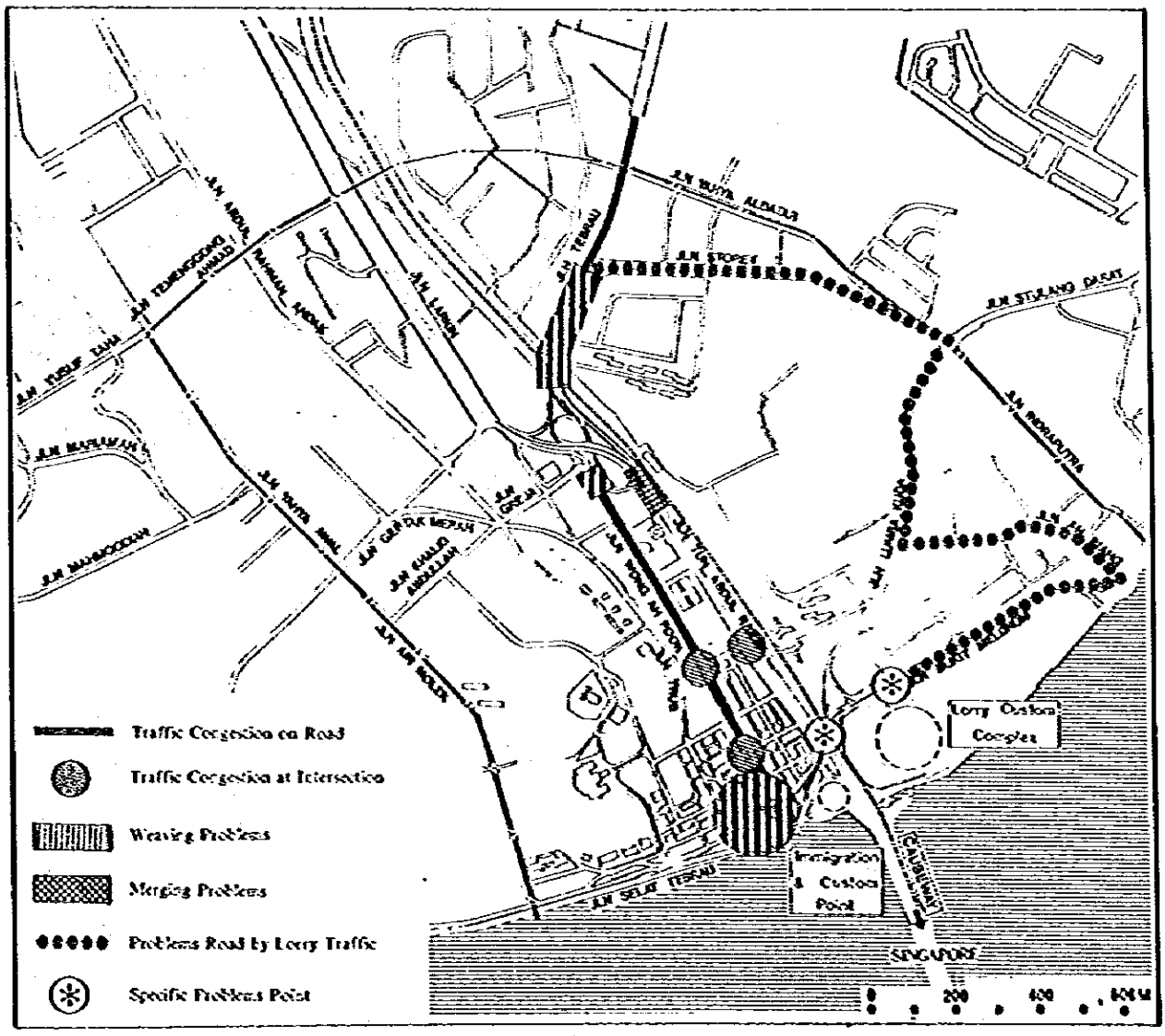


FIG. 4-28 EXISTING TRAFFIC PROBLEMS

(2) Foreseeable Problems around 1990

Fig. 4-29 and 4-30 show the projected traffic volume and its congestion degree on the road network.

This is the results of traffic assignment with the OD traffic volume in 1990 being assigned to the road network that consists of the existing read network and the committed project (hereinafter referred to as the "base case")

From these figures, major traffic problems identified in 1990 are summarized in Table 4-15 and illustrated in Fig. 4-31

They are as follows:

1. Traffic Congestion on Roads

a. Further congestion and conflict on Jalan Wong Ah Fook between the Southern Interchange and Tebrau Interchange with a congestion degree of 1.47,
b. Congestion on Jalan Tun Abdul Razak between Jalan Station and Tebrau Interchange with a congestion degree of 1.18,
c. Congestion along designated lorry route, such as Jalan Storey, Jalan Lumba Kuda and Jalan Ah Siang with a congestion degree of 1.10 — 1.36,
d. Congestion along Jalan Trus with a congestion degree of 1.10.

2. Traffic Congestion at Intersections

a. Greater congestion at the intersection of Jalan Wong Ah Fook and Jalan Station with a congestion degree of 1.36,
b. Congestion at the intersection of Jalan Mohamed Noor and Jalan Trus with a congestion rate of 1.16,
c. Congestion at the intersection of Jalan Ayer Molek and Jalan Gertak Merah with a congestion rate of 1.03,
d. Congestion at the intersection of Jalan Lumba Kuda and Jalan Storey with a congestion rate of 1.50.

3. Weaving Problems

The weaving problems, which are cited as the existing problems, will still exist but in a more severe manner around 1990.

4. Merging Problems

Further congestion owing to the merging difficulty encountered near the merging points of two (2) ramps from Jalan Tebrau and Jalan Tun Abdul Razak will emerge.

5. Specific Problems

The other problems which are cited as the existing problems, such as long queues of awaiting vehicles due to immigration clearance and Lorry custom clearance as well as adverse effects along the Lorry Route, are expected to be much greater than the present situation.

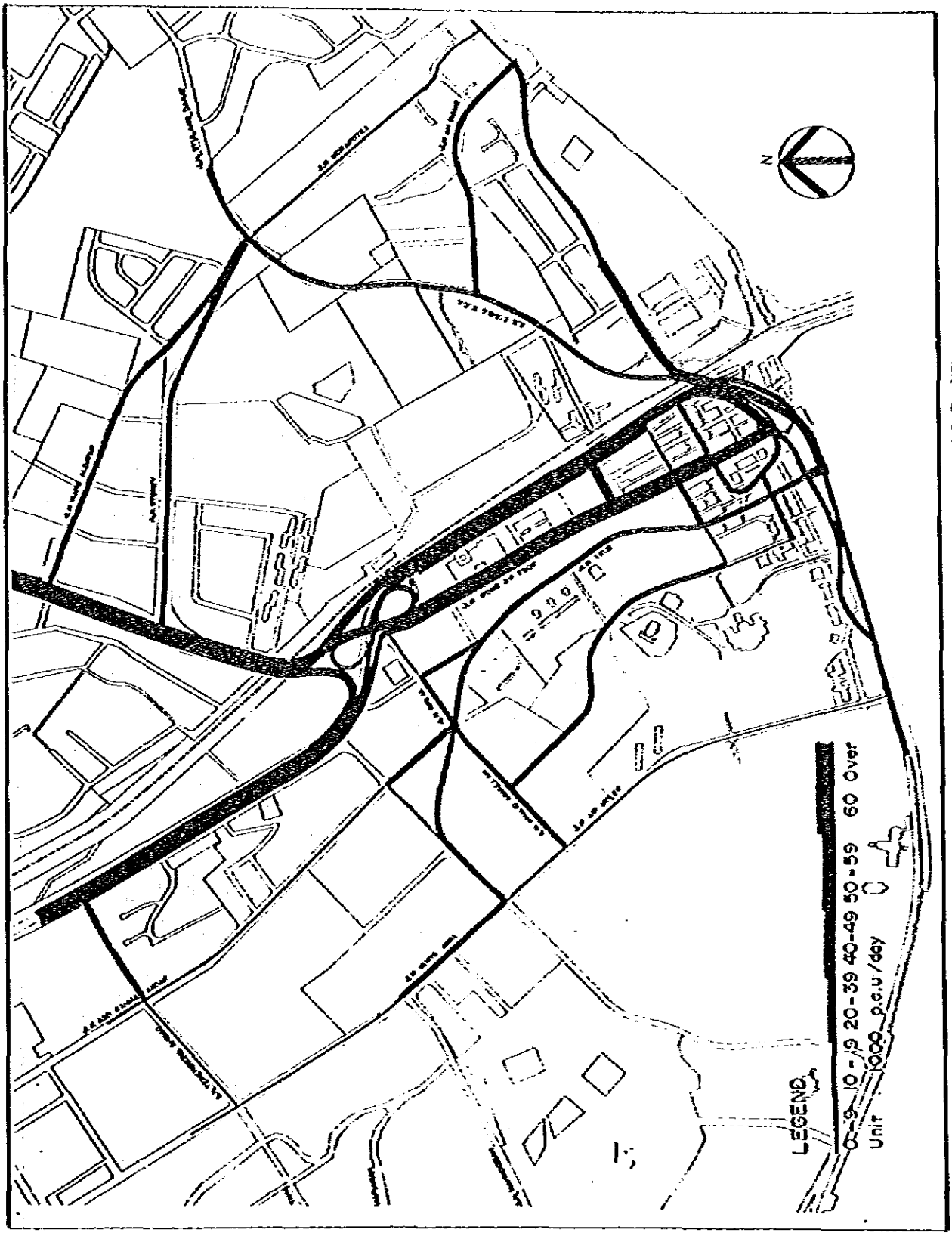


FIG. 4.29 DAILY TRAFFIC VOLUME IN 1990 (BASE CASE)

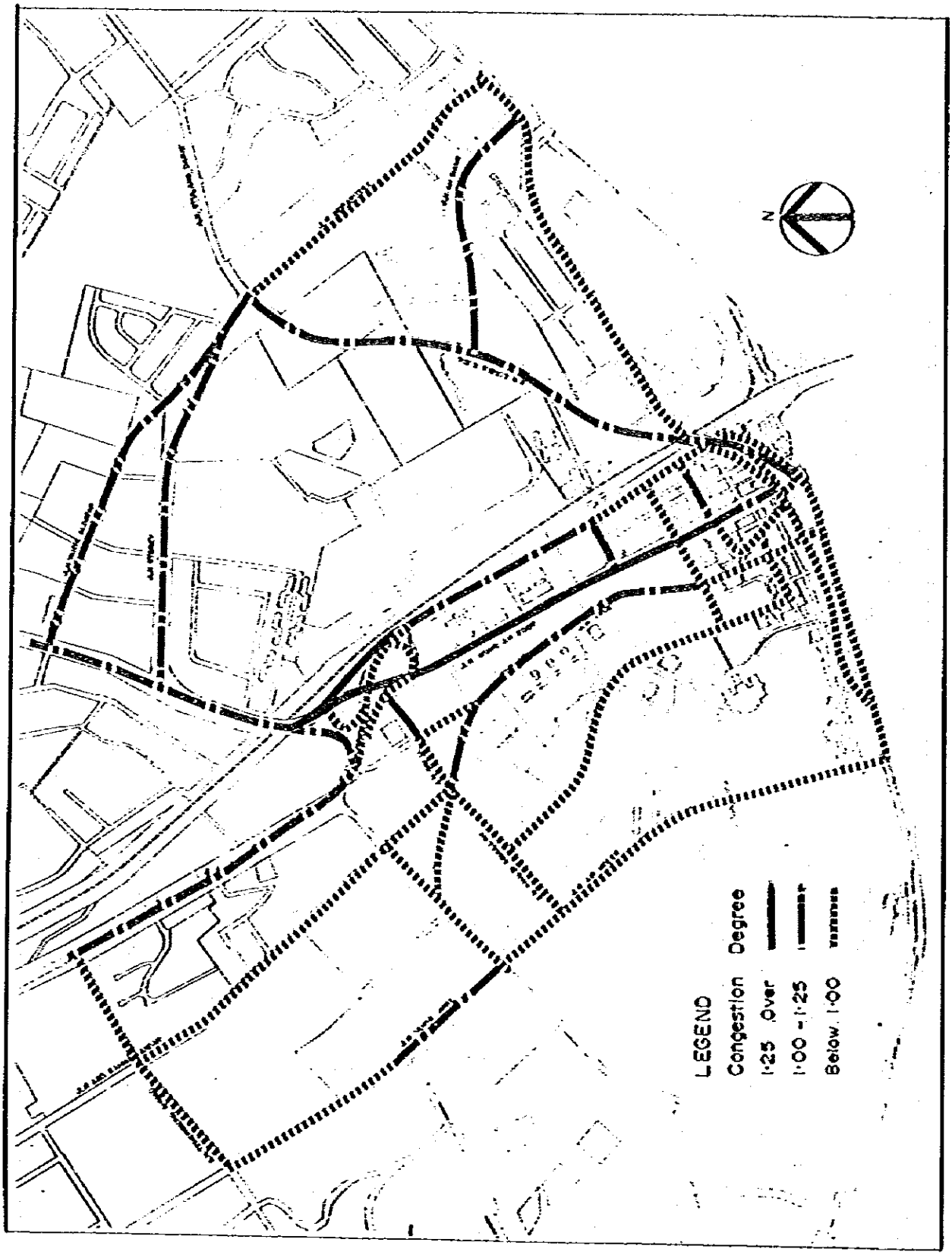


FIG. 4-30 TRAFFIC CONGESTION ON ROADS IN 1990 (BASE CASE)

TABLE 4-15 FORESEEABLE TRAFFIC PROBLEMS AROUND 1990

Items of Problems	Problem Sections/Intersections
1 Traffic Congestion on Roads	a. Jalan Wong Ah Fook between Jalan Ibrahim and Tebrau Interchange with a congestion degree of 1.47
	b. Jalan Tun Abdul Razak between Jalan Station and Tebrau Interchange with a congestion degree of 1.18
	c. Jalan Storey with a congestion degree of 1.10
	d. Jalan Lumba Kuda with a congestion degree of 1.36
	e. Jalan Ah Siang with a congestion degree of 1.10
	f. Jalan Trus between Jalan Md. Noor and Jalan Ungku Puan with a congestion degree of 1.10
2 Traffic Congestion at Intersections	a. Intersection of Jalan Wong Ah Fook with Jalan Station with a congestion degree of 1.36
	b. Intersection of Jalan Md. Noor with Jalan Trus with a congestion degree of 1.16
	c. Intersection of Jalan Ayer Molek with Jalan Gertak Merah with a congestion degree of 1.03
	d. Intersection of Jalan Lumba Kuda with Jalan Storey with a congestion degree of 1.50
3 Weaving Problems	a. Jalan Selat Tebrau between Causeway Entry Point and Jalan T. Duke.
	b. Jalan Ibrahim between Jalan T. Duke and Jalan Wong Ah Fook.
	c. Jalan Sawmill, around the roundabout
	d. Jalan Wong Ah Fook near Tebrau Interchange.
	e. Jalan Tebrau between Tebrau Interchange Jalan Storey.
4 Merging Problems	a. Jalan Tun Abdul Razak from Jalan Larkin and Jalan Tebrau.
5 Specific Problems	a. Awaiting vehicles to exit point on Jalan Tun Abdul Razak.
	b. Awaiting lorries to Lorry Custom on Jalan Bukit Meldrum.
	c. Greater adverse effects on Jalan Lumba Kuda and Jalan Ah Siang along the Lorry Route

Notes: 1) As for Traffic Congestion, same Definitions as Mentioned in Table II-4
2) Traffic Situations are Expected to be the without the Short-Term Actions

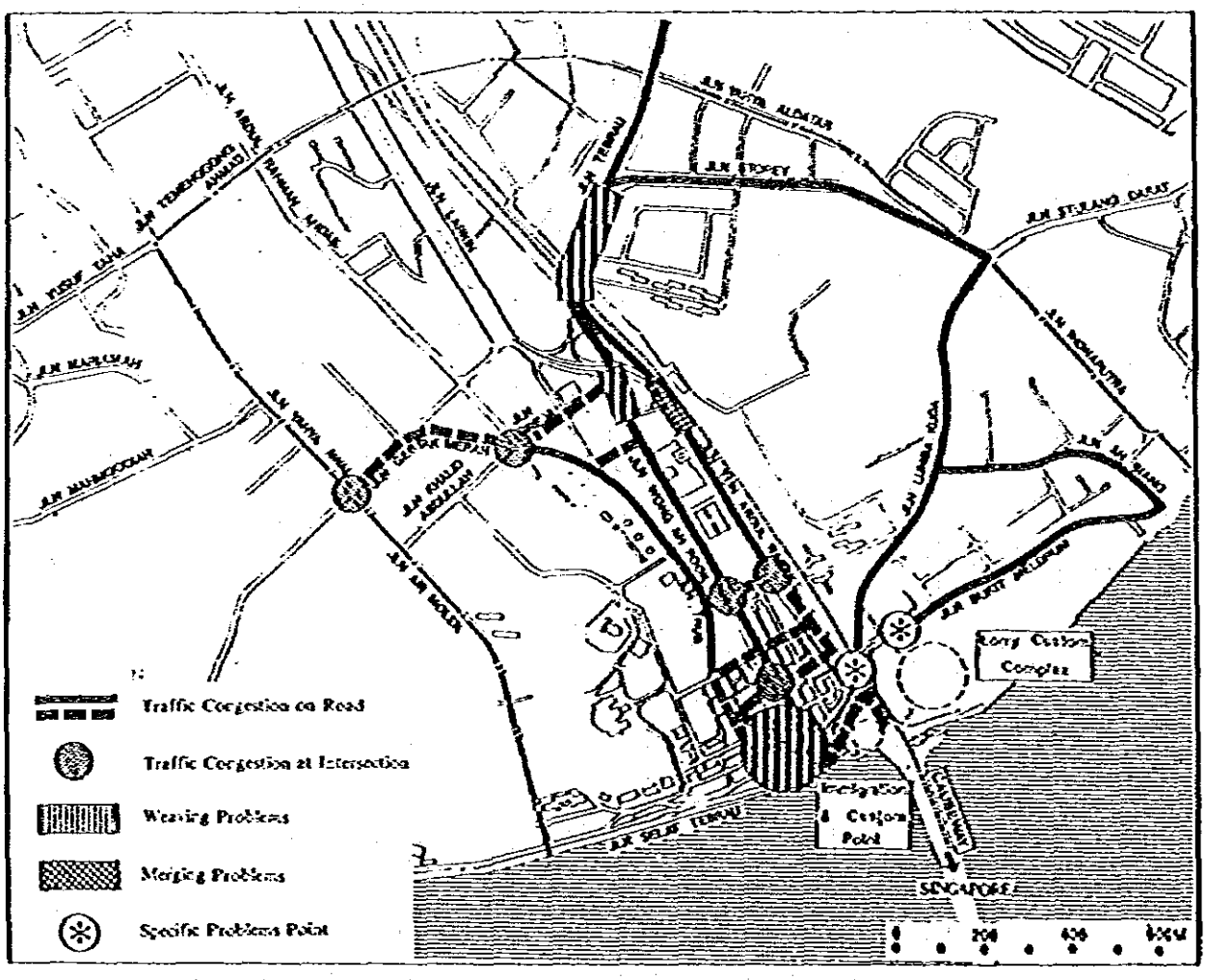


FIG. 4-31 FORESEEABLE TRAFFIC PROBLEMS AROUND 1990

4-6-3 Policy and Strategies for Causeway Traffic Dispersal Scheme

The main concern of the Causeway Traffic Dispersal Scheme is the provision of both Short-Term Action and Long-Term Plan to disperse the CBD traffic as well as the Causeway traffic and to modernize the transport system in the Central Area of Johor Bahru. The policy and strategies for the Short-Term Action are mainly to ensure maximum utilization of the existing roads and the related road facility in a smooth, effective and safe manner with minimum capital investment. For the Long-Term Plan, however, it concentrates mainly on increasing their capacity by construction of roads and interchanges and improvement of the existing roads and intersections.

Keeping the general policy and strategies in mind, the following strategic measures are to be taken in order to solve the existing and foreseeable problems:

1. Traffic Engineering and Management Measures

a. One-Way System,
b. Traffic Signal Renovation and Area Traffic Control,
c. Parking Control and Provision,
d. Traffic Regulation,
e. Pedestrian Facility.

2. Construction and Improvement Measures

a. Jalan Wong Ah Fook,
b. Jalan Tun Abdul Razak,
c. Jalan Bukit Meldrum/Jalan Ibrahim,
d. Inner Ring Road including Lorry Route,
e. Connecting Roads between Jalan Wong Ah Fook and Jalan Tun Abdul Razak,
f. Jalan Ayer Molek,
g. Jalan Duke.

3. Construction and Improvement Measures

a. Tebrau Interchange,
b. South Interchange,
c. Minor Intersections.

Where the road construction and improvement measures are concerned, the construction of the Inner Ring Road including the Lorry Route is an important item. This is because it is one of the major dispersal roads.

Table 4-16 and 4-17 show the strategic measures which will solve the existing and foreseeable problems. Based on the relationship, the following alternative dispersal plans can be identified:

For Short-Term Actions (No alternative is considered)

1. Traffic Engineering and Management Measures

a. Modification of One-Way System,
b. Traffic Signal Renovation,
c. Traffic Regulational Measures,
d. Other Supporting Traffic Management Measures.

2. Construction and Improvement of Roads

a. Upgrading of Jalan Wong Ah Fook,
b. Modification of Jalan Tun Abdul Razak,
c. Construction and Upgrading of the Connecting Road between Jalan Wong Ah Fook and Jalan Tun Abdul Razak,
d. Construction and/or Improvement of the Lorry Route.

For the Long-Term Plan, the following alternative plans are suggested:

TABLE 4-16 COUNTER MEASURES TO EXISTING TRAFFIC PROBLEMS

Traffic Problems		Traffic Engineering Measures						Roads						Interchanges & Intersections			
		One-Way System	Traffic Signal Renovation & Area Control System	Parking Control	Traffic Regulation	Pedestrian Facility	Jln. Wong Ah Fook	Jln. Tun Abd. Razak	Jln. Bukit Meldrum/ Solat Tebrau	Inner Ring Road with Lorry Route	Connecting Road	Jln. Ayer Molek	Jln. Duke	Tebrau Interchange	South Interchange	Minor Intersection Plan	Jln. Tebrau Widening Project
1 Traffic Congestion on Roads	a. Jalan Wong Ah Fook, between Jalan Station and Tebrau Interchange	●	○	○	○	○	●	○	○	○	○	○	○	○	○	○	
	b. Jalan Tebrau between Jalan Yahya Awaar and Jalan Storey								○								●
2 Traffic Congestion at Intersections	a. Intersection of Jalan Tun Abdul Razak with Jalan Station		●		○			●			●						
	b. Intersection of Jalan Wong Ah Fook with Jalan Station	●			○		●				●						
	c. Intersection of Jalan Wong Ah Fook with Jalan Segget		●				●										
3. Weaving Problems	a. Jalan Solat Tebrau between Causeway Entry Point and Jalan T. Duke				○				●						●		
	b. Jalan Ibrahim between Jalan T. Duke and Jalan Wong Ah Fook		○	○	○	○									●		
	c. Jalan Sasamil around roundabout			○	○	○									●		
	d. Jalan Wong Ah Fook near Tebrau Interchange	●			○									●			
	e. Jalan Tebrau between Tebrau Interchange and Jalan Storey									○				●			
4 Merging Problems	a. Jalan Tun Abdul Razak from Jalan Larkin and Jalan Tebrau	●			○			○									
5 Specific Problems	a. Awaiting vehicles to exit point on Jalan Tun Abdul Razak	●			○												
	b. Awaiting vehicles to Lorry Customs on Jalan Bukit Meldrum								●								
	c. Adverse effects on Jalan Lumba Kuda and Jalan Ah Siang along the Lorry Route				○					●	●						

● Counter Measures

○ Supporting Measures

TABLE 4-17 COUNTER MEASURES TO FORESEEABLE TRAFFIC PROBLEMS AROUND 1990

		Traffic Problems Identified / Traffic Engineering Measures									Roads						Interchanges & Intersections		
		One-Way System	Traffic Signal Renovation & Area Control System	Parking Control	Traffic Regulation	Pedestrian Facility	Jln. Wong Ah Fook	Jln. Tun Abd. Razak	Jln. Bukit Meldrum/ Selat Tebrau	Inner Ring Road with Lorry Route	Connecting Road	Jln. Ayer Molek	Jln. Duke	Tebrau Interchange	South Interchange	Minor Intersection Plan
1. Traffic Congestion on Roads	a. Jalan Wong Ah Fook between Jalan Perdana and Tebrau Interchange	●	O	O	O	O	●	O	O	O	O	O	O	O	O	
	b. Jalan Tun Abdul Razak between Jalan Station and Tebrau Interchange	●			O			●								
	c. Jalan Stoney									●						
	d. Jalan Lumba Kuda									●						
	e. Jalan Ah Siang									●						
	f. Jalan Trus between Jalan M.I. Noor and Jalan Ungku Puan	●		O	O							O	O			
2. Traffic Congestion at Intersections	a. Intersection of Jalan Wong Ah Fook with Jalan Station	●			O	O	●									
	b. Intersection of Jalan M.I. Noor with Jalan Trus	●	●		O							O	O			●
	c. Intersection of Jalan Ayer Molek with Jalan Gertak Merah		●									●				●
	d. Intersection of Jalan Lumba Kuda with Jalan Stoney		●							●						●
3. Weaving Problems	a. Jalan Selat Tebrau between Causeway Entry Point and Jalan Tanggu Duke				O				●						●	
	b. Jalan Perdana between Jalan T. Duke and Jalan Wong Ah Fook		O	O	●	O									●	
	c. Jalan Stoney around roundabout			O	●	O									●	
	d. Jalan Wong Ah Fook near Tebrau Interchange	●			●									●		
	e. Jalan Tebrau between Tebrau Interchange Jalan Stoney									O				●		
4. Merging Problems	a. Jalan Tun Abdul Razak from Jalan Lumba and Jalan Tebrau	●			O			●								
5. Specific Problems	a. Avoiding vehicles to exit point on Jalan Tun Abdul Razak	●			O											
	b. Avoiding buses to Lorry Custom on Jalan Bukit Meldrum								●							
	c. Greater adverse effects on Jalan Lumba Kuda and Jalan Ah Siang along the Lorry Route				O					●	●					

● Counter Measures

O Supporting Measures

Alternative Plan 1

Same as Short Term Actions Plan

Alternative Plan 2

1. Traffic Engineering and Management Measures.

Same as Alternative Plan 1

2. Construction of the Inner Ring Road including Lorry Route between Jalan Tebrau and Jalan Bukit Meldrum

Alternative Plan 3

1. Traffic Engineering and Management Measures

a. Additional One-Way System, Jalan Trus and Jalan Duke,
b. Traffic Signal Renovation and Area Traffic Signal System,
c. Traffic Regulational Measures,
d. Other Traffic Management Measures.

2. Construction and Improvement of Roads

a. Construction of the Inner Ring Road including Lorry Route between Jalan Tun Abdul Razak and Jalan Bukit Meldrum,
b. Improvement of Jalan Bukit Meldrum/Jalan Ibrahim,
c. Improvement of Ayer Molek.

3. Construction and Improvement of Intersection and Interchanges

a. Construction of Southern Interchange,
b. Other Minor Intersection Improvements.

TABLE 4-18 CAPACITY KILOMETER VIS-A-VIS VEHICLE KILOMETER WITH AND WITHOUT SHORT-TERM ACTION IN 1985

	Capacity Kilometers	Vehicle Kilometers	Congestion Degree
Base Case	116,360	59,090	0.51
Short-Term Actions	135,440	59,710	0.44

4-6-4 Traffic Analysis of the Causeway Traffic Dispersal Scheme

(1) General

The main aim of this traffic analysis is to examine the efficiency and effectiveness of the alternative plans from the perspective of traffic flow.

Hence, this traffic analysis is carried out with the comparison of cases with and without the Projects. In this analysis, the following factors are considered:

a. Total vehicle kilometers vis-a-vis total capacity kilometers,
b. Congestion degree.

(2) Traffic Analysis of the Short-Term Actions Plan

Fig. 4-32 shows the congestion degree on the road network in 1985 and Table 4-18 and 4-19 show the comparison of the total capacity kilometer vis-a-vis the total vehicle kilometers and congestion degree on the road network in the same year with and without the Short-Term Actions respectively.

It is found that the Short-Term Actions Plan will be effective in solving the anticipated traffic congestion in 1985.

TABLE 4-19 ROAD LENGTH BY CONGESTION DEGREE WITH AND WITHOUT SHORT-TERM ACTIONS IN 1985

	Base	Short-Term Actions
1.50 and Over	0	0
1.25 – 1.49	0.2 0.9	0
1.00 – 1.24	2.4 10.9	0
0.75 – 0.99	7.7 35.0	9.2 41.3
Below 0.74	11.7 53.2	13.1 58.7
Total	22.0 100.0	22.3 100.0

1) Upper figure : Road length (kilometers)
Lower figure : Composition to total length

2) Congestion degree is defined as
Daily traffic demand/road capacity
Road capacity is calculated based on service level 'D'

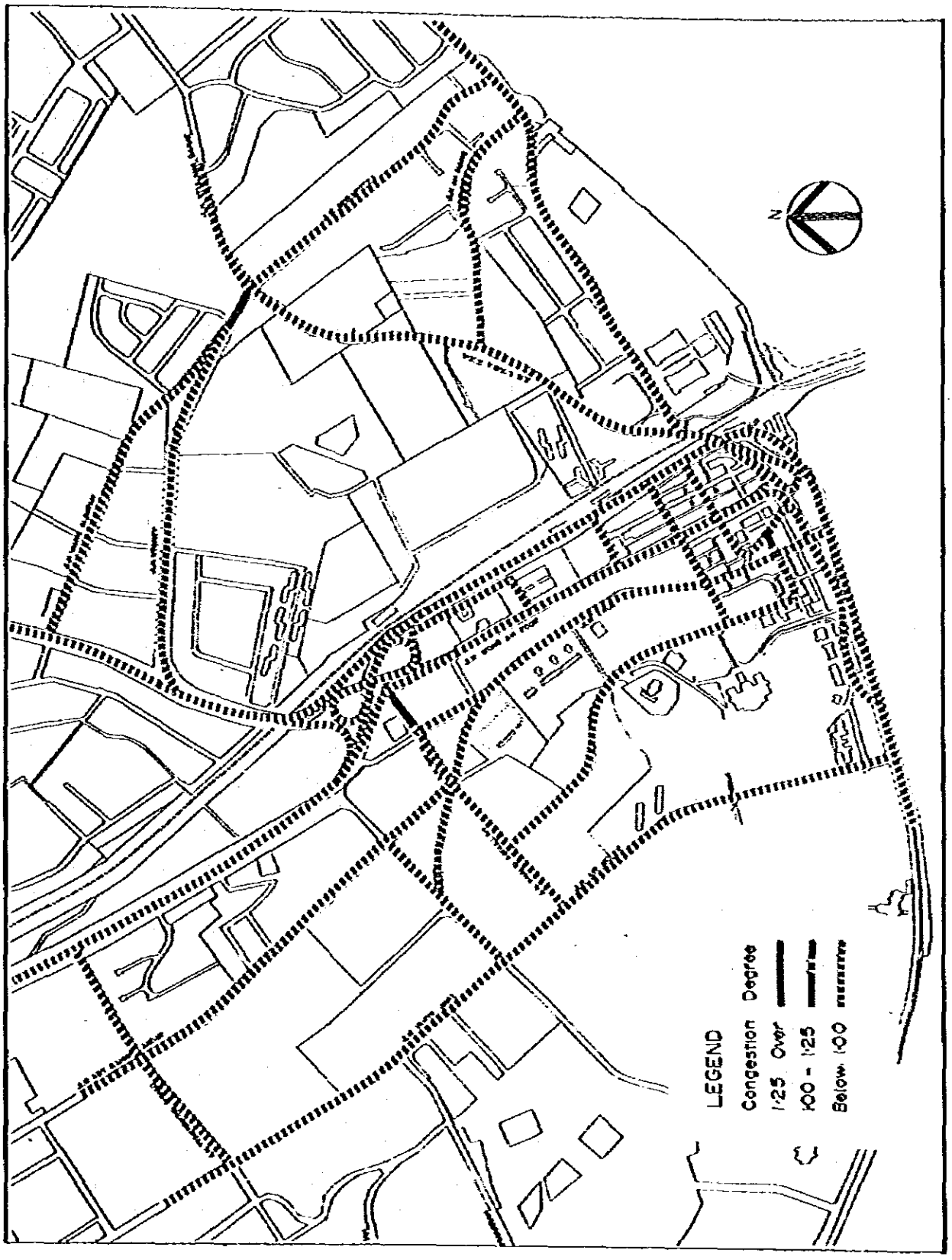


FIG. 4·32 TRAFFIC CONGESTION ON ROADS IN 1985

(3) Traffic Analysis of the Long-Term Plan

Figs. 4.33, 4.34 and 4.35 show the anticipated traffic congestion on the road network by the alternatives established in 1990. Tables 4-20 and 4-21 show the comparison of the total vehicle kilometers vis-a-vis the total capacity kilometers and congestion degree on the road network in 1990 with and without the alternative long term plans.

The results of the comparison show that the alternative is effective for the traffic situation anticipated in the year 1990.

However, even if this plan is implemented around the year 1990, this plan will not be able to meet the traffic demands in the year 2000. This suggests that in the year 2000, traffic restraint measures such as parking control, cordon pricing and introduction of new transit system should be implemented in order to control the vehicular traffic demands within the capacity of roads (see Fig. 4-36).

TABLE 4-20 CAPACITY KILOMETER VIS-A-VIS VEHICLE KILOMETER BY ALTERNATIVES

	Capacity Kilometers	Vehicle Kilometers	Congestion Degree
Base Case	540,300	494,500	0.92
Short-Term Actions (Alternative 1)	607,100	505,500	0.83
Long-Term Plan (Alternative 2)	727,100	530,700	0.73
Long-Term Plan (Alternative 3)	840,390	528,100	0.63

TABLE 4-21 ROAD LENGTH BY CONGESTION DEGREE AND ALTERNATIVES

	Base Case	Short-Term (Alt. 1)	Long-Term Plan Alternative 2	Long-Term Plan Alternative 3
1.50 and Above	0.3 1.4	0 0	0 0	0 0
1.25 – 1.49	1.1 5.0	0.3 1.3	0.6 2.5	0 0
1.00 – 1.24	8.3 37.7	7.0 31.4	2.5 10.3	0 0
0.75 – 0.99	2.7 12.3	5.6 25.1	8.4 34.7	5.1 20.7
Below 0.74	9.6 43.6	9.4 42.2	12.7 52.5	19.5 79.3
Total	22.0 100.0	22.3 100.0	24.3 100.0	24.6 100.0

Notes : 1) Upper figure : Road length (Kilometers)
Lower figure : Composition to total length

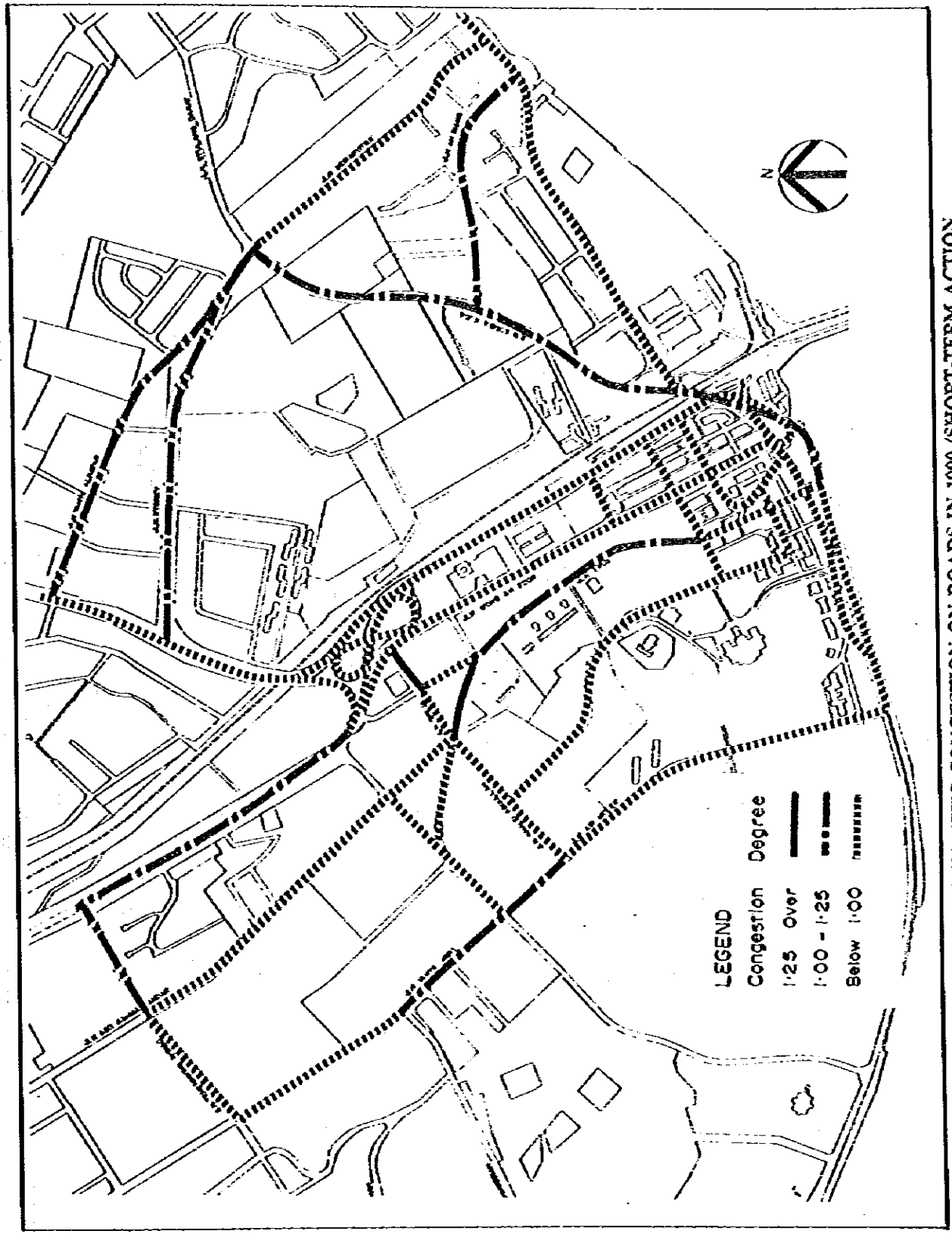


FIG. 4-33 TRAFFIC CONGESTION ON ROADS IN 1990 (SHORT-TERM ACTION IMPLEMENTED)

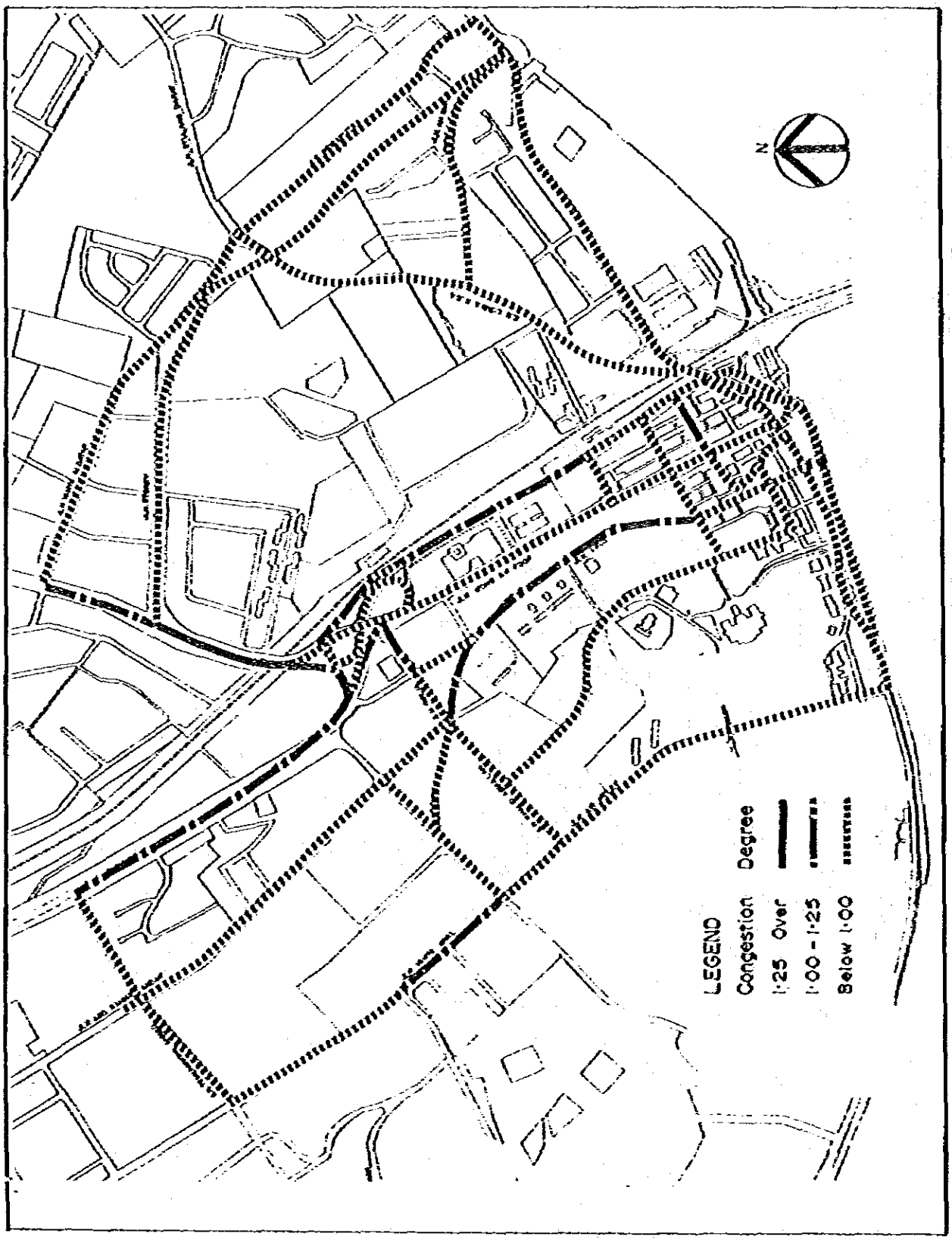


FIG. 4·34 TRAFFIC CONGESTION ON ROADS IN 1990 (LONG-TERM PLAN 1 IMPLEMENTED)

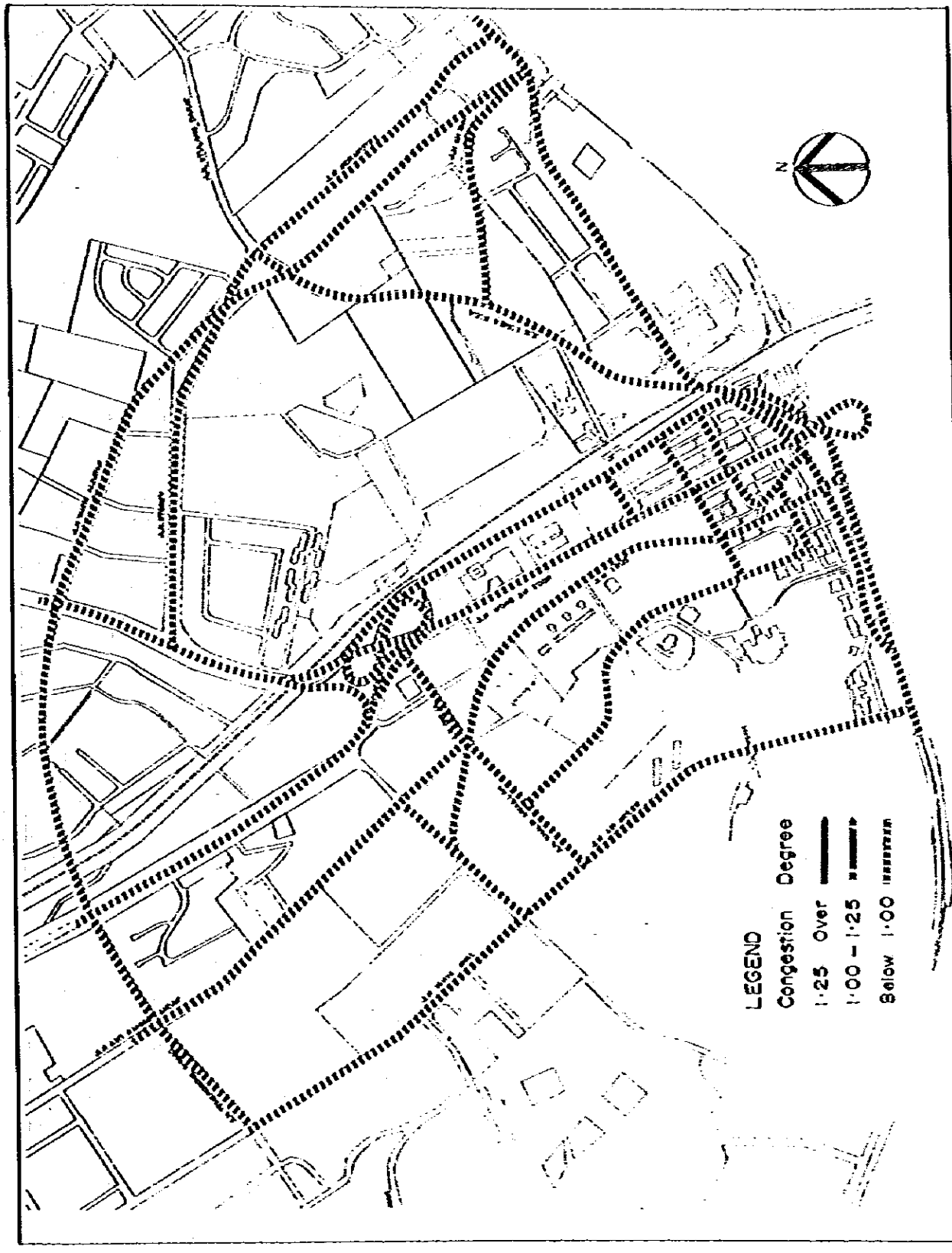


FIG. 4-35 TRAFFIC CONGESTION ON ROADS IN 1990 (LONG-TERM PLAN 2 IMPLEMENTED)

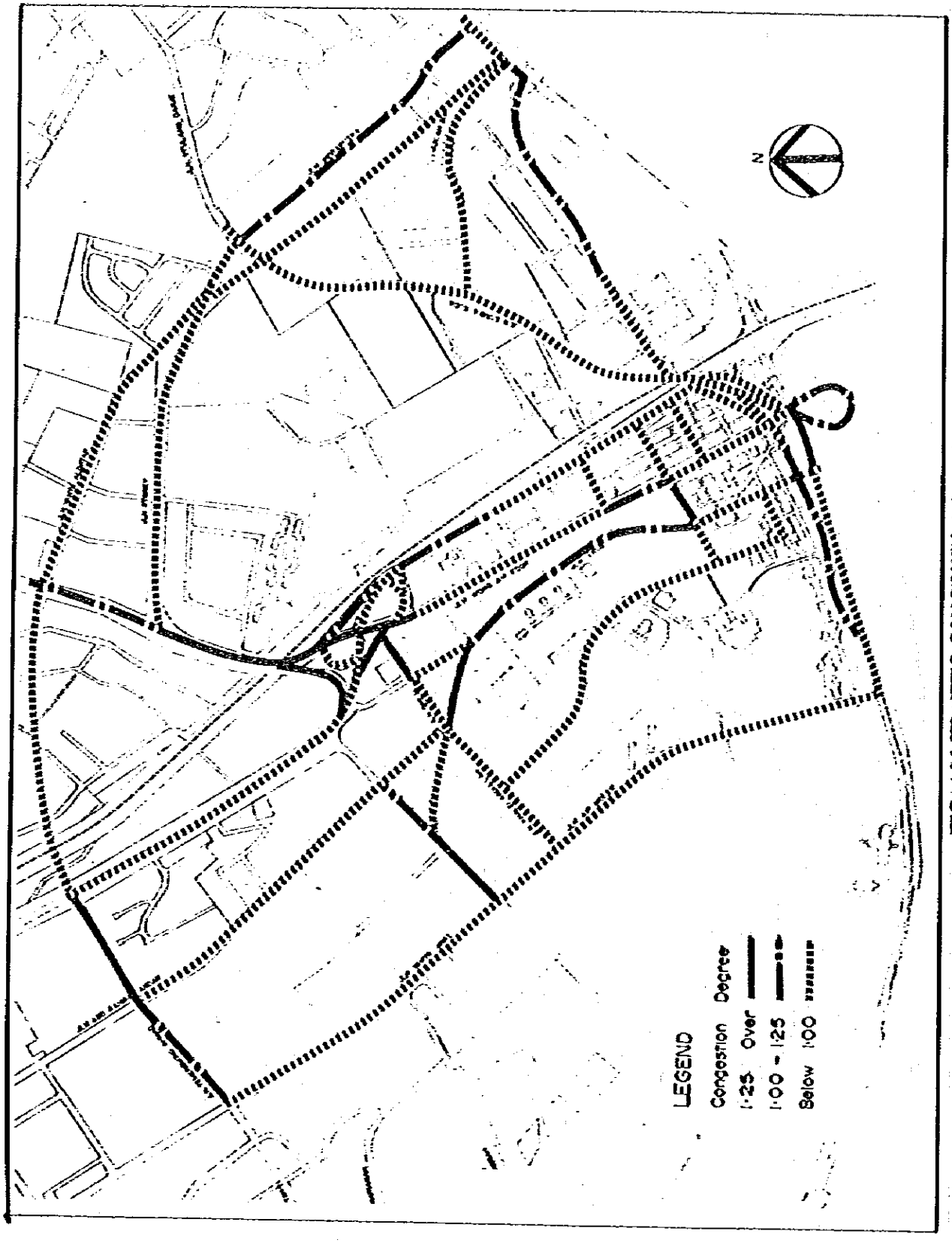


FIG. 4·36 TRAFFIC CONGESTION ON ROADS IN 2000

4-6-5 Short-Term Actions

The Short-Term Actions have been formulated to cope with the traffic situation till the year 1990, when the widening of Jalan Tebrau and the Causeway Renovation Plan will have been implemented.

In the heart of Johor Bahru, some innovational improvements are proposed in conjunction with the widening of Jalan Tebrau following which the traffic demand is expected to increase accordingly, though the plan is on the whole, intended to improve the existing road and traffic conditions and operational system with minimum modifications.

Briefly, the main feature of this plan is the introduction of a pair of one-way carriageway — Jalan Tun Abdul Razak, southbound and Jalan Wong Ah Fook, northbound — together with innovational improvements which include the widening of the two (2) roads.

The proposed plan which is focussed on the key measures is schematically illustrated in Fig. 4-37 and Fig. 4-38.

The key measures can be identified as follows:

a. Upgrading of Jalan Wong Ah Fook

Five (5)-lane and four (4)-lane carriageways are proposed for the southern section and the northern section respectively to meet the anticipated traffic demand.

The former section is mainly designed for collecting and distributing the traffic channelled into Jalan Wong Ah Fook.

The latter section is, however, designed for through outflow traffic with optimal capacity attained.

b. Modification of One-Way System

Jalan Tun Abdul Razak is proposed to be converted into a four (4)-lane one-way southbound carriageway with contra exclusive bus and taxi lane. As such, Jalan Tun Abdul Razak and Jalan Wong Ah Fook forms a pair of one-way system.

c. Improvement and Construction of the Connecting Roads

Jalan Station is proposed to be improved to become a four (4)-lane dual contra flow carriageway so that inflow and outflow from and to the one-way roads can be smoothly facilitated.

The road connecting Jalan Wong Ah Fook and the contra lane along Jalan Tun Abdul Razak is proposed to be constructed between the Tun Abdul Razak Complex and the existing market place.

d. Minor Modifications of Southern Interchange

The proposed modifications are as follows:

- Jalan Ibrahim is to be separated from the roundabout by installing island,
- Jalan Sawmill is to be converted into an eastbound one-way road.

The proposal of this circulation plan is justified by the following reasons:

- The increase of the burden caused by longer detour on the roads enroute can be accommodated by the improvement of the already mentioned roads.
- The removal of merging point at the roundabout will result in higher capacity at the roundabout, thereby dispersing easily the traffic which is expected to increase.

e. Improvement of the Tebrau Interchange

The widening of the rampway from Jalan Tebrau to Jalan Tun Abdul Razak into a three (3)-lane roadway is proposed in compatibility with the three (3)-lane southbound roadway of Jalan Tebrau.

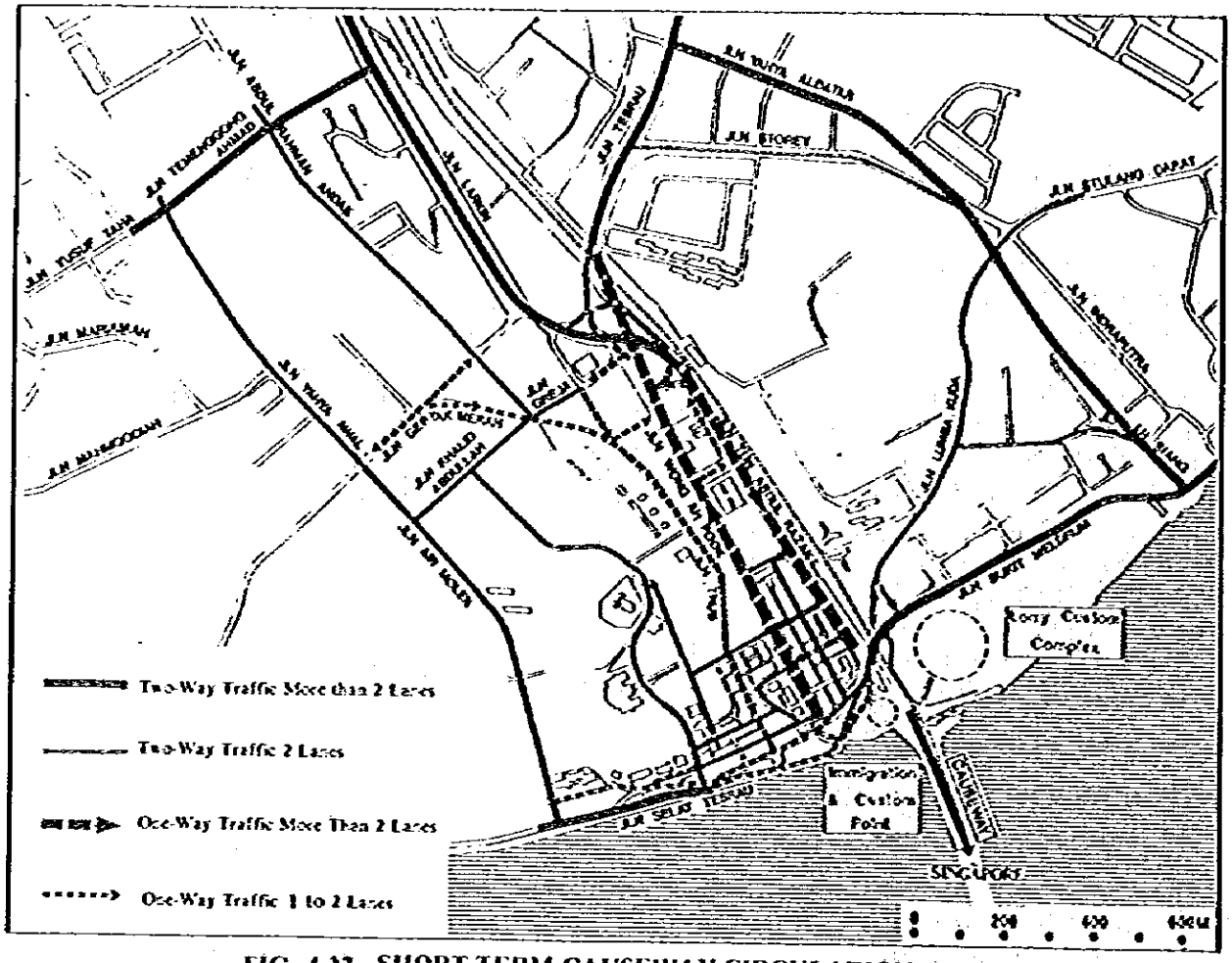


FIG. 4-37. SHORT-TERM CAUSEWAY CIRCULATION PLAN

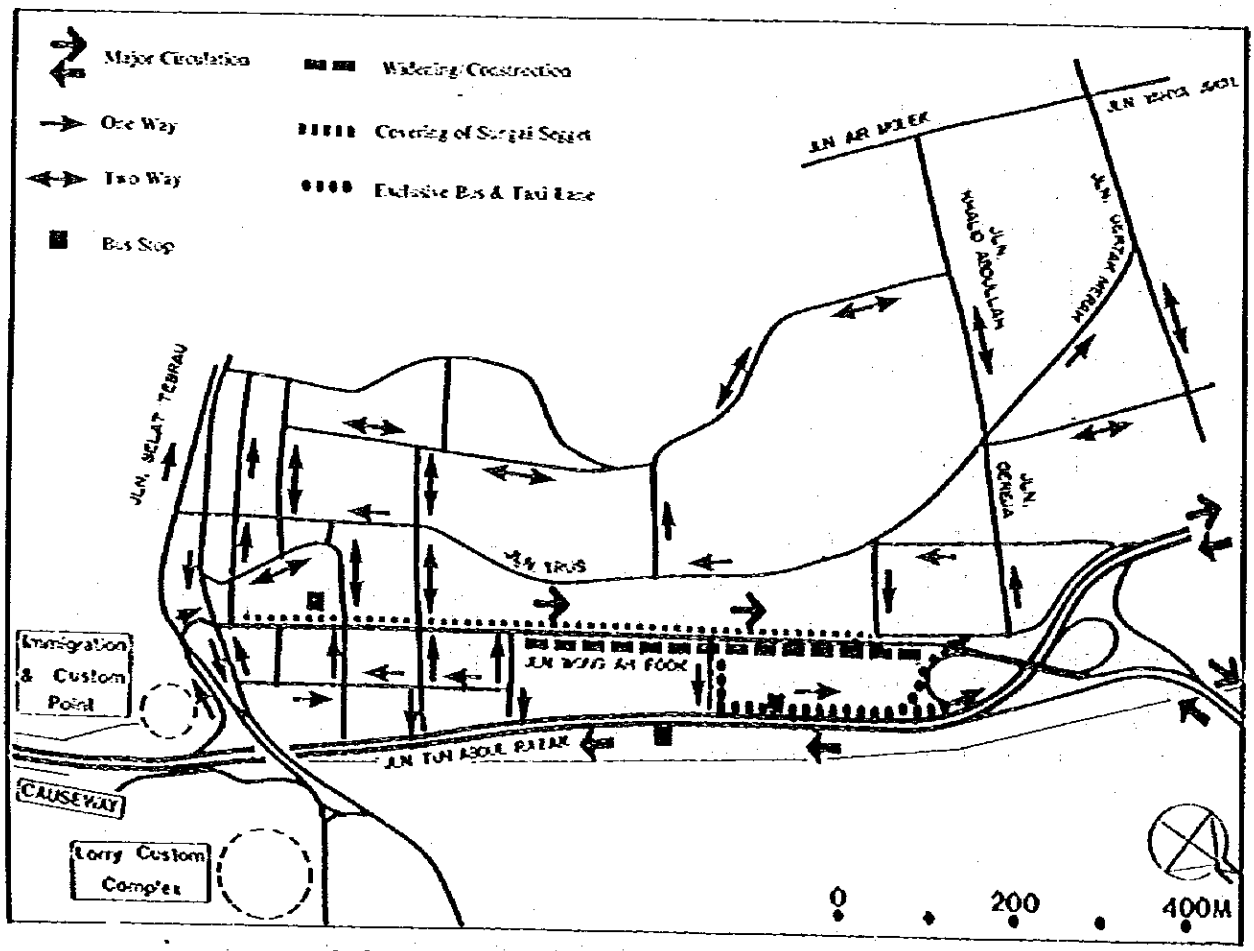


FIG. 4-38 SHORT-TERM DISPERSAL PLAN.

f. Improvement and Construction of Inner Ring Road including Lorry Route, section between Jalan Tebrau and Jalan Bukit Meldrum or Lorry Custom Complex

This proposal will be discussed in detail in Section 4.8 in this report. However, it is found that the Inner Ring Road including the Lorry Route should be urgently constructed to mitigate the adverse effects caused by the huge lorry traffic.

g. Introduction of Area Traffic Signal Control Scheme

The area traffic signal control system is proposed to be introduced as shown in Fig. 4-19. In the short term actions, the area traffic signal control is expected to be introduced to the traffic signals along Jalan Tebrau and its surrounding roads and along Jalan Kebun Teh/Jalan Larkin.

h. Improvement of Pedestrian Facilities

It is proposed that a wide variety of measures required to improve the facilities for pedestrians be undertaken. Effort should be concentrated primarily on constructing pedestrian malls, pedestrian crossings, pedestrian deck and side-walks to that they can move about safely, comfortably and without obstruction.

The proposal for the pedestrian facilities are shown in the Technical Drawings.

i. Other Supporting Measures

—Modification of bus stops along Jalan Wong Ah Fook,
—Control of on-street parking and construction of off-street parking.

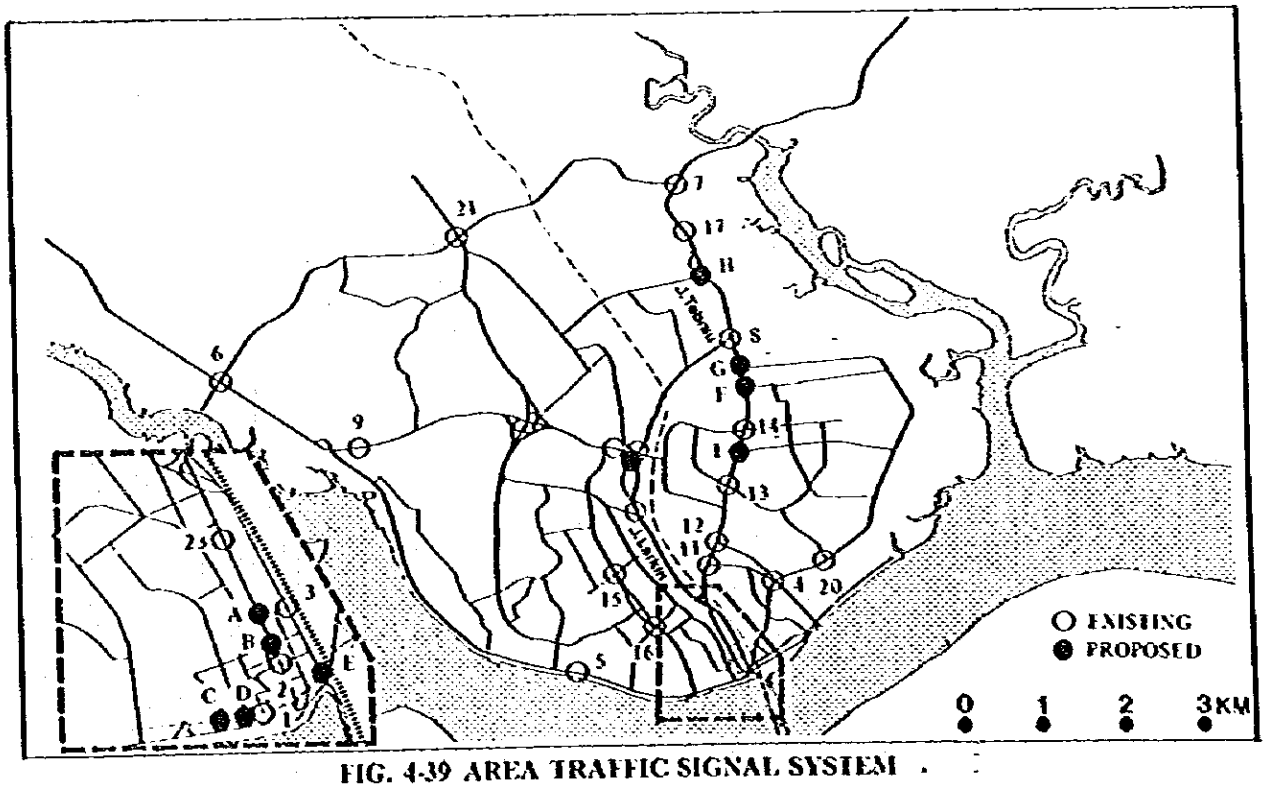


FIG. 4-39 AREA TRAFFIC SIGNAL SYSTEM

4-6-6 Long-Term Plan

The Long-Term Plan is formulated to cope with the traffic situations after the year 1990, when the widening of Jalan Tebrau, the Causeway Renovation Plan and the Short-Term Causeway Dispersal Scheme will have been implemented.

As mentioned in paragraph 4-6-3, the Long-Term comprises mainly the construction and/or improvement of roads and interchanges which are to be carried out after the implementation of the Short-Term Plan. The concept plan of the Causeway Traffic Dispersal Scheme in the Central Area of Johor Bahru is illustrated in Fig. 4-40.

The main feature of this plan is the completion of the East Ring of the Inner Ring Road including the Lorry Route, the construction of the Southern Link, the improvement of Jalan Bukit Meldrum, Jalan Selat Tebrau and Jalan Ayer Molek and additionally, a pair of one-way carriageways — Jalan Trus and Jalan Duke.

The proposed plan in the Heart Area and the Central Area is illustrated in Figs. 4.40 and 4.41.

The key measures can be identified as follows:

a. Construction and Improvement of Roads

- —Completion of East Ring of Inner Ring Road with Lorry Route,
- —Improvement of Jalan Bukit Meldrum,
- —Improvement of Jalan Ayer Molek.

b. Construction of Interchanges

- —Construction of South Interchange.

c. Traffic Engineering and Management

- —Additional Pair of One-Way Carriageway,
- —Jalan Trus and Jalan Duke.
- —Expansion of Area Signal Control Scheme,
- —Control of On-Street Parking and Construction of Off-Street Parking Spaces.

The Long-Term Causeway Traffic Dispersal Scheme is subject to an economic evaluation, as reported in Chapter 6.

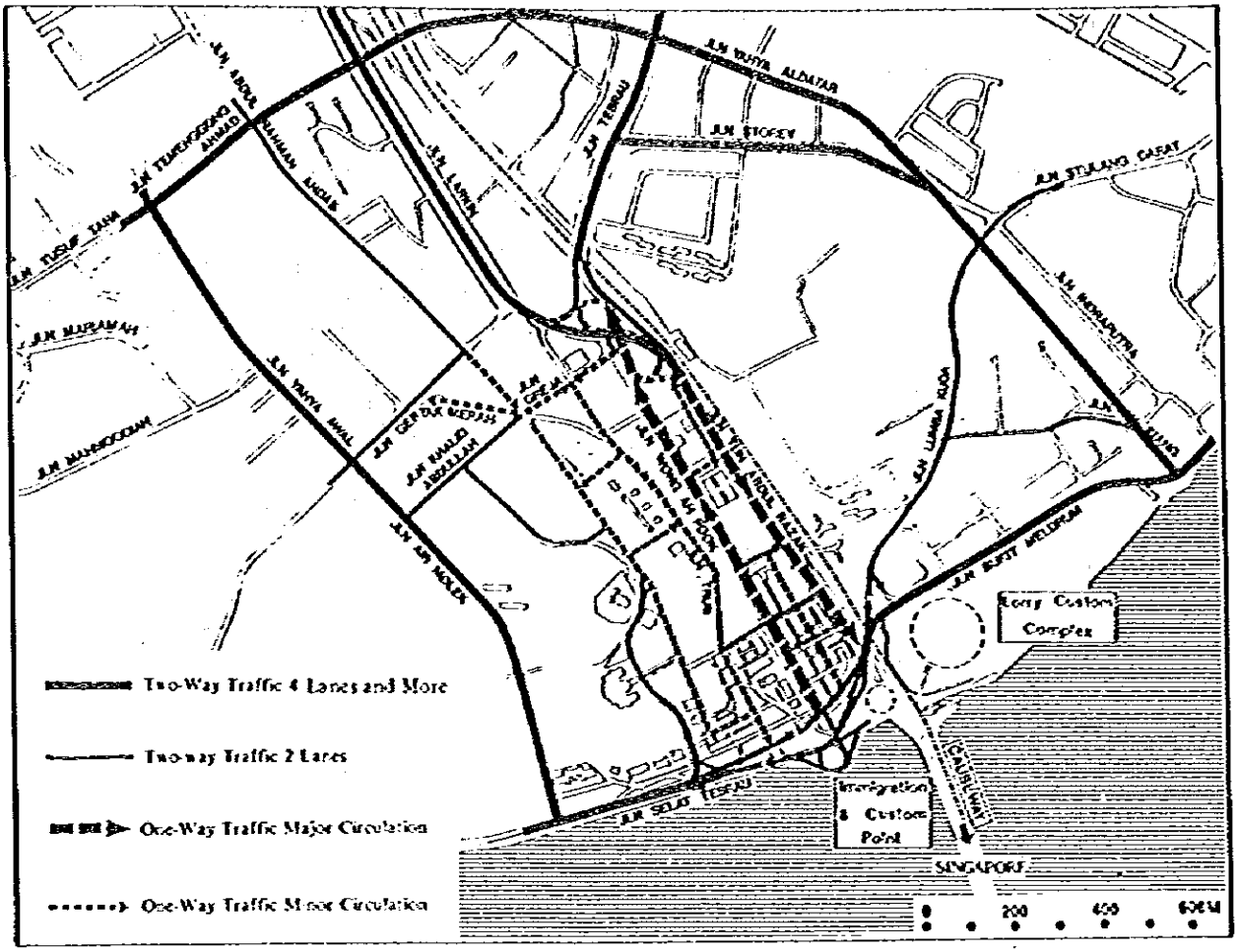


FIG. 4-40 LONG-TERM CAUSEWAY CIRCULATION PLAN

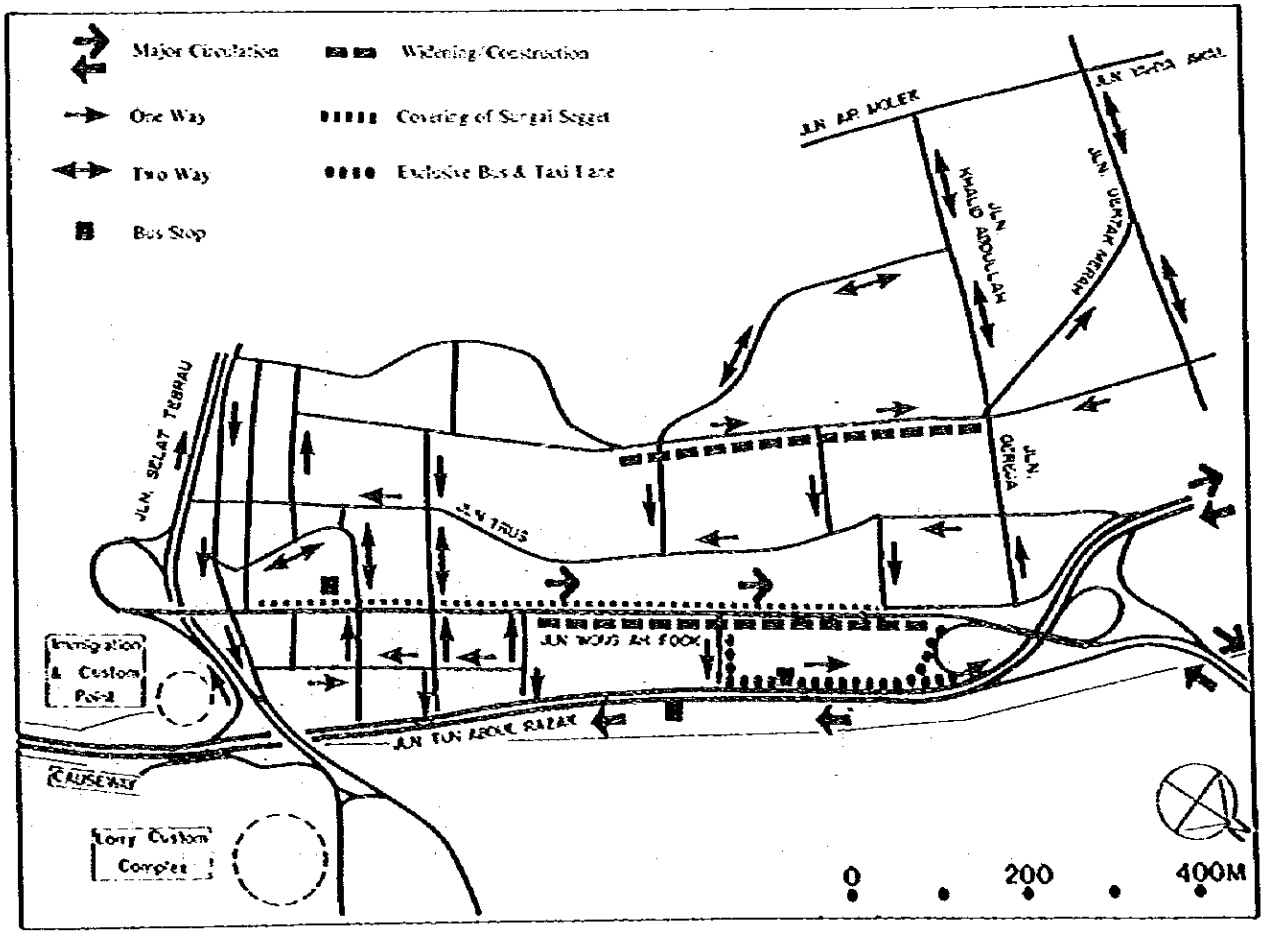


FIG. 4-41 LONG-TERM DISPERSAL PLAN

4-7 ALTERNATIVE ROUTES AND PRELIMINARY DESIGN ON THE TOLL EXPRESSWAY ACCESS

4-7-1 General

The Toll Expressway Access can be divided into three (3) sections:

Section '1': Pandan intersection — Kampung Dato Sulaiman Menteri.
Section '2': Kampung Dato Sulaiman Menteri — Marine Dockyard.
Section '3': Marine Dockyard — Southern Link.

Based on the sectioning made of this Project, the alternative route and the preliminary design will be discussed below.

4-7-2 Alternative Route Study

Based on the field investigations, landuse survey along the proposed route and traffic study, alternative routes have been suggested for certain sections along the proposed route. They are as follows:

Section '1': No alternative route is considered.
Section '2': Two (2) alternative routes are suggested.
Section '3': Two (2) alternative routes are suggested.

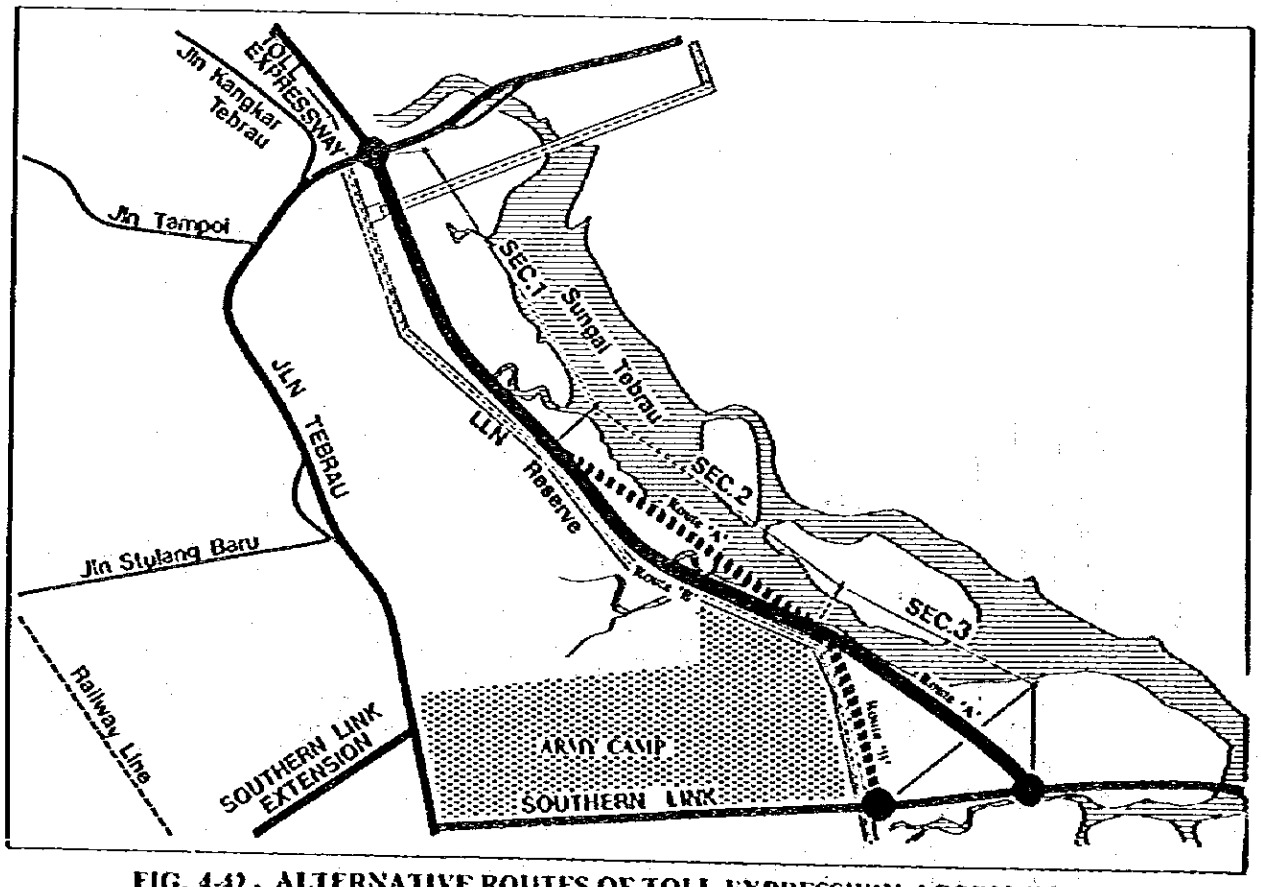


FIG. 4-42. ALTERNATIVE ROUTES OF TOLL EXPRESSWAY ACCESS ROAD

The alternative routes are evaluated from the technical, socio-environmental and economical standpoints for their viability. Following a comparative analysis of the above evaluation (Table 4-22), the following conclusions are arrived at:

a. Section '2'

The comparative analysis shows that Route 'B' is strongly recommended in terms of its economical construction cost and effective land utilization between the Project Road and the transmission line.

b. Section '3'

The comparative analysis shows that Route 'A' seems to be a better route that the other. This is based on the consideration of the socio-environmental impacts such as the land acquisition of Kg. Bakar Batu and disruption of community anticipated in Route 'B'.

TABLE 4-22 COMPARISON OF ALTERNATIVE ROUTES — TOLL EXPRESSWAY ACCESS

		Section 2		Section 3	
		Route 'A'	Route 'B'	Route 'A'	Route 'B'
Outline	Length	1,610 m	1,650 m	1,130 m	840 m
	Plan	Straight route	Follow transmission line	East side of Kg. Bakar Batu	Follow transmission line
	Landuse	Swampy	Swampy	Swampy	Kampong and Army areas
Technical Aspect	Construction Condition	Comparatively difficult	Comparatively easy	Comparatively easy	Easy
	Traffic Flow and Network	Smooth	Smooth	Staggered junction	One point junction
	Major Structure	Revetment required	None	3-leg interchange	4-leg interchange
	Alignment	Smooth	Smooth	Smooth	Smooth
	Other Technical Feature	Soft ground treatment required	Soft ground treatment required	Soft ground treatment required	Soft ground treatment required
Socio Environmental Aspect	Disruption of Community	None	None	None	Anticipated, but minor
	Impact on Existing Urban Facility	Marine dockyard affected	Marine dockyard affected	None	Minor
	Impact on Urban Environment	None	None	Some squatter houses affected 20 units	Some houses affected 30 units
	Impact on Natural Environment	Anticipated	Anticipated	Anticipated	Small
Construction Cost	Construction Cost	M$ 9,300,000	M$ 9,400,000	M$ 6,800,000	M$ 3,600,000
	Land Acquisition	–	–	800,000	3,200,000
	Total	9,800,000	9,400,000	7,600,000	6,800,000
Recommendation		Not Recommendable	Most Recommendable	Most Recommendable	Recommendable

4-7-3 Preliminary Design

(1) General

The preliminary design of the selected route is made on the topographic surveying sheets. The scale of each design is shown below:

(2) Road Alignment

The horizontal and vertical alignments for the recommended route are drawn on the plan and profile of horizontal scale of 1:2500 and are compiled in the Technical Drawings.

TABLE 4-23 SCALE USED IN THE PRELIMINARY DESIGN

			Scale
Road Design	Plan		1 : 2500
	Profile	Horizontal	1 : 2500
		Vertical	1 : 500
Typical Cross-Section			1 : 150
Intersection Design			1 : 1000
Bridge Design			1 : 1000

(3) Cross-Section

1) Number of Lanes

Judging from the result of the projected traffic volumes assigned to the road network in the years 1990 and 2000 and design capacity of the Toll Expressway Access, a four (4)-lane road is proposed.

2) Proposed Cross-Section

Based on the elements of cross-sectional components applicable to the Toll Expressway Access, the typical cross-section is illustrated in Fig. 4-43.

TABLE 4-24 DESIGN CAPACITY OF THE TOLL EXPRESSWAY

Number of Lanes	Capacity pcu/day	Level of Service	Design Capacity (pcu/day)
4-lane	70,600	0.85	60,000

Note : The level of service for the Project Road is employed as service level IV.

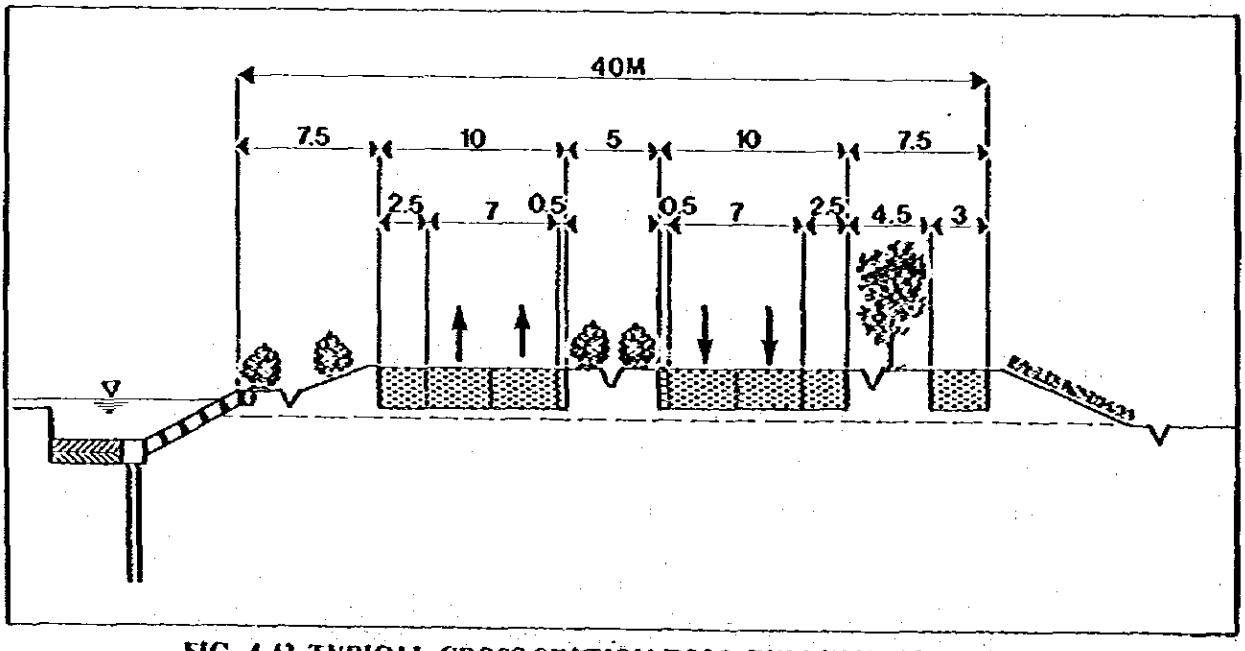


FIG. 4-43 TYPICAL CROSS-SECTION TOLL EXPRESSWAY ACCESS

(4) Bridge Design

The Toll Expressway Access has two (2) small bridges with a total length of 30 meters on Sg. Selubong and Sg. Tampoi. The type of bridge recommended is of pre-stressed concrete. The location of these bridges are shown in Fig. 4-44.

(5) Interchange and Intersection Designs

Based on the basic guideline established and the projected turning movement of traffic volume, the types of interchange at two (2) locations are proposed and are as shown in Fig. 4-45.

It is proposed that a full service interchange be implemented at the intersection of the Toll Expressway Access and the Toll Expressway with Jalan Pandan.

As A result of the discussions made with the Malaysia Highway Authority, construction of rampways between the Toll Expressway and Jalan Pandan is expected to be implemented by the Highway Authority in line with the Toll Expressway Project. In this Study, therefore, the other rampways between the Toll Expressway Access and the Toll Expressway — Jalan Pandan are designed and shown in Fig. 4-46.

The other interchange, which is at the intersection of the Toll Expressway Access with the proposed Southern Link, is proposed to be construction initially as a three (3) leg interchange .

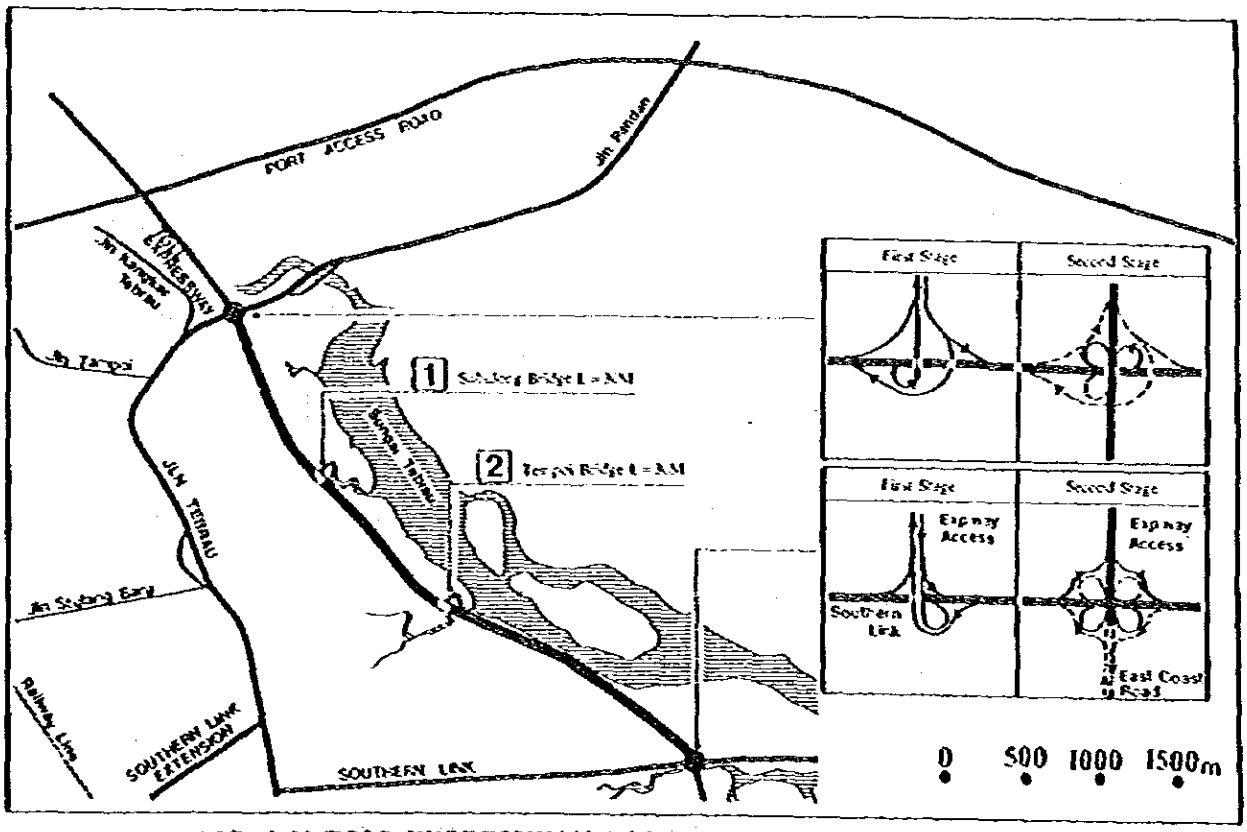


FIG. 4-44 TOLL EXPRESSWAY ACCESS: BRIDGE LOCATION
FIG. 4-46 INTERSECTION/INTERCHANGE RECOMMENDED PLAN

(6) Pavement Design

On careful weighing of the CBR value of the subgrade, the traffic volume and the lifetime of the pavement, the proposed thickness of the pavement for the Toll Expressway Access is 55 cm. The proposed thickness of each respective individual course is shown in the following figure.

(7) Drainage Design

1) Box culvert

Please refer to Section 4-5-5, (7) 'Drainage Design' for the box culvert sizes considered. Large box culvert is, however, adopted because of the possibility of obstruction by various materials flowing into the culvert.

Special channel openings at adequate intervals have to be provided in the Toll Expressway Access in order to allow the unimpeded flow of the storm discharge from the smaller streams and residential drains into the Tebrau River. Such provision is necessary to avoid flooding the lowlying coastal inland as a result of the construction of the Toll Expressway along the coastal line.

2) Roadside Drainage

See Section 4-5-5 under 'Suburban Areas'. Open Channel drains are considered for the Toll Expressway Access project. Catchment basins are to be provided.

3) Revetment

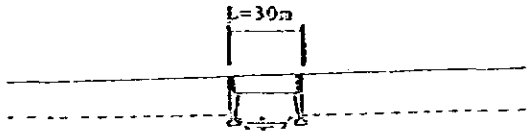
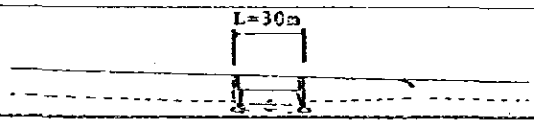
Stone pitching along the Tebrau River coastline is required and special channel openings to avoid flooding, as noted above, are considered.

(8) Utility Space

See also Section 4-5-5, (8) with regards to consideration for facilitating public utility works.

To enable utilities to be maintained and installed without inconveniences to the general public and especially the drivers, the Study Team suggest that the utilities be laid under the sidewalk of the Toll Expressway Access reserve. In addition to the space available from the Green Belt side, a total width of 4.0 m is available for housing the various cables, lines and pipes.

TABLE 4-45 BRIDGES REQUIRED FOR TOLL EXPRESSWAY ACCESS

Name of Bridge	Bridge Type	Length of Bridge	Width	General Profile
Sg. Selubong	T-Shaped girder	30 meters	To Southern Link 12.0 meters To Expressway 12.0 meters	
Sg. Tampoi	T-Shaped girder	30 meters	To Southern Link 15.0 meters	

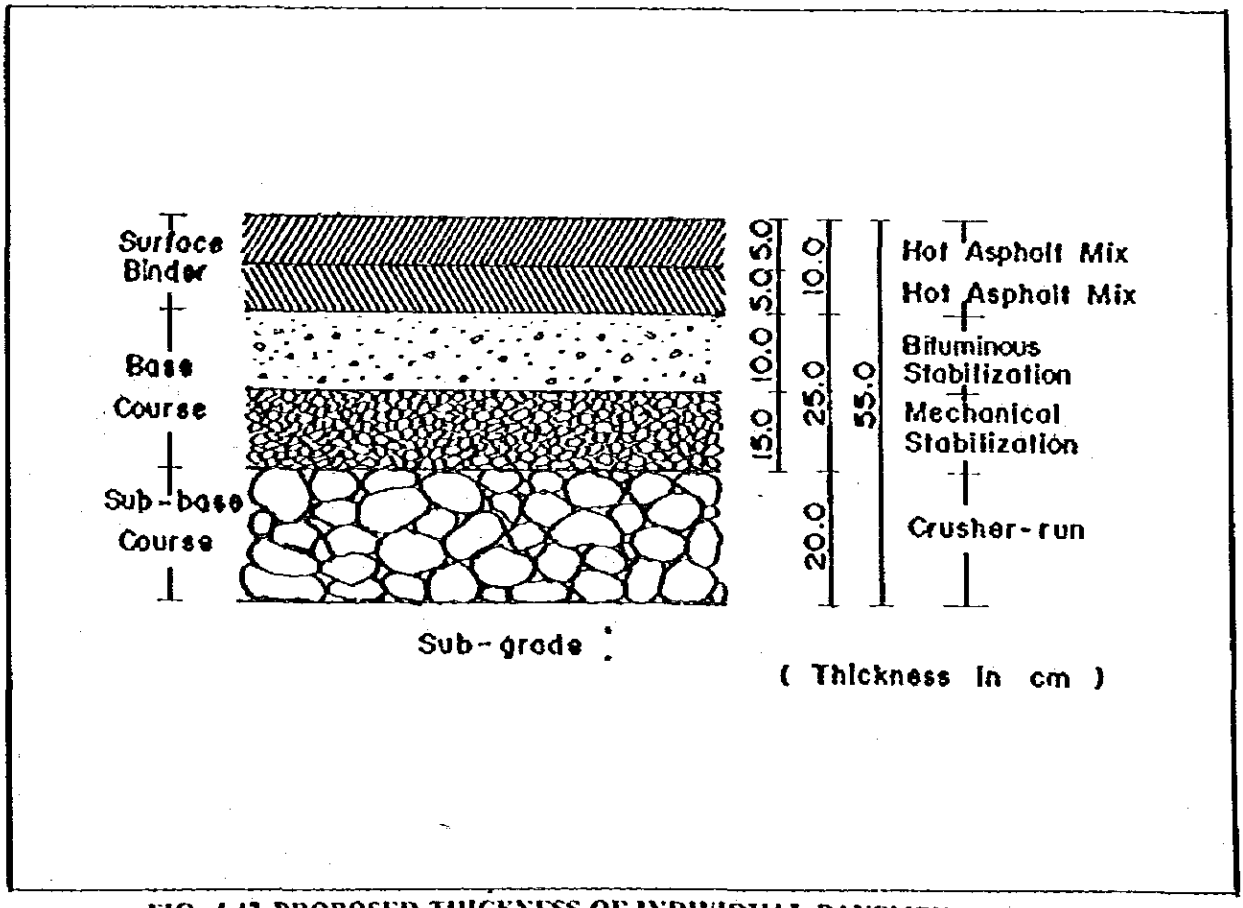


FIG. 4-47 PROPOSED THICKNESS OF INDIVIDUAL PAVEMENT COURSE

4-8 ALTERNATIVE ALIGNMENTS AND PRELIMINARY DESIGN ON THE INNER RING ROAD INCLUDING LORRY ROUTE

4-8-1 General

The Inner Ring Road can be divided into three (3) sections and five (5) segments (See Fig. 4-48):

As far as the Lorry Route is concerned, no sectioning is considered.

4-8-2 Alternative Alignments Study

(1) Inner Ring Road

Topographically, the terrain condition of this Project Road is undulating in nature. The land in this corridor is being developed into institutional and residential areas.

The alternative alignments for the Sections concerned are as follows:

Section 'I'

Four (4) alternative routes are established based on the field surveys made and landuse and the traffic studies conducted.

These routes are evaluated on the criteria of the technical, socio-environmental and construction cost aspects.

The results of the comparative analysis are shown in Table 4-25. Among the alternative routes, Route 'C' is considered to be as the best route.

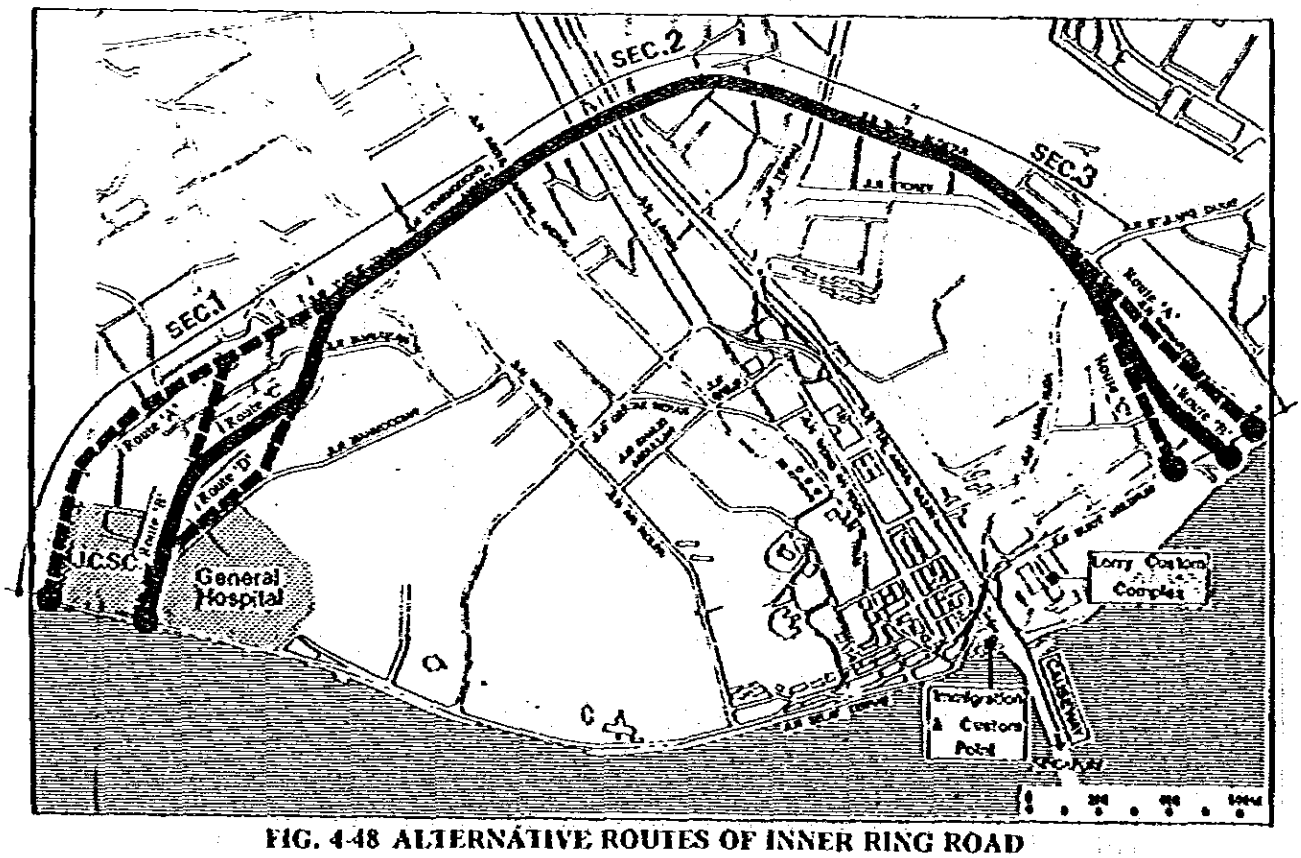


FIG. 4-48 ALTERNATIVE ROUTES OF INNER RING ROAD

TABLE 4-25 COMPARATIVE TABLE — INNER RING ROAD (SECTION 1)

Section 1		Route A	Route B	Route C	Route D
	Route	Jalan Thompson, New Linkage Road, Jalan Bilal Mahmood, Jalan Yusuf Taha	Jalan Abdul Samad, Jalan Bilal Yusuf Taha	Jalan Abdul Samad, New Linkage Road, Jalan Yusuf Taha	Jalan Abdul Samad, Jalan Mahmoodiah, Jalan Petri, Jalan Yusuf Taha
Technical Aspect	Route Length	1780 m	1580 m	1590 m	1550 m
	Minimum Radius m	225	225	150	150
	Gradient	5% (Proposed)	5% (Proposed)	4% (Proposed)	7% (Existing Terrain)
	Road Structure	Depressed Roadway Required (Girls' Hostel Vicinity)	Depressed Roadway Required (Girls' Hostel Vicinity)	Embankment Required (Highest Level is about 4 m)	Not Required
Socio-Environmental Aspect		In Proximity to Schools	Affects some Residents of Kg. Baru	Affects some Residents of Kg. Baru	General Hospital Land and NFPU Building Affected
		Disrupts Kg. Baru Residents	Children Traffic Training Park and JCSC Tennis Court Affected	Children Traffic Training Park and JCSC Tennis Court Affected	Malay Cemetery Affected
		Land from Masonic Lodge Required	Disrupts the Existing Community	Some Disruption to the Existing Community	
Land and Building Acquisition	Area Required (Ha)	Institutional = 0.26 Residential = 2.72 Total = 2.98	Institutional = 0.79 Residential = 2.11 Total = 2.90	Institutional = 0.68 Residential = 2.11 Total = 2.79	Institutional = 1.70 Residential = 0.96 Total = 2.66
	Number Units Affected	Detached (c) = 13 C : Concrete Detached (w) = 25 W : Wooden Semi-Detached (c) = 6 Total = 44	Detached (c) = 10 Detached (w) = 19 Semi-Detached (c) = 4 Total = 33	Detached (c) = 6 Detached (w) = 17 Semi-Detached (c) = 6 Terrace (c) = 5 Total = 34	Detached (c) = 4 Detached (w) = 16 Semi-Detached (c) = 2 Terrace (c) = 5 Total = 27
Project Cost (in M$ Million)		16.3	14.3	13.8	9.9
Recommendation		Not Recommendable	Recommendable	Most Recommendable	Recommendable

Although Route 'C', as an ultimate plan of Section '1', is not easy to implement in view of its socio-environmental impacts, the Study Team considers it as necessary to be formed as part of the Ring Road in Johor Bahru in order to disperse traffic and maximize benefits.

Section '2'

Where Section '2' is concerned, one (1) horizontal alignment and two (2) vertical alignment have been established as follows:

	Maximum Gradient
Plan 'A'	2%
Plan 'B'	5.2%

As the results of the comparative analysis show, Plan 'B' is the best alignment among the alternatives from the point of minimizing demolition of properties, preserving connections with existing roads and minimizing construction cost.

TABLE 4-26 COMPARISON OF ALTERNATIVE ALIGNMENT ROUTES — INNER RING ROAD (SECTION 2)

		Plan 'A'	Plan 'B'
Outline	Length	1,450 m	1,450 m
	Plan	Alignment is designed at new road level (4–lane or 6–lane)	Alignment follows exisiting terrain (4–lane or 6–lane)
	Land Use	Residential and Commercial	Residential and Commercial
Technical Aspect	Construction Condition	Difficult	Comparatively easy
	Alignment	Almost flat	Up and down slope
	Traffic Flow	Smooth	Not smooth
	Major Structure	5 overpasses	3 overpasses
	Maximum Gradient	2%	5.2%
Socio Environmental Aspect	Disruption of Community	Anticipated	Anticipated
	Impacts on Existing Urban Facility	Houses affected	Houses affected
	Impacts on Urban Environment	Anticipated	Anticipated
	Housing Units Affected	59 units	59 units
	Accessibility To/From Minor Road	Not Easy	Easy
Construction Cost	Construction Cost	M$ 28,000,000	M$ 23,600,000
	Land Aquisition Cost	13,300,000	12,100,000
	Total	41,300,000	35,700,000
	Recommendation	Not Recommendable	Recommendable

Section '3'

Where Section '3' is concerned, three (3) alternative vertical alignments have initially been established. These alternatives were evaluated by a comparative analysis of their technical, socio-environmental impacts and construction costs.

The results of the initial comparative analysis are show in Table 4-27.

It is found that Route 'B' is the best route among the alternatives from the point of view of minimizing the demolition of properties and construction cost.

In the second stage, two (2) alternative horizontal alignments have been established in the Study. These alternatives are further evaluated on the similar set of criteria.

As the results of the comparative analysis show, (Table 4-28), Plan 'B' is the better alignment with its merits of minimizing construction cost and preserving connection with the existing roads.

TABLE 4-27 COMPARISON OF ALTERNATIVE ROUTES — INNER RING ROAD (SECTION 3)

		Route 'A'	Route 'B'	Route 'C'
Outline	Length	1,750 m	1,740 m	1,720 m
	Plan	Widening of J. Yahja Aldatar and J. Indra Putra (4-lane and/or 6-lane)	Widening of J. Yahya Aldatar and construction of new road (4-lane and/or 6-lane)	Widening of J. Yahya Aldatar and construction of new road (4-lane and/or 6-lane)
	Land Use	Residential and Institutional	Residential and Institutional	Residential and Institutional
Technical Aspect	Construction condition	Comparatively Easy	Comparatively Easy	Comparatively Easy
	Alignment	Up and down slope	Up and down slope	Up and down slope
	Traffic Flow	Smooth	Smooth	Smooth
	Compatibility with IC Causeway Relocation Plan	Compatible	Compatible	Not compatible
	Maximum Gradient	6%	4%	5%
Socio Environmental Aspect	Disuption of Community	Anticipated	Anticipated	Anticipated, but minor
	Impacts on Existing Urban Facility	Many houses affected	Many houses affected	Some houses and SEDC lands affected
	Impacts on Urban Environment	Some problems	Some problems	Comparatively small
	Housing units affected	74 units	45 units	33 units
Construction Cost	Construction Cost	M$ 14,200,000	M$ 14,600,000	M$ 14,900,000
	Land Acquisition Cost	15,100,000	12,200,000	15,000,000
	Total	29,300,000	26,800,000	29,900,000
	Recommendation	Not Recommendable	Most Recommendable	Recommendable

TABLE 4-28 COMPARISON OF ALTERNATIVE VERTICAL ALIGNMENTS — INNER RING ROAD (SECTION 3)

Plan		Plan 'A'	Plan 'B'
Maximum Gradient		4% (depressed roadway)	6% (existing terrain)
Width of Road		50 m	40 m
Interchange & Intersection	J. Tun Abdul Razak	Diamond Interchange	Diamond Interchange
	J. Tebrau	Diamond Interchange	Diamond Interchange
	J. Lumba Kuda	Diamond Interchange	At-grade Intersection
	J. Btk. Medrum	Trumpet Interchange	Trumpet Interchange
Construction Quantity	Bridge	10,600 m^2	7,300 m^2
	Retaining Wall	3,530 m	2,220 m
	Earthwork	219,000 m^3	164,000 m^3
Acquisition Required	Land	94,400 m^2	75,600 m^2
	Building	90 units	86 units
Cost of Project		66.5 million M$	51.5 million M$
Traffic Problem		* Management of intersection at J. Yahya Aldatar – J. Tebrau location with respect to the lorry traffic	* Management of intersections at J. Yahya Aldatar – J. Tebrau and J. Yahya Aldatar – J. Lumba Kuda * Traffic capacity is lower than Plan 'A'
Social-Environmental Problem		* Much land to be acquired * Community disrupted * Accessibility from abutting property is restricted	* Noise and pollution very much increased compared to Plan 'A'
Recommendation		Not Recommendable	Recommendable

(2) Lorry Route

Based on the field investigation and the landuse and traffic studies conducted, four (4) alternative routes for the lorry traffic have been established and presented in Fig. 4-49.

These alternative routes are evaluated by a comparative analysis from the technical, socio-environmental, and construction cost standpoints. The results of the comparative analysis are shown in Table 4-29. Consequently, the following conclusions are made:

a. If the eastern part of the Inner Ring Road can be implemented as soon as possible, Route 'D' is the most preferable among the alternatives although the additional construction cost required of Route 'D' to that of the Inner Ring Road is more than that of Route 'C'.

b. Route 'C' is the cheapest plan among the alternatives. However, the implementation of 'C' will involve a duplicate investment when the construction of the Inner Ring Road is completed.

In addition, Route 'C' presents weaving problems at the section between Tebrau Interchange and Storey Intersection. Therefore, Route 'C' is not recommended to be implemented as the Lorry Route.

c. The other routes, Route 'A' and 'B' are not recommended as they interfere with the development plan of the Malayan Railway as well as the urban development plan formulated by the Structure Plan.

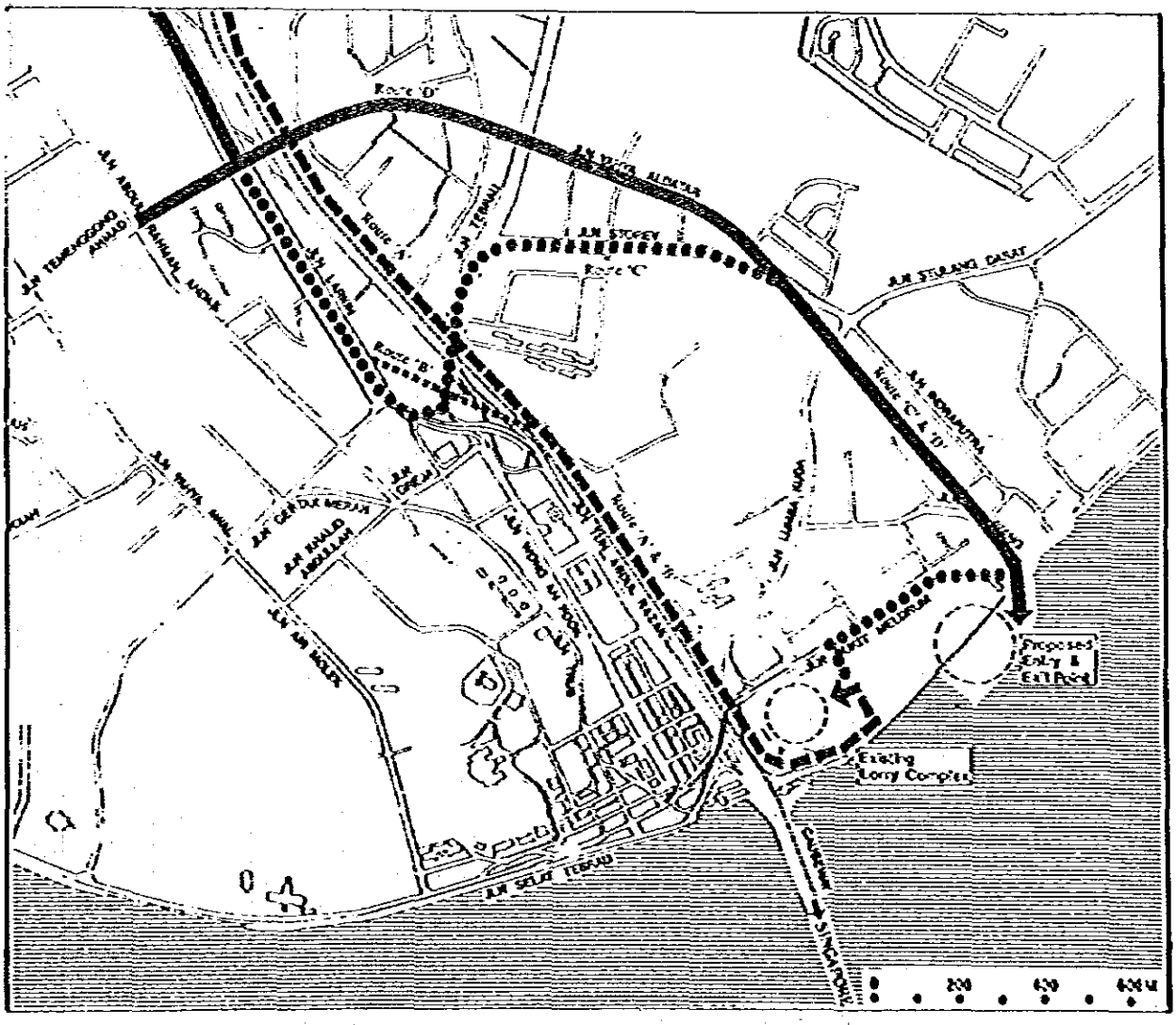


FIG. 4-49 ALTERNATIVE ROUTES OF LORRY ROUTE

TABLE 4-29 COMPARISON OF ALTERNATIVE LORRY ROUTES

		'A'	'B'	'C'	'D'
Outline	Lenght	7,870 m	2,670 m	3,380 m	2,980 m
	Plan	Construction of Exclusive Lorry way from Kompas to Lorry Complex utilizing K.T.M's reserve	Construction of Exclusive Lorry way from Tebrau Interchange to Lorry Complex utilizing K.T.M's reserve	Widening of Jln. Storey into 4 lanes of which 2 lanes are utilized as an Exclusive Lorry Lane	Following an alignment at the eastern part of proposed Inner Ring Road. 2-lane lorry route is constructed
Technical Aspect	Major Structure	• Construction of new interchange on Port Access Road • Reconstruction of 5 existing roadway bridges across Malayan Railway	• Reconstruction of 1 existing roadway bridge • Construction of new interchange	• An overpassing bridge on Jln. Tebrau • Improvement of Tebrau interchange	• Construction of 2 major interchange
	Traffic Flow	No specific problem	No specific problem	weaving problem between Tebrau interchange and J. Storey	No specific problem
	Impacts on Existing Facilities	• 2 water-pipelines are affected • 5 roadway bridges are affected	• 1 water-pipeline is affected • 1 roadway bridge is affected	• Some houses affected	• Some houses affected • 1 water-pipeline is affected
	Flexibility	Not flexible	Not flexible	Flexible	Little flexibility, expecially between Foderal Route 1 and J. Tebrau
Socio Environmental Aspect	Number of Housing Units affected	522 units (Mostly squatter houses)	18 units	24 units	59 units
	Impacts on Urban Environment	• Environmentally, more preferable than the others • Reduction of traffic congestion on the lorry route	• Environmentally, preferable to Route 'C', 'D' and 'Dj' • Partial reduction of traffic congestion on the lorry route	• Environmentally some Problems, but can be mitigated	• Environmentally some problems, but can be mitigated
	Impacts on Development Plan	• Interfere with K.T.M's development plan	• Interfere with K.T. M's development plan	None	None
Construction Cost	Construction Cost	M$ 14,500,000	M$ 10,100,000	M$ 9,200,000	M$ 20,300,000
	Land Acquisition & Compensation Cost	26,000,000	6,300,000	6,350,000	15,550,000
	Total Cost	40,500,000	16,400,000	15,550,000	35,850,000
	Recommendation	Not Recommendable	Not Recommendable	Recommendable	Most Recommendable

4-8-3 Alternative Cross-Sections

As concluded in Section 4-8-2, it is preferable to align the same route of the Inner Ring Road with the Lorry Route for the section between Jalan Tun Abdul Razak and Jalan Bukit Meldrum.

Based on this conclusion, the elements of cross-sectional components and the traffic demand-capacity analysis, the following alternative cross-sections are proposed and presented in Fig. 4-50.

Alternative 1: Dual carriageway with no lorry lane designated
Alternative 2: Dual carriageway with lorry lane being designated exclusively on both curb lanes.
Alternative 3: Carriageway with lorry lane being designated exclusively in the center.

As a result of the comparative analysis made from the environmental and traffic flow viewpoints, Alternative '3' is selected as the best cross-section among the alternatives. This is on account of its low adverse environmental effects such as noise, vibration and probability of lorries parking along the designated Lorry Route.

For the Eastern Segment of the Inner Ring Road, the following two (2) typical cross-sections are proposed and presented in Fig. 4-51:

Four (4)-Lane Plan: Four (4)-lane carriageway with the central two (2) lanes designated exclusively for lorries
Six (6)-Lane Plan: Six (6)-lane carriageway with the central two (2) lanes designated exclusively for lorries.

For the Western Segment of the Inner Ring Road, one (1) cross-section, a Four (4)-lane Plan, is proposed and presented in Fig. 4-51.

4-8-4 Preliminary Design

(1) General

The preliminary design of the recommended route selected is made on the topographic surveying sheets. The scale of each design is shown below:

TABLE 4-30 SCALE USED IN THE PRELIMINARY DESIGN

Items			Scale
Road Design	Plan		1 : 2500
	Profile	Horizontal	1 : 2500
		Vertical	1 : 500
Typical Cross-Section			1 : 150
Intersection Design			1 : 1000
Bridge Design			1 : 1000

(2) Horizontal and Vertical Design

Based on the results of the Alternative Alignment Study made, both the horizontal and vertical alignments are designed on the surveyed map of 1:2500 and compiled in the Technical Drawings.

Major factors considered in the alignment design are as follows:

a. Minimizing the demolition of land and properties as much as possible.
b. Avoiding, absolutely, the demolition of the Malay Cemetery, the General Hospital and Schools.
c. Utilizing the existing right-of-way.
d. Conforming to the existing ground level.
e. Decreasing the construction cost.

(3) Bridge Design

The Inner Ring Road including the Lorry Route has two (2) bridges with a length of 150 meters and 45 meters on the Malayan Railway and Jalan Wadi Hana, respectively. The type of bridge recommended, with minimum cost as a main controlling factor, is of the prestressed concrete. The location and general profile of these two (2) bridges are shown in Figs. 4-52 and 4-53.

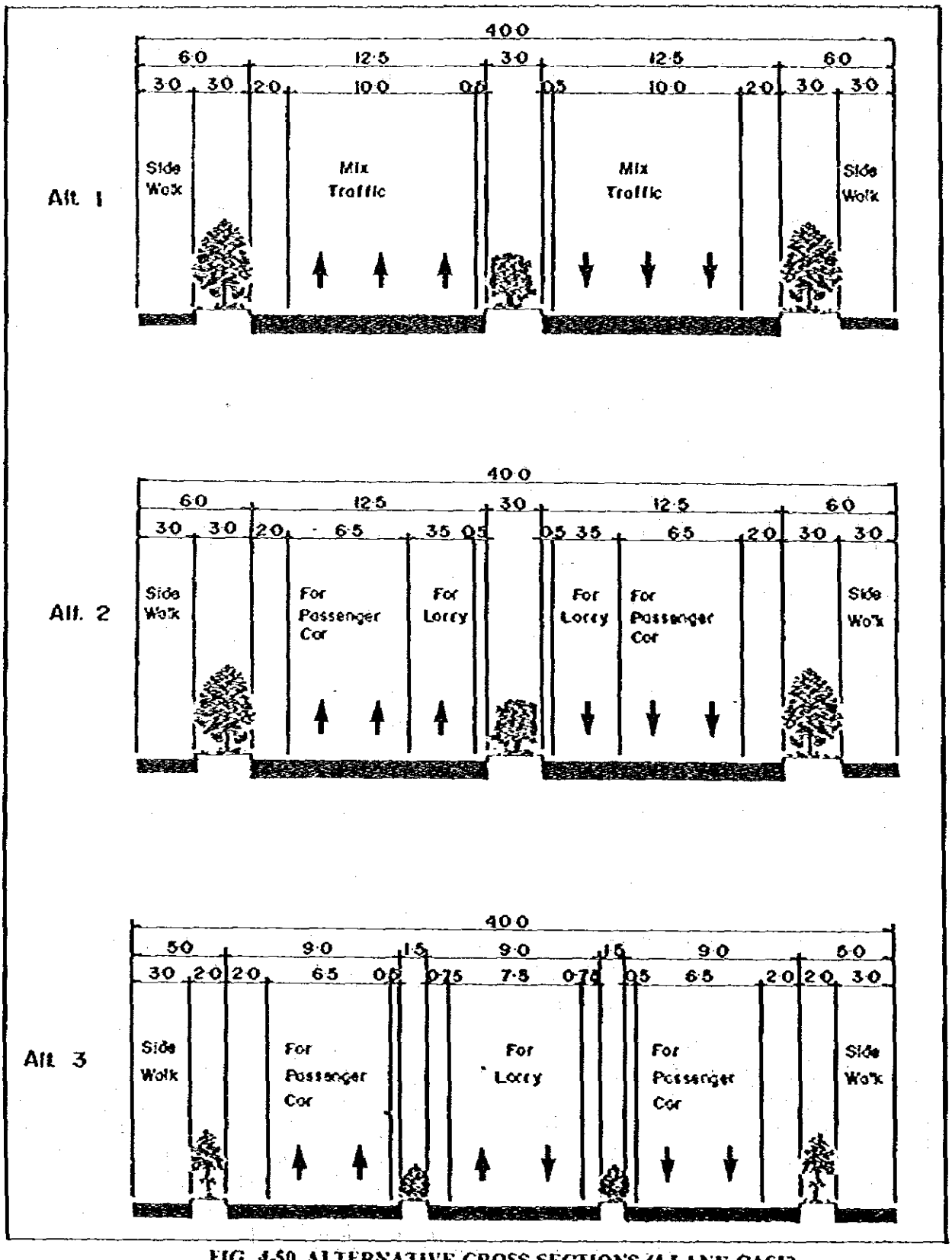


FIG. 4-50 ALTERNATIVE CROSS SECTIONS (4-LANE CASE)

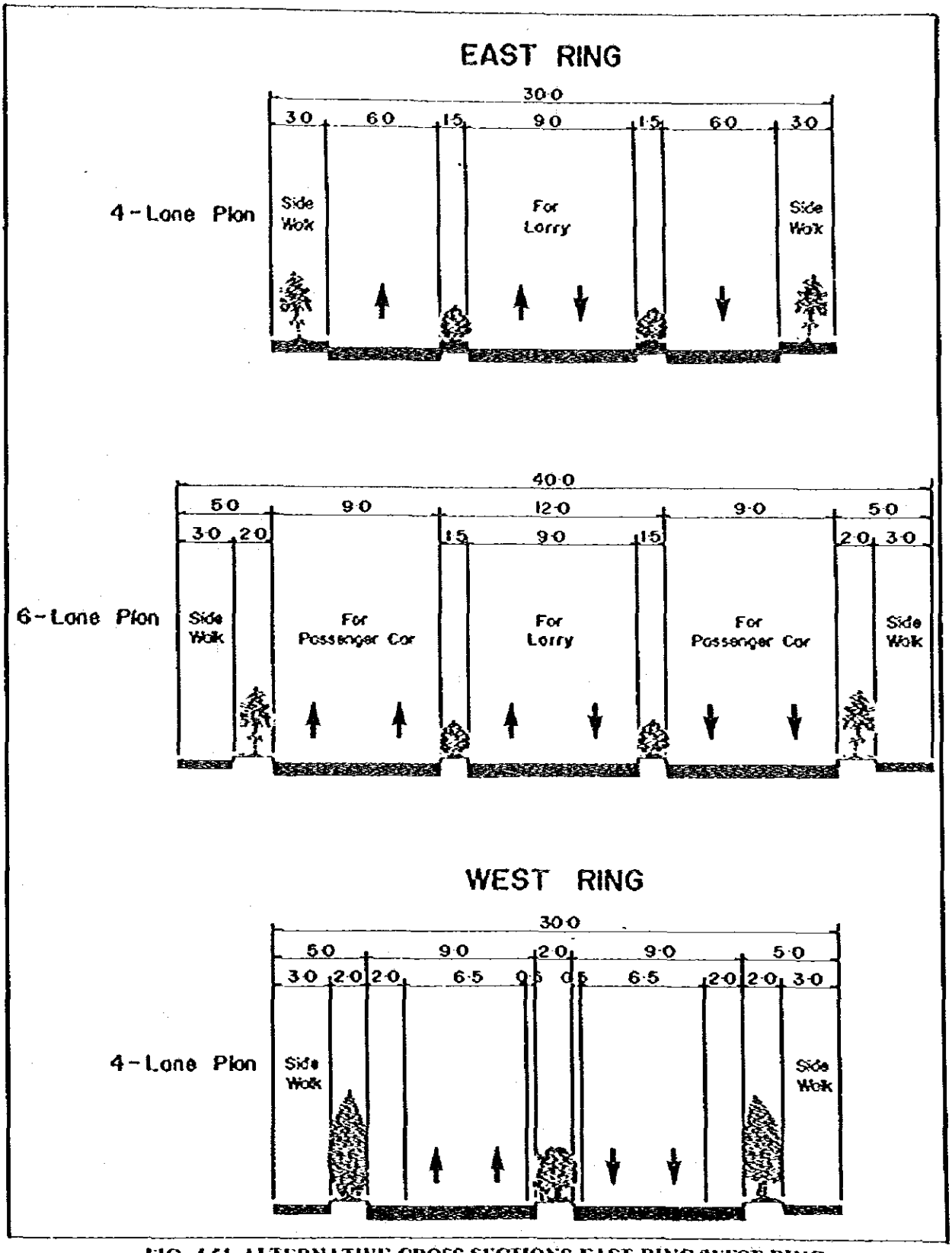


FIG. 4-51 ALTERNATIVE CROSS SECTIONS EAST RING/WEST RING

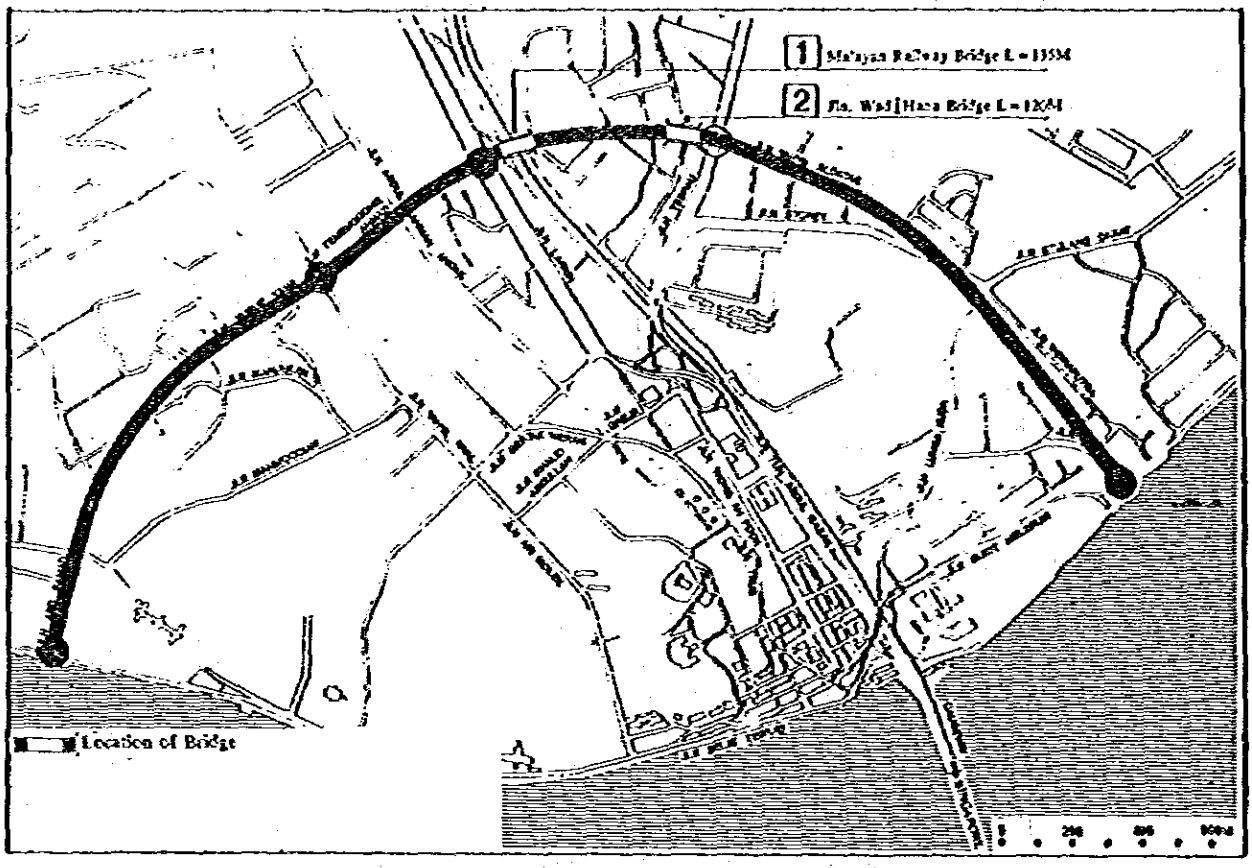


FIG. 4-52 INNER RING ROAD: BRIDGE LOCATION

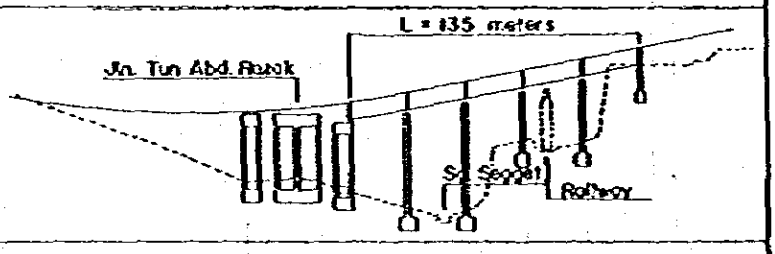
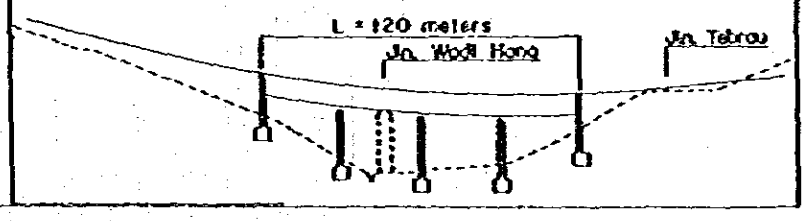
NAME OF BRIDGE	BRIDGE TYPE	LENGTH OF BRIDGE	WIDTH	GENERAL PROFILE
Malayan Railway, Sg. Segget & Jalan Tun Abd Razak	T-shaped Girder	135 meters	14 meters for West bound 11 meters for East bound	
Wadi Hana	PC Continuous Hollow Slab	120 meters	28 - 34 meters	

FIG. 4-53 BRIDGE REQUIRED FOR INNER RING ROAD

(4) Interchange and Intersection Design

Five (5) grade-separated intersections and six (6) at-grade intersections are proposed in this Study and are shown in Fig. 4-54. Following the proposed interchange and intersection locations, the preliminary designs of these interchanges are drawn and shown in the Engineering Drawings.

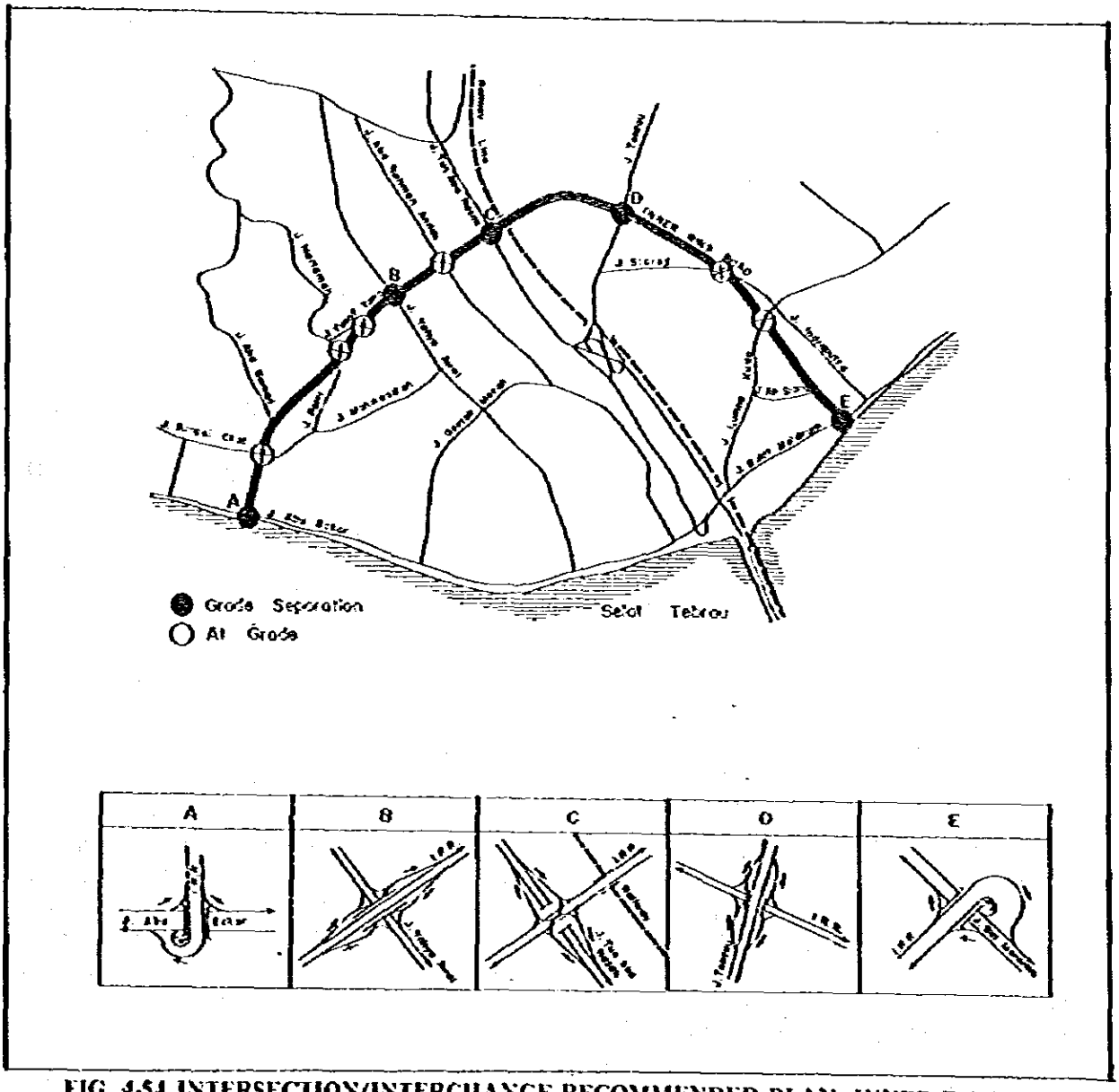


FIG. 4-54 INTERSECTION/INTERCHANGE RECOMMENDED PLAN: INNER RING ROAD

(5) Pavement Design

Taking the CBR value of the subgrade, the traffic volume, and the lifetime of the pavement into consideration, the proposed thickness of the pavement for the Inner Ring Road is 45 cm and for the Lorry Route, 55 cm. The proposed thickness of each individual course is as shown in the figure below.

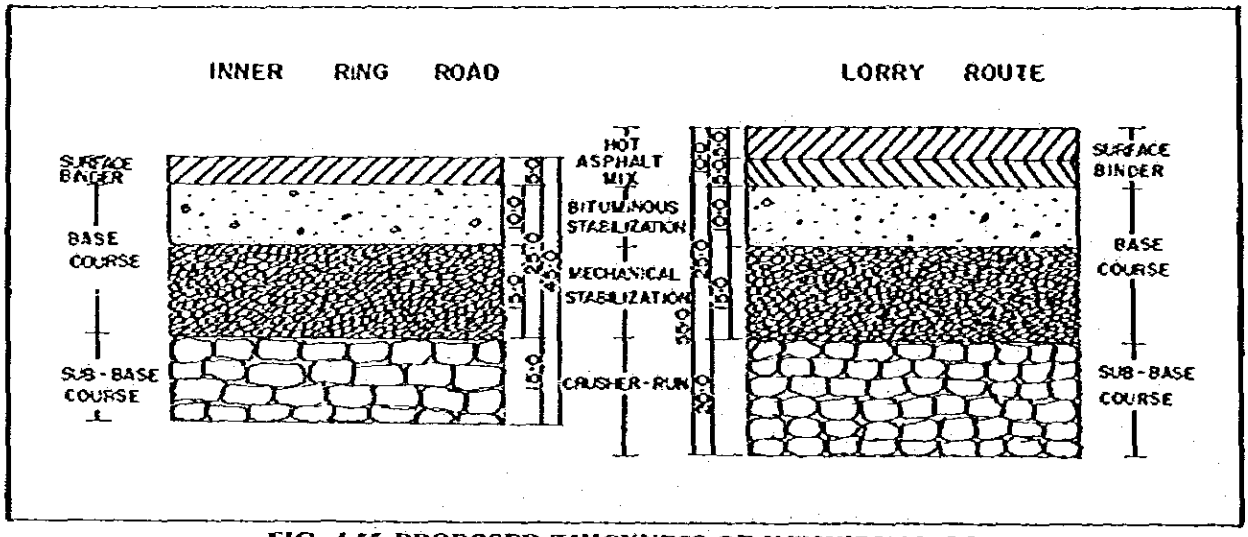


FIG. 4-55 PROPOSED THICKNESS OF INDIVIDUAL COURSE

(6) Drainage Design

1) Box Culvert

Please refer to Section 4-5-5, (7) 'Drainage Design' for the box culvert sizes considered. Box culverts longer than that computed by design is adopted considering the possibility of obstruction by various materials flowing into the culvert.

2) Roadside Drainage

See Section 4-5-5 under 'Urban Areas'. Curb and gutter drain type with inlet is considered for the Inner Ring Road project. Catchment basins at appropriate intervals also are necessary in this case.

3) Reclamation

Reclamation is required in the Inner Ring Road project in two areas for the construction of interchange:

- Jalan Abu Bakar, near the Hospital.
- Jalan Bukit Meldrum, near the Marine Flats.

Revetment is required and stone pitching method is recommended.

Reclamation is also required for the CBD Road Improvement project at Jalan Selat Tebrau. Revetment by stone pitching method is again recommended for technical and economical reasons.

(7) Utility Space

Please refer to Section 4-5-5, (8) with regards to consideration for facilitating public utility works.

To enable utilities to be maintained and installed without inconveniences to the general public and especially the drivers, the Study Team suggest that the utilities be put under the sidewalk of the Inner Ring Road reserve.

In addition to the space available from the Green Belt side, a total width of 4.0 m is available for housing the various utilities.

4-9 ENVIRONMENTAL CONSIDERATION

4-9-1 Objectives of the Study

The objectives of the Environmental Study is to minimize the effects and conflicts that may presumably arise due to the construction of the Projects.
Three (3) main aims of the Study are:

a. To identify environmental impacts,
b. To establish environmental indicators and to conduct preliminary analysis,
c. To formulate plans and designs to mitigate foreseeable environmental disturbances.

The Study approach is as shown schematically in Fig. 4-56.

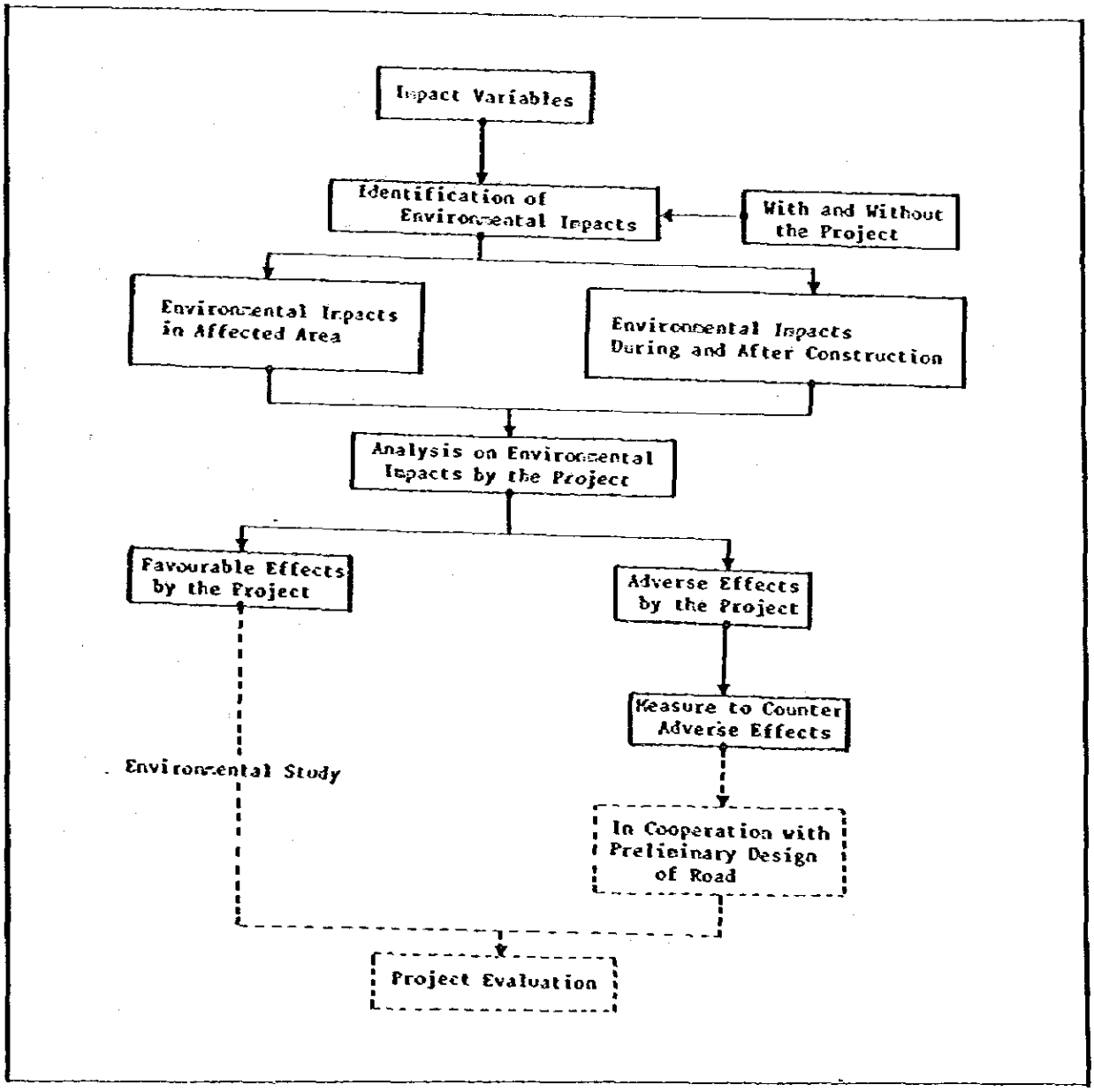


FIG. 4-56 FLOW CHART OF ENVIRONMENTAL STUDY

4-9-2 Identification of Environmental Indicators and Preliminary Analysis

Noise and air pollution are frequently seen as the major effects of traffic on the environment, but under some situations other side effects may also have considerable impacts. Therefore, the following environmental aspects such as man's surroundings inclusive of all physical, economical, historical, institutional, aesthetical, cultural and social conditions existing within the area which will be affected by the project, are dealt with in this Study. These are classified into two (2) categories, of which one is physical and the other is social and economical.

1) Physical Indicators

a. Biology and ecology (flora, fauna and aquatic).
b. Topography and geology (landscape and soil condition).
c. Hydrography (drainage, underground water and floods).
d. Meteorology (climate and weather).
e. Traffic nuisance (noise and air pollution, vibrations and other undesirable factors).
f. Traffic accident.

2) Social and Economical Indicators

a. Transport mobility and accessibility.
b. Promotion of development/redevelopment.
c. Population distribution.
d. Employment Opportunities.
e. Industrial Production.
f. Prices of Commodities.
g. Land prices.
h. Community cohesion.
i. People displacement.
j. Landscape.
k. Tourism and recreation.

The following corridors of the Projects are taken into consideration in the analysis:

1. Johor Bahru-Pasir Gudang Southern Link
   a. Southern Link
      — Section1
      — Section 2
      — Section 3
      — Section 4
   b. Southern Link Extension
2. Causeway Traffic Dispersal Scheme
3. Toll Expressway Access
4. Inner Ring Road including Lorry Route
   a. Western Segment
   b. Western Segment
      — Jalan Tun Abdul Razak-Jalan Tebrau
      — Jalan Tebrau-Jalan Bukit Meldrum

The environmental analysis is made for the following two (2) time periods:

a. During Construction
b. After Opening of the Projects

The preliminary quantitative analysis of the foreseeable effects of the Project on the above-mentioned environmental indicators has been carried out. From the results of the analysis, the foreseeable magnitude matrix is obtained as in Table 4-31.

The preliminary analysis shows that the Projects will have favourable effects which consists of:

a. Increases of Transport Mobility and Accessibility,
b. Promotion of Development/Redevelopment,
c. Redistribution of Population,
d. Increases of Employment Opportunities,
e. Increases of Industrial Production,
f. Reduction of Commodity Prices,
g. Provision of Beautiful Landscape,
h. Provision of Tourism and Recreation.

On the other hand, the adverse effects are as follows:

a. Effects on Biology and Ecology,
b. Effects of Topography and Geology,
c. Traffic Nuisance,
d. Construction Nuisance,
e. Community Disruption,
f. People Displacement.

TABLE 4-31 MAGNITUDE MATRIX DURING CONSTRUCTION/AFTER OPENING TO TRAFFIC

	Southern Link				Southern Link Extension	Moll Expressway Access	Inner Ring Rd. Including Lorry Route		Causeway Traffic Dispersal Scheme	Remarks
	Sec. 1	Sec. 2	Sec. 3	Sec. 4			West Ring	East Ring		
1. Physical Indicators										
a. Biology and Ecology		●	●			●				
b. Topography and Geology		●	●			●				
c. Hydrography										
d. Meteorology										
e. Traffic Nuisance	◉				◉	●	●	◉		
f. Traffic Accident										
g. Construction Nuisance	◉	◉	◉	◉	◉	◉	◉	◉	◉	During construction period only
2. Socio Economical Indicators										
a. Transport Mobility and Accessibility	○	○	○	○	○	○	○	○	○	
b. Promotion of Development/Redevelopment		○	○	○	o	o	o	○	○	
c. Population Distribution		○	○	○	o	o	o	○	○	
d. Employment Opportunities		○	○	○					○	
e. Industrial/Comercial Development		○	○					○	○	
f. Prices of Commodities						○		○		
g. Land Prices		○	○	○		o			○	
h. Community Cohesion	●						◉	◉		
i. People Displacement	●				●		◉	◉		
j. Landscape		○	○	○		○			○	
h. Tourism and Recreation		○	○							

Note : ○ Highly Favourable o Fairly Favourable
◉ Significant in Adverse effect ● Some Problems

4-9-3 Preliminary Environmental Analysis and Its Mitigation Measures

(1) Johor Bahru–Pasir Gudang Southern Link

The southern Link would lead to the elevation of landuse potential of Johor Bahru–Pasir Gudang Corridor and promote the development of new towns.

The existing landuse of Section '1' is for residence and housing the army camp, Section '2' is mainly for Tebrau River and its surroundings, and Section '3' is chiefly for rubber estates. However, measuring the impact influence of the project road construction and after construction, it is recognized that it will create a high degree of favourable effects in the Johor Bahru–Pasir Gudang Corridor. On the other hand, there is the fear that it also creates adverse effects such as traffic nuisance etc.

1. Favourable Effects

a. Transport Mobility and Accessibility

The project road will become the main work for the large-scaled projects scheduled for Johor Bahru–Pasir Gudang Corridor, and will not only help to secure transport mobility and accessibility but will play an important role in establishing accessibility between these development areas and the CBD of Johor Bahru.

b. Development Potential

Presently the Johor Bahru–Pasir Gudang Corridor consists mainly of rubber estates. But with the development of the project road, the development potential in the surrounding area of the project road and Johor Bahru–Pasir Gudang Corridor will be greatly enhanced.

c. Landscape

Roads are a very important landscape component. The project road will not only handle the expected high volume of future traffic in the area but will also change the landscape into a more comfortable and orderly urban environment.

2. Adverse Effects and Measures

a. Biological, Topography and Hydrography

Presently, the Johor Bahru–Pasir Gudang Corridor is made up of rubber estates or virgin forest, and the development of the project road may lead to biological, topographical and hydrographical changes.

Anyway, large-scaled development have already been scheduled for these areas, and this would lead to drastic biological, topographical and hydrographical changes in the future. Therefore, to conduct special measure on the adverse effects due to the project road may not be necessary.

b. Traffic Nuisance

Based on the calculations of the traffic noise along the Southern Link and in relation to the estimated traffic volume in 1990 the noise levels are estimated to range from 59 dB(A) — 64 dB(A). This noise level is generally within the permissible level. Further a sufficiently wide buffer zone between the carriageway and the residential area has been secured, and it is also possible to introduce remedial measures such as roadside planting. As for Taman Sentosa and Kg. Bakar Batu in Section '1', it is indicated that the present quite living environment would deteriorate which is unavoidable. And to cope with the deteriorating nuisance with the increase in the volume of traffic after 1990, it is necessary to introduce measures to reduce vehicular noise.

With regard to air pollution and vibration, compared with noise, the effect of diminishing distance is high, as such, in the case of the Southern Link it may not pose a serious problem.

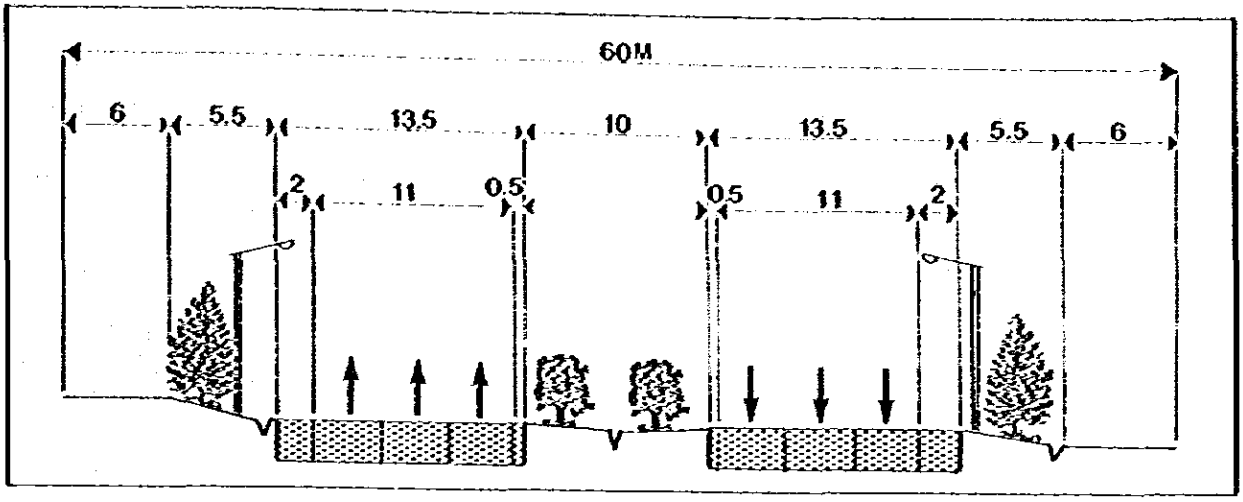


FIG. 4-57 TYPICAL CROSS SECTION OF SOUTHERN LINK

c. Construction Nuisance

The area surrounding Jalan Bakar Batu and Kg. Bakar Batu will be affected during construction by noise, gas, fumes, dust and dirt caused by unstable and abnormal conditions incidental to construction works and activities.

Moreover, the migratory workers who have to stay during construction will strain existing services and facilities and aggravate public health in the area.

However with proper construction management and supervision the construction nuisance will be decreased or at least controlled.

(1-2) Southern Link Extension

In the Southern Link Extension Project area is the present two (2)-lane Jalan Kebun Teh which is to be expanded into four (4)-lane. The main landuse in the Section between Jalan Larkin and Malayan Railway is the existence of the JKR workshop and cemetery and the Section between Malayan Railway and Jalan Tebrau houses a cemetery and residential area. The environmental impact characteristics of this project could be the major improvement on transport mobility and accessibility of Johor Bahru area after construction. On the other hand, there is the danger that traffic nuisance would deteriorate and traffic accidents would increase in the surrounding area of the project road.

1. Favourable Effects

a. Transport Mobility and Accessibility

Jalan Kebun Teh is playing an important position as the District Distributor linking Federal Route 1 with Jalan Tebrau, and the volume of traffic is expected to increase tremendously in the future. At present, Jalan Kebun Teh is a two (2)-lane road and traffic congestion is common. This project would help to reduce traffic congestion and is expected to improve traffic services in the Johor Bahru town area.

Accordingly, transport mobility and accessibility of Johor Bahru area will be improved due to the reduction of travel time and cost.

b. Landuse Potentiality and Land Price

The land along the projected road has already been used for various purposes, but with its development into a four (4)-lane road as District Distributor would at the same time increase the

landuse potential and price of land along this road. This may lead to the conversion of residential land for commercial use. This change is desirable from the environmental point of view and from the administrative standpoint it should be encouraged.

2. Adverse Effects and Measures

a. Traffic Nuisance

The expansion of Jalan Kebun Teh from two (2) to four (4) lanes would lead to the increase in traffic as well as the travel speed of the traffic. Thereby, there is a possible danger of increasing traffic nuisance. However, the noise level is estimated to be below 60 dB(A). For the future there would be no fear or concern for any major destruction of living environment.

b. Construction Nuisance

In implementation this project, it is not only necessary to take into consideration noise, gas fumes, dust and dirt pollution, but in order in avoid obstruction to traffic using the present Jalan Kebun Teh, it is also necessary to introduce proper construction management and supervision and adopt proper construction equipment and methods.

(2) Toll Expressway Access Road

The Toll Expressway Access Road will be constructed on the swamp area along Sg. Tebrau and as such the problem of traffic nuisance such as noise, air pollution, vibration affecting existing residential area does not exist. The Expressway Access Road will help to secure accessibility to the Johor Bahru–Pasir Gudang corridor which runs along the Southern Link, and is expected to contribute towards the development of the eastern part of Johor Bahru.

1. Favourable Effect

a. Transport Mobility and Accessibility

The Toll Expressway Access which links the Expressway with the Southern Link, provides accessibility between the Expressway and Johor Bahru–Pasir Gudang Corridor and together with Jalan Tebrau function as the basic transport system for the eastern part of Johor Bahru, thus ensuring the transport mobility within that region.

b. Landuse Potential

Landuse potential in the surrounding area of the project roads will be greatly enhanced. However, the region is mostly a swampy area and for development some reclamation work will be necessary.

2. Adverse Effects and Measures

a. Biology, Topography and Hydrography

The impact of this project, with the embankment and development (reclamation) of the surrounding area, will lead to changes on the present biology, topography and hydrography. For hydrography, in particular, it is necessary to fully understand its present situation, and measures should be taken to avoid causing any adverse effects.

As for biology and topography, there is no problem for these is nothing particularly important.

Further, together with this project the development of areas along Sg. Tebrau is to be encouraged and the Toll expressway be developed as a parkway so as to improve the natural environment which in turn will lead to the securing of a better urban environment.

b. Traffic Nuisance

As a result of calculations based on the projected traffic demands, the noise level at a point 30m away from the mid-

dle of the road is expected to range from 59 dB(A) to 62 dB(A) by the year 2000. It is therefore necessary to provide measures that will reduce automobile noise in the future or remedial measure such as the planting of trees in the buffer zone.

(3) Inner Ring Road including Lorry Route

The Inner Ring Road would contribute to the efficiency of the roads network within the city and also secures transport mobility and accessibility. At the same time the adverse effects on the Inner Ring Road and its Corridor is rather severe.

1. Favourable Effects

a. Transport Mobility and Accessibility

The Inner Ring Road will make circular pass possible and will greatly enhance and strengthen the function of the road network system in Johor Bahru.

Moreover, the establishment of the project road will improve traffic service within the surrounding areas and reduce traffic congestion within CBD. Accordingly, transport mobility and accessibility, not only along the Corridor of the project road but also in the area of Johor Bahru, will be improved because of reduction of travel and traffic cost.

b. Landuse Potential

The present landuse at the Western Segment are institutional facilities such as hospital, cemetery school and residential; at the Section between Jalan Tun Abdul Razak and Jalan Tebrau is the new residential areas and at the Section between Jalan Tebrau and Jalan Bukit Meldrum are the residential areas and a mixture of commercial and institutional facilities such as schools, JKR, and Telecom.

The Corridor of the project road will be progressively developed with commercial activities following the enhancement of landuse potentiality.

c. Urban Renewal and Landscape

Roads serve as an important component in forming the landscape. According to the Masterplan or the Structural Plan, the Inner Ring Road will not only handle the expected traffic in the area but by virtue of its location will also enhance the urban landscape.

2. Adverse Effects and Measures

a. Hydrographical

The Inner Ring Road passes through a comparatively undulated region, and the project road runs across the valley. the drains in Jalan Yahya Awal, the vicinity of Jalan Larkin and Jalan Wadi Hana very often overflows and inundates the roads. Therefore, in the design of the project road, attention must be given to provide and secure sufficient traffic space so as to avoid causing any adverse effects.

b. Traffic Nuisance

The areas along the Inner Ring Road are expected to be affected by traffic noise, air pollution, and vibration. With the present landuse and the future traffic demands, the level of these influences for the Western Segment is however within a permissible level because of the comparatively low traffic demand and low infiltration of large vehicles. However, for the Eastern Segment which consists of lorry lanes the problems would be serious.

To cope with this foreseeable problem, the following measures are proposed:

a. The Center two (2) lanes are to be designated as the Lorry Route,
b. Wider sidewalk be provided,

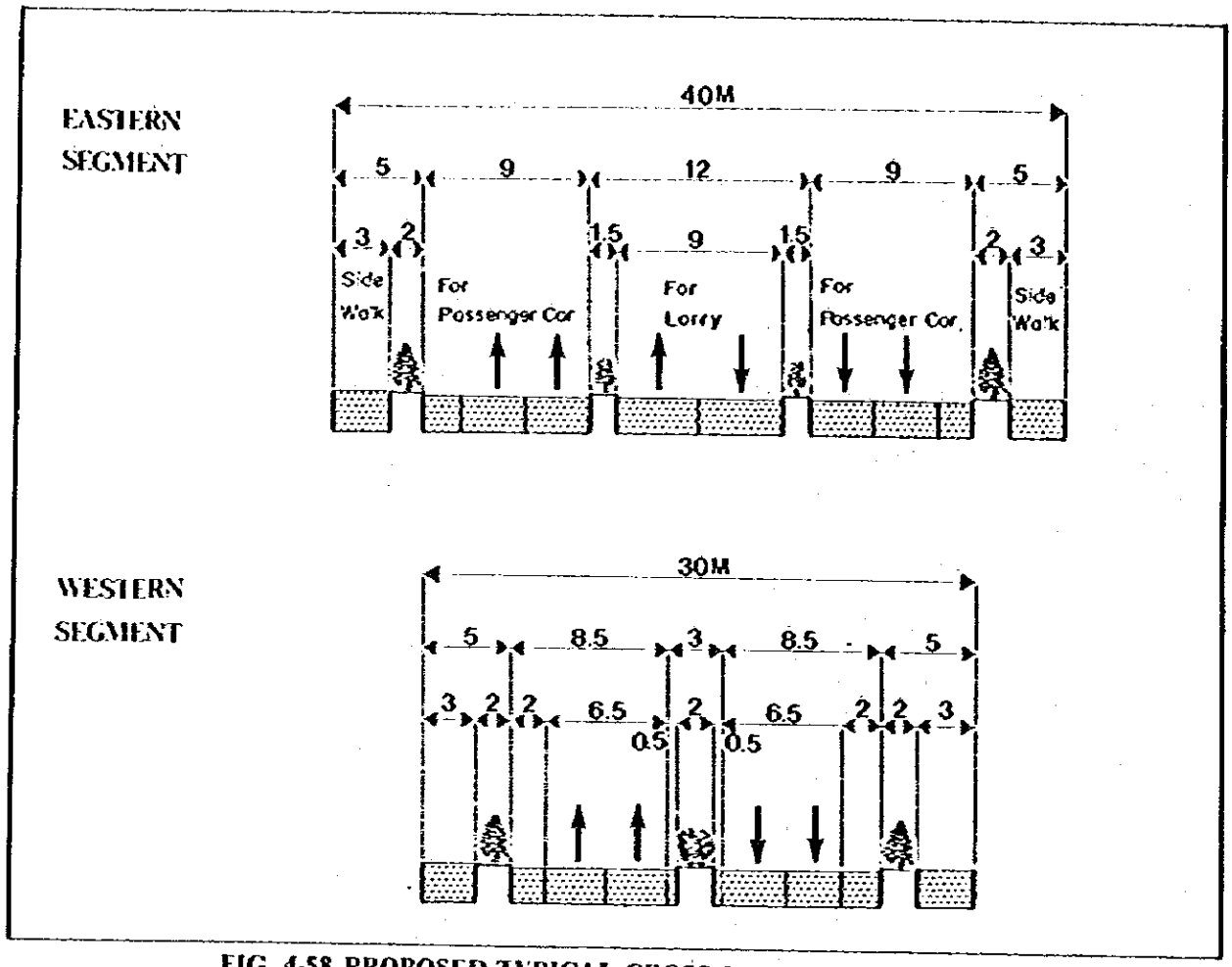


FIG. 4-58 PROPOSED TYPICAL CROSS SECTION

c. Roadside trees be planted along the sidewalk,
d. Planting in the strip between the Lorry Lane and Passenger Car Lane.

c. *Construction Nuisance*

As mentioned earlier, the Corridor of the Inner Ring Road consists of residential and institutional facilities such as hospital and, school which require a quiet environment. Further, the number of pedestrians is high along this corridor. Therefore it is imperative not only to have proper construction management and supervision but also the adoption of proper construction equipments and methods.

d. *Resident Displacement*

The existing resident along the proposed alignment will have to be removed in accordance with the right-of-way acquisition of the project road. The total number of houses is about 34 units for Section 1, 59 units for Section 2 and 45 for Section 3. However, if appropriate measures are taken to provide alternative housing for these residents, they are equally able to enjoy a new life at the new resettlement sites.

(4) Causeway Traffic Dispersal Scheme

As for the causeway traffic dispersal scheme, many favourable effects are found. These include the increase of transport mobility and accessibility, promotion of redevelopment in the Central Area of Johor Bahru, beautification in the said area.

For the adverse effects, only construction nuisance has been identified. In order to avoid the obstruction to traffic, it is necessary to introduce proper construction management and supervision and adopt proper construction equipment and methods.

CHAPTER 5

PROJECT COST ESTIMATES

5-1 INTRODUCTION

5-1-1 General

The project cost comprises of the following components:

a. Land Acquisition and Compensation Cost.
b. Construction Cost of Roads.
c. Construction Cost of Structures.
   C-1 Bridge
   C-2 Interchange

These components are quoted in:

a. Foreign Currency.
b. Local Currency.
c. Tax.

Following the above-mentioned components, the project cost represented in 1983 prices is estimated from the unit cost analyzed and the quantities required for each project which are estimated based on the preliminary designs made.

5-1-2 Cost Estimation Process

The cost estimation process is shown in Fig. 5-1.

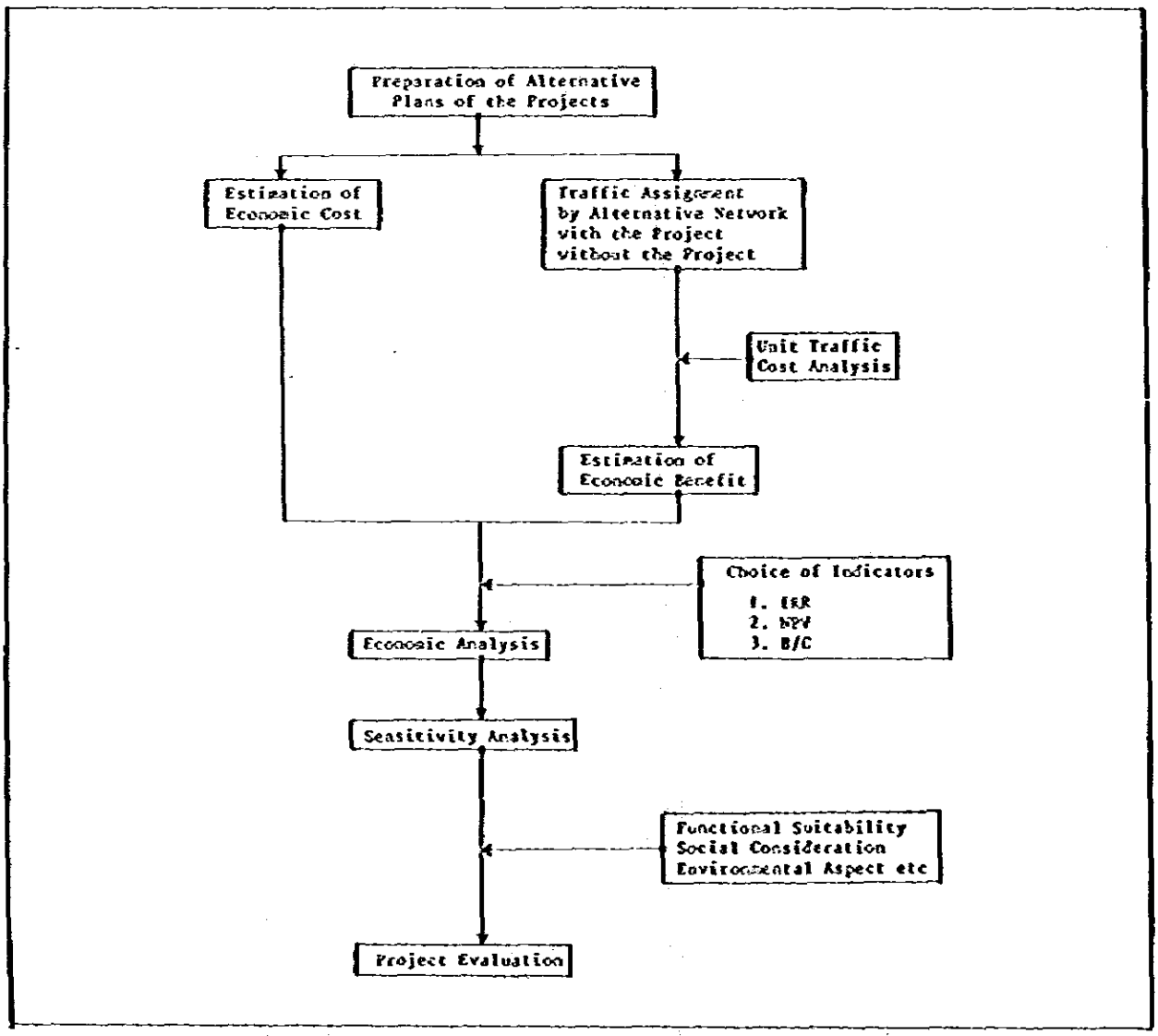


FIG. 5-1 FLOW OF THE COST ESTIMATION PROCESS

5-1-3 Component of the Construction Cost

The construction cost consists of the following components.

a. Base Cost,
b. Overhead Cost,
c. Contractor's Profit,
d. Contractor's Tax,
e. Detailed Engineering and Supervision,
f. Contingency.

Of which the base cost consists of the following items:

a. Cost of Labour,
   — Skilled and unskilled labour
b. Cost of Materials,
c. Cost of Equipment,
d. Cost of Other Necessary Items.

5-1-4 Definition of Foreign and Local Components

The foreign currency is incurred in:

a. Cost of imported machineries and materials,
b. A portion of the detailed engineering and supervision service fees,
c. A portion of the overhead, profit and contingency cost.

The local currency component is incurred in:

a. Cost of purchasing domestic products,
b. Labour cost and transportation cost,
c. Cost of land acquisition and compensation.

5-1-5 Alternatives Considered

The following alternatives which are subject to the economic evaluation are included in the estimation of construction cost:

1. Johor Bahru–Pasir Gudang Southern Link
   a. Northern Link
      i) Four (4)-Lane Plan
      ii) Six (6)-Lane Plan
   b. Southern Link Extension
      i) Four (4)-Lane Plan (no alternative)
2. Causeway Traffic Dispersal Scheme
   a. Short-Term Actions
   b. Long-Term Plan
3. Toll Expressway Access
   i) Four (4)-Lane Plan (no alternative)
4. Inner Ring Road
   a. Four (4)-Lane Plan
   b. Four (4) and Six (6)-Lane Plan (Six (6)-Lane Plan has a two (2)-lane provision for the Lorry Route).

5-2 UNIT COST ANALYSIS

5-2-1 Components of Unit Costs

The unit cost itself is split into three (3) parts as foreign currency, local currency and tax. The foreign currency and local currency includes six (6) components.

The percentage distribution of each cost component is shown in Table 5-1.

5-2-2 Labour Cost

The Labour Cost is shown in Table 5-2.

5-2-3 Cost of Construction Material

The cost of the major construction materials is derived following a discussion with the State JKR and related offices; and several private companies.

The cost list of the major materials is shown in Table 5-3.

5-2-4 Construction Equipment

The unit cost of various plants in Malaysia was analyzed. Based on this information, the cost performances of the plants which are considered suitable for the construction of the Project Roads in its size and capacity range are described as follows:

(i) Service life plant — 8 years
(ii) Working hours per annum — 2,160 hours
(iii) Interest per capital outlay — 8%
(iv) Spare parts cost per annum — 5% of initial cost of plant
(v) Maintenance and repairs — 5% of the initial cost of plant
(vi) Average plant efficiency — 70%

5-2-5 Result of Unit Cost Analysis

The result of unit cost analysis is shown in Table 5-4 and Table 5-5. The unit cost includes the six (6) components as shown in Table 5- 1.

TABLE 5-1 PERCENTAGE OF COST COMPONENT

Component	Percentage
Base Cost	100
Overhead	10
Contractor's Profit	10
Contractor's Tax	3
Detailed Engineering and Supervision Fees	10
Contingency	5
Total	138

Unit Cost is calculated as follows:-

Unit Cost = Base Cost x 1.38

TABLE 5-2 LABOUR COST

Items	Unit Cost 8-hour per day (M$)
1. General Labourer	14.0
2. Concrete Labourer	20.0
3. Mason	30.0
4. Mason's Labourer	16.0
5. Carpenter	32.0
6. Carpenter's Labourer	18.0
7. Steel Bender and Fixer	30.0
8. Pneumatic Toll Operator	30.0
9. Fitter	30.0
10. Welder	32.0
11. Painter	32.0
12. Truck Driver	24.0
13. Earth Moving Equipment Operator	32.0

TABLE 5-3 COST LIST OF MAJOR MATERIALS

Material	Description	Unit	Market Cost (M$)	Remarks
Soil	Red Earth	m^3	9	Hauling Distance 5km
Sand	Coarse Sand	m^3	29	
Aggregate	Fine Aggregate	m^3	32	Concrete
	Coarse Aggregate	m^3	46	Concrete
Crushed Stone	ϕ 20 – ϕ 40	m^3	40	Base Coarse
	ϕ 40 – ϕ 60	m^3	32	Sub-Base Coarse
	ϕ150 – ϕ200	m^3	30	Structure Foundation
Concrete	Grade 20	m^3	115	210 kg/cm^3
	Grade 30	m^3	128	270 kg/cm^3
Cement	Portland	50kg	8	
Asphalt	Grade (60 – 100)	t	580	
	Cut Back Bitumen	t	670	
Steel Bar	ϕ 9 – ϕ13	t	650	
	Dϕ16 – Dϕ25	t	585	
	Dϕ32	t	609	
Form	Wood	m^2	32	
	Metal	m^2	66	
Pile	Dϕ 400	m^2	71	
	ϕ 600	m^2	89	
	ϕ 800	m^2	149	
	ϕ1000	m^2	214	
Drainage	Curb & Cutter	m^2	28	
	Block Drain 18"	m^2	51	
	Block Drain 30"	m^2	114	
	Concrete Pipe 18"	m^2	78	
	Concrete Pipe 30"	m^2	131	
Guard Rail		m^2	65	
Street Lighting	Lamp Post (8m)	each	770	Single arm
	Lamp Post (8m)	each	1,140	Double arm
Gas, Oil	Diesoline	100l	55	
	Petrol	100l	102	

TABLE 5-4 CONSTRUCTION UNIT COST — ROAD AND INTERCHANGE

Items	Subitem	Class	Unit	Unit Cost			
				F C	L C	Tax	Total
Site Clearing	Developed Area	Removal of Tree and Structure	m²	0 45	1 32	0 08	1 6
	Undeveloped Area	Grubbing	m²	0 15	0 42	0 03	0 6
	Swampy Area	Grubbing	m²	0 60	1 68	0 12	2 4
Excavation	Usable Common	Soil	m³	2 10	3 54	0 36	6 0
	Waste Common	Soil	m³	3 15	5 31	0 54	9 0
Embankment	Usable Common	Soil	m³	1 05	1 77	0 18	3 0
	Borrow Common	Soil	m³	4 20	7 08	0 72	12
	Borrow Selected	Soil	m³	6 30	10 62	1 08	18
Reclamation	Borrow Common	Soil	m³	6 45	9 50	1 05	15
	Stone Band	Crushed stone	m³	85	100	15	200
Slope		Grass	m²	2 45	2 45	0 30	4 0
Turfing	Roadside, Median	Tree & Grass	m²	2 83	4 80	0 49	8 0
	Open space	Grass	m²	2 10	3 60	0 30	6 0
Pavement	Carriageway	Rebar t=45cm	m²	23	27	4	54
	Carriageway	Rebar t=55cm	m²	27	32	4	63
	Shoulder		m²	19	22	3	44
	Sidewalk		m²	11	13	2	26
Drainage	Concrete Curb		m	35	41	6	70
	Concrete Curb & Gutter	t=50cm	m	43	72	7	122
	Curb Inlet		each	150	254	26	430
	Catch Basin		each	441	743	76	1260
	Block Drain	24cm – 30cm	m	39	66	7	112
	Block Drain	45cm – 60cm	m	68	116	12	196
	Block Drain	75cm – 90cm	m	109	184	19	312
	Concrete Pipe	ϕ 45cm – ϕ 60cm	m	53	89	9	151
	Concrete Pipe	ϕ 75cm – ϕ 90cm	m	150	182	18	308
	Concrete Pipe	ϕ100cm – ϕ150cm	m	265	447	45	757
Road Devices	Road Sign	Normal size	each	117	90	18	225
	Road Sign	Special size	each	2218	1664	438	4380
	Guard Rail	Steel	m	65	97	13	175
	Street Lighting	Single arm	each	582	426	112	1120
	Street Lighting	Double arm	each	275	566	143	1430
	Traffic Signal	3 leg Intersection	each	23430	17430	4560	45500
	Traffic Signal	4 leg Intersection	each	31390	22430	6000	60000
	Pavement Marking		m²	3 6	2 4	0 5	6 6
	Delineator		each	30	18	4	52
Others	Utility Box Culvert	1.5 x 1.5	m	559	828	193	1430
	Utility Transfer	Major	m	268	356	36	430
	Utility Transfer	Medium	m	143	156	24	279
	Utility Transfer	Minor	m	83	67	15	179
	River Relocation	W = 3	m	235	341	43	619
	River Relocation	W = 6	m	335	343	69	555
	River Relocation	W = 10	m	356	824	192	1462
	River Relocation	W = 15	m	783	1136	145	2066
	River Relocation	W = 20	m	1156	1670	213	3043
	Original Relocation		m	1145	1650	210	3000

TABLE 5-5 CONSTRUCTION UNIT COST — STRUCTURE

Items	Sub Item	Class	Unit	Unit Cost			
				F.C	L.C	Tax	Total
Road Structure	R.C Hollow Slab	L= 15 – 20m	m²	490	702	104	1300
	P.C.I Girder	L= 20 – 40m	m²	600	780	820	1500
	Box Culvert	2 – 9.5 x 6.0	m	11837	17833	2180	31150
	Box Culvert	8.0 x 4.0	m	3324	5390	686	9350
	Box Culvert	6.0 x 6.0	m	3960	5331	729	10420
	Box Culvert	2.0 x 2.0	m	825	1193	152	2170
	Box Culvert	3.0 x 3.0	m	1383	2002	255	3640
	Box Culvert	2 – 2.0 x 2.0	m	1421	2057	262	3740
	Box Culvert	2 – 3.0 x 3.0	m	2386	3454	439	6280
	Stone Masonry	H = 1 – 3m	m	833	228	19	380
	Concrete Gravity Type	H = 3 – 5m	m	504	864	72	1440
	Concrete Inverted T – Type	H = 5 – 7m	m	854	1193	833	2210
	Pedestrian Overpass		m²	380	550	70	1000
	Pedestrian Stair		Each	3040	4430	560	8000
Super Structure	Concrete	400 kg/cm²	m³	133	179	23	325
	Concrete	300 kg/cm²	m³	114	165	21	300
	Concrete	240 kg/cm²	m³	106	154	20	280
	Form		m²	25	45	5	75
	Steel Reinforcement	SD 30	ton	650	783	129	1560
	P.C. Strand	12T 12.4	ton	3120	4456	624	5200
	P.C. Strand	12 ø 7	ton	3000	4400	600	5000
	Steel Bar	ø 26	ton	930	459	159	1550
	Bearing Shoe	Cast Iron	ton	9600	4855	6920	16000
	Rigging and Cable Crane		L.S	220000	336000	144000	1200000
	Erection Girder		ton	88	59	13	160
	Curb	210 kg/cm²	m³	98	165	17	280
	Guard Rail	Aluminum	m	104	76	20	200
	Pavement	Carriageway	m²	83	15	2	30
	Pavement	Side Walk	m²	17	20	3	40
	Expansion Joint	Steel, Rubber	m	1369	630	219	2150
	Drainage	Cast Iron	Each	294	147	49	490
Sub Structure	Concrete	240 kg/cm²	m³	106	154	20	280
	Form		m²	25	45	5	75
	Steel Reinforcement	SD 30	ton	650	783	120	1550
	P.C. Pile	ø 60cm	m	62	81	12	155
	False Work		m²	18	29	3	50
	Excavation		m³	14	28	2	43
	Steel Sheet Pile		m²	168	218	34	420
	Concrete Sheet Pile		m²	81	142	14	240
	Landing Stage		m²	200	260	40	500

5-3 CONSTRUCTION QUANTITIES ESTIMATE

5-3-1 General

Based on the preliminary design drawings of scale 1:2500 for roadway (part of Southern Link Road uses 1:5000 scale) and 1:1000 for interchange and bridges, the construction quantities were estimated.

Segmentation of each project road is made as shown in Fig. 5-2.

5-3-2 Construction Quantities

The major construction items for roadway, bridge and interchange are as follows:

1. Roadway and Interchange

a. Earthwork (Embankment, Excavation, Slope Protection, Reclamation)
b. Pavement (Carriageway, Shoulder, Sidewalk)
c. Drainage (Drain, Pipe Culvert, Catch Basin)
d. Minor Structure (Wall, Box Culvert, Catch Basin)
e. Road Devices (Road Sign, Street Lighting, Guard Rail, Traffic Signal, Pavement Marking)
f. Others (Utility Box Culvert, Transfer of Utilities, River Relocation)

2. Bridge

a. Superstructure: Concrete, Reinforcement Form, PC Stand, Shoe, Joint
b. Substructure: Earthwork, Concrete, Reinforcement Form, Pile, Temporary Work

The results of the construction quantities estimated for each project by alternatives are shown in the Supplementary Volume.

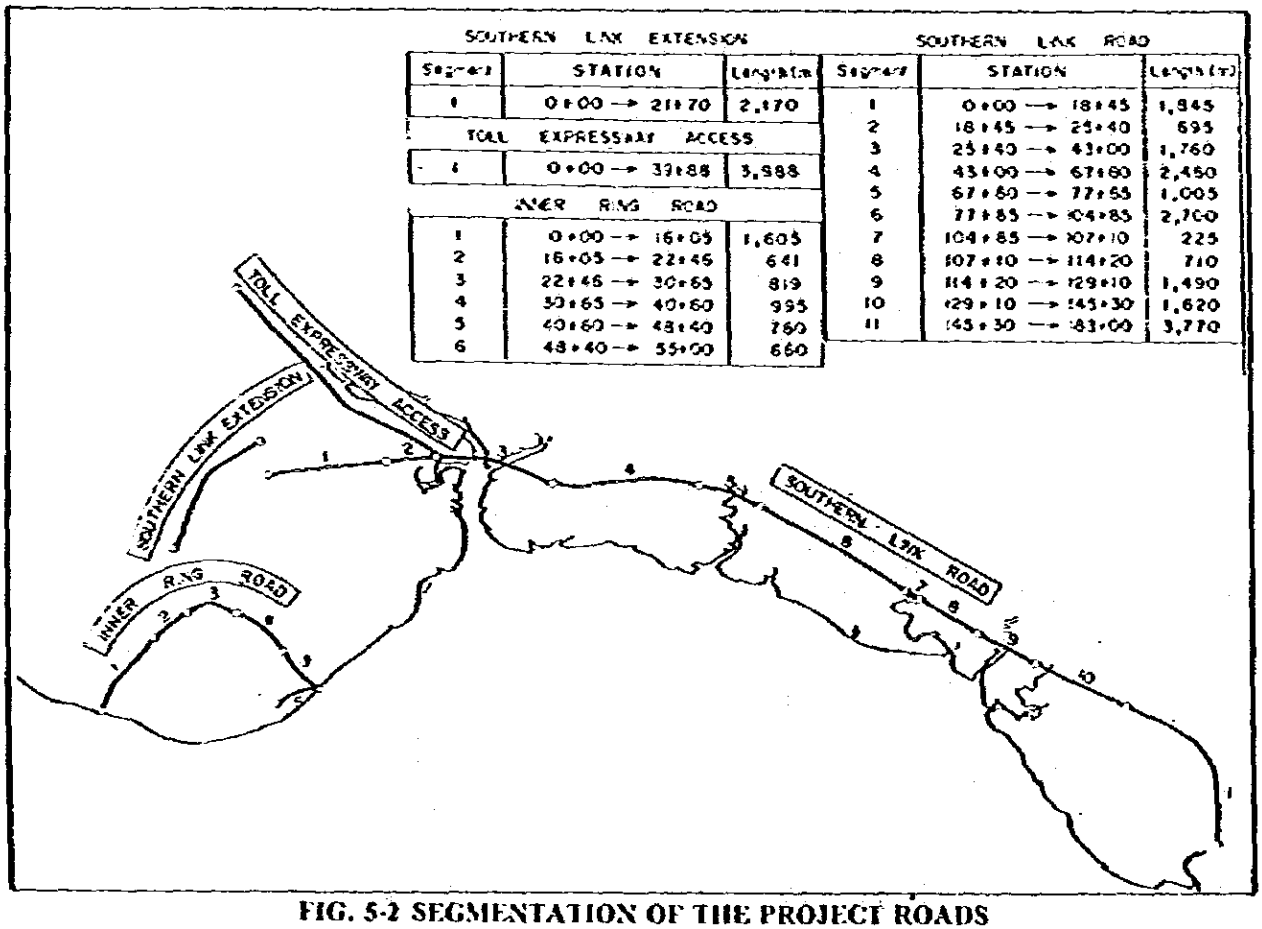


FIG. 5-2 SEGMENTATION OF THE PROJECT ROADS

5-4 CONSTRUCTION COST

5-4-1 Construction Cost of Roads

Based on the unit cost analysed and quantities estimated, the construction cost of of the road by segments of each project is estimated.

5-4-2 Construction Cost of Bridges

The construction cost of the bridges are estimated on the basis of the unit cost and quantities estimated for each bridge in the projects.

5-4-3 Construction Cost of Interchanges

The construction cost of the interchanges are also estimated on the basis of the unit cost and quantities of each interchange in the project.

5-4-4 Results of the Construction Cost Estimates

Each component of these estimated construction costs is summed up by each road segment of the projects and tabulated as shown in Table 5-6.

5-5 LAND ACQUISITION AND COMPENSATION COSTS

5-5-1 Procedure

In order to estimate the land acquisition and compensation costs, the following procedure is followed:

a. To conduct a survey of affected lands and buildings along the project roads,
b. To classify the lands and buildings,
c. To analyse the unit cost of the lands and buildings,
d. To identify the lands buildings affected by the project roads,
e. To estimate the land acquisition and compensation costs.

5-5-2 Estimation of Land Acquisition and Compensation Costs

(1) Classification of Lands and Buildings

The lands effected by the project roads are classified as follows:

a. Government land — either occupied or unoccupied.
b. Private land for residential use — either occupied or unoccupied.
c. Rubber and cultivated lands.
d. Existing road reserve.
e. Swampy area.
f. Reserved land for river, sea, etc.

The private land for residential use is further divided into high, medium and low class.

As for the buildings, the following classification is adopted:

a. Bungalow — concrete or wooden
b. Semi-detached — concrete on wooden
c. Terrace — concrete of wooden
d. Squatters

(2) Unit Cost of Lands and Buildings

The unit cost of the lands and buildings affected is obtained from the land office and from results of the surveyed market prices.

(3) Results

The land acquisition and compensation costs estimated on the basis of the unit cost analysed and the land areas and buildings affected along the project road are shown in Table 5-6.

5-6 ESTIMATION OF THE PROJECT COST

The project cost for each of the projects is summed up and tabulated in Table 5-6.

The estimated project cost is as follows:

(1) Johor Bahru — Pasir Gudang Southern Link

The project cost for the Southern Link as a six (6)-lane road is estimated: at M$178.5 million, whereas that as a four (4)-lane road is estimated at M$94.2 million. As for the Southern Link Extension, the project cost amounts to M$19.6 million.

(2) Causeway Traffic Dispersal Scheme

The project costs for the Short-Term and Long-Term Plans are estimated at M$15.0 million and M$26.9 million respectively.

(3) Toll Expressway Access

The project cost for the Toll Expressway Access is estimated at M$50.9 million although the total length of this road is only 3.99 kilometers. This is due to the large amounts allocated for intersection construction.

(4) Inner Ring Road Including Lorry Route

The project cost for the Inner Ring Road including Lorry Route is estimated at M$97.7 million, of which the amount of M$67.3 million is allocated for the Eastern Ring of the Inner Ring Road with the Lorry Route, and M$30.5 million for the Western Ring of the Inner Ring Road (without the Lorry Route).

TABLE 5-6 SUMMARY OF THE PROJECT COST (IN THOUSAND M$ AT 1983 PRICES)

	Plan	Length of Road (km)	Land Acquisition Cost	Construction Cost			Total	In Foreign Currency	In Local Currency
				Roadway	Structure	Sub-Total			
Johor Bahru - Pasir Gudang Southern Link	4 & 6 - Lane	29.47	12,542	76,305	101,691	166,935	193,661	76,559	121,413
South Link (ultimate plan)	6 - Lane	13.30	5,931	72,337	100,299	172,545	178,477	71,206	107,270
South Link (initial plan)	4 - Lane	14.53	5,931	56,543	31,320	87,262	94,193	36,642	57,551
Southern Link Extension	4 - Lane	2.17	4,111	6,531	6,958	13,479	19,590	5,444	14,146
Causeway Traffic Dispersal Scheme	-	(7.45)	3,376	14,458	24,094	38,552	41,928	16,443	25,485
Short - Term	-	(3.59)	0	5,317	9,731	15,048	15,048	6,474	8,574
Long - Term	-	(4.37)	3,376	9,141	14,333	23,504	25,853	9,974	16,906
Toll Expressway Access	6 - Lane	3.99	4,951	24,852	21,155	45,947	50,318	18,727	32,191
Inner Ring Road including Lorry Route	4 & 6 - Lane	5.50	35,153	23,714	38,852	62,576	97,729	25,187	72,542
Eastern Ring (ultimate plan)	6 - Lane	3.25	24,583	14,687	28,256	42,932	67,275	17,462	49,813
Eastern Ring Toll Inform - J.B. Middle (initial plan)	4 - Lane	2.44	14,378	7,303	0	7,303	22,281	2,849	19,432
Western Ring	4 - Lane	2.25	19,730	9,027	13,657	19,684	30,454	7,725	22,729
Total	-	29.36	55,522	141,942	191,378	333,139	388,642	137,013	251,630

Note : 1) Total project costs are calculated based on the ultimate plan.
2) Figures in brackets represent partial length.

5-7 ANNUAL MAINTENANCE COST

Estimation of the annual maintenance cost for each of the project roads were made after discussions with J.K.R and references to reports of other comparable project roads.

The following items are taken into account in the estimation of the annual maintenance cost:

(1) Resurfacing of Roads

The resurfacing of the carriageway and shoulder is to be carried out once every 10 years. The unit cost of resurfacing per square meter with 5cm thick premixed Asphalt Macadam is estimated at $6.0/m^2$.

(2) Roadside Planting

The maintenance of roadside trees consist of the trimming of branches, ensuring water supply, protection of the trees, and other upkeeping works. The unit cost is estimated at $5 per tree.

Grass planting, as for roadside trees, is to be upkept once every year. The unit cost for this work is estimated at $0.05/m^2$.

(3) Drainage

The lifespan of the drainage system is assumed to be 20 years and 2% of its has to be renewed or repaired every year. The unit cost of drainage maintenance is estimated at $37/m.

The lifespan of the inlets is also assumed to be 20 years and clearing once a year has to be carried out. The unit cost for the maintenance of each inlet is estimated at $220.

(4) Roadside Devices

The major items considered in the maintenance of the roadside devices are:

a. The Curbs

The lifespan of the curbs is assumed to be 20 years and 2% of it has to be renewed or repaired once every year. The unit cost of changing the curbs is estimated at $20/m^2$.

b. Road Marking

This maintenance involves pavement markings, curb repainting, repainting of traffic signs and others. This has to be carried once every 3 years and the unit cost is estimated at $6/m^2$.

c. Road lighting

The maintenance of road lighting includes repairing and renewing them whenever necessary. Basically, the bulbs would have to be changed once every 10 years. The unit cost for replacing each bulb is estimated at $180.

d. Guard Rails

The maintenance of guard-rails includes its repair and replacement. Two per cent (2%) of the guard-rails have to be renewed or repaired every year. The cost of changing is estimated at $70/m.

(5) Structures

The maintenance of structures includes those of joints, drains, and slabs. These have to be changed or repaired whenever found faulty. Their lifetime is estimated to be 10 years and the unit cost of their maintenance is estimated at $10/m^2$.

(6) Annual Maintenance Cost

A summary of the estimated annual maintenance cost for each road project is given in Table 5-13 .

TABLE 5-7 PROJECT COST OF JOHOR BAHRU-PASIR GUDANG SOUTHERN LINK (4-LANE)
(In thousand M$ at 1983 prices)

Seg	Station	Length (m)	Component	Construction Cost						Land Acquisition and Compensation	Total	
				Road		Bridge		Interchange				
	0 + 00		F.C	2424		0		0			2424	
1		3545	L.C	3274	6955	0	0	0	0	223	3497	6318
	18 + 45		Tax	337		0		0			337	
	18 + 45		F.C	1631		0		0			1631	
2		655	L.C	2131	3997	0	0	0	0	4439	6570	8436
	25 + 45		Tax	265		0			0		265	
	25 + 45		F.C	5650		5093	Tebrau River	0			11743	
3		1760	L.C	4562	8914	8315	18541	0	0	0	33577	27455
	43 + 00		Tax	692		8533		0			3135	
	43 + 00		F.C	2677		0		0		Permas Baja	2677	
4		2450	L.C	3651	6791	0	0	0	0	0	3651	6791
	67 + 83		Tax	433			0	0			433	
	67 + 83		F.C	2483		824	Ecosite River	0			3313	
5		1305	L.C	3228	6128	554	1532	0	0	378	4569	8438
	77 + 85		Tax	418		154		0			565	
	77 + 85		F.C	2635		0		0		Kota Putri	2635	
6		2720	L.C	3622	6754	0	0	0	0	0	3622	6754
	104 + 85		Tax	432		0	0				432	
	104 + 85		F.C	1910		354	Pelek River	0			1454	
7		225	L.C	1285	2455	436	902	0	0	0	1721	3367
	107 + 13		Tax	170		72		0			242	
	107 + 13		F.C	1232		0		0		Gunung Pajar	1232	
8		710	L.C	1545	2931	0	0	0	0	0	1545	2931
	114 + 29		Tax	293		0		0			293	
	114 + 29		F.C	3133		3155	Masai River	0			6288	
9		1490	L.C	4514	8558	3179	6337	0	0	831	8524	15895
	129 + 19		Tax	531		693		0			1224	
	129 + 19		F.C	1931		1324	Masai Kechil	0		SEDC	3225	
10		1620	L.C	3436	4543	1441	River	0	0	0	3853	7657
	145 + 30		Tax	312		240	3068	0			552	
	145 + 30		F.C	0		0		0			0	
11		3270	L.C	0	0	0	0	0	0	0	0	0
	183 + 00		Tax	0		0		0			0	
			F.C	21912		33720		0			56632	
Total		18300	L.C	36339	56342	14928	31329	0	0	5931	51238	94193
			Tax	3558		2602		0			6353	
Southern	0 + 00		F.C	1658		323	Over Railway	0			2911	
Link		2370	L.C	2651	4564	369	Bridge	0	0	154	2554	4920
Extension	21 + 70		Tax	245		65	752	0			345	

Notes: 1) FC means the foreign currency component.
2) LC means the local currency component.
3) The southern link extension is based on the initial stage of a four (4) – lane road.

TABLE 5-8 PROJECT COST OF JOHOR BAHRU–PASIR GUDANG SOUTHERN LINK (6-LANE)
(In thousand M$ at 1983 prices)

Seg	Station	Length (m)	Component	Construction Cost						Land Acquisition and Compensation	Total	
				Road		Bridge		Interchange				
	0 + 00		F.C	3020		0		0			3020	
1		1845	L.C	4911	7529	0	0	0	0	223	4234	3743
	18 + 45		Tax	459		0		0			459	
	18 + 45		F.C	1881		0		0			1881	
2		695	L.C	2558	4537	0	0	0	0	4439	6567	9136
	25 + 40		Tax	358		0		0			358	
	25 + 40		F.C	4037		15580	Tebrau River	0			15617	
3		1760	L.C	5197	9855	17044	35568	0	0	0	22241	45463
	43 + 00		Tax	661		2344		0			3655	
	43 + 00		F.C	3677		0		2713	Permas Jaya	Permas Jaya	6390	
4		2480	L.C	5051	9316	0	0	3687	6929	0	8738	16236
	67 + 80		Tax	588		0		529			1118	
	67 + 80		F.C	2883		1547	Lumbu River	0			4530	
5		1005	L.C	3765	7121	1309	3564	0	0	308	6052	11563
	77 + 85		Tax	473		308		0			781	
	77 + 85		F.C	3843		0		2258	Kota Puteri	Kota Puteri	6128	
6		2730	L.C	5183	9536	0	0	2692	5703	0	8365	15338
	104 + 85		Tax	613		0		432			1245	
	104 + 85		F.C	1589		287	Kebun River	0			1876	
7		225	L.C	1391	2662	872	1933	0	0	0	2263	4555
	127 + 10		Tax	182		144		0			326	
	107 + 10		F.C	1533		0		1951	Gemang	Gemang	3484	
8		713	L.C	1956	3733	0	0	2528	4847	0	4484	8565
	114 + 20		Tax	250		0		358			608	
	114 + 20		F.C	3651		6310	Masai River	0			9961	
9		1490	L.C	5219	9471	6357	13573	0	0	631	12467	24255
	129 + 10		Tax	601		1256		0			1857	
	129 + 10		F.C	2537		2500	Masai Kechil	2755	Port Access	SEDC	7823	
10		1620	L.C	3303	6259	2727	River	4141	7335	0	10171	19305
	145 + 30		Tax	419		454	5681	458			1332	
	145 + 30		F.C	874		0		5612	Jln Simas		5455	
11		3770	L.C	1915	2030	0	0	7548	Jln Pekan	0	8563	15555
	183 + 00		Tax	143		0		1100	Nanas 14555		1243	
			F.C	29022		26924		15363			71206	
Total		12300	L.C	35509	72337	28959	69789	21182	39429	5931	94522	174877
			Tax	4715		3956		2878			12549	
Southern	0 + 00		F.C	2670		323	Ulu Railway	2458	Jln Lkbn		5448	
Link		2170	L.C	3456	6581	369	Bridge	3262	6136	6111	13213	19533
Extension	21 + 70		Tax	455		63	752	418			933	

Notes: 1) y 2) Same as Table
3) The southern link extension is based on the ultimate plan of a four (4) – lane road.

TABLE 5-9 PROJECT COST OF CAUSEWAY TRAFFIC DISPERSAL SCHEME
(In thousand M$ at 1983 prices)

	Project	Length (m)	Component	Construction Cost						Land Acquisition and Compensation	Total	
				Road		Bridge		Interchange				
Short Term	J.T.A. Razak	3365	F.C	2192	5317	0	0	0	0	0	2192	5317
	J. Wong Ah Fook		L.C	2753		4671	9731	0			7424	
	J. Station		Tax	372		778		0			1150	
	Sg. Segget	593	F.C	0	0	4282	9731	0	0	0	4282	9731
			L.C	0		4671		0			4671	
	Improvement		Tax	0		778		0			778	
	Total		F.C	2192	5317	4282	9731	0	0	0	6474	15048
			L.C	2753		4671		0			7424	
			Tax	372		778		0			1150	
Long Term	Sekat Tebrau	2563	F.C	1631	3955	0	0	0	0	1896	1631	5851
	Ibrahim Sultan		L.C	2364		0		0			3959	
	Air Molek		Tax	270		0		0			270	
	Yahya Awal	1995	F.C	2135	5326	0	0	0	0	1495	2135	6906
			L.C	2709		0		0			4189	
			Tax	382		0		0			382	
	Southern Interchange	Bridge 2655m²	F.C	0	0	2906	4560	3300	3165	0	3306	7328
			L.C	0		2163		1659			3548	
			Tax	0		365		209			574	
	Sg. Segget Improvement	260	F.C	0	0	2902	5535	0	0	0	2902	6555
			L.C	0		3155		0			3156	
			Tax	0		527		0			527	
	Total		F.C	3706	5181	6908	11155	3300	3165	3376	5976	20859
			L.C	4763		5355		1659			15153	
			Tax	652		892		209			1753	

TABLE 5-10 PROJECT COST OF TOLL EXPRESSWAY ACCESS
(In thousand M$ at 1983 prices)

Project	Station	Length (m)	Component	Construction Cost						Land Acquisition and Compensation	Total	
				Road		Bridge		Interchange				
Toll Expressway Access	0 + 00	3335	F.C	10183	24592	218	Sekudang River Tampoi River 1770	2766	J. Pandan S.E.R.	4353	18727	53918
			L.C	12907		853		13266			26954	
	33 + 58		Tax	1213		141		1383	13335		3337	

TABLE 5-11 PROJECT COST OF INNER RING ROAD INCLUDING LORRY ROUTE (4-LANE)
(In thousand M$ at 1983 prices)

Seg	Station	Length (m)	Number of Lanes	Component	Construction Cost						Land Acquisition and Compensation	Total	
					Road		Bridge		Interchange				
1 (4 – lane)	0 + 00	1655	4 – lane	F.C	2518	6369	0	0	1576	J. Abu Bakar 3915	8734	4284	18678
				L.C	3435		0		2953			13552	
	16 + 55			Tax	426		0		266			712	
2 (4 – lane)	16 + 55	641	4 – lane	F.C	2554	2654	0	0	2587	J. Yahya Awal 6742	2376	3641	11376
				L.C	1428		0		3634			7438	
	22 + 46			Tax	176		0		531			697	
3 (4 – lane)	22 + 46	959	4 – lane	F.C	824	2265	3343	Ova Railway Bridge Widening 7539	4571	J. T.A Razak 11953	8295	8859	29359
				L.C	1132		3648		6432			13457	
	33 + 65			Tax	149		658		847			1654	
4 (4 – lane)	33 + 65	955	4 – lane	F.C	1532	4261	0	0	0	0	5928	1532	9189
				L.C	2719		0		0			8338	
	43 + 63			Tax	259		0		0			259	
5 (4 – lane)	43 + 63	783	4 – lane	F.C	1155	3330	0	0	0	0	9159	1156	12183
				L.C	1673		0		0			12828	
	48 + 43			Tax	196		0		0			196	
6 (4 – lane)	48 + 43	660	4 – lane	F.C	101	212	0	0	0	0	0	101	212
				L.C	93		0		0			93	
	55 + 00			Tax	18		0		0			18	
Total		5590	–	F.C	9295	18535	3343	7539	8834	22697	23697	18472	82434
				L.C	10056		3648		17119			58336	
				Tax	1224		658		1654			3455	

Notes:
Notes: 1) F.C same as Table
2) L.C

TABLE 5-12 PROJECT COST OF INNER RING ROAD INCLUDING LORRY ROUTE (4- and 6-LANE)
(In thousand M$ at 1983 prices)

Sg	Station	Length (m)	Number of Lanes	Component	Construction Cost						Land Acquisition and Compensation	Total	
					Road		Bridge		Interchange				
1	0 + 00	1695	4 – lane	F.C	2508	6369	0	0	1576	S. Abu Bakar 3915	8354	4084	18678
				L.C	3435		0		2053			13582	
	16 + 05			Tax	426		0		286			732	
2	16 + 05	641	4 – lane	F.C	1054	2658	0	0	2587	S. Yahya Awal 6742	2376	3641	11776
				L.C	1428		0		3634			7438	
	22 + 45			Tax	176		0		521			697	
3	22 + 45	813	6 – lane	F.C	1128	2876	4598	Over Railway Bridge Work Hazardfact 10676	4571	J. T.A Razak 11359	8295	10503	33707
				L.C	1458		5125		6432			21260	
	30 + 65			Tax	290		853		847			1900	
4	30 + 65	995	6 – lane	F.C	2143	5336	0	0	0	0	5828	2143	11164
				L.C	2829		0		0			8657	
	40 + 60			Tax	358		0		0			358	
5	40 + 60	780	6 – lane	F.C	1550	3942	0	0	2200	S. Bkt. Meldrum 5573	9150	3750	18571
				L.C	2133		0		2981			14254	
	48 + 40			Tax	259		0		398			657	
6	48 + 40	660	6 – lane	F.C	1016	2533	0	0	0	0	1916	1916	3733
				L.C	1353				0		1200	2553	
	55 + 00			Tax	164				0			164	
Total		5500	–	F.C	9455	23714	4598	10676	11934	26185	55153	25187	97729
				L.C	12676		5125		15130			65154	
				Tax	3583		853		2552			4458	

Notes: 1) FC same as Ta
Notes: 1) FC same as Table
2) LC

TABLE 5-13ANNUAL MAINTENANCE COST

Project Roads		Annual Maintenance Cost (M$/Km)
Southern Link 6 – Lane		34,700
Southern Link 4 – Lane		25,600
Southern Link Extension	4 – Lane	26,100
Toll Expressway Access	4 – Lane	29,800
Inner Ring Road including Lorry Route	6 – Lane	33,700
Inner Ring Road including Lorry Route	4 – Lane	26,100

CHAPTER 6

ECONOMIC EVALUATION

6-1 GENERAL

6-1-1 Procedure

As already discussed in Chapter 4, the best routes for Johor Bahru–Pasir Gudang Southern Link, Toll Expressway Access and Inner Ring Road including Lorry Route were selected out of various alignments through a screening from the engineering and social aspects.

The main purpose of the economic evaluation therefore is to examine the economic viability of the selected plans.

Hence, the economic analysis is mainly carried out by comparing the cases with and without the Project.

As an additional factor for the evaluation, alternative cross-sections are also considered.

The procedure of the economic evaluation of the Project is shown in Fig. 6-1.

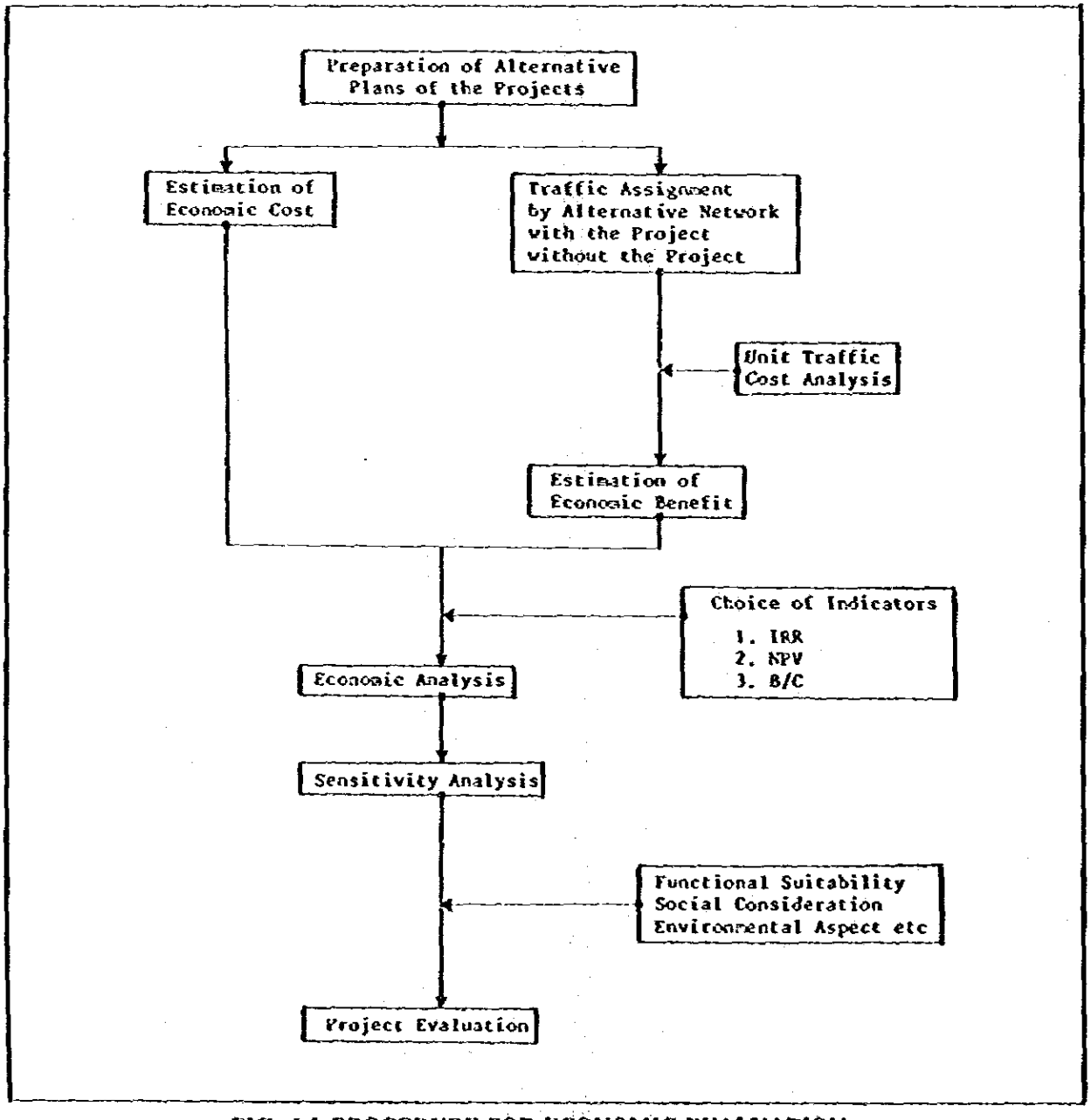


FIG. 6-1 PROCEDURE FOR ECONOMIC EVALUATION

6-1-2 Choice of Indicators for Economic Evaluation

Following the standard procedure of the Economic Planning Unit and international financing organizations, three (3) types of economic indicators are calculated.

(1) Internal Rate of Return (IRR)

The IRR shows the discount rate which gives the break even point between the present value of benefit and that of cost as given by the following formula.

$$B(R) - C(R) = 0$$

$$B(R) = \sum_{i=1}^{n} \frac{bi}{(1+R)^i}$$

$$C(R) = \sum_{1=0}^{n-1} \frac{bi}{(1+R)^i}$$

R : Internal Rate of Return

Ci : Cost in the year (i)

bi : Benefit in the year (i)

n : Project Life in years

In order that the project be economically feasible, the IRR should be more than the rate of opportunity cost of capital in Malaysia, generally 12 percent.

(2) Net Present Value (NPV)

The NPV will indicate the difference between the discounted benefit and cost using the rate of opportunity cost of capital. A positive NPV means the project is economically feasible.

(3) Benefit Cost (B/C Ratio)

The B/C ratio is the ratio obtained by dividing the present value of benefit by that of cost.

$$\text{Benefit Cost Ratio} = \frac{B}{C}$$

where

$$B = \sum_{i=1}^{n} \frac{bi}{(1+r)^i}$$

$$C = \sum_{1=0}^{n-1} \frac{Ci}{(1+r)^i}$$

bi : Benefit in the year (i)

Ci : Cost in the year (i)

r : Discount Rate

n : Project Life in years

The first indicator is used for determining whether investing in the transport sector rather than in other sectors is justified, and for selecting the best plan among the alternatives or determining the project priority.

The second and third ones come in useful where no significant difference is observable in the plan selection or project priority determination when conducted by way of the first indicator.

6.2 ALTERNATIVE PLANS

In the preparation of alternative plans for each Project, various factors such as route alignment, structural type, cross-section, type of interchange were taken into account as already explained in Chapter 4.

The best alignments for the Project Roads, the most appropriate types of structures and interchanges have been selected directly based on the engineering and social criteria since the accrued benefits do not differ significantly among the alternatives.

As for the cross-section, the Johor Bahru–Pasir Gudang Southern Link and the Eastern Half of the Inner Ring Road are the only Project Roads with alternative plans of either four (4) lanes or six (6) lanes.

Consequently the alternative cases to be economically evaluated are as summarized in Table 6-1.

TABLE 6-1 ALTERNATIVE CASES

Project	Alternative A	Alternative B
1. Johor Bahru – Pasir Gudang Southern Link	4 lanes	6 lanes
2. Causeway Traffic Dispersal Scheme	No Alternatives	
3. Toll Expressway Access	No Alternatives	
4. Western Half of Inner Ring Road	No Alternatives	
5. Eastern Half of Inner Ring Road including Lorry Route	4 lanes	6 lanes

In the above projects, Johor Bahru–Pasir Gudang Southern Link and Inner Ring Road, are evaluated by section which is shown as follows:

1) Johor Bahru–Pasir Gudang Southern Link

Section 1: Johor Bahru–Pasir Gudang Southern Link from Jalan Tebrau to Pasir Gudang
Section 2. Johor Bahru–Pasir Gudang Southern Link Extension namely Jalan Kebun Teh

2) Inner Ring Road

Section 1: Jalan Abu Bakar–Jalan Larkin (Western Half)
Section 2: Jalan Larkin–Jalan Bukit Meldrum (Eastern Half)

6-3 ESTIMATION OF ECONOMIC COST

The project costs in terms of financial value were already estimated in Chapter 5. They consist of land acquisition and compensation, and the construction of roads and related structures.

For the economic evaluation of the Project, the costs and benefits should be expressed in economic values.

Therefore, the following are considered in the conversion of the financial cost to economic cost.

1) An amount for tax will be deducted.
2) For the labour cost and land cost, the shadow prices will be applied.
3) For the traded goods, they will be valued in terms of c.i.f. or f.o.b prices depending upon whether they are imported or exported.
4) For the non-traded goods, a standard conversion factor will be applied.

6-3-1 Shadow Prices

1) Skilled Labour

Like many other development countries, the market for skilled labour in Malaysia reflects a scarcity rather than a surplus of skilled labour. One may therefore assume that its opportunity cost is adequately reflected by its market wage. Accordingly the market wage will be applied in this Study.

2) Unskilled Labour

The market for unskilled labour is considered to be in a different situation compared with that of skilled labour.

Most portions of unemployment are regarded as unskilled labour, and there is a considerable number of part-time workers among the employed unskilled labourers.

The average monthly income of an unskilled construction worker in the Study Area is estimated to be about M$150, from the results of Home Interview Survey done by the Study Team in 1981.

Since the market wage for unskilled labour in the construction sector is approximately M$290 per month, the conversion factor is calculated to be 0.52.

In past studies undertaken in Malaysia, the opportunity cost taken for unskilled labour ranges from 45% to 50% of the market wage.

Taking the decreasing tendency of the unemployment rate and the Government's efforts for eradication of poverty into account, the conversion factor estimated above seems to be reasonable.

3) Land

The land to be acquired for the Project is mainly urbanized. Even for the Johor Bahru–Pasir Gudang Southern Link, most of the housing schemes along the Project Road have already been approved.

For urban land, its opportunity cost is considered to be reflected by its market value. Hence the market price will be applied. In the case of Government land, its cost evaluated by the market price will be taken into account.

4) Non-Traded Items

For non-traded items involved in the construction cost, a standard conversion factor will be applied to convert their domestic values into foreign exchange values i.e. the values at border prices in terms of domestic currency unit.

The standard conversion factor can be calculated, as the average import tariff less export duty weighed by their elasticity.

In past recent years, the import duties have been at an average level of 9% and the export taxes at an average level of about 8% as shown in Table 6-2.

Since the balance of trade is not far from equilibrium in recent years, the divergence of the standard conversion factor from unity is somewhere between -9% and +8%, therefore the conversion factor will be between 0.91 and 1.08. According to the World Bank's Report* , the elasticity of demand for imports is somewhat higher than the elasticity of supply for exports. However unity will be chosen as the conversion factor in order to make a conservative evaluation.

TABLE 6-2 AVERAGE IMPORT/EXPORT DUTIES

	Average Import Duties	Average Export Duties
1976	10.2%	7.6%
1977	10.4%	9.4%
1978	10.0%	8.6%
1979	9.1%	8.1%
1980	8.9%	9.2%
1981	8.3%	8.3%
1982	7.0%	6.4%
Average	9.1%	8.2%

Source : Calculated from Economic Report 82/83, Ministry of Finance.

Note *
Appraisal of a Highway Project in Malaysia: Use of the Little-Mirrlees Procedures. Sudhir Anand, World Bank Staff Working Paper No. 213, July 1975.

6-3-2 Construction Cost

In order to convert the construction costs estimated in the previous Chapter into the economic value, by using shadow prices, the following are taken into account.

a. In the Study Area, the amount attributable to labour in the construction cost of Projects is estimated to be about 35% for road construction, 25% for bridge construction and 30% for interchange construction.

b. It has been illustrated that the ratio of skilled to unskilled labour in highway construction is about 46% skilled and 54% unskilled[1].

Estimated economic costs are shown in Table 6-3.

TABLE 6-3 ECONOMIC COST OF PROJECTS (M$'000)

Project	No. of Lanes	Construction Cost	Land Acquisition	Total
Johor Bahru – Pasir Gudang Southern Link (Jalan Tebrau – Pasir Gudang)	4 – lane	84,874	23,565	108,439
	6 – lane	156,960	35,172	178,477
Johor Bahru – Pasir Gudang Southern Link Extension (Jalan Kebun Teh)	4 – lane	11,425	6,111	17,536
Causeway Traffic Dispersal Scheme (Short-Term)	–	12,869	1,770	14,639
Causeway Traffic Dispersal Scheme (Long-Term)	–	56,748	29,273	86,021
Toll Expressway Access	4 – lane	39,128	4,951	44,079
Western Segment of Inner Ring Road	4 – lane	16,745	10,770	27,515
Eastern Segment of Inner Ring Road including Lorry Route	4 – lane	20,489	15,455	35,944
	6 – lane	36,666	24,383	61,049

6-3-3 Maintenance Cost

For the maintenance of the Project Roads, the following factors are taken into account.

a. Resurfacing of the pavement,
b. Planting of the roadside trees,
c. Renewal and maintenance of drainage,
d. Renewal of the road devices such as curbs, markings, lighting, guard rail etc,
e. Repair of structures.

As a result, the following maintenance cost are considered.

6-3-4 Disbursement Schedule

In order to find the best investment timing of the Project Roads, the construction schedule is tentatively assumed as follows so as to implement the projects within the shortest possible period.

Accordingly, the Project Road is expected to be open to traffic in the year 1989.

Taking the type of construction work of the Projects into account, the disbursement schedule assumed is as shown in Table 6-5.

Regarding the detailed engineering cost, it is assumed to be 3% of the construction cost.

TABLE 6-4 MAINTENANCE COST

Project Road	No. of Lanes	Distance (km)	Annual Maintenance Cost (M$'000)
Johor Bahru – Pasir Gudang Southern Link	4 – lane	18.30	1,098.0
	6 – lane	18.30	915.0
Southern Link Extension (Jln Kebun Teh)	4 – lane	2.17	76.0
Toll Expressway Access	4 – lane	3.99	199.4
Western Half of Inner Ring Road	4 – lane	2.25	78.6
Eastern Half of Inner Ring Road including Lorry Route	4 – lane	3.26	113.9
	6 – lane	3.26	162.8

	1985	1986	1987	1988	1989
Detailed Engineering	———				
Land Acquisition		———			
Construction		———	———	———	

TABLE 6-5 DISBURSEMENT SCHEDULE

	1986	1987	1988
Land Acquisition	100%	–	–
Road Construction	30%	30%	40%
Structure Construction	10%	40%	50%
Interchange Construction	20%	35%	45%

6-4 ESTIMATION OF ECONOMIC BENEFIT

6-4-1 General

In general among the various benefits derived from the construction of roads, the following factors are considered as major direct benefits.

a. Savings in Vehicle Operating Cost
b. Reduction in Travel Time (Time Savings)
c. Reduction of Accidents

Besides these benefits, there are also indirect benefit such as the proportional effect of regional development, expansion of market. However these are generally difficult to quantify and may sometimes lead to a double-counting of benefits. Accordingly they are excluded from the analysis.

6-4-2 Vehicle Operating Cost

Vehicle operating cost is calculated for the representative car, bus, lorry and motorcycle based on experimental data on the corresponding operating expenses.

Vehicle operating cost is composed of running cost and fixed cost.

1) Running Cost

a. Fuel Cost

The fuel cost is calculated using the fuel consumption rate by vehicle running speed and the current fuel price.

b. Engine Oil Cost

The engine oil cost is calculated using the oil consumption rate and current oil price.

c. Tyre Cost

The tyre cost is calculated using the annual running distance (in kilometer), type life and the set price of tyres.

d. Maintenance and Repair Cost

The maintenance and repair cost are divided into those of labour and spare parts cost. The labour cost is calculated using the local labour hour for each type of vehicle while the cost of spare parts is estimated on the basis of vehicle cost in percentage.

e. Depreciation Cost

Vehicle depreciation cost is calculated taking into account the economic life of the vehicle and the annual running mileage.

The distance determined depreciation cost is estimated by setting up the percentage of depreciation to the total depreciation cost as shown in Table 6-6 which also indicates the salvage value.

The basic running cost per kilometer is calculated by summing up all the elements mentioned above as shown in Table 6-7.

TABLE 6-6 DEPRECIATION AND SALVAGE VALUE

Type of Vehicle \ Item	Percentage of Depreciation (%)	Salvage Value (% of Vehicle Cost)
Motorcycle	30	15
Private Car	30	20
Bus	70	15
Lorry	70	15

Source : Year Book of Transport Statistics 1980.

TABLE 6-7 VEHICLE RUNNING COST

(¢/KM 1982 PRICES)

	Motorcycle	Car	Bus	Lorry
Running Cost	5.0	13.0	33.7	36.4
Fuel	2.7	6.5	10.3	13.5
Oil	0.2	0.6	1.2	1.2
Tyre	0.1	0.4	2.4	2.1
Maintenance	1.4	4.0	12.5	15.5
Depreciation	0.6	1.5	7.5	4.2

Source : Transport Statistics 1980.
Study Team's Estimates.

2) Fixed Cost

a. Crew Cost

The crew cost is obtained by calculating the hourly payment made to drivers of buses and lorries, bus conductors and labourers enlisted for cargo loading etc.

b. Depreciation Cost

The time-related depreciation cost is given by subtracting the distance-related portion from the total depreciation cost. Then the depreciation cost per hour is calculated by estimating vehicle life and annual running hours.

c. Interest

Since the opportunity cost of capital is assumed to be 12% per annum, this rate is employed for the interest rate.

d. Overhead Cost

As a substitute for accident cost, insurance and overhead costs are included in the fixed cost.

As a result, the fixed costs by types of vehicle are estimated and they are as follows:

TABLE 6-8 VEHICLE FIXED COST (IN MS/HR AT 1982 PRICES)

	Motorcycle	Car	Bus	Lorry
Fixed Cost	0.0	0.28	6.69	4.59
Crew Cost	–	–	4.46	3.43
Depreciation	0.17	0.37	0.55	0.25
Interest	0.16	0.56	1.87	0.82
Overhead	–	–	2.67	2.06
Sub-Total	0.33	0.93	9.55	6.56
Fleet Substitutability Factor	0.0	0.3	0.7	0.7

6-4-3 Time Value

The purpose for the access of the time value is to convert the saved time in trips into monetary terms.

However the time value may differ according to individuals and trip purpose, for instance if the saved time in a trip is not utilized for an economic activities, the saving will not be accounted as an economic benefit.

Accordingly, the value of each type of vehicle is calculated by the following formulae:

$$Vj = Nj \cdot Ij \times \sum_i Ti \cdot Pi$$

where Vj : Time Value of Vehicle j
Nj : Average Occupancy of Vehicle j
Ij : Hourly Income of Passenger of Vehicle j
Ti : Composition Ratio of Trip Purpose i
Pi : Time Value Factor of Trip Purpose i

1) Average Occupancy (Nj)

a. Passenger Car: 1.8 passengers/vehicle
b. Motorcycle: 1.2 passengers/vehicle
c. Bus: 30 passengers/vehicle

Source: Johor Bahru–Transplan 1982.

2) Hourly Income (Ij)

The hourly income is calculated from the results of Home Interview Survey Survey conducted in 1981.

a. Non-Vehicle Owner: $1.65/hr
b. Motorcycle Owner: $1.87/hr
c. Car Owner: $3.29/hr
(in 1981 prices)

3) Time value Factor (Pi) and Composition Ratio (Ti) of Trip Purposes

TABLE 6-9 TIME VALUE FACTOR (PI) AND COMPOSITION RATIO (TI) OF TRIP PURPOSES

Trip Purpose	Time Value Factor	Composition Ratio	
		Owner	Non-Owner
To Work	50%	34.1%	48.1%
To School	25%	8.7%	6.2%
Business	100%	16.1%	9.0%
Private	0%	41.1%	36.6%
Total	–	100.0%	100.0%

Source : Car Owner Interview Survey.
Home Interview Survey 1981.

Therefore Σ Pi . Ti = 35.3% (for car owner)
33.05% (for non-car owner)

4) Time Value

Time value is calculated as follows:

TABLE 6-10 TIME VALUE (IN M$/HR 1981 PRICE)

Vehicle Type	Time Value
Passenger Car	2.09
Motorcycle	0.74
Bus	16.50

Above values are converted into 1983 prices for the benefit calculation.

6-4-4 Accident Benefits

Accident benefits are not always included in the economic evaluation of road projects, as, in comparison with the other benefits, the accident benefits are sometimes insignificant in terms of the amount, and less reliable in terms of accuracy.

Accordingly they are experimentally estimated in this Study in order to find whether or not they represent a significant value.

The accident benefits are calculated by kilometrage savings multiplied by the accident cost per km.

Utilizing the accident statistics in Johor State and the results of the traffic projection, the accident benefits are estimated as follows:

TABLE 6-11 ACCIDENT BENEFITS IN 1990

Project Road	Reduction in Vehicle-km (1000 pcu.km)	Accident Benefits (M$'000 in 1983 prices)
Johor Bahru – Pasir Gudang Southern Link (6 – lane)	116,532	241.2
Toll Expressway Access	7,308	15.1
Inner Ring Road Eastern Segment including Lorry Route	37,703	78.0

In comparison with the above benefits, the other benefits derived from savings in vehicle operating cost and travel time are much higher as recognized from Table 6-12 in the following section.

The accident benefits are less than 1% of the total of other benefits in any case.

Hence, the accident benefits will be neglected in the economic evaluation.

6-4-5 *Benefit Calculation*

Each type of benefit is calculated by using the following formulae:

a. Savings in Vehicle Operating Cost

$$BV = \sum_k \sum_i \sum_j (PC_{ijk}^{vo} - RC_{ijk}^{v}) + (t_{ijk}^{vo} - t_{ijk}^{v}) FC_{ijk}$$

where:

BV : Savings in Vehicle Operating Cost

PC_{ijk}^{vo} : Running Cost of Mode k between Zones i and j in the case of without Project

RC_{ijk}^{v} : Running Cost of Mode k between Zones i and j in the case of with Project

t_{ijk}^{vo} : Travel Time of Mode k between Zones i and j in the case of without Project

t_{ijk}^{v} : Travel Time of Mode k between Zones i and j in the case of with Project

FC_{ijk} : Fixed Cost of Mode k between Zones i and j

b. Savings in Travel Time

$$BT = \sum\sum\sum P_{ijk} (t_{ijk}^{vo} - t_{ijk}^{v}) V_k$$

where:

BT : Savings in Travel Time

P_{ijk} : Number of Passengers using Mode k between Zones i and j

V_k : Time Value of the Passengers using Mode k

Using the network assignment model, the benefits of each Project are calculated as shown in Table 6-12.

TABLE 6-12 ESTIMATED BENEFITS IN 1990

Project Road		No. of Lanes	Time Savings	Fixed Cost Savings	Running Cost Savings	Total Benefits
Johor Bahru – Pasir Gudang Southern Link	including Jalan Kebun Teh (4 lanes)	4	17,386	9,722	27,341	54,449
		6	23,815	11,645	28,376	63,836
	excluding Jalan Kebun Teh	6	18,064	9,515	24,309	51,888
Causeway Traffic Dispersal Scheme	Short-Term Plan	–	6,512	1,695	566	8,773
	Long-Term Plan	–	6,467	5,675	8,223	20,365
Toll Expressway Access		4	2,390	653	1,374	4,417
Whole Inner Ring Road including Lorry Route	Western Half Eastern Half	4 6	10,522	5,511	5,299	21,332
	Western Half Eastern Half	4 4	7,955	4,713	4,996	17,664
Western Half of Inner Ring Road		4	2,450	935	1,335	4,750
Eastern Half of Inner Ring Road including Lorry Route		4	4,827	4,411	3,676	12,914
		6	8,042	4,576	3,954	16,582

6-5 ECONOMIC EVALUATION

The project roads are economically evaluated on the basis of the following assumptions:

a. The life of project roads is assumed to be twenty (20) years.
b. The discount rate is 12% per annum.
c. The maintenance work for overlaying the pavement etc is required every five (5) years.
d. The benefit flow begins from the year 1989.

6-5-1 Johor Bahru–Pasir Gudang Southern Link

The economic indicators for Johor Bahru--Pasir Gudang Southern Link are as shown in Table 6-13 .

It is found that both the cases involving four (4) lanes and six (6) lanes are economically feasible, and the case of four (4) lanes represents higher economic return than the case of six (6) lanes.

It is also found that the widening of Jalan Kebun Teh together with the construction of the Southern Link is more advantageous than the case without the widening of Jalan Kebun Teh.

TABLE 6-13 ECONOMIC INDICATORS FOR JOHOR BAHRU–PASIR GUDANG SOUTHERN LINK

	Alternative Cases		
	With Widening of Jalan Kebun Teh		Without Widening of Jalan Kebun Teh
No. of Lanes of Southern Link	4 lanes	6 lanes	6 lanes
Discounted Benefits (M$'000)	339,785	464,756	374,194
Discounted Costs (M$'000)	106,680	174,201	159,396
B/C Ratio	3.19	2.67	2.35
Net Present Value (M$'000)	233,105	290,555	214,798
Internal Rate of Return (%)	32.7%	27.2%	24.3%

However if the construction is postponed for five (5) years, it reverses the preference of the alternative cross-sections; the case of six (6)-lane instead has a higher economic indicator.

Accordingly it is suggested that the Johor Bahru–Pasir Gudang Southern Link is to be construction as a four (4)-lane road including Jalan Kebun Teh at the first stage and to be expanded to a six (6)-lane road in the later stage.

The economic indicators shown below indicate that the expansion will be required after 1994.

TABLE 6-14 ECONOMIC INDICATORS FOR JOHOR BAHRU–PASIR GUDANG SOUTHERN LINK IN THE CASE OPEN TO TRAFFIC IN 1994

	4 lanes	6 lanes
Discounted Benefits (M$'000)	367,712	621,102
Discounted Costs (M$'000)	106,679	174,201
B/C Ratio	3.45	3.57

6-5-2 Causeway Traffic Dispersal Scheme

Regarding the Causeway Traffic Dispersal Scheme, a Short-Term Plan as well as a Long-Term Plan were formulated in Chapter 4.

These plans are economically evaluated as the package plans in the short-term and the long-term independently.

1) Short-Term Plan

The Table 6-15 shows the economic indicators for the Causeway Traffic Dispersal Scheme.

Obviously the Short-Term Plan is economically more feasible.

TABLE 6-15 ECONOMIC INDICATORS FOR CAUSEWAY TRAFFIC DISPERSAL SCHEME

	Short-Term Plan	Long-Term Plan
Discounted Benefits (M$'000)	55,852	133,112
Discounted Costs (M$'000)	12,078	80,516
B/C Ratio	4.62	1.65
Net Present Value (M$'000)	43,774	52,596
Internal Rate of Return (%)	44.3%	19.1%

2) Long-Term Plan

The Long-Term Plan includes the Eastern Half and a part of the Western Half (Section II-1) of the Inner Ring Road in its package plan. The Long-Term Plan is also found to by economically justifiable as recognized from Table 6-15.

6-5-3 Toll Expressway Access

As shown in Table 6-16, the construction of Toll Expressway Access cannot be economically justified. However, it is found that if the construction is postponed for as long as four (4) years, namely it is open to traffic only in 1992, then the Project is economically feasible.

TABLE 6-16 ECONOMIC INDICATORS FOR WHOLE INNER RING ROAD

	Open to Traffic in 1989	Open to Traffic in 1993
Discounted Benefits (M$'000)	31,652	37,075
Discounted Costs (M$'000)	36,216	36,216
B/C Ratio	0.87	1.02
Net Present Value (M$'000)	−4,564	859
Internal Rate of Return	10.4%	12.3%

6-5-4 Inner Ring Road including Lorry Route

With regard to the Eastern Half of the Inner Ring Road, two (2) alternative cross-sections can be considered, four (4)-lane and six (6)-lane, where two (2) lanes are used as an exclusively Lorry Route.

As shown in Table 6-17, both cases of the Inner Ring Road Including Lorry Route as a whole are economically feasible.

The project feasibility is further examined by section as shown in Table 6-18.

The table above indicates that both the sections are found to be economically feasible project, with the economic feasibility of the Eastern Half at a much higher rate than the Western Half.

As for the Eastern Half, the case of the four (4)-lane has higher economic indicators than the case of the six (6)-lane. This again suggests that the Eastern Half should be constructed as a four (4)-lane road at the first stage and expanded to a six (6)-lane road at the later stage, since the case of the six (6)-lane becomes more advantageous than the four (4)-lane after 1994.

TABLE 6-17 ECONOMIC INDICATORS FOR WHOLE INNER RING ROAD

	Western Segment 4 lanes Eastern Segment 4 lanes	Western Segment 4 lanes Eastern Segment 6 lanes
Discounted Benefits (M$'000)	100,224	128,727
Discounted Costs (M$'000)	53,554	74,444
B/C Ratio	1.87	1.73
Net Present Value (M$'000)	46,670	54,283
Internal Rate of Return (%)	21.0%	19.9%

TABLE 6-18 ECONOMIC INDICATORS OF INNER RING ROAD BY SECTION

	Western Half	Eastern Half	
	4 lane	4 lane	6 lane
Discounted Benefits (M$'000)	26,849	74,934	104,283
Discounted Costs (M$'000)	23,183	30,371	51,261
B/C Ratio	1.16	2.47	2.03
Net Present Value (M$'000)	3,666	44,563	53,022
Internal Rate of Return	14.0%	26.7%	22.4%

6-5-5 Stage Construction

The above results of the economic analysis suggests an application of stage construction for the two (2) Projects, Johor Bahru–Pasir Gudang Southern Link and the Eastern Half of the Inner Ring Road including Lorry Route.

Hence the widening of the two (2) Projects from four (4) lanes to six (6) lanes will be economically evaluated in order to find the project priority.

The economic indicators for the construction of the additional two (2) lanes are obtained as follows:

Table 6-19 indicates that the widening of the two (2) Projects from four (4) lanes to six (6) lanes are economically justified, however the economic rates of returns accrued from the widening are much lower than those from the construction of six (6)-lane roads. This implies that once a four (4)-lane road is constructed, the additional benefits by the widening to six (6) lanes are small compared with the first stage of the construction.

TABLE 6-19 ECONOMIC INDICATORS OF WIDENING

	Widening of Johor Bahru – Pasir Gudang Southern Link	Widening of Eastern Half Ring
Discounted Benefits (M$'000)	124,971	29,349
Discounted Costs (M$'000)	67,521	20,890
B/C Ratio	1.85	1.40
Net Present Value (M$'000)	57,450	8,459
Internal Rate of Return (%)	19.5%	16.1%

6-5-6 Toll Application on Tebrau Bridge

If the toll is considered to be too high for Bridge of Johor Bahru–Pasir Gudang Southern Link is examined in order to explore how it will influence the traffic demand on the Bridge, and whether or not the capital cost of the Bridge can be reimbursed, when a reasonable amount of toll is levied to traffic passing over the Bridge.

1) Estimation of Traffic Diversion

The effect of charging tolls on the Bridge will be a reduction in the traffic using the Bridge.

In the toll is considered to be too high for a driver, he will not use the Bridge and will divert to the other alternative route, say via Port Access Road and Jalan Tebrau.

If the toll is small, he will use the Bridge. In order to estimate the traffic diversion, it was confirmed in the Study related to the Kuala Lumpur–Seremban Expressway that the following diversion curve, which was developed in the United States, will also be applicable to Malaysian conditions.

$$P = \frac{1}{1 + T^6}$$

where P : The Proportion of Traffic using the New Route

T : C1/C2

Ci : The Perceived Cost of Travel on the New Route

Ce : The Perceived Cost of Travel on the Old Route

The traffic costs C1 and C2 are calculated by summing up the vehicle operating cost and time const shown in 6-7 and 6-8, and the toll.

Considering the existing toll rates on Kuala Lumpur-Seremban Expressway,* the toll rates on the Tebrau Bridge is assumed as follows:

Car	¢ 50
Motorcycle	¢ 30
Heavy Vehicles	$1.00

By applying the above model, the traffic diversion in 1990 is estimated as follows:

TABLE 6-20 TRAFFIC DIVERSION DUE TO TOLL APPLICATION

	Traffic Volume on Tebrau Bridge (p.c.u/day)	Diverted Traffic to Other Routes (p.c.u/day)
Without Toll Application	49,980	–
With Toll Application	39,440	10,540

The above result indicates that about 20% of the traffic on the Bridge will divert to the other routes by the introduction of toll on the Bridge. This percentage approximately coincides with the existing situation of Kuala Lumpur–Seremban Expressway.

2) Financial Analysis

Besides the construction cost of the Tebrau Bridge, an additional cost for toll application, which consists of the following items, are included in the capital cost.

a. Toll Booths and Control Building,
b. Highway Works at the Plaza Site,
c. Additional Lighting,
d. Toll Collection Equipment.

In addition, the operating and maintenance cost for toll application is required every year. These are estimated as follows:

Note * Toll System of Kuala Lumpur Expressway (60 km) is as follows:

North Toll Plaza	Car:	¢ 50
	Heavy Vehicles:	$ 1.00
South Toll Plaza	Car:	$ 1.00
	Heavy Vehicles:	$ 2.00

TABLE 6-21 CAPITAL COST AND OPERATING AND MAINTENANCE COST

Cost Item	M$ million in 1983 prices
1. Construction Cost of Tebrau Bridge	35.57
2. Construction Cost of Toll Plaza etc	2.79
Total Capital Cost	38.36
Operating and Maintenance Cost	0.595

Note :
Estimated by Study Team based on "Feasibility Study and Detailed Engineering for the Improvement of the Kuala Lumpur - Seremban Expressway including the Study on Toll Application" April, 1980.

Assuming that the annual revenue will increase in proportion to the annual traffic growth, it is roughly estimated as follow:

TABLE 6-22 ANNUAL REVENUE BY TOLL APPLICATION

Year	Annual Revenue (M$'000)
1990	M$ 18.8 x 365 = M$ 6,860
2000	M$ 33.8 x 365 = M$ 12,350

For the financial analysis, the following assumptions are additionally made:

a. Interest rate is 11% per annum.
b. The Bridge, constructed during the three (3) years 1986 — 1988, will be open to traffic in 1989.

The results of the financial analysis are shown in Table 6-23. It is found that the reimbursement of the capital cost can be accomplished within ten (10) years of opening the Bridge to traffic, i.e. by the year 1998.

TABLE 6-23 FINANCIAL ANALYSIS OF TEBRAU BRIDGE (M$'000)

Year	Cost	Accumulated Cost including Interest	Revenue	Balance
1985	1,070	–	–	–
1986	3,560	4,748	–	–
1987	14,230	19,500	–	–
1988	20,580	42,225	–	–
1989	595	47,465	6,470	–40,995
1990	595	46,099	6,860	–39,239
1991	595	44,151	7,270	–36,881
1992	595	41,532	7,710	–33,823
1993	595	38,139	8,180	–29,959
1994	595	33,849	8,680	–25,169
1995	595	28,533	9,200	–19,333
1996	595	22,055	9,760	–12,295
1997	595	14,242	10,350	–3,892
1998	595	4,915	10,980	+6,065
1999	595	–6,137	11,640	+17,777
2000	595	–19,137	12,350	+31,487

6-6 SENSITIVITY ANALYSIS

6-6-1 General

In order to examine the validity of the economic evaluation shown above, a sensitivity analysis is made in this section. The factors that will be manipulated are as follows:

a) Increase in the estimated project costs,
b) Decrease in the estimated benefits,
c) Postponement of the target year for the economic growth.

Regarding the factors a) and b), a 20% increase and/or decrease of costs and/or benefits is examined as usual in a Feasibility Study. As for the factor c), seven (7) years delay in the attainment of the target originally expected in 2000 is examined.

Accordingly the following cases will be considered.

As an additional sensitivity analysis, two (2) optional Long-Term Plans regarding the Causeway are also considered in order to find out as to what degree these plans will affect the economic feasibility of the Inner Ring Road including the Lorry Route and the Causeway Traffic Dispersal Scheme.

The optional Long-Term Plans are:

a) The Immigration and custom Checkpoint is to be relocated to the east of the existing location.
b) A Second Linkage is constructed.

These are rather risky assumptions, however, should they materialize, they may drastically change the traffic flows in the Study Area and may affect the project viability.

TABLE 6-24 CASES FOR SENSITIVITY ANALYSIS

Case	a) Projects Costs	b) Benefits	c) The Year of the Target Attainable
1	+20%	±0	2000
2	±0	−20%	2000
3	±0	±0	2007
4	+20%	−20%	2000
5	+20%	±0	2007

6-6-2 Results

The Table 6-25 gives the results of the sensitivity analysis concerning the three (3) factors.

It is found that both cross-section plans of Johor Bahru–Pasir Gudang Southern Link, the Eastern Half of the Inner Ring Road including Lorry Route and Long-Term Causeway Traffic Dispersal Scheme are economically feasible in any of the cases, however the Toll Expressway Access and the Western Half of the Inner Ring Road cannot be economically justified.

For the worst case, i.e. case 4, in order to justify the constructions of Toll Expressway Access and the Western Half of the Inner Ring Road, the opening years should be postponed as long as nine (9) years and five (5) years; namely, it should be open to traffic in 1998 and 1994 respectively.

TABLE 6-25 ECONOMIC SENSITIVITY

	Johor Bahru – Pasir Gudang Southern Link		Causeway Traffic Dispersal Scheme (Long-Term)	Toll Expressway Access	Inner Ring Road	
	4 lanes	6 lanes			Western Half (4 lanes)	Eastern Half (6 lanes)
Case 1 Costs: +20%	B = 339,785 C = 328,016 B/C = 2.65	B = 454,756 C = 209,041 B/C = 2.22	B = 333,112 C = 96,619 B/C = 1.38	B = 31,652 C = 43,459 B/C = 0.73	B = 25,418 C = 27,820 B/C = 0.91	B = 104,283 C = 61,513 B/C = 1.10
Case 2 Benefits: –20%	B = 271,828 C = 166,680 B/C = 2.55	B = 371,855 C = 176,201 B/C = 2.13	B = 106,490 C = 80,516 B/C = 1.32	B = 25,322 C = 36,216 B/C = 0.70	B = 23,334 C = 23,183 B/C = 0.88	B = 83,426 C = 51,261 B/C = 1.63
Case 3 7 Years delay in Target Attainment	B = 278,183 C = 106,680 B/C = 2.61	B = 326,954 C = 174,201 B/C = 1.88	B = 113,924 C = 80,516 B/C = 1.41	B = 25,341 C = 36,216 B/C = 0.70	B = 21,365 C = 23,183 B/C = 0.92	B = 87,882 C = 51,261 B/C = 1.71
Case 4 Costs: +20% Benefits: –20%	B = 271,828 C = 328,016 B/C = 2.12	B = 371,855 C = 209,041 B/C = 1.78	B = 106,490 C = 96,619 B/C = 1.10	B = 25,322 C = 43,459 B/C = 0.58	B = 20,334 C = 27,820 B/C = 0.73	B = 83,426 C = 61,513 B/C = 1.36
Case 5 Costs: +20% 7 years delay in Target Attainment	B = 278,183 C = 328,016 B/C = 2.17	B = 326,954 C = 209,041 B/C = 1.56	B = 113,924 C = 96,619 B/C = 1.18	B = 25,341 C = 43,459 B/C = 0.58	B = 21,365 C = 27,820 B/C = 0.77	B = 87,882 C = 61,513 B/C = 1.43

Note : B : Discounted Benefits (M$'000).

C : Discounted Costs (M$'000).

6-6-3 Consideration of Long-Term Causeway Plan

1) Eastern Half of the Inner Ring Road including Lorry Route

The Table 6-26 represents the results of economic analysis.

In the case of the relocation of Immigration/Custom Checkpoint, both the alternative cross-sections are found to be more feasible, even though higher project cost is required, compared with the original case.

This is because with a direct connection with the Inner Ring Road by the relocation, the Causeway Traffic can utilize the Inner Ring Road more effectively.

On the other hand, in the event of the Second Linkage being constructed, it is found that the case of the four (4)-lane is still feasible, while the case of the six (6)-lane cannot be economically justified, since about 35% of Causeway Traffic, particularly lorries, will be diverted to the Second Linkage.

2) Causeway Traffic Dispersal Scheme (Long-Term Plan)

The Long-Term Package Plan for Causeway Traffic Dispersal Scheme is found to be economically feasible for both cases of the Long-Term Option Plans of the Causeway.

It should be noted that in the case of Second Linkage Plan, the Eastern Half of the inner Ring involved in the package is evaluated as a four (4)-lane road, since the Lorry Route may not be required.

TABLE 6-26 ECONOMIC INDICATORS OF EAST HALF OF INNER RING ROAD FOR LONG TERM CAUSEWAY PLAN

	Relocation of Checkpoint		Second Linkage	
	4 – lane	6 – lane	4 – lane	6 – lane
Discounted Benefits (M$'000)	90,280	118,011	42,054	48,210
Discounted Costs (M$'000)	30,371	57,696	30,371	51,261
Benefit Cost Ratio	2.97	2.05	1.38	0.94
Net Present Value (M$'000)	59,909	60,315	11,683	–3,051
Internal Rate of Return (%)	30.8%	22.7%	15.5%	10.2%

TABLE 6-27 INDICATORS OF CAUSEWAY TRAFFIC DISPERSAL SCHEME FOR LONG TERM CAUSEWAY PLAN

	Relocation of 1) Checkpoint	Second 2) Linkage
Discounted Benefits (M$'000)	150,810	67,946
Discounted Costs (M$'000)	86,950	59,626
Benefit Cost Ratio	1.73	1.14
Net Present Value (M$'000)	63,860	8,320
Internal Rate of Return (%)	20.1%	13.6%

6-7 CONCLUSION

From the above economic analysis, the following conclusion can be derived.

6-7-1 Johor Bahru-Pasir Gudang Southern Link

a. The construction of Johor Bahru-Pasir Gudang Southern Link is economically feasible.

b. Johor Bahru-Pasir Gudang Southern Link is recommended to be a four (4)-lane road at first including the bridge section and to be widened to a six (6)-lane road after the year 1994. However, with regard to its extension, i.e. Jalan Kebun Teh section, it is recommended to be a four (4)-lane road.

c. According to a preliminary financial analysis on the toll application to the Tebrau Bridge, the capital costs can be reimbursed by applying a toll charge of 50¢, 30¢, $1.00 for car, motorcycle and heavy vehicles respectively.

Taking the circumstances of the Government budget into account, it is suggested that the possibility of toll application be further examined.

6-7-2 Causeway Traffic Dispersal Scheme

a) Both the Short-Term Action and the Long-Term Plan for Causeway Traffic Dispersal Scheme are found to be economically feasible.

b) In particular, the Short-Term Action is highly feasible, provided that the widening of Jalan Tebrau is implemented.

c) Even in the case that the Long-Term Plan of Causeway (Relocation of the immigration/custom checkpoint or Second Linkage) is realized, the Long-Term Dispersal Scheme will still be economically valid.

6-7-3 Toll Expressway Access

a. The construction of Toll Expressway Access is premature at present.

b. However, if the construction is postponed for as long as four (4) years namely, opening to traffic in 1992, it is economically feasible.

6-7-4 Inner Ring Road including Lorry Route

a. The construction of the Inner Ring Road including Lorry Route is economically feasible.

b. The Eastern Half of the Inner Ring Road has a higher priority rating than the Western Half.

c. It is recommended that the Inner Ring Road be constructed as a four (4)-lane road at the first stage and widened to six (6) lanes after the year 1994.

It is also recommended that the central two (2)-lane be utilized as an exclusively Lorry Route.

d. Also in the case of the Causeway Checkpoint relocation, the construction of the Eastern Half of the Inner Ring Road including Lorry Route is highly feasible.

However in the case that the Second Linkage is realized, the Lorry Route is not necessary.

6-7-5 Project Priority

Table 6-28 shows the summary of the economic analysis by Projects.

TABLE 6-28 SUMMARY OF ECONOMIC INDICATORS BY PROJECT

Projects	Economic Indicators		
	NPV (M$'000)	B/C	IRR (%)
Johor Bahru – Pasir Gudang Southern Link			
Construction of 4 lanes	233,105	3.19	32.7
Widening to 6 lanes	57,450	1.85	19.5
Causeway Traffic Dispersal Scheme			
Short Term Action	43,774	4.62	44.3
Long-Term Plan	52,596	1.65	19.1
Toll Expressway Access	4,564	0.87	10.4
Inner Ring Road including Lorry Route			
Eastern Segment			
Construction of 4 lanes	44,563	2.47	26.7
Widening to 6 lanes	8,459	1.40	16.1
Western Segment	3,666	1.16	14.0

In addition to the economic analysis, the Projects can be evaluated from the following aspects.

a. Regional Development Aspect

This evaluation criterion is concerned with how the project can contribute toward regional development.

The rating given is as follows:

3: Significantly effective
2: Moderately effective
1: Lowly effective

b. Social Consideration

This aspect is to assess whether the implementation of the project may involve any social problems such as difficulty in land acquisition or adverse effects on the environmental conditions.

1: Net benefit
0: Balance
−1: Net disbenefit

c. Urgency from Traffic Aspect

This evaluation is concerned with the severity of the existing traffic problem and the possibility of new problems arising in the near future in the case without the implementation of the Project.

2: Urgently required
1: Fairly urgent
0: Not so urgent

The ratings of the Projects due to the evaluation from the above aspects and the comprehensive evaluation are summarized as in Table 6-29.

Consequently, the project priority is rated as follows:

1. First Priority Projects
   a. Construction of Johor Bahru–Pasir Gudang Southern Link with four (4) lanes.
   b. Implementation of Short-Term Causeway Traffic Dispersal Scheme.
   c. Construction of the Eastern Half of Inner Ring Road including Lorry Route with four (4) lanes.
2. Second Priority Projects
   a. Widening of Johor Bahru–Pasir Gudang Southern Link into six (6) lanes.
   b. Implementation of Long-Term Causeway Traffic Dispersal Scheme.
   c. Construction of the Eastern Half of Inner Ring Road as six (6) lanes.
3. Third Priority Projects
   a. Construction of Toll Expressway Access.
   b. Construction of the Western Half of Inner Ring Road.

TABLE 6-29 COMPREHENSIVE EVALUATION OF THE PROJECTS

	Economic Analysis	Regional Development	Social Aspect	Traffic Aspect	Total
Johor Bahru – Pasir Gudang Southern Link					
Construction of 4 lanes	3	3	0	1	7
Widening into 6 lanes	2	3	0	0	5
Causeway Traffic Dispersal Scheme					
Short-Term Action	3	2	1	2	8
Long-Term Plans	2	1	1	1	5
Toll Expressway Access	0	1	0	0	1
Inner Ring Road including Lorry Route					
Eastern Segment					
Construction of 4 lanes	3	2	0	2	7
Widening of 6 lanes	2	2	0	1	5
Western Segment	1	1	–1	0	1

CHAPTER 7

IMPLEMENTATION PROGRAMME

7-1 INTRODUCTION

The main purpose of this Chapter is to examine the financial acceptability for the implementation of the Projects and to formulate the implementation programme if it is financially acceptable.

The main steps in this analysis are:

a. To predict highway allocated to Johor State,
b. To predict highway funds allocated to Johor State,
c. To established to implementation programme,
d. To estimate the investment requirements.

7-2 HIGHWAY FUNDS IN JOHOR STATE

In order to estimate the future highway funds, the past data is examined. Table 7-1 shows the past expenditure of the transport sector vis-a-vis that of development expenditure. Although the share of expenditure in the transport sector to that of the development expenditure varies year by year, approximately fifteen (15) per cent of development expenditure has been spent on the transport sector.

Development expenditure is largely dependent upon the economic activity in Malaysia so that the relationship between the Gross Domestic Product (GDP) and development expenditure is examined and presented in Table 7-2. This table shows that about fifteen (15) per cent of GDP has been spent toward development.

As mentioned in Chapter 3, the GDP has already been estimated and presented in Table 7-3. Based on the estimated GDP, the development expenditure is estimated and shown in Table 7-4. In the Fifth Malaysia Plan period, development expenditure is expected to range from M$78 billion to M$67 billion, of which the transport sector is expected an allocation of M$11.7 billion to M$10.1 billion as shown in Table 7-5. As for the highway sector, about eighteen (18) per cent of the transport sector expenditure is expected to be spent for highway expenditure and the results of the highway sector expenditure is shown in Table 7-6.

The highway sector fund is broken down to the Johor State as shown in Table 7-7. Accordingly, in the Fifth Malaysia Plan period (1986 — 1990), the highway fund is expected to range from M$169.7 million to M$145.4 million

If an average of about 8% of the total highway funds in Malaysia is allocated to Johor Bahru and its Conurbation, it seems the funds available will amount to M$145 million for the 1986 — 1990 period, M$190 million for the 1991 — 1995 period and M$250 million for the 1996 — 2000 period.

TABLE 7-1 RELATIONSHIP BETWEEN DEVELOPMENT EXPENDITURE AND TRANSPORT EXPENDITURE (M$ MILLION IN CURRENT PRICES)

	Development Expenditure	Transport Expenditure	Percent Share to Development Expenditure
1975	2,151	486	22.6
1976	--	--	--
1977	3,217	652	20.3
1978	3,782	637	16.8
1979	4,282	675	15.8
1980	7,463	1,031	13.8
1981	11,358	1,272	11.2
1982	10,434	1,897	18.2
1983	11,270	1,973	17.5

Note : Figures are obtained from the Economic Report

TABLE 7-2 RELATIONSHIP BETWEEN GDP AND DEVELOPMENT EXPENDITURE (M$ MILLION IN CURRENT PRICES)

	GDP	Development Expenditure	Percent Share To GDP
1975	22,332	2,151	9.6
1976	--	--	--
1977	32,340	3,217	9.9
1978	36,272	3,782	10.4
1979	45,083	4,282	9.5
1980	51,838	7,463	14.4
1981	57,061	11,358	19.9
1982	60,409	10,434	17.3
1983	66,952	11,270	16.8

Note: : Figures are obtained from the Economic Report.

TABLE 7-3 PREDICTED GROSS DOMESTIC PRODUCT 1981 — 2000 (M$ MILLION IN 1980 PRICES)

	Original Plan (High Estimates)	Alternative Plan (Low Estimates)
1976 – 1980	113,064	113,064
1981 – 1985	164,050	156,489
1986 – 1990	243,056	209,429
1991 – 1995	358,579	276,981
1996 – 2000	524,424	363,724

1) Based on the Fourth Malaysia Plan.
2) The Study Team estimates.

TABLE 7-4 (1) PREDICTED DEVELOPMENT EXPENDITURES (HIGH ESTIMATE)
(M$ MILLION IN 1983 PRICES)

	GDP	Percent Share to GDP	Development Expenditure
1991 – 1985	351,967	15.0	52,795
1986 – 1990	521,473	15.0	78,221
1991 – 1995	769,326	15.0	115,399
1996 – 2000	1,125,144	15.0	168,772

TABLE 7-4 (2) PREDICTED DEVELOPMENT EXPENDITURE (LOW ESTIMATE)
(M$ MILLION 1983 PRICES)

	GDP	Percent Share to GDP	Development Expenditure
1981 – 1985	335,745	15.0	50,362
1986 – 1990	448,941	15.0	67,341
1991 – 1995	594,259	15.0	89,139
1996 – 2000	780,364	15.0	117,055

TABLE 7-5 (1) PREDICTED TRANSPORT EXPENDITURES (HIGH ESTIMATE)
(M$ MILLION IN 1983 PRICES)

	Development Expenditure	Percent Share to Development Expenditure	Transport Expenditure
1981 – 1985	52,795	15.0	7,919
1986 – 1990	78,221	15.0	11,733
1991 – 1995	115,399	15.0	17,310
1996 – 2000	168,772	15.0	25,316

TABLE 7-5 (2) PREDICTED TRANSPORT EXPENDITURES (LOW ESTIMATE)
(M$ MILLION IN 1983 PRICES)

	Development Expenditure	Percent Share to Development Expenditure	Transport Expenditure
1981 – 1985	50,362	15.0	7,554
1986 – 1990	67,341	15.0	10,101
1991 – 1995	89,139	15.0	13,370
1996 – 2000	117,055	15.0	17,558

TABLE 7-6 (1) PREDICTED HIGHWAY EXPENDITURES (M$ MILLION IN 1983 PRICES)

	Transport Expenditure	Percent Share to Transport Expenditure	Highway Expenditure
1981 – 1985	7,919	18.0	1,425
1986 – 1990	11,783	18.0	2,121
1991 – 1995	17,310	18.0	3,116
1996 – 2000	25,316	18.0	4,557

TABLE 7-6 (2) PREDICTED HIGHWAY EXPENDITURES (M$ MILLION IN 1983 PRICES)

	Transport Expenditure	Percent Share to Transport Expenditure	Highway Expenditure
1981 – 1985	7,554	18.0	1,360
1986 – 1990	10,101	18.0	1,818
1991 – 1995	13,370	18.0	2,407
1996 – 2000	17,558	18.0	3,160

TABLE 7-7 (1) ALLOCATION OF HIGHWAY FUNDS TO JOHOR STATE

	Highway Funds	Allocation to Johor State		
		6%	8%	10%
1986 – 1990	2,121	127.3	169.7	212.1
1991 – 1995	3,116	187.0	249.3	311.6
1996 – 2000	4,557	273.4	364.6	455.7

TABLE 7-7 (2) ALLOCATION OF HIGHWAY FUNDS TO JOHOR STATE

	Highway Funds	Allocation to Johor State		
		6%	8%	10%
1986 – 1990	1,818	109.1	145.4	181.8
1991 – 1995	2,407	144.4	192.6	240.7
1996 – 2000	3,160	189.6	252.8	316.0

7-3 IMPLEMENTATION PROGRAMME

Judging from the priority of the Projects and the results of the financial analysis of the Government, the Project shall preferably be implemented according to the following schedule:

Phase 1: 1985 — 1990

1. Johor Bahru–Pasir Gudang Southern Link
   a. Construction of the Southern Link, encompassing the section between Jalan Tebrau and the planned cloverleaf interchange on the Port Access as a four (4)-lane road.
   b. Construction of the Southern Link Extension (Jalan Kebun Teh) as a four (4)-lane road.
2. Implementation of the Short-Term Causeway Traffic Dispersal Scheme
3. Construction of the Inner Ring Road with the Lorry Route, encompassing the section between Jalan Tebrau and Jalan Bukit Meldrum or the Lorry Custom Complex as a four (4)-lane road.

Phase 2: 1991 — 1995

1. Johor Bahru–Pasir Gudang Southern Link
   a. Widening of the Southern Link, encompassing the section between Jalan Tebrau and the Pasir Gudang Port, into a six (6)-lane road.
   b. Construction of eight (8) grade-separated interchanges.
2. The Long-Term Causeway Traffic Dispersal Scheme.
3. The Inner Ring Road including the Lorry Route.
   a. Construction of the Inner Road with the Lorry Route (Section between Jalan Tun Abdul Razak and Jalan Tebrau) as a six (6)-lane road.
   b. Widening of the Inner Ring Road with the Lorry Route (Section between Jalan Tebrau and Jalan Bukit Meldrum or Lorry Custom Complex).
   c. Construction of the Inner Ring Road (Section between Jalan Yahya Awal and Jalan Tun Abdul Razak) as a four (4)-lane road.

Phase 3: 1996 — 2000

1. Constructed of the Toll Expressway Access.
2. Construction of the section of the Inner Ring Road Between Jalan Abu Bakar and Jalan Yahya Awal.

The recommended implementation schedule is illustrated in Tables 7-8 to 7-10.

TABLE 7-8 RECOMMENDED IMPLEMENTATION PROGRAMME AND INVESTMENT REQUIREMENTS FOR PHASE 1

Project	Number of Lane	Total Length (km)	Year 1985	1986	1987	1988	1989	1990	Project Cost (M$'000)
1. Johor Bahru – Pasir Gudang Southern Link									
a. Southern Link, section between Jalan Tebrau and Port Access	4	14.53		----------	*********	———			94,193
b. Southern Link Extension	4	2.17			---------	**********	———		13,454
2. Short – Term Causeway Dispersal Scheme	–	3.09	---------	———	———				15,048
3. Inner Ring Road including Lorry Route section between Jalan Tebrau and Jalan Bukit Meldrum/Lorry Custom Complex	4	2.44		---------	**********	———			22,281
Investment Requirements for Phase	Annual Cost ($'000)		752	12,755	23,605	32,764	41,468	33,632	144,976
	Share in Total (%)		0.5	8.8	16.3	22.6	28.6	23.2	100
	Achievement (%)		0.5	9.3	25.6	48.2	76.8	100	--

Notes: --------- Detailed Engineering
********* Land Acquisition
——— Construction

TABLE 7-9 RECOMMENDED IMPLEMENTATION SCHEDULE AND INVESTMENT REQUIREMENTS FOR PHASE 2

	Number of Lane	Total Length (km)	Year 1991	1992	1993	1994	1995	Project Cost (M$'000)
1. Johor Bahru – Pasir Gudang Southern Link								
a) Widening of Southern Link, section between Jalan Tebrau and Pasir Gudang Port	6	18.30	---------	———	———	———		44,564
b) Construction of 8 Grade-Separated Interchanges			---------	———	———	———		45,556
2. Long – Term Causeway Traffic Dispersal Scheme	–	4.37	--------- *********	———	———			26,850
3. Inner Ring Road including Lorry Route								
a) Inner Ring Road with Lorry Route section between Jalan Yahya Awal and Jalan Tebrau	4 & 6	1.46	---------	*********	———	———		38,741
b) Widening of Inner Ring Road with Lorry Route section between Jalan Tebrau and Jalan Bukit Meldrum/ Lorry Custom Complex	6	2.44	*********	———	———	———		11,287
Investment Requirements for Phase 2	Annual cost ($'000)		13,105	45,447	44,515	42,154	22,107	167,328
	Share in Total (%)		7.8	27.2	26.6	25.2	13.2	100%
	Achievement (%)		7.8	35.0	61.6	86.8	100	—

TABLE 7-10 RECOMMENDED IMPLEMENTATION SCHEDULE AND INVESTMENT REQUIREMENTS FOR PHASE 3

	Number of Lane	Total Length (km)	Year 1996	1997	1998	1999	2000	Project Cost (M$'000)
1. Toll Expressway Access	4	3.99	--------	********	———	———	———	50,918
2. Inner Ring Road, section between Jalan Abu Bakar and Jalan Yahya Awal	4	1.60	--------	********	———	———	———	25,420
Investment Requirements for Phase 3	Annual Cost ($'000)		1,890	13,345	18,395	24,441	18,267	76,338
	Share in Total (%)		2.5	17.5	24.1	32.0	23.9	100%
	Achievement (%)		2.5	20.0	44.1	76.1	100	—

7-4 INVESTMENT REQUIREMENTS

Based on the implementation schedule, the investment requirements for the Projects are estimated for land acquisition, compensation and construction of roadway and structure. They are divided into foreign and local currency and are presented in 1983 prices. The investment requirements of the Project by Phase as well as by year are shown in Tables 7-11 to 7-14.

TABLE 7-11 INVESTMENT REQUIREMENTS BY PHASE (M$'000 IN 1983 PRICES)

	Foreign	Local	Total
Phase 1			
Detailed Engineering	1,653	2,332	3,985
Land Acquisition	0	27,019	27,019
Construction	47,265	66,707	113,972
Road	29,507	44,111	73,618
Structure	17,758	22,596	40,354
Total	48,918	96,058	144,976
Phase 2			
Detailed Engineering	1,840	2,635	4,475
Land Acquisition	0	15,157	15,157
Construction	60,788	86,908	147,696
Road	13,635	19,945	33,580
Structure	47,153	66,963	114,116
Total	62,628	104,700	167,328
Phase 3			
Detailed Engineering	1,524	2,255	3,779
Land Acquisition	0	13,345	13,345
Construction	23,942	35,272	59,214
Road	11,929	17,900	29,301
Structure	12,013	17,900	29,913
Total	25,466	50,872	76,338
Grand Total	137,012	251,630	388,642

Note : Tax is included in the local currency.

TABLE 7-12 ANNUAL INVESTMENT REQUIREMENTS FOR PHASE 1 (IN THOUSAND M$ AT 1983 PRICES)

Year	Detailed Engineering	Land Acquisition Cost	Construction Cost			Total
			Road	Structures	Sub-Total	
1985	752	–	–	–	–	752
1986	2,130	4,993	1,010	4,622	5,632	12,775
1987	1,047	15,916	2,020	4,622	6,642	23,605
1988	–	4,073	16,539	12,152	28,691	32,764
1989	–	2,037	26,841	12,590	39,431	41,468
1990	–	–	27,208	6,368	33,576	33,576

TABLE 7-13 ANNUAL INVESTMENT REQUIREMENTS FOR PHASE 2 (IN THOUSAND M$ AT 1983 PRICES)

Year	Detailed Engineering	Land Acquisition Cost	Construction Cost			Total
			Road	Structures	Sub-Total	
1990	705	–	–	–	–	705
1991	3,467	3,376	–	5,557	5,557	12,400
1992	303	11,781	5,947	27,416	33,363	45,447
1993	–	–	8,933	35,582	44,515	44,515
1994	–	–	9,350	32,804	42,154	42,154
1995	–	–	9,350	12,757	22,107	22,107

TABLE 7-14 ANNUAL INVESTMENT REQUIREMENTS FOR PHASE 3 (IN THOUSAND M$ AT 1983 PRICES)

Year	Detailed Engineering	Land Acquisition Cost	Construction Cost			Total
			Road	Structures	Sub-Total	
1996	1,890	–	–	–	–	1,890
1997	–	13,345	–	–	–	13,345
1998	–	–	6,048	12,347	18,395	18,395
1999	–	–	12,094	12,347	24,441	24,441
2000	–	–	12,094	6,173	18,267	18,267

Note : The Construction Cost includes the cost of Construction Supervision