# Chapter 8

# Development Plan for Model Area

# Chapter 8 Development Plan for Model Area

The so-called China town and its peripheral area were selected as a model area for the case study to formulate an immediate action plan and a future transportation facility development plan. The area is considered to be one of the most congested areas in the Study area.

## 8.1 Immediate Action Plan

(1) Objectives

The objectives of the model area planning consist of the enhancement of public transport usage and alleviation of traffic congestion in the area. To achieve the objectives in a short period, the following measures are considered to be practical and attainable :

- Bus route re-organisation
- Effective traffic circulation system, and
- Creation of a "pedestrian-friendly" environment.

(2) Model area

The model area is shown in Figure 8.1.1.

(3) Land use

The model area is the old town of the City of Kuala Lumpur, in which many kinds of economic activities are concentrated, including retail shops, financial businesses, restaurants, eating houses, offices of many kinds of business and so on.

The retailers, eating houses and small offices compose a densely built-up area. Except for the high rise buildings of financial businesses, most buildings in the area are so-called shop-houses, which is an ancient Chinese-style, two or three-story terrace house. Some of them have been located there since the 19th century.

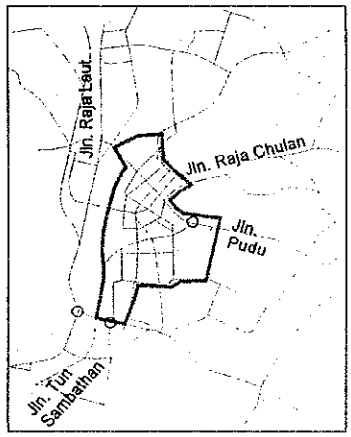


**Figure 8.1.1**
**Location of the Model Area**

(4) Current problems and planning issues

1) Transportation problems

Vehicle traffic flows in the area are shown in Figure 8.1.2. Heavy through traffic and bus services are observed in this small area. Transportation problems in the area are summarised as shown in Figure 8.1.3.

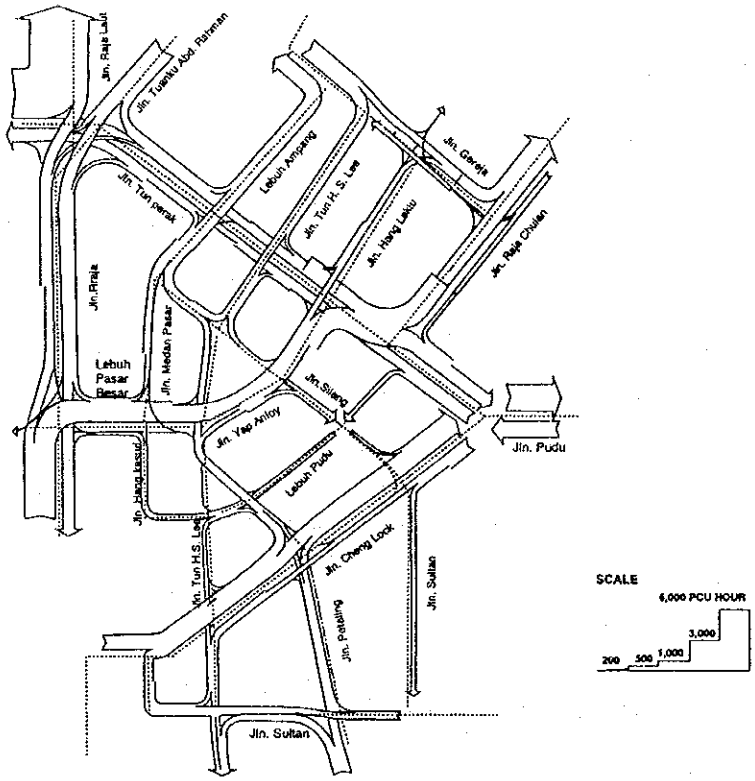


**Figure 8.1.2(1) Vehicle Traffic Volume Flow in the Morning Peak Hour**

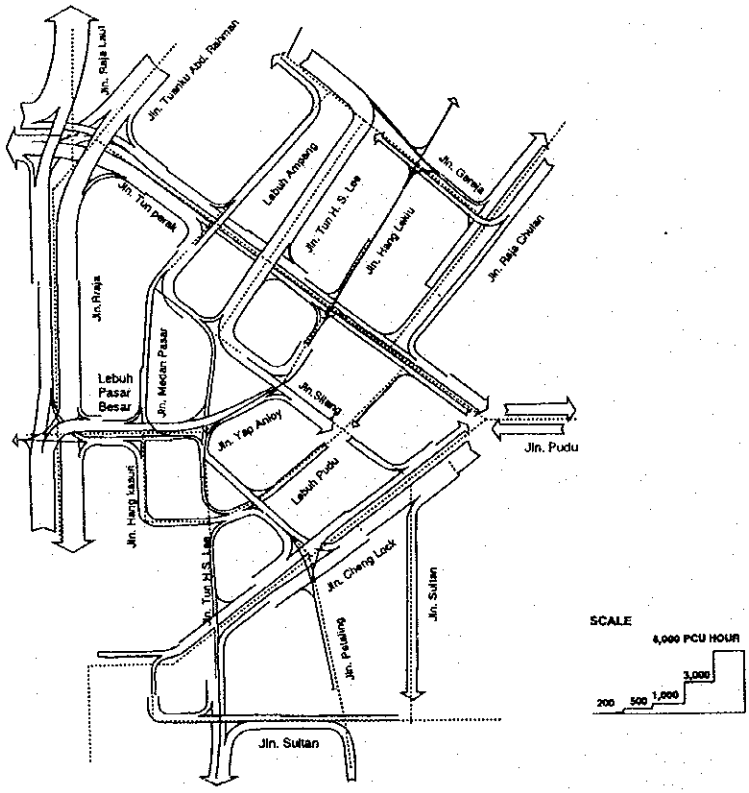


**Figure 8.1.2(2) Vehicle Traffic Volume Flow in the evening Peak Hour**

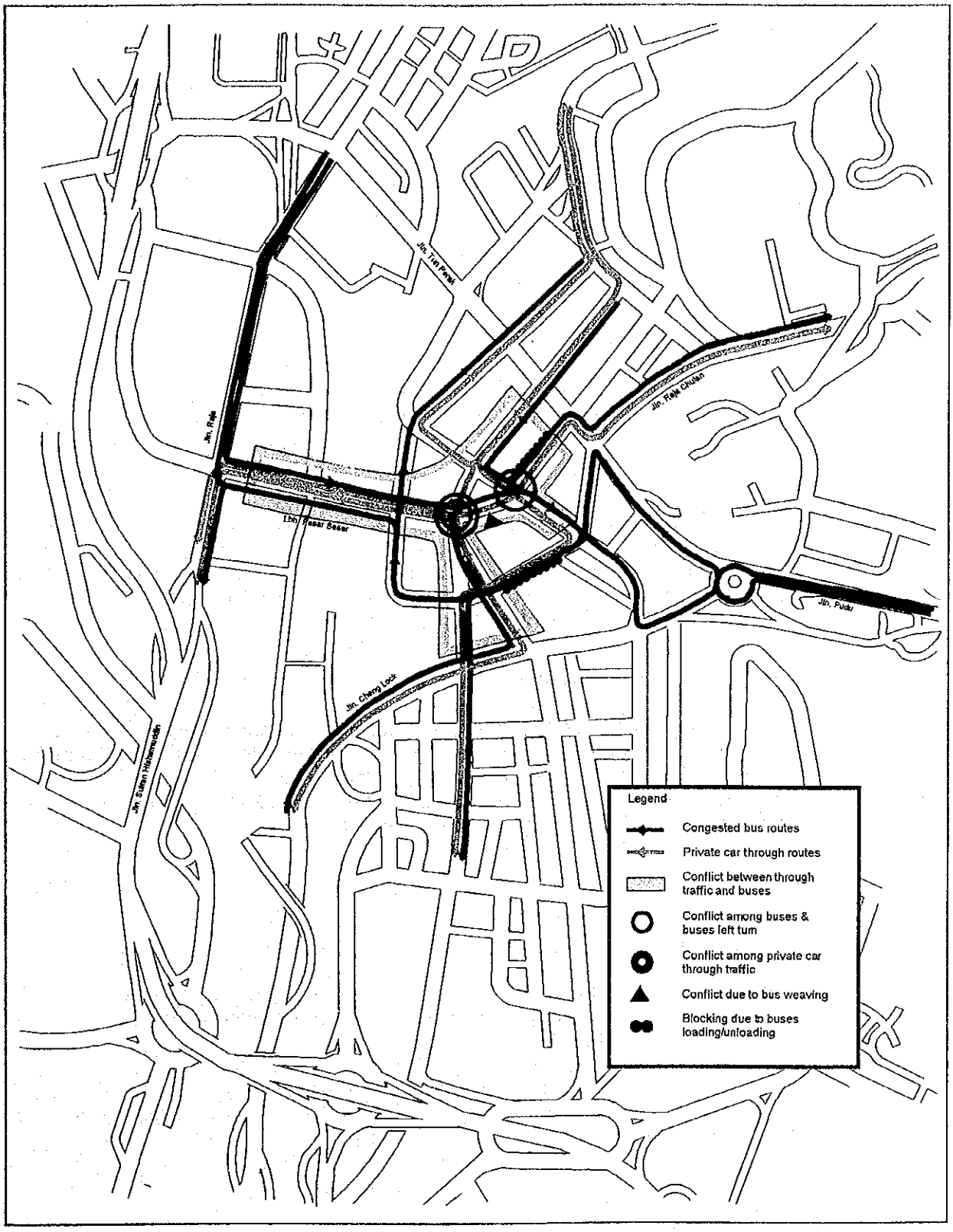


**Figure 8.1.3 Major Traffic Problems and Causes**

2) Planning issues

a. Bus route re-organisation

Because the area has been a commercial centre and business district from old times, most bus routes depart and arrive from/to the area. This causes serious traffic congestion with a considerable number of buses making turns along narrow one way streets within the Model area. It would be effective to re-organise the bus routes which has termini in the area.

b. Through traffic control

A considerable part of through-traffic originates from Jln. Sultan Hishamuddin, which is located to the west of the area. This accelerates the traffic congestion along with the bus operation and local traffic. It is necessary to separate these three kinds of traffic as completely as possible.

c. Traffic circulation system

One-way control is a major traffic control means to secure smooth traffic in the area at present. Establishment of a traffic circulation system would be important, along with the above mentioned separation of the through traffic.

d. Pedestrian friendly environment

Narrow sidewalks and street vendors are frequently observed in the area. These issues disturb the pedestrian flow. Pedestrian roads and transit malls will have a remarkable effect at reducing pedestrians involved in traffic accidents, and would also create a comfortable environment for the pedestrians. Furthermore, it is crucial to remove street vendors to regain the fundamental role of roads.

(5) Action Plan

1) Bus route re-organisation

As mentioned above, many bus routes have turning points in the area. It would be effective to create through bus operation routes by combining several of the existing routes (refer to Figure 8.1.4).

For smooth bus operations, it would be effective to convert some segments of the existing bus route into transit malls. This will be helpful in creating a nice pedestrian environment as well.

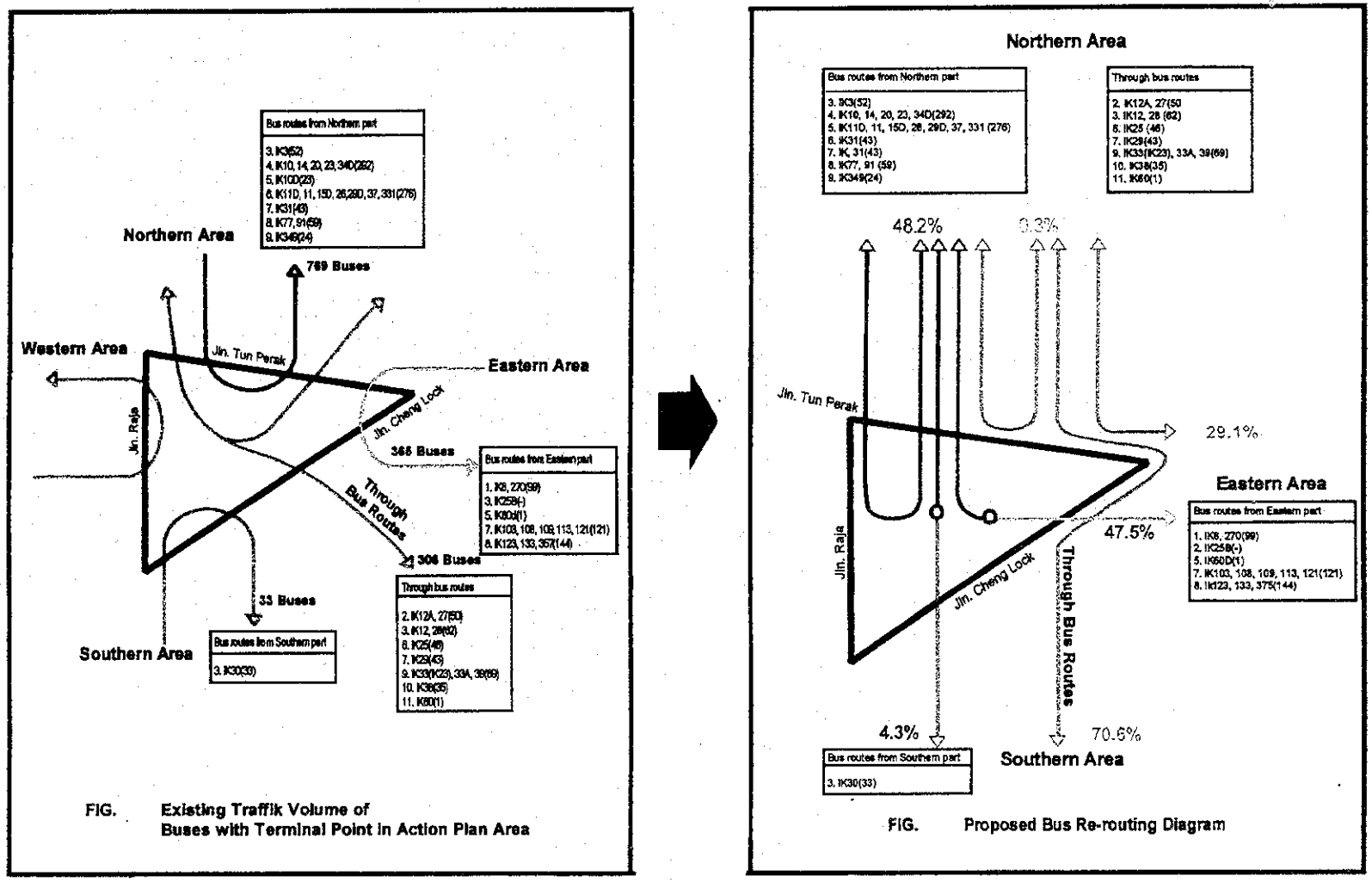


FIG. Existing Traffik Volume of Buses with Terminal Point in Action Plan Area

FIG. Proposed Bus Re-routing Diagram

Figure 8.1.4 Conceptual Figure of Bus Re-routing

2) Traffic circulation plan

- Remove bus routes from Jln. Pasar Besar to which a significant part of the through traffic from Jln. Sultan Hishamuddin travels. By removing the bus routes from Jln. Pasar Besar, smooth through traffic is expected.
- For local traffic, traffic control should be conducted based on a loop type traffic circulation system.

3) Pedestrian facility plan

A segment from the Central Market to Jln. Pasar Besar is planned as a pedestrian road, to where some of the street vendors could be moved to cater to the pedestrians. A pedestrian network is planned, by combining this pedestrian road with a pedestrian mall.

4) Conversion of roundabout into ordinary intersection

It is planned to convert the Pudu Raya roundabout into an ordinary signalised intersection.

5) Drawing up of options

Based on the above plans, seven options were worked out (Figure 8.1.5). The major intentions and contents are shown in Table 8.1.1.

**Table 8.1.1 Major Contents of Alternatives**

| Alternative | Major Contents |
|---|---|
| Alternative 1 | Removing through-traffic completely |
| 1-1 | Extensive transit mall introduction |
| 1-2 | Introduction of bus lanes by reducing transit mall |
| 1-3 | Reduced transit mall |
| Alternative 2 | A part of through-traffic is controlled |
| 2-1 | Extensive transit mall introduction |
| 2-2 | Introduction of bus lanes by reducing transit mall |
| 2-3 | Reduced transit mall |
| 2-4 | No transit mall nor bus lane |

Source : SMURT-KL

6) Evaluation of the options

Three representative options, namely Alternatives 1-1, 2-2 and 2-4, were evaluated in terms of total stopping delay by using a dynamic simulation model. Table 8.1.2 shows the results.

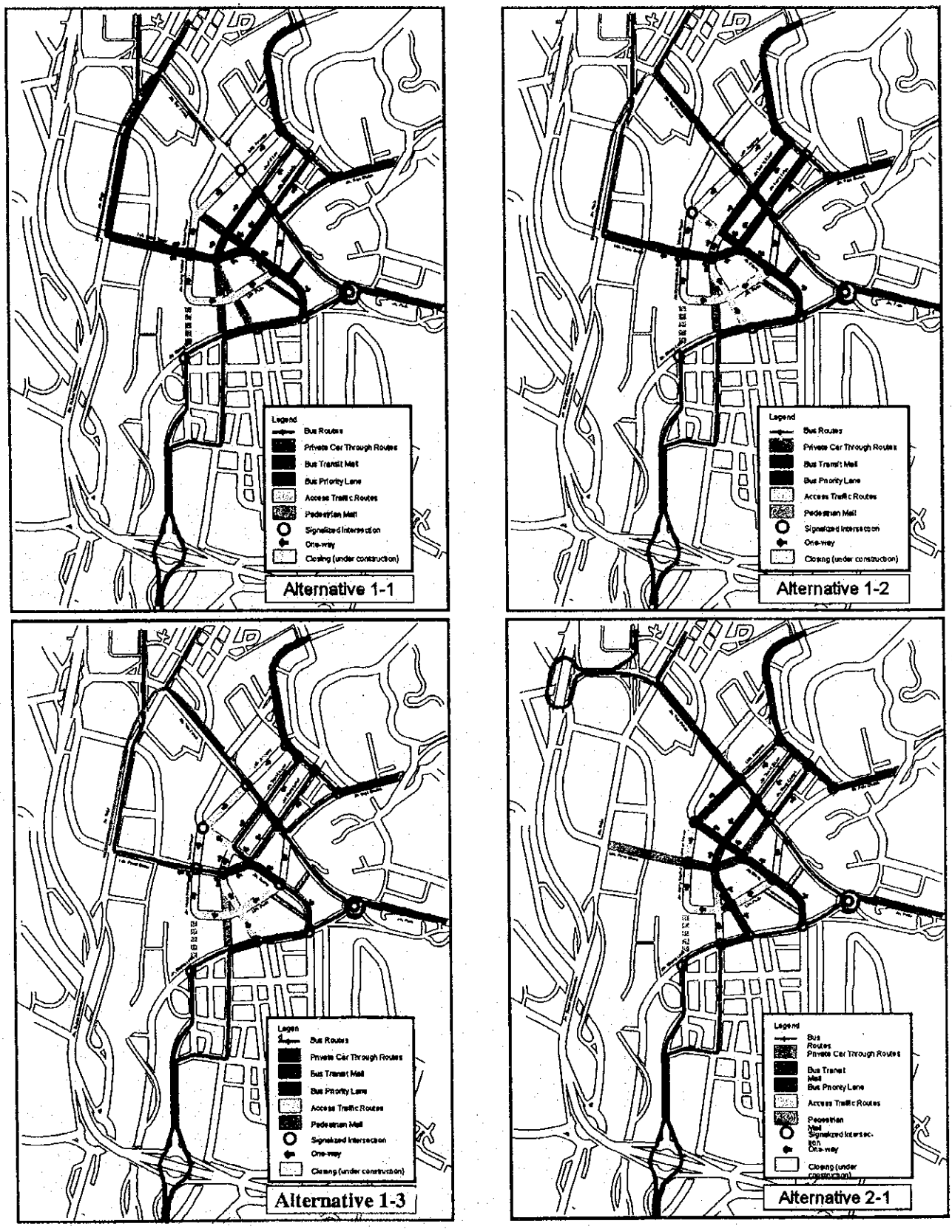


**Figure 8.1.5(1) Alternative Immediate Action Plan**

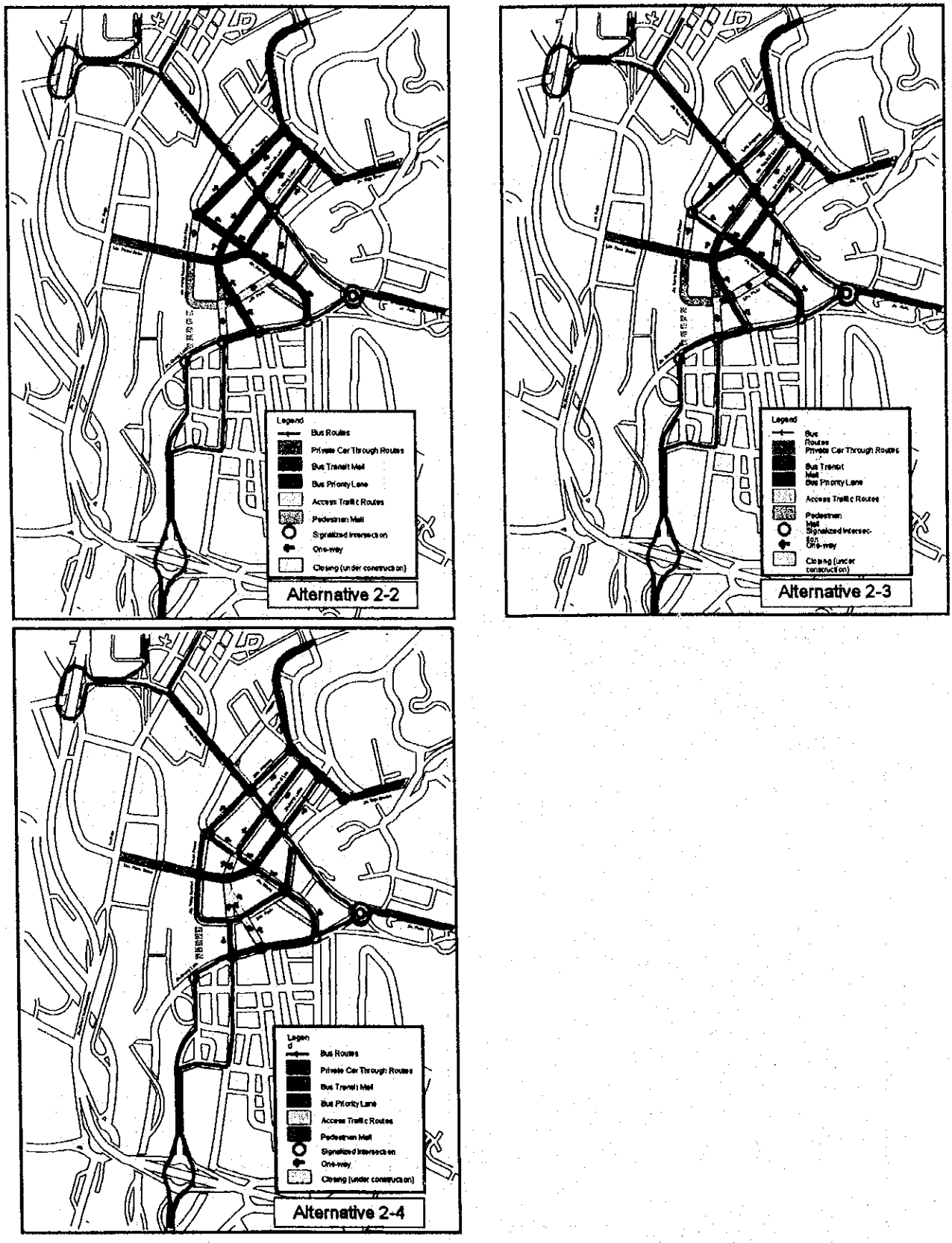


**Figure 8.1.5(2) Alternative Immediate Action Plan**

**Table 8.1.2 Comparison of Total Stopping Delay by the Dynamic Simulation**

Morning Peak Hour (7:30-8:30 a.m.) [Unit: hour]

| Streets | Present | Alternative 1-1 | Alternative 2-2 | Alternative 2-4 |
|---|---|---|---|---|
| **Arterial Roads** | | | | |
| Jalan Gereja | 1.2 | 1.6 | 1.8 | 1.6 |
| Jalan Tun Perak | 2.8 | 5.9 | 6.1 | 2.9 |
| Jalan Raja | 2.3 | 5.9 | 2.3 | 2.5 |
| Jalan Cheng Lock | 8.6 | 5.6 | 5.5 | 8.1 |
| **Total** | **14.9** | **19.1** | **15.7** | **15.0** |
| **Collector Roads*** | | | | |
| **Total** | **23.2** | **2.0** | **11.1** | **19.0** |
| **Grand Total** | **38.1** | **21.0** | **26.8** | **34.0** |

* Collector roads indicate all the streets in the model area except for the arterial roads.

Source : SMURT-KL Estimate

7) Selected improvement plan

Alternative 2-2 was selected as the most desirable plan as a result. According to the table, alternative 2-4 was excluded because the stopping delay is considerably long. With regard to alternative 1-1, the total stopping delay on arterial roads is longer than that for alternative 2-2. This may result in traffic congestion in the surrounding areas. Therefore, alternative 2-2 was selected as the best option.

## 8.2 Comprehensive Transport Facility Development Plan for the Model Area

(1) Objective

Although inter-modal facility development is important for public transport improvement, it is not realistic to draw up plans for all potential facility development covering all the areas in a master plan. Therefore, the Study intended to draw up typical facility development plan within the model area in order to provide guidelines for facility development plans in the other areas.

(2) Problems in the Model Area

1) Superannuated buildings

Most buildings in the model area are superannuated, though the situation varies from district to district to some extent. In the southern area of Jln. Cheng Lock, in particular, there are many terrace type Chinese shop-houses, which were estimated to have been built in the 19$^{th}$ century.

2) Lack of public space

The road width of most of the roads in the area is narrow as a whole. Some local roads are occupied by neighbouring shops for their use. Fundamental road functions are disturbed in the area.

3) Lack of amenity

Retail shops and eating houses are dominant in the area as a whole, except for high rise buildings of financial businesses at Masjid Jamek Station and the area between Jln. Tun Pelak and Jln. Cheng Lock. Office buildings are also small and business activities do not seem to be vital. The town is not considered to be attractive enough.

(3) Planning issues

1) Northern area from Jln. Pasar Besar

Major activities of the area will not change significantly in the future as well, consisting of financial services for local companies along with retail shops, restaurants and miscellaneous goods shops for employees. Public space should be developed along Jln. Tun Perak, because the LRT System (I) and (II) intersect with each other at Masjid Jamek Station, and inter-modal facilities will be necessary for transfer to buses and taxies.

2) Area between Jln. Pasar Besar and Jln. Cheng Lock

Department stores and the Central Market are located in this area. This area attracts many local people and foreign tourists. Since the area is considered to be the most attractive in the model area, improvement of the pedestrian environment will be a focal point. It is urgent that a safe and comfortable pedestrian space be provided, thus, increasing prosperity and a good turnout by attracting many people.

3) Southern area along Jln. Cheng. Lock

Many bus routes are concentrated on Jln. Cheng Lock. Most buses go into the northern area of Jln. Cheng Lock to collect passengers and come back to the road. In the future, pedestrian facility development should be emphasised in the area surrounded by arterial roads. Therefore, it is necessary to secure convenient bus services to utilise the southern area along Jln. Cheng Lock by creating public space for a large scaled bus bay, for example, after demolishing the old shop-houses.

4) Southern area of Jln. Cheng Lock

The existing land use of the area is in disorder, due to the mixed location of very old buildings, small shops, eating houses and restaurants. To improve this situation, long term planning will be necessary. The area will not be able to change into a business area with many high rise buildings, because competition will be keen from the existing business areas, such as KLCC. Considering that the northern area of Jln. Cheng Lock will enjoy prosperity for the time being, it is envisaged that this area should be improved to attract local people and foreign tourists through the synergistic effect development with

the north area. In this context, transport related improvements will become important, namely a consistent development with accessibility from the outside, and in terms of the pedestrian environment, by the introduction of a traffic circulation system utilising the arterial roads.

(4) Transport Facility Development Plan and Traffic Control System Development Plan in the Model Area

The development plan is shown in Figure 8.2.1.

1) Traffic circulation system

It is necessary in the long-term to limit vehicles entering into this area by excluding unnecessary vehicle trips except for goods vehicles loading and unloading commodities. Vehicle traffic should be banned from entering the area by Jln. Pasar Besar, Jln. Cheng Lock and Jln. Tun Perak.

2) Parking area development

Two new parking areas are proposed utilising the redevelopment area at Masjid Jamek Station and the Klang bus terminal. These parking areas, along with the existing parking facilities, are expected to be used by visitors from outside who come by car, who move around in the area on foot.

3) Bus route reorganisation

In a short-term, bus routes should be re-organised into a through type operation. The re-organised routes are placed on bus priority lanes and transit malls in the area.

Areas along Jln. Cheng Lock and Jln. Tun Perak are planned to be redeveloped over the long-term. Large scaled bus stops will be developed along the roads. Therefore, bus passengers are expected to get on and off there. A minimum number of buses are allowed to enter the area.

4) Pedestrian facilities

a. Development of pedestrian network

Within the area, pedestrian environment is to be improved by developing a pedestrian network and by limiting bus and car usage to the surrounding arterial roads. In the future, the north and the south area of Jln. Cheng Lock will be united to generate a synergistic effect, by creating a pedestrian network from Pasar Senen Station and Masjid Jamek Station.

b. Development of pedestrian crossing bridge

A facility to secure smooth pedestrian movements between the areas is necessary in order to unite the two the south and north areas of Jln. Cheng Lock. A pedestrian crossing bridge equipped with escalators is planned taking into account pedestrian flows.

A small plaza is effective for transferring passengers at stations of the rail-based transport modes. A plaza for buses and taxies is planned at the Daya Bumi Station because space under the elevated structure can be utilised for the purpose. With regard to the Masjid Jamek Station, it is considered difficult to create such a plaza.

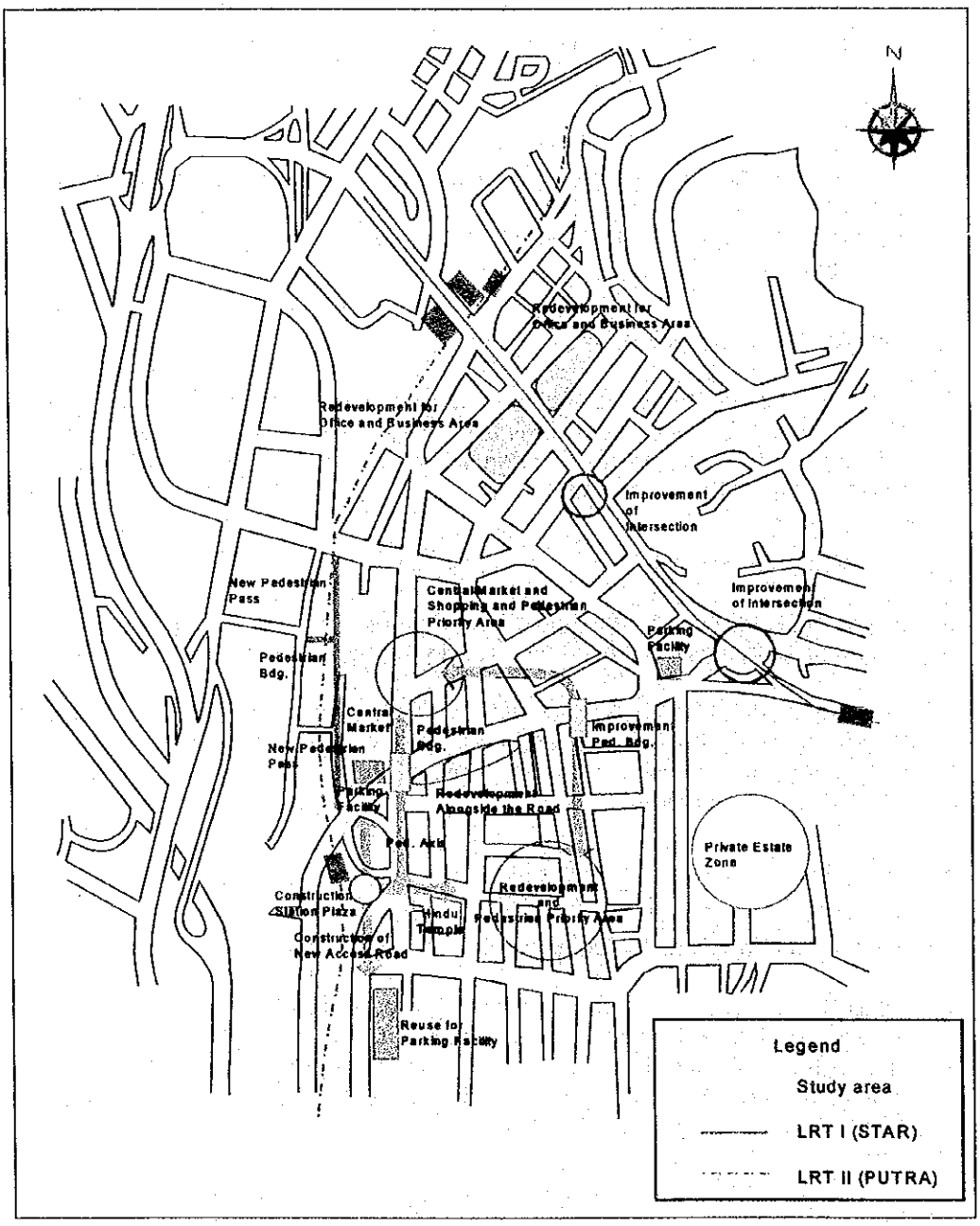


**Figure 8.2.1 Planning Concept of Facility Development for the Model Area**

# Chapter 9

# Environmental Consideration

# Chapter 9 Environmental Consideration

## 9.1 Environmental Aspects of Human Activities

Human activities have influenced the environment significantly. One of the important indicators of such influence on the environment is human energy consumption. Generally, higher energy consumption implies a higher probability of pollutants' emission and an increased necessity for detailed assessment of impacts. If energy consumption of development is minimised, the environmental influence will decrease. Therefore, the energy saving is a vital issue for environmental conservation and sustainable development.

According to this viewpoint, the development of public transportation system has considerable advantage for sustainable development. The energy consumption rates per person and per km in Japan show that a train is twelve times and a bus is four times more efficient than a passenger car. The development of public transportation is, thus, effective for environmental mitigation.

Malaysia's $CO_2$ emissions were 28 million ton-C in 1996, and the share of land transport was 23% to 24%. Per capita $CO_2$ was 1.20 ton-C in 1995, being approximately equivalent to a half of Japan's.

## 9.2 Current Atmospheric Pollution Concerning Transportation in Kuala Lumpur

The Malaysian Environmental Quality Report 1997 indicates that air quality was generally good during the first six months until the advent of haze in mid-July, which lasted till November 1997. The air quality returned to normal in November coinciding with the beginning of the monsoon season. Throughout 1997, the level of gaseous pollutants and lead in ambient air remained below the value stipulated in the Recommended Malaysian Guidelines.

The SMURT-KL Environmental Survey revealed unfavourable conditions in the limited areas, i.e. vicinities of busy traffic crossings. Furthermore, the SMURT-KL Opinion Survey revealed that approximately 80% of workers and students in the Study area regarded air pollution as serious.

The current atmospheric situation in the Kuala Lumpur metropolitan area can be recognised as good or moderate, but some areas, especially vicinities of busy traffic crossings, are not favourable. And people demand a steady improvement of atmospheric conditions.

## 9.3 Environmental Improvement

### 9.3.1 Urban Environmental Management

The policy for urban environmental improvement is closely related to the urban management policy. Urban transportation management is an important field, which is closely related to urban environmental mitigation. The transportation sector has emitted

a major share of air pollutants in the urbanised area. Vehicles also cause noise pollution. The improvement of traffic management and the enhancement of public transportation may lessen the burden on the urban environmental significantly. Urban transportation policies should, therefore, be recognised as a part of environmental policies. For the Kuala Lumpur metropolitan area, the first priority should be given to the enhancement of public transportation.

### 9.3.2 Development of Environmental Technology of Vehicles

Environment-friendly vehicles are nowadays being developed rapidly. Main directions are pollution abatement and $CO_2$ reduction. Broad research has brought about the variety of innovation. The innovations include the direct injection of fuel into the combustion cylinders, introduction of alternative vehicle energy, development of extremely low emission vehicles, and development of secondary battery and fuel cell cars. Utilising these technologies, pollutant emissions can be reduced significantly and the fuel economy can be improved. Current technology development will generate benefits for pollution mitigation.

### 9.3.3 Environmental Policy for Individual Vehicles

(1) Regulations on Exhaust Gas

Regulations for four wheelers in Malaysia, which follow that of the EU, are listed in Table 9.3.1.

**Table 9.3.1 Current Emission Standard of Four Wheeler**

| Standard | Model | Vehicle Type |
|---|---|---|
| Petroleum Vehicles | | |
| ECE 15.04 | Before 01.01.97 | less than 3.5 t |
| 91/441/EEC | On and after 01.01.97 | Passenger Car, less than 2.5 t |
| 93/59/EEC | On and after 01.01.97 | Commercial Car, less than 3.5 t |
| Diesel Vehicle | | |
| ECE 15.04 and ECE 24.03 | Before 01.01.97 | less than or equal 3.5 t |
| ECE 49 | Before 01.01.97 | More than 3.5 t |
| 93/59/EEC | On and after 01.01.97 | less than or equal 3.5 t |
| ECE 49.02 (EURO 1) | On and after 01.01.97 | More than 3.5 t |

The regulation is, in general, considerably more lenient than that of the EU. However, the standard 94/12/EC for petroleum vehicles has been already scheduled for introduction on and after January 1, 2000. It is of great importance to implement this schedule for petroleum vehicles and it is also necessary to introduce further regulations for diesel vehicles. Current atmospheric pollution and the increasing trend of registered number of cars call for the introduction of further regulations. Furthermore, advances in vehicle technology in the world makes it possible to introduce further regulations without excessive technological difficulties.

As for motorcycles, exhaust emission standards are under study and have not been applied yet. The authorities concerned and the motorcycle industry have been discussing the applicability of Taiwan Stage 2 regulations and ECE 40.02. Regulations for motorcycles should also be introduced in Malaysia, and the regulations should be appropriate in deliberating the considerable share of pollutant emission caused by motorcycles. The regulation for motorcycle emission should not be overlooked for too long.

(2) Regulations against Noise

For motorcycles, the second stage regulation against noise was implemented on January 1, 1990. For cars and trucks, the regulation against noise was implemented on July 16, 1987. According to the Malaysia Environmental Quality Report 1996 and 1997, Department of Environment (hereinafter referred to as DOE), the share of noise complaint is 4% of the total complaints. The public awareness for noise may not yet be at a critical stage.

The driving manner is an indispensable element in noise mitigation. The noise level will decrease, if excessive acceleration and cutting-in are avoided through polite driving practices. Public enlightenment on the environment is a powerful measure for promoting gentle driving.

(3) Introduction of Low Emission Vehicles

It is one-sided to only stress further implementation of emission regulations; the introduction of low emission vehicles (hereinafter referred to as LEVs) is also indispensable. There are many types of LEVs. Because of its energy resources and technologies, it may be suitable for Malaysia to focus on Natural Gas Vehicles (hereinafter referred to as NGVs). Malaysia produces plenty of natural gas from its gas fields. Natural gas taxies are already utilised in the Klang Valley region, and a natural gas fuelling station has been constructed in Sarawak. The introduction of NGVs forms the mainframe of LEV policies. The public sector should lead in the introduction of LEVs.

(4) Periodic Inspection and Roadside Surveillance of Motor Vehicles

The Road Transport Department (RTD) presides over periodic inspection. The stipulations for inspection are applied to commercial vehicles and not to private passenger cars. The test procedure includes tests for exhaust gas emission and noise level. DOE with the co-operation of the Royal Malaysian Police conducts enforcement campaigns for emission control. The Area Watch and Sanction Inspection (AWASI) programme by DOE's mobile squads has been implemented, and consequently smoky vehicles have effectively been reduced. Roadside inspections of motorcycle noise are undertaken by the DOE State Offices with the co-operation of the Royal Malaysian Police. Model approvals for car and truck noise are undertaken by the Standards and Industrial Research Institute of Malaysia (SIRIM). These are the efforts of inspection and surveillance of vehicles, in addition to the periodic inspection by the RTD.

It is better to integrate the political will of the relevant agencies, and formulate co-operative efforts, in order to develop more an effective inspection and surveillance system. In addition, public relations and the enlightenment of drivers and owners about proper maintenance and its positive effects on the environment should be enhanced.

### 9.3.4 Estimation of Pollutant Emissions of the Long-term Development Plan

(1) Methodology of Estimation of Pollutant Emissions

The emission volume caused by vehicles was calculated by multiplying the vehicle's emission factor, driving distances, and vehicle volume. The emission factor represents emission volume per unit vehicle and unit distance, depending on the vehicle type, engine type, and running speed. Vehicle age was taken into consideration through a deteriorating rate of the emission factor. In establishing the future emission factor, proper regulation was considered.

The study area was divided by 250m x 250m grid units. The amount of emission in the individual grid unit represents the cumulative emission of vehicles when they operate in the grid area.

(2) Estimated Pollutant Emission of the Long-term Development Plan

For the year 2020, the target year of the Long-term Development Plan, pollutant emission in the Study area from vehicles was estimated by simulation. Since the year 2020 is too far away to estimate environmental situations and regulations, applied emission conditions for the simulation did not fully depend on authorised ones. The assumption regarding regulation for the simulations is presented in Table 9.3.2.

**Table 9.3.2 Assumption on Regulations for Estimation**

| | 1997 | 2020 |
|---|---|---|
| Four Wheeler | Petroleum Vehicle :<br>ECE 15.04, 91/441/EEC, 93/59/EEC<br>Diesel Vehicle :<br>ECE 15.04, ECE 49, 93/59/EEC, ECE49.02 | Commercial Vehicle :<br>Natural Gas Vehicle<br>Others (Petroleum) :<br>94/12/EC |
| Motorcycle | Without Regulation | Taiwan Stage 2 |

The simulation results of NOx are illustrated in Figures 9.3.1 and 9.3.2. The amounts of NOx and CO emission in the Study area are listed in Table 9.3.3. Though the traffic demand will increase toward 2020, pollutant emission in the area was estimated to decrease remarkably. Regarding the case of 2020 "with the Master Plan", NOx and CO emission volume were reduced approximately by 60% and 50%, respectively, compared to the volume of the year 1997. The regulations assumed for the estimation, listed in the Table 9.3.2, are effective for the mitigation of NOx and CO. Thus, the recommended transportation policies as well as the scheduled environmental regulations can be regarded as effective in achieving sustainable environment in the area.

An expansion of human activities will result in the development and economic growth of the area. The accumulation of development activities up till the year 2020 will bring about significant changes of environment in the metropolitan area. It is necessary to show a clear direction and to establish long-term environmental policies, in order to maintain the environment throughout the period.

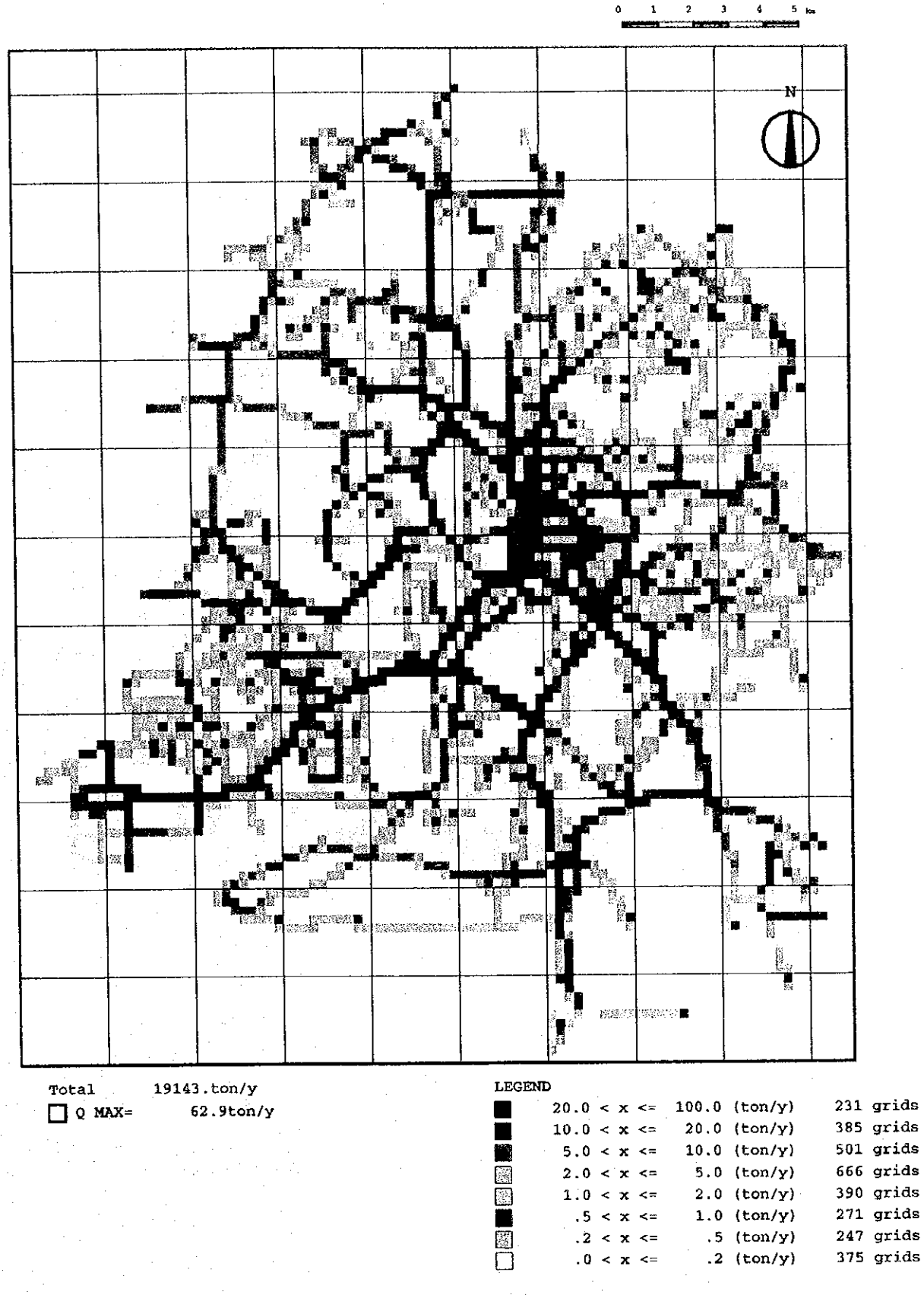


**Figure 9.3.1 Estimated NOx Emission in 1997**

1997, Present, KL,Study Area, 98/11/18
NOx Emissions 98/11/11

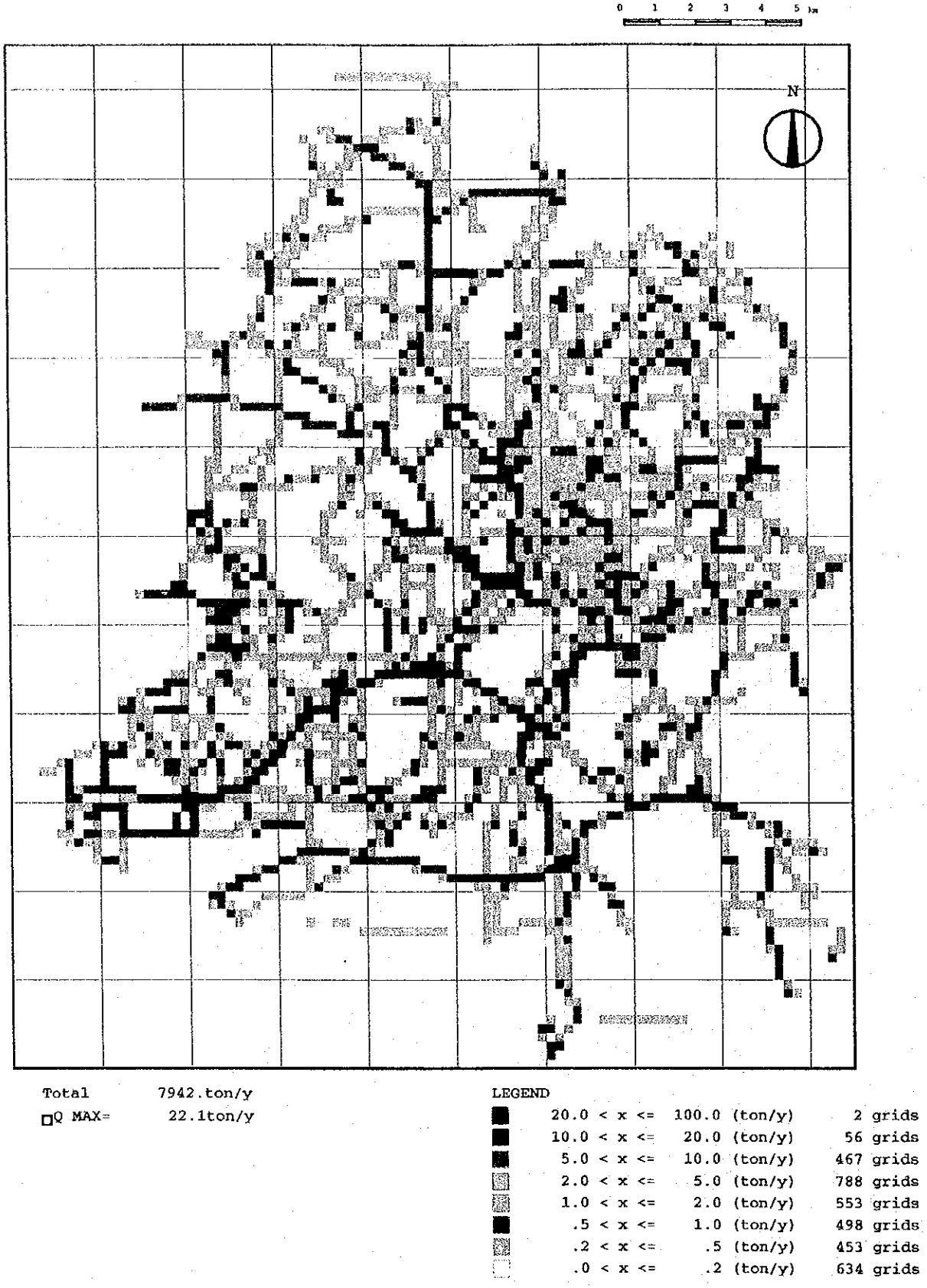


**Figure 9.3.2 Estimated NOx Emission in 2020 ( Master Plan Case)**

2020, traf.=control, emis.=control, 98/11/11
NOx Emissions 98/11/11

**Table 9.3.3 Estimated Emission Pollutants in 2020**

| | NOx (t/year) | CO (t/year) |
|---|---|---|
| 1997 | 19,100 | 272,000 |
| 2020 Without Master Plan | 7,800 | 165,000 |
| 2020 With Master Plan | 7,900 | 136,000 |

Source : SMURT-KL Estimate

(3) Pollutant Emission under the Short-term CPA Traffic Control/Management Plan

The pollutant emission in the year 2000 was estimated based on the traffic flow data obtained from the dynamic simulation under the current environmental regulation. The estimated emission volume of NOx and CO, and the sum of fuel (petroleum and diesel) consumption in terms of calorie in the CPA during the morning peak hour (from 07:30 to 08:30) are summarised in Table 9.3.4.

**Table 9.3.4 Estimation of Pollutant Emission for Short-term Package Plan (2000)**

| | NOx (kg/h) | CO (kg/h) | Fuel Consumption (Gcal/h) |
|---|---|---|---|
| Without Package Plan | 227 | 4390 | 120 |
| With Package Plan | 263 | 4157 | 129 |
| Relative Value per Unit Car (With P. Plan / Without P. Plan) | 1.06 | 0.87 | 0.99 |

Note : Package Plan includes Reversible Flow Lane, Bus Priority lane, Improvement of Signal Control System, and Improvement of Non-Signalised Roundabout
Source : SMURT-KL Estimate

Implementation of the package plan in the CPA will improve traffic flow when compared to the case without any improvement. The traffic volume will increase approximately by 10 percent. Regarding the environmental aspect, the one-hour amount of CO emissions will decrease through implementation of the package plan; in contrast, that of NOx and fuel consumption will increase. The relative value, in terms of unit amount per car, shows a significant decline of CO, increase of NOx, and a slight decline in fuel consumption. These results were derived from the characteristics of the respective pollutant emission and fuel consumption related to the driving speed of vehicles.

Considering the various advantages to be expected in the CPA, the package plan can be regarded as a reasonable plan to achieve sustainable environment. A decrease in CO, travel time savings for human activities, and less energy consumption are acceptable. However, it is necessary to conduct strict enforcement of the current regulation and to implement the scheduled regulations for NOx reductions steadily in order to realise better ambient air in the CPA.

The implementation of the current regulation 93/59/EEC and EURO 1, and the planned regulation 94/12/EC from the year 2000 onward would lead the emission levels of NOx from vehicles to a lower level. Furthermore, phasing out of old vehicles and the introduction of new cars complying with the regulation will contribute to reduce NOx emissions.

# Chapter 10

# Economic Analysis of Master Plan

# Chapter 10 Economic Analysis of Master Plan

## 10.1 Cost Estimates and Implementation Schedule

### 10.1.1 Project Components and Implementation Schedule

The proposed projects/programmes are classified into the following four (4) groups and an implementation schedule is proposed as shown in Table 10.1.4:

1) Major Transport Facility Development, such as rail based projects, highway projects and trunk bus projects, so as to meet the increased traffic demand;

2) Public Transport-enhancing Projects to promote use of the public transport mode;

3) Traffic Control and Management Projects in the CPA, including area pricing; and

4) Traffic Information System and others.

### 10.1.2 Cost Estimates

A total amount of RM 20.4 billion is estimated as the capital cost, definitely the incremental capital costs, of the SMURT-KL Master Plan at market prices as of September 1998. Of this total, RM 0.3 billion, RM 12.3 billion, and RM 7.8 billion are allocated to the Short-Term, Medium-Term and Long-Term Phase, respectively.

**Table 10.1.1 Capital Cost of SMURT-KL Master Plan**

| | | Short-Term | Medium-Term | Long-Term | Total |
|---|---|---|---|---|---|
| | | 1999 \| 2000 | 2001 \| 2010 | 2011 \| 2020 | |
| 1. | Major Transport Facility Development | | | | |
| | 1-1 New Rail Projects | 0 | 0 | 4,768 | 4,768 |
| | 1-2 Trunk Bus System | 217 | 286 | 0 | 504 |
| | 1-3 Highway Projects | 8 | 11,758 | 2,994 | 14,760 |
| | Subtotal | 225 | 12,044 | 7,761 | 20,031 |
| 2. | Public Transport-Enhancing Projects | 0 | 38 | 20 | 58 |
| 3. | Traffic Control / Management in CPA | | | | |
| | 3-1 Traffic Control/Management | 51 | 0 | 0 | 51 |
| | 3-2 Area Pricing | 5 | 0 | 0 | 5 |
| | Subtotal | 56 | 0 | 0 | 56 |
| 4. | Transport Information System & others | 33 | 180 | 0 | 213 |
| | Total | 315 | 12,262 | 7,781 | 20,358 |

Note: 1) The costs without Project Scenario are excluded from the above figure. Namely the LRT projects and Expressway projects, which are expected to be completed by 2000, are not included in the costs.
2) Land and compensation costs are estimated based on LAPORAN RASARAN HARTA (Property Market Report), 1997.
3) Physical contingency is estimated at 20 % of the construction costs.
4) Land and compensation costs of new rail project: An additional cost is included, while the land converted from trunk bus route is included in the trunk bus costs.

Source: SMURT-KL

### 10.1.3 Economic Cost

All costs and benefits for the projects are evaluated at economic prices in the Cost-Benefit Analysis. The capital costs in Table 10.1.1 are converted into economic prices as shown in Table 10.1.2.

**Table 10.1.2 Economic Capital Cost of SMURT-KL Master Plan**

Unit: RM million

| | | Short-Term 1999 \| 2000 | Medium-Term 2001 \| 2010 | Long-Term 2011 \| 2020 | Total |
|---|---|---|---|---|---|
| 1. | Major Transport Facility Development | | | | |
| | 1-1 New Rail Projects | 0 | 0 | 4,060 | 4,060 |
| | 1-2 Trunk Bus System | 216 | 286 | 0 | 501 |
| | 1-3 Highway Projects | 8 | 10,614 | 2,634 | 13,256 |
| | Subtotal | 224 | 10,899 | 6,694 | 17,817 |
| 2. | Public Transport-Enhancing Projects | 0 | 37 | 19 | 56 |
| 3. | Traffic Control / Management in CPA | | | | |
| | 3-1 Traffic Control/Management | 47 | 0 | 0 | 47 |
| | 3-2 Area Pricing | 4 | 0 | 0 | 4 |
| | Subtotal | 51 | 0 | 0 | 51 |
| 4. | Transport Information System & Others | 28 | 167 | 0 | 195 |
| | Total | 303 | 11,102 | 6,713 | 18,119 |

Note: National Parameters for Project Appraisal in Malaysia in 1986 and the current Malaysian Customs Tariff are referred to convert the market prices into economic prices.
Conversion Factors; Highway 80-90%, Railway 85% and Signalling & other equipment 80-90%
Source: SMURT-KL

In terms of economic prices, the total cost of the proposed Master Plan, including the operation and maintenance costs, is estimated at about RM 19.4 billion during the period from 1999 to 2020. Out of this total RM 0.3 billion, RM 11.4 billion and RM 7.7 billion are allocated for the Short, Medium and Long Term Phases, respectively, as shown in Table 10.1.3.

**Table 10.1.3 Total Economic Cost of SMURT-KL Master Plan**

Unit: RM million

| | Short-Term 1999 \| 2000 | Medium-Term 2001 \| 2010 | Long-Term 2011 \| 2020 | Total |
|---|---|---|---|---|
| 1. Capital Investment Costs | 98 | 7,390 | 6,155 | 13,643 |
| 2. Land & Compensation | 204 | 3,712 | 627 | 4,543 |
| Subtotal | 303 | 11,102 | 6,782 | 18,187 |
| 3. Operation & Maintenance Costs | 2 | 342 | 892 | 1,236 |
| Total | 304 | 11,445 | 7,673 | 19,423 |

Note: The replacement costs of the equipment is included in the capital costs.
Source: SMURT-KL

# Table 10.1.4 Proposed Projects and Implementation Schedule (1/2)

1. Arterial Transport Facility Development Projects (1/2)

| Project | Project No. | Stage | Implementation Schedule 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 |
|---|---|---|---|
| **1-1 NEW RAIL PROJECTS** | | | |
| (1) New LRT Development (Damansara-Cheras) | RT-1 | 2020 | |
| (2) New LRT Development (Jalan Ipoh/Jalan Kepong)) | RT-2 | 2020 | |
| (3) New LRT Development (Jalan Damansara) | RT-3 | 2020 | |
| (4) Monorail (South Extension) | RT-4 | 2020 | |
| **1-2 TRUNK BUS SYSTEM** | | | |
| (1) Trunk Bus System | BS-1 | 2010 | |
| - Damansara | | | |
| - Genting Klang | | | widening |
| - Cheras | | | |
| - Ampang | | | |
| - Kepong | | | |
| - Puchong | | | widening |
| (2) Bus Priority Lane Reversible Lane | BS-2 | 2010 | widening |
| Exclusive Bus Lane | | | |
| **1-3 HIGHWAY PROJECTS** | | | |
| **1) CURRENT PLAN (COMMITTED)** | | | |
| (1) New Pantai Highway | HW-1 | 2010 | |
| Subang Jaya - Jalan Templer | | | |
| Jalan Templer - JalanDangsar | | | |
| (2) KLIA Dedicated Highway | HW-2 | 2010 | |
| Section 1 Pandan Roundabout - Technology Park | | | |
| Section 2 Technology Park - KLIA | | | |
| (3) Kajang Traffic Dispersal Ring Road (Balakong-SG.Long-Semenyih-UPM Junction) | HW-3 | 2010 | |
| (4) Western KL Traffic Dispersal Scheme | HW-4 | 2010 | |
| (5) Pandan Corridor Extension | HW-5 | 2010 | |
| (6) KL Elevated Inner Ring Road | HW-6 | 2010 | |
| Section 1 SG.Besi - KLCC | | | |
| Section 2 Jalan Duta - KLCC | | | |

1. Arterial Transport Facility Development Projects (2/2)

| Project | Project No. | Stage | Implementation Schedule 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 |
|---|---|---|---|
| (7) KL Transit Route | HW-7 | 2010 | |
| Package 1 upgrading Jalan Kuching | | | |
| Package 2 upgrading Jalan Duta | | | |
| Package 3 Damansara Transit Route | | | |
| (8) Kuala Lumpur-Rawang Expressway | HW-8 | 2010 | |
| (9) Wangsa-Keramat Expressway | HW-9 | 2010 | |
| Kg. Relawan - Wangsa maju | | | |
| Kg. Dato Keramat - Kg. Pandan | | | |
| (10) Kajang-Seremban Expressway | HW-10 | | |
| Kajang - Seremban | | | |
| (11) Kajang Bypass | HW-11 | | |
| (12) Shah Alam-Rawang Expressway | HW-12 | | |
| Sg.Damansara - Tmn. Subang I/C | | | |
| Tmn. Subang I/C - Paya Jaras I/C | | | |
| Paya Jaras I/C - Kuang System I/C | | | |
| (13) KL Outer Ring Road | HW-13 | | |
| **2) NEWLY PROPOSED** | | | |
| (1) Under Ground Expressway | HW-14 | 2020 | |
| (2) Arterial Road 1 (KL Elevated HWY-Wangsa Keramat) | HW-15 | 2020 | |
| (3) Arterial Road 2 (KL Elevated-New Pantai) | HW-16 | 2010 | |
| (4) Local Road 1 Jalan Genting Kelang - Jalan Damansara | HW-17 | 2020 | |
| (5) Local Road 2 Jalan Yap Kwan - Jalan Datuk Abu Mali | HW-18 | 2010 | |
| (6) Local Road 3 Jalan Conlay - Jalan Raya Chulan | HW-19 | 2000 | |
| (7) Local Road 4 S.G. Besi - Jalan Tenteram | HW-20 | 2010 | |
| (8) Local Road 5 Jalan Pantai - Jaln Gasing | HW-21 | 2010 | |
| (9) Local Road 6 KL - Seremban - Jalan Syed | HW-22 | 2020 | |
| (10) Local Road 7 Jala Ipoh - Jalan Sentul | HW-23 | 2010 | |
| (11) Local Road 8 Fontage of North-East Expressway | HW-24 | 2010 | |
| (12) Local Road 9 Jalan Cheras - Jalan 3/29 1A | HW-25 | 2010 | |
| (13) Connecting Link 1 ( to Petaling Jaya) | HW-26 | 2010 | |
| (14) Connecting Link 2 (Shah Alam Expressway-Federal Highway) | HW-27 | 2010 | |

# Table 10.1.4 Proposed Projects and Implementation Schedule (2/2)

## 2. Public Transport-Enhancing Projects

| Project | Project No. | Stage | Implementation Schedule 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 |
|---|---|---|---|
| **1) Inter-modal Facility** | | | |
| (1) Transferring System | PT-1 | 2010 | |
| - Sultan Ismail, P. Ramlee and Wawasan Stations | | | |
| - Bank Negara and Bandaraya Stations | | | |
| (2) Rail Station Plaza and Park and Ride Facility | RT-2 | 2010 | |
| - Ampang Station | | | |
| - Masjit Jamek Station | | | |
| - 6 Stations (Gombak-Dato Keramat / LRT 2) | | | |
| - 5 stations (Setia Jaya-Petaling / KTMB) | | | |
| - 5 Stations (Kg. Pasir-Lambah Pantai / PRT) | | | |
| - 2 Stations (Rawang Line / KTMB) | | | |
| - 2 Stations (Batu Cave Line /KTMB) | | | |
| **2) Improvement of Access Road to Railway Stations** | | 2010 | |
| (1) Access to Railway Station | RT-3 | | |
| - Ampang (LRT I/Ampang Line) | | | |
| - Campaka (LRT I/Ampang Line) | | | |
| - Pandan Indah (LRT I/Ampang Line) | | | |
| - Pandan Jaya (LRT I/Ampang Line) | | | |
| **3) Relocation of Inter-state Bus Terminal** | RT-4 | 2020 | |
| - Klang Bus Terminal | | | |
| - Pudraya Bus Terminal | | | |
| **4) New Railway Station (KTMB)** | RT-5 | 2010 | |
| - Cucpacs | | | |

## 3 Traffic Control / Management in CPA

| Project | Project No. | Stage | Implementation Schedule 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 |
|---|---|---|---|
| **3-1 TRAFFIC CONTROL/MANAGEMENT** | | | |
| 1) Traffic Signal Control System | CP-1 | 2000 | |
| - Traffic Signal Light Coordination System & Signal Phase System | | | |
| 2) Improvement of No-signalised Roundabout & Others | CP-2 | 2000 | |
| - Improvement of Roundabout (Pudu) | | | |
| - Traffic Signalized Intersection | | | |
| Jalan Pajang - Jalan Tun Razak | | | |
| Jalan Pudu - Jalan Yew | | | |
| Jalan Syed Putra | | | |
| Jalan Stan Hisyamuddi - Jalan Kinabalu | | | |
| Jalan Pudu - Jalan Tun Perak | | | |
| - Channelaization System | | | |
| 3) Improvement of Pedestrian Facilities. | CP-3 | 2000 | |
| - Signalized Pedestrian Crossing | | | |
| - Pedestrian Crossing Bridge | | | |
| - Scramble Pedestrian Crossing | | | |
| - Pedestrian-friendly Sidewalk | | | |
| Jalan Raya Abdullah | | | |
| Jalan Ampang | | | |
| Jalan Sultan Ismail | | | |
| Jalan Ramlee | | | |
| Jalan Raja Chulan | | | |
| **3-2 AREA PRICING** | | | |
| 1) Area Pricing in CPA | CP-4 | | |

## 4. Transport Information System & others

| Project | Project No. | Stage | Implementation Schedule 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 |
|---|---|---|---|
| **4-1 TRANSPORT INFORMATION SYSTEM** | | | |
| 1) Bus Location System | IS-1 | 2000 | |
| 2) Modernization and Improvement Current System (First Stage) | IS-2 | 2000 | |
| - Parking Guidance System | | | |
| 3) Navigation and Route Guidance System (Second Stage) | IS-3 | 2010 | |
| 4) Automated Driving System (Third Stage) & Others | | 2020 | |
| **4-2 PROJECT FOR FREIGHT MOVEMENT** | | | |
| 1) Truck Terminal | ZZ-3 | 2010 | |

## 10.2 Economic Analysis

The total cost of the Master Plan over the period from 1999 to 2020 is estimated to amount to RM 19.4 billion in terms of economic prices as shown in Table 10.1.3. In the meantime, the cumulative GRDP of the Study area is estimated to be RM 3,110 billion in 1998 prices over the same period. The amount of RM 19.4 billion accounts for more than 0.6 % of the future GRDP of the Study area. The economic viability of the Master Plan is examined from the nation's economic view point, adopting the Cost-Benefit Analysis under the "With Project" and "Without Project" scenarios as shown in Figure 10.2.1. The following assumptions are also taken into account.

a. Project Life: 20 years after the target year of 2020, namely from 1999 to 2040.

b. Discount Rate: A discount rate of 12 % is used; and

c. Foreign Exchange Rate: For the purpose of the Study the foreign exchange rate is fixed at the rate; US Dollar 1.00 equivalent to RM3.80. A shadow exchange rate is not considered.

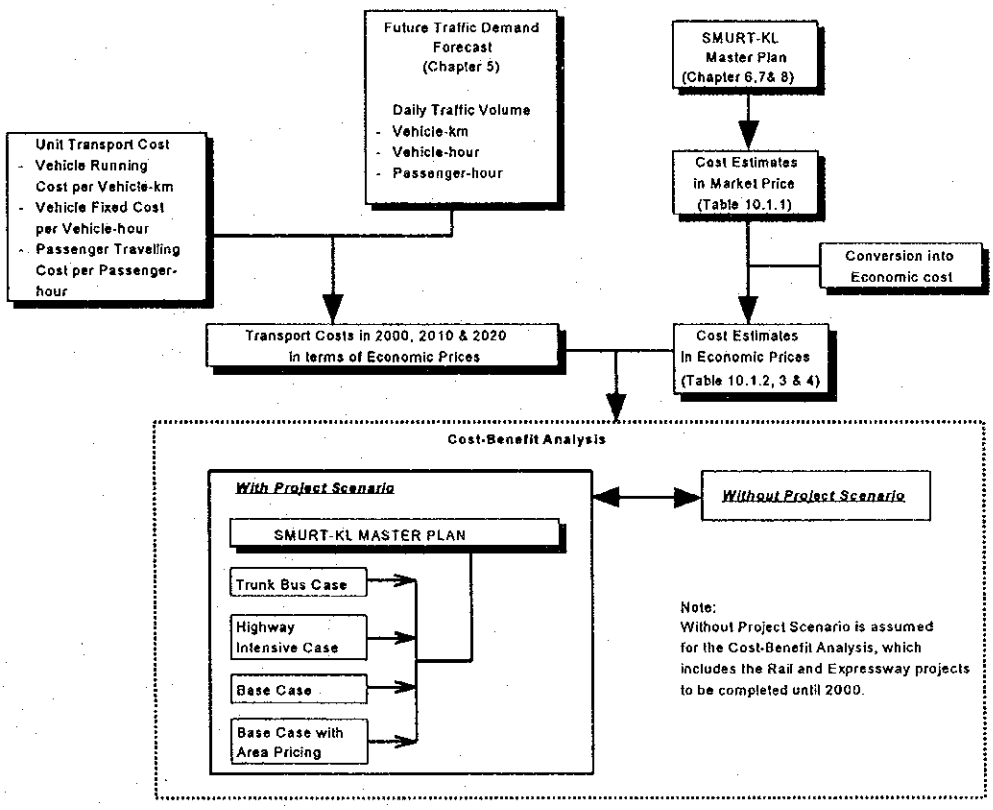


**Figure 10.2.1 Flowchart of Cost-Benefit Analysis**

### 10.2.1 Evaluation Cases

Regarding the "With Project" scenario, the following five (5) alternative cases have been formulated for the Cost-Benefit Analysis.

**Table 10.2.1 Five Cases and Major Development Components**

| Case / Major Development Components | Trunk Bus | Highway Intensive | Base Case | Base Case with Area Pricing | SMURT-KL Master Plan |
|---|---|---|---|---|---|
| Trunk Bus System | – | | – | – | – |
| Public Transport-enhancing Project | – | – | – | – | – |
| Highway Development | | – | – | – | – |
| Area Pricing | | | | – | – |
| New LRT System | | | | | – |

1) **Base Case:** The Base Case includes the Major Transport Facility Development, such as the Trunk Bus System and Highway Projects, except for the New LRT System (Damansara–Cheras Line). Area pricing is not included in this case.
2) **Trunk Bus:** This case examines the economic viability when only the trunk bus system is introduced.
3) **Highway Intensive:** This case evaluates an urban transport system which depends intensively on highway development and requires huge investment costs.
4) **Base Case with Area Pricing:** This case proposes the introduction of Area Pricing in addition to the Base Case.
5) **SMURT-KL MASTER PLAN (Base Case with Area Pricing and New LRT):** This case includes the complete set of components, including the New LRT Line between Damansara and Cheras, and is ultimately proposed as the SMURT-KL Master Plan in the Study.

**Table 10.2.2 Capital Costs of Five (5) Cases in Economic Prices**

Unit: RM million

| | Total Economic Cost | Case of Cost Benefit Analysis | | | | |
|---|---|---|---|---|---|---|
| | | Trunk Bus Case | Highway Intensive Case | Base Case | Base Case with Area Pricing | SMURT-KL Master Plan |
| 1 Major Transport Facility Development | | | | | | |
| 1-1 New Rail Projects | 4,060 | 0 | 0 | 0 | 0 | 4,060 |
| 1-2 Trunk Bus System | 501 | 501 | 0 | 501 | 501 | 501 |
| 1-3 Highway Projects | 13,256 | 0 | 13,256 | 13,256 | 13,256 | 13,256 |
| 2 Public Transport-Enhancing Projects | 56 | 56 | 56 | 56 | 56 | 56 |
| 3 Traffic Control/Management in CPA | | | | | | |
| 3-1 Traffic Control/Management | 47 | 0 | 0 | 0 | 0 | 0 |
| 3-2 Area Pricing | 4 | 0 | 0 | 0 | 4 | 4 |
| 4 Transport Information System & Others | 20 | 20 | 0 | 20 | 20 | 20 |
| - Bus Location System & Others | 175 | 0 | 0 | 0 | 0 | 0 |
| - Others | | | | | | |
| Total | 18,119 | 577 | 13,311 | 13,832 | 13,837 | 17,897 |
| | 100% | 3% | 73% | 76% | 76% | 99% |

Note: The projects, which will not affect directly traffic demand, are deleted from the project lists.
Source: SMURT-KL

### 10.2.2 Benefit

Savings in vehicle operation costs and travelling time costs to passengers are defined principally as benefits for the economic evaluation of the Master Plan as shown in Figure 10.2.2.

Traffic safety is also one of the important impacts resulting from the improvement of urban transportation. The effect of accident reduction is counted as supplementary benefits, and the magnitude of this impact on the indices of economic evaluation is examined.

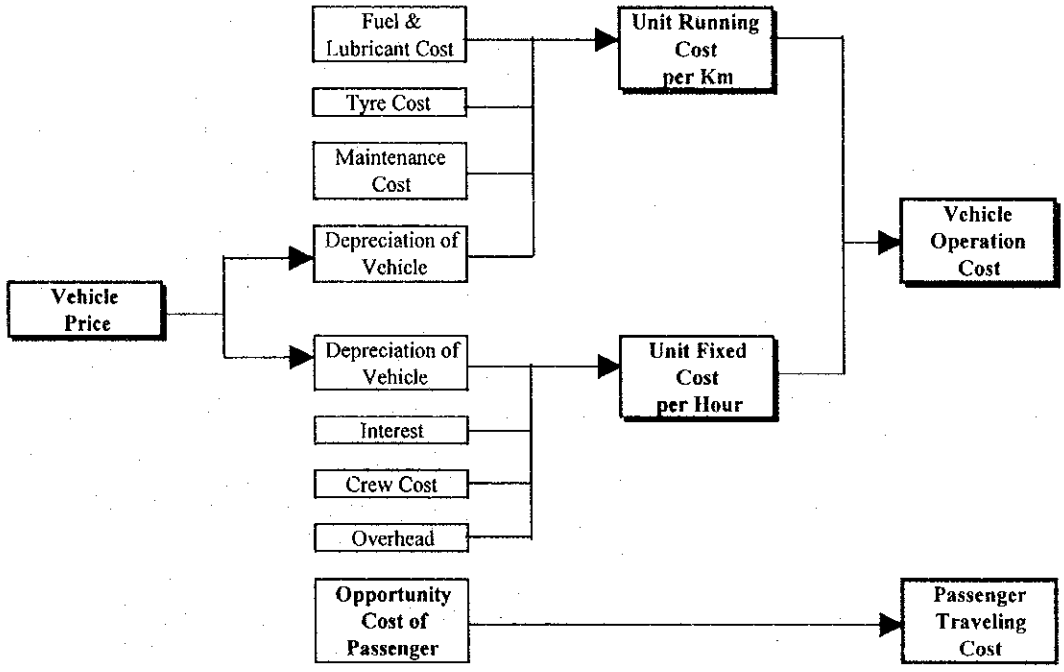


**Figure 10.2.2 Vehicle Operation and Passenger Travelling Time Cost**

(1) Vehicle Operation Cost

The vehicle running costs consist of lubricant cost, tyre cost and maintenance cost, which vary with the running distance of the vehicle (*vehicle-km*). Fuel costs vary with both running distance and speed of the vehicle. On the other hand, the fixed vehicle costs such as interest cost, crew cost and overhead vary with the period of vehicle operation (*vehicle-hour*). The vehicle price is divided into the distance portion (running cost) and the time portion (fixed cost).

The vehicle operation costs are estimated for the vehicle running costs and fixed costs as shown in Tables 10.2.3 and 10.2.4, respectively.

## Table 10.2.3 Unit Running Cost of Vehicle per Vehicle-Km by Speed

Unit: RM/Vehicle-km

| Speed (KM/Hour) | Passenger Car | Small Lorry | Heavy Lorry | Bus | Motorcycle |
|---|---|---|---|---|---|
| Financial Cost | | | | | |
| 5 | 0.344 | 0.462 | 0.965 | 1.399 | 0.097 |
| 15 | 0.310 | 0.425 | 0.896 | 1.326 | 0.087 |
| 25 | 0.284 | 0.396 | 0.842 | 1.269 | 0.080 |
| 35 | 0.265 | 0.375 | 0.803 | 1.228 | 0.075 |
| 45 | 0.253 | 0.362 | 0.779 | 1.203 | 0.072 |
| 55 | 0.248 | 0.358 | 0.770 | 1.194 | 0.071 |
| 65 | 0.250 | 0.362 | 0.776 | 1.201 | 0.071 |
| 75 | 0.260 | 0.375 | 0.797 | 1.224 | 0.074 |
| 85 | 0.277 | 0.396 | 0.832 | 1.263 | 0.079 |
| 95 | 0.302 | 0.425 | 0.883 | 1.318 | 0.085 |
| Economic Cost | | | | | |
| 5 | 0.246 | 0.398 | 0.846 | 1.262 | 0.078 |
| 15 | 0.226 | 0.370 | 0.795 | 1.208 | 0.072 |
| 25 | 0.210 | 0.349 | 0.755 | 1.166 | 0.068 |
| 35 | 0.199 | 0.333 | 0.726 | 1.136 | 0.065 |
| 45 | 0.192 | 0.324 | 0.709 | 1.117 | 0.064 |
| 55 | 0.189 | 0.321 | 0.702 | 1.111 | 0.063 |
| 65 | 0.191 | 0.324 | 0.706 | 1.116 | 0.063 |
| 75 | 0.197 | 0.333 | 0.722 | 1.133 | 0.065 |
| 85 | 0.207 | 0.349 | 0.748 | 1.161 | 0.067 |
| 95 | 0.221 | 0.371 | 0.785 | 1.202 | 0.071 |

Note: The details of the estimation of each item are shown in Appendix 10.2 in the Main Text.
Source: SMURT-KL

## Table 10.2.4 Unit Fixed Cost of Vehicle per Vehicle-Hour

Unit: RM/Vehicle-hour

| | Passenger | Small Lorry | Heavy Lorry | Bus | Motorcycle |
|---|---|---|---|---|---|
| Financial Cost | | | | | |
| Depreciation | 3.751 | 0.769 | 1.158 | 6.119 | 0.533 |
| Interest | 5.745 | 1.848 | 3.647 | 14.703 | 0.584 |
| Crew Cost | 0.000 | 12.629 | 14.857 | 7.429 | 0.000 |
| Overhead | 3.560 | 7.401 | 10.330 | 10.330 | 0.640 |
| Total | 13.057 | 22.646 | 30.352 | 38.581 | 1.757 |
| Economic Cost | | | | | |
| Depreciation | 2.967 | 0.692 | 1.347 | 5.704 | 0.523 |
| Interest | 4.544 | 1.664 | 3.237 | 13.705 | 0.573 |
| Crew Cost | 0.000 | 12.629 | 14.857 | 7.429 | 0.000 |
| Overhead | 2.563 | 5.699 | 7.438 | 7.438 | 0.461 |
| Total | 10.074 | 20.683 | 26.879 | 34.275 | 1.556 |

Source: SMURT-KL

(2) Passenger Travelling Cost

1) Opportunity Cost of Passenger:

The improvement of urban transport system reduces the travelling time of passengers and induces benefits. The opportunity cost of passengers in 2000 is estimated at RM 48,648 per year or RM 23.2 per hour based on the GRDP and the number of employees in the Planning Framework. The growth of productivity is taken into account to estimate the future opportunity cost of passenger travelling time.

2) Business related Trip Share:

The results of the Home Interview Survey show that the share of Non-Home Based Business and Home-Based Work trips is 15 percent and 41 percent, respectively, of the total motorised mode trips. Accordingly, it is assumed that 56 percent of the total saved passenger-hours could be accounted for as benefits from savings in passenger travelling time.

3) Vehicle Occupancy:

The vehicle occupancy is 1.47, 1.14 and 13.30 persons per vehicle for passenger car, motorcycle and bus, respectively.

### 10.2.3 Evaluation

Table 10.2.5 shows the results of calculations using the indices of the Net Present Value (NPV), B/C Ratio and Internal Rate of Return (IRR) for the five cases.

**Table 10.2.5 NPV, B/C Ratio and IRR of Five Cases**

| Case | Net Present Value | Present Value (Discount Rate : 12%) | | | | | Benefit-Cost Ratio | Internal Rate of Return |
|---|---|---|---|---|---|---|---|---|
| | | Cost | Benefits (RM million) | | | Benefits | | |
| | Discount Rate : 12% (RM million) | (RM million) | Vehicle Running Cost Savings | Vehicle Fixed Cost Savings | Passenger Travelling Time Savings | (RM million) | (Discount Rate 12%) | |
| **SMURT-KL Master Plan** | 7,862 | 6,978 | 152 | 4,043 | 10,644 | 14,840 | 2.13 | 18.8% |
| Trunk Bus | 1,276 | 390 | 120 | -30 | 1,576 | 1,666 | 4.28 | 27.5% |
| Highway Intensive Case | 7,376 | 6,051 | -555 | 3,514 | 10,469 | 13,428 | 2.22 | 19.3% |
| Base Case | 6,430 | 6,419 | -299 | 3,463 | 9,685 | 12,849 | 2.00 | 18.7% |
| Base Case with Area Pricing | 4,997 | 6,428 | 124 | 4,013 | 10,288 | 14,425 | 2.24 | 19.0% |

Source: SMURT-KL

The IRR of the SMURT-KL Master Plan is estimated at 18.8 %, which is sufficiently high to justify the implementation of the project. The major benefits are derived from the cost savings in time related portions such as vehicle fixed costs and passenger travelling

costs. The total benefit of the SMURT-KL Master Plan is the highest out of the five cases, and, at the same time, the total investment cost is also the highest.

The investment costs of the new LRT Line between Damansara and Cheras, which is proposed to be completed in 2020, is estimated to be RM 4,060 million at 1998 prices, accounting for about 23 % of the total investment cost of the SMURT-KL Master Plan. However, an additional burden of RM 4,060 million is discounted into RM 464 million in present value, and the effect on the economic analysis is not significant.

Although the effects of each component of the SMURT-KL Master Plan on traffic volume are interdependently linked and complicated, they can be explained from the results of the evaluation of the four cases as follows.

(1) Trunk Bus:

The IRR shows a sufficiently high rate of 27.5 % to justify the project. A trunk bus system is recommended to introduce in the early stage of the Master Plan, as the cost burden of the project is small.

(2) Highway Intensive Case:

The cost savings in vehicle running costs are negative in this case, since vehicle running costs or distance related costs increase due to the addition of expressway links. By providing expressways, the speeds of the vehicles running on the expressways is faster than the economic running speeds of around 55 km per hour, thus the vehicle running costs could increase. Besides, the addition of expressways will reduce the travelling time but sometimes the travel distance could be longer due to detours and result in increased distance related costs. The IRR is highest of all the cases except for the Trunk Bus Case.

(3) Base Case and Base Case with Area Pricing:

The benefits with the Area Pricing is greater than that without it in every item as shown in Table 10.2.5. The total benefits increase from RM 12,849 million to RM 14,425 million by a rate of 12 % with Area Pricing. The results explain that restraint of automobile traffic by Area Pricing induces benefits to the society.

The benefits, the costs, the annual net benefits and the cumulative net benefit in present value during the period of the Master Plan is depicted in Figure 10.2.3. The annual net benefit turns positive in 2008, while the cumulative net benefits is continuously negative until 2016 and turns positive from 2017 onwards.

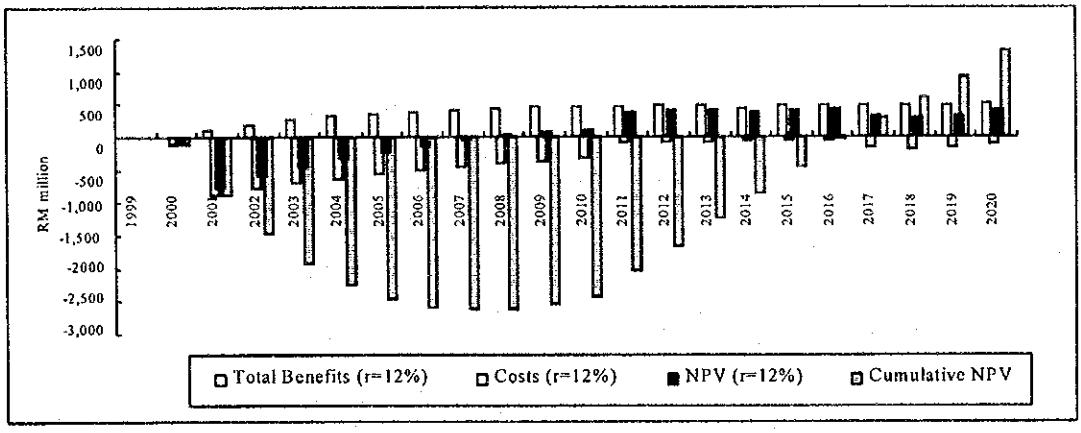


**Figure 10.2.3 Benefits, Costs, Annual Net Benefits and Cumulative Net Benefit of SMURT-KL Master Plan in Present Value (1999 – 2020)**

### 10.2.4 Sensitivity Analysis

(1) Sensitivity Analysis

The sensitivity of the SMURT-KL Master Plan is examined under the following assumptions.

1) Increase of the Investment Costs by 20 %: the IRR decreases from 18.8 % to 16.9 %. However, it remains high enough to show the viability of the Project to be implemented.

2) The share of Business Trip at 36 % in stead of 56 %: Assuming that NHBB trips and a half of the HBW trips are taken into account to estimate the opportunity cost of passengers, the benefit decreases by 26 % and the IRR declines to 16.0 %.

3) Traffic Accident Reduction: Assuming that the Study area could gradually reduce the rate of death caused from traffic accidents to 0.08 in 2010 and later to 0.05 in 2020 from 0.40 per thousand population in 1997, the benefit of lives saved from death are calculated under the following assumptions:

   - The average residual year of the person is 30 years; and
   - The benefit is the saved GRDP per Capita discounted at a rate of 12 %.

   The saved costs account for RM 4,900 million in 1998 prices or RM 1,118 million in present value during the period from 1999 to 2020. The benefit raises the IRR of the SMURT-KL Master Plan from 18.8 % to 20.4 %.

Table 10.2.6 summarises the results of the sensitivity analysis.

**Table 10.2.6 Results of Sensitivity Analysis**

| Case | Net Present Value (Discount Rate:12%) (RM million) | Present Value (Discount Rate: 12%) Costs (RM million) | Present Value (Discount Rate: 12%) Benefits (RM million) | Benefit-Cost Ratio (Discount Rate:12%) | Internal Rate of Return % |
|---|---|---|---|---|---|
| **SMURT-KL Master Plan** | 7,862 | 6,978 | 14,840 | 2.13 | 18.8% |
| Investment Cost Increase by 20% | 6,466 | 8,374 | 14,840 | 1.77 | 16.9% |
| Business related Trip: 36% | 4,060 | 6,978 | 11,038 | 1.58 | 16.0% |
| With Benefit of Accident Reduction | 8,979 | 6,978 | 15,957 | 2.29 | 20.4% |

Source: SMURT-KL

(2) Non-rail Case

A Non-rail Case is assumed as a "without project" scenario and its traffic demand is compared with that of the SMURT-KL Master Plan. It is assumed in the Non-rail Case, that every rail project, including the operating lines and the planned lines of the LRT and the Monorail, will be suspended in 2000, while the other projects proposed in the SMURT-KL Master Plan except for the rail projects will be implemented.

As shown in Table 10.2.7, the IRR of the SMURT-KL Master Plan is estimated at 41.8 %. It reveals that the society would incur much lower transport costs in the SMURT-KL Master Plan than in the Non-rail Case.

**Table 10.2.7 Evaluation of Non-rail Case**

| | Net Present Value (Discount Rate: 12%) (RM million) | Present Value (Discount Rate: 12%) Costs (RM million) | Benefits (RM million) Vehicle Cost Savings on Road | Benefits (RM million) O & M Costs Savings of Rail | Benefits (RM million) Passenger Travelling Time Savings | Total Benefits (RM million) | Benefit-Cost Ratio (Discount Rate:12%) | Internal Rate of Return % |
|---|---|---|---|---|---|---|---|---|
| **SMURT-KL Master Plan** | 9,116 | 2,880 | 14,182 | -4,616 | 2,430 | 11,996 | 4.17 | 41.8% |

Note: The costs for the rail projects until 1999 is assumed to be sunk costs except for the costs of rolling stocks. The residual value of rolling stocks is calculated as an inverse cost in 2000.