MINISTRY OF PUBLIC WORKS
MAMMINASATA METROPOLITAN
DEVELOPMENT COOPERATION BOARD (MMDCB)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

INTEGRATED SPATIAL PLAN
FOR
THE MAMMINASATA METROPOLITAN AREA

SUBSTATION EXPANSION
AND
DISTRIBUTION SYSTEM REHABILITATION

Pre-Feasibility Study (3)

July 2006

KRI INTERNATIONAL CORP.
NIPPON KOEI Co., Ltd.

Exchange Equivalents
US$ 1 = IDR 8,760 = ¥ 114.0
(As of May 2006)

SUBSTATION EXPANSION

AND

DISTRIBUTION SYSTEM REHABILITATION

Pre-Feasibility Study (3)

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1. BACKGROUND

1.1 Power System of South Sulawesi

1.1.1 System Configuration

The Mamminasata Metropolitan area receives electric power from the grid electric power system in South Sulawesi (called the System SULSEL or the System). The backbone of the System is composed of 150 kV and 70 kV overhead transmission lines (see Figure-1). The primary distribution lines are 30 kV and 20 kV middle voltage lines depending on the voltage levels of the step down transformers at substations.

The 150 kV transmission lines form the backbone of the System, and runs from north to south of Mamminasata. As of May 2005, there are five 150 kV substations; i.e., Bosowa Substation (S/S) in Maros, Tello S/S and Tello-Lama S/S in Makassar, Tallasa S/S in Takalar, and Sungguminasa S/S in Gowa. With the financial assistance of KfW[*1], a 150 kV transmission line and related substations are being expanded from Sungguminasa to Tanjung Bunga, and from Tallasa to Jeneponto. These lines will be energized in July 2006.

The 70 kV lines run through the major demand centers of Mamminasata. Five 70 kV substations are located in Bontoala, Daya, and Panakukkang in Makassar, Mandai in Maros, and Borongloe in Gowa. The 30 kV and 20 kV trunk distribution lines encompass the center of Makassar City and extend to the KIMA industrial estate.

The Transmission loss and distribution loss of the System was 5.2% and 10.8%, respectively. A distribution loss of 10.8% is comparable with that of Java Island (10.2%), and it can be judged as reasonable. However, since the biggest demand center of Makassar is located far from the major power stations, the transmission loss of 5.2% is bigger than the PLN average of 2.5%.

Figure-1: South Sulawesi System

[1] KfW development bank finances investments and accompanying consulting services in developing countries.

1.1.2 Power Generation

There are 39 power generating units with a total generating capacity of 555.9 MW within the System[*2] (as of the end of April 2006). Of the total installed capacity, 438.0 MW, or 78.8% of total is regarded as available capacity. Figure 2 and 3 illustrates the typical daily load curve of the System and the generation pattern of the power plants in the dry and wet seasons.

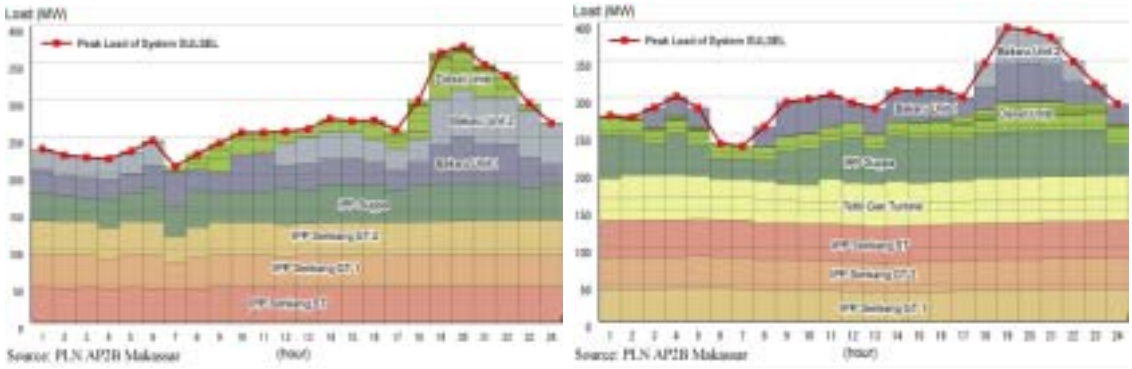

Figure-2: Daily Load Curve of South Sulawesi System (Left: Wet Season, Right: Dry Season)

PLN's Bakaru Hydropower Plant and Sengkang IPP Gas Combined Cycle Power Plant[*3] play an important roll in the System. During 2005, Bakaru and Sengkang generated 31.7% and 45.7% of energy in the System. The plant load factor[*4] of those plants is much higher than the average plant load factor of other power plants (Bakaru was 67.0%, and Sengkang was 90.3%, while others were 19.1% in 2005).

The Sengkang power station has two gas turbines and one steam turbine. All three units supply stable power and energy to the System throughout the year serving as a base load power station.

The Bakaru hydropower station has two generating units. During the wet season, both units are fully operated to supply base/middle load utilizing available water. On the other hand, during the dry season, while one unit is operated continuously to fulfill base/middle load, the other unit is operated only for peak load.

The IPP Suppa diesel power station is operated for base/middle load in the dry season and for peak load in the rainy season. Due to high operation cost and deteriorated equipment, the average plant load factor of PLN's other units was only 15.1% in 2005.

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[2] Excluding existing small diesel units in Jeneponto, Makale, Swaitto, Mamuju, Bantaeng, Matekko, Loka, and Sinjai. These generators are already disconnected to the gird and will be relocated to other isolated grids.

[3] The power station is owned and operated by the PT. Energi Sengkang. The Australian energy company "Energy Equity" owns a 47.5% stake while another 47.5% stake is owned by"El Paso Energy International" a USA registered company. The rest of the stake is owned by the Indonesian company "Triharsa Sarana Jaya Purnama".

[4] Plant Load Factor: The ratio of the electric energy produced by a generating unit for a year to the electrical energy that could have been produced at continuous full-power operation during the year. A higher value indicates higher utilization.

1.2 Unstable Electricity Supply in Mamminasata

1.2.1 Energy Crisis at South Sulawesi Province in 2005

While the peak load of the South Sulawesi System is between 400 – 420 MW, the available capacity of the System is 438.0 MW. The reserve capacity of the System is only 4.1% to 8.7%, which is far below the minimum target level of 20%. Consequently any maintenance outage or forced outage of generating units soon leads to a supply shortage.

Mamminasata experienced serious load shedding (rolling blackouts or scheduled blackouts) from 22 July to 9 October 2005, mainly because of lower power generation by IPP Suppa power station. This resulted from the soaring international fuel oil price and associated rapid increase in the domestic fuel oil subsidy, as well as subsequent insufficient allocation of fuel oil from Pertamina. In May 2006, Mamminasata again suffered from extensive load shedding during the overhaul of one generating unit of the Sengkang plant. During these periods, load shedding is executed in accordance with a predetermined scheduled at timed intervals, i.e., 2- 4 hours blackout, two to four days a week on average.

Such frequent load sheddings are attributable to (i) delay in power station development, and (ii) lack of fuel oil resulting from a surge in international oil price. In addition, low energy production of the Bakaru hydropower station and insufficient capacity of power transformer have aggravated the problem.

Lack of generation capacity will continue until the completion of IPP Poso hydropower station in Central Sulawesi in August 2007 (180 MW) or expansion of Sengkang Gas Combined Cycle power station (65 MW).

1.2.2 Frequent Interruptions

Table-1 shows the "System Average Interruption Duration Index" (SAIDI) and the "System Average Interruption Frequency Index" (SAIFI) of PLN Makassar Branch[*5] and the Indonesian average. SAIDI indicates the cumulative length of power interruption in hours. On the other hand, SAIFI indicates the average number of times that each customer has experienced interruption per annum.

Table-1: SAIDI and SAIFI of Study Area and the Indonesian Average

	SAIDI (hours/customer)	SAIFI (times/customer)
Cabang Makassar[*]	6.57 (in 2005)	29.81 (in 2005)
Indonesian Average[**]	9.43 (in 2004)	11.78 (in 2004)

Source: PLN Annual Report 2004, PLN South Sulawesi Statistics 2005

[5] Franchise area of the PLN Makassar branch consists of the Makassar, Maros, Takalar, Gowa and Pangkep.

While the duration of the interruptions in Mamminasata was shorter than the Indonesian average, the frequency of interruption was about 2.5-times higher than the Indonesian average. During 2004, there were 5,696 times of forced outages were happened within the System, of which 97.7% resulted from troubles in the distribution system.

1.3 Issues to be Addressed

As mentioned in the previous section, electricity supply in Mamminasata is in a critical situation. To solve the problems, as stated in the "Power Sector Report" of the "Integrated Spatial Plan for the Mamminasata Metropolitan area", there are four major issues to be addressed urgently:

(i) Timely Development of the Power Stations
(ii) Forming Two Ring Shaped Transmission Networks
(iii) Timely Expansion of the Transformer Capacity
(iv) Rehabilitation and Modernization of Existing Distribution Facility

Most of the power stations envisaged in "the Power Development Plan 2005-2014, PLN South Sulawesi Region" are to be developed by private investors, such as Bosowa, PT. Kassa Lindo, and PT. Energi Sengkang. Takalar Coal fired Power Station (200 MW) will be constructed by the public sector using external financial assistance.

In the case of the transmission line, a ring shaped 150 kV network (Tello- Parepare- Sidrap- Soppeng- Watampone- Bulukumba- Takalar- Sungguminasa) started operation in May 2006. The other ring-shaped network, Sidrap- Maros- Sungguminasa- Tello- Pangkep- Parepare, should be completed before the commissioning of Malea hydropower station in 2012. Thus, the construction of the latter ring-shaped network is not so urgent.

However, although, augmentation of transformer capacity as well as rehabilitation/ modernization of existing distribution facilities should be urgently executed by the public sector, sufficient budget allocation from PLN's equity cannot be expected under the constrained financial conditions of PLN. The necessity of the power transformer capacity augmentation project and rehabilitation/modernization of the distribution network is explained next section.

2. NECESSITY OF THE PROJECT

2.1 Necessity of Power Transformer Augmentation Project

Overloading transformers shortens their life, increases transformation loss, and causes a drop in voltage. If the overload continues, brownout/blackout of surrounding areas or breakdown of the transformer would occur. Thus, PLN adopts an allowable load factor of 80% in view of the stability of the grid and avoiding the forced outage of other transformers.

At the time of the Master Plan Study (August 2005), the transformers at several substations were frequently overloaded. Overloading of these transformers resulted in blackout and load shedding of their supply area. For example, KIMA Industrial estate is supplied with electricity from Daya substation. At the time, since the transformer in Daya substation was repeatedly overloaded during the operating hours of KIMA, energy consumption in KIMA factories has been depressed. The factories located in KIMA were seriously hindered.

After that, transformers were installed at Daya (20 MVA), Panakukkang (60 MVA), Takalar (30 MVA), Borongole (10 MVA), and Mandai (20 MVA). The transformer capacity was then, for the most part, adequate.

Figure-3 and Figure-4 illustrate the load factor[*6] of transformers in Mamminasata in April 2006. The horizontal axis indicates the days in April, the vertical axis indicates the maximum load factor recorded during a day. As shown in the figures, except for the transformer in Panakukkang substation, the maximum load factor of each transformer was generally within the range of 30% to 80%.

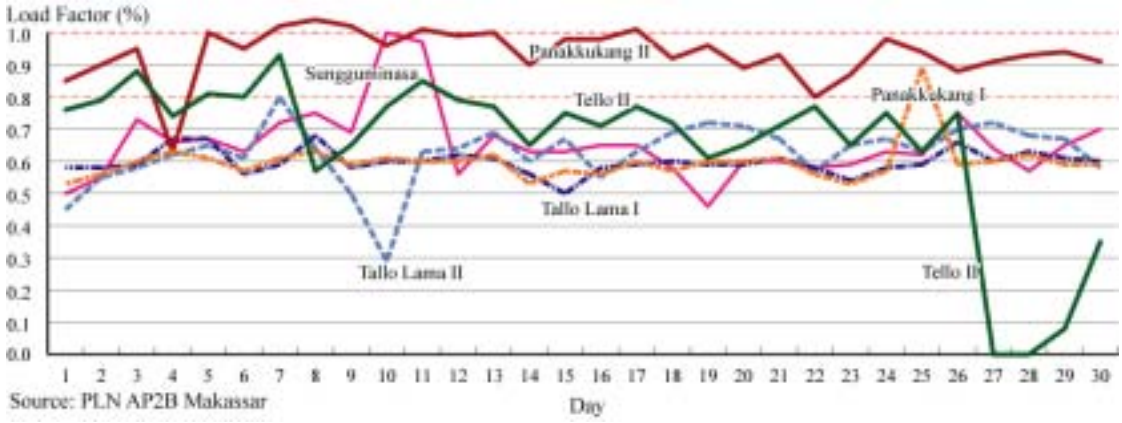

Figure-3: Load Factor of 150 kV Transformers in Mamminasata (April 2006)

[6] Load Factor: A ratio of maximum load levied on a transformer to rated capacity of the transformer.

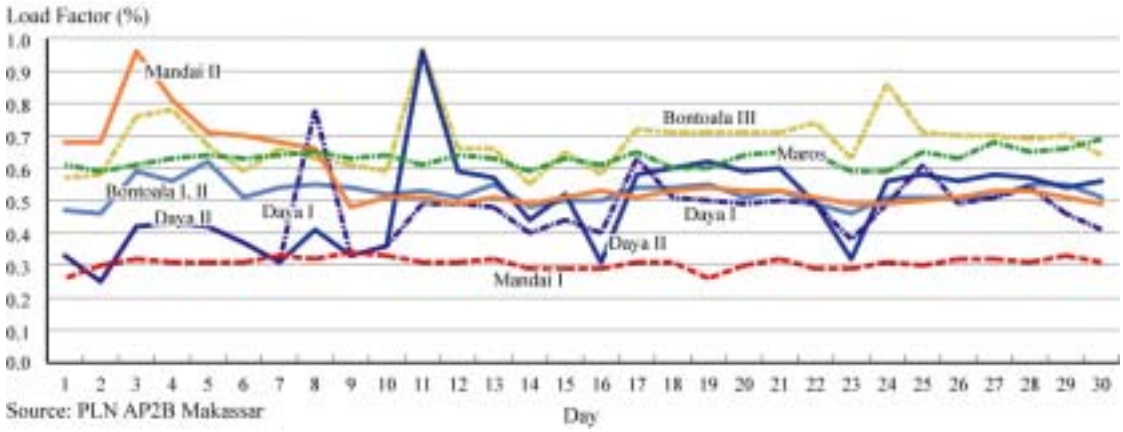

Figure-4: Load Factor of 70 kV Transformers in Mamminasata (April 2006)

However, the maximum load of the transformers in Panakukkang substation mostly exceed the allowable limit of 80%, and even exceed 100% for some of the time (see Figure-3 and Figure-5).

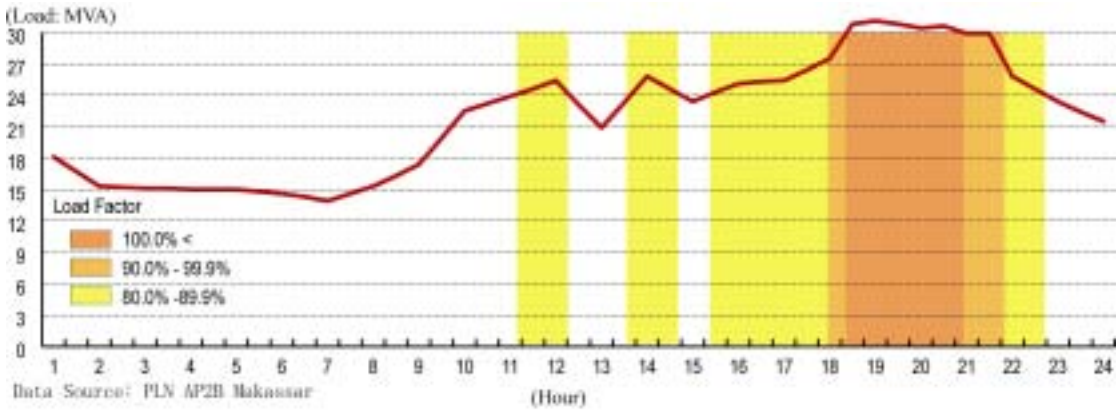

Figure-5: Hourly Load of 30 MVA transformer in Panakukkang Substation (8th April 2006)

In the case of the new Tanjung Bunga substation, which will commence operation in July 2006, PLN has already installed a 30 MVA transformer. Although the transformer capacity of Tanjung Bunga substation was decided to be 30 MVA several years ago, the demand in the area has rapidly increased. Thus, PLN forecasted that the 30 MVA transformer will exceed 90% soon after it is commissioned.

In order to avoid hindrances, urgent expansion of the transformer capacity is required at Panakukkang and Tanjung Bunga. In addition, to accommodate the growing demand, augmentation of transformer capacity will be required in Maros substation in 2008 and Sungguminasa substation in 2009.

2.2 Necessity of the Rehabilitation/ Modernization of Distribution Network

The distribution facilities in Mamminasata are generally old, poorly maintained, overloaded, and too weak to accommodate the increasing demand or even to maintain

acceptable supply quality to the existing demand.

During the year 2005, there were 5,696 forced outages[*7] within the franchise area of PLN Makassar branch. Of these, 5,567 times (97.7%) were caused by problems with distribution lines, followed by substation and/or transformers problems (77 times: 1.4%), generation troubles (56 times: 1.0%), and transmission line problems (8 times: 0.1%). Owing to these interruptions, 1,839 MWh of energy were lost in 2005. The frequency of forced outages is about 2.5 times larger than the Indonesia average.

The need for rehabilitation/modernization of the distribution system is well recognized by PLN. However, the budget allocation for the distribution system is insufficient. In 2006, while PLN South Sulawesi brunch requested an investment budget of Rs. 220.3 billion, the actual allocation was only Rs. 88.1 billion (40% of the requested amount).

In order to stabilize the electricity supply, rehabilitation/upgrading of the distribution facilities and strengthening of the operation and maintenance capability are required. Also, the scope should include replacement of the existing transmission line between Bontoala - Tallo Lama (about 11 km) from 70 kV to 150 kV, and new construction of 150 kV transmission line between Bontoala and Tanjung Bunga (about 4 km).

[7] Forced Outage is unplanned blackout; it excluds planned outages such as for load shedding and maintenance .

3. PROJECT DESIGN

3.1 Project Objective and Scope

The main objectives of the project are to (i) meet the growing power demand arising from the increased economic activities in Mamminasata, (ii) provide a high quality and stable electricity system thus reducing interruption and load shedding, and (iii) facilitate enhancement of the people's livelihood and economic development of Mamminasata

The project scope can be broadly divided into the following two components:

(a) Power Transformer Capacity Augmentation

This sub-project includes procurement and installation of transformers and associated equipment at four substations.

(b) Rehabilitation and Modernization of Distribution Network

The Project is designed to rehabilitate, upgrade, and reinforce medium-voltage and low voltage distribution systems as well as replace and construct new 150 kV transmission lines in Mamminasata.

3.2 Project Scope and Estimated Costs

3.2.1 Power Transformer Capacity Augmentation

This sub-project aims to install additional transformers at substations at Mamminasata where the load is exceeding the transformer capacity. The sub-project includes procurement and installation of transformers and associated equipment at the four substations shown in Table-3. The scope and cost of the project are also shown in Table-3.

Table-2: Scope and Estimated Cost for the Power Transformer Capacity Augmentation

Items	Estimated Cost (US$ 1,000)			Year
	Foreign	Local	Total	
1. Panakukkang - 1 x 150 kVA Transformer Bay - 1 x 60 MVA Power Transformer 150/20 kV - 10 x 20 kV Switchgear	1,446	248	1,694	2007
2. Tanjung Bunga - 1 x 150 kVA Transformer Bay - 1 x 60 MVA Power Transformer 150/20 kV - 10 x 20 kV Switchgear	1,446	248	1,694	2007
3. Maros - 1 x 150 kVA Transformer Bay - 1 x 30 MVA Power Transformer 150/20 kV - 9 x 20 kV Switchgear	1,021	175	1,196	2008

4. Sungguminasa - 3 x 150 kVA Transformer Bay - 1 x 30 MVA Power Transformer 150/20 kV - 9 x 20 kV Switchgear	1,021	175	1,196	2009
Total	4,935	845	5,780	

The estimated period of implementation required for the project is approximately 37 months from the commencement of works.

3.2.2 Rehabilitation and Modernization of Distribution System

This sub-project will comprise replacement and extension of medium and low voltage lines and upgrades of distribution substations. This component includes increasing the voltage level that will reduce distribution loss. In addition, distribution substations will be upgraded in areas where the transformer loading is reaching limits owing to the load growth.

Rehabilitation and modernization of distribution system includes following works.

(i) Upgrading outgoing feeder cable from Panakukkang substation to Latanete (XLPE 3 x 70 mm^2 → XLPE 3 x 240mm^2): 0.4 km

(ii) Upgrading low voltage distribution feeder from Tanjung Bunga to Barombong (Cu 3 x 16 mm^2 → AAAC 3 x 150 mm^2): 5.0 km

(iii) Construction of new interconnecting feeder between Hertasning Baru Road and Tello substation: 3.8 km

(iv) Construction of new feeder line (XLPE 3 x 300 mm^2) Tanjung Bunga substation and Sungguminasa substation: 11 km

This sub-component includes replacement of the existing transmission line between Tallo Lama - Bontoala (about 11 km), upgrading voltage level from 70 kV to 150 kV, and construction of a new 150 kV transmission line between Bontoala and Tanjung Bunga (about 4 km).

With the completion of these sub-components, 150 kV transmission lines with form a small ring shaped network within Mamminasata area (please refer to Figure-6). This component is expected to substantially stabilize electricity supply in Mamminasata.

Figure-6: Proposed 150 kV Transmission Line

Table-3: Scope and Estimated Cost for Rehabilitation/Modernization of Distribution System

(Unit: US$ 1,000)

Items	2007		2008		Total	
	Volume	Cost	Volume	Cost	Volume	Cost
Service Transformer	45 No.	297.3	85 No.	561.5	130 No.	858.8
Terminal Connector	1 No.	102.8	1 No.	102.8	2 No.	205.7
Medium Voltage Line 3 x 240 mm^2	0.0 km	-	4.1 km	369.3	4.1 km	369.3
Terminal Connector Panel	12 sets	413.8	22 sets	758.7	34 sets	1172.5
Low Voltage Distribution Panel	120 sets	216.9	240 sets	433.8	360 sets	650.6
Distribution Transformer	48 sets	260.4	90 sets	488.2	138 sets	748.6
Low Voltage Twisted Connector	25.0 km	158.7	45.0 km	285.7	70.0 km	444.4
Low Voltage Conductor 3x 150 mm^2	15.0 km	134.0	29.0 km	259.1	44.0 km	393.0
150 kV Transmission Line	10.8 km	1,125.8	4.2 km	469.3	15.0 km	1,695.1
Total (Round the value to the US$ 1,000)		**2,810.0**		**3,728.0**		**6,538.0**

Note: Exchange Rate Used: US$ 1= Rp. 8,760

The estimated period required for implementation of the project is approximately 24 months from the commencement of works.

3.2.3 Total Estimated Cost

The total project cost is estimated to be approximately US$ 12,317 thousand. Of which, the cost of power transformer capacity augmentation is US$ 5,780 thousand (47% of total project cost), and rehabilitation/ modernization of distribution network is US$ 6,538 thousand (53% of total cost).

4. EFFECTS OF THE PROJECTS

Both components are expected to reduce load shedding through augmentation of transformers and distribution transformers. The reduction in load shedding itself would bring large improvement in comfort for households and reduced loss in production and sales and less need for back-up generators for businesses. These benefits would in turn provide a more favorable environment for potential foreign investment in Mamminasata and improve Mamminasata's economic growth perspectives.

4.1 Effects of Power Transformer Augmentation

When a power demand is predicted to exceed the capacity of the transformer, then measures such as scheduled outages need to be taken to prevent malfunctioning of the power supply system. In order to prevent such a situation from occurring and to stabilize the power supply, each substation needs to be equipped with transformers with sufficient capacity. If the project is not executed, the load on the transformers will exceed their capacity in the near future.

Table-4: Effect of the Power Transformer Capacity Augmentation Project

		With the Project	Without the Project	Note
Panakukkang	Capacity	60 MVA	120 MVA	Additional transformer capacity is enough to cover the demand until 2013
	Load Factor	87% in 2007	44% in 2007	
Tanjung Bunga	Capacity	30 MVA	90 MVA	Additional transformer capacity is enough to cover the demand until 2012
	Load Factor	102% in 2007	34% in 2007	
Maros	Capacity	20 MVA	30 MVA	Additional transformer capacity is enough to cover the demand until 2011
	Load Factor	84% in 2008	56% in 2008	
Sungguminasa	Capacity	30 MVA	60 MVA	Additional capacity is enough to cover the demand until 2013. Exiting 20 MVA (10 x 2 units) will be relocated to other substation.
	Load Factor	100% in 2009	50% in 2009	
Total	Capacity	140 MVA	300 MVA	

Source: JICA Study Team

The direct effect of the sub-project is to increase transformer capacity of the four selected substations from 140 MVA to 300 MVA. After the project, load shedding or long term blackouts resulting from a lack of transformer capacity will be averted and such effects as stable power supply, improvement in reliability, reduction of power outage period, etc. are expected with this increase in the power supply capacity.

Moreover, implementation of the project and replacement of old and deteriorating equipment by more reliable units will reduce the cost and time needed for repair and maintenance and lower environmental risks such as soil contamination through leakage of insulation oil.

After the project, target substations will be able to cover the demand until 2011 (Maros), 2012 (Tanjung Bunga), and 2013 (Panakukkang and Sungguminasa).

4.2 Effects of Rehabilitation and Modernization of Distribution Network

The benefits would consist of: (i) fewer unplanned outages, improved quality of electricity supply (e.g., less voltage fluctuation) and lower distribution losses; (ii) improved in the power sector from the reduction in power distribution losses; and (iii) reduced load shedding from the improved capacity of distribution transformers.

In year 2005, 1,839 MWh of energy or US$ 122 thousand was lost due to the blackouts resulted from problems of distribution line. And if distribution loss is reduced by 1% point, PLN can save US$ 1,721 thousand. Accordingly reduction in distribution loss and reduction in blackouts result from distribution line will bring about fiscal benefits and allow these budgetary resources to be used for other critical needs.

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INTEGRATED SPATIAL PLAN
FOR
THE MAMMINASATA METROPOLITAN AREA

IMPROVEMENT OF PERINTIS - URIP ROAD

Pre-Feasibility Study (4)

July 2006

KRI INTERNATIONAL CORP.
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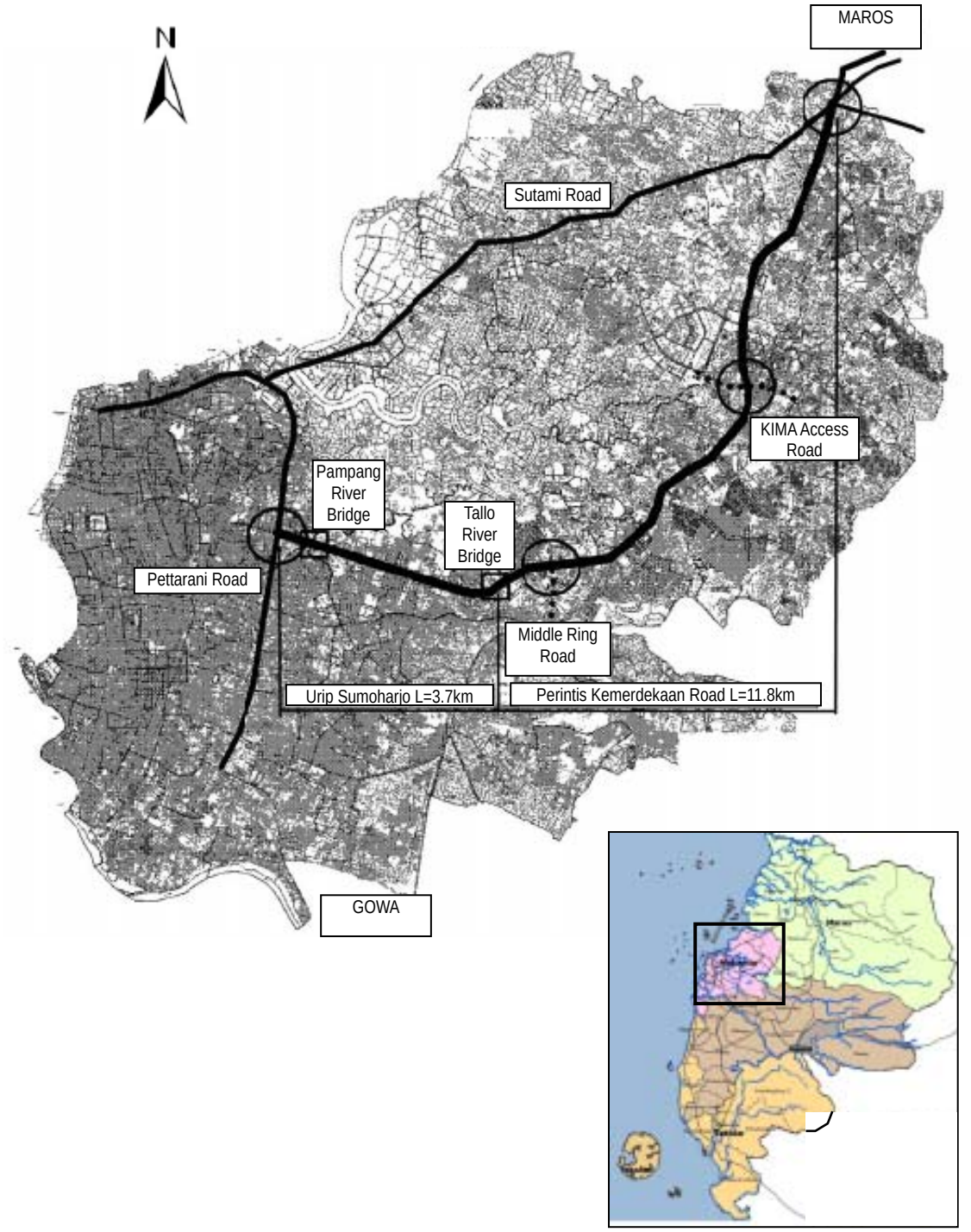

LOCATION MAP OF THE PROJECT

IMPROVEMENT OF PERINTIS - URIP ROAD

Pre-feasibility Study (4)

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1. INTRODUCTION

1.1 Background and Objective

(1) Background

Prior to this pre-feasibility study, the Master Plan was formulated for the Mamminasata metropolitan area and priority projects have been selected.

Selection of the priority projects was conducted based on traffic assignment simulation and the following selection criteria were adopted for selection.

(i) The project has an effective role for the future urban growth and development of the urban arterial road network, and,

(ii) The project can contribute to envisaged residential and industrial development plans and projects.

The following 16 projects were proposed as comprising the Master Plan.

a) Perintis with Urip Smoharjo
b) Ir Sutami
c) Arauding
d) Marino Access
e) Middle Ring Road
f) KMA Access
g) Tan Jun Bunga Access
h) Takalar Access
i) Mamminasata Bypass (inc Bridge)
j) Abudull Daeng Siura
k) Around Air Port
l) Airport Access
m) Trans Sulawesi (inc Bridge)
n) Heltasning
o) KIWA Access
p) Around Sungm inasa

The above 16 projects were further studied and modified as integral components of the proposed Master Plan. Perintis with Urip Sumoharjo road project was approved as the priority project for the pre-feasibility study due to its urgency for implementation.

This report embodies the results of the study on Urip Sumoharjo road and Perintis Kemerdekaan road, which together are referred to as “the study road” throughout this report.

(2) Objectives

The most important policy agenda for sustainable metropolitan area development and growth is efficient and effective road network development. Comprehensive social and economic development and population increment expected in the future requires a huge amount of urban areas for housing and other

socio-economic activities. In order to support and guide these development demands properly, a well articulated road network is a must. Without provision of adequate roads, it is difficult to achieve planned land-use, ensure accessibility to necessary urban services, or realize a good environment.

The importance of the study road is highly significant in the sense that the study road is presently functioning as an intercity/intra trunk road and will become a critical major urban road in the future because of urban expansion. More commercial and residential developments will take place along the roads.

1.2 Project scope and components

The scope and components of this study have been defined as follows:

(i) Conduct traffic demand forecast: this has been done in the Master Plan and the subjected area is further examined in some detail.

(ii) Determine the role and function of the study road:

(iii) Conduct preliminary engineering study of the following sections:

- Urip Sumoharjo road section; widening
- Perintis Kemerdekaan road section; widening

(iv) Evaluate the project from economic, financial, environmental and social perspectives.

(v) Develop a project implementation plan

2. CURRENT CONDITION OF THE PROJECT AREA

2.1 Overview

The study road traverses rolling terrain including two major river crossing of Pampa and Tallo. The study road runs through various land use zones such as commercial, residential and educational areas, government office district, industrial estate, and forest. A satellite view of the project area is shown in Figure 2.1.1.

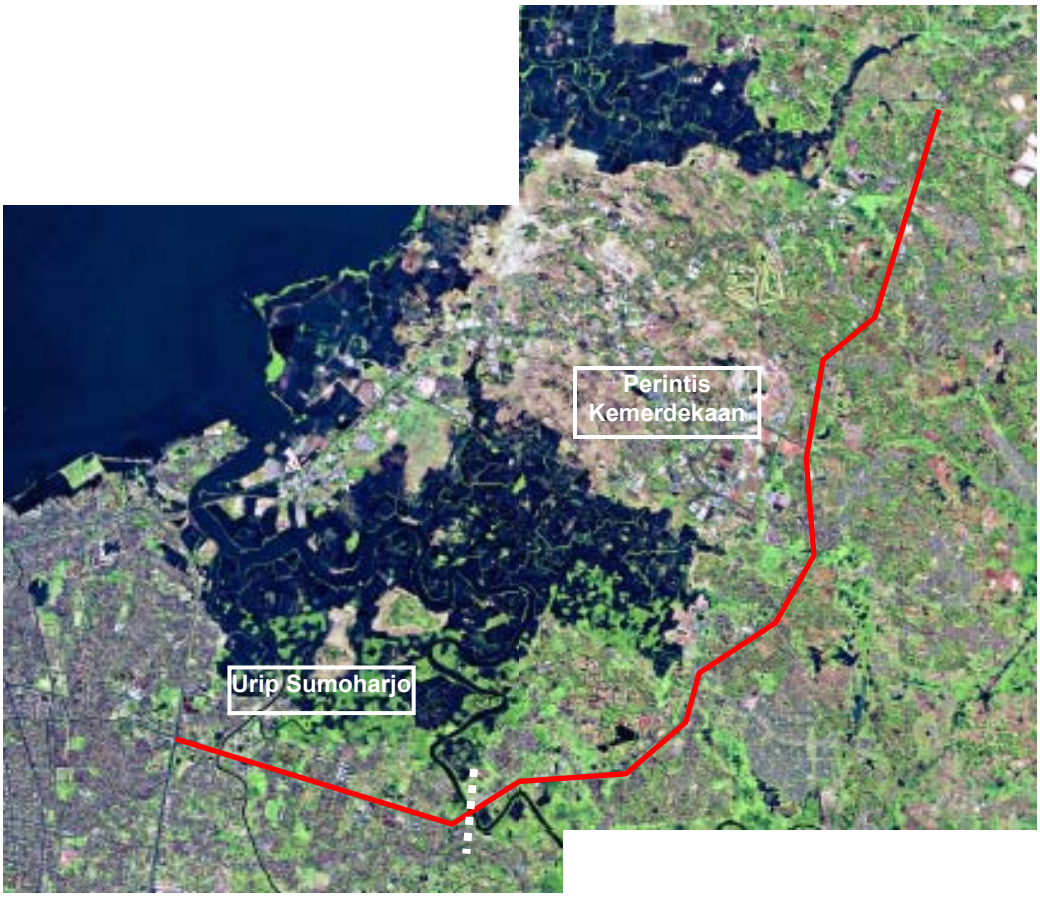


Figure 2.1.1 Satellite View of the Project Area

2.2 Natural Conditions

The current condition of the natural environment is examined based on the existing data and the results of site survey.

(1) Topographic and Geological Features

The project area consists of Urip Sumoharjo street, which is the west part from Tallo River, and Perintis street which is the north part.

The project area is located almost in the center of Makassar city close to Maros regency to the north side. The area is the flood plain of the Tallo River and a hilly zone in the north part of Makassar city. The elevation is in the range between about 2 m and 24 m.

The Urip Sumohrjo street is lowland. The lowest elevation is 2.1 m and the highest is 16.5 m. The street is near the flood plain of the Tallo River and its tributary, the Pampang River that is used for drainage.

Perintis street crosses relatively hilly terrain. The lowest elevation is 2.3 m near the Tallo River in Tamaranrea region and the highest near the border of Biringkanaya region is 24.3 m. The elevation becomes lower towards the border of Maros regency.

The Urip Sumoharjo and the southern part of Perintis is located in the flood plain of the Tallo and Pampang rivers, where there are sedimentary rocks consisting of tuffaceous sandstone, siltstone and weathered volcanic rocks. It seems that a laterite layer exists within the soil in the hilly area.

(2) Soil Erosion

Soil erosion sometimes occurs on the area upstream of Tello Bridge. Arable land such as paddy field or crops land located in the lowland is often inundated in the rainy season, and it may cause the damage by erosion. Almost no soil erosion occurs downstream of Tello Bridge where there are many brackish fish ponds along the river. On the other hand, as these ponds act as a regulation pond for flood overflow from the Tallo River, it seems that inundation damages to the lowland residential areas are restrained.

(3) Groundwater

Most of the residents along the project area use dug wells, mainly for daily use, i.e. bathing and washing, but not direct ingesting. There are no available detailed data on the depth of the wells and the water level in the project area. Concerning the groundwater quality of Makassar city in 2002, the density of fecal coliform exceeds the standard. The groundwater quality is not good for directly drinking, because most of the wells near the project area are dug wells that are easily contaminated by rainwater runoff and waste. This is one of the main causes of groundwater contamination.

(4) Meteorology

The project area is located in the northern part of Makassar city where the climate is tropical monsoon with high temperature and little variation throughout the year and distinct wet/dry seasons. There is, however, a large spatial variation in annual rainfall and temporal variation in monthly rainfalls.

The northwest monsoon in the project area prevails from November to April and delivers a high amount of precipitation. The mean annual temperature in 2002 was 27.7 degrees and the difference between mean maximum and mean minimum temperature is 7.3 degrees. Monthly maximum difference in 2002 was 9.1 degrees in October. Annual

rainfall in 2002 was 2,729 mm, monthly maximum rainfall was 788 mm in January. About 96% of the annual rainfall falls during the rainy season. Average monthly maximum rainfall 1996-2002 is 1,034 mm in February and the average monthly minimum is no rainfall in August.

(5) Hydrological Situation

The Tallo River crosses the project alignment and has a catchment area of 407 km^2, but the discharge data is not measured along this river. The Tallo River meets the tributary of the Pampang River at the lower reach and empties into Makassar strait.

The fish ponds downstream of the Tallo River contribute to flood control in the rainy season. The tributary of Pampang River is used as a drainage channel in the eastern part of Makassar urban district. The Manggala swamp upstream of Pampang River plays a vital role as a regulation pond with surrounding paddy fields.

(6) Flora and Fauna

The existing investigation data for the EIA report of the center ring road and middle ring road can be used to describe the flora and fauna around the project area. Protected species according to Indonesian law were not recorded in this investigation.

During the field reconnaissance along the Tallo River, water birds such as egrets, wild ducks, kingfishers and so on were observed. However, the existing species are mainly common ones in the rural area of South Sulawesi. It is not possible to find any mammals in the project area.

The vegetation consists mainly of planted species along the existing road. The nipah palms that flourish along the Tallo River contribute to the purification of water quality. It seems that there are no precious vegetation species, as determined by Indonesian law, found around the project area.

It is considered that there are no data available on freshwater aquatic species in the ponds and rivers of the project area.

(7) Landscape

The landscape of urban districts spreads on both sides of Urip Sumoharjo while houses, small shops, restaurants, some government offices and so on are dotted along Perintis street. The density of buildings along Urip Sumoharjo is high, while along Perintis it becomes relatively low.

Urip Sumoharjo street passes through the east part of Makassar urban district. Therefore, many houses and buildings exist behind the buildings along the street. So Perintis street passes through the suburban area, except for the surrounding area of UNHAS, Daya and

Pai town located at the boundary of Tamaranrea and Biringkanaya region, houses and buildings are scattered.

2.3 Environmental Conditions

(1) Air Pollution

In the center of Makassar city, it seems that the air quality is slowly becoming better, as the results of air quality surveys in recent year (2003-2006) do not show any significant increase. However, the numbers of motorcycles and vehicles have not changed seriously, and the emission of industrial factories and so on is a few originally. It appears that the exhaust gas from motorcycles and vehicles has improved by enforcing the regulations, and the quality of gasoline and/or diesel fuel has improved gradually.

However, the values of TSP and PM10 concerning suspended particulate matter are high in the dry season, and the lead concentration (Pb) is still rather high. It seems that the traffic volume will be increased by degrees. The ambient air quality is likely to become worse in future.

The survey result along the project area is shown in Table 2.1.1. All survey items are under the standard of ambient air quality, but the concentration value of HC, TSP and Lead (Pb) are relatively high at some points.

Table 2.3.1 Ambient Air Quality in 2006

	Survey Point		SO_2 μg/Nm3	CO μg/Nm3	NO_2 μg/Nm3	O_3 μg/Nm3	HC μg/Nm^3	PM_{10} μg/Nm3	TSP μg/Nm3	Pb μg/Nm3	Nox μg/m3	Remarks
analysis result *1)	1 UNHAS	1 hour	114.84	570.55	87.35	92.97	33.25					11-Feb-06
		24 hours	29.73	361.77	23.94		3 hours	30.92	156.25	0.31	29.73	
	2 Jl. Sumoharjo	1 hour	144.78	460.69	29.12	36.06	61.25					13-Feb-06
		24 hours	83.00	356.48	10.04		3 hours	47.17	179.55	1.13	15.16	
	3 Jl. Perintis-1	1 hour	132.35	479.38	34.94	49.42	104.25					14-Feb-06
		24 hours	57.44	362.40	8.82		3 hours	61.96	196.01	0.89	17.08	
	4 Jl. Perintis-2	1 hour	89.94	563.23	23.29	50.64	23.75					15-Feb-06
		24 hours	52.65	301.03	8.57		3 hours	41.54	116.87	0.10	16.71	
National standard for ambient air quality *2)												
measured duration		1 hour	900	30,000	400	235	-	-	-	-	-	
		3 hours	-	-	-	-	160	-	-	-	-	
		24 hours	365	10,000	150	-	-	150	230	2.00	92.5*4)	
Local standard for ambient air quality *3)												
measured duration		1 hour	900	30,000	400	230	-	-	-	-	-	
		3 hours	-	-	-	-	160	-	-	-	-	
		24 hours	360	10,000	150	-	-	150	230	2	92.5*5)	

Notes: Exceeding the standard

Source:

*1) Mamminasata JICA study team data Year 2006

*2) Government Regulation regarding Control of Air Pollution No.41-1999

*3) Governor's Regulation of South Sulawesi Province No. 14-2003

*4) Governor's Dgree of the Minister for Environment concerning Guidekines for Establishment of Environmental Quality Standards No.2-1988

*5) Governor's Dgree of South Sulawesi Province No.465-1995

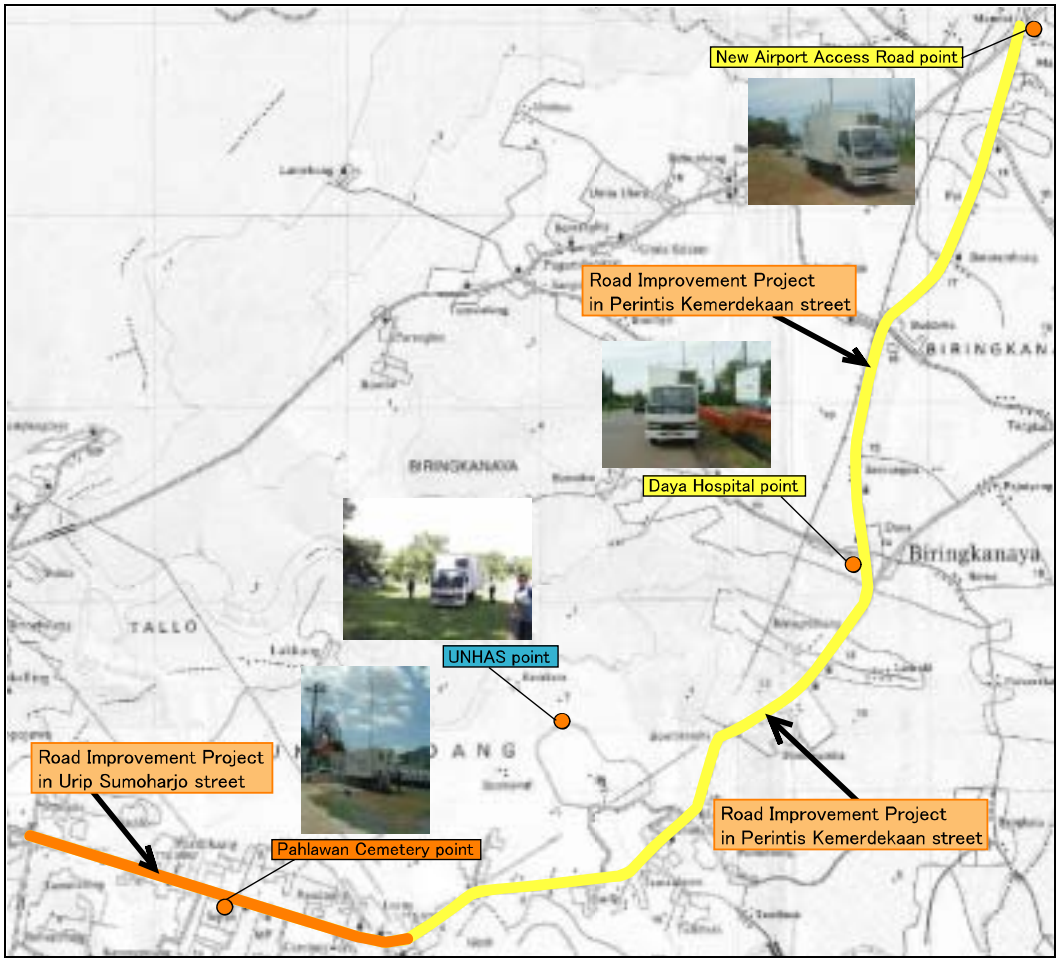


Figure 2.3.1 Ambient Air Quality Survey Points

(2) Water Pollution

The surface water quality of the Tallo River around the project area is improving, though the population has increased and urbanization has expanded to rural areas. The water quality of Pampang River, which is used as drainage canal in Makassar city, is poor. The concentrations of DO, BOD5, COD and TDS exceed the environmental standards for Class IV.

According to available data of the water quality around the project area, Iron (Fe), Manganese (Mn), Hydrogen Sulphite (H2S-), Ammonium (NH3-N), Nitrite (NO2-N), Zinc (Zn), Organic matter (KMnO4), Cadmium (Cd), Cupper (Cu) and Fecal Coliform value exceed the environmental standard for Class IV.

Table 2.3.2 Result of Water Quality Survey at Tell Bridge and Pampang Bridge

Parameters	2003		2004		2005		2004
	dry	rainy	dry	rainy	dry	rainy	Pampang R.
pH	7.0	6.0	7.0	7.0	7.0	6.6	7.4
DO	2.6	2.8	-	3.9	-	-	1.5
BOD_5	140.0	125.0	5.4	3.1	3.0	1.4	43.7
COD	233.0	280.0	17.0	9.5	16.4	14.7	126.0
TDS	305.0	197.0	11.0	605.0	1,253.0	148.0	13,400.0
TSS	7.0	23.0	224.0	163.0	111.0	46.0	-

(3) Noise

According to the results of survey data along the project area, the L50 of noise level along roads with heavy traffic is over 70.6 dB(A). This is higher than the environmental standard for commercial and service land use zone or even for industry. The main sources of the noise are horns, exhaust and friction of tires of vehicles and motor bikes. Especially, in Indonesia, horn sounds cause high noise. According to a survey by a hand-held noise level meter in Makassar city, the ambient noise at main streets is about 60~70 dB(A). Most noise level is recorded 75~80 dB(A) along the Hasanuddin street momentarily. The survey points are the same as ambient air quality.

Table 2.3.3 Noise Level in 2006

	NO.	L5	L10	L50	L90	L95	Average	Remarks
analysis result	1 UNHAS	44.5	51.7	49.4	58.1	64.4	53.5	11-Feb-06
	2 Jl. Sumoharjo	67.9	67.3	70.9	72.8	74.2	70.6	13-Feb-06
	3 Jl. Perintis-1	62.8	62.3	69.2	70.8	71.8	67.4	14-Feb-06
	4 Jl. Perintis-2	60.9	63.0	65.1	67.9	70.0	65.4	15-Feb-06

Source : Mamminasata JICA study team data Year 2006

(4) Offensive Odor

The main sources of odor in the project area are the stagnation of rivers, canals and ditches that domestic waste water flows into, emissions from exhausts of vehicles, motorcycles and so on. However, offensive odor in this area is not a significant problem at present. Around the project alignment, the main source of odor is the domestic waste water from each household. Septic tanks for the waste water of each household should be improved. Garbage of each household is also a source of odor; however, it is not significant because the garbage volume along main streets is presently small.

(5) Historic and Cultural Properties

Though there are many mosques in Makassar city, there are only a few historic buildings necessary to preserve. In the project area, there are some mosques; however none of them need relocation or a preservation plan if the project is executed. Moreover,

there are no well-known remains or cultural properties along the project alignment.

(6) Ownership of Land

The land along the project area is owned by individual landowners. It seems that most residents around the street have property rights by surrounding interview survey.

(7) Solid Waste

The solid wastes from houses, shops and so on in Makassar city are collected, transported, and disposed of in a landfill site by the Cleansing Department (Dinas Keindahan Kota Makassar). The roadsides of the city are kept comparatively clean. However, waste is scattered around the waste collection points in the city. The problem is that residents frequently dump rubbish into the gutters, drainage canals, and rivers.

In the project area also, the waste collection points near the regional market are dirty and there is much waste around the roadside and gutters. Also many wastes of plastic bottles, bags, garbage and so on can be seen along the riverside of the Tallo and Pampang rivers. The collection of solid waste is implemented around the project area but the frequency of collection is low. Therefore, solid waste and garbage from each household is presently disposed of and/or dumped into a pit near the house.

(8) Domestic Waste Water

The sewage treatment plant is not available in Makassar city. Though the treatment of domestic waste water depends on the leaching pit and/or septic tank of individual houses or buildings, in the present state of affairs such facilities are not set up in most houses and buildings. Treatment facilities for waste water are not available in most houses along the project area.

(9) Hazards

Some parts of the project area are flooded in the rainy season, but most of the area is on high land. Therefore, it seems that the damage from flooding is not so significant.

(10) Minority

There are no legally protected minority groups in the project area, and no minority issues occur. Disputes between indigenous and ethnic Chinese occur sometimes triggered by accidents and/or gossip.

2.4 Socio-economic Framework

The Master Plan Study sets a socio-economic framework for population and GRDP in the region, and these have already been approved to be adopted for the study purpose. In this pre-feasibility study, the same framework is adopted.

(1) Population

Present population of the whole Mamminasata area in 2005 is 2,254,000, of which the majority of 57% inhabits Makassar, followed by 27% in Gowa, 14% in Maros and 11% in Takalar. Overwhelming majority is concentrated in Makassar, and its adjacent kacamatans have higher populations than those of others in the three regencies i.e. Gowa, Maros, and Takalar. This population distribution reflects the expansion of the urban area from the center of Makassar city east towards the vicinity along the road.

Future population up to the year 2020 has also been estimated based on the past trends and projections of fertility, mortality, and migration. And proposed future town planning is also reflected in this projection. The Mamminasata population is predicted to grow at 1.7% annually in 2005-2020 as shown in Tables 2.4.1 and 2.4.2. A high unemployment ratio is a significant feature.

Two cases of socio-economic framework were established as the “Base Case” and “Moderate Case”. The base case was an ambitious scenario prepared by BAPPEDA and population projected by JICA Study Team. In the moderate case, both population and GRDP were projected by the JICA Study Team based on practicability, and therefore lower growth rates than the base cases were set.

Table 2.4.1 Framework of Residential Population in Mamminasata

(unit: 1,000 persons)

Regency	2005	2010	2015	2020	Growth Rate (%)
Makassar	1,285	1,374	1,372	1,371	0.4%
Maros	313	339	419	498	3.1%
Gowa	599	702	799	896	2.7%
Takalar	248	256	258	314	1.6%
Total (4 Regencies)	2,446	2,671	2,849	3,079	1.5%
Mamminasata	**2,254**	**2,478**	**2,655**	**2,884767**	**1.7%**

Source: JICA Study Team

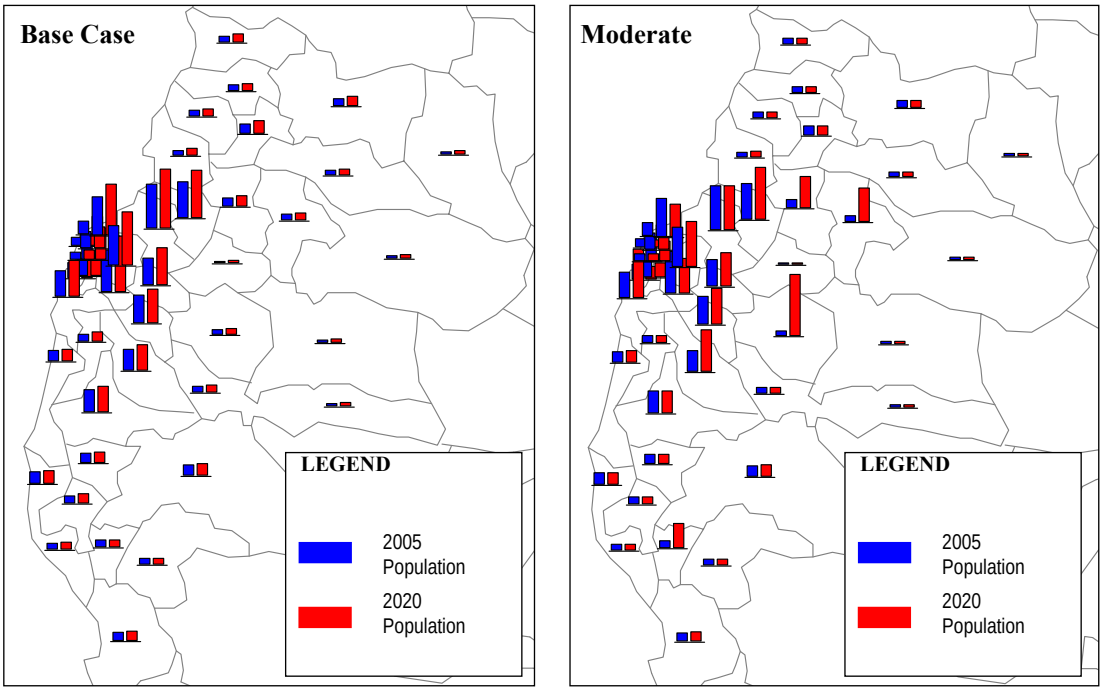
Table 2.4.2 Working Population and Unemployment in Mamminasata

(unit: 1000 persons)

	District	2005	2010	2015	2020
Makassar	Working Population	415,361	443,843	477,654	477,110
	(Unemployment Rate)	11.1%	11.1%	8.7%	8.7%
Maros	Working Population	107,774	120,297	161,959	192,469
	(Unemployment Rate)	5.3%	5.3%	3.1%	3.1%
Gowa	Working Population	219,402	310,153	379,465	431,209
	(Unemployment Rate)	3.1%	3.1%	3.1%	3.1%
Takalar	Working Population	96,284	103,931	111,438	137,647
	(Unemployment Rate)	2.0%	2.0%	2.0%	2.0%
Total	Working Population	838,822	978,225	1,130,515	1,238,436
	(Unemployment Rate)	7.2%	6.9%	5.4%	5.1%

Source: JICA Study Team

Figure 2.4.1 illustrates population by traffic zone (= kacamatan). The future traffic demand was mainly forecasted only for the moderate case i.e., practical scenario. In this moderate case, the distribution of the future population is more dynamic outside the Makassar center, indicating more dispersion into surrounding area, especially Kecamatan Parangloe of Gowa Regency, Mandai and Tanralili of Maros Regency.



Source: JICA Study Team

Figure 2.4.1 Comparison of Population between 2005 and 2020

(2) GRDP

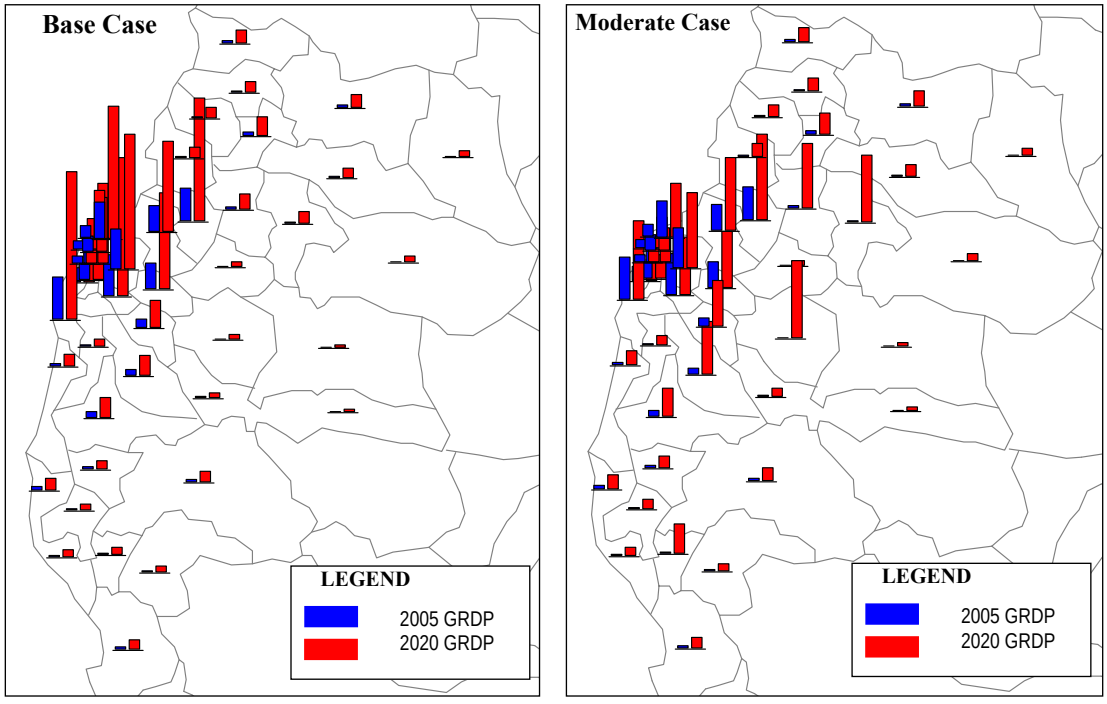
The national mid-term plan (2005-2009, BAPPENAS) sets a GDP growth rate target of 8.7%, while the provincial government expects 8.2% in 2005-2020. The expected growth rates are high in comparison with the recent trends of 4.2%. So the moderate growth scenario was adopted for the Master Plan and pre-feasibility study. Features of the sub-sector are shown in Table 2.4.3.

Table2.4.3 Macro-economic Framework for Mamminasata (2005-2020)

Regency	High Growth (BAPPEDA Case)	**Moderate Growth (JICA Case)**	Low Growth (Trend Case)
Agriculture	6.0%	**3.0%**	2.3%
Mining & Quarrying	5.9%	**6.2%**	0.2%
Manufacturing	9.8%	**6.3%**	5.2%
Electricity, Gas, Water Supply	7.6%	**7.9%**	3.4%
Construction	7.9%	**7.1%**	2.1%
Trade, Hotel & Restaurant	7.6%	**7.8%**	5.7%
Transportation, Communication	7.3%	**7.6%**	3.2%
Finance, Leasing & Business Service	10.6%	**9.7%**	4.4%
Service	7.6%	**7.5%**	3.0%
Total	8.2%	**7.1%**	4.2%

Source: BAPPEDA and JICA Study Team

The sub-urban areas, just as for the population distribution, show dynamic economic growth, and GRDP figures are more than double those of 2005, and growth of some kacamatans reflect the establishment of new industrial estates and new towns.



Source: JICA Study Team

Figure 2.4.2 Comparison of GRDP between 2005 and 2020

(3) Land use

1) General features of land use in Makassar

The current land use map in Mamminasata reveals that about 43% is occupied by agricultural area (106,320 ha), 29% by green and forest areas, and 6.0% by urban area that can be further sub-divided into residential areas (13,140 ha), commercial/business areas (1,290 ha) and industrial areas (500 ha). Figure 2.4.3 shows the land use along the study road and surrounding areas.

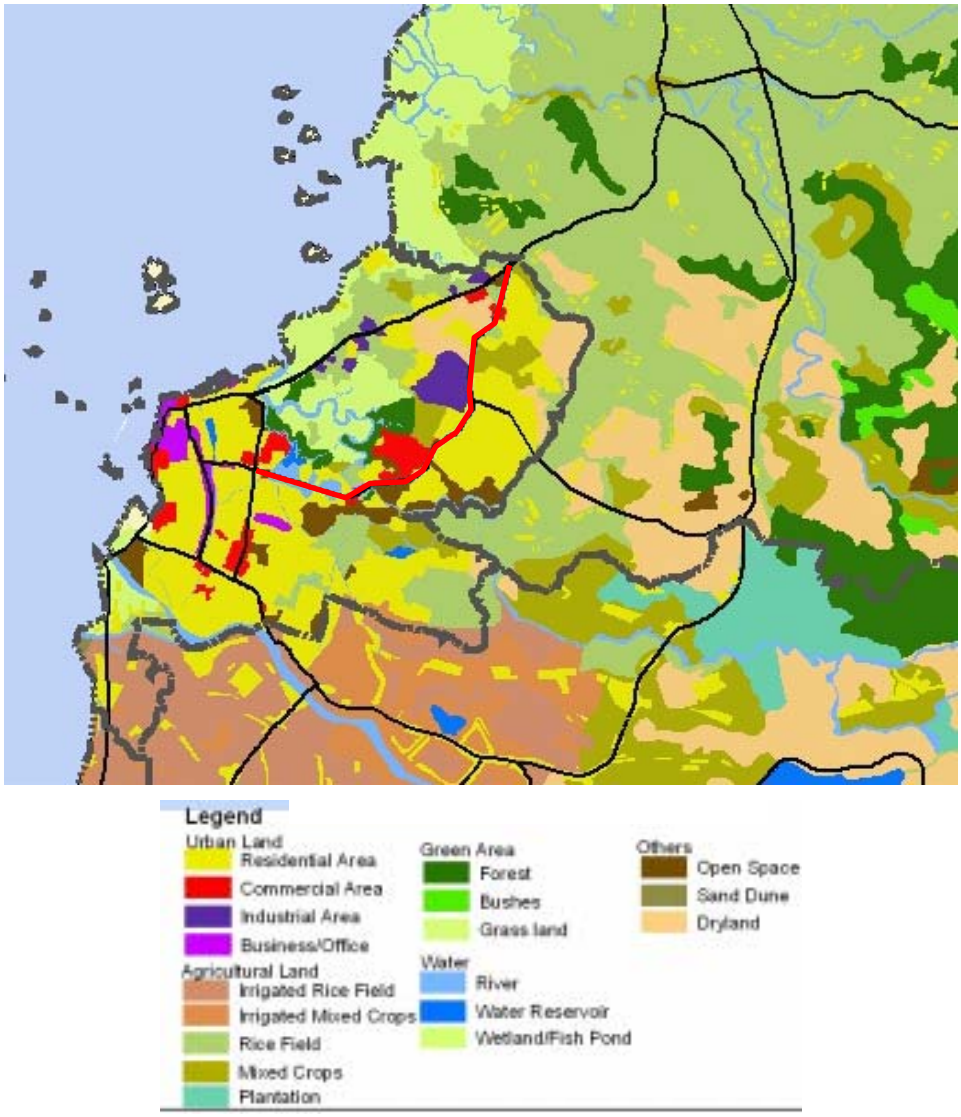


Figure 2.4.3 Current Land Use around the study road

Residential area spreads along the Perintis and other trunk roads. Urbanization has been very rapidly progressing eastward from the old Makassar area between the coastline and Veteran Utara road. It also spreads in the northern part of Makassar City along the major trunk roads, especially Perintis road, and into the whole area of Kacamatan Biringkanaya of Makassar city and Kacamatan Mandai of Maros. This trend has been on-going after the 4-lane Inner Ring Road i.e. the Andi Pangerang Pettarani and the Tol

Reformasi road, had been opened to the public. The down stream of the Tallo River is a natural sanctuary space that is missing in the Makassar city center.

2) Land use along the study road

The study road i.e. Perintis - Urip road runs through various land use zones such as commercial, residential and educational areas, government office district, and industrial estate. Behind the main street, new residential estates and factories are under development even though public utilities such as access roads, electricity, and water supply are not sufficiently provided, resulting in disorderly development.

Land use along the study road is explained in order from west to east of the road. Commercial area (pasar) is observed at the west end of the study road near the junction of the Urip Sumoharjo and the Ando Pangerang Pettarani; there are also illegal mini shops along the road.

The residential zone and business/office zone spread along Perintis road up to KIMA road, especially between the Tallo River Bridge and KIMA road, and these are surrounded by forest.

Then comes other crowded commercial areas, locating at the junction with KIMA road where there are a bus terminal and a market i.e. Pasar Daya, being crowded with commuters and shoppers. This area is a logistic hub for commodities for the inhabitants behind the newly developed residential area which is connected with a narrow road network. On the opposite side of the commercial area, behind the bus terminal, there is a big KIMA industrial estate full of factories and warehouses.

KIMA Industrial estate is located near the east end of the study road, between Perintis road and Sutami road in the Kacamatans Tamalanrea and Biringkanaya, attracting traffic of heavy vehicles. Between KIMA road and the junction of Sutami and Perintis roads are surrounded by mixture of the wild fields, padi field and residential area.

As discussed for the future development direction of the Mamminasata metropolitan area, it is recommended to effectively control the disordered urban sprawl to provide a better urban environment. A good example of development control to use as a model was found in the course of the Study in Curitiba city, Brazil. In the 1970s, Curitiba city introduced an innovative approach to development control in which trunk road development and land use regulation were combined in order to induce/guide private sector building activities to limited high development density along the major trunk road. Meanwhile such high dense developments were strictly prohibited in the hinterland to keep low dense development with rich green open space for living as shown in Figure 2.4.4.

Figure 2.4.4 High dense development along a major road in Curitiba City

In consideration of the current land use conditions of the study road section, particularly in the Perintis sub-section, it is proposed to introduce a new type of land use regulation approach in the road improvement, as learned from the Curitiba case, with a combination of road widening, so as to contribute not only to mitigating traffic congestion but also absorbing the increasing population in the Mamminasata area. The conceptual design for this approach is shown in Figure 2.4.5.

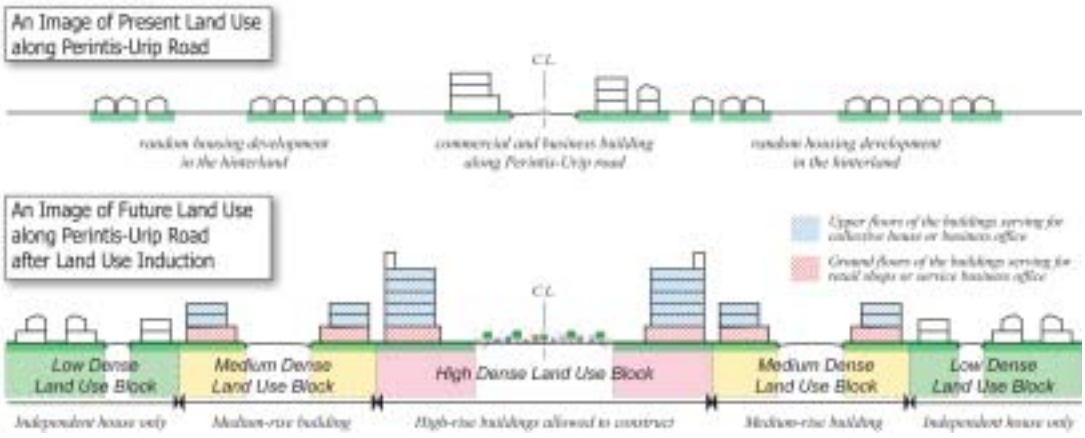


Figure 2.4.5 Preliminary Image of Land Use Induction along the Study Road

2.5 Road Conditions

(1) Existing Condition of the Study Road

South Sulawesi province has national roads of 1,556 km in total length and provincial roads of 1,209 km under the jurisdiction of the South Sulawesi Road Department (Bina Marga). The study roads are part of the national road network and generally function as north-south trunk roads. Table 2.5.1 shows features of the study road and the location of the study roads are shown in Figure 2.5.1.

Table 2.5.1 Features of the study road

Section	Length (km)	Lanes	Right of Way Width (m)	Major Land Use along the Road
Urip Sumoharjo	3.7	4	22-24	Residential and Commercial
Perintis Kemerdekaan	11.8	4	22-24	Governmental and forest

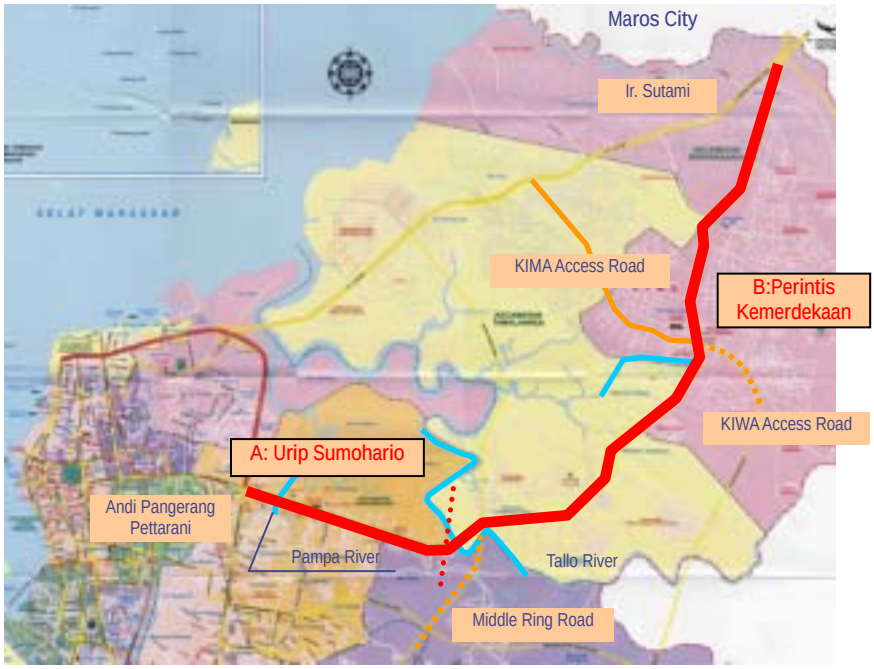


Figure 2.5.1 Location of the study roads

Four lane asphalt paved carriageway are provided on Urip Sumoharjo and Printis Kemerdekaan road, and the lanes for the opposing directions are partially separated by median strip to control access from access roads as shown in Figure 2.5.2. Urip Sumoharjo and the Printis Kemerdekaan road receive periodic maintenance by the Regional Infrastructure Services, Dinas PU Bina Marga.

Open drainage channels and sidewalks are installed on both sides of Urip Sumoharjo road and partial installation of open drainage and sidewalks have been implemented along Perintis Kemerdekaan road.

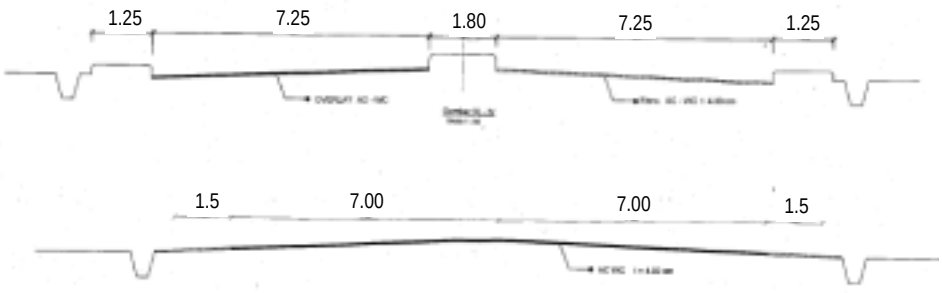


Figure 2.5.2 Existing Cross Section of the Study Road

About 50% of the study road section has a flat vertical grade and the rest is rolling. However, the vertical grade is not steep, as shown in Table 2.5.2. As shown in the Table, three bridges and five culverts are installed over rivers and drainage channels.

Table 2.5.2 Sectional Condition of the study road

KM		Vertical Grade Condition	Bridge	Box Culvert	Remarks
0 - 1	0+750	Flat	Pampang River Bridge		
1 - 2		Flat			
2 - 3		Rolling			imax=2.3%
3 - 4		Rolling			imax=-1.6%
4 - 5	4+050	Flat	Tello River Bridge		
5 - 6		Flat			
6 - 7	6+475	Rolling		B2.8m/H1.2m	imax=1.9% imax=-1.9%
7 - 8		Flat			
8 - 9	8+825	Flat		B1.2m/H1.3m	
9 - 10	9+850	Flat	Daya River Bridge		
10 - 11		Rolling			imax=2.6% imax=-0.8%
11 - 12	11+075	Rolling		B1.0m/H0.6m@3	imax=1.9%
12 - 13		Rolling			imax=2.4% imax=-1.1%
13 - 14		Rolling			imax=-1.1%
14 - 15	14+150 14+675	Flat Flat		B3.65m/H1.9m@2 B3.4m/H2.1m	
15 - 15.5		Rolling			imax=2.2% imax=-0.8%

(2) Road Side Condition of the Study Road

A 22-m to 24-m wide strip of land is reserved as right of way for Urip Sumoharjo road and Perintis Kemerdekaan road. Makassar municipality has installed bench marks along the Perintis Kemerdekaan in preparing for a road widening project. Bench marks are installed at 21 m from the existing centerline on both road sides as shown in Figure 2.5.4. Public utilities such as electric cables and poles, telephone lines and boxes, and water mains pipes are installed in the right of way and these would be affected by the road widening. Therefore, a relocation plan shall be considered in the project study. Existing road side conditions are shown in Figure 2.5.3 and Figure 2.5.4.

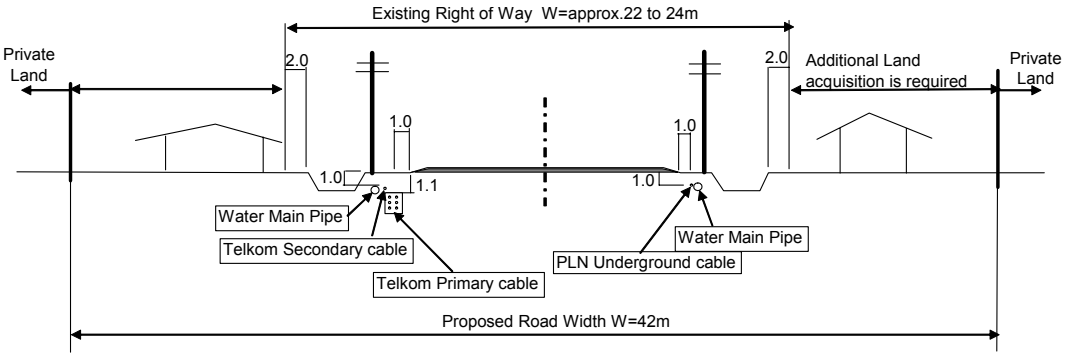


Figure 2.5.3 Existing condition of Urip Sumoharjo

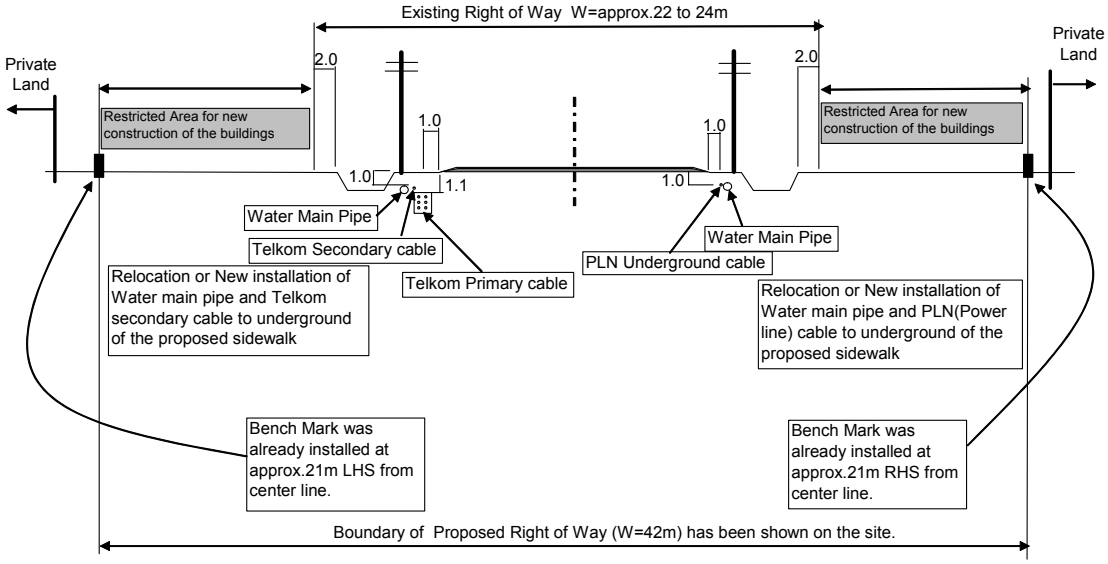


Figure 2.5.4 Existing condition of Perintis Kemerdekaan

(3) Public Transport

Public transport that utilizes the study road are mini buses, which are used for intra city transportation services, and long distance buses, which provide inter city transportation service between Makassar city and northern cities such as Maros city. Facilities for these public transportations is mainly road side bus lay-by. However, the number of bus lay-bys and size of the lay-bys are not adequate for the existing number and size of buses. As a result, mini buses take on passengers outside the bus lay-bys and this causes bottle necks along the study road, especially in the morning and evening peak hours.

Figure 2.5.5 Traffic congestion caused by mini bus parking

2.6 Ongoing Road Development Project

Four related road development projects are identified as necessary to coordinate with the study road. Pettarani-Urip Sumoharjo JCT is located at the beginning point of the project and is an interchange type junction for providing a full access service to toll way users. Implementing status of Middle Ring Road is still vague. However, connection points and the number of lanes are assumed as shown in Table 2.6.1. Based on interview with the road authority, the situation of KIMA access road is the same as for Middle Ring Road. Sutami-Perintis Kemerdekaan JCT Plan has been implemented by a BOT system by an Indonesian contractor.

Table 2.6.1 Related Road Development Projects

Project Name	Status	Remarks
Pettarani-Urip Sumoharjo JCT	F/S	
Middle Ring Road	M/P	8 lanes
KIMA Access Road	M/P	8 lanes
Sutami-Perintis Kemerdekaan JCT Plan	D/D	Implemented by BOT

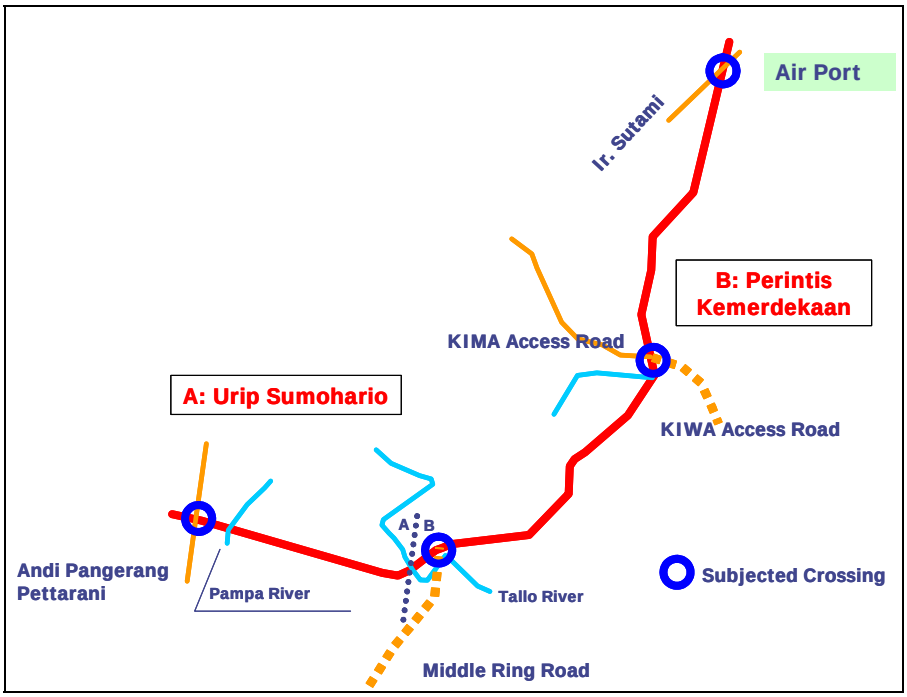
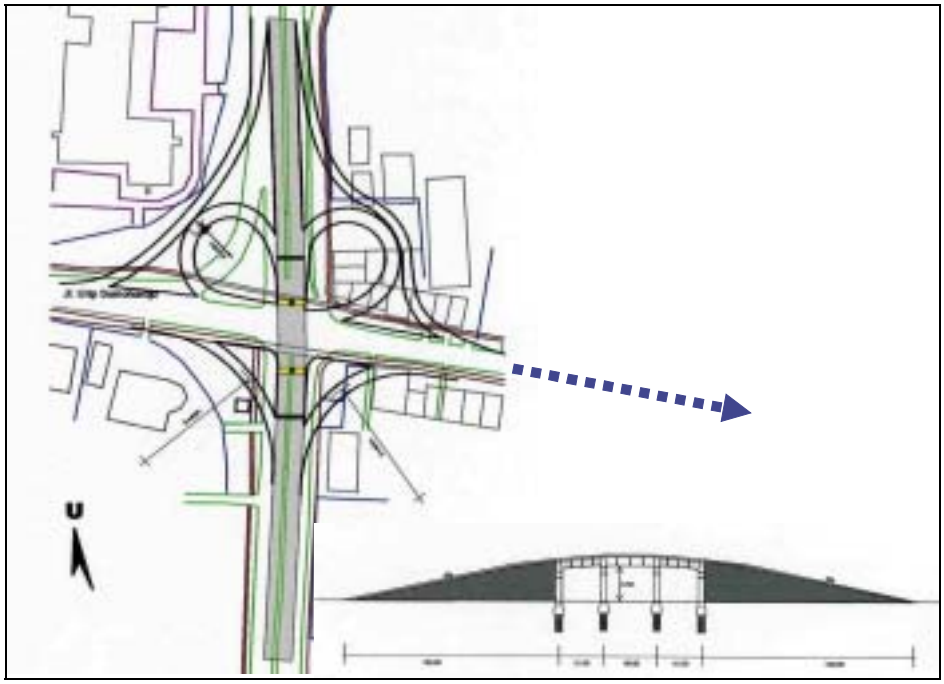
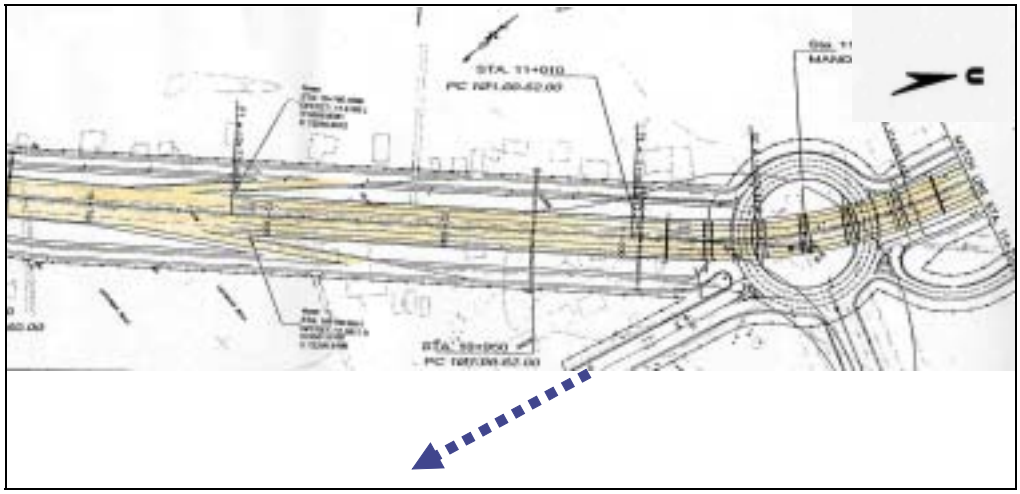


Figure 2.6.1 Relevant Road Projects



Source: F/S Report Oct. 2005 DINAS

Figure 2.6.2 Pettarani-Urip Sumoharjo JCT Plan



Source: Preliminary Design Drawing Apr.2005 BINA MARGA

Figure 2.6.3 Sutami-Perintis Kemerdekaan JCT Plan

3. CURRENT AND FUTURE TRAFFIC DEMAND

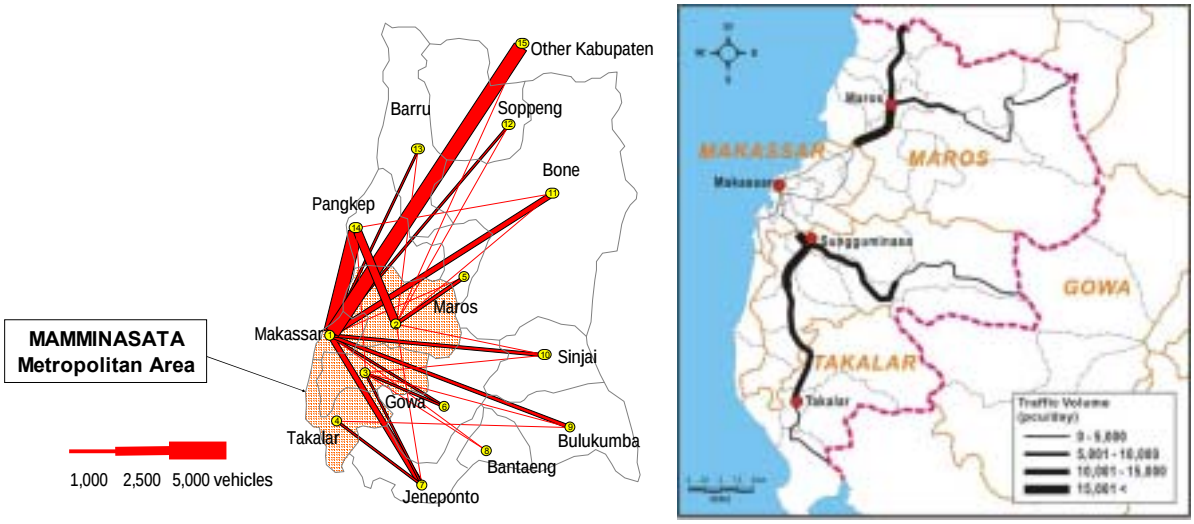
All the data of current traffic conditions and traffic demand forecast were compiled in the Master Plan of this JICA Study for establishing the road network development in the whole Mamminasata region up to 2020. Current and future traffic data of Perintis road were extracted from the data source of the JICA Master Plan 2006.

3.1 Current Traffic Volume

JICA Traffic Count and Interview Survey (May 2005 - June 2005) provides a basic date to reveal the current traffic conditions together with the travel speed survey, freight transport survey, public transport survey that form a suite of traffic surveys.

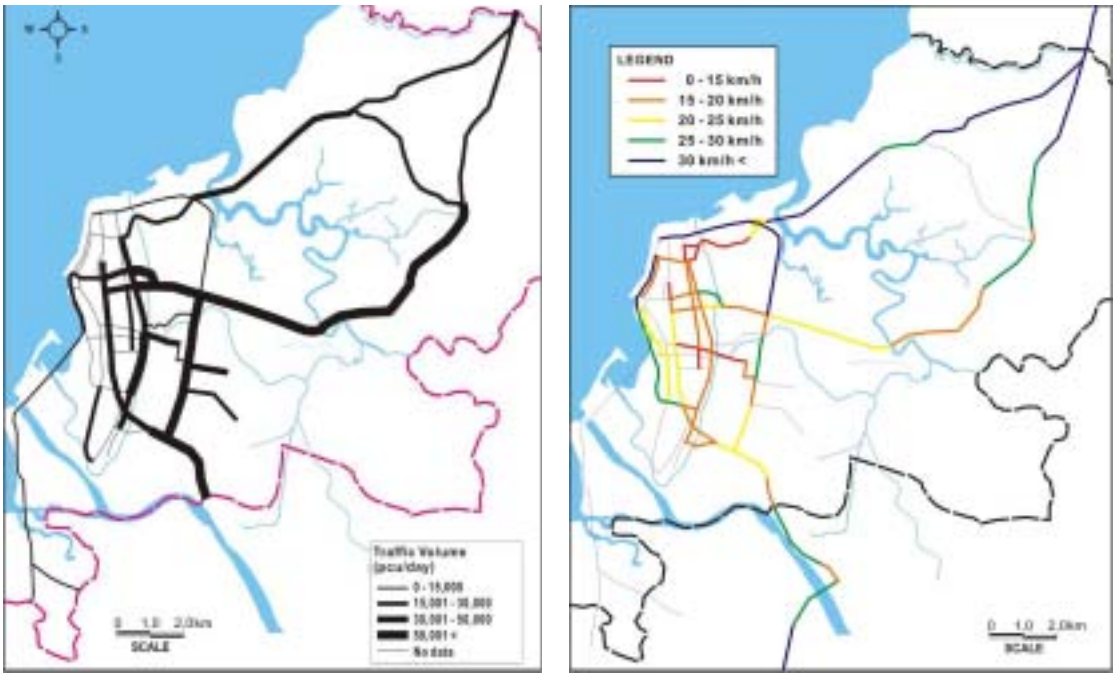
These traffic surveys clarify the features of the traffic flows across the boundaries of Mamminasata. Figure 3.1.1 shows the desired line of inter-regional transport, indicating overwhelming traffic demand on the Makassar city along the north-south axis, and the Perintis and Sutami roads have to serve these traffic flows. No other roads are planned to improve the transport capacity along this direction.

Traffic volume within the Makassar city is illustrated in Figure 3.1.2, revealing that all the major trunk roads have more 50,000 pcu of heavy traffic volume.



Source: JICA Study Team

Figure 3.1.1 Traffic Volumes outside Makassar



Source: JICA Study Team

Figure 3.1.2 Traffic Volumes and Travel Speed in Makassar City

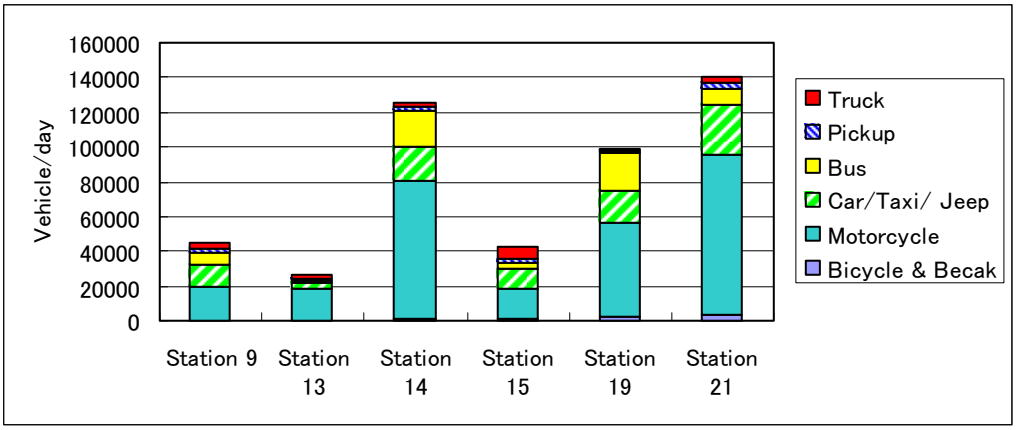
Figure 3.1.3 and Table 3.1.1 present the traffic volume on Perintis road and those on its connecting main roads. Its features are summarized as follows:

(i) On every survey point, motorcycles account for the overwhelming majority of traffic, and on Perintis road reach 64% of all types of vehicle.

(ii) Another feature is the high number of buses that flow from Maros and pass through Urip Sumoharjo road, forming the major bus flow line. Pepe-Pete service routes correspond to this finding.

(iii) Truck flow is clearly seen running from Sutami road into KIMA road and Maros, and vice versa. This is attributable to the fact that the major cargoes are generated in and are attracted to the KIMA Industrial Estate and from the outskirts of Makassar.

(iv) And total traffic are concentrated on Perintis road, Urip Sumoharjo road, and Andi Pangerangt Pettarani road, and this is attributable to the traffic pattern that the traffic travels along Perintis road and then separates into Urip Sumoharjo road, and Andi Pangerangt Pettarani road, and vice versa.



Note: Location of stations are noted in Table 3.1.1
Source: JICA Study Team

Figure 3.1.3 Current Traffic Volume on Perintis Road and Connecting Roads

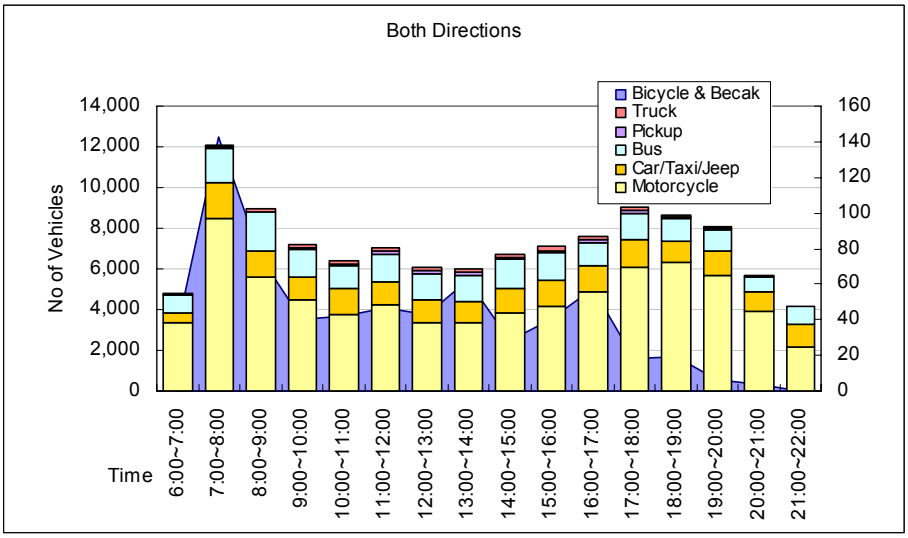
Table 3.1.1 Actual Traffic Volume

Station No	Bicycle & Becak	Motorized Vehicle						PCU
		Motor-cycle	Car/Taxi/ Jeep	Bus	Pickup	Truck	Total	
Station 9 (near the junction of Sutami & Perintis Roads on the airport side)	269	19,274	12,639	6,834	1,927	4,230	44,904	36,459
Station 13 (on the road that runs through KIMA Industrial Estate)	254	18,098	2,991	1,694	1,263	1,717	25,763	15,519
Station 14 (near the Tell River Bridge on the Perintis Road)	**708**	**79,650**	**20,268**	**20,590**	**1,785**	**2,229**	**124,522**	**76,889**
Station 15 (near the Tell River Bridge on Sutami Road)	589	18,332	10,653	3,515	2,744	6,672	41,916	34,823
Station 19 (on the Urip Sumoharjo inside the Andi Pangerang Pettarani Road)	1,736	54,741	18,374	21,420	1,657	1,038	97,230	66,063
Station 21 (on the Andi APangerangt Pettarani Road)	3,985	91,750	28,739	8,907	3,840	3,566	136,802	80,696
							Unit:%	
Station 9	0.6	42.7	28.0	15.1	4.3	9.4	100.0	-
Station 13	1.0	69.6	11.5	6.5	4.9	6.6	100.0	-
Station 14 (Perintis Road)	**0.6**	**63.6**	**16.2**	**16.4**	**1.4**	**1.8**	**100.0**	**-**
Station 15	1.4	43.1	25.1	8.3	6.5	15.7	100.0	-
Station 19	1.8	55.3	18.6	21.6	1.7	1.0	100.0	-
Station 21	2.8	65.2	20.4	6.3	2.7	2.5	100.0	-

Source: JICA Study Team, Traffic Survey (May 2005)

As a result, the low vehicle travel speed is attributable to the huge volume of traffic. The closer to the city center the vehicle runs, the lower the travel speed, reaching less than 15 km/h. On Perintis road, it is more than 30 km/h at the junction with Sutami road near the airport, and gradually reduced to 25 - 30 km/h and 15 km/h. It is estimated that this travel speed pattern is kept all day (07:00 - 21:00), and the worst time is the morning peak between 07:00 ~ 08:00. In this way, traffic along Perintis road has been aggravated and its volume-capacity ratio reached at 1.5 - 2.00 km/h between the bus terminal and Tell River Bridge, and 1.0 - 1.5 km/h between i) the junction with the Golf road and the bus terminal, and ii) the Tell River Bridge and the junction with Andi Pangerang Pettarani road.

The hourly traffic fluctuations are illustrated in Figure 3.1.4.



Source: JICA Study Team

Figure 3.1.4 Hourly Fluctuation of Traffic on Perintis Road

3.2 Future Traffic Volume

Traffic demand forecast is conducted according to the normal procedure of the four step estimation method: produced traffic, generation-attracted traffic, distributed traffic, and traffic assignment. Detailed description is presented in Sector Study Paper (13).

(1) Traffic Zone

The study area consists of sixty (60) zones that are segmented by the local administrative unit of kecamatan. Table 3.2.1 and Figure 3.2.1 show the zone titles and the zoning map.

Zones 11, 13, and 14 (Panakkukang, Biringkanaya and Tamalanrea) are the kecamatans where the planned Perintis road and planned BOT-financed Sutami road run through.

Within this zone framework, the traffic volume, patterns and characteristics are compiled to elaborate the future traffic demand by road.

Figure 3.2.1 Zone Title and Zoning Map

Table 3.2.1 Traffic Zones

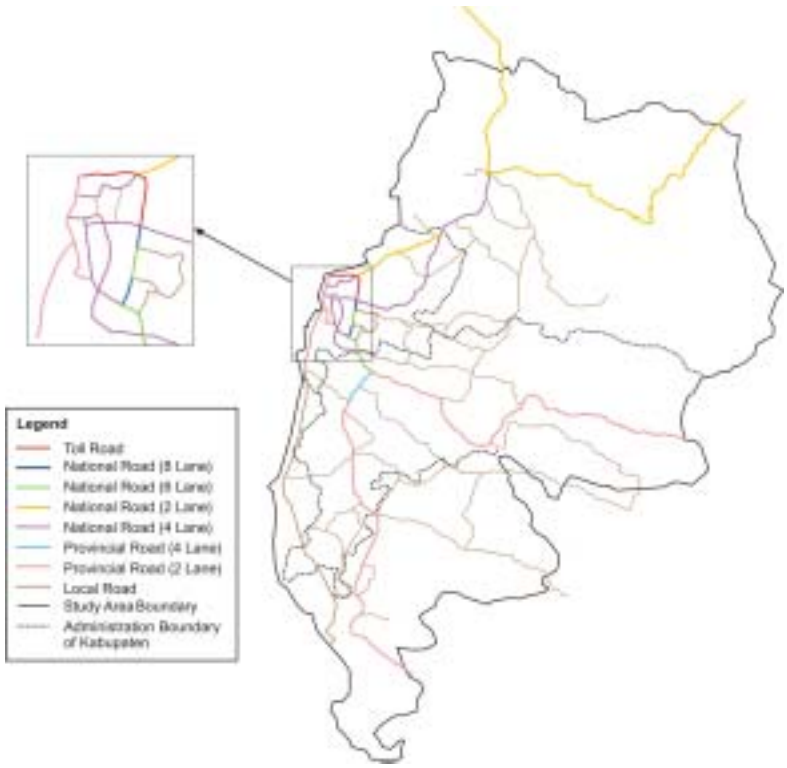
Inside of Study Area						Outside of Study Area		
Zone No	Kabu-paten	Keca-matan	Zone No	Kabu-paten	Keca-matan	Zone No	Kabu-paten	Keca-matan
1	Makassar	Mariso	23	Maros	Simbang	44	Maros	Camba
2	Makassar	Mamajang	24	Maros	Tanralili	45	Maros	Mallawa
3	Makassar	Tamalate	25	Maros	Tompobulu	46	Gowa	Tinggimoncong
4	Makassar	Rappocini	26	Maros	Cenrana	47	Gowa	Bungaya
5	Makassar	Makassar	27	Gowa	Bontonompo	48	Gowa	Tompobulu
6	Makassar	Ujung Pandang	28	Gowa	Bajeng	49	Gowa	Tombolo Pao
7	Makassar	Wajo	29	Gowa	Pallangga	50	Gowa	Bontolempangan
8	Makassar	Bontoala	30	Gowa	Somba Opu	51	Gowa	Biringbulu
9	Makassar	Ujung Tanah	31	Gowa	Bontomarannu	52	Jeneponto	All Kecamatan
10	Makassar	Tell	32	Gowa	Parangloe	53	Bantaeng	All Kecamatan
11	Makassar	Panakkukang	33	Gowa	Bontonompo Selatan	54	Bulukumba	All Kecamatan
12	Makassar	Manggala	34	Gowa	Barombong	55	Sinjai	All Kecamatan
13	Makassar	Biringkanaya	35	Gowa	Pattallassang	56	Bone	All Kecamatan
14	Makassar	Tamalanrea	36	Gowa	Manuju	57	Soppeng	All Kecamatan
15	Maros	Mandai	37	Takalar	Mangarabombang	58	Barru	All Kecamatan
16	Maros	Moncongloe	38	Takalar	Mappakasunggu	59	Pangkep	All Kecamatan
17	Maros	Maros Baru	39	Takalar	Polombangkeng S.	60	Other Kabupaten	All Kecamatan
18	Maros	Lau	40	Takalar	Polombangkeng U.			
19	Maros	Turikale	41	Takalar	Galesong S.			
20	Maros	Marusu	42	Takalar	Galesong U.			
21	Maros	Bontoa	43	Takalar	Pattalassang			
22	Maros	Bantimurung						

Source: JICA Study Team

(2) Assumption of Road Network

1) Present Road Network

First, the present road network was established, which was classified into four (4) items: i) toll road, ii) national road, iii) provincial road, and iv) local road as shown in Figure 3.2.2.



Source: JICA Study Team

Figure 3.2.2 Road Network in Study Area

The road network is composed of i) distance, ii) capacity, and iii) travel speed as characteristics of each link. And the relationship between traffic volume and travel speed in the Makassar area is formulated to execute a traffic assignment of traffic volume on the individual roads. Figure 3.2.3 shows each value of maximum travel speed and maximum traffic volume by number of lanes and by road type based on the Indonesian Highway Capacity Manual.

Items	No. of Lanes	Vmax (km/h)	Qmax (pcu/day)
Toll Road	4	80	72,000
National Road	8	35	136,000
	6	35	102,000
	4	35	40,000–48,000
	2	30	20,000
Provincial Road	4	25	40,000–48,000
	2	20	12,000
Local Road	1.5 – 2.0		6,300–10,000

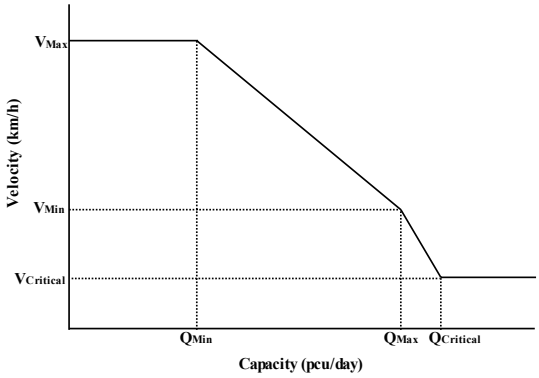


Figure 3.2.3 Q-V Formula and its Information

2) Future Road Network

The future road network is established in the Master Plan of this JICA Study, and its network in 2020 is shown in Figure 3.2.4. Its phased construction plan is also shown in Table 3.2.2.

Source: JICA Study Team

Figure 3.2.4 Planned Road Network in Mamminasata

Table 3.2.2 Phased Construction Plan of the Road Network

	2005	2010	2015	2020
Name of Major Roads Proposed in Master Plan	Road network as it is	In addition to the road network in 2005, the following are necessary.	In addition to the road network in 2010, the following are necessary.	In addition to the road network in 2015, the following are necessary.
	-	1. Perintis (4 lanes) & flyover (2) 2) Sutami (4 lanes) + flyover (1)	1) Trans-Sulawesi (Junneberang) 2) Mamminasa Bypass (M2-M6)1) 3) Middle Ring Road (Section 1) 4) Abudullah Daeng Sirua2) Tanjung Bunga access 5) Takalar Access 6) Malino Access	1) Trans-Sulawesi (Takalar & Makassar) 2) Mamminasa Bypass (M1 & Bridge) 3) Hertasnig 4) Airport Access 5) KIWA & KIMA road

Source: JICA Study Team

Sutami road is now under the widening works by a BOT company, i.e. BOSOWA, as of May 2006, and its opening is targeted at the end of 2007. Thus its completed 4-lane-road condition is assumed as the pre-existing condition for the Perintis road widening project.

3) Present OD Table

Traffic interview survey data were compiled into Origin-Destination (OD) table, which was then adjusted by the sampling ratio against the actual traffic volume. Traffic volumes of missing pairs were estimated according to the gravity model with socio-economic data i.e., population and GRDP by zone.

4) Produced Traffic

The produced traffic is defined as a control total of the OD table, and it is estimated based on the standard assumption that the growth rate of produced traffic is in proportion to the total number of registered vehicles, i.e., motorcycles, cars/taxis/jeeps, minibuses, large buses, pickups, small trucks and large trucks. The future number of registered vehicles was estimated by the following equation:

$$RV = 0.0571 + 0.3453 \cdot (GRDP) - 1496096 \cdot (POP) \quad (R^2 = 0.919)$$

Where

RV :	Number of registered vehicles
GRDP :	GRDP (Million Rp.)
POP :	Population
α, β & γ :	Co-efficient

By adopting the above equation and socio-economic frames, the growth rates for the total number of registered vehicles, i.e. the produced traffic, was obtained. And the results are shown in Table 3.2.3.

Table 3.2.3 Estimated Number of Registered Vehicle

Year	Base Case		Moderate Case	
	Estimated No. of Registered Vehicle	Growth Rate (%)	Estimated No. of Registered Vehicle	Growth Rate (%)
2005	677,482	-	677,482	-
2006	729,986	7.75	732,683	8.15
2007	785,161	7.56	790,966	7.95
2008	843,189	7.39	852,558	7.79
2009	904,264	7.24	917,706	7.64
2010	968,596	7.11	986,675	7.52
2011	1,037,557	7.12	1,051,310	6.55
2012	1,110,567	7.04	1,119,541	6.49
2013	1,187,922	6.97	1,191,613	6.44
2014	1,269,942	6.90	1,267,792	6.39
2015	1,356,970	6.85	1,348,361	6.36
2016	1,455,785	7.28	1,426,808	5.82
2017	1,561,678	7.27	1,508,960	5.76
2018	1,675,242	7.27	1,595,026	5.70
2019	1,797,115	7.28	1,685,233	5.66
2020	1,927,996	7.28	1,779,817	5.61

Source: JICA Study Team

5) Generated/Attracted Traffic

Generated and attracted traffic models were developed by vehicle type to consider the impact of modal split among passenger vehicles (motorcycles, cars, and buses), and the "trip end model" was adopted for this purpose together with GRDP and population data by zone. Models are shown together with the corresponding co-efficient below:

Passenger Model	*Freight Model*
$Gi, Ai = \alpha \cdot POPi + \beta \cdot Di + \gamma$ Where Gi and Ai : Vehicle Traffic (Motorcycle, Car, and Bus) POPi : Population in zone i Di : Dummy Variable α, β & γ : Coefficient	$Gi, Ai = \alpha \cdot GRDPi + \beta \cdot Di + \gamma$ Where Gi and Ai : Truck Traffic GRDPi : GRDP in zone i Di : Dummy Variable α, β & γ : Coefficient

Coefficients and R^2

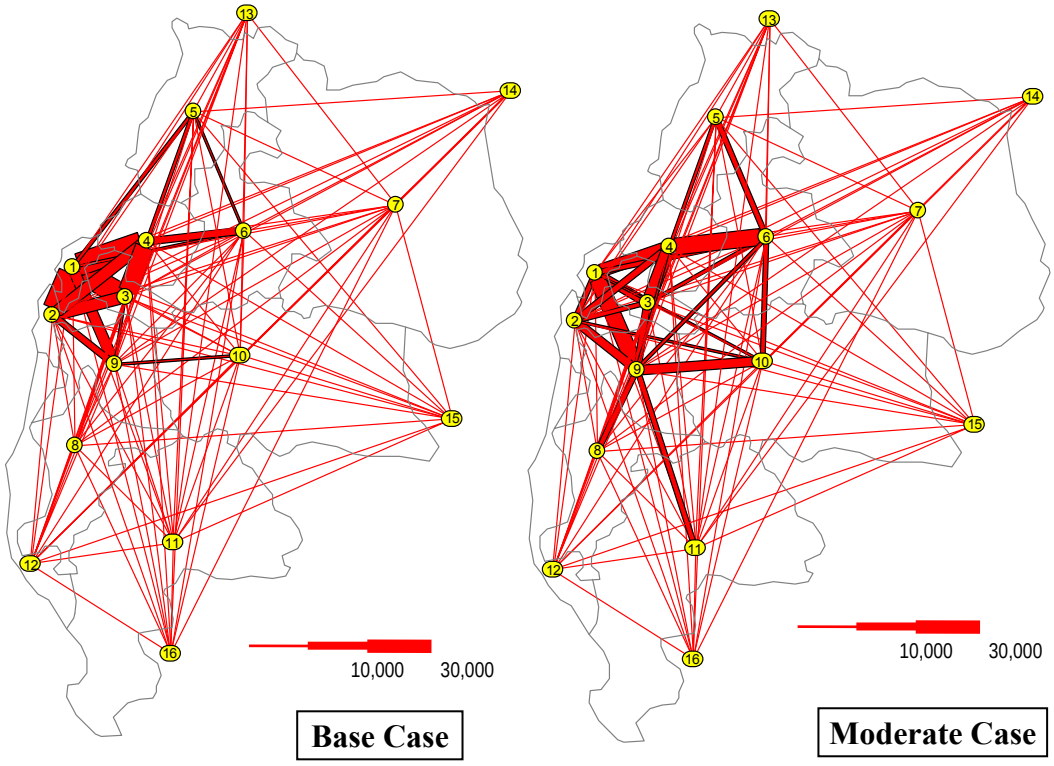
Vehicle Type	α	β	γ	R^2
Motorcycle	0.09149	25872	-817	0.856
Car	0.01519	5573	360	0.820
Bus	0.01627	4235	-235	0.871
Truck	0.00155	642	289	0.807

Source: JICA Study Team

Airport and seaport are points of large traffic generation and attraction, and their impacts were also estimated by applying simple regression analysis. The predictor variable in this analysis was total GRDP of South Sulawesi.

6) Distributed Traffic

Traffic volume was distributed on to the road network by simulating the computer assignment model based on the present OD pattern and future generated and attracted traffic. This forecast adopted the "Present Pattern Method". Results are shown in Figure 3.2.5. It shows a sharp contrast that the traffic is concentrated in Makassar in the Base Case and more spread into the suburban areas in the Moderate Case. Results are tabulated in the future OD table.



Source: JICA Study Team

Figure 3.2.5 Future Desired Line (2020)

7) Traffic Assignment

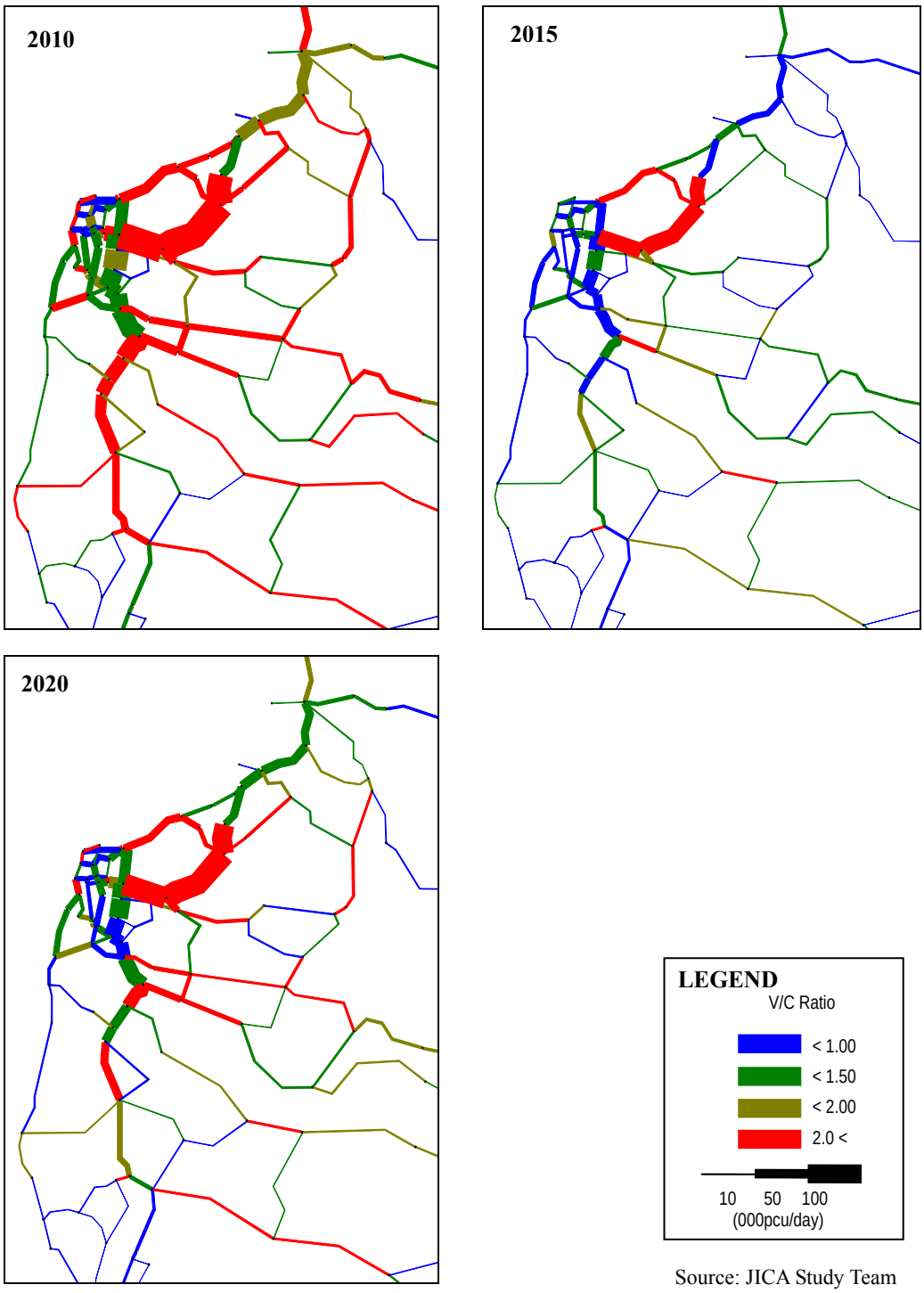
Future traffic volumes shown in the desired lines in the future were assigned on the road network. In assigning the future traffic volume, the travel time minimization method was adopted, and the simulation was conducted 10 times by dividing total traffic volume into 10% for each assignment.

a) Results of the Moderate Case are shown in Figure 3.2.6. It indicates that the traffic volumes of Sutami road, Urip Sumoharjo road and Perintis Kemerdekaan road exceed the capacity of those roads by as much as 2 times (VCR > 2.0) in 2010.

b) Sutami road running parallel to the Perintis road is also facing over capacity traffic volumes by 2010, showing a VCR higher than 2.0. This Sutami road is expanded to 4 lanes by the end of 2007, and the same 4 lanes are assumed for traffic

assignment in 2010, suggesting that 6 lanes will be necessary in 2020, even through Perintis road will be expanded to 8 lanes in 2010.

c) Such situation is not stable for the realization of the project. Moreover, sacrificed case of "with future road network", traffic flows of base and moderate cases in 2020 are significantly improved outside the center of Makassar city. However, roads with over capacity traffic still remain in center of Makassar city along the sea coast, justifying the effect and necessity of the proposed road network.



Source: JICA Study Team

Figure 3.2.6 Traffic Volume of Moderate Case (Without Future Road Network Plan)

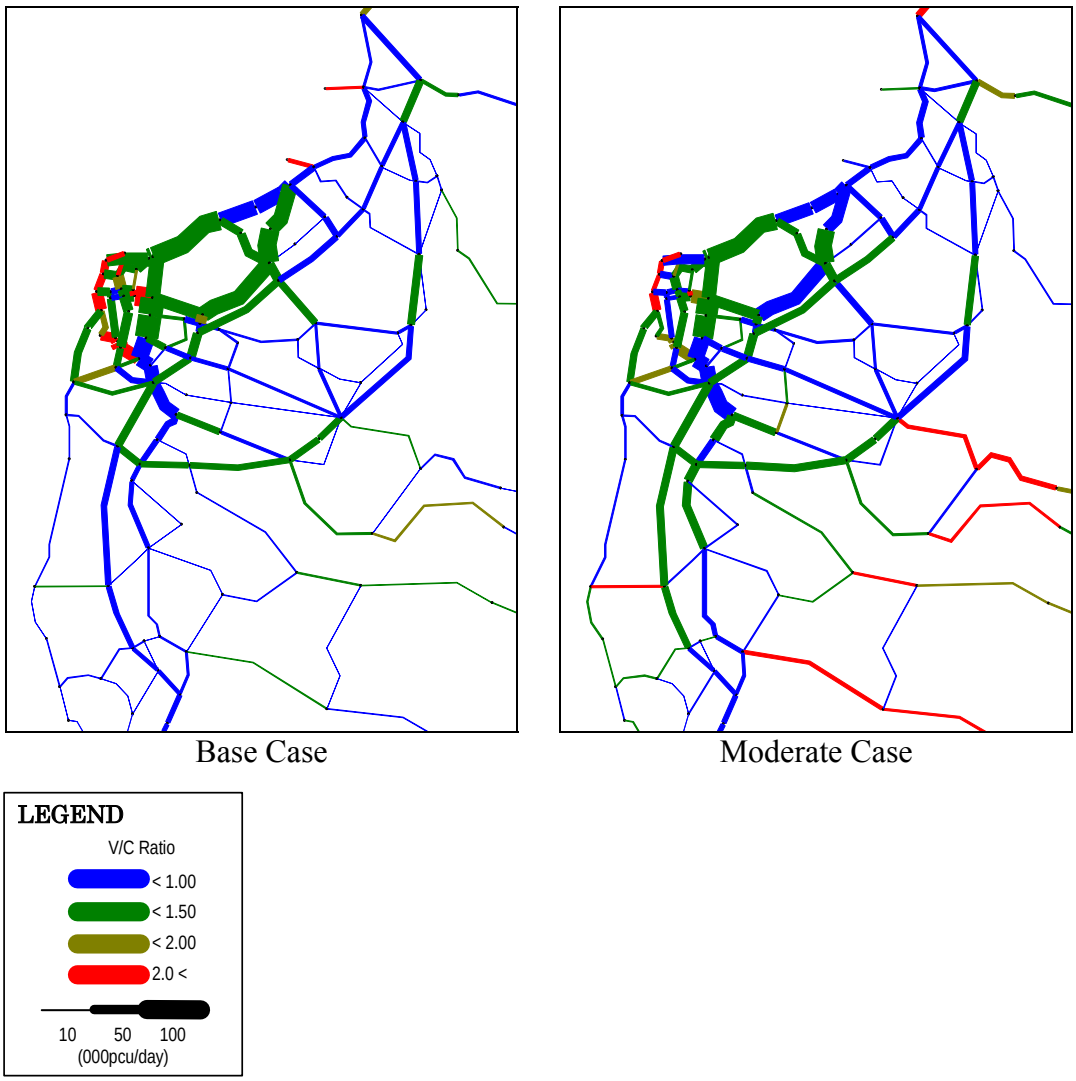
And two cases i.e. “without the Perintis Widening Project” and “with the Perintis Widening Project” in 2020 are compared to measure the magnitude of the Perintis Widening Project in Figure 3.2.7.

In the Moderate case, V-C Rations of all the major trunk roads shows less than 1.5 and that of Perintis road shows partially less than 1.0, assuring smooth traffic flow at the most economic travel speed.

Traffic volume of Perintis road is forecast to increase by approximately three times in 2020 compared with that in 2005, resulting in an aggravation of the volume-capacity ratio from 1.0~1.5 for the Jn. Toll road ~ Tell Bridge section and 1.5~2.0 for the Tell Bridge ~ KIMA road to more than 2.0 for the whole section, and the average travel speed is estimated to be less than 15 km/h.

Sutami road also shows the same trend as Perintis road; however, its road capacity is 2 lanes with no shoulder pavement, and therefore its traffic volume is strictly limited by its lane number (= 2 lanes) and its volume is approximately double that of 2005. However, its volume-capacity ratio (VCR) will exceeds 2.0 in 2010 and thereafter constantly up to 2020.

It is difficult to assess which road of Sutami and Perintis roads should be widened first, and which second. However, the traffic demand forecast clarifies that the most preferable countermeasure is to widen both roads at the same time up to 2010. And fortunately, it is announced that Sutami road will be widened to 4 lanes by private company, i.e. BOSOWA, under a build-operate-transfer (BOT) scheme. Therefore the project policy can concentrate its effort on widening Perintis road.



Source: JICA Study Team

Figure 3.2.7 Traffic Volume in 2020 (With Future Road Network Plan)

Table 3.2.3 Traffic Volume without Perintis Road Widening Project

(Unit: 1,000 pcu/day)

	Without Perintis Widening Project	
Perintis Road	Jn. Toll Road ~ Tell Bridge	Tell Bridge ~ KIMA Road
Traffic Volume		
2005 (4 lanes)	682	733
2020 (ditto)	1,976	2,130
Volume-Capacity Ratio (=VCR)		
2005 (4 lanes)	**1.0~1.5**	**1.5~2.0**
2020 (ditto)	**>2.0**	**>2.0**
Sutami Road	Tell Bridge ~ KIMA Road	KIMA Road ~ Jn. with Perintis
Traffic Volume		
2005 (2 lanes)	355	221
2020 (ditto)	760	422
Volume-Capacity Ratio (=VCR)		
2005 (2 lanes)	**1.5~2.0**	**1.0~1.5**
2020 (ditto)	**>2.0**	**>2.0**

Source: JICA Study Team

From all the findings above, it is judged that the widening of Sutami and Perintis road are necessary by the year 2010 at latest.

8) No impact of Perintis road widening on Sutami toll road

The above analysis shows that the traffic volume of Sutami toll road will not decrease as a result of the widening project of Perintis road. In the case that the package of proposed road network improvement plans is executed in the whole of the Mamminasata area, the traffic volume on Perintis road and Sutami road is tabulated in Table 3.2.4.

Traffic volume on Perintis road will increase gradually after the widening to 8 lanes in 2010; however, it will then trend downward because of new services, mainly i) the newTrans-Sulawesi road and ii) the improvement of the Abdullar Daeng Sirua road, and iii) the Middle Ring Road (Section 1).

Sutami road will show a constant increase in traffic volume from 2005 up to 2020; however, its volume-capacity ratio will stay at 1.0 ~ 1.5 for the Tell Bridge ~ KIMA road section and less than 1.0 for KIMA road ~ Junction with Perintis road, and can consequently guarantee a comfort and economic travel speed, an essential factor for business purpose vehicles.

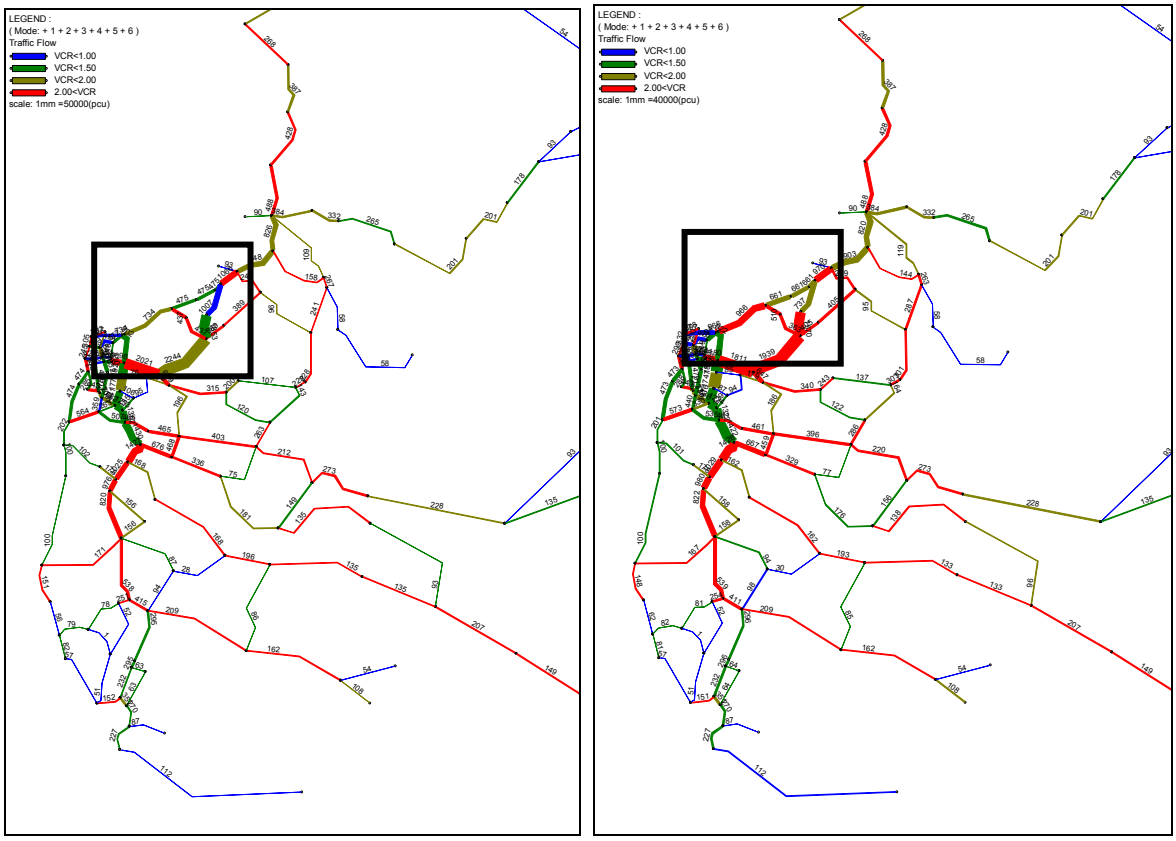
Table 3.2.4 Traffic Volume without/with Whole Package of Mamminasata Road Improvement Plan

(unit: 1,000 pcu/day)

	Without whole network improvement in Mamminasata		With whole network improvement in Mamminasata	
Perintis Road	Jn. Toll Road ~ Tell Bridge	Tell Bridge ~ KIMA Road	Jn. Toll Road ~ Tell Bridge	Tell Bridge ~ KIMA Road
Traffic Volume				
2005 (4 lanes)	682	733	-	-
2010 (8 lanes)	1114	1219	730	762
2015 (ditto)	965	1077	665	996
2020 (ditto)	813	1226	723	923
Volume-Capacity Ratio (=VCR)				
2005 (4 lanes)	1.0~1.5	1.0~1.5		
2010 (8 lanes)	>2.0	>2.0	1.0~1.5	<1.0
2015 (ditto)	1.0~1.5	1.0~1.5	<1.0	1.0~1.5
2020 (ditto)	1.0~1.5	1.0~1.5	1.0~1.5	<1.0
Sutami Road Traffic Volume	Tell Bridge ~ KIMA Road	KIMA Road~ Jn. with Perintis	Tell Bridge ~ KIMA Road	KIMA Road~ Jn. with Perintis
2005 (2 lanes)	355	221		
2010 (6 lanes)	471	235	965	761
2015 (ditto)	1292	1020	1024	736
2020 (ditto)	1333	1000	1117	799
Volume-Capacity Ratio (=VCR)				
2005 (2 lanes)	1.5~2.0	1.0~1.5	-	-
2010 (6 lanes)	>2.0	1.0~1.5	1.0~1.5	<1.0
2015 (ditto)	1.0~1.5	1.0~1.5	1.0~1.5	<1.0
2020 (ditto)	1.0~1.5	1.0~1.5	1.0~1.5	<1.0

Source: JICA Study Team

These traffic situations (without Perintis widening, and with Perintis widening) in 2020 are illustrated in Figure 3.2.8. In the case that Perintis road is not widened, the traffic demand on the Sutami toll road will exceed 2.0 of VCR resulting in heavy congestion. On the contrary, if the Perintis is improved, the traffic congestion ratio (VCR) will be kept between 1.0 and 1.5, and traffic volume will constantly increase and guarantee the profitability of the Sutami toll road.



(With Perintis Widening Project) (Without Perintis Widening Project)

Source: JICA Study Team

Figure 3.2.8 Comparison of Future Traffic Volume on Sutami Road and Perintis Road

4. PRELIMINARY ENGINEERING STUDY

4.1 General

This chapter describes the results of the preliminary engineering study, including design standards to be applied for roads, bridges, and the junctions with Middle ring road and KIMA access road. The study road is shown in Figure 4.1.1

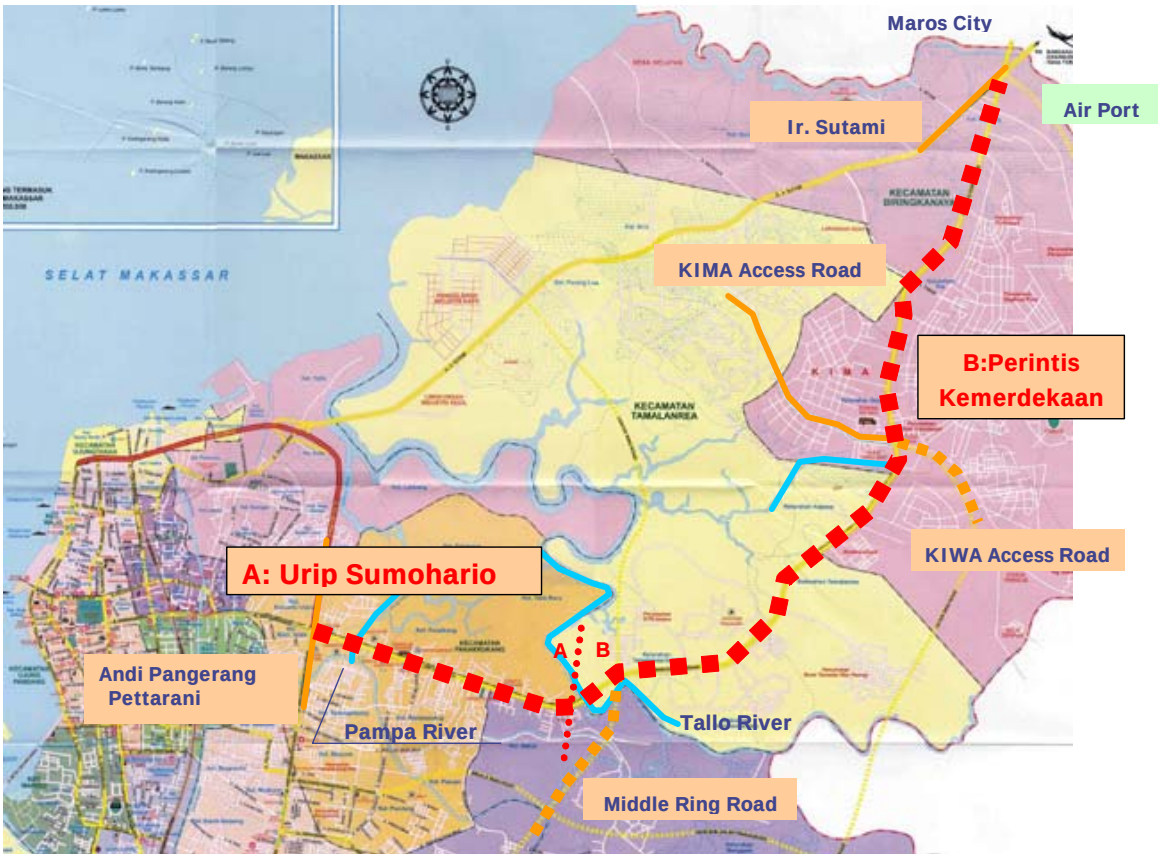


Figure 4.1.1 Location of the study road

4.2 Road design standards

(1) General

The roads, bridges and other road structures will be planned and designed based on Indonesian standards together with other international specifications.

(2) Design standard of the road

The following Indonesian design standards have been referred to for the Study.

- Standard Specifications for Geometric Design of Urban Roads, MoPW, Indonesia, 1992
- Indonesian Highway Capacity Manual, MoPW, Indonesia, 1993
- Tata Cara Perencanaan Tebal Perkerasan Lentur Jalan Raya Dengan Metode

Analisa Komponen, Dewan Standardisari Nasional-DSN, 1987

- Produk Standar Untuk Jalan Perkotaan, Departemen Pekerjaan Umum, Direktorat Jenderal Bina Marga, 1987

Also the following design standards have been consulted to complement the above standards.

- A Policy on Geometric Design of Highways and Streets, AASHTO, 2004
- Road Structure Ordinance, Japan Road Association, 2005
- Guide for Design of Pavement Structures, AASHTO, 1993
- Manual for Design and Construction of Pavement, Japan Road Association, 2002

1) Road Classification

In the design standard of MoPW, the JICA Study Team has judged that it is reasonable for the Study roads to apply Type-II, Class-I road classification.

2) Geometric Design Condition

Geometric design conditions were determined applying the design standard mentioned above.

Table 4.2.1 Geometric Design Conditions

Item		Design Standard Value	Applied Value
Road Classification		Type-II, Class-I	
Design Speed		60km/h	
Cross-section	Carriageway Width	3.5m	3.25m (considering land acquisition)
	Shoulder Width	0.5m	0.5m
	Sidewalk Width	3.0m	3.0m
Horizontal Alignment	Min. Radius	150m	150m (except intersections)
	Min. Curve Length	100m	100m
	Omission of Transition	>600m	>600m
Vertical Alignment	Min. Curve Length	25m	25m
	Cross-fall	2.0%	2.0%

Note: Exceptional case is applied to minimize land acquisition or to follow the existing alignment.

(3) Bridge design criteria

1) Specifications and Design Standards

The following design standards have been applied to the design of Pampa and Tell river bridges.

- Standard Specifications for Geometric Design of Urban Roads, MoPW, Indonesia, 1992
- Bridge Design Manual Section 2 in Bridge Management System,"BMS",

BinaMarga, Indonesi- a, 1992.

- Standard Specifications for Highway Bridges, 17th Edition,"AASHTO", 2002.
- Tata Cara Perencanaan Ketahanan Gempa Untuk Bangunan Gedung,"SKS", (Directorate Gene- ral of Regional Infrastructure Indonesia), 2002.
- Uniform Building Code "UBC", (International Conference of Building Official, California), 1997.
- Building Code Requirements for Reinforced Concrete,"ACI" 318-92. , (American Concrete Institute).

2) Geometric Design Criteria

The geometric design criteria of the bridges are summarized in Table 4.2.2.

Table 4.2.2 Summary of Geometric Design Criteria of the Bridges

Items	Design Standard	Remarks
Road class	Type II, Class I	
Design speed	60km/h	
Lane width	3.25m	
Shoulder width(Left)	0.5m	With side walk
Shoulder width(Right)	0.5m	
Clearance height	5.1m	
Minimum curve radius	150m	
Minimum curve length	50m	
Maximum super elevation	4.0%	
Minimum spiral curve length	50m	
Maximum grade	5.0%	
Minimum vertical curve length	50m	

Source: Standard Specifications for Geometric Design of Urban Roads, MoPW, 1992

4.3 Examination of Typical Cross Section

(1) General

Because the study road is located in the Mamminasata Metropolitan area, the typical cross-section for the study road will be examined carefully taking into consideration both traffic and urban development functions. The traffic function will be further divided into normal traffic and public transport (bus transport). Since huge number of Inter-city traffic would pass through the road, the road will provide 4 lanes each for Inter and Intra city traffic. Accordingly, the issues to design the typical cross-section are summarized in Table 4.3.1.

Table 4.3.1 Design Issues for Typical Cross-section for the study road

Function	View points of examination
Traffic function	Balance between traffic demand and capacity Segregation of inter and intra city traffic Control of roadside parking Public transport facility(bus stop)
Urban development (spatial) function	Sufficient space for pedestrians Environmental spaces (planting)

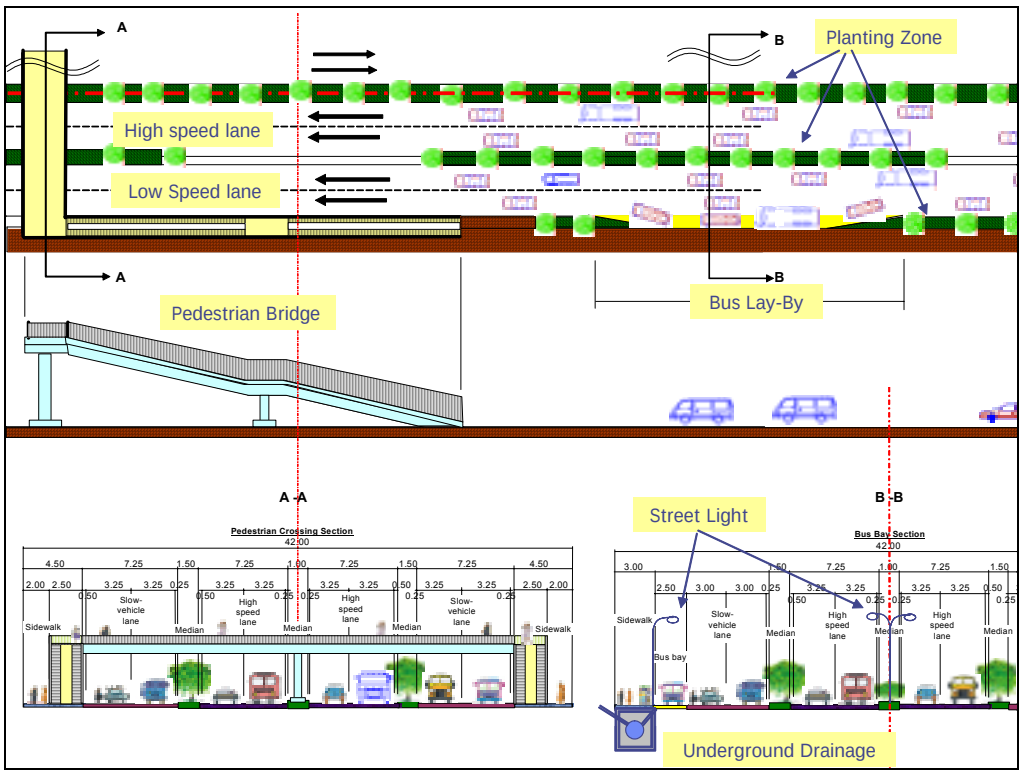
Based on the above issues, necessary road facilities corresponding with road functions are proposed as follows. Figure 4.3.1 shows a concept drawing for road facilities for ensuring the above road functions.

1) Traffic Function

- To Provide Adequate Capacity for Future Traffic Demand
  - 8 Lane Carriage Way
- To Provide Partial Access Control for Inter & Intra City Traffic
  - High and Low Speed Lanes with Partial Access Control by Median
- To Facilitate Public Transportation
  - Full Scale Bus Lay-By

2) Spatial Function

- To Improve Landscape as Urban Symbol and for Environmental Space
  - Planting on Median Zone
- To Provide Space for Public Utilities
  - Utilize Sidewalk Underground Space for Public Utilities
- To Ensure Pedestrian Space and Safety
  - Pedestrian Bridge, Continuous Side walk, Signalized Intersection, Street Light



Source: JICA Study Team

Figure 4.3.1 Concept of road facilities

(2) Traffic Demand and Number of Lanes:

The future traffic demand was predicted in the Master Plan. Table 4.3.2 shows the traffic volume in 2020. The design hourly volume was calculated for a 10% peak coefficient in accordance with the Standard Specifications for Geometric Design of Urban Roads for the study road. The possible capacity of one lane in standard design daily traffic per lane of Type II, Class I is 13,000 PCU/day and in case of the road is interrupted by many intersections shall be 60% of the above.

Because there are many number of intersections on the study road and continuity of the road width, 8 lanes is proposed for the study road, respectively. However, further study to justify appropriate number of lanes in consideration of land use plan and comprehensive network shall be done at next design stage.

Table 4.3.2 Traffic Volume In 2020 and Requirement Number of Lanes

Section	Traffic Volume in 2020		Required Number of Lanes
	(PCU/day)	(PCU/hour)	
Start – Tallo Bridge	72,300	7,230	8 (6)
Tallo Bridge - End	92,300	9,230	8

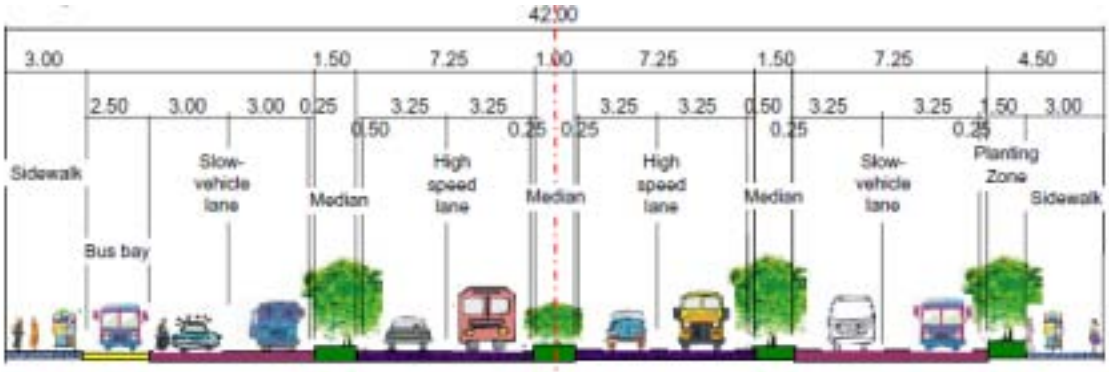
Source: JICA Study Team

(3) Design of Typical Cross-section

Based on the discussion above, typical cross-sections for the study road are proposed as shown in Figure 4.3.2 to 4.3.6. The width of each element is indicated in the figure and some elements, such as the sidewalk and environmental space, will have an option for which area is examined based on roadside urban development. The ROW for the proposed project road will therefore be at least 42m. The minimum ROW of 42 meters should be reserved under this road project; however, additional ROW should be provided around urban developments along the proposed road.

Source: JICA Study Team

Figure 4.3.2 Typical Cross Section (Flat Section)

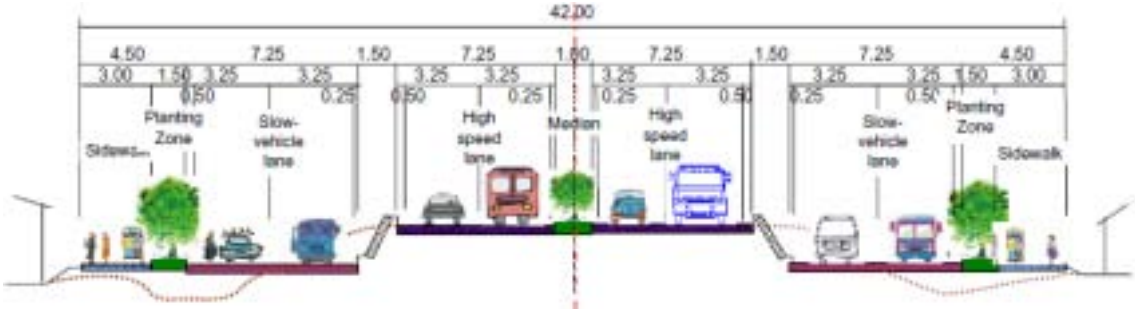


Source: JICA Study Team

Figure 4.3.3 Typical Cross Section (Bus Bay Section)

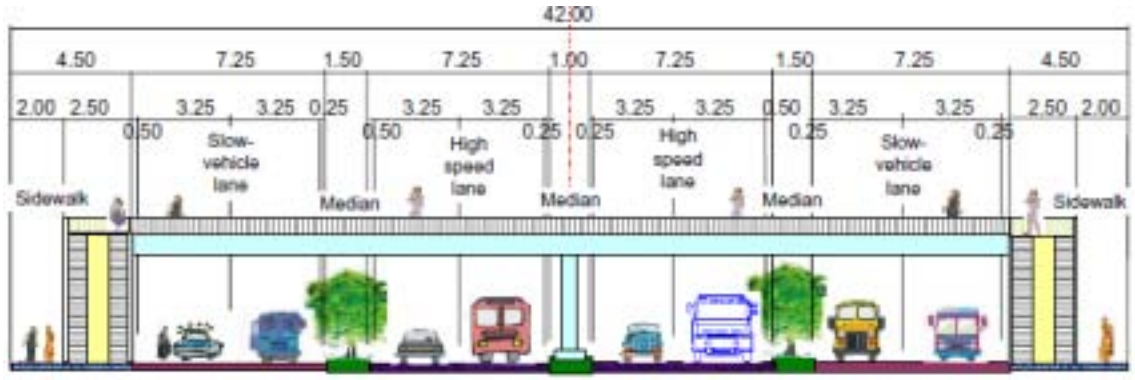
Source: JICA Study Team

Figure 4.3.4 Typical Cross Section (Filling Section)



Source: JICA Study Team

Figure 4.3.5 Typical Cross Section (Cutting Section)



Source: JICA Study Team

Figure 4.3.6 Typical Cross Section (Pedestrian Crossing Section)

4.4 Preliminary Design of Highway

(1) General

Since the proposed roads including Urip Sumoharjo road and Perintis Kemerdekaan road are sensitive to land acquisition, the right of way (ROW) was studied carefully. The design was executed without engineering surveys such as a topographic survey or geological survey due to time constraints at this pre-feasibility stage.

(2) Road alignment

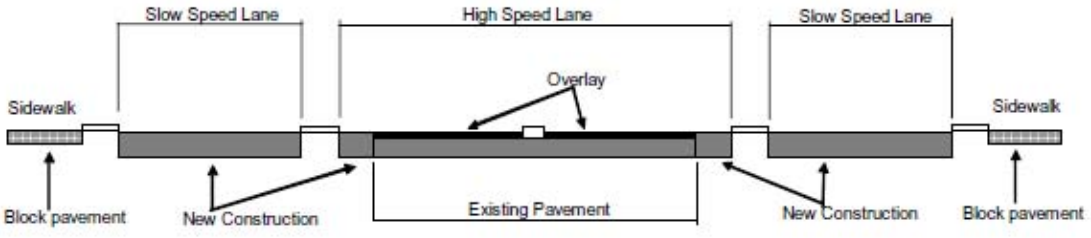
This project intends to improve the traffic function of two existing road sections, Urip Sumoharjo road and Perintis Kemerdekaan road. New land acquisition should be minimum for smooth project implementation. Thus the road alignment is basically planned following the existing centerlines of the two road sections. The design drawings are stated in Annex 2.

(3) Pavement design

The existing pavement is mostly in fair condition and some parts of the pavement were rehabilitated for the maintenance purposes by the Urban Road and Regional Road Section of the Department of Public Works. There are two options for proposed

pavement type for high speed lanes, overlay on the existing pavement section or new construction. The proposed pavement type for the slow speed lane is new construction. The pavement type of sidewalk is pavement block or interlocking pavement. The interlocking pavement or semi-flexible pavement is a desirable pavement type at bus bay section to prevent pavement deformation at the bus bay.

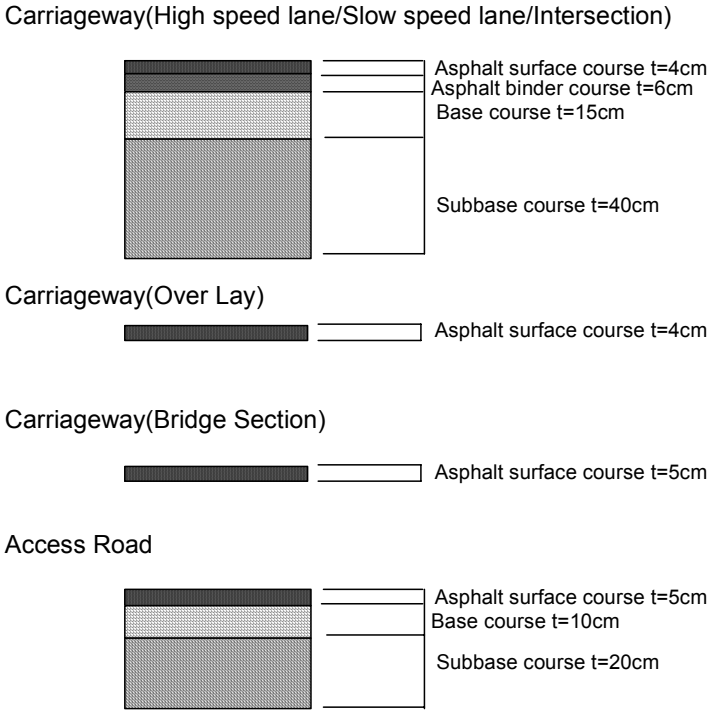
Proposed pavement types for the widening of the objective roads are shown in Figure 4.4.1.

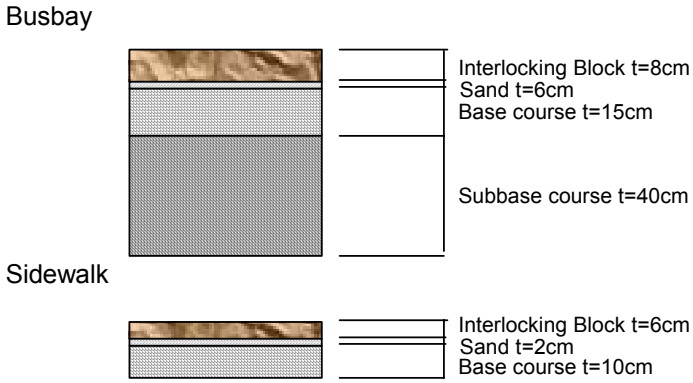


Source: JICA Study Team

Figure 4.4.1 Pavement Type for the Widening of JL.Urip Sumoharjo and JL. Perintis

Pavement thickness will be determined in consideration of future traffic volume and design CBR at the next design stage in accordance with the pavement design standard. In this preliminary design, the pavement thickness presently used for rehabilitation work of Perintis road shown in Figure 4.4.2 is adopted in the design as the most reliable example.



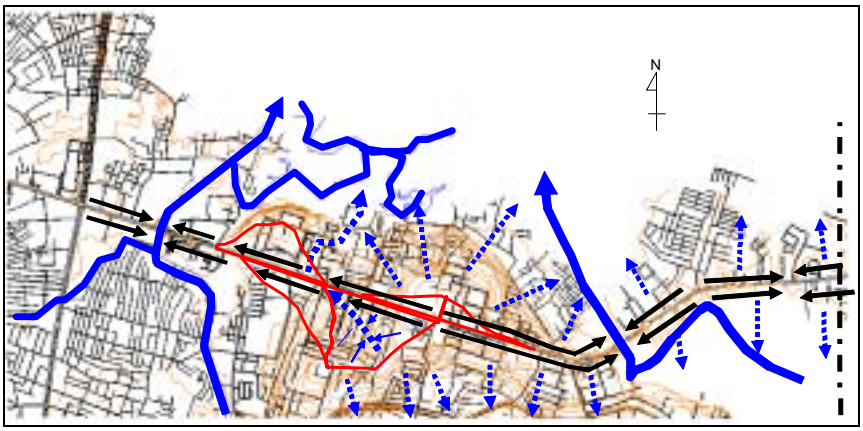


Source: JICA Study Team

Figure 4.4.2 Pavement structure at the rehabilitated section of Perintis Road

(4) Drainage design

The existing drainage network is shown in Figures 4.4.3 to 4.4.6. The drainage network design was based on the existing drainage network and outlets because road improvement basically follows the existing surface ground height.



Source: JICA Study Team

Figure 4.4.3 Existing Drainage Network (1/4)

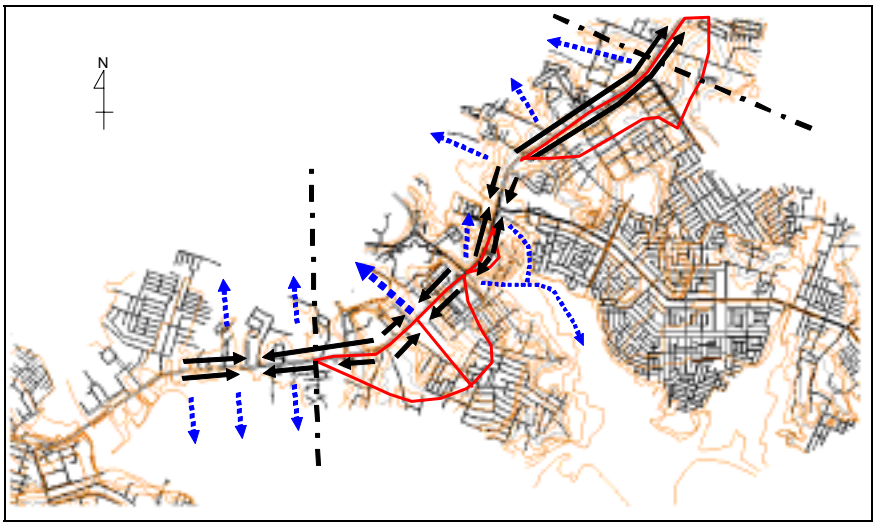


Figure 4.4.4 Existing Drainage Network (2/4)

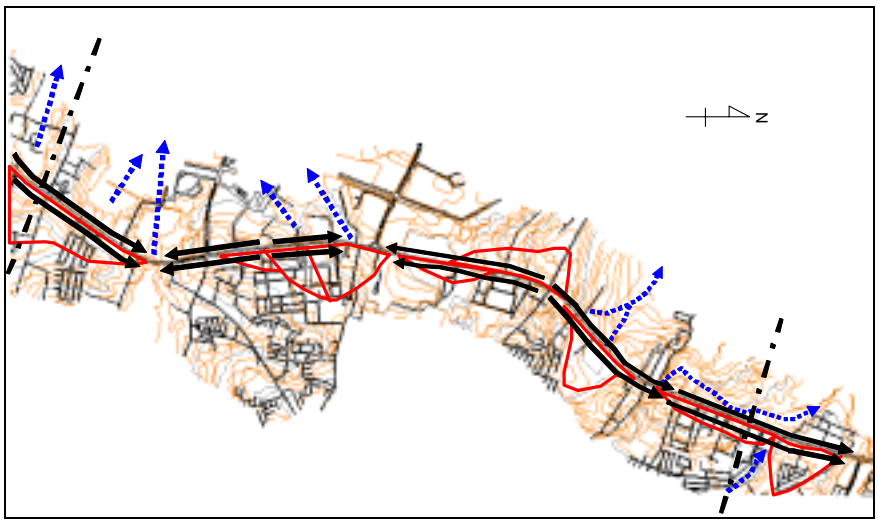


Figure 4.4.5 Existing Drainage Network (3/4)

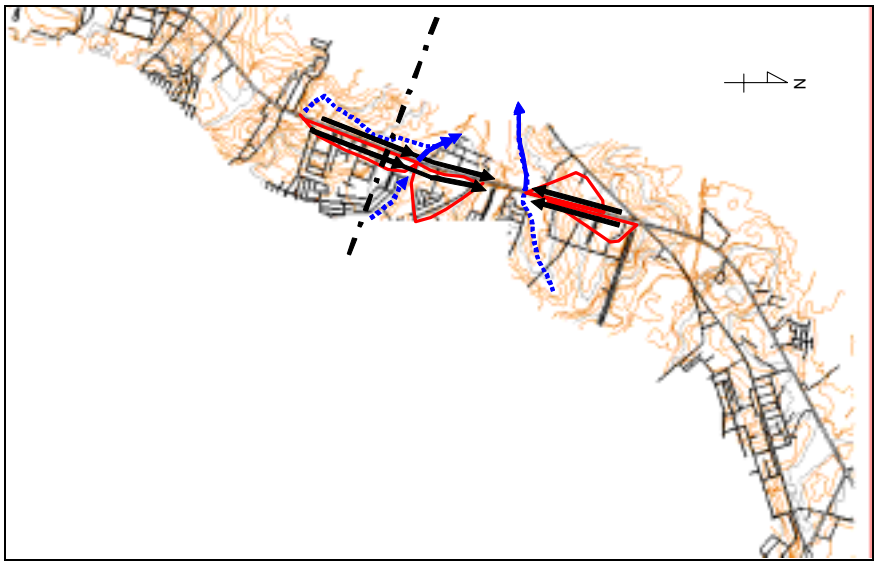
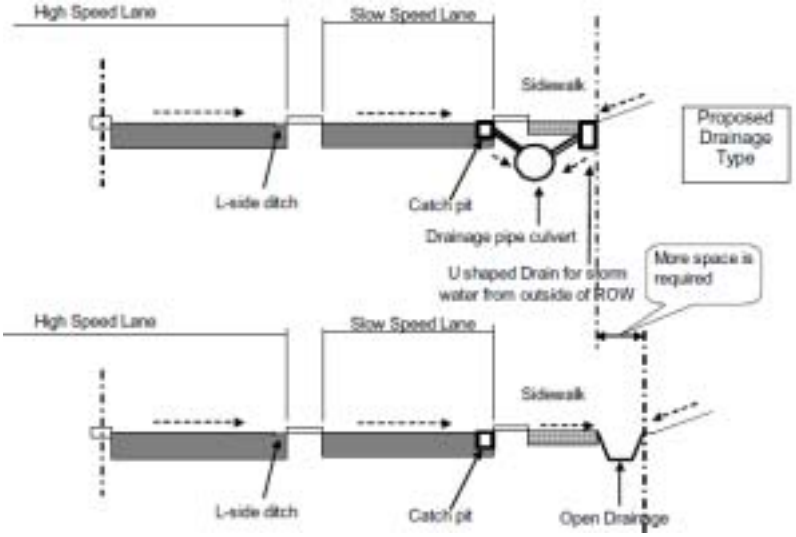


Figure 4.4.6 Existing Drainage Network (4/4)

The existing type of drainage along the study roads is open drainage. Open drainage is also proposed in the planning for the widening of Perintis road proposed by the Municipality of Makassar. In the case of a typical cross section proposed by the JICA study team, the proposed width for the right of way exceeds the 42 m proposed by Municipality of Makassar because open drainage needs more space. The appropriate size of pipe culvert is proposed along the study road. Proposed drainage type is shown in Figure 4.4.7.



Source: JICA Study Team

Figure 4.4.7 Comparison of Drainage Type

Each proposed drainage type and size are determined by run-off and out-flow calculated by the rational formula. Rainfall intensity is determined in consideration of rainfall data in Makassar.

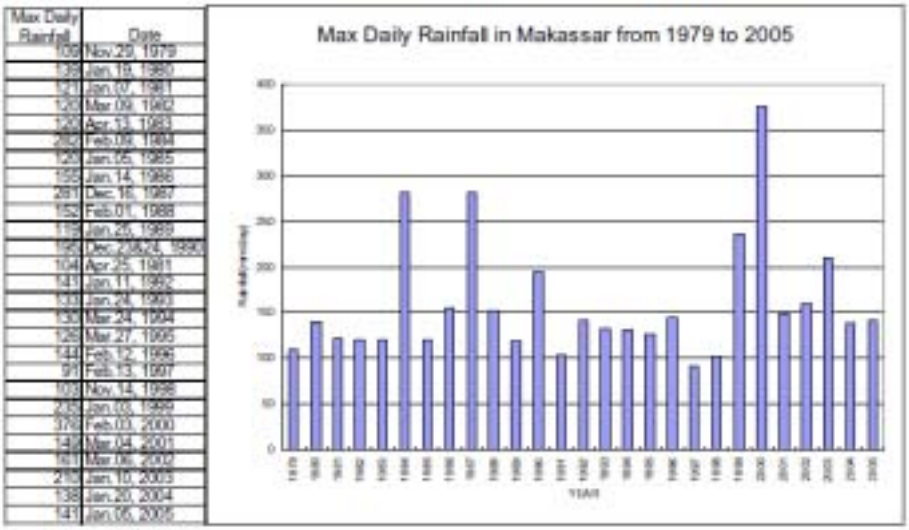


Figure 4.4.8 Rainfall Data from 1979 to 2005

According to the drainage design standard of Indonesia, the design period for culverts along the arterial road is 10 years.

Table 4.4.1 Required Design Period for Culvert

Road Classification	Required Design Period for Culvert
Toll Road	25 years
Arterial Road	10 years
Local Road	5 years

Source: Metode, Spesifikasi dan tata cara Edisi Pertama, Dec.2002 Bagian:13 Kayu, Bahan lain, lain-lain Departemen Permukiman dan Prasarana Wilayah Badan Penelitian dan Pengembangan P.659 3.4 7)

Table 4.4.2 Probable Daily Rainfall calculated by Gumbel Method

Return Period	3	5	10	25	50
Probable Daily Rainfall	175.4	205.4	243.2	290.8	326.1

4.5 Junction plan

(1) General

The study road would be designated as a primary arterial road in the Mamminasata metropolitan area. However, a huge volume of short trip traffic such as mini buses has been accessing the study road due to constraints in the available road network. Therefore, an access system with crossing roads should be considered, not only for inter-city traffic but also for intra-city traffic.

(2) Guidelines for type of intersection

Selection of interchanges, grade separations, and at-grade intersections will be made based on the number of lanes of crossing roads. In principle, for Type I and Type II crossings with partial access control and crossing more than 4 lanes, the crossing should be provided with grade separation in accordance with standard Specifications for Geometric Design of Urban Roads. Traffic control type of at-grade intersection will be selected based on the available capacity of control system for traffic demand and cost effectiveness. Table 4.5.1 shows the proposed junction type selection.

Table 4.5.1 Proposed Selection of Interchanges, Grade Separations, and At-grade Intersections Based on Road Classifications in Urban Areas

Urban Area	Type-I	Type-II (Partial access control)	Type-II (More than 4 lanes)	Type-II (Less than 4 lanes)
Type-I	1	1	1	-
Type-II (Partial access control)		1	1	2
Type-II (More than 4 lanes)			1	2
Type-II (Less than 4 lanes)				3

Source: JICA Study Team

Notes: 1 - Normally grade separations.

2 - Normally signal controlled intersections, but grade separations can be justified where:
- Capacity limitation causes serious delay,
- Injury and fatality rates are high, and
- Cost would be lower than an intersection.

3 - Normally stop controlled intersection, or signal controlled intersection.

Based on traffic and safety condition of the site, adoption of the following junction types should be considered.

- Grade-separation with access.
- Grade separation with access, but without access at low traffic volume.
- Grade separation with access, but without access where accessible grade separation spacing is too close.
- Grade separation without access, but with access to:
  - Relieve congestion
  - Serve high density traffic generators
- Grade separation without access.
- At-grade intersection, but grade separation with access can be justified when:
  - Capacity limitation causes serious delay
  - Injury and fatality rates are high
- At-grade intersection, but grade separation without access at low traffic volume.
- At-grade intersection

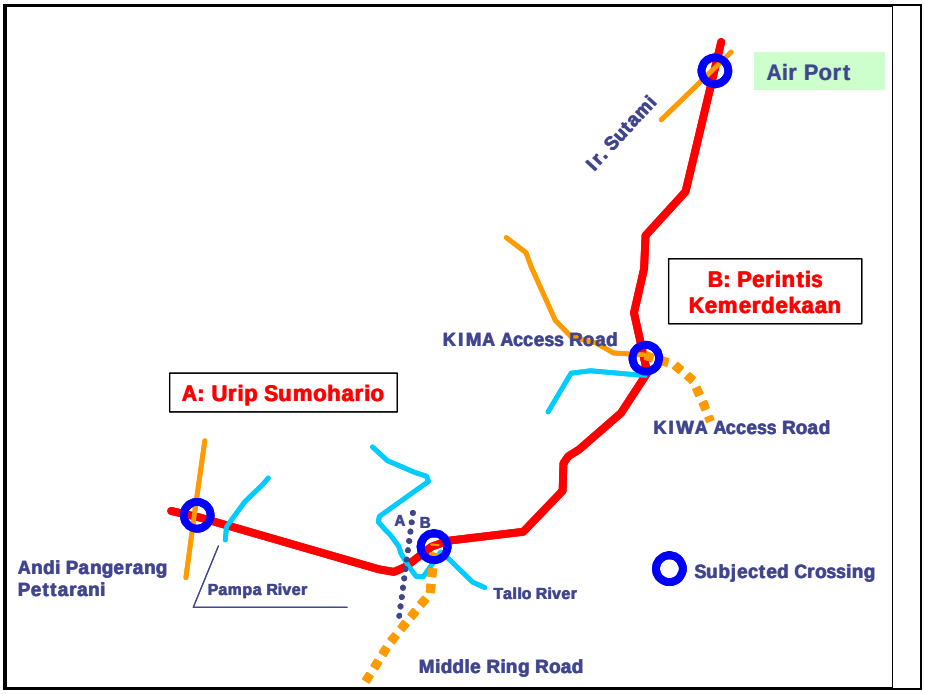
(3) Major Junctions on the study road

Four major junctions are planned on the study road as shown in Table 4.5.2. Two junctions planned at the beginning and end of the study road have been studied. The junction at the beginning point is located at the crossing of Andi Pangerang Pettarani and Urip Sumoharjo and a feasibility study for this has been carried out by PU. However, the feasibility study did not consider the Urip Sumoharjo improvement plan. Therefore, both plans should be coordinated in this regard. The junction at the end point is located at the crossing of Ir. Sutami and Perintis Kemerdekaan and preliminary design study was carried out by a private company who was entitled to a privilege as a contractor for BOT operation. In the preliminary design, the junction was designed based on existing lane condition of JL Perintis Kemerdekaan and the design proposed rotary junction system. However, the capacity of the proposed rotary junction would not be adequate for future traffic demand in case of improvement of Perintis Kemerdekaan. Therefore, both plans should be coordinated in this regard.

Since the specific plan of the middle ring road has not been obtained from the planning authority, the crossing location has been assumed by the JICA Study Team based on considerations of land use and geometric conditions.

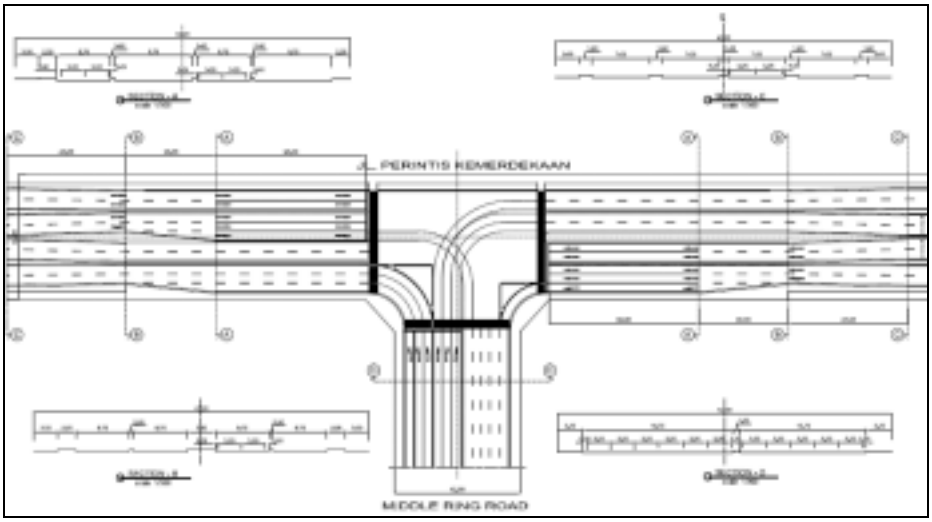
Table 4.5.2 List of Junctions on the study road

Locations	Type of Junction	Forecasted Traffic demand in 2020 (00/day)	Remarks
Beginning Point	Interchange	-	Status (F/S), PU
Middle Ring Road	At-Grade	508	T Junction
KIMA access road	Grade separation	483/565	
End Point	Grade separation	-	Status (Preliminary design), BOT(Local)



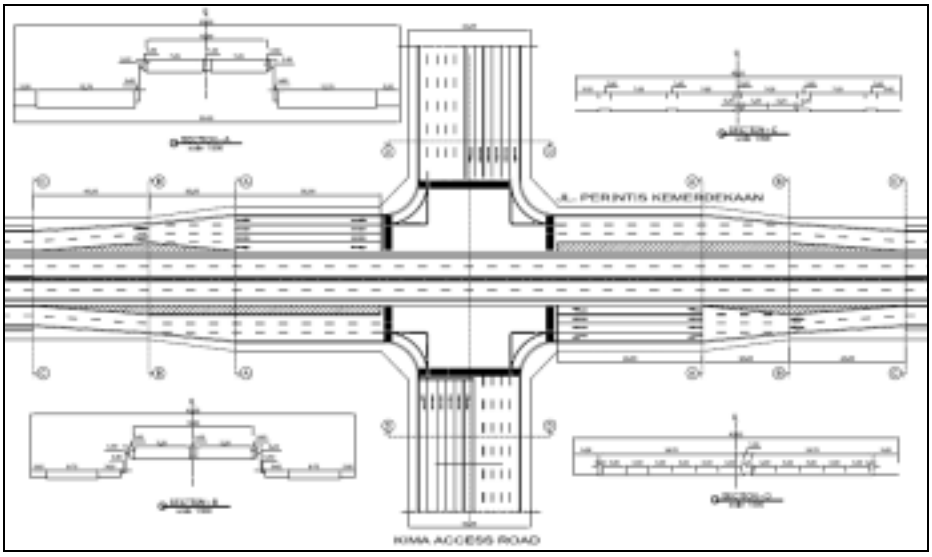
Source: JICA Study Team

Figure 4.5.1 Location of Outstanding Junctions



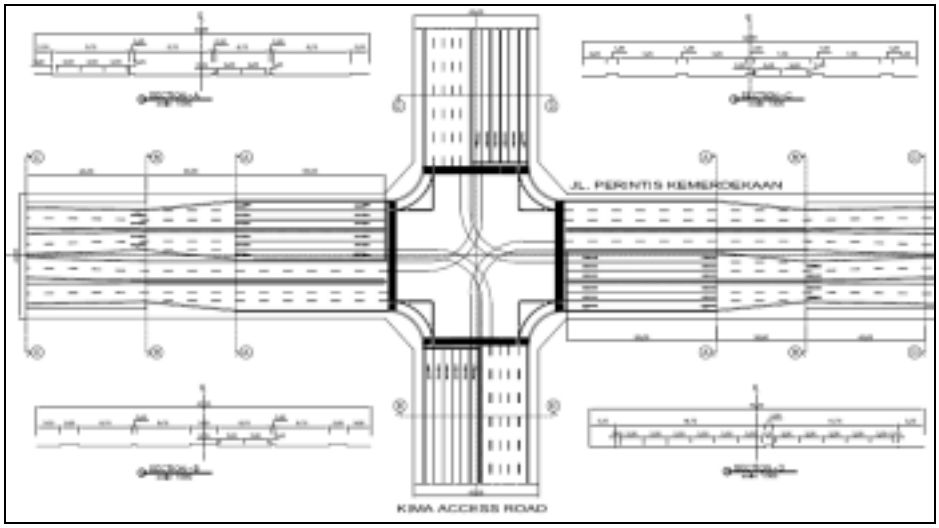
Source: JICA Study Team

Figure 4.5.2 Plan of Middle Ring Road



Source: JICA Study Team

Figure 4.5.3 Plan of KIMA Access Road (Case-1 Flyover)

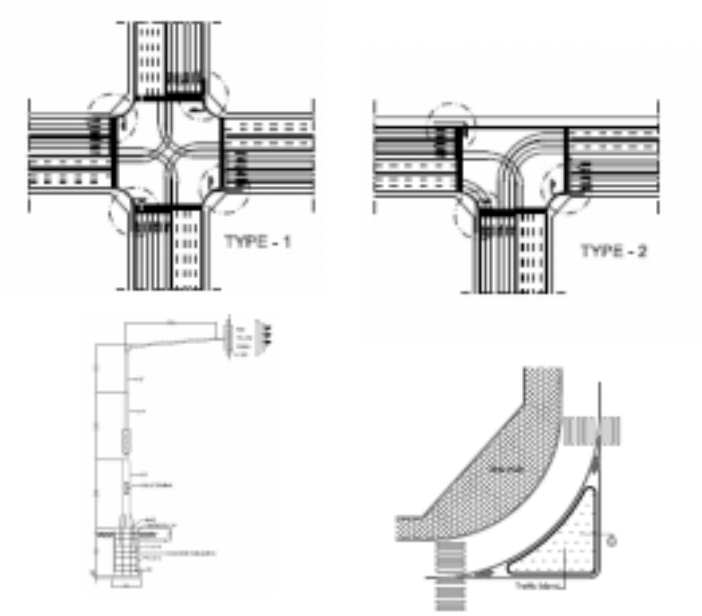


Source: JICA Study Team

Figure 4.5.4 Plan of KIMA Access Road (Case-2 At-Grade)

(4) Signal controlled intersections and pedestrian crossing facilities

For ensuring traffic function as a primary arterial road, installation of signal controlled intersections should be minimized. Installation of signal controlled intersections should be considered at an appropriate distance from major interchanges and grade separations to minimize the reduction in traffic efficiency and serviceability for intra-traffic movement. On the other hand, ensuring pedestrian network connectivity is essential for avoiding division of the community and integral area development. Therefore, pedestrian crossing facilities such as pedestrian crossing, pedestrian bridge and pedestrian signals should be installed at appropriate locations on the study road.

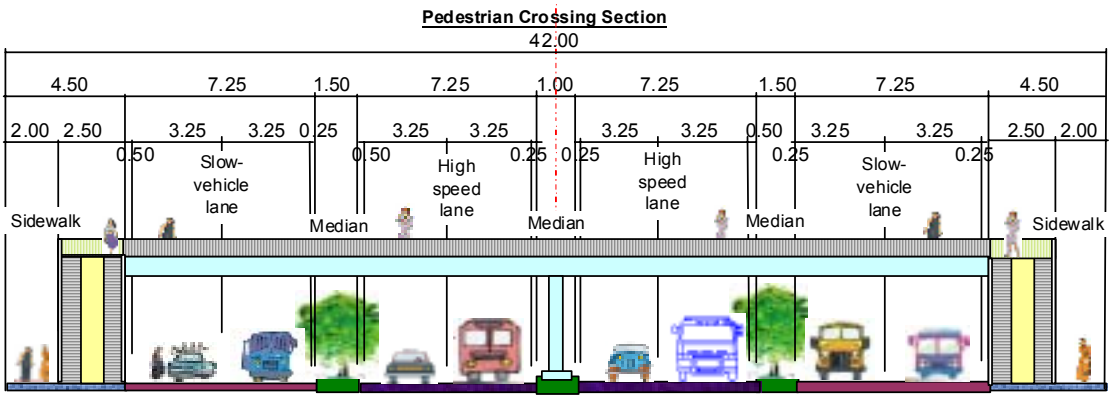


Source: JICA Study Team

Figure 4.5.5 Location and Detail of Signal System

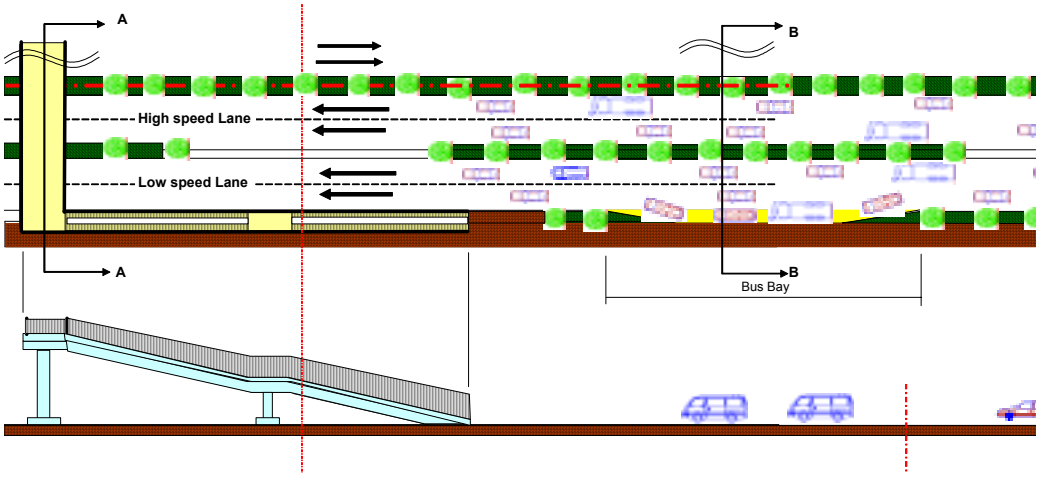
Appropriate locations for installation of pedestrian bridges are at bus bay sections, markets, educational facilities, institutional facilities, governmental offices, and so on.

The location of the proposed intersections and pedestrian bridges are presented in Annex-2.



Source: JICA Study Team

Figure 4.5.5 Section of Pedestrian Crossing



Source: JICA Study Team

Figure 4.5.6 Plan of Pedestrian Crossing

4.6 Examination of Alternative Plans for Pampa and Tallo Bridges

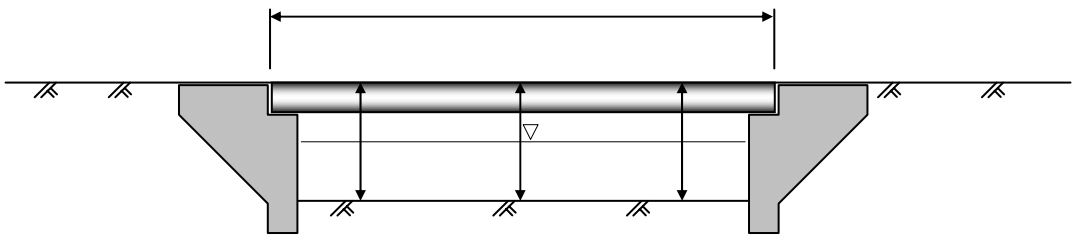
(1) General

Two major bridges are located on the Panpang and Tallo rivers with 4-lane carriageways. These bridge sections are necessary for giving additional 4 lanes due to the increment in traffic demand in 2020. However, existing pipes for drinking water are located beside the bridges and are a constraint on widening.

(2) Conditions to be considered Pampa bridge

Present condition of Pampa bridge is as follows;

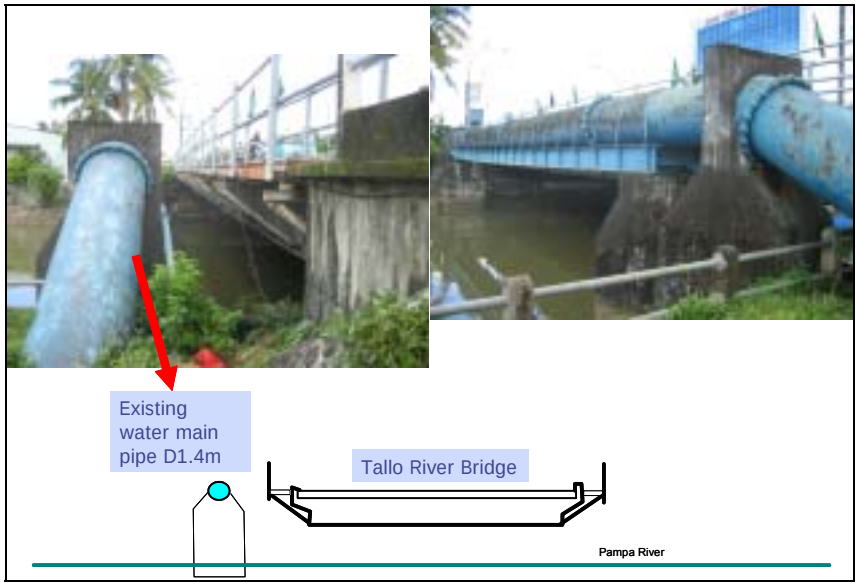
- Bridge length :30.4m
- Width :16.3m
- Bridge Type :Plate girder (1span)



Source: JICA Study Team

Figure 4.6.1 Existing Pampa Bridge

The critical control for arrangement of the cross section on this bridge is the existing 1.4 m diameter water main pipe which is located 1.5m away from the left side edge of the bridge. The pipe is supported by stable bridge structures. The study team has discussed with the authority responsible about the possibility of relocation of the pipe and the necessary cost of the relocation work.

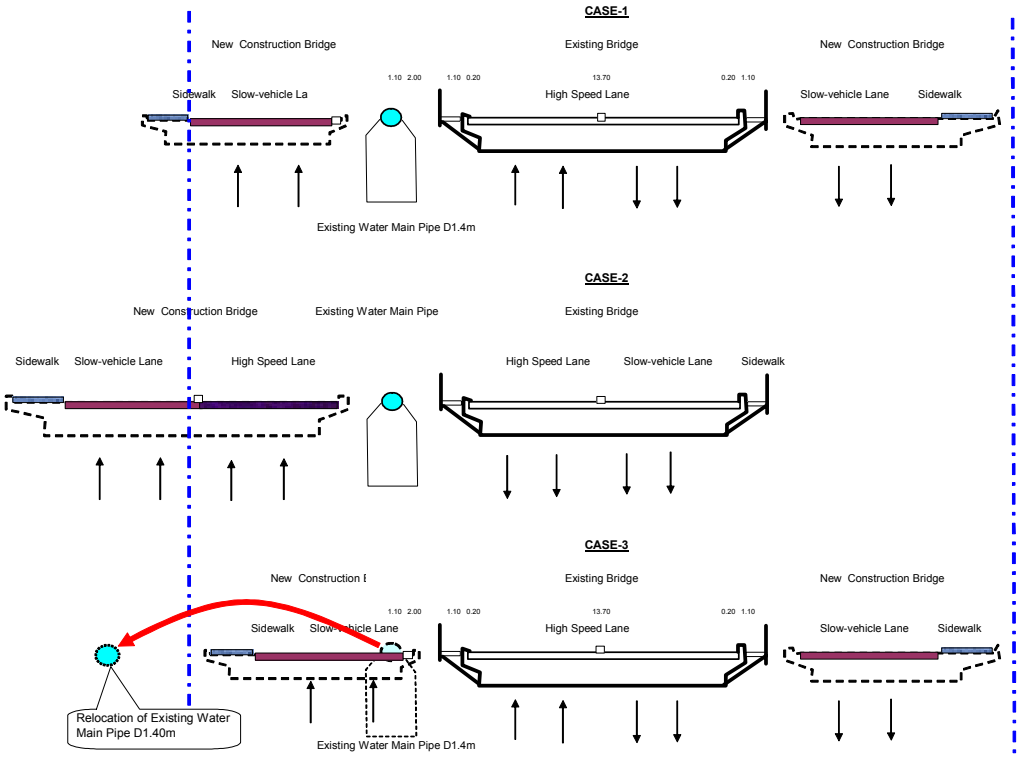


Source: JICA Study Team

Figure 4.6.2 Existing Condition of Pampa Bridge

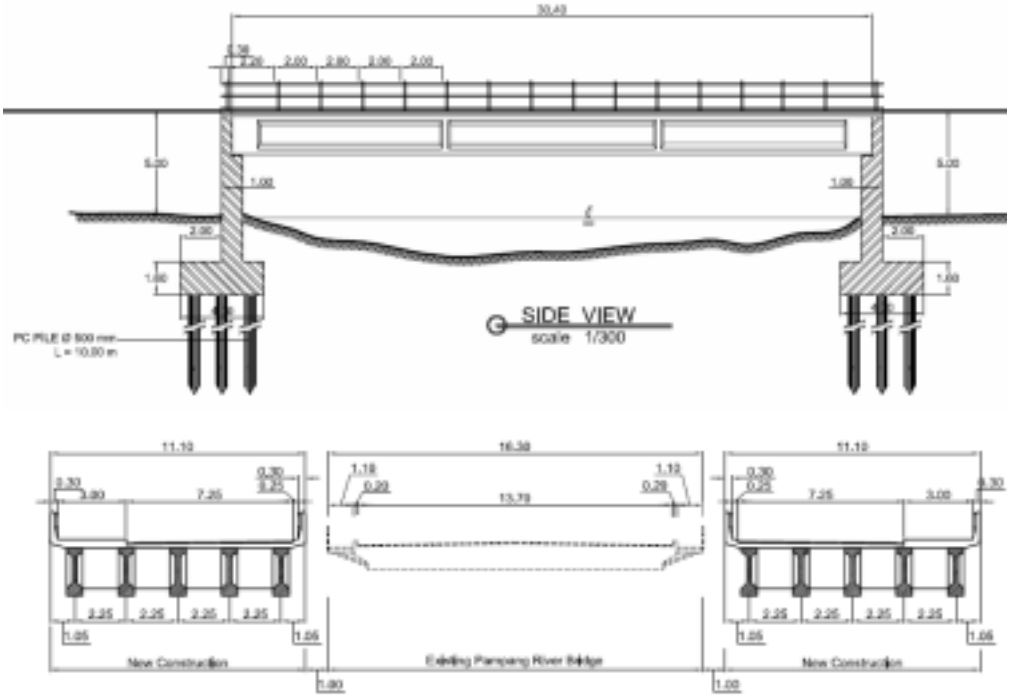
(3) Comparison of Pampa bridge alternatives

Figure 4.6.3 shows three alternative bridge plans. Case 1 and 2 are planned without relocation of the existing pipe. Case 3 is planned with pipe relocation. The most desirable alternative plan for road geometry is Case 3; however, the plan involves relocation of the pipe and the matter has been discussed with the responsible authority for a further study stage.



Source: JICA Study Team

Figure 4.6.3 Alternative Bridge Arrangement Plan



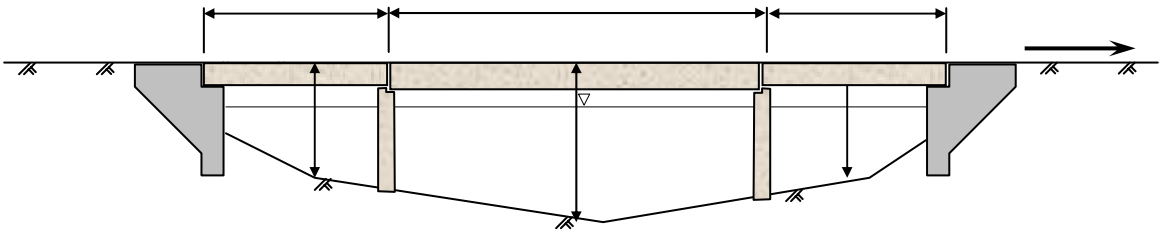
Source: JICA Study Team

Figure 4.6.4 Pampang Bridge Plan

(4) Conditions to be considered Tallo bridge

Present condition of Tallo bridge is as follows;

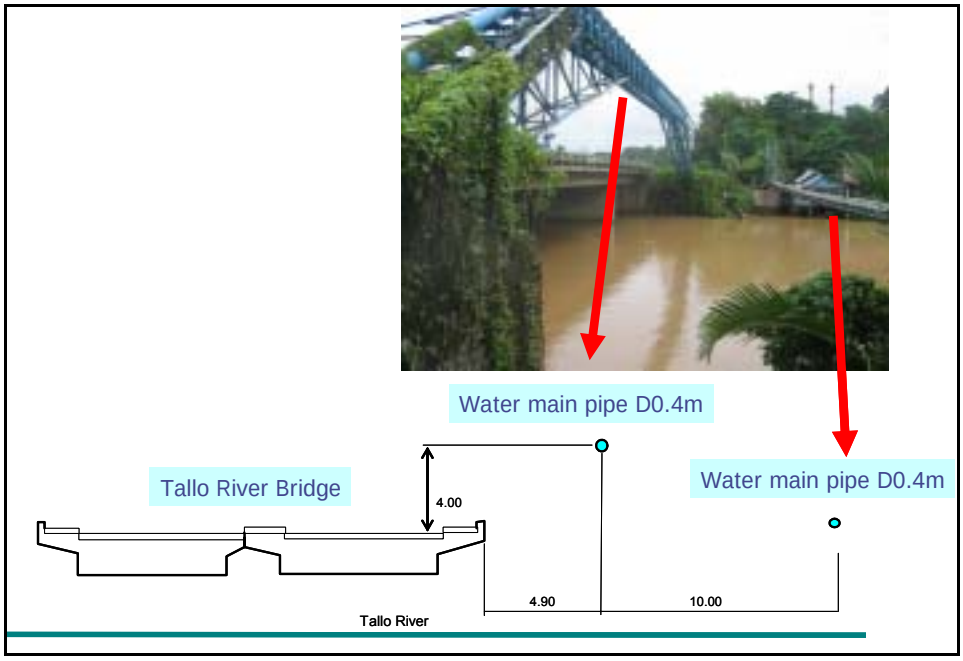
- Bridge length :60m (35.7m (Main), 12.7m + 11.6m (Approach))
- Width :19m
- Bridge Type :PC I-girder (Main), RC slab (Approach)



Source: JICA Study Team

Figure 4.6.7 Existing Tallo Bridge

The critical control on the arrangement of the cross section of this bridge is an existing 0.4 m diameter water main pipe which is located 4.9m away from the right side edge of the bridge. The pipe is conveying drinking water to households and is supported by stable bridge structures. The study team has discussed with the responsible authority about the possibility of relocation of the pipe and necessary cost for the relocation work.

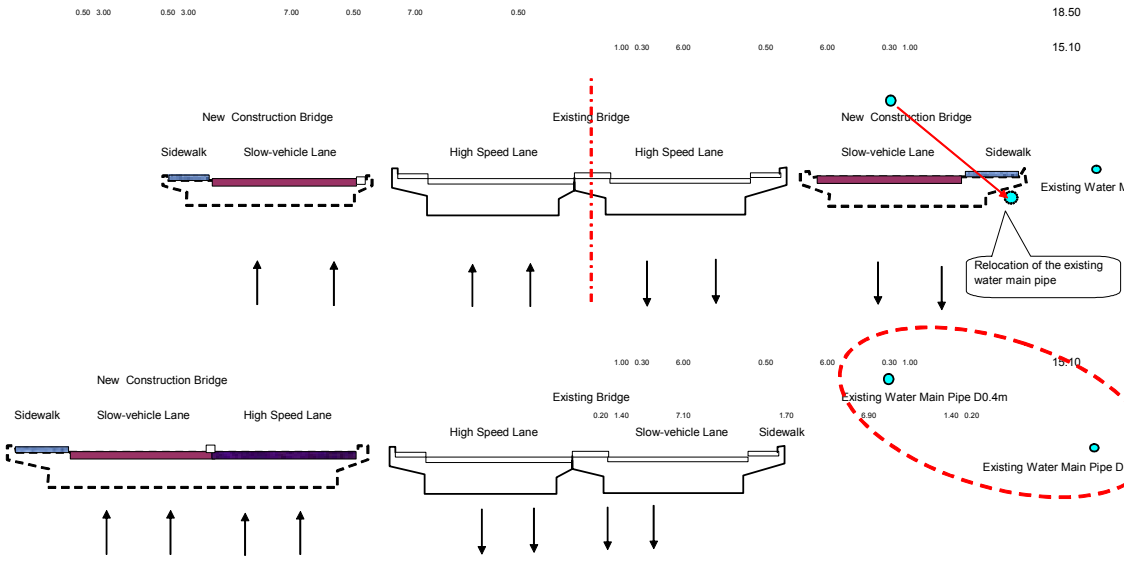


Source: JICA Study Team

Figure 4.6.8 Existing Condition of Tallo Bridge

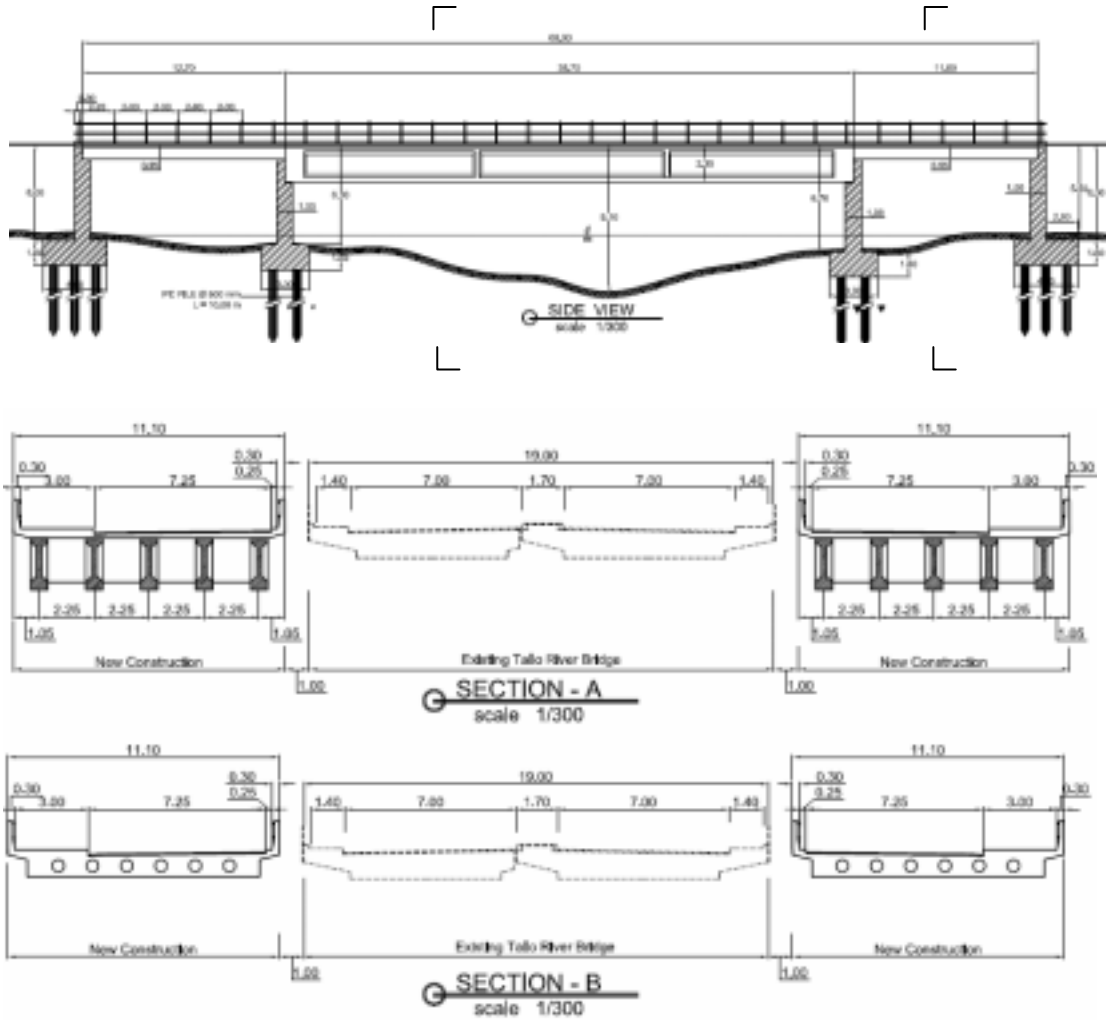
(5) Comparison of Tallo bridge types

Figure 4.6.9 shows two alternative bridge plans. Case 1 is a plan with relocation of the existing water main pipe. Case 2 is a plan without pipe relocation. The desirable alternative for road geometry is case 1; however, the plan involves relocation of the water main pipe and the matter has been discussed with responsible authority for further study stage.



Source: JICA Study Team

Figure 4.6.9 Alternative Bridge Arrangement Plan



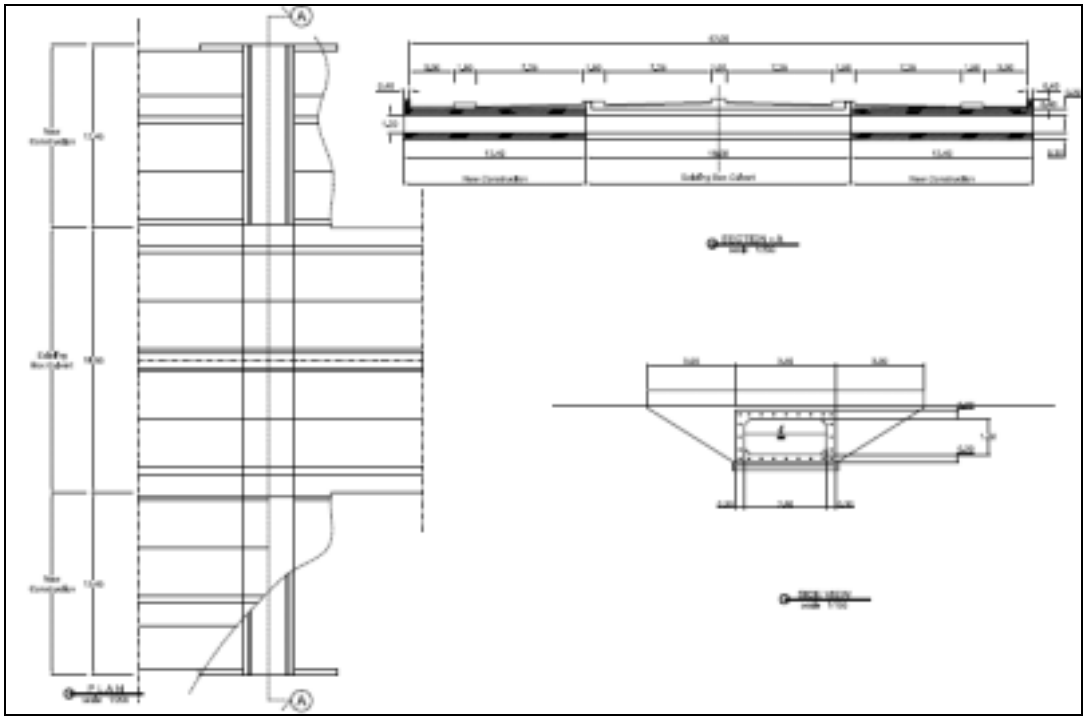
Source: JICA Study Team

Figure 4.6.10 Tallo Bridge Plan

4.7 Other major structures

(1) Culvert

There are five existing culverts on the study road section. They serve as drain outlets for the road side drainage and covey river water under the road. Because the existing culverts work properly and are in a stable condition, extension of the existing culverts is planned as shown in Figure 4.7.1.

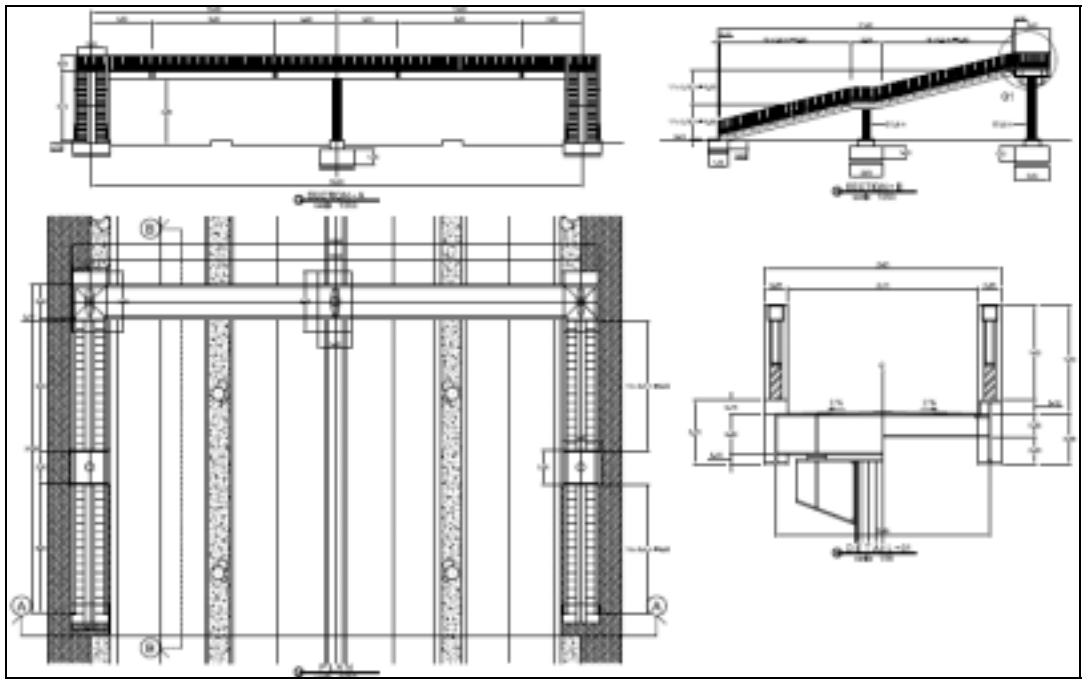


Source: JICA Study Team

Figure 4.7.1 Culvert Plan

(2) Pedestrian Bridge

Pedestrian bridge shall provide accessibility for pedestrians with comfortable pedestrian space function. Therefore, the bridge is given gentle grade slope as shown in Figure 4.7.2.



Source: JICA Study Team

Figure 4.7.2 Pedestrian Bridge Plan

4.8 Public Utility Relocation Plan

Public utilities such as power lines, telecommunication lines and water mains are installed along the study road.

(1) Power line

Low tension 20kv overhead power lines are installed along the roadside. An underground 20kv cable is located on the right hand side of the section from the 1.75km point to the Tallo River. At Urip Sumoharjo, a 20kv overhead cable is located on the right hand side and a low tension overhead cable is located on the left hand side. On the other hand, at Perintis, a 20kv overhead cable is located on the left hand side and a low tension overhead cable is located on the right hand side.

(2) Telecommunication line

There are two types of telecommunication line installed underground at the side of the study road. One is a primary line including optical fiber cable, the other is a secondary cable. The primary line has many cables so is difficult to relocate. Adjustment of the level of the manhole cover for the primary line is required for the widening of the study road. The secondary line should be relocated under the proposed sidewalk.

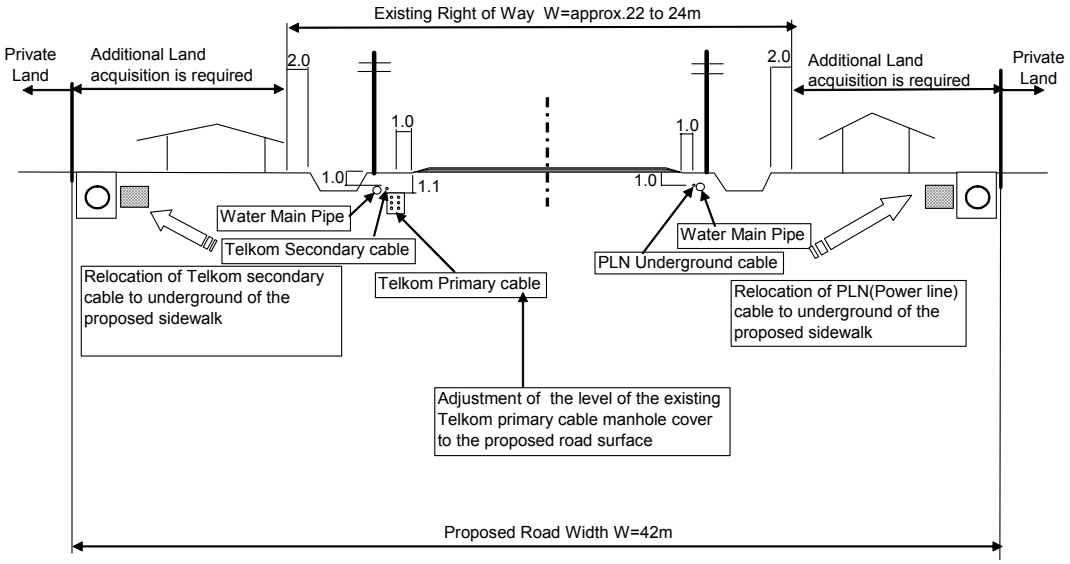
(3) Water main pipe

D150, 200, 250, 300, 400 and 1,000mm water mains pipes are located on both sides of the study road. The water mains pipe on the right hand side was installed in 1978 and the water main pipe on the left hand side was installed in 1977. The depth of these water mains pipes is not clear because the as-built drawings for these water main pipes are missing at the Water Supply Corporation. The D1000 pipe appears at the Pampang Bridge section. D200, D400 pipes appear at the Tallo Bridge section. These water pipes should be removed and new water mains pipes installed outside the alignment of the proposed bridges.

(4) Provision of the Public Utilities Space

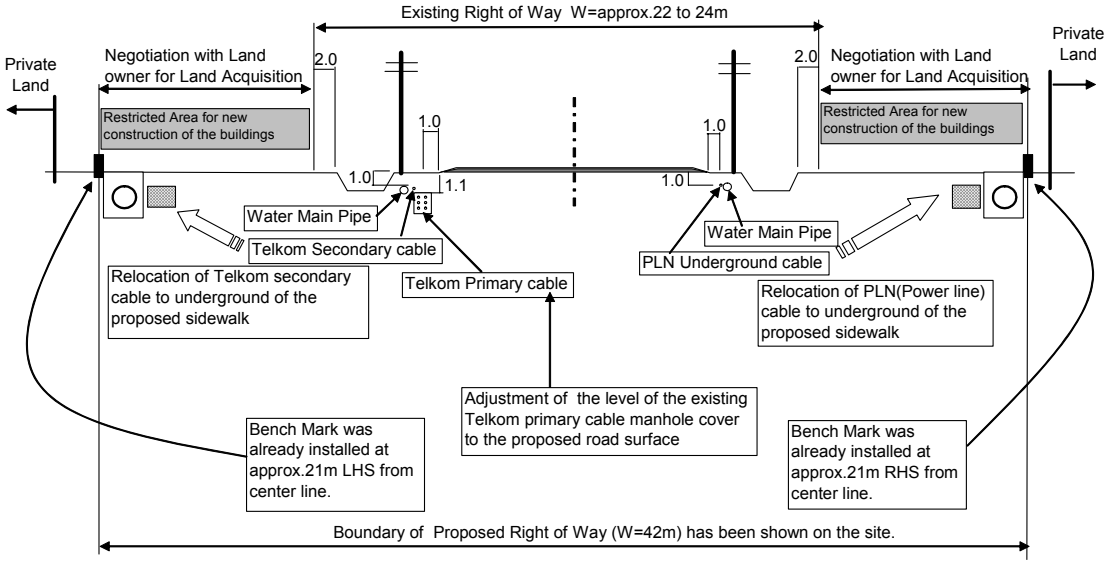
Existing public utilities which would be affected by the proposed road should be relocated to the proposed sidewalk. Installation of new common duct under the sidewalk might be desirable to provide a space for public utilities.

Te precise locations of each public facility should be confirmed at the detailed design stage.



Source: JICA Study Team

Figure 4.8.1 Public Utilities Relocation Plan (Urip Sumoharjo)



Source: JICA Study Team

Figure 4.8.2 Public Utilities Relocation Plan (Perintis Kemerdekaan)

4.9 Maintenance Plan

(1) General

Highway maintenance is one of the most important factors of a highway system. It is a program to preserve and repair the road system and its elements to its designed or accepted configuration. The elements include road surface, shoulders, roadside, drainage facilities, retaining structures, bridges, traffic markings and signs, lighting fixtures etc. The maintenance operations involve assessment of the conditions of the

above-mentioned elements, diagnosis of the problems, and adoption of the most appropriate countermeasures.

The maintenance management should be developed based on the management techniques and materials and equipment that are available. The planning and scheduling, fiscal control system, maintenance criteria and standards should be properly studied.

(2) Maintenance system

The national roads are managed by the Ministry of Public Works, and the city roads are maintained by State and city, using public executing corporations.

South Sulawesi state is assumed to be the implementing agency of this project to develop the Urip Sumoharjo and Perintis Kemerdekaan functionally and effectively as provided in the scope of work. It is preferable that South Sulawesi state basically executes the maintenance for the future road network, the future land use along the study road, and so forth.

(3) Maintenance work

Maintenance works are classified as three types: routine, periodic, and emergency.

Routine maintenance: Requires routine inspection of the condition of pavement, drainage, cut and fill slopes, bridges and other structures and facilities to monitor any defects and damage. The results of routine inspection are promptly reported to the maintenance office for follow-up maintenance works to be undertaken either continually throughout a year or at certain intervals every year. Clearing, mowing of grass and repairs are executed according to the routine maintenance plan, the.

Periodic maintenance: Is based on detailed inspection performed at certain time intervals, such as seasonally or yearly depending on the type and kind of facilities. Includes checking and testing the conditions of various structures and facilities. Defects and damage will be reported for repairs or remedies. The clearing, repairing and renewal are then executed according to the periodic maintenance plan,.

Emergency maintenance: Involves restoring road and road related facilities to their normal operating conditions after they are damaged by road accidents or natural causes. Table 4.9.1 summarizes the typical activities of each type of maintenance work.

Table 4.9.1 Typical Maintenance Activities

Routine Maintenance
Inspection and patrol including removal of obstacles
Clearing of road surface
Clearing of ditches, culverts and bridges
Vegetation control; mowing and maintaining of plants
Repair of traffic safety and management facilities
Repair of devices and equipment including lighting facilities
Pothole patching and crack sealing
Repair of cut and fill slopes
Periodic Maintenance
Inspection and test
Renewal of traffic safety and management facilities
Renewal of devices and equipment
Repair of ditches, culverts and bridges
Overlay and re-pavement for bridges
Replacement of expansion joints and bearing for bridges
Emergency Maintenance
Removal of debris or obstacles from natural causes
Repair of damage caused by traffic accidents
Repair of damage caused by natural causes

Source: JICA Study Team

5. COST ESTIMATE AND IMPLEMENTATION SCHEDULE

5.1 Composition of Project Cost and Preconditions

The project cost is estimated on the basis of the results of the preliminary design and quantity calculation of work items (construction cost), detailed design and supervision services, land acquisition and compensation cost. Construction cost includes direct construction cost, indirect construction cost and physical contingency. The prevailing unit cost of ordinary construction work items are prepared with reference to Indonesian standard unit construction costs in 2006. Construction costs are calculated based on these unit costs.

Table 5.1.1 Project Cost Component

Project Cost	Construction Cost	Direct Construction Cost	Material Cost
			Labor Cost
			Equipment Cost
			General Cost
		Indirect Construction Cost	Overhead & Profit
		Physical Contingency	
	Detailed Design and Supervision Services		
	Land Acquisition and Compensation Cost		
Maintenance Cost			

Source: JICA Study Team

(1) Construction cost

When the construction cost of each section was calculated, the following basic premises were required.

- Companies to undertake the construction work will be selected by international competitive bidding.
- The exchange rate applies at the time of May, 2006 (US$ 1.0= ¥113.90=8,760 IDR).

The direct construction cost is built up by using the above unit costs. And, the contingency was assumed as 10% of the direct cost of construction.

(2) Land acquisition, compensation and resettlement

The cost required for the land acquisition, compensation and resettlement was estimated based on the market price in Makassar.

(3) Engineering services

Engineering services including detailed design, construction supervision and the like is assumed to be 10% of the construction cost.

(4) Maintenance

The cost required for maintenance is estimated in the Maintenance Plan, which is described in next section.

(5) Project cost

The project costs estimated according to the above-mentioned conditions are shown below. However, the project costs excludes the operation and maintenance Cost, Land Acquisition, Compensation and Resettlement Cost or interest during construction.

5.2 Construction Cost Estimate

Construction cost was estimated under the following work categories:

- Site Clearing Work
- Demolition and Relocation Work
- Earth Work
- Pavement Work
- Drainage Structure
- Bridges Work
- Culvert Work
- Safety Facility Work
- Ancillary Work

The summary of the construction cost is shown in Table 5.2.1.

Table 5.2.1 Summary of Construction Cost Estimate

	ITEMS	Amount(Rp)		
		A. JL.Urip Sumoharjo	B. JL.Perintis	Total
I	Construction Cost	75,648,320,000	251,818,710,000	327,467,030,000
1	Site Clearing Work	362,200,000	1,223,400,000	1,585,600,000
2	Demolition & Relocation Work	724,000,000	2,338,600,000	3,062,600,000
3	Earth Work	3,653,500,000	17,016,000,000	20,669,500,000
4	Pavement Work	17,976,800,000	59,720,400,000	77,697,200,000
5	Drainage Work	34,696,500,000	117,891,800,000	152,588,300,000
6	Bridge Work	4,308,200,000	10,414,600,000	14,722,800,000
7	Culvert Work	0	1,303,700,000	1,303,700,000
8	Safety Facility Work	3,482,600,000	6,847,900,000	10,330,500,000
9	Ancillary Work	3,567,400,000	12,169,700,000	15,737,100,000
	Contingency (10%)	6,877,120,000	22,892,610,000	29,769,730,000
II	Detailed Design and Supervision	7,564,832,000	25,181,871,000	32,746,703,000
	10% of Construction Cost	7,564,832,000	25,181,871,000	32,746,703,000
III	Total (I+II)	83,213,152,000	277,000,581,000	360,213,733,000

Source: JICA Study Team estimate

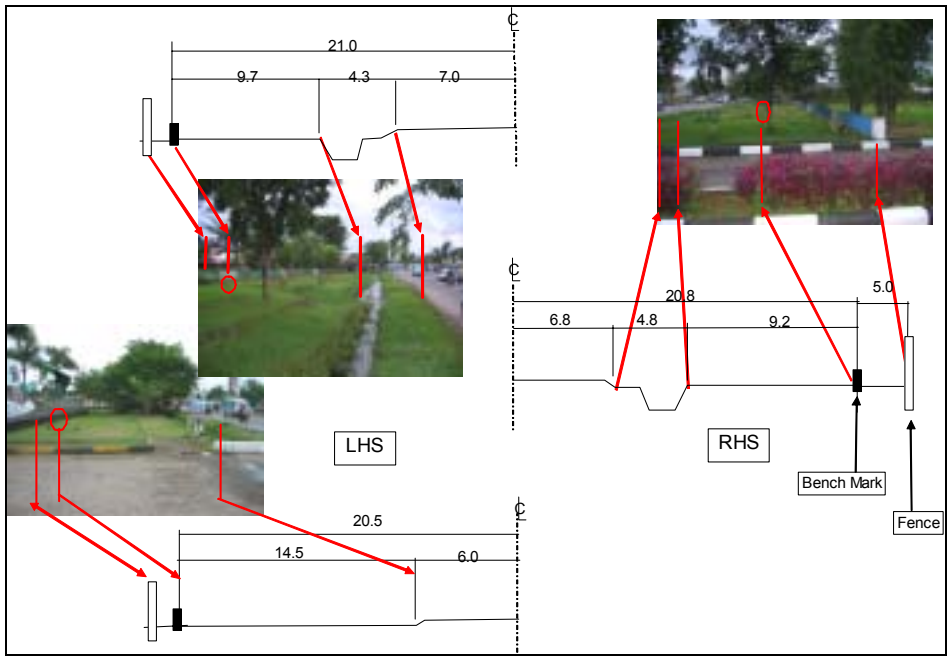
5.3 Estimated Cost of Land Acquisition and Resettlement

(1) Mechanism of land acquisition in Indonesia

The legal procedure for land acquisition and compensation are enacted in law. The responsible authority for funding and administration of land acquisition and compensation are the PU and municipal office.

(2) Present status of Land acquisition and compensation

Necessary land for road widening along Perintis Kemerdekaan road has not been acquired. However, boundary piles have been installed and construction restriction has been conducted from the Tallo River to the project end as shown in Figure 5.3.1.



Source: JICA Study Team

Figure 5.3.1 Construction Restriction Piles

(3) Range of Land Acquisition

The range of land acquisition is defined as the area within the right of way (ROW) of the project. The area includes all ROW of the road.

(4) Unit Price for Compensation

Based on the current government rule, the following unit prices were adopted for this study.

Table 5.3.1 Assumed Unit Prices for Compensation

Road	Section		Value(Rp./m2)		
			Unreg. Land	Reg. Land	Building
JL.Urip Sumoharjo	Pampang		520,500	694,000	206,000
		L	520,500	694,000	206,000
		R	520,500	694,000	206,000
	Panaikang		520,500	694,000	206,000
		L	520,500	694,000	206,000
		R	520,500	694,000	206,000
JL.Perintis	Tamalanrea		300,000	400,000	206,000
		L	300,000	400,000	206,000
		R	300,000	400,000	206,000
	Daya		225,000	300,000	206,000
		L	225,000	300,000	206,000
		R	225,000	300,000	206,000
	Sudiang		187,500	250,000	206,000
		L	187,500	250,000	206,000
		R	187,500	250,000	206,000

(5) Total Estimated Cost

Based on the above unit prices, the total compensation cost is estimated in Table 5.3.2.

Table 5.3.2 Estimated Cost for Land Acquisition and Resettlement

Item		Unit	Quantity	Unit Price(Rp)	Total (Rp)
Unregistered Land		m2	75,614	520,500	39,357,100,000
Registered Land		m2	14,472	694,000	10,043,600,000
Building		m2	7,305	206,000	1,504,800,000
Demolition Work	Building	house	117	5,000,000	585,000,000
Total (Urip Sumoharjo)					51,490,500,000

Item		Unit	Quantity	Unit Price(Rp)	Total (Rp)
Unregistered Land	Tamalanrea Section	m2	90,529	300,000	27,158,700,000
Unregistered Land	Daya Section	m2	66,677	225,000	15,002,300,000
Unregistered Land	Sudiang Section	m2	75,779	187,500	14,208,600,000
Registered Land	Tamalanrea Section	m2	53,551	400,000	21,420,400,000
Registered Land	Daya Section	m2	13,923	300,000	4,176,900,000
Registered Land	Sudiang Section	m2	20,743	250,000	5,185,800,000
Building		m2	18,569	206,000	3,825,200,000
Demolition Work	Building	house	312	5,000,000	1,560,000,000
Total (Perintis Kemerdekaan)					92,537,900,000
Total (Urip Sumoharjo+Perintis Kemerdekaan)					144,028,400,000

Source: JICA Study Team estimate

5.4 Maintenance Cost

The maintenance costs are estimated by each component. For the cost estimation, the main assumptions are as follows;

(1) Routine maintenance

- Inspection and patrol
- Pothole patching and crack sealing
- Repair of traffic safety and management facilities

- Repair of bridge paint
- Clearing, vegetation control and others.

(2) Periodic maintenance

- Overlay for roads at 5-year intervals
- Re-pavement of bridges at 20-year intervals

Based on the above assumptions, the maintenance costs are estimated as shown in Table 5.4.1.

Table 5.4.1 Maintenance Cost

Annual Routine Maintenance Cost for JL.Urip Sumoharjo & JL Perintis Kemerdekaan (Rp.)

No.	Items	JL.Urip Sumoharjo	JL Perintis Kemerdekaan	Remarks
		L=3.9km	L=11.5km	
1	Pavement Routine Maintenance Work	390,000,000	1,150,000,000	50,000,000 per km
2	Road Marking Maintenance Work	169,000,000	498,333,333	130,000,000 per km
3	Shoulder Routine Maintenance Work	5,850,000	17,250,000	1,500,000 per km
4	Drainage Channel, Water Main Pipe Routine Maintenance Work	4,387,500	12,937,500	750,000 per km
5	Bridge Routine Maintenance Work	13,500,000	2,550,000	50,000 per m
	Sub Total	582,737,500	1,681,070,833	
	Total		2,263,808,333	

Periodical Maintenance Cost for JL.Urip Sumoharjo & JL Perintis Kemerdekaan (Rp.)

No.	Items	JL.Urip Sumoharjo	JL Perintis Kemerdekaan	Remarks
		L=3.9km	L=11.5km	
1	Pavement Repaire Work	719,072,000	2,388,816,000	
	Total		3,107,888,000	

Note; Periodical maintenance cost are estimated 20% of pavement would be reconstructed for 5 year.

Source: JICA Study Team estimate

5.5 Implementation Schedule

(1) General

In this chapter, several crucial subjects necessary for project implementation, such as financial source, organizational arrangement, employment of the Consultant and procurement of the Contractor, are discussed.

(2) Executing Agency

The Directorate General of Highways, Ministry of Public Works, Government of Indonesia will be responsible for construction and operation/maintenance of the Project in cooperation with South Sulawesi state and kota.

(3) Expected Financial Source

Considering the annual budget constraints of South Sulawesi state and kota, it is

obviously impossible to implement the Project under these funds. Through discussions with agencies and authorities concerned during the study period, it is considered that foreign financial assistance by soft loan would be the most likely financial source for the Project. The South Sulawesi state and kota should identify a funding source for the Project and apply for financial assistance for the Project based on the results of this pre-feasibility Study.

(4) Implementation Schedule of the Project

After the pre-feasibility Study, the following several steps need to be cleared before construction commences.

- Application to the donor agency and/or country by the Indonesian government for financial assistance for the feasibility study, detailed design, construction supervision and construction works
- Appraisal of the financial assistance by the donor
- Conclusion of the Loan Agreement
- Employment of the Consultant for the detailed design and construction supervision
- Preparation of the detailed design and tender documents
- Procurement of the Contractor (Pre-qualification and tender)
- Construction

1) Application of the Foreign Financial Assistance for Feasibility study, Detailed Design, Construction Supervision and Construction

After the pre-feasibility study is completed, the should be done by Indonesian government should apply to the donor agency or country based on the results of this pre-feasibility study. Required time for this procedure depends on the official procedure in Indonesian government

2) Appraisal of the financial assistance by the donor

After receipt of the application, the donor agency or country will appraise the financial assistance for the Project. After the appraisal is successfully completed, feasibility study will be conducted.

3) Employment of the Consultant

Employment of the Consultant will be done according to the regulations and guideline of the donor agency. Normally the Consultant will be selected by international competitive bidding.

4) Detailed Design

The Consultant will conduct detailed design and preparation of the tender documents for the Project in this stage. It takes at least ten months for the detailed design

including detailed topographic survey and geological survey.

5) Procurement of the Contractors

The procurement process will be conducted according to the regulations and guidelines of the donor agency. Usually for projects of such scale and kind as this Project, pre-qualification method will be employed to ensure the technical and financial capability of the invited tenderer. Invitation to tender will be issued to the pre-qualified tenderers only. Tender evaluation results will be subject to the final approval of the donor agency.

The period required for this process will be nine months or longer including pre-qualification, tender, tender evaluation, negotiation and necessary approvals by Indonesian government and the donor agency.

Procurement of the Contractors will be done for the respective construction packages independently.

6) Construction

After signing of the contracts, the construction works will be started. The estimated construction period for each construction package is as follows:

Perintis Kemerdekaan	:	24 months
Urip Sumoharjo	:	24 months

7) Land Acquisition

Land acquisition should be done in parallel with the above procedure. It is strongly recommended that the land acquisition should be commenced during the detailed design stage and completed before commencement of the construction works.

The above implementation schedule is presented in Figure 5.5.1.

Table 5.5.1 Construction Time Schedule

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year
JL. Perintis (11.6 km)						
Detailed Design						
Land Acquisition						
PQ and Tendering						
Construction						
JL. Urip Sumoharjo (3.9 km)						
Detailed Design						
Land Acquisition						
PQ and Tendering						
Construction						

Source: JICA Study Team estimate

6. ANTICIPATED ENVIRONMENTAL IMPACT

6.1 Environmental Laws and Regulations

(1) Environmental Impact Assessment System

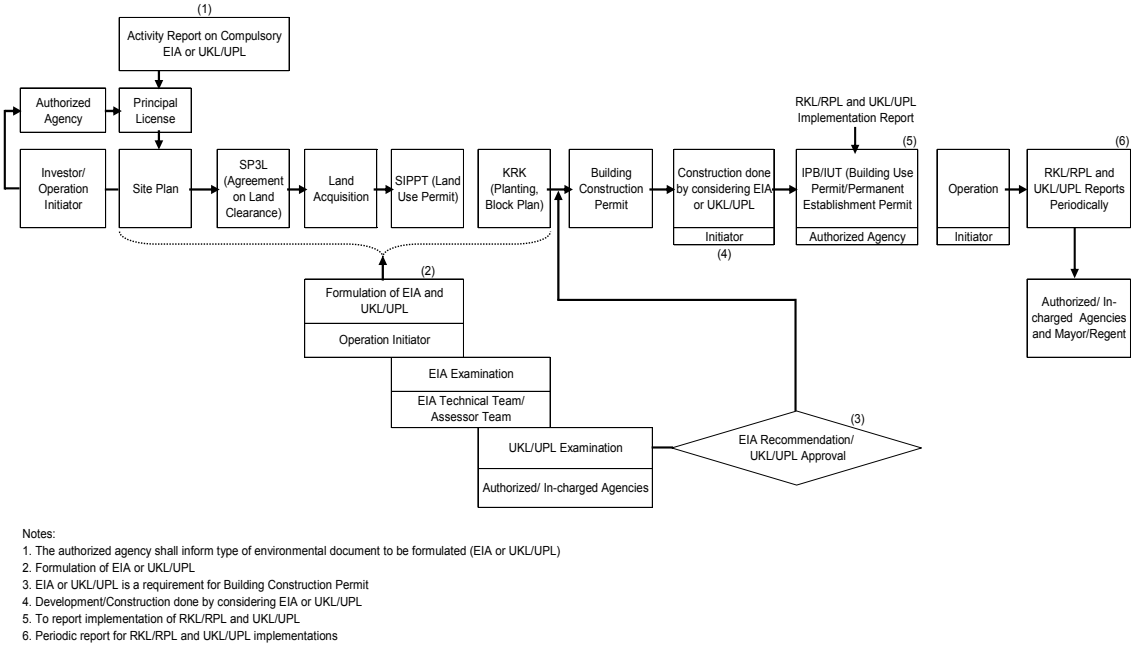
Decree of State Minister for the environment No.17/2001 provides the types of business and/or activity plans that are required to be completed with the Environmental Impact Assessment (EIA).

The Governor Decree No.494/VII/2003 and Decree of State Minister for the Environment No.17/2001 stipulate the types and activity plans in South Sulawesi Province that require EIA (AMDAL) and an environmental management plan (RKL) or environmental monitoring plan (RPL). It may be concluded that the legislation is generally acceptable, but it has not been always observed by the stakeholders in Mamminasata.

The Decree of the Ministry of Living Environment No.40/2000 provides the responsibility and relationship of Central Government and Regency/City in assessing environmental impact analysis. If one project will be established and it is located in and/or will impact on more than one province, then the analysis of EIA will be conducted by the Central Government.

Whether a project needs EIA or not is determined from its scale, project category and so on. If EIA process is needed, BAPEDALDA at the provincial/regency level will determine whether the EIA should be conducted by the central, provincial or regency-city level. After presentation of the framework concerning EIA guidelines, the document of EIA (AMDAL), Environmental Management Plan (UKL/RKL) and Environmental Monitoring Plan (UPL/RPL) are made by the project execution organization.

If the authority determines that EIA is to be conducted, it must be considered whether areas receiving indirect influenced must be considered along with the directly affected area. Therefore, it is recommended that the area evaluated fairly and reasonably by the concerned AMDAL is not limited only to the area in and around the project site. The existing procedure for EIA is shown in Figure 6.1.1.



Notes:
1. The authorized agency shall inform type of environmental document to be formulated (EIA or UKL/UPL)
2. Formulation of EIA or UKL/UPL
3. EIA or UKL/UPL is a requirement for Building Construction Permit
4. Development/Construction done by considering EIA or UKL/UPL
5. To report implementation of RKL/RPL and UKL/UPL
6. Periodic report for RKL/RPL and UKL/UPL implementations

Figure 6.1.1 EIA Procedure Flow

(2) Environmental Standard

There are environmental standards at each of National and Provincial level. Basically, Provincial Environmental Standards are prescribed under the National ones.

The central government stipulates the limit value of ambient air quality and noise level. The Government Regulation No.41/1999 concerning Ambient Air Quality Standard provides 13 parameters, i.e.; SO_2, CO, NO_2, O_3, HC, PM_{10}, $PM_{2.5}$, TSP, Lead (Pb), Dust and so on. Decree of State Minister for Living Environment No.KEP-48/MENLH/XI/1996 regards Ambient Noise Level Standard, Decree of State Minister for Living Environment No. KEP-49/MENLH/XI/1996 shows Vibration Level Standard.

On the other hand, South Sulawesi Provincial government also stipulates the standard value under the Governor's Decree No.14/2003. The provincial environmental standard is the lowest administrative level to have environmental standards, and is no additional environmental regulations exist at the municipality and regency levels. The ambient air quality standard in South Sulawesi is shown in Table 6.1.1.

Table 6.1.1 Ambient Air Quality Standard

Air Quality items		SO_2	CO	NO_2	O_3	HC	PM_{10}	$PM_{2.5}$	TSP	Pb	Dustfall	F	Flour index	Cl/ClO_2	SO_3
unit		$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	$\mu g/Nm^3$	ton/km^2	$\mu g/Nm^3$	$\mu g/100cm^2$	$\mu g/Nm^3$	$mg/100cm^3$
National standard for ambient air quality *1)															
measured duration	1 hour	900	30,000	400	235	-	-	-	-	-	-	-	-	-	-
	3 hours	-	-	-	-	160	-	-	-	-	-	-	-	-	-
	24 hours	365	10,000	150	-	-	150	65	230	2	-	3	-	150	-
	30 days	-	-	-	-	-	-	-	-	-	10(residence)/ 20(industry)	-	40	-	1
	90 days	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-
	1 year	60	-	100	50	-	-	15	90	1	-	-	-	-	-
Local standard for ambient air quality *2)															
measured duration	1 hour	900	30,000	400	230	-	-	-	-	-	-	-	-	-	-
	3 hours	-	-	-	-	160	-	-	-	-	-	-	-	-	-
	24 hours	360	10,000	150	-	-	150	65	230	2		3	-	150	-
	30 days	-	-	-	-	-	-	-	-	-	10(residence)/ 20(industry)	-	40	-	1
	90 days	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-
	1 year	60	-	100	50	-	-	15	90	1	-	-	-	-	-

Source:
*1) Government Regulation regarding Control of Air Pollution No.41-1999
*2) Governor's Regulation of South Sulawesi Province No. 14-2003

The ambient noise level standard in South Sulawesi is shown in Table 6.1.2.

Table 6.1.2 Ambient Noise Level Standard

Land Use / Type of Activity	Noise Level dB (A)	
	State Decree of Environment Ministry No.48 1996	Governor's Regulation of South Sulawesi Province No.14 2003
a. Land Use		
1. Housing and Settlement	55	55
2. Commercial and Service	70	70
3. Office Buildings and Commercial	65	65
4. Green Open Space	50	50
5. Industry	70	70
6. Government and Public Facilities	60	60
7. Recreation	70	65
8. Special:		
- Airport *)		75
- Railway Station *)		–
- Port	70	70
- Culture Preserve	60	60
b. Type of Activity		
1. Hospital or the like	55	55
2. School or the like	55	55
3. Worship place or the like	55	55

Notes: *) adjusted with regulation of Ministry of Transportation Affairs

The vibration level standard in South Sulawesi is shown in Table 6.1.3.

Table 6.1.3 Vibration Level Standard

Rate of Vibration Level in micron (10^{-6} meter)				
Frequency	Undisturbed	Disturbed	Discomfort	Hurting
4	<100	100-500	>500-1,000	>1,000
5	<80	80-350	>350-1,000	>1,000
6.3	<70	70-275	>275-1,000	>1,000
8	<50	50-160	>160-500	>500
10	<37	37-120	>120-300	>300
12.5	<32	32-90	>90-220	>220
16	<25	25-60	>60-120	>120
20	<20	20-40	>40-85	>85
25	<17	17-30	>30-50	>50
31.5	<12	12-20	>20-30	>30
40	<9	9-15	>15-20	>20
50	<8	8-12	>12-15	>15
63	<6	6-9	>9-12	>12

Remarks : State Decree of Environment Ministry (No.48 1996) and Governor's Regulation of South Sulawesi Province (No.14 2003) are applied same standard level.

6.2 Anticipated Environmental Impacts and Mitigation Measures

The target project is the improvement of existing road, Urip Sumoharjo and Perintis street in Makassar city with a length of about 15 km. The South Sulawesi regulations stipulates that road improvement of more than 1 km in a metropolitan city requires an environmental impact assessment (EIA) to be conducted, and the scope of the assessment is determined by the magnitude of the project and the present environmental conditions of the area.

Above all factors of the EIA, land acquisition and compensation for resettlement need to comply with Presidential Regulation No.36/2005. The processes of land acquisition and compensation should have the participation of communities. In addition, monitoring programs during the construction and operation phase must be conducted and the results should be compared with prescribed values and conditions.

(1) Scope of Assessment

In Makassar city, all road improvement projects of more than 1 km in length are required by the regulations to conduct EIA. However, certain items may not need to be covered by the assessment depending on the magnitude of the project or the site conditions. Therefore, the scope of the EIA of the project should be limited to relevant items for forecast and evaluation.

In Table 6.2.1, items marked with “O” need the survey of current conditions around the project area, a forecast of future conditions, and evaluation of the environmental impact. Items marked with “△” need evaluation of environmental impact considering the existing survey/analysis reports, the planned studies around the project area, and the

proposed countermeasures including the implementation program.

Table 6.2.1 Summary of Environmental Impacts and Effective Factors

Environmental Impacts / Effective Factors		Pollution						Natural Environment								Social Environment												
		1 Air Pollution	2 Water Pollution	3 Soil Contamination	4 Noise and Vibration	5 Land Subsidence	6 Offensive Odor	7 Topography and Geology	8 Soil Erosion	9 Groundwater	10 Hydrological Situation	11 Coastal Zone	12 Biology (Flora and Fauna)	13 Meteorology	14 Landscape	15 Global Warming	16 Resettlement	17 Economic Activities	18 Landuse and Resional Resource	19 Social Communities	20 Infrastructure and Public Service	21 Minorities and Low Income People	22 Uneven Distribution of Interest	23 Gendor	24 Right of Children	25 Cultural Property	26 Public Health Condition	27 Waste and Garbage	28 Water Rights・Right of Common	29 Hazards and Accident
General		○	△		○										△		○	+		○							△	△		△
Construction Phase	Change of Topography・Occupation		△				△		△		△	△			△		○	+	△	△		+	△				△	△	△	△
	Construction Vehicles	△			△																									
	Construction Machines	△			△																									
Operation Phase	Occupation														+		△		+	○										△
	Operation	○	△		○		△									△		+			+						△	△		△

○: significant negative impact
△: less negative impact
brank: no effect
+: positive impact as expected

Source: JICA Study Team

This road improvement project could potentially have four types of significant negative impacts: air pollution, noise/vibration, resettlement (land acquisition) and social communities (split of communities).

It is considered that air quality would clearly deteriorate according to increased traffic volume in the project area. The noise and vibration level along the two target streets would similarly increase. As the land acquisition affects the regional society and economy, it is considered that the serious impact occurs around the project area. The road improvement is planned for a width of 42 m; therefore, crossing of the road in the project area will be more difficult. However, the four types of impact mentioned above are limited to densely populated areas near the urban district of Makassar. In the thinly population area on the north part of Perintis street, it is guessed that the significant negative impact is resettlement (land acquisition) only.

The items of the less negative impact are related to pollution (water pollution), the natural environment (landscape values), and social issues (public health condition, waste/garbage, and hazards/accident). The other items, on the other hand, will have negligible negative impact. Favorable impact is expected in relation to economic activities, infrastructure and public services, and low income people in relation to social issues.

(2) Pollution and Mitigation Measures

1) Air Pollution

Ambient air quality along the project area is polluted to some extent, with the presence of elevated levels of hydrocarbon (HC), total suspended particulates (TSP), such as dust in and around the street, and lead (Pb). The air conditions will be changed by exhausts from vehicles along the study road, particularly HC, Pb and TSP, though its density is different by season.

During the construction phase, the operation of trucks and construction machines will affect air quality conditions. However, the environmental impact may be forecast and evaluated based on the planned environmental studies and countermeasures.

For example, the evaluation can be based on the following conditions:

- the number of vehicles is minimized
- the tires are washed when they go out from the construction area
- construction machines are regularly inspected and monitored
- their operation is efficiently planned

In addition, dust from the construction should be regularly monitored and evaluated against the environmental standards.

After the completion of the project, it is necessary to regularly monitor the air conditions caused by the operating vehicles on the road. The number of vehicles on the target roads is reproduced in a summarized form in Tables 6.2.2 and 6.2.3.

Traffic volumes in 2020 are predicted to be 1.6~1.7 times compared with the number in 2005. In the case of "without the project", traffic volumes will be 2~2.5 times. However, air quality would not deteriorate simply and immediately with the increase in traffic volume. It is necessary to investigate the composition of operating vehicles, kind of fuel, exhaust gas quality and so on for a more accurate prediction of air quality.

Table 6.2.2 Traffic Demand Forecast Result in 2020 (with project)

Unit:Vehicles/day

	Motorcycle	Car/Taxi/Jeep	Bus	Pickup	Truck	Total
Perintis	122,509	22,179	27,065	1,448	1,577	201,526
Urip Sumoharjo	118,218	22,943	18,108	2,829	1,394	163,492

Table 6.2.3 Traffic Demand Forecast Result in 2020 (without project)

Unit:Vehicles/day

	Motorcycle	Car/Taxi/Jeep	Bus	Pickup	Truck	Total
Perintis	172,400	60,163	58,109	6,253	9,585	306,510
Urip Sumoharjo	131,909	25,014	30,489	3,555	2,627	193,594

A trial calculation of air pollutant volumes in exhaust gas from vehicles has been conducted by applying the above traffic demand forecast results (present condition, with project and without project). In these calculations, some assumptions have been set.

- Calculation of unit volume of pollution gas from vehicles exhaust in 2005 is used by referring to the regulations before 2003
- Unit volume of pollution gas from vehicles exhaust in 2020 adopts the new regulations from 2003

Table 6.2.4 Unit Volume of Exhaust Gas in 2005

Unit:g/km

before 2003		Motorcycle	Car/Taxi/Jeep	Bus	Pickup	Truck
CO	Gasline	56.3	84.4	61.9	101.3	
	Gas-oil	-	75.0	55.0	90.0	180.0
	2stroke	112.5	168.8	-	-	-
NOx	Gasline	4.5	3.2	2.4	3.9	
	Gas-oil	-	3.2	2.4	3.9	7.7
	2stroke	10.7	6.4	-	-	-
HC	Gasline	1.4	1.1	0.8	1.4	
	Gas-oil	-	1.1	0.8	1.4	2.7
	2stroke	3.5	2.3	-	-	-

Remarks: Estimated by JICA Study Team on the basis of regulation in 2003

Table 6.2.5 Unit Volume of Exhaust Gas in 2020

Unit:g/km

after 2003		Motorcycle	Car/Taxi/Jeep	Bus	Pickup	Truck
CO	Gasline	7.0	5.0	5.0	5.0	
	Gas-oil	-	1.5	1.5	1.5	5.0
	2stroke	14.0	10.0	-	-	-
NOx	Gasline	0.7	0.2	0.2	0.2	
	Gas-oil	-	0.6	7.0	0.6	7.0
	2stroke	1.3	0.4	-	-	-
HC	Gasline	1.2	0.5	0.5	0.5	
	Gas-oil	-	1.0	1.2	1.0	1.1
	2stroke	2.4	1.0	-	-	-

Remarks: Set by JICA Study Team

The components of operating vehicles in 2005 and 2020 are set as follows.

Table 6.2.6 Component of Operating Vehicles

	Motorcycle	Car/Taxi/Jeep	Bus	Pickup	Truck
Gasline	50%	95%	90%	90%	
Gas-oil	-	5%	10%	10%	100%
2stroke	50%				

Remarks: Set by JICA Study Team

The accommodation ratio for the regulation of exhaust gas is presumed as follows.

- All operating vehicles in 2005 conform to the exhaust gas regulation before 2003.

- In the case of increasing the estimated vehicles in 2020, 80% of increased vehicles conform to the new regulations (after 2003) and 20% conform to the old regulation (before 2003).
- n the case of decreasing the estimated vehicles in 2020, 40% of traffic density conforms to the new regulation and 60% is conforms to the old regulation.

It is assumed that the average velocity of the car/taxi/jeep and truck will be changed from 25km/h to 31km/h by the proposed improvement. For the small buses (Pete-pete) there will be bus lay-bys provided; therefore their average velocity will speed up similarly. It is expected that the control of exhaust pollution gas would be reduced about 4%~18% by the improvement of average velocity. However, in the case of without projects the improvement of vehicle velocity is not expected, it is forecasted that the average velocity of operating vehicles will slow down.

The result of trial calculation of exhaust volume in air pollutants is shown in Table 6.2.7. The exhaust volumes in pollutants are controlled as the traffic density of with project case is decreased if compared to the case of without project. Moreover, there will be increased efficiency for travel and physical distribution.

Table 6.2.7 Exhaust Volume of Air Pollutions (Trial Calculation)

Unit:Kg*vehicles/km

		2005	2020with	2020without	with/without
CO	Perintis	10,261	10,548	14,428	73.1%
	Urip Sumoharjo	7,824	8,455	10,165	83.2%
NOx	Perintis	742	767	1,090	70.3%
	Urip Sumoharjo	539	615	746	82.4%
HC	Perintis	245	300	487	61.7%
	Urip Sumoharjo	179	274	341	80.4%

2) Noise and Vibration

Noise of the construction machines can be reduced by regular maintenance and efficiently scheduled operation. The noise around the construction areas should be monitored so that countermeasures can be taken timely. For example, it is evaluated whether the noise impact could be reduced by a proper schedule of the operating hours of construction machines.

The number of the vehicles and machines is limited. Therefore, the environmental impact during the construction phase may be forecast and evaluated based on the planned study and countermeasures for noise and vibration. Monitoring of noise and vibration along the planned alignment is also necessary for evaluation according to the standard.

After completion of the project, noise will be caused by the operating vehicles on the

road. In the future, as the traffic volume will certainly be increased, it is necessary to plan countermeasures against traffic noise impact to protect hospitals and schools along the target streets. Noise and vibration levels do not become higher simply and immediately due to increased traffic volume. It is necessary to investigate the composition of operating vehicles, noise and vibration level of vehicles for more accurate determination of their levels.

3) Water Pollution

Tallo and Pampang rivers around the project area are polluted by domestic waste water from neighboring households resulting in rather high indexes of BOD5, COD and Total Suspended Solid (TSS). However, the density of heavy metals is thought to be low because no polluting factories are located along the rivers.

The road construction will be increase TSS in the near-by river bodies. However, it can be minimized by installing temporary sedimentation ponds at an early stage of the construction. The pollution is also thought to be limited because turbid water will be generated for a limited period during excavation and ground filling. Construction of bridge piers in the rivers needs to adopt the steel sheet pile method or other similar methods in order to avoid turbid water.

The drainage water should be discharged after proper treatment of TSS, pH, oil and grease. It is also important to enforce regular monitoring to evaluate the conditions against the river water standard. Storm water from the construction site is difficult to analyze because it is affected by a variety of conditions such as rainfall, reclamation, ground and soil. Therefore, the environmental impact may be evaluated based on the planned studies, programmed countermeasures and the scheduled monitoring on water pollution.

During the operation phase, it is judged that there is no cause of wastewater discharge from the target road.

(3) Natural Environmental Impacts and Mitigation Measures

1) Landscape

There are some mosques along the project roads but no historic assets. The road improvement will excavate some part of the hilly area along the north part of Perintis street, but it appears that the change could be negligible by minimizing the excavation volume.

Artificial structures will be created, namely, two bridges, one over the Tallo River and one over the Pampang River. These bridges will be designed considering the shapes so that they will become new landmarks of this street. Moreover, green belts will be

created along the road and its median strips considering the surrounding environmental condition. The typical sections are shown in Figure 6.2.1.

Figure 6.2.1 Typical Section of Proposed Road Improvement

(4) Social Environmental Impacts and Mitigation Measures

1) Involuntary Resettlement (Land Acquisition)

The project implementation involves land acquisition, involuntary relocation, and resettlement of residents along the project area. The project executing organization has to prepare the program for relocation and resettlement before proceeding with land acquisition and relocation procedures. The plan should be based on the community participation approach and the social and economic acceptability.

The process of relocation for residents along the road includes land appraisal, survey of land use, and compensation for land acquisition cost. It is important to properly evaluate the land for compensation, relocation and resettlement. The land evaluation should be based on fair judgment on the land use, conditions and the life of buildings, fruit and other trees. Moreover, it should be impartial without bias for individual interests. The criteria for calculation of land compensation and buildings should be disclosed to the people concerned. It is noted that a land re-adjustment method and incentives in re-allocation should also be studied and applied, as further discussed later in Chapter 7.2.

2) Split of Communities

Along the road, there extend residential regions, deserted copses, low-lying farms and grasslands. In addition, places at which people gather exist along the streets, such as mosques, regional markets and universities. Many people cross the target road in daily life.

During the construction and operation phase, the risk of traffic accidents on crossing the road will be higher. On the other hand, old people and infants, who are disadvantaged by traffic, will not be able to cross the street. Therefore, pedestrian bridges and crosswalks

will be properly provided as designed previously.

Moreover, the enlightenment and enhancement for road safety and safety education are necessary for citizens. For drivers, the advancement of driving etiquette, consideration and gentleness for pedestrians are very important.

3) Public Health

During the construction phase, the mobilization of many laborers may deteriorate sanitary conditions in the project area. However, the problem can be avoided by organizing the management system and implementing regular monitoring. It is therefore necessary to manage solid waste and wastewater at the workers' dormitories and resting facilities. Consideration is needed to avoid flies and other noxious insects from the waste and also to avoid untreated effluent to the rivers.

An issue after the project completion is exhaust from vehicles on the road. However, the effect on health of near-by residents is not thought to be significant because diseases caused by exhaust are not recorded presently. However, it is necessary to monitor the health condition around the project area, because the traffic volume will increase considerably.

4) Solid Waste and Garbage

It is important that the construction administrator manages the waste generated by the construction and that the management process of the waste is monitored. The excavated soil will be used as road construction material and the remaining soil will be disposed of in a designated plot. Therefore, there will be no problem.

During the operation phase, there will be no solid waste generated directly by the road facilities. Illegal disposal of waste from vehicles will need to be prevented by campaigns to improve public morals.

5) Risks of Hazards and Accidents

Accidents in the construction work can be avoided by proper maintenance of construction machines, full attention to safety measures and safety campaigns. It is also important to establish a safety system in which every worker is ensured safety. In order to minimize risks of erosion of slopes or landslides, proper reinforcement measures should be applied.

Hazards during the operation phase include traffic accidents. However, they should be prevented by improvement of driving manners, traffic safety campaigns, proper inspection and maintenance of the road.

6.3 Environmental Monitoring

(1) Introduction

In order to identify the project's environmental impact and to minimize the negative impact on the project area, environmental monitoring should be conducted during both the construction and operation phase. The aims of monitoring are to evaluate whether the construction is implemented under the plan with the required considerations for the environment and to judge whether unexpected or serious effects are caused by the project.

If a sign of a serious impact is detected during the construction period, immediate actions should be taken to manage existing and/or forward impacts. The following actions are needed.

- Monitor the sign of environmental change
- Analyze the environmental impact
- Propose possible changes of operation or mitigating measure(s)
- Implement the proposed measure(s)
- Evaluate the effectiveness of the mitigating measure(s) taken

(2) Detailed Design – Pre Construction Phase

In the detailed design phase, it is necessary to pay attention to the environmental condition in deciding the proper construction scheme. The construction plan should be worked out in due consideration of the following items.

- Selection of environmentally-sound construction technology
- Identification of potential environmental impact associated with the work
- Development of the details of the mitigating measures
- Development of the plan to audit the performance of the mitigating measures

(3) Construction Phase

The construction should be monitored against planned targets for components of construction (number of construction vehicles, machines and operating persons etc.), the mitigation measures, the water quality of drainage, the construction noise level and so on.

(4) Operation Phase

At the end of the construction phase, the project authority must prepare and submit the operation-phase environmental monitoring plan to AMDAL. The monitoring plan aims at identifying the environmental performance of this project and to mitigate any unexpected environmental impacts in the operation phase. The environmental elements

that need to be monitored in the operation phase should include, but not be limited to.

- Air quality condition (regularly and fixed points)
- Water quality condition
- Noise and vibration
- Landscape (photographic assessment etc.)
- Result of resettlement and land acquisition
- Split of communities (actual condition of crossing etc.)

7. ECONOMIC EVALUATION AND IMPLEMENTATION STRATEGY

7.1 Economic Evaluation

(1) Economic Cost

1) Cost items and Conversion into Economic Cost

Costs are calculated from the major components of construction works, and it is confirmed that all the materials except fuel will be available domestically.

All costs at market price are converted into economic cost that reflects the actual value of materials by adjusting transfer items such as taxes and subsidies. Price adjustment of transfer items that do not reflect actual production value are conducted on the following items:

VAT:	This is equivalent to 10% of the price. All the project expense except labor will be subject to this VAT.
Fuel:	Government subsidies are offered to keep the fuel price lower than the international price and to keep it at an affordable level for the people. It is thus more rational to use the international price as the economic price of fuel. However, there has been a drastic price hike in fuel as of May 2006, and prices have increased three-hold and constantly remained high. This study adopts fuel price in current price turmoil for the economic cost estimation since it will be paid within a period the expected fuel price hike, while current economic benefit estimation will adopt fuel prices before the price hike to keep consistency with other studies and to eliminate temporary disturbance factor in the Study. This cost item will be subject to sensitivity analysis.
Labor:	Actual wages are adjusted by the un-employment ratio. It is assumed in the Master Plan that the un-employment ratio remains at 11.1% up to 2010 and falls to 8.7% in 2015. All cost disbursement will be finished until 2012, so 11.1% is used in this study.
Land Acquisition	Authorized price table used in Makassar city is adopted for the land acquisition price. It is assumed equal to the actual production value.

2) Maintenance Cost

Annual and periodical maintenance works are also required. These maintenance works can contribute to save the total road rehabilitation cost over the project life of the road, and thus is an indispensable cost.

These maintenance costs are also estimated based on the unit cost of the road construction. Periodical rehabilitation such as over-lay work is planned at a regular interval period i.e., 5 years.

Maintenance cost is estimated as follows:

Annual maintenance cost	:	Urip Sumoharjo Road: 582 million Rp. Perintis Kemerdekaan Road: 1,681 million Rp.
Periodical maintenance cost	:	This will be expended by every 5 year, and its amount is estimated equal to 20% of the pavement cost: Urip sumoharjo Road: 844 million Rp. Perintsi Kemerdekaan Road: 2,244 million Rp.

3) Calculation of Total Economic Cost

The total project cost at market price amounts to Rp. 536 billion (equivalent to US$ 61.1 million) in 2006 prices, and the total economic cost is estimated to be Rp. 510 billion, equivalent to 95.2% of the market price.

Table 7.1.1 Project Cost at Market Price and Economic Price (unit: billion Rp.)

Items	Cost at Market (Million Rp.)	Conversion Factor	Economic Cost (Million Rp.)	Ratio (%)
I. Construction Cost (by Material)				
Labor	9,601	0.89	8,535	
Machine	58,246	0.90	52,421	
Cement	82,156	0.90	73,940	
Reinforced Bar (steel)	49,687	0.90	44,718	
Straight Asphalt (Oil related)	20,785	1.49	30,970	
Aggregate (Stone etc.)	76,340	0.90	68,706	
Wood	10,025	0.90	9,023	
Others	20,626	0.90	18,563	
Sub-total	327,466		306,877	93.7%
II. Detail Desing and Supervision 10% of Construction Cost	32,747	-	30,688	
III. Total 1: (I+II)	360,213	-	337,565	
IV. Land Acquisition and House Relocation Cost	144,028	1.0	144,028	100.0%
V. Public Utility Relocation Cost	31,740	0.9	28,566	90.0%
VI. Total 2: (IV+V)	175,768	-	172,594	
VII. Grand Total (III+VI)	**535,981**	**-**	**510,159**	95.2%

Source: JICA Study Team estimate

(2) Economic Benefit

In this pre-feasibility study, the economic benefit will be counted on two items: i) saving in vehicle operating cost (VOC), and ii) saving in travel time.

1) VOC

VOC accounts for the actual unit cost of fuel, lubricant, tires, and maintenance and other items. These vary with travel speed since fuel consumption at 10 km/h is higher per km and decreases gradually up to the economic travel speed of

approximately 70-75 km/h, and then turns upward at further higher speed. On the other hand, higher speed constantly results in more frequent maintenance works for vehicles and replacement of parts.

In compiling experimental data, co-efficient functions were estimated by means of regression analysis by the World Bank and various other published studies.

This study adopted VOC table by speed in the report entitled "The Study on Integrated Transportation Master Plan for JABOTABEK (Phase I)" (Janurary 2001) after up-dating works based on the general consumer price index of Makassar city (= 1.47).

Table 7.1.2 VOC by Type of Vehicle, 2006 (Unit: Rp.)

Speed (km/h)	Car/Taxi /Jeep	Bus		Pick-up	Truck (Large)	Motor-cycle
		Mini	Large			
10	3,246	2,224	2,313	1,827	3,347	461
15	2,423	1,742	1,779	1,388	2,558	366
20	1,989	1,483	1,511	1,152	2,161	312
25	1,713	1,319	1,353	1,000	1,924	277
30	1,521	1,207	1,253	892	1,772	252
35	1,378	1,127	1,186	813	1,670	234
40	1,268	1,070	1,142	752	1,602	220
45	1,181	1,032	1,117	705	1,558	210
50	1,111	1,007	1,104	670	1,533	204
55	1,054	994	1,101	643	1,523	200
60	1,009	992	1,107	623	1,525	200
65	972	999	1,121	610	1,536	202
70	947	1,015	1,142	603	1,558	205

Source: JICA Study Team, "The Study on Integrated Transportation Master Plan for JABOTABEK (Phase I)" (January 2001), and BPS Statistical Indonesia.

This calculation of VOC excludes the impact of the current price hike in fuel. The fuel price in 2001 was 1,100 Rp./liter (Premium) and has increased to 4,500 Rp./liter in May 2006, an approximate 4-fold increase. However, it cannot be forecasted that this high level of fuel price will last for a long period of more than 10 years from now on. And the economic cost saving is expected to generate after 2012, and therefore the fuel price before the price hike is adopted to set VOC in this study.

VOC is expressed on the basis of constant price in 2006 for the entire period of the project life (30 years). This is because constant price provides the most neutral device to represent the value in the future and is free from the arbitrary bias of future inflation.

The surface condition affects the rate of fuel consumption; however, the current

Perintis road has a good road surface and no significant improvement can be expected even after the road expansion works. The slope and curve of a road also affects the fuel consumption ratio. Another consideration is a VOC change at a curved section; however, this project will not change the road alignment, and there are no hilly areas in Makassar. So a change in VOC due to slope and curve impacts are excluded from this study.

2) Time Value

Time value is defined as the value of production of additional working time, and this is derived under the assumption that the saving of travel time will be utilized for further production activities.

The average number of passengers in the vehicle was measured by the road-side interview by the JICA Study Team in May 2005. The wages of the drivers and assistants were based on actual payment records. The table shows the figures adopted in calculating the economic internal rate of return.

Table 7.1.3 Number of Passengers and Wages

	Car/Taxi/Jeep	Minibus (<=25 pax)	Standard Bus (>25 pax)	Pickup	Truck	Motorcycle
No. of Persons per Vehicle						
1) Driver	1	1	1	1	1	1
2) Assistance			1	1.05	1.23	0.07
3) Passengers	1.53	4.78	13.95			
Wages (Rp./hour)						
1) Driver	6000	5,300	5,300	5,300	6,000	6,000
2) Assistance		3,000	3,000	3,000	3,000	3,000
3) Passengers	6000	3000	3000			
Time Value	15180	19640	50150	8450	9690	6210

Source: JICA Study Team

3) Calculated Total Economic Benefit

The project road will ease traffic jams in the whole Mamminasata area, and its construction is planned together with other road network improvement as a system for each phase (-2010, 2011-2015, 2016-2020). Perintis's contribution to traffic congestion cannot be generated on the total road network and cannot be estimated separately from the impact of the total road network. In this study, the economic benefit of the Perintis only is derived from the proportional method of total economic benefit in each phase.

Table 7.1.4 Summary of Economic Benefit (unit: million Rp.)

Year	Without Project Package		With Project Package		Benefit Attributable to Perintis Road	
	VOC	Time Value	VOC	Time Value	Saving in VOC	Saving in Time Value
2010	3,129,872	2,281,866	2,2942,679	2,030,685	60,129	80,682
2015	4,633,879	2,851,049	4,416,004	3,223,345	84,020	138,095
2020	6,647,285	6,230,397	6,420,925	5,214,869	101,836	159,858

Source: JICA Study Team estimate

4) Flows of Economic Benefit and Cost

The following assumptions are adopted.

Base Year	:	2006
Project life	:	30 years (2007~2036)
Price	:	2006 prices
Construction Period	:	DD and other preparatory works will Urip Sumoharjo Road: 2011 ~ 2012 (2 years) Perintis: 2009 ~ 2010 (2 years)
Residual Value	:	Not considered
Opportunity cost of capital	:	This is set at 12.5 % (equal to the interest of long term loan), and is quoted from the Indonesian Bank rate as of early June, 2006. This figure is the criteria to judge the feasibility of the project, and EIRR above 12.5% suggests soundness of project investment.

The project road will be constructed in 2 phases: first for Perintis Road (open in 2011) and secondly Urip Sumoharjo Road (open in 2013). And there is a gap of 2 years between partial opening and full opening of the whole length. Thus, the benefit accruing to the first section only is derived by dividing the total benefit of Perintis road by vehicle-km of both sections.

Values between each benchmark year are calculated based on the interpolation method, and the value after 2020 assumes that they will increase in parallel with the GRDP growth (=7.1%) as suggested as the authorized economic framework in the Master Plan.

Values between each benchmark year are calculated based on the interpolation method. And the calculation of economic benefit and cost is shown at constant price. This aims at eliminating the impact of arbitrary factors.

Residual values at the end of the project life are not estimated since materials used for the road cannot be used for other purposes, and thus it is assumed that the residual value of the road is zero.

EIRR of this project is 30.6%, far higher than the opportunity cost of capital (=12.5%) that is the current interest rate of the Bank Indonesia. And it is judged that the proposed improvement is economically feasible and is recommended to implement.

This high EIRR is attributable to the character of the project: i.e. an expansion project, and the location of the project site. This project aims at adding more than four lanes to the existing four lanes, and thus the VOC saving and time saving attributable to the traffic on the existing lanes is also included in the project benefit. Furthermore, this project road now faces traffic jams, especially in both the morning and afternoon peak hours. And this situation will be aggravated further because the hinterland of this road is in the progress of drastic residential development, and drastic increase in traffic volume are expected. All these factors contribute to the high EIRR of this project.

(unit: million Rp.)

No.	Year	Economic Cost													Economic Benefit			Net Flow
		Urip Sumoharjo Road						Perintis Road						Total				
		D/D	Land Acquisition	Utilities Relocation Fee	Construction	Routine Maint.	Peirodical Maint.	D/D	Land Acquisition	Utilities Relocation Fee	Construction	Routine Maint.	Peirodical Maint.		Saving in VOC	Saving in Time Value	Sub-total	
	2006																	
1	2007	7,672						23,016						30,688			0	-30,688
2	2008								92,598	21,045				113,583			0	-113,583
3	2009		25746								117,977			143,723			0	-143,723
4	2010		25746	7,521							117,977			151,244			0	-151,244
5	2011				35,441							1,575		37,016	62,996	97,572	160,567	113,551
6	2012				35,441							1,575		37,016	65,863	94,461	160,324	123,308
7	2013					546						1,575		2,121	74,463	115,130	189,593	187,472
8	2014					546						1,575		2,121	79,242	126,612	205,854	203,733
9	2015					546							2,103	2,649	84,020	138,095	222,115	219,466
10	2016					546						1,575		2,121	87,583	142,448	230,030	227,909
11	2017						791					1,575		2,366	91,146	146,800	237,946	235,580
12	2018					546						1,575		2,121	94,709	151,153	245,862	243,741
13	2019					546						1,575		2,121	98,273	155,505	253,778	251,657
14	2020					546							2,103	2,649	101,836	159,858	261,693	259,044
15	2021					546						1,575		2,121	109,066	171,207	280,274	278,153
16	2022						791					1,575		2,366	116,810	183,363	300,173	297,807
17	2023					546						1,575		2,121	125,103	196,382	321,485	319,364
18	2024					546						1,575		2,121	133,986	210,325	344,311	342,190
19	2025					546							2,103	2,649	143,499	225,258	368,757	366,108
20	2026					546						1,575		2,121	153,687	241,251	394,939	392,818
21	2027						791					1,575		2,366	164,599	258,380	422,979	420,613
22	2028					546						1,575		2,121	176,285	276,725	453,011	450,890
23	2029					546						1,575		2,121	188,802	296,373	485,174	483,053
24	2030					546							2,103	2,649	202,207	317,415	519,622	516,973
25	2031					546						1,575		2,121	216,563	339,952	556,515	554,394
26	2032						791					1,575		2,366	231,939	364,088	596,028	593,662
27	2033					546						1,575		2,121	248,407	389,939	638,346	636,225
28	2034					546						1,575		2,121	286,044	417,624	703,668	701,547
29	2035					546							2,103	2,649	284,933	447,276	732,208	729,559
30	2036					546						1,575		2,121	305,163	479,032	784,195	782,074
Total		7,672	51,491	7,521	70,882	10,920	3,164	23,016	92,598	21,045	235,954	33,075	10,515	567,794				
																	IRR=	30.6%

(3) Sensitivity Analysis

This aims at measuring the impact of un-expected changes in cost and benefit. Potential factors are changes in GRDP growth rate, growth rate of car sales (related to the number of car registrations in the future), price hike in materials such as fuel and labor.

Table 7.1.6 Results of Sensitivity Analysis

	+ 15%	+ 10%	+ 5%	Normal	- 5%	- 10%	- 15%
Change in Cost	27.9%	28.7%	29.6%	30.6	31.7%	32.9%	34.1%
Change in Benefit	33.6%	32.6%	31.6%	30.6%	29.6%	28.5%	27.4%
Case cost: +10% benefit: -10%	26.7%						
Case cost: +15% benefit: -15%	24.9%						

Source: JICA Study Team estimate

As the table shows, all cases indicate higher figures of EIRR than the opportunity cost of capital and are more beneficial than bank deposit.

However, a change in cost results in slightly more significant movement of EIRR than a change in benefit. So it is suggested that a close attention be paid to the change in cost during the project implementation in order to efficiently keep the validity of the project investment. At present, the price hike in fuel is drastically accelerated, and thus this price trend in the future is a potential item to be observed carefully.

When the cost increase and benefit decrease occur at the same time, the EIRR will drop to 26.7% (cost increase by 10%, and benefit decrease by 10%), and 24.9% (same by 15%), keeping a far higher level than the opportunity cost of capital (12.5%). This assures the viability of the project profitability from economic analysis.

7.2 Implementation Strategy

(1) Financial Options for Implementation

There are three options to finance the project.

Government Budget:	Government shall secure full budget for land acquisition, resettlement, and re-allocation of the public utilities beside construction cost.
Private Participation:	Build-Operate-Transfer (BOT) Scheme The private sector bears 100% of the project cost without any government support, and the private sector will collect the toll fee and pay back the investment cost and secure profit. Public-Private-Partnership (PPP) Some portion of the project cost will be shared by the Government and the rest will be financed by the private sector. The financial burden of the government will be determined to keep the private sector investment financially viable. In many cases the land acquisition cost and re-settlement cost will be shared by the Government.
ODA Loan:	The Government is required to finance the land acquisition and re-settlement cost prior to the commencement of the project. The construction cost will be financed by a donor's soft loan.

The third option, i.e. ODA financed option, is recommended for this project implementation, because i) this project is urgently needed to alleviate the traffic jam in the regional center, ii) the government budget is now in a shortage to cover the initial investment, and iii) the BOT option has been applied to Sutami toll road running in parallel to the project road and the toll road is not applicable to the national trunk roads connecting to the center of Makassar city.

The Government finance, however, will be required to cover the land acquisition and re-settlement costs and some portion of theconstruction cost.

(2) Land re-adjustment for land acquisition

In the case of the Middle Ring Road (Section 1), land acquisition took nearly 10 years, hindering dynamic land and residential development of the planned road.

Land re-adjustment method is an alternative approach to land acquisition. It can work effectively in areas where public facilities, such as roads, parks, etc., are necessary to improve the infrastructure condition when land use is to be improved. The land owners, whose properties are partly included in the planned public

facility site, would provide/share part of their land in proportion to their land area and location. The provided/shared land will be allotted for the use of the public facility site, while they could receive the merit of an increase in value of their remaining land after the public facility development/improvement. If the reallocated land is more/less than the original in value, the balance is transacted with the public agency in monetary terms in principle.

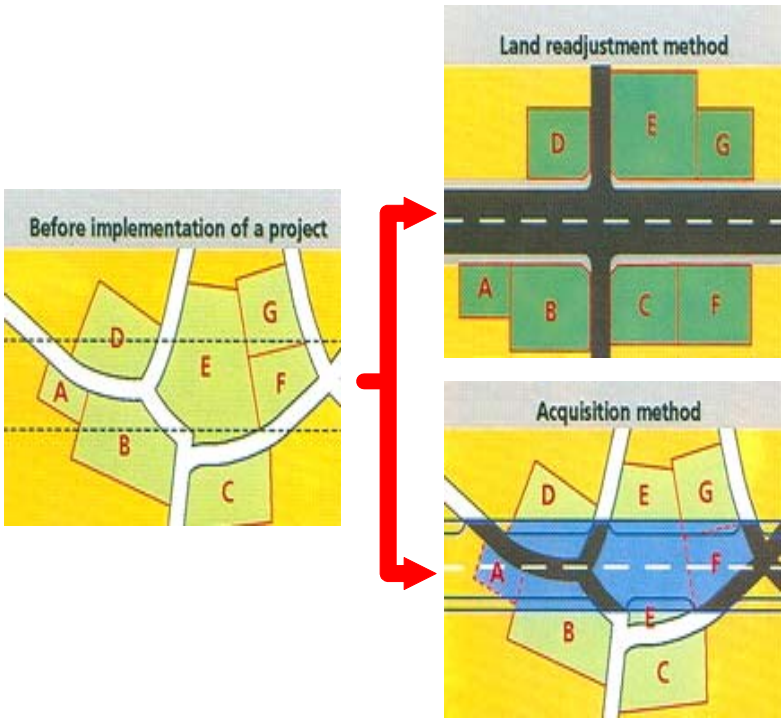


Figure 7.2.1 Land Readjustment Method

The land re-adjustment method is useful to make the land acquisition progress smoothly. This method is already introduced in Indonesia, providing alternative land to the current land-owners on the basis of an exchange of land of equivalent value. This method is suggested, especially for land acquisition along Urip Sumoharjo road. A diagramatic illustration is shown in Figure 7.2.1.

8. CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

The pre-feasibility study on the improvement of Perintis - Urip road will lead the following conclusion.

(1) The widening of Urip Sumoharjo and Perintis roads is indispensable, and this improvement is an urgent task for economic and social development in Mamminasata, as well as for South Sulawesi.

(2) This project is economically feasible with a high EIRR of 30.6%. Even in the worst case of cost increase by 15% and benefit decrease by 15%, the EIRR is still high (=24.9%) ensuring the viability of the investment.

(3) The most critical issue in executing the project is land acquisition. If it is not implemented smoothly, the traffic jam will jeopardize the economic developent of the region. The budget allocation to this end is the most urgent task for the Government. In executing the land acquisition, a land re-adjustement method is to be introduced to promote the land acquisition more smoothly.

(4) A soft loan should be secured to minimize a financial burden. Financing by the soft loan should envisage not only road improvement but also development along the road and in the metropolitan area, as well as regional development in South Sulawesi.

(5) Most of the construction meterials can be procured in domestic market and in the project area, and it would contribute to the regional economy and reduction of unemployment in the region.

(6) There are no techhnical difficulties in implementing the project. EIA is needed, and the authorities concerned are suggested ot proceed to the execution of EIA at the earliest.

8.2 Recommendations

(1) For improving the precision of design and cost estimation presented in this pre-feasibility study, necessary surveys, especially topographic and geological surveys, should be conducted in the subsequent stage of the project implementation.

(2) EIA should also be conducted at the earliest, as noted previously, paying attention to the scoping of environmental impacts as presented in this study.

(3) Financial arrangement should proceed with the central and provincial government, as well as with the international financial agencies to secure a soft loan for the construction of the proposed improvement works.

ANNEX