CHAPTER 7 ENGINEERING STUDY

7.1 General

(1) F/S and Pre-FS Roads

The following 16 road projects were proposed by the study on Implementation of Integrated Spatial Plan for the Mamminasata Metropolitan Area (hereinafter referred to as "the Mamminasata Spatial Plan" or "the Mamminasata Study").

a)	Jl.Perintis/Jl. Urip Sumoharjo	i)	Mamminasa Bypass (incl. bridges)
b)	Jl. Tol. Ir. Sutami	j)	Jl.Abdullah Daeng Sirua
c)	Jl.Sultan Alauddin	k)	Around Air Port
d)	Malino Access	l)	Airport Access
e)	Middle Ring Road	m)	Trans-Sulawesi Mamminasata (incl. bridges)
f)	KIMA Access	n)	Jl.Hertasning
g)	Tanjung Bunga Access	o)	KIWA Access
h)	Takalar Access	p)	Access Roads around Sunggminasa

Of the above, Tanjung Bunga Access Road (Jl Metro Tanjung Bunga) at the north of the Jeneberang River) and Airport Access were completed. Ir.Sutami toll road, part of Abdullah Daeng Sirua Road and Hertasning Road are under construction. Trans-Sulawesi Mamminasata Road includes a), e), h) and m) of the above list.

The Feasibility Study ("F/S" or "FS") covers the four priority roads selected from the above list (**Table 7.1.1**) in the Mamminasata Study.

Table 7.1.1 List of F/S and Pre-F/S Roads

	No.	Name of Road/Road Section		Length (km)	Function	Administrative Status
F/S	1	Mamminasa Bypass		49.1	Arterial	- #
	2	Trans-Sulawesi Road Mamminasata Section (Total: 58 km)	Maros-Middle Ring (Perintis Kemerdekaan Road)	19.6	Arterial (Primary)	National
			Middle Ring Road	7.3	Arterial (Secondary)*	- **
			Middle Ring Road Access	8.6	Arterial (Secondary)*	- **
			Middle Ring Road Access-Takalar	22.5	Arterial (Primary)	National
	3	Hertasning Road (Section D Only)		4.9	Arterial (Secondary)*	Province
	4	Abdullah Daeng Sirua Road (Excluding Section B)		15.3	Arterial (Secondary)*	Makassar/ - #
Pre-F/S	5	Outer Ring Road		20.4	Arterial	- #
			Total:	147.7	km	

Notes: * Proposed function
** Proposed to be national road in future (strategic road)
# Proposed to be provincial road (strategic road)

In addition, a pre-feasibility study on the outer ring road, which was proposed by the South Sulawesi Government and Makassar City and agreed between the Directorate General of Highways and JICA, was carried out in the Study. The Study Team conducted route selection, development concept establishment and preliminary design for the Outer Ring Road and the results are reported in Appendix F**.**

(2) Engineering Study based on the Latest Information and Data

The JICA Study Team updated the information and suggestions made in the Mamminasata Spatial Plan based on the results of site survey, discussions with the concerned regional agencies and comments given at the workshop/seminar. The detailed design of a part of Hertasning Road, Abdullah Daeng Sirua and Perintis Kemerdekaan Road has been completed and the construction of some subsections is under way. The Study Team has kept such subsections unchanged in the Study and design to avoid influence to the on-going sections. Land acquisition is in progress for the Middle Ring Road and Jl.Perintis Kemerdekaan and, therefore, the Study Team recommended a road development plan to be implemented within the secured right-of-way (ROW), except for intersections.

The Study Team also studied the latest developments of the related traffic programs including busways and left-lane-use for motorcycles and established the road development concept which is able to accommodate these programs on the F/R roads. The Study Team carefully studied and followed the relevant laws and regulations, including Road Law (UU No 38 Year 2004) and Road Regulation (PP No 34 Year 2006, governing the road development planning and environmental considerations. As most part of the F/S roads is located in the urban area, the Study Team applied the environmental effect mitigation approaches, especially minimizing resettlement, through the engineering study.

(3) Tj. Bunga – Takalar Road (Jalan Lintas Barat Makassar – Takalar)

Floods do not occur at the Jeneberang Rive estuary since the Bili-bili dam was constructed in the early 1990s. A bridge was constructed at the mouth of the Jeneberang River in 2005 and connected Tj.Bunga (GMTDC) and the Jeneberang River south plain. Therefore, development of the south area is unavoidable. An earliest improvement of the Jl.Tj.Bunga – Takalar (Lintas Barat) is recommended to regulate sprawled urban development. This road link constitutes one of the radial roads (south radial road) in the Mamminasata Urban Arterial Road Network System and access to Galesong Port. It is also recommended to upgrade road status from Kabupaten road to provincial road as it connects Makassar City and Takalar (Capital of Takalar Regency) along the west coast.

The Takalar Regency requested JICA through South Sulawesi Government to conduct a preliminary study for Tj. Bunga – Takalar Road and JICA accepted it. The Study Team conducted the supplemental study and reported the results in Appendix G**.**

7.2 Arterial Road Network System for Mamminasata Metropolitan Area

(1) Arterial Road Network Study by JICA

JICA conducted the "Ujung Pandang Highway Development Study"in 1989 (the 1989 JICA study) for the target year of 2009. Makassar City has developed the urban arterial road network according to recommendations of the 1989 JICA study. The arterial road network system in the Mamminasata Metropolitan Area comprises of five radial roads and three ring roads. These development plans are well coordinated with the spatial plan of Makassar City.

The Mamminasata Spatial Plan reviewed and added two new concepts, Mamminasa Bypass and Trans-Sulawesi Mamminasata Road, to the highway plan of JICA 1989 study. The current status, future plan, issues and relations with the F/S are summarized in **Table 7.2.1**.

Table 7.2.1 Current Status of JICA 1989 Road Plan and Relations with the FS

Function	JICA Study (1989)	Current Status (2007)	Future Plan, Issues and Relations with the FS
Radial Roads	1. Widening of Jl.Ir.Sutami (as a toll road)	Freeway (toll) and frontier roads are under construction by BOT scheme (4 lanes + 4 lanes) but only 2 lane bridge x 2	Earliest completion of the freeway and frontier roads for integration of industrial area, warehouse, business and residential area development along the road. Logistic support for Makassar Port and Hasanuddin Airport
	2. Widening of Jl.Urip Sumoharjo and Jl.Perintis Kemerdekaan	Widened to 4 lanes (completed)	Further widening to 6-8 lanes (pre-feasibility study was conducted by Mamminasata Study)*. Land acquisition is in progress (80% progress). Bina Marga commenced widening to 6 lanes and will complete it by 2010 (APBN)
	3. Extension of Jl.Boulevard Pannakukang (Central Radial Road) to the east and west	Delayed due to difficulty in land acquisition	Development of Jl.Hertasning and Jl.Abdulla Daeng Sirua (4-lane road)* together with the central radial road. Extension to the west (old town) up to the coast road is required in future.
	4. Widening of Jl.Sultan Alauddin (Jl.Gowa Raya)	Widened to 4 lanes except a part in Kabupaten Gowa (completed)	Traffic volume has reached to the capacity limit but land acquisition is difficult for further widening. Development of Jl.Hertasning and the middle ring road will supplement this road function.*Middle ring road extension to the south over Jeneberang river will also solve traffic jam
	5. South Radial Road (Takalar – Jl.Metro Tj.Bunga Road)	Jl.Metro Tj. Bunga (coastal road) was completed as a 4-lane road. A bridge over Jeneberang River was completed (2-lane bridge) in 2005.	The 1st stage: Widening of the existing city and Kabupaten road (Takalar) to a 6-7 m road as a provincial road up to Takalar Town through Galesong. The 2nd stage: Widening to a 4 lane road up to the Mamminasa Bypass entrance*.
Ring Roads	1. Inner Ring Road Widening of Jl.AP Pettarani (4 lanes) Construction of Inner Ring Road Arc (Jl. Tol Reformasi)	Widened to 6 -8 lanes (completed) Completed as a toll road (4 lanes) Widening of Losari Beach road (completed)	South extension of Jl.AP.Pettarani and completion of the inner ring road (west ring) with collaboration of an old town area re-development.
	2. Middle Ring Road (MRR)	Not yet implemented due to delay in land acquisition. About 60-70 % of the land was already secured. North section was deleted to reserve swamp and considering higher cost in Mamminasata Spatial Plan Study	The first priority project. The FS is conducted as a part of the Trans-Sulawesi Road Mamminasata Section* A south extension was planned in Mamminasata Spatial Plan. North section will be necessary to connect to KIMA and Jl.Tol.Ir.Sutami while reserving a buffer space from the Tallo River
	3. Outer Ring Road (ORR)	Not yet implemented due to difficulty in land acquisition near Jl.Perintis Kemerdekaan and Sungguminasa	Mamminasata Spatial Plan did not recommend ORR. Pre-feasibility study is conducted as proposed by South Sulawesi Province* and Makassar City
	4. Outer-Outer Ring Road/Mamminasa Bypass (Not planned)	Mamminasata Spatial Plan proposed Mamminasa Bypass to guide satellite town development	Mamminasa Bypass has two functions; bypass and ring road. (The southern part is also expected to work as part of the Outer Ring Road)*

Note: *To be studied under the FS of JICA
Source: JICA Study Team

(2) Future Arterial Road Network System

The Study Team updated and partially revised the existing road master plans to meet the latest development progress and solve key issues found through the study. **Figure 7.2.1** shows the urban arterial road network system recommended by the 1989 JICA study, the Mamminasata Spatial Plan and updated in this F/S for the target year of 2023.

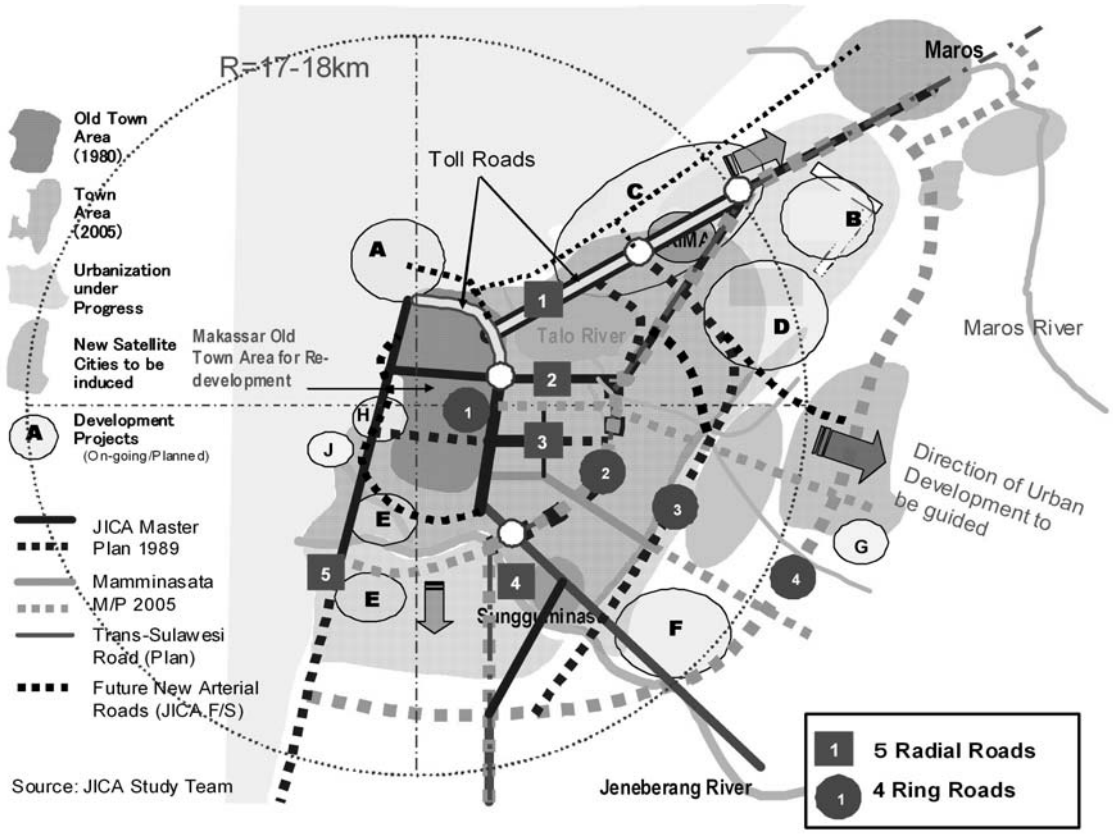


Figure 7.2.1 Urban Arterial Road Network System for Mamminasata Metropolitan Area

The Mamminasata Master Plan deleted the Outer Ring Road because of difficulty in land acquisition but a pre-feasibility study has been conducted in the Study to identify appropriate routes as requested by the South Sulawesi Province (refer to **Appendix F**).

The Mamminasata Plan also deleted the northern part of the Middle Ring Road taking the preservation of the Tallo River environment and higher construction cost into consideration. The connection between the existing port/new port/Ir.Sutami Toll Road and the Middle Ring Road/Outer Ring Road is inevitable for the Mamminasata Metropolitan Area development and logistic support. The Study Team confirmed that as most of the east river flood plain is composed of paddy fields and fish farming ponds, a new road will not give negative effects on the environment. The Study Team recommended these northern extensions by keeping a 500 m buffer zone from the Tallo River.

(3) Other important Roads in Long-Term (2023) for Mamminasata Metropolitan Area

Figure 7.2.2 shows major roads in 2006. The other road links important for the Mamminasata Metropolitan Area other than the F/S and Pr-F/S roads in the long-term (year 2023) are as follows:

* Tj.Bunga – Takalar Road (Jalan Lintas Barat Makassar - Takalar)
* Access road from Metro Tj.Bunga Road to the Middle Ring Road (Middle Ring Road Tj.Bunga Access)
* Connection between Perintis Kemerdekaan Road/ KIMA and the Mamminasa Bypass
* KIMA/Ir.Sutami Toll Access Road widening
* Malino Access Road (widening of provincial road)
* West Coast Road, Ir.Sutami Toll Road/New Port – North of Maros (Jalan Lintas Barat Makassar - Maros)
* Central Radial Road (east and west extensions of Boulevard Pannakukang Road)
* Inner Ring Road (Losari Beach to the port and south arch)
* New Makassar Port Access Road.

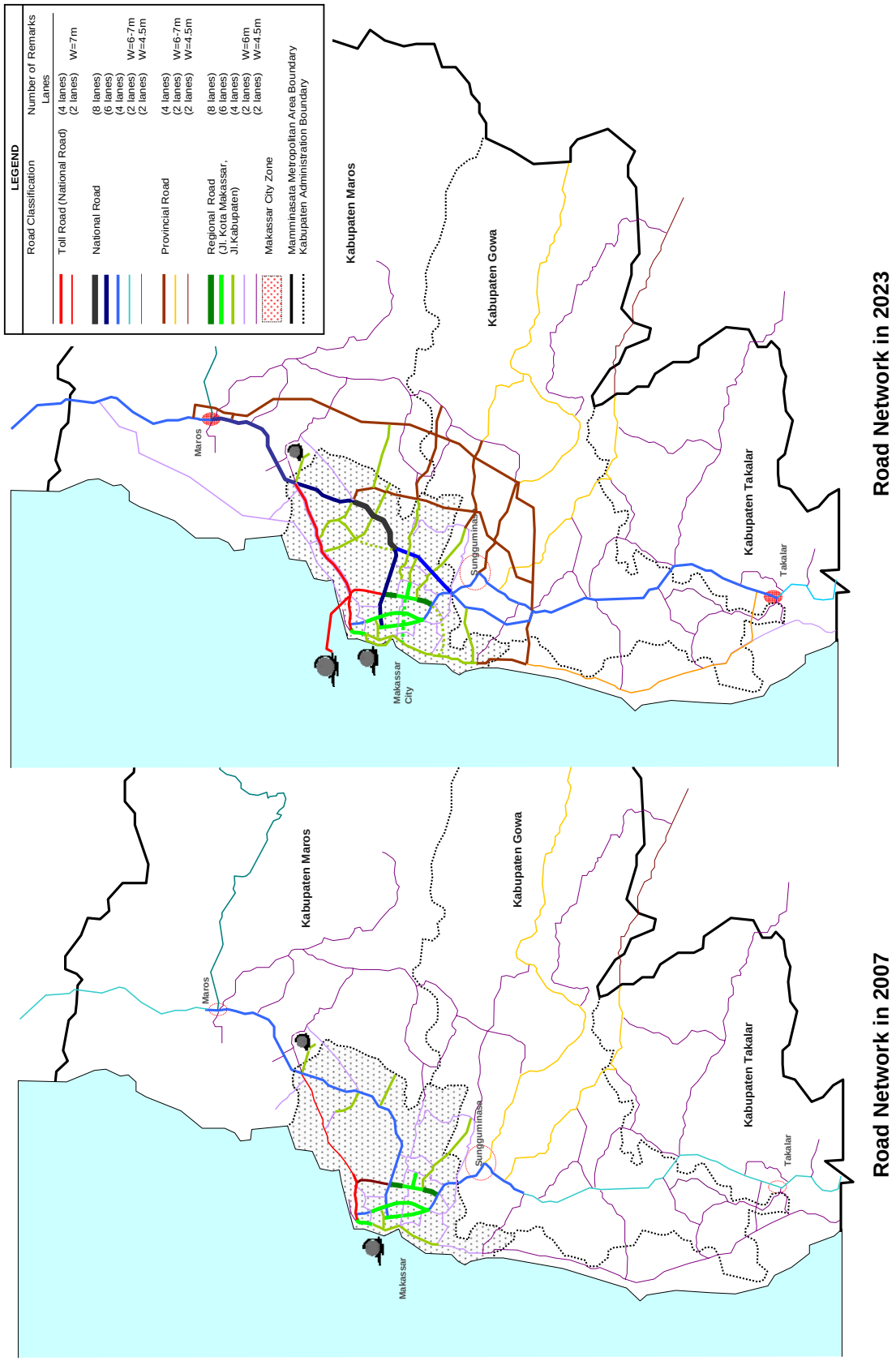


Figure 7.2.2 Major Road Network in 2007 and 2023

7.3 Review of the F/S Road Development Plan in the Mamminasata Spatial Plan

7.3.1 Modification of Feasibility Study Road Routes

(1) Trans-Sulawesi Road Mamminasata Section

The originally planned route of the Trans-Sulawesi Mamminasata Section was a new road running in parallel with the existing Trans-Sulawesi route (national road). However, the north and south sections were modified, taking difficulty in land acquisition and resettlement, traffic flow, topography (Tallo River basin) and required road function into consideration, to use the existing national roads in the Inception Report stage (**Figure 7.3.1**). Most of the traffic is to/from Makassar City and through traffic is small. Substantial traffic is within Makassar City and Sungguminasa Town in Kabupaten Gowa.

The north section is comprised of Perintis Kemerdekaan Road in Makassar City and national road in Kabupaten Maros. The middle section comprised of the Middle Ring Road and its southern extension over the Jeneberang River, which is the same as in the Mamminasata Plan. The original route between Sungguminasa and Takalar Town in the Mamminasata Spatial Plan was a new route running in parallel with the existing national road. However, as approximately 65% - 67% of the traffic is composed of motorcycles and 10% of minibus, it will not be appropriate to construct a new 4-lane road. The proposed improvement in this F/S is widening of the existing national road.

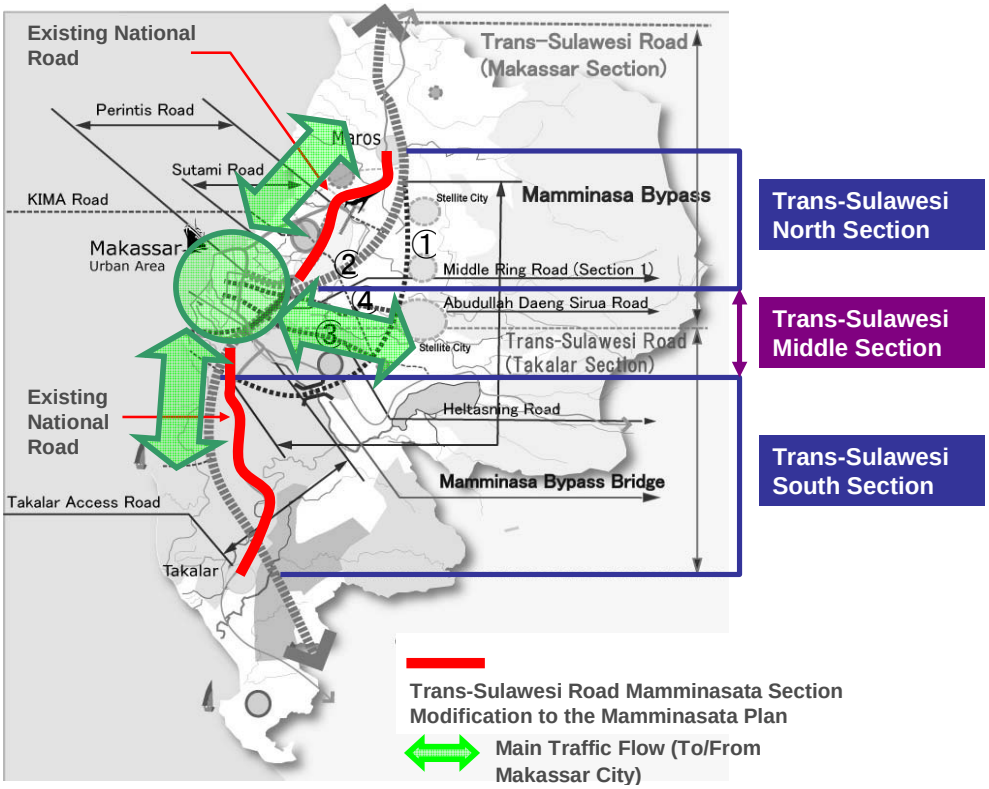


Figure 7.3.1 Modification of Route of Trans-Sulawesi Mamminasata Section

(2) Location of Satellite Towns and Position of Mamminasa Bypass

The Mamminasata Spatial Plan suggested development of satellite towns along the Kabupaten roads passing through Moncongloe from Kabupaten Gowa to Maros, located approximately 15-20 km east of the Makkassar City center to absorb the increased population by 2020. As the Mamminasata Spatial Plan indicated only a development concept, the Study Team studied and identified an appropriate location at the west foot of Mt. Moncongloe, at the boarder of Maros and Gowa Regencies (refer to Section 4.5).

The location of the Mamminasa Bypass was initially considered along the existing Kabupaten roads passing behind Mt. Moncongloe. However, as it is a bit far from Makassar City and KIMA, the JICA Study Team moved it to the front of that mountain in the Inception Report stage (**Figure 7.3.2**).

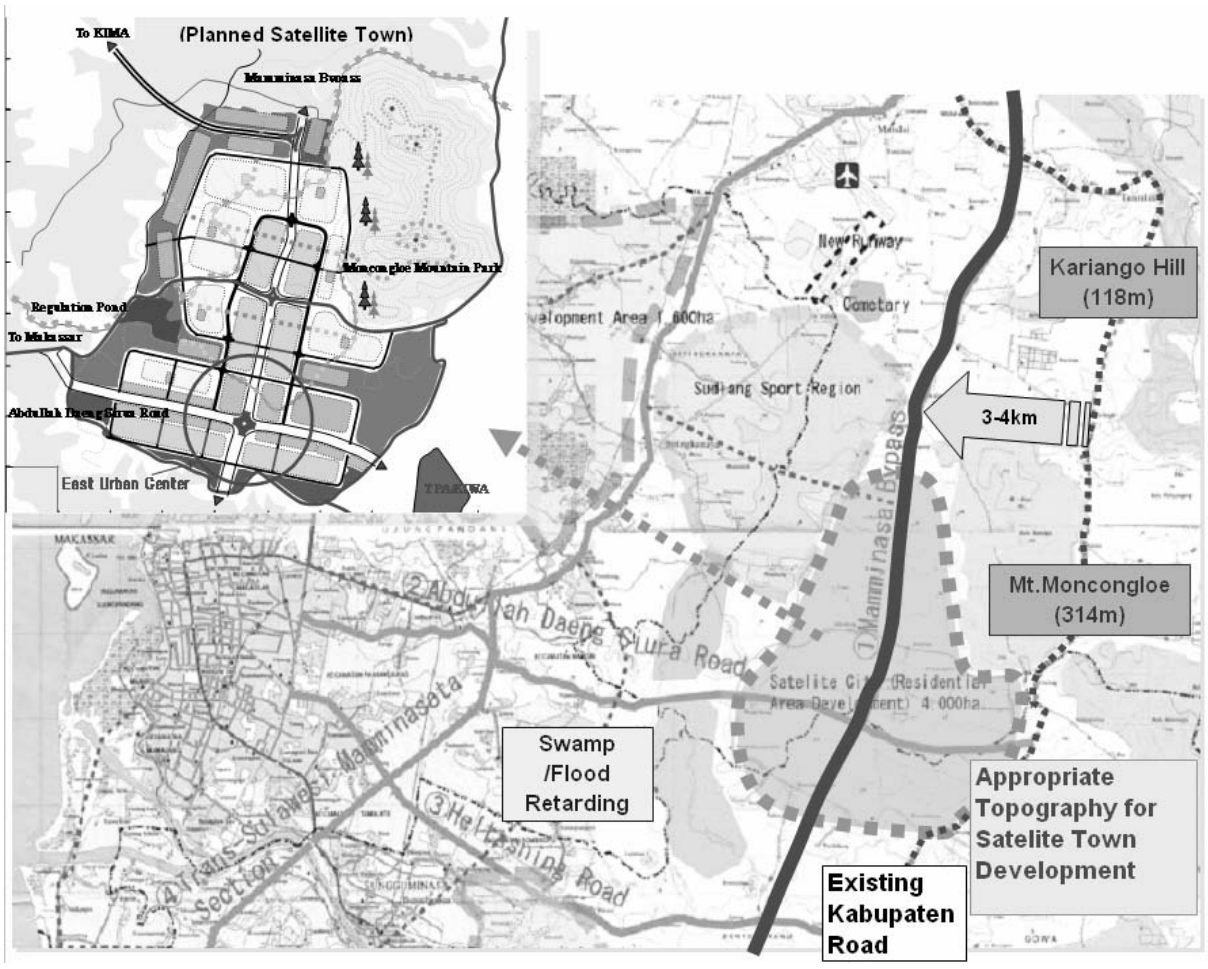


Figure 7.3.2 Appropriate Topography for Satellite Town and Location of Mamminasa Bypass

7.3.2 Busways (Bus-lane) and Left-lane-Use for Motorcycles

(1) Busways

The Mamminasata Spatial Plan recommended introducing Busways for the major arterial roads to shift from mini buses (pete-pete) to large buses. Makassar City has prepared an implementation plan for the following six routes in **Table 7.3.1** (refer to Figure 2.4.9 in Section 2.4.3).

Table 7.3.1 Busways Routes for Makassar City

Corridor No.	Corridor Name
1	Terminal Regional Daya – Telekom Pettarani
2	Karebosi – Tanjung Bunga
3	Pelabuhan Makassar – Terminal Mallengkeri
4	Terminal Regional Daya – Pasar Panampu
5	Jl.Ulip Sumoharjo Km 4 - Karebosi
6	Tello – Terminal Panakkukang

Source: Makassar City (Dinas Transport)

Pedestrian bridges are planned at approximately 500 m intervals on these routes for road crossing and bus stops are located at the median. Pedestrian bridge construction has been commenced in 2006 and would be continued. A bus company in Jakarta agreed to start bus operation once the Busways and related facilities (road widening, Busways separator, bus stops at the median, pedestrian bridges and assistance in procurement of buses) are completed.

Since the number of lanes from Daya to Perintis road / Middle Ring Road is six (6) until 2016, traffic capacity of the section will be affected if bus lanes are installed without additional lane construction. Therefore, careful consideration is needed regarding the Busways introduction.

It is recommended to introduce a policy for shifting from small buses (pete-pete) to medium buses for passenger service while providing fixed bus stops at appropriate interval to regulate these public transports.

(2) Left-lane-Use for Motorcycles

Makassar City has introduced a left-lane-use regulation for motorcycles passing through Jl. AP Pettarani, Jl. Jenderal Sudirman, Jl. Ahmad Yani and Jl. Perintis Kemerdekaan since January 2007. Motorcycles have to run on the left lane for safety and smooth traffic flow as shown in the following photographs.

Figure 7.3.3 Left-lane-Use for Motorcycles on Jl A.P. Pettarani

The dominant vehicles in 2023 will still be motorcycles and minibuses (pete-pete) on the F/S roads accounting for 41% and 12% of the total traffic, respectively (**Table 7.3.2**). This means that the traffic management for these two types of vehicles is very important on safety and traffic capacity aspects. Motorcycles, minibuses and bicycles are competing on the same left lane and cross over at intersections. The current system should be carefully monitored for adoption of the most ideal method in the future.

Table 7.3.2 Vehicle Composition on the F/S Roads in 2023

Unit: vehicle

Name of Road/Road Section		Motor-cycle	Car/Taxi / Jeep	Small Bus	Large Bus	Pickup	Truck	Total
Mamminasa Bypass		5,100	16,300	900	300	600	1,100	24,300
Trans-Sulawesi Road Mamminasata Section	Maros-Jl.Ir.Sutami IC	15,700	22,000	5,200	800	2,400	4,500	50,600
	Jl.Ir.Sutami IV-Middle Ring (Perintis Kemerdekaan Road)	39,300	21,500	14,800	800	2,400	1,700	80,500
	Middle Ring Road	21,300	25,600	8,800	700	2,400	4,100	62,900
	Middle Ring Road Access	19,100	20,000	5,500	900	2,200	3,600	51,300
	Boka-Takalar	22,400	13,600	8,900	800	1,800	3,200	50,700
Hertasning Road		20,100	11,700	5,700	300	800	1,800	40,400
Abdullah Daeng Sirua Road		22,500	12,200	4,300	200	1,200	1,300	41,700
Outer Ring Road		19,400	14,700	5,600	500	1,200	1,100	42,500
Average Composition		41%	37%	12%	1%	3%	5%	100%

Source: JICA Study Team

7.3.3 Review of Freeway and Toll Road Plan

(1) Review of Sulawesi Island Freeway Toll Road Plan

The Directorate General of Highways (DGH) conducted an express freeway/toll road study in 2006 for Sulawesi Island. The study recommended five road sections which could be implemented as priority development programs in the period of 2006 – 2010. Three of such road sections are Trans-Sulawesi Maros-Mandai-Makassar, Middle Ring Road (Makassar - Sungguminasa) and Sungguminasa - Takalar, which were recommended in the Mamminasata Spatial Plan. A joint investment by government and private sectors (Public Private Partnership) is required to secure the marginal FIIR of 16% in project implementation. The following **Tables 7.3.3** and **7.3.4** show the

classification of finance and conclusion of the study by section.

Table 7.3.3 Proposed Classification of Finance for Trans-Sulawesi Mamminasata Road in the Freeway/Toll Road Study of DGH

No.	Route / Section	Classification	PPP	GS	O/M	Equity	Debt	Note
1	Maros-Mandai - Makassar	Toll	Central Government & Private Sector	ROW and part of construction	Private Sector	Private Sector	Central Government	Budget of government from grant/soft loan
2	Makassar - Sungguminasa (Middle Ring Road)	Toll	PSO	Government investment	JV (+ Central & Regional Government)	Central Government	Central Government	Budget of government from grant/soft loan
3	Sungguminasa - Takalar	Express Freeway	Central Government	Central / Regional Government	Private Sector			Budget of government from grant/soft loan/APBN

Notes:
PPP: Public Private Partnership O/M: Operation and Maintenance
GS: Government support PSO: Public Service Obligation
Source: Penyusunan Program Pengembangan Jaringan Jalan Bebas Hambatan dan Jalan Tol Di Pulau Sulawesi, Bina Marga

Table 7.3.4 FIRR and PPP Indicators

No.	Route / Section	Length		Cost			FIRR 2011	Required Share of Government Investment (PPP)		
		Arterial	Toll	Construction (Mil.Rp)	ROW (Mil.Rp)	Total (Mil.Rp)	(%)	ROW	Construction	FIRR
1	Maros-Mandai - Makassar	13.30	12.00	410,130	43,470	453,600	11.41%	100.0%	45.9%	16.0%
2	Makassar - Sungguminasa (Middle Ring Road)	13.55	11.50	331,582	118,145	449,727	13.68%	100.0%	9.1%	16.0%
3	Sungguminasa - Takalar	37.26	26.00	888,616	94,185	982,801	7.94%	100.0%	76.1%	16.0%
Total		64.11	49.50	1,630,328 86%	255,800 14%	1,886,128 100%	11.01% (average)	100.0% (average)	43.7% (average)	16.0% (average)

Source: Penyusunan Program Pengembangan Jaringan Jalan Bebas Hambatan dan Jalan Tol Di Pulau Sulawesi, Bina Marga

According to the above table, the Government needs to finance 100% of ROW and 45.9%, 9.1% and 76.1% of the construction cost for Maros-Mandai-Makassar, Middle Ring Road and Sungguminasa - Takalar, respectively. The FIRR in the above table seems to be too optimistic and these costs include profit and overhead of private companies. The JICA Study Team carefully examined whether the above PPP plans have advantages compared with the ordinary government investment method from the technical, economic and other viewpoints in Section 9.3.

(2) Technical Review of Trans-Sulawesi Mamminasata Freeway/Toll Road

The Study Team reviewed the DGH's plan and identified that both the north section (Maros-Mandai-Makassar) and the south section (Sungguminasa–Takalar) are not appropriate to be developed as freeway/toll roads.

The north section of the Trans-Sulawesi Mamminasata road was moved to the existing national road as described in Section 7.3.1. Construction of an expressway on the national road is not

appropriate as there are many intersections and they will affect the function of national road. Therefore, the Maros-Mandai-Makassar section on the above table will not be recommended on technical aspects.

The vehicle composition for the Sungguminasa – Takalar Section is as shown in **Table 7.3.5**. The traffic share of motorcycles is 65.1% - 67.3% and that of small buses (mostly pete-pete) is 11.2 – 13.7%. As those vehicles will not divert to the express toll road, construction of the expressway is not recommended for this section.

Table 7.3.5 Vehicle Composition for Sungguminasa – Takalar Road

Unit: Vehicles/24 hrs

Road Link Name / (Link	Location of Traffic Survey	Motor-cycle	Car/Taxi/ Jeep	Small Bus	Large Bus	Pickup	Truck	Total
Sungguminasa - Takalar	Station 6	**Year 2006 Traffic**						
		20,296	3,524	3,381	87	718	2,154	30,160
		67.3%	11.7%	11.2%	0.3%	2.4%	7.1%	100.0%
		(Total: Excluding 90% of bus & 100% of Motorcycle 6,821 vehicles)*						
Sungguminasa - Takalar	Station 7	11,803	1,926	2,480	81	666	1,167	18,123
		65.1%	10.6%	13.7%	0.4%	3.7%	6.4%	100.0%
		(Total: Excluding 90% of bus & 100% of Motorcycle 4,088 vehicles)*						

Note: * vehicles subjected to the expressway/toll road
Source: JICA Study Team

Figure 7.3.4 shows a comparison between the traffic forecast by the DGH study and the JICA F/S. The forecast ADT and estimated traffic diverted to the toll road between the DGH study and the JICA F/S has difference. The latter is low both in the total traffic and diversion rate. The small buses (pete-pete) will not divert to the toll road as their passengers stay along the existing national road and this is why the low diversion rate is forecasted in the F/S.

It seems that there is not much difference in the traffic between the both studies in the case of the Middle Ring Road (Makassar-Sungguminasa Section). Therefore, this section was subjected to a freeway/toll road review in Section 9.3.

Note: The Makassar-Mandai section was not recommended by the DGH study in the 2006-2010 programs as its EIRR is low compared with other road sections.

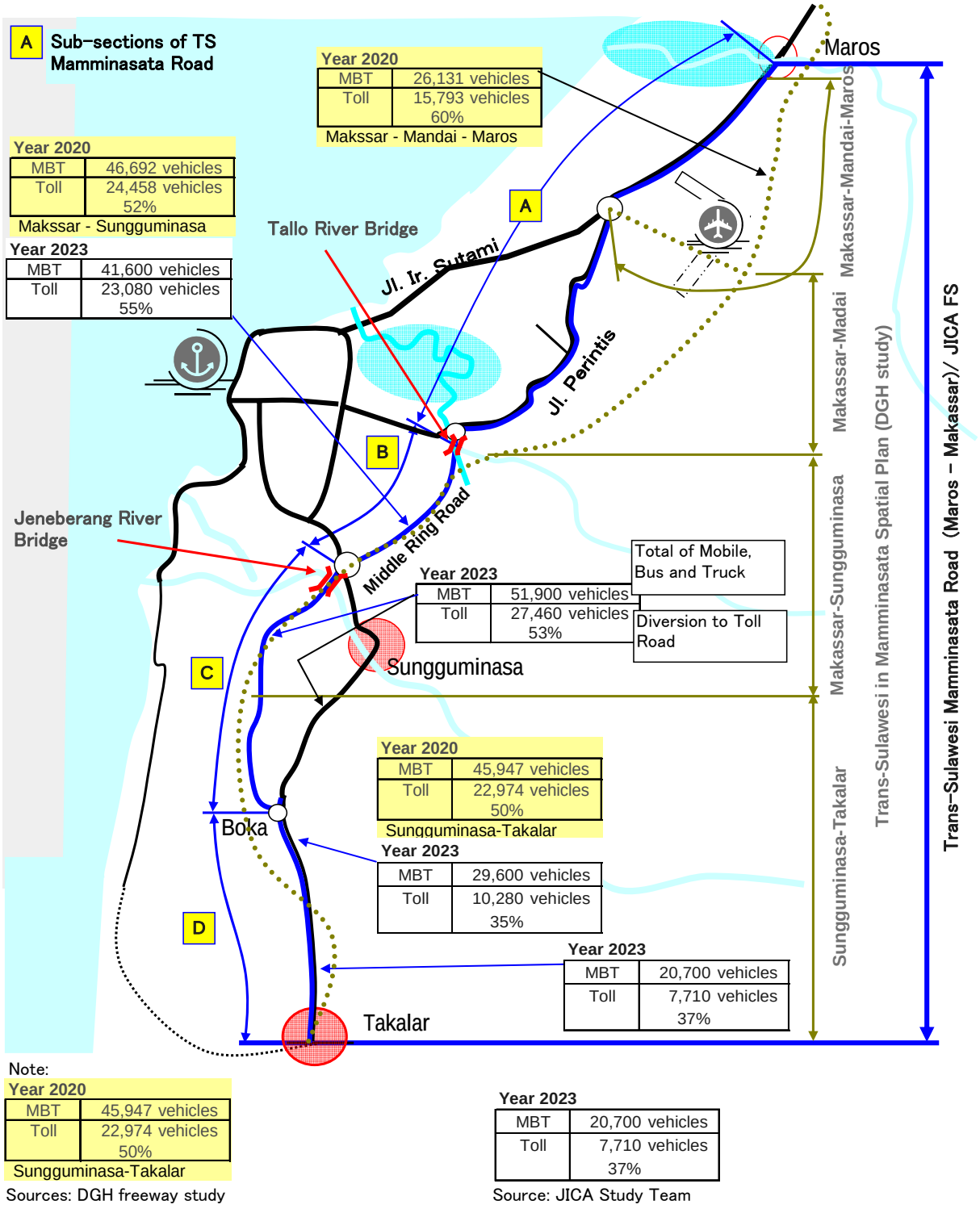


Figure 7.3.4 Comparison of Future Traffic Between GHA Study and JICA F/S

(3) Interchanges, Ramps and Underpasses Required for Access Control

Interchanges, ramps and underpasses are required for access control of freeway/toll roads. There are four major roads (Abdullah Daeng Sirua Road, Central Radial Road, Borong Raya Road, Hertasning Road) and many other minor roads crossing the Middle Ring Road. Box culverts or bridges are required for these crossings. Off- and On-Ramps are required for the inflow and outflow traffic. These will cause considerably higher cost compared with at-grade access free roads.

As the Middle Ring Road passes through a dense residential area of Makassar City, frontage roads on both sides of the expressway/freeway are required for local traffic. **Figure 7.3.5** illustrates a typical section of the expressway/freeway. Additional ROW is required for accommodating expressway, frontage roads and ramps.

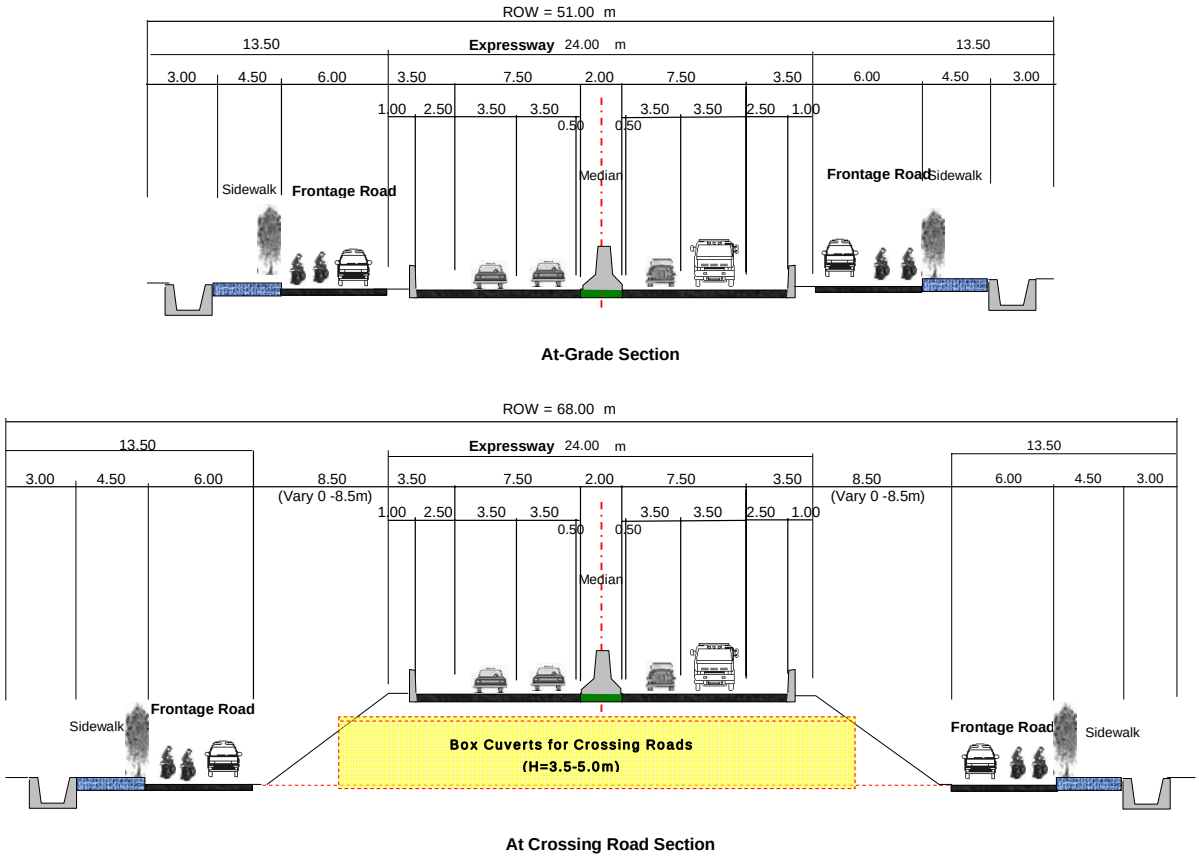


Figure 7.3.5 Typical Section of Expressway / Frontage Road for Middle Ring Road

If additional ROW acquisition is difficult, adjustment of the roadway width and special earth retaining structures (reinforced earth) will be required for accommodating crossroads under the expressway (**Figure 7.3.6**).

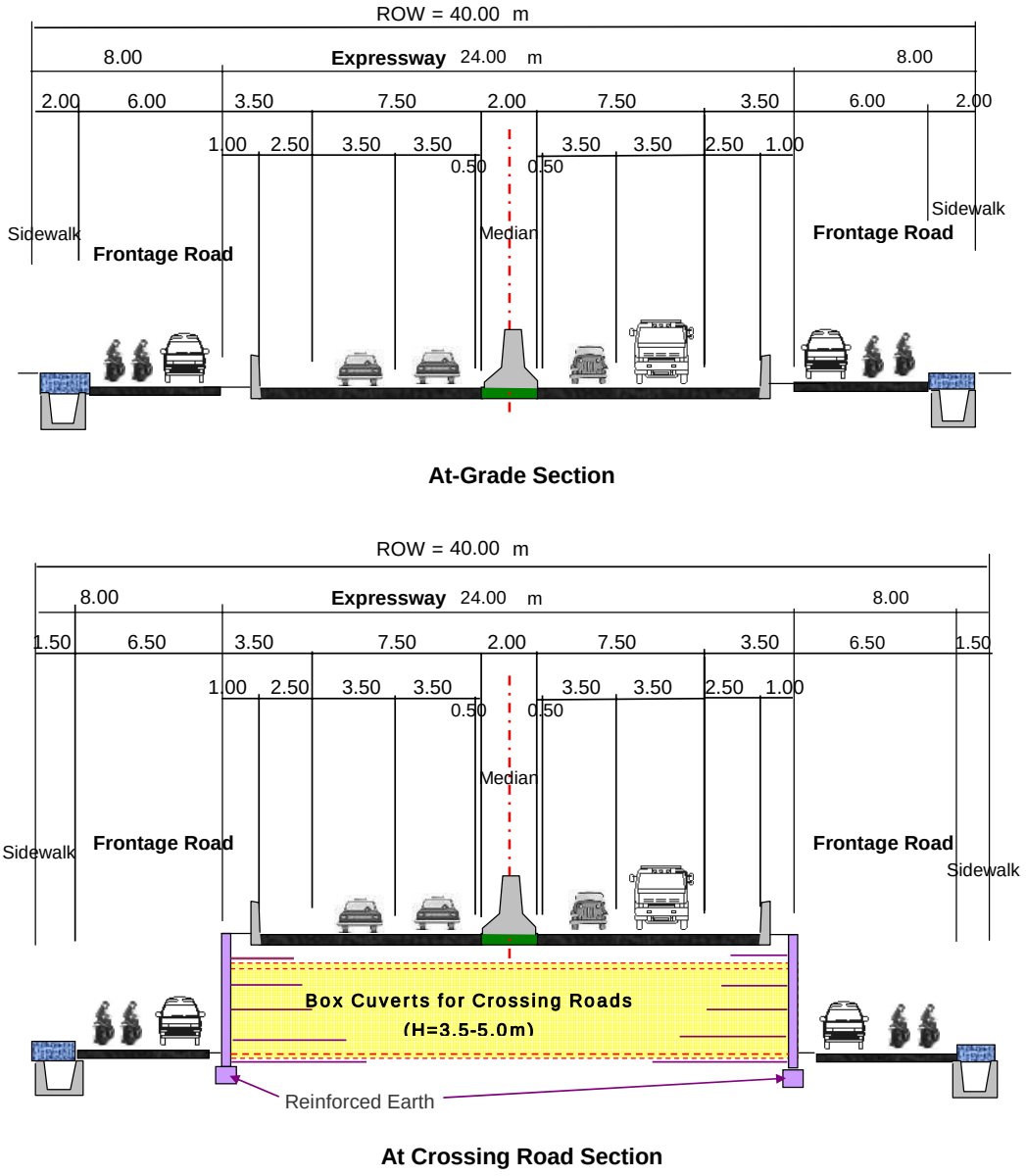
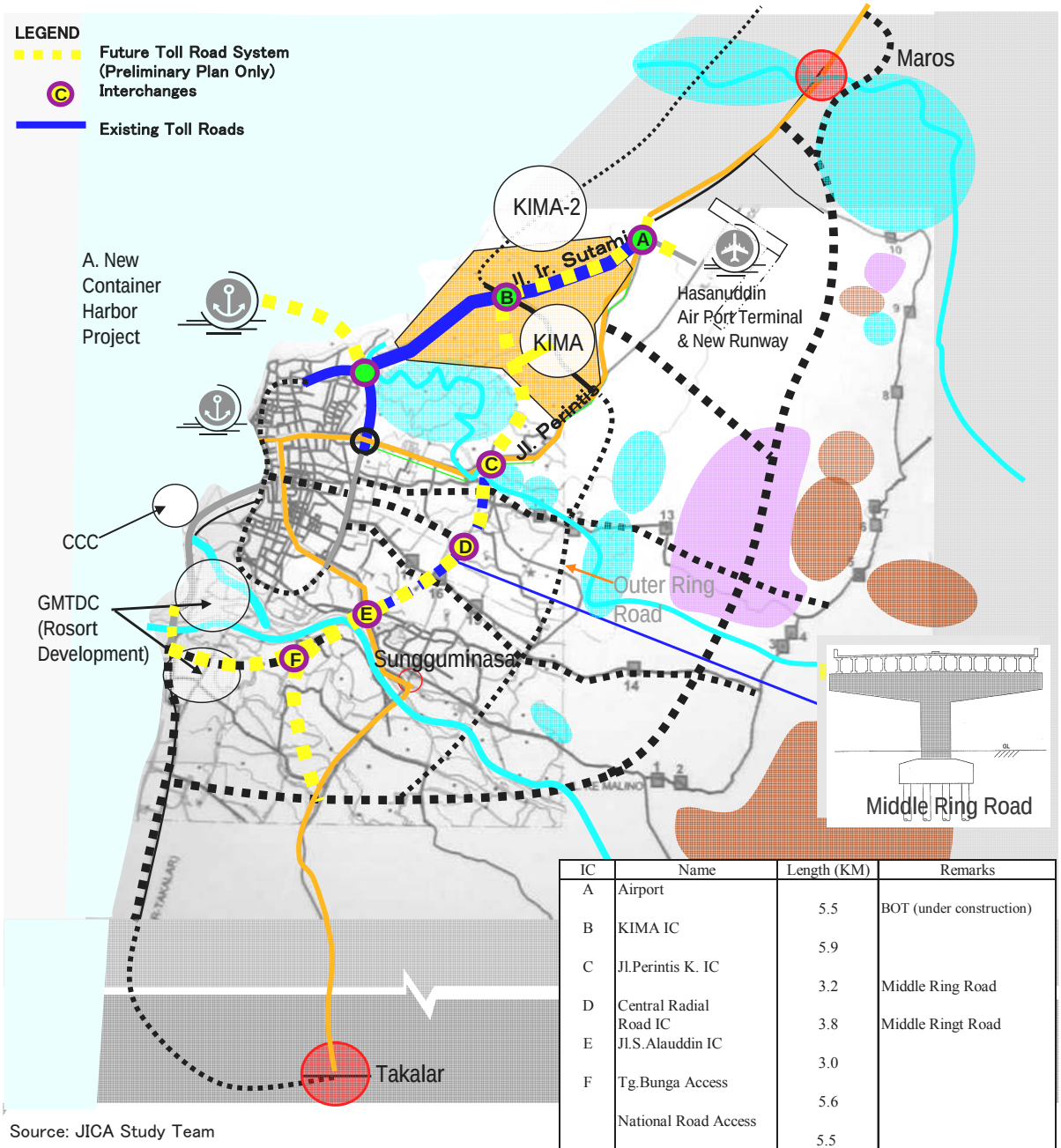


Figure 7.3.6 Typical Section of Expressway / Frontage Road for Middle Ring Road within the Current ROW

(5) Future Freeway/Toll Road System

A freeway/toll road through the Middle Ring Road might be required in the future. A preliminary plan for the freeway/toll road system is shown in **Figure 7.3.7**. The expressway will start from the airport and pass through Ir.Sutami Toll Road and divert to the south through the Middle Ring Road. It will be connected to both Tj.Bunga (GMTDC and CCC) and the national road to Takalar. Interchanges will be required at major traffic flow changing points. Viaducts (elevated structures) would be required for the Middle Ring section as additional land acquisition and resettlement will be difficult. A separate technical study will be required in the future for evaluating the feasibility of the proposed expressway/freeway road.



IC	Name	Length (KM)	Remarks
A	Airport	5.5	BOT (under construction)
B	KIMA IC	5.9	
C	Jl.Perintis K. IC	3.2	Middle Ring Road
D	Central Radial Road IC	3.8	Middle Ringt Road
E	Jl.S.Alauddin IC	3.0	
F	Tg.Bunga Access	5.6	
	National Road Access	5.5	
	Tj.Bunga		
	Total	32.5 (27.0)	(excluding BOT section)

Figure 7.3.7 Future Expressway/Toll Road System (Preliminary Study)

(6) Conclusion

It seems that sufficient traffic may pass on the expressway in the Makassar-Sungguminasa Section (Middle Ring). However, the JICA Study Team does not recommend constructing the expressway/freeway at this stage on the following technical aspects:

* Higher costs for access control facilities, including box culverts or bridges on crossing roads and off-/on-ramps at interchanges,
* Higher costs for construction of both expressway and frontage roads, and
* Necessity of additional land acquisition and resettlement. The current ROW is 40 m wide but a width of 49.5 - 66.5 m is required for the expressway and frontage roads.

7.3.4 Bikeways

(1) General

The use of bicycles in the Mamminasata metropolitan area has shrunk due to low transport efficiency and recent motorization. However, large bicycle traffic is still seen on several road sections in the Mamminasata Metropolitan Area for commuting, business (small-scale retailers of marine/agricultural products), schooling, etc.

In consideration of above situation, introduction of bikeway is planned to separate bicycle and motor vehicle traffic for enhancing safety and trafficability.

(2) Geometric Standard

Standard Specifications for Geometric Design of Urban Roads, March 1992, Directorate General of Highways, Ministry of Public Works stipulated criteria for bikeway provision and geometric standard as shown in **Table 7.3.6** to **Table 7.3.8**.

Table 7.3.6 Bikeway Provision Criteria

Unit: Traffic Volume/12h

Case	Bicycle	Pedestrian	Vehicle	Bicycle Facility
1	More than 500	More than 1,000	More than 2,000	Bicycle Way
2	More than 500	-	More than 2,000	Separated Bicycle Way
3	More than 200	-	More than 2,000	Bicycle Lanes

Bicycle dimensions are defined in Standard Specifications for Geometric Design of Urban Roads, March 1992, DGH/MPW as shown in **Table 7.3.7**. However, the Study Team proposes a 1.2m "horizontal space occupied by a cyclist", because a number of bicycles carrying marine and agricultural products are observed and they usually occupy 1.2 m width of roadway as shown in **Figure 7.3.7**.

Figure 7.3.8 Bicycle of Retail Seller

Table 7.3.7 Bicycle Dimensions

Type of Dimensions	Handleber Width	Horizontal Space Occupied by a cyclist	Cycle height	Vertical space occupied by a cyclist	Cycle Length	Pedal Height
Standard	0.6m	1.0m	1.0m	2.25m	1.9m	0.05m
Proposed	0.6m	**1.2m**	1.0m	2.25m	1.9m	0.05m

Table 7.3.8 Geometric Design Standard of Bikeways

		Bikeways	Bicycle/Pedestrian Ways	Bicycle Lane
Design Speed (km/h)		15		
Minimum Width (m)	Standard	2.0	3.5	1.0
	Proposed	**2.4**	**3.9**	**1.2**
Vertical Clearance (m)		2.5		-

(3) Present Situation of Bicycle Traffic

Traffic surveys were carried out in the Mamminasata Spatial Plan in June 2005, JICA. Traffic characteristics of bicycle traffic found in the survey were reviewed to estimate the demand and to identify the necessity of bikeway facility.

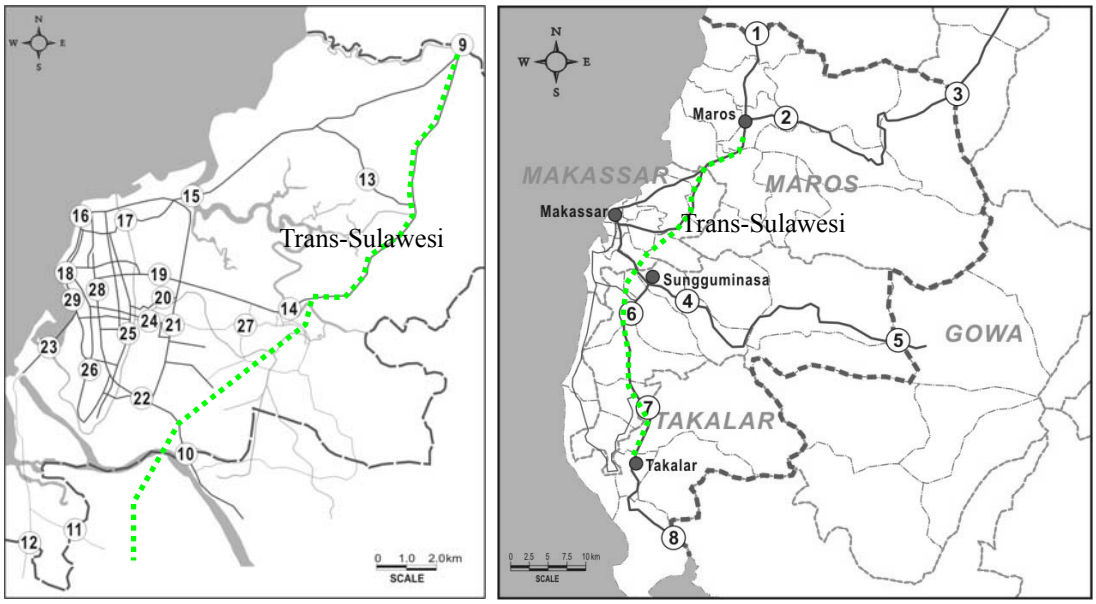


Figure 7.3.9 Traffic Survey Stations in Mamminasata Metropolitan Area

1) Number of Samples for OD interview survey and Average Passenger Occupancy

The sampling rate of the survey was 3.7% with 2,470 samples at 28 stations. The average occupancy by vehicle type obtained from the OD interview survey is shown in **Table 7.3.9**.

Table 7.3.9 Average Passenger Occupancy

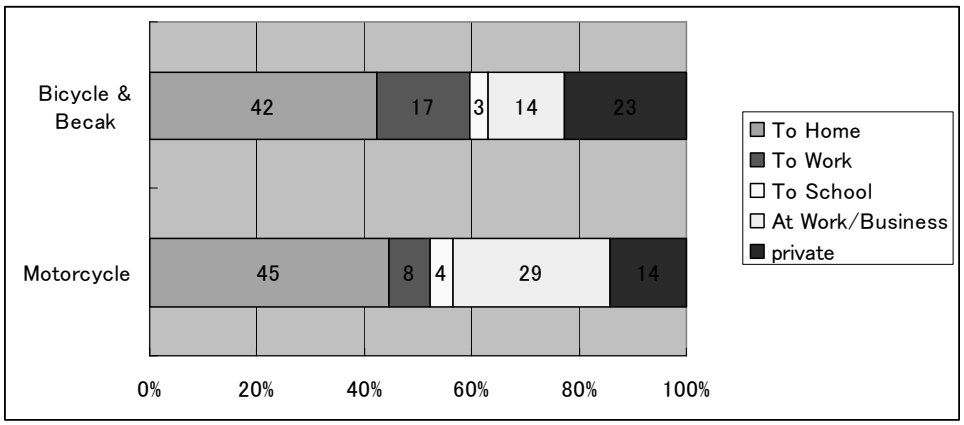
Vehicle Type	Total Passengers	Number of Sample	Average Occupancy (passenger/vehicle)
Bicycle	1,406	1,314	1.07
Becak	2,186	1,156	1.89
Motorcycle	26,307	17,747	1.48

Note: Above figures included drivers

2) Trip Purpose and Travel Time

The trip purpose varies by vehicle type. As illustrated in **Figure 7.3.9**, the share of "To home" trips was the highest for bicycle/becak and motorcycle. Approximately 80% of bicycle traffic is either

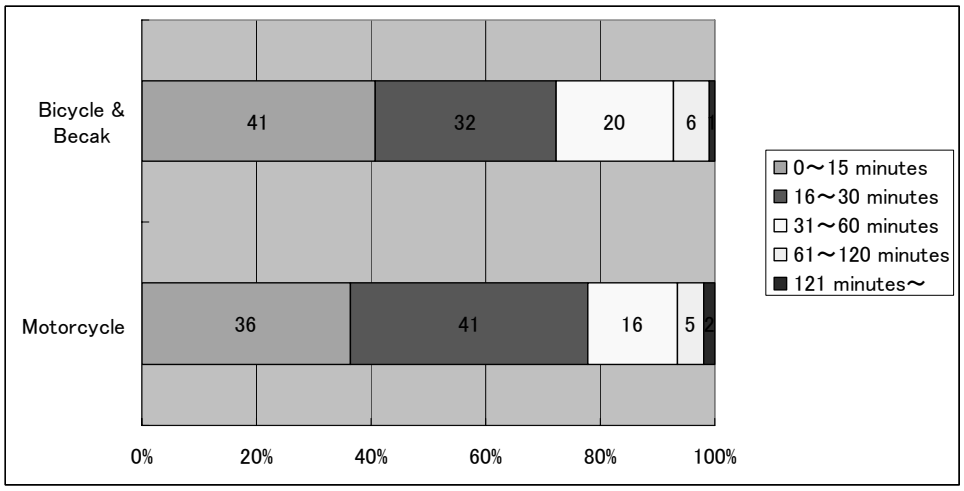
for commuting or business purpose.



Source: JICA Study Team

Figure 7.3.10 Trip Purpose by Vehicle Type

Figure 7.3.10 shows travel time distribution for bicycle/becak and motorcycle. More than half of respondents answered that their travel time is less than 30 minutes. This means that their living sphere is generally within a 30-minute radius.



Source: JICA Study Team

Figure 7.3.11 Travel Time by Vehicle Type

3) Traffic Volume around Trans-Sulawesi Mamminasata Road

Traffic survey stations related to Trans-Sulawesi Road are No. 6, 7, 9, 10 and 14 in **Figure 7.3.8**. Number of bicycles at station No. 6 and 10 are many, and these areas need an ordinary bikeway or a separated bikeway in accordance with the criteria shown in **Table 7.3.6**. Bicycle lanes might be necessary for station No. 14 as well.

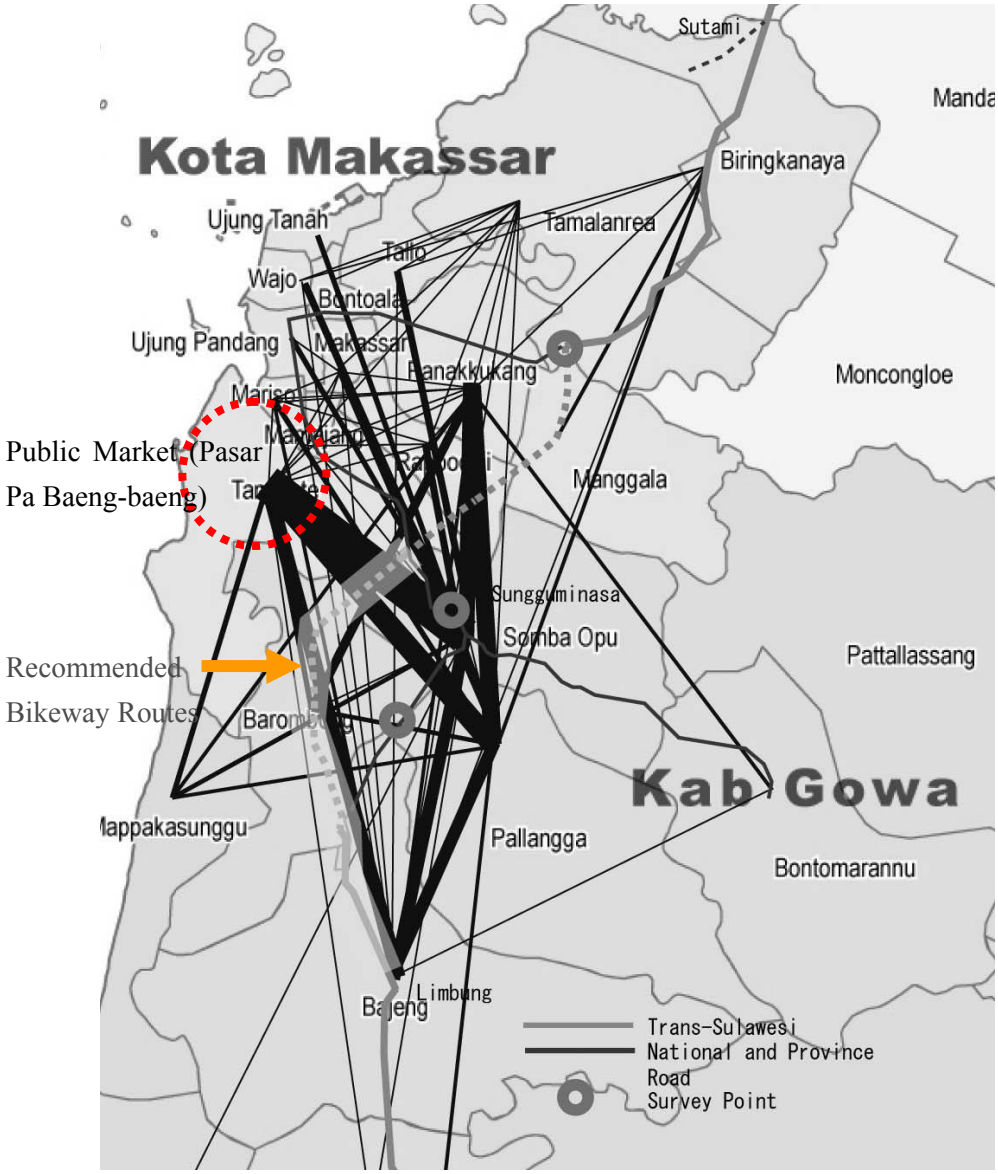
Table 7.3.10 Bicycle Traffic near Trans Sulawesi Road (12h)

Station	Bicycle	Becak	Motorcycle
1	136	132	2,923
2	261	732	4,385
3	31	4	1,168
4	334	17	5,719
5	0	0	471
6	3,080	177	14,472
7	189	83	9,634
8	76	33	1,707
9	142	77	13,362
10	6,960	333	32,336
11	335	16	1,751
12	919	21	2,822
13	171	40	13,675
14	468	165	55,644
15	523	11	14,474
16	0	0	0
17	3,400	6,048	12,074
18	990	1,477	12,771
19	997	283	38,428
20	958	2,197	11,924
21	1,780	1,307	57,442
22	2,473	3,299	30,379
23	777	0	7,679
24	1,035	1,807	23,689
25	2,265	3,672	40,774
26	961	2,855	17,405
27	826	245	15,665
28	537	113	21,352
29	1,137	1,624	15,846

4) Bicycle Traffic Demand in the Mamminasata Metropolitan Area

OD matrices of bicycle were built and their desired lines are represented in **Figure 7.3.11**. It is noteworthy that bicycle traffic on the existing national highways on Sultan Alaudin Road and Sungguminasa – Bajeng road is outstanding. Substantial part of the bicycle traffic on this road is coming from Kabpaten Gowa and going to public markets in the Makassar City center by transporting agricultural products.

From the above bicycle traffic characteristics, Section C (Kec.Bajeng (Boka IC) – Sultan Alaudin Road IC) of Trans- Sulawesi Mamminasata Road seems to be effective for bikeways.



Source: JICA Study Team

Figure 7.3.12 Distribution of Bicycle Traffic Demand (Desired Lines)

(4) Initial assessment for Bikeway Introduction

Bicycle traffic volume (3,080/12h) of station No. 6 represents the Bajeng (Boka IC) – Jl. Sultan Alaudin section (Section C of the Trans-Sulawesi Road). According to the criteria and judging from the bicycle and pedestrian traffic volume, separated bikeway will best suit for this section. **Figure 7.3.12** and **Figure 7.3.13** shows provision of the bikeway on sidewalks and carriageway, respectively. Therefore, sidewalk width for Jeneberang Bridge should be more than 1.2m to accommodate bikeways. However, further discussion would be required during the detailed engineering stage.

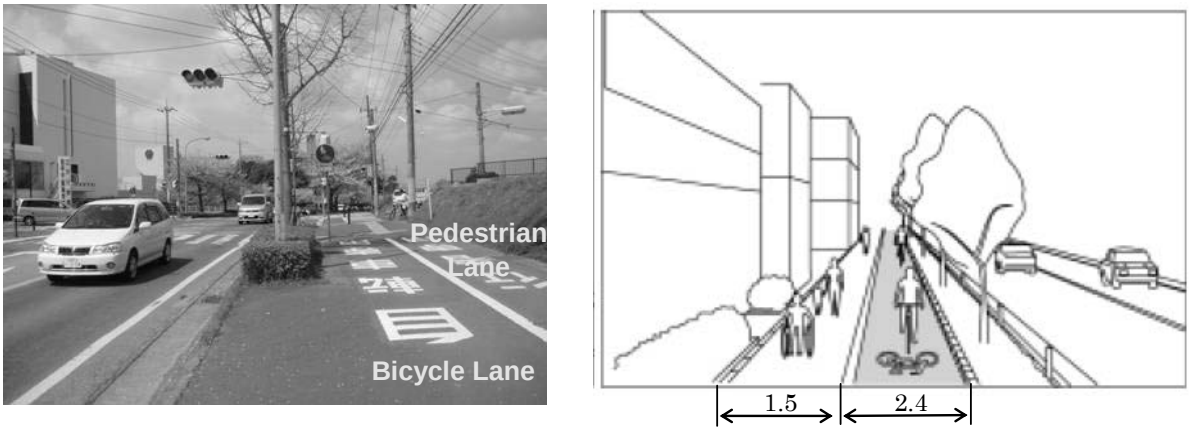


Figure 7.3.13 Typical Cross Section (Separated Bikeway on Sidewalk)

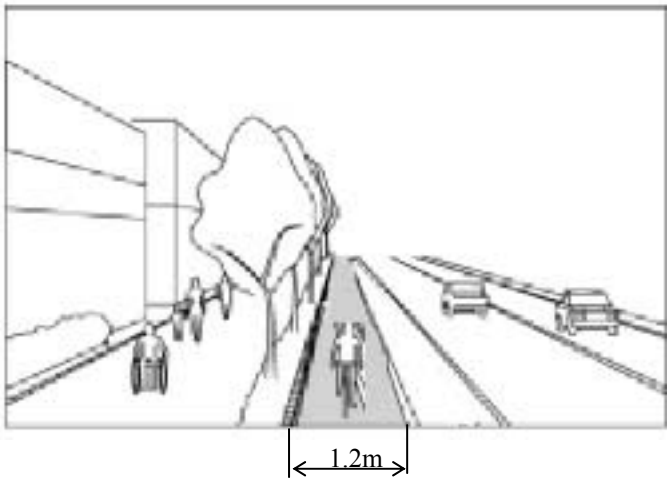


Figure 7.3.14 Typical Cross Section (Bicycle Lane on Travelway)

Some legal framework will be necessary if separated bicycle lanes are installed allowing bicycle passage on the sidewalk. Traffic regulations are required to change and traffic management facilities are required modifying.

7.4 Proposed Geometric Design Criteria for F/S Roads

(1) Design Standard

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

The following Indonesian design standards as well as the Road Law and the Road Regulations, including UU No 38 Year 2004 and PP No 34 Year 2006, have been referred to in the F/S.

i) Tata Cara Perencanaan Geometrik Jalan Antar Kota, Direktorat Jenderal Bina Marga, 1997

ii) Standard Specifications for Geometric Design of Urban Roads, MPW, Indonesia, 1992

iii) Indonesian Highway Capacity Manual, MPW, Indonesia, 1993

iv) Tata Cara Perencanaan Tebal Perkerasan Lentur Jalan Raya Dengan Metode Analisa Komponen, Dewan Standardisari Nasional-DSN, 1987

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

vi) Bridge Design Code and Bridge Design Manual (BMS 1993)

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

i) A Policy on Geometric Design of Highways and Streets, AASHTO, 2004

ii) Road Structure Ordinance, Japan Road Association, 2005

iii) Guide for Design of Pavement Structures, AASHTO, 1993

iv) Manual for Design and Construction of Pavement, Japan Road Association, 2002

v) The Planning and Design of At-Grade Intersections, June 1988, Japan Society of Traffic Engineer

(2) Road Classification

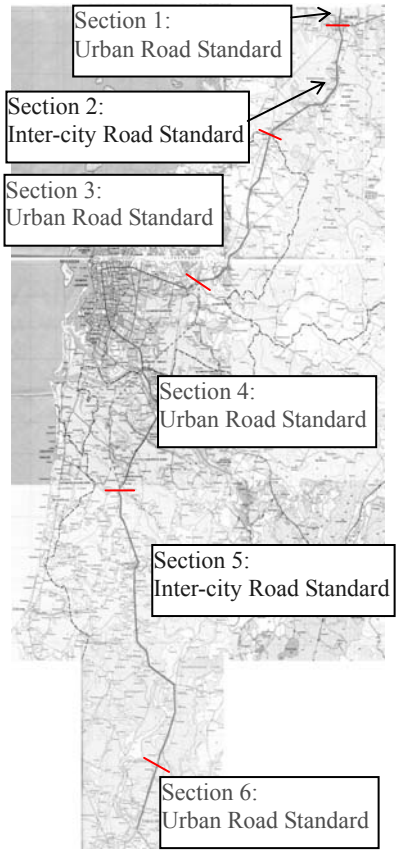
The FS roads are classified as shown in **Table 7.4.1** in accordance with the Road Law and design guides in the above list and traffic demand forecast given in Chapter 5.

In principle, the Standard Specifications for Geometric Design of Urban Roads, MPW, Indonesia, 1992 will be applied as reference geometric criteria for the FS routes. The Tata Cara Perencanaan Geometrik Jalan Antar Kota, Direktorat Jenderal Bina Marga, 1997 will be applied for sub-sections of the Trans-Sulawesi road which are categorized as inter-city roads in the Keputusan Menteri Permukiman Dan Prasarana Wilayah No. 375/KPTS/M/2004 (**Table 7.4.1)**.

Table 7.4.1 Classification of the FS Roads

No.	Name of Road/Road Section		Classification	
			Function (proposed road Function)	Type Class
1	Mamminasa Bypass		Arterial (Secondary)	Type II Class I
2	Trans-Sulawesi Road Mamminasata Section	Maros-Middle Ring(Perintis Kemerdekaan)	Arterial Primary	Type II Class I
		Middle Ring Road	Arterial (Secondary)	Type II Class I
		Middle Ring Road Access	Arterial (Secondary)	Type II Class I
		Middle Ring Road Access-Takalar	Arterial Primary	Type II Class I
3	Hertasning Road		Arterial (Secondary)	Type II Class I
4	Abdullah Daeng Siura Road		Arterial (Secondary)	Type II Class I
5	Outer Ring Road		Arterial (Secondary)	Type II Class I

Standard Application Boundary of Trans-Sulawesi



(3) Geometric Design Condition

Geometric design standards for the F/S roads were established in accordance with the above design guides as outlined in **Table 7.4.2** and **Table 7.4.3**.

Table 7.4.2 Geometric Design Standards (Urban Road)

Item		Design Standard Value	Applied Value
Road Classification		Type-II, Class-I	
Design Speed		60km/h	
Cross-section	Carriageway Width	3.5m	3.5m (3.25m)*
	Median	2.0m (min)	2.0m (min)
	Shoulder Width (Right)	0.5m	0.5m
	Shoulder Width (Left with Side Walk)	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 as well as low traffic volume of heavy vehicles.

Table 7.4.3 Geometric Design Conditions for Trans-Sulawesi Road (Inter-City Road Section)

Item		Design Standard Value	Applied Value
Road Classification		Arterial, Class-I	
Design Speed		70-120km/h	80km/h
Cross-section	Carriageway Width	3.5m	3.5m (3.25m)*
	Shoulder Width	2.5m (2.0m)**	2.5m
Horizontal Alignment	Min. Radius	210m	210m
	Omission of Transition	>900m	>600m
Vertical Alignment	Min. Curve Length	80m	25m
	Cross-fall	2.0%	2.0%

Notes: *: Exceptional case is applied to minimize land acquisition or to follow the existing alignment as well as low traffic volume of heave vehicle.
**: Minimum case

7.5 Proposed Typical Cross Sections

(1) General

The typical cross-sections for the F/S roads are examined carefully taking both traffic demand and road functions required for urban development and road network system into consideration. National and regional policies on vehicle modal shift to public transport (bus transport) are also considered. Since as a large number of inter-city and intra-city traffics will pass on the F/S roads, an appropriate number of lanes should be provided to meet the traffic demand while avoiding over-estimation. The key elements to be considered for establishment of typical cross-sections are as summarized in **Table 7.5.1**.

Table 7.5.1 Key Elements for Establishment of Typical Cross-sections for the FS Roads

Element	Key Elements for Planning
Traffic Demand	- Balance between traffic demand and capacity - Separation of inter- and intra-city traffics - Shift of vehicle mode to public transport (Busways, bus stop and pedestrian bridge) - Motorcycle lanes (Encouragement for use of bicycles for short distance commuters)
Road Functions required for Urban Area Development	- Sufficient space for pedestrians - Control of roadside parking - Right-turn lane and U-turn lanes - Environmental spaces (planting) - Interchanges for efficient use of road facilities - Traffic safety facilities

Appropriate road facilities corresponding to the traffic demand and road functions have been proposed based on the above table.

(2) Traffic Demand and Number of Lanes

The future traffic demand in 2023 was predicted as indicated in development concept tables in Section 7.6. The design hourly traffic was assumed to be 10% (peak hour traffic coefficient) in accordance with the Standard Specifications for Geometric Design of Urban Roads for the FS roads (refer to **Table 7.5.2**). The deign capacity of 13,000 pcu/day per lane was applied for Type II, Class I roads (multiple lanes). In the case that the road is interrupted by many intersections, it can be reduced to 60% - 80% of the standard capacity. The number of lanes for the FS roads was planned based on the traffic demand and capacity analysis, and proposed in Section 7.6 “Road Development Concept”.

(3) Typical Cross-sections

The proposed standard cross-sections for the FS roads are as shown in **Figures 7.5.1** to **7.5.2**. The width of each element is indicated in the figures and some elements, such as the sidewalk and environmental space, have an option to be decided based on the roadside urban development level. As the ROW for the Trans-Sulawesi Road will require at least 42 m, a minimum 42 m ROW should

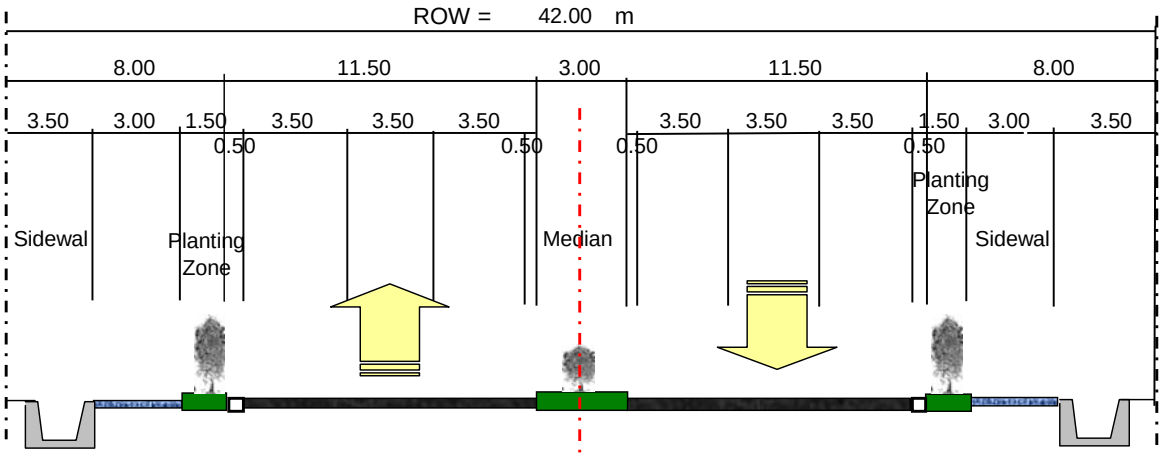
be reserved if possible. These standard cross sections are used with some modifications to meet the available ROW, dominant topography and other existing conditions.

Table 7.5.2 Design Traffic for FS Roads

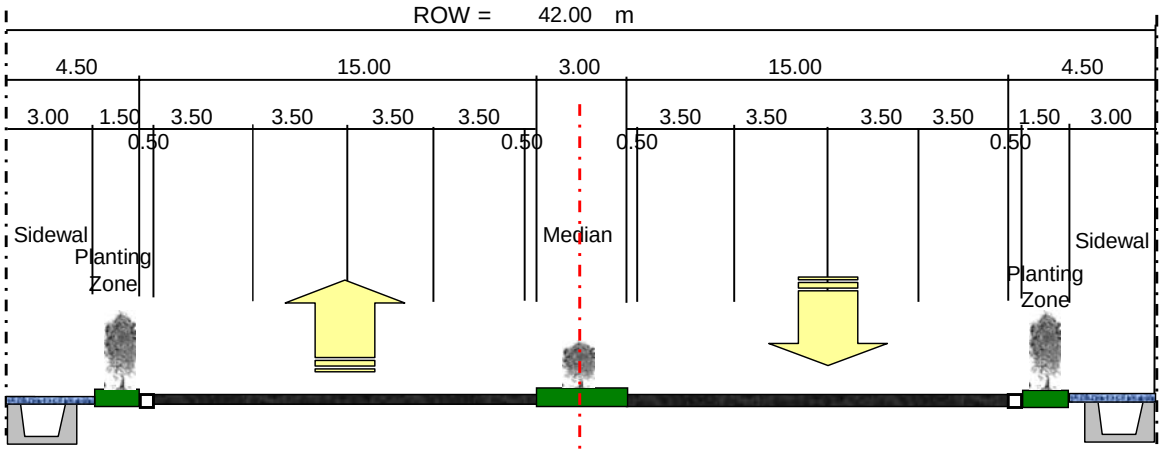
Unit: pcu

Road Classification		Standard Design Daily Traffic								
		4 lanes			6 lanes			8 lanes		
		Normal	80%*	60%*	Normal	80%*	60%*	Normal	80%*	60%*
Type I	Class I	60,000	48,000	36,000	90,000	72,000	54,000	120,000	96,000	72,000
	Class II	56,000	44,800	33,600	84,000	67,200	50,400	112,000	89,600	67,200
Type II	Class I**	52,000	41,600	31,200	78,000	62,400	46,800	104,000	83,200	62,400
	Class II	52,000	41,600	31,200	78,000	62,400	46,800	104,000	83,200	62,400
	Class III	48,000	38,400	28,800	72,000	57,600	43,200	96,000	76,800	57,600

Notes: * with many intersections
** applicable for the JICA FS roads
Source: Geometric Design Standard for Urban Road, 1992, DGH



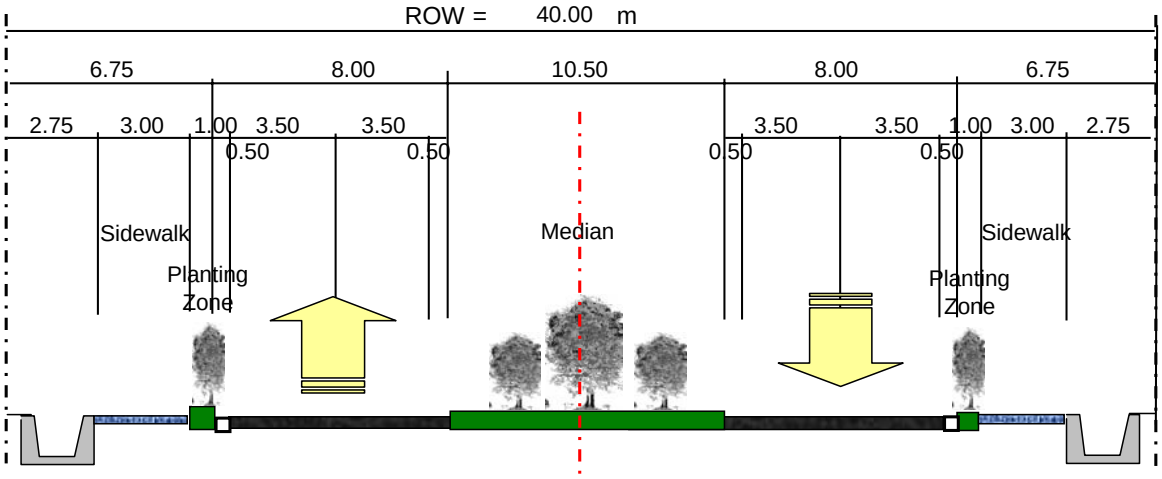
6-Lane Road Cross Section



8-Lane Road Cross Section

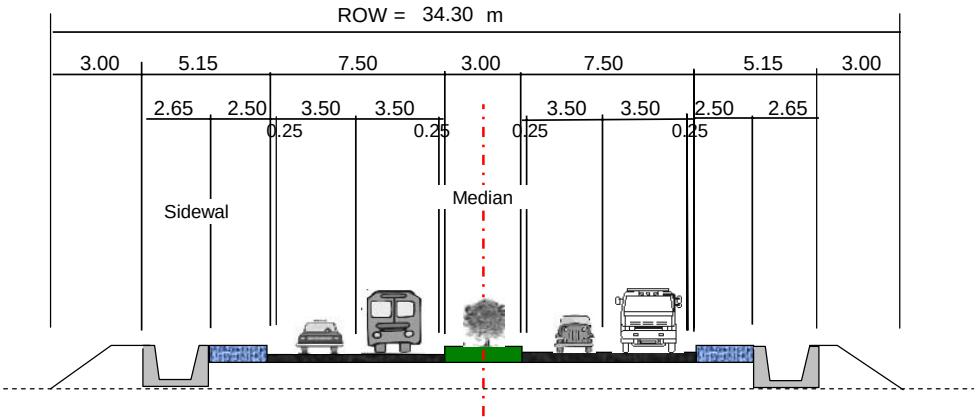
Source: JICA Study Team

Figure 7.5.1 Typical Cross Section of Trans-Sulawesi Road (Perintis Kemerdekaan Road)



Source: JICA Study Team

Figure 7.5.2 Typical Cross Section for Mamminasa Bypass and Trans-Sulawesi Road C-Section



Source: JICA Study Team

Figure 7.5.3 Typical Cross Section for Hertasning Road and Trans-Sulawesi D-Section (Sungguminasa –Takalar)

7.6 Road Development Concept

7.6.1 Trans-Sulawesi Road Mamminasata Section (Maros – Takalar)

The Trans-Sulawesi Road Mamminasata Section comprises four (4) sections. Section A is from Maros (Km 29.00) to the Middle Ring Road on the existing national road. Section B is the Middle Ring Road section between Perintis Kemerdekaan Road and Sultan Alauddin Road (border between Makassar City and Kabupaten Gowa). Section C is from the Middle Ring Road to Boka IC on the national road, approximately 5.3 km south of Sungguminasa. Section D is from Boka IC to Takalar (national road).

Table 7.6.1 shows the development concept of the Trans-Sulawesi Mamminasata Road by section.

Table 7.6.1 Development Concept of Trans-Sulawesi Mamminasata Road

No.	Section	Classification				Traffic Volume		Number of Lanes		Develop-ment Plan	ROW Width (m)	Current Staus of ROW Acquisition	Planned Interchanges (IC)
		Length (km)	Function	Administrative Status	Type / Class	2006	2023	Exsting	Plan				
A	Maros - Jl.Tol.Ir.Sutami IC	8.7	Arterial (Primary)	National	Types II / Class I	23000-30000	53000-54000	4	6	Widening	42	Not yet	Jl.Ir.Sutami
	Jl.Tol.Ir.Sutami IC-Middle Ring Road (Jl.Perintis)**	10.9	Arterial (Primary)	National	Types II / Class I	29000-62000	60000-100000	4	6-8	Widening	42	On-going	
B	Middle Ring Road	7.3	Arterial (Secondary)*	*	Types II / Class I	-	46000-52000	-	6	New Road	40-42	On-going	Jl.Sultan Alauddin
C	Middle Ring Road Access	8.6	Arterial (Secondary)*	*	Types II / Class I	-	47000	-	4	New Road	40	Not yet	-
D	Middle Ring Road Access-Takalar	22.5	Arterial (Primary)	National	Types II / Class I	13000-36000	30000-47000	2	4	Widening	30	Not yet	-
	Total:	58.0 km											

Notes: * Proposed status after construction
** DGH started 6-lane widening and complete it by 2010

The recommended development concept for the section from Maros to Ir.Sutami Toll Road in Section A is to widen the existing 4-lane road to a 6-lane road. No widening will be made for the Maros new town section to avoid adverse effects on the current town development concept.

As to Perintis Kemerdekaan Road, the standard cross-section suggested in the Pre-FS in the Mamminasata Study will be modified to meet the current 6-lane widening design undertaken by BDGH. Busways planned by Makassar City could be accommodated in these 6 lanes. Pedestrian bridges will be provided at about 500-1000 m intervals. Stage construction (6-lane at the initial stage) is applied to minimize initial investment cost and influence to the on-going BOT toll road project of Ir.Sutami Toll Road.

The planned Middle Ring Road (Section B) is a new 6-lane road. Sidewalks will be provided on the side ditches along the roadway as the ROW is 40m. Busways planned by Makassar City could be accommodated in these 6 lanes.

Four lanes are required for the Middle Ring Road Access (Section C) and its development concept is similar to that of the new airport access road (refer to the right photograph). A wide median of 10 m will be provided to secure a widening space in the future. An introduction of bike lane is one of the recommended options.

Photo: New Airport Terminal Access Road of which Development Concept will be similar to C-section

Section D is widening of the existing national from 2 lanes to 4 lanes with a median from Boka, located approximately 5 km south of Sungguminasa), to Takalar. The road within Takalar town is a non-divided 4-lane road.

7.6.2 Mamminasa Bypass

The development objective of Mamminasa Bypass is to induce a new satellite town at about 15 km east of Makassar City, at the Kabupaten Gowa and Maros border. The southern part of this road is a part of the Outer Ring Road.

Mamminasata Bypass is comprised three (3) sections: south, middle and north sections. The south section will start at the Tj Bunga–Takalar Road (approximately 6.6 km south of the Jeneberang River), runs to the east to meet the Middle Ring Road access (extension) and the national road at Boka village on the national road, approximately 5.3 km south of Sungguminasa. From then it goes to the east to meet the Jeneberang River and turns to the north after crossing it and join the middle section. The middle section runs to the north through rolling and flat topography up to Maros. The north section is a bypass for the Maros town. Two outlets are planned; one before Maros town and the other after Maros town.

The development concept of Mamminasa Bypass is to construct a new 4-lane road with a wide median (10 m for a widening space in the future). This is similar to the concept of new airport access road.

Table 7.6.2 Development Concept of Mamminasa Bypass

Section	Length (km)	Classification			Traffic Volume 2023(pcu)	Number of Lanes		Development Plan	ROW Width (m)	Bridge
		Function	Administrative Status	Type / Class		Existing	Plan			
South	16.7	Arterial * (Secondary)	Provincial **	Type II / Class I	20000 - 44000	-	4	New Road	40	Jeneberang River (L=154m)
Middle	19.7	Arterial * (Secondary)	Provincial **	Type II / Class I	15000 - 23000	-	4	New Road	40	-
North	12.6	Arterial * (Secondary)	Provincial **	Type II / Class I	11000 - 33000	-	4	New Road	40	Maros River (L=126m)
Total:	49.1 km									

Notes: * Proposed function
* Proposed administrative status is provincial strategic road

7.6.3 Hertasning Road

Hertasning (15.6 km in total length) is divided into four (4) sections. Section A (5.2 km long) is from the AP Pettarani Road junction to the Makassar and Gowa border (the end of the current urban area). This section was already improved to a 4-lane road by South Sulawesi Province. Section B (2.3 km) is under construction by the province. Section C (3.7 km) is in detailed design stage. Section D is in a planning stage and subjected to the F/S. **Table 7.6.3** shows a summary of current status and development concept of Hertasning Road by section. Only Section D (4.9 km in length) is subjected to the F/S. The development concept is to widen the existing 2 lane road (4.5 m travelway) to a 4-lane road.

Table 7.6.3 Current Status and Development Concept of Hertasning Road

Section	Length (km)	Function	Administrative Status	Traffic Volume (2023)	Number of Lanes		Development Plan	ROW Width (m)	Current Status of ROW Acquisition
					Existing	Plan			
A	5.2	Arterial (Secondary)	Makassar	24000	4	4	Completed	34	-
B	2.3	Arterial (Secondary)	Provincial**	24000	2	4	Under construction	34	Completed
C	3.7	Arterial * (Secondary)	Provincial**	30000	2	4	Completed detailed design	34	Not yet
D	4.9	Arterial * (Secondary)	Provincial**	21000	2	4	Widening	34	Not yet
Total	16.1 km								

Notes: * Proposed status
* * Proposed administrative status is provincial strategic road

7.6.4 Abdullah Daeng Sirua Road

Abdullah Daeng Sirua Road (17.8 km in total length) is divided into six (6) sections. The current status and alternative plans of this road are as summarized in **Table 7.6.4**. The existing 2-lane road will be improved to a 4-lane road. However, as Section A (1.4 km) is located in the dense residential and business area of Makassar City center, it is impossible to secure the right-of-way unless the land adjustment method is used (refer to Section 7.12). Only traffic control will be applied for this section while an extension of the central radial road from Boulevard Pannakukang

Road to the Middle Ring Road planned by Makassar City is recommended for implementation.

Table 7.6.4 Current Status and Development Concept of Abdullah Daeng Sirua Road

Section	Section Name	Length (km)	Function	Administrative Status	Traffic Volume (2023)	Number of Lanes		Development Plan	ROW Width (m)	ROW Acquisition Status
						Existing	Plan			
A	Jl.Pettarani - Canal Penampu	1.4	Arterial * (Secondary)	Makassar	25000	2	2	Use of Existing Road with traffic control	-	-
B	Canal Penampu - Jl.Poros	2.5	Arterial * (Secondary)		25000	2	4	Under Construction	15	On-going
C	Jl.Antang Raya	0.8	Arterial * (Secondary)		25000	2	4	Additional 2 lanes (New)	15	Not Yet
D	Jl.Antang Raya - Bts.Makassar/ Maros	4.8	Arterial * (Secondary)		27000	2	4	Additional 2 lanes (New)	25	Not Yet
E	Bts.Makassar/ Maros (Tallo River) - Mangempang	1.2	Arterial * (Secondary)	Provincial**	21000	2	4	Additional 2 lanes (widneing)	40	Not Yet
F	Mangempang - Moncongloe (End)	7.1	Arterial (Secondary)*	Provincial**	21000	-	4	New	34	Not Yet
Total:		17.8	km							

Notes: * Proposed status
* * Proposed administrative status is provincial strategic road

7.7 FS Road Route Study

7.7.1 Trans-Sulawesi Road Mamminasata Section (Maros – Takalar)

(1) Sections A, B and D

The Trans-Sulawesi Road Mamminasata Section is comprised of four (4) sections; A, B, C and D (refer to **Figure 7.7.1**). The basic concept of Sections A is to widen the existing national road. An initial alternative route study was conducted to check the possibility of alternative alignments which could reduce the resettlement along the national road in Kabupaten Maros, especially in Mandai area. However, no appropriate alternative routes were identified on engineering aspect. Land acquisition for widening Perintis Kemerdekaan Road is approximately 80% complete as of October 2007. No alternative route study was conducted for Section B (the Middle Ring Road) as land acquisition is approximately 60% - 70% complete.

(2) Section C

Three (3) alternative routes were studied for Section C (refer to **Attachment 1** in Appendix A, detailed location map indicating alternative routes on Google Earth satellite maps). Alternative 1 is a new road of 8.6 km in length with alignment aimed at minimizing resettlement. Alternative 2 applies better geometric curves and shorter route of 7.6 km in length. Alternative 3 uses the existing national road (8.7 km) without widening, which is treated as "zero option" under an environmental evaluation category. Alternative 3 cannot meet the traffic demand and may cause fatal traffic jam, especially at Sungguminasa.

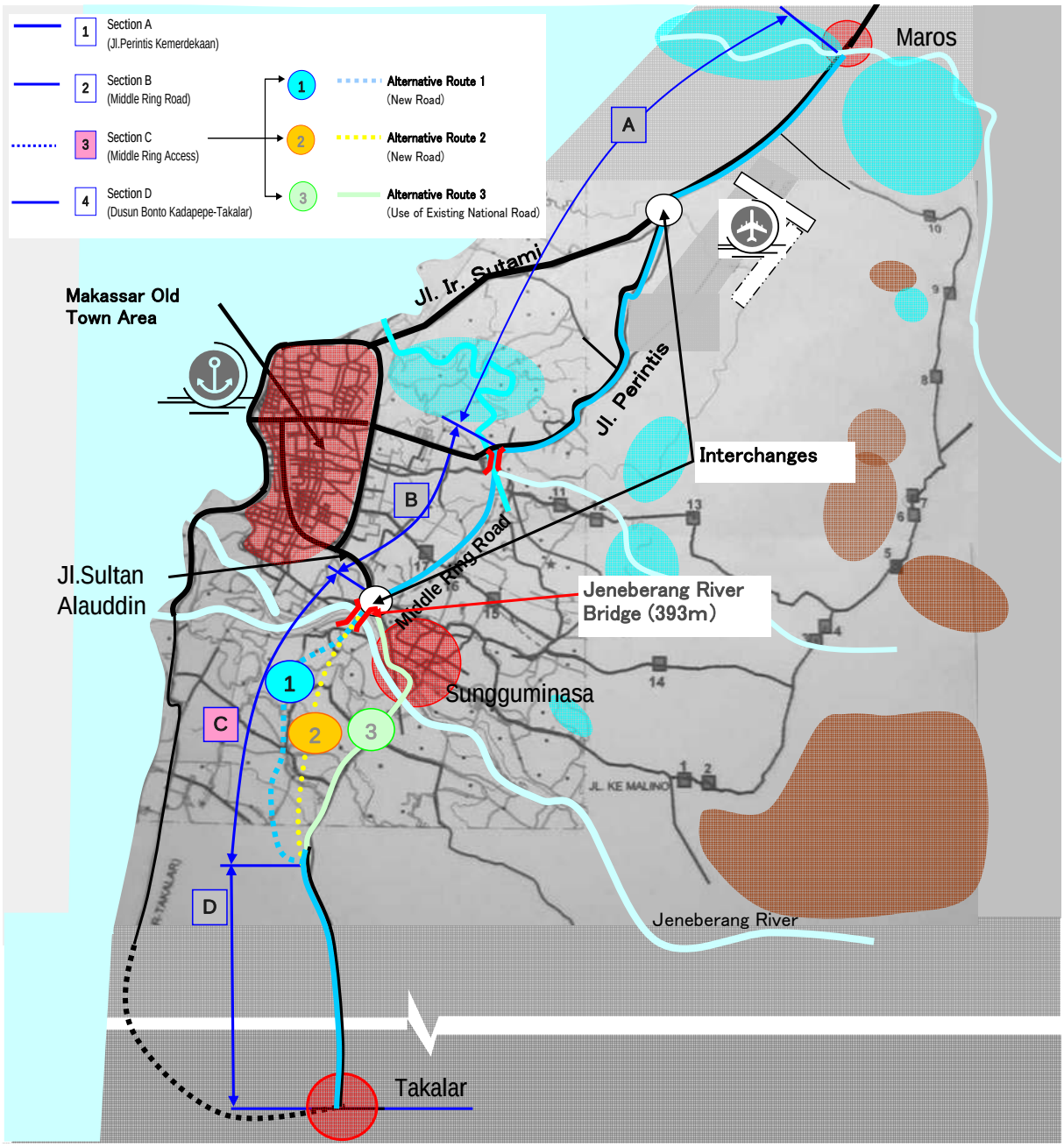


Figure 7.7.1 Proposed Route of Trans-Sulawesi Road Mamminasata Section

The multi matrix analysis was made for alternatives on the engineering, economic and environmental aspects. Results are indicated in **Table 7.7.1.**

(3) Evaluation of Alternatives

The alternatives, including zero option (without project case) at each section were evaluated on the engineering, economic and environmental aspects. Summary of Multi Criteria Analysis (MCA) is summarized in Ta**ble 7.7.1** (refer to Appendixes B and C as to details).

Table 7.7.1 Summary of Evaluation of Alternatives for Trans-Sulawesi Road by Section

Item	Section A		Section B		Section C			Section D	
	Alternative 1	Zero Option	Alternative 1	Zero Option	Alternative 1	Alternative 2	Zero Option	Alternative 1	Zero Option
	Widening road	Existing road	New route	Existing road	New route	New route	Existing road through Sungguminasa	Widening road	Existing road
	19.6km	19.6km	7.3km	11.5km	8.6km	7.6km	8.7km	22.5km	22.5km
Engineering Aspects	45.0	35.0	46.6	33.4	46.6	46.6	26.7	47.1	32.9
Economic & Financial Aspects	38.0	22.0	36.4	23.6	31.1	33.8	25.2	36.4	23.6
Environmental Aspects	25.0	35.0	25.5	34.5	27.5	24.7	37.9	26.4	33.6
Total	108.0	92.0	108.5	91.5	105.2	105.1	89.8	109.9	90.1
Recommendation	O		O		O			O	

Note: Refer to Appendix B and C as to detailed of the MCA

There is little difference between Alternatives 1 and 2 in the case of Section C. The JICA Study Team recommended Alternative 1 as the resettlement requirement was less compared with the latter.

7.7.2 Mamminasa Bypass

The Mamminasata Bypass is comprised three (3) sections: south, middle and north sections as shown in **Table 7.7.2**, **Figure 7.7.2** and **Attachments 2, 3 and 4** in Appendix A.

Table 7.7.2 Alternative Routes for Mamminasa Bypass by Section

Section	Alternatives		Length (km)	Administrative Status	Number of Lanes		Development Plan	ROW Width (m)	Bridge
					Existing	Plan			
South	1	Start point at 6 km south of Jeneberang River	16.8	Provincial *	-	4	New Road	40	Jeneberang River (L=154m)
	2	Start point at 12 km south of Jeneberang River	20.3	Provincial *	-	4	New Road	40	Jeneberang River (L=154m)
	3	Widening of existing Provincial road	9.1	Provincial	2 (width: 6-7m)	6	Widening	35	-
	4	Zero-option: Use of existing Provincial road**	9.1	Provincial	2 (width: 6-7m)	2 (width: 6-7m)	-	-	-
Middle	M1	New Road	19.7	Provincial *	-	4	New Road	40	-
	M2	Widening of existing Kabupaten road	26.4	Provincial *	2 (width: 4.5m)	4	Widening	30	-
	M3	Zero-option: Use of existing Kabupaten road**	27.4	Kabupaten	2 (width: 4.5m)	2 (width: 4.5m)	-	-	-
North	1	New Road (2-accesses)	12.6	Provincial *	-	4	New Road	40	Maros River (L=126m)
	2	New Road (1-access at south of Maros Town)	8.5	Provincial *	-	4	New Road	40	
	3	Widening of existing Kabupaten road	6.8	Provincial *	2 (width: 4.5m)	4	Widneing	30	-
	4	New Road (1-access at north of Maros Town)	11.8	Provincial *	-	4	New Road	40	Maros River (L=126m)
	5	Zero-option: Use of existing Kabupaten road**	6.8	Kabupaten	2 (width: 4.5m)	2 (width: 4.5m)	-	-	-

Notes: * Proposed administrative status
** zero option means without-project case

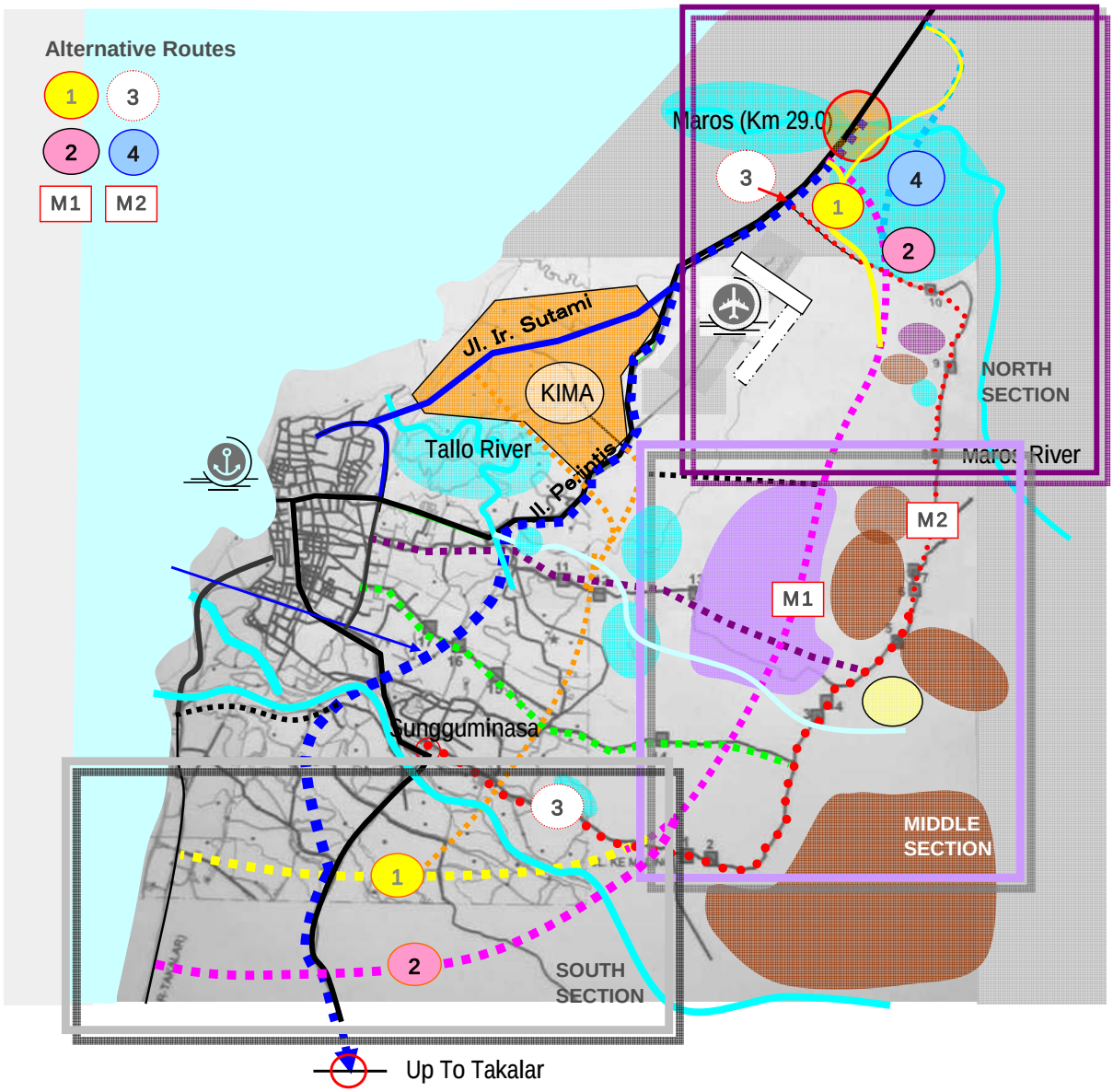


Figure 7.7.2 Alternative Routes for Mamminasa Bypass

(1) South Section

Three (3) alternative routes were studied for the south section as shown in **Figure 7.7.2**. Alternative 1 is a new road of 4.7 km in length. It starts at 6.6 km south of the Jeneberang River on Tj Bunga-Takalar road and crosses the national road at approximately 5.3 km south of the Sungguminasa Bridge. Alternative 2 is a ring road larger radius than Alternative 1. It starts at Galesong, 12 km south of the Jeneberang River on Tj Bunga-Takalar road, and crosses the national road near Limbung. Both routes will extend to the east and cross the Jeneberang River (refer to **Figure 7.7.3**).

Source: Drawn by the JICA Study Team on Google Earth Map

Figure 7.7.3 Overview of Alternative Route 1 Crossing Jeneberang River

The above three alternatives were evaluated on engineering, economic and environmental aspects (refer to Table 7.7.3 at the end of this sub section). The JICA Study Team recommended Alternative 1 as it is the most advantageous plan. This route will have both ring road and bypass functions. The ring road in Alternative 2 is far from Makassar City when considering the current urbanization border, though it will be required in the future when considering a port plan at Galesong. Alternative 3 requires many resettlements, especially at Sungguminasa and it does not constitute an appropriate ring for the Mamminasata urban area. As the 4-lane widening of the Malino road (provincial road) will start in 2007, this program should be continued to meet the traffic demand and connection to the Mamminasa Bypass.

In relation with the Mamminasa Bypass, the existing Tj Bunga – Takalar road (one of the radial roads in the Mamminasata Metropolitan Road Network System) should be improved to 7.0 m road to/form a ring road. This road will also be used as an alternative route of the national road for the traffic between Makassar and Takalar as it can directly access the GTC, CCC, Losari Beach and the old town center.

(2) Middle Section

Two alternatives were set up. One is the widening of the existing Kabupaten road and the other is the construction of a new road. The Mt. Moncongloe, Maros River, a new runway for Hasanuddin Airport and Kostrad Kariango (army quarters) are major control points (refer to **Attachment 3** in **Appendix A**). Mt. Kariango (elevation 115 m) behind Kostrad Kariango was also taken into account in route selection. There is a high land (elevation 20-40m) of approximately 4,000 ha at the Makassar side of Mt. Moncongloe and this area will be appropriate for a new town development as suggested in the Mamminasata Plan (refer to Section 4.5). Alternative 1 passes through this area while avoiding the control points. Alternative 2 is the widening of the existing Kabupaten road (width 4.5 m) to a 4-lane road. Socio-environmental impact is negative for Alternative 2 as it requires a lot of resettlements and separates regional communities facing the existing road. Alternative 3 is a zero-option, i.e. the use of the existing Kabupaten road without widening.

The above three alternatives were evaluated on engineering, economic and environmental aspects (refer to Table 7.7.3 at the end of this subsection). The JICA Study Team recommended Alternative 1 as it was the most advantageous plan.

(3) North Section

Four alternatives were set up for the north section near Maros Town. The major control points are a flood retarding basin, a crossing point (new bridge location) of the Maros River, and connection points to the national road (refer to **Attachment 4** in **Appendix A**).

Alternative 1 is the route to avoid the planned flood retarding basin. It turns toward the existing national road after crossing the Kabpaten road and passes behind the Bupati's office (Office of Regency Governor). Two accesses will be provided for the national road, one before the new Maros town and the other approximately 1.3 km after the Maros town for bypassing this town. This route also crosses the national road going to the east coast (Watampone / Bajoe Port) and through traffic will use this road as a bypass.

Alternative 2 passes through the planned flood retarding basin and joins the national road before the Maros town. Alternative 4 also passes through the flood retarding basin but joins the national road after the Maros town by bypassing it. Alternative 3 is the widening of the existing Kabupaten road (width 4.5 m) to a 4-lane road and requires a lot of resettlements. Alternative 5 is a zero-option, i.e. the use of the existing Kabupaten road without widening. The JICA Study Team recommended Alternative 1 as it is the most advantageous plan.

(4) Evaluation of Alternatives

The alternatives, including zero option (without project case) at each section were evaluated on the engineering, economic and environmental aspects. Summary of Multi Criteria Analysis (MCA) is summarized in Ta**ble 7.7.3** (refer to Appendixes B and C as to details).

Table 7.7.3 Summary of Evaluation of Alternatives for Mamminasa Bypass by Section

Item	South Section				Middle Section			North Section				
	Alternative 1	Alternative 2	Alternative 3	Zero Option	Alternative 1	Alternative 2	Zero Option	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Zero Option
	New route	New route	Widening existing	Existing road	New route	Widening road	Exsisting road	New route	New route	Widening road	New route	Existing road
	16.8km	20.3km	9.1km	9.1km	19.7km	26.4km	27.4km	12.6km	8.5km	6.8km	11.8km	6.8km
Engineering Aspects	50.8	43.0	34.1	32.1	57.2	35.3	27.6	51.1	40.2	36.9	43.6	28.2
Economic & Financial Aspects	40.8	23.8	32.2	23.2	40.1	31.3	18.6	34.6	30.2	33.9	26.4	24.9
Environmental Aspects	31.6	25.5	23.8	39.1	30.5	21.9	37.5	31.0	29.8	24.1	28.8	36.3
Total	123.2	92.4	90.0	94.4	127.8	88.5	83.7	116.7	100.2	95.0	98.7	89.5
Recommendation	O				O			O				

Note: Refer to Appendix B and C as to detailed of the MCA

7.7.3 Hertasning Road

Only D is in a planning stage and subjected to the F/S. No alternative routes were studied as the project planning is almost completed. However, the improvement plan was compared with zero-option (without project case) as shown in **Table 7.7.4** (refer to Appendixes B and C as to details).

Table 7.7.4 Summary of Evaluation of Alternatives for Hertasning Road

Item	Section D	
	Alternative 1 Widening road 4.9km	Zero Option Exsisting road 4.9km
Engineering Aspects	51.7	28.3
Economic & Financial Aspects	35.0	25.0
Environmental Aspects	26.0	34.0
Total	112.8	87.2
Recommendation	O	

Note: Refer to Appendix B and C as to detailed of the MCA

7.7.4 Abdullah Daeng Sirua Road

Abdullah Daeng Sirua Road (17.8 km in total length) is divided into six (6) sections (refer to **Attachment 5 in Appendix A**). Alternative plans of this road are as summarized in **Table 7.7.**5 and described in the following sub-sections.

Table 7.7.5 Alternative Plans for Abdullah Sirua Road by Section

Section	Section Name	Alternative		Length (km)	Number of Lanes		Development Plan	ROW Width (m)	ROW Acquisition Status
					Existing	Plan			
A	Jl.Pettarani - Canal Penampu	1	Use of Existing Road with traffic control (one-way operation)	1.4	2	2	-	-	-
		2	Widening of Existing Road to 4 lanes		2	4	-	27	Not Yet
		3	Zero-option (no improvement)		2	2	-	-	-
B	Canal Penampu - Jl.Poros	1*	Construction of new 2 lanes at the opposite side of PDAM Canal	2.5	2	4	Under Construction	15	On-going
C	Jl.Antang Raya	1	Construction of new 2 lanes at the opposite side of PDAM Canal	0.8	2	4	Additional 2 lane construction (New)	15	Not Yet
		2	Zero-option (no improvement)	-	2	2	-	-	-
D	Jl.Antang Raya - Bts.Makassar/ Gowa (Tallo River)	1	New road along/on swamp and rice field	4.8	-	4	New 4 lanes	34	Not Yet
		2	A combination of a new 2 lanes at the opposite side of PDAM Canal and existing road widening		2	4	Additional 2 lanes (New)	15	Not Yet
		3	New road mostly on the PDAM		2	4	Additional 2/4 lane construction (New)	25	Not Yet
		4	Zero-option (no improvement)	-	2	2	-	-	-
E	Bts.Makassar/ Gowa (Tallo River) - Mangempang	1	Widening of Existing Road to 4 lanes	1.2	2	4	Additional 2 lanes (widneing)	40	Not Yet
		2	Zero-option (no improvement)	-	2	2	-	-	-
F	Mangempang - Moncongloe (End)	1	New road alignment	7.1	-	4	New Road	34	Not Yet
		2	Widening of Existing Road to 4 lanes		2	4	Additional 2 lanes (widneing)	25	Not Yet
		3	Zero-option (no improvement)	-	2	2	-	-	-

Note: * No zero options as this section is under construction.

(1) Section A (Jl.Pettarani - Canal Penampu)

Section A is 1.35 km long and starts from the A.P.Pettarani Road junction to the drainage canal (Canal Penampu). Alternative 1 is use of the existing 2-lane road with one way traffic control. Alternative 2 is widening of the existing 2-lane road to 4-lane road with a median.

Shops and houses are densely located on both sides of the street as shown in **Figure 7.7.4**. It is difficult to widen the existing 2 lanes to 4 lanes without applying a land adjustment method introduced in Section 7.12, which is not possible in the short-middle term, to secure the right-of-way. Hence, the Study Team recommended Alternative 1.

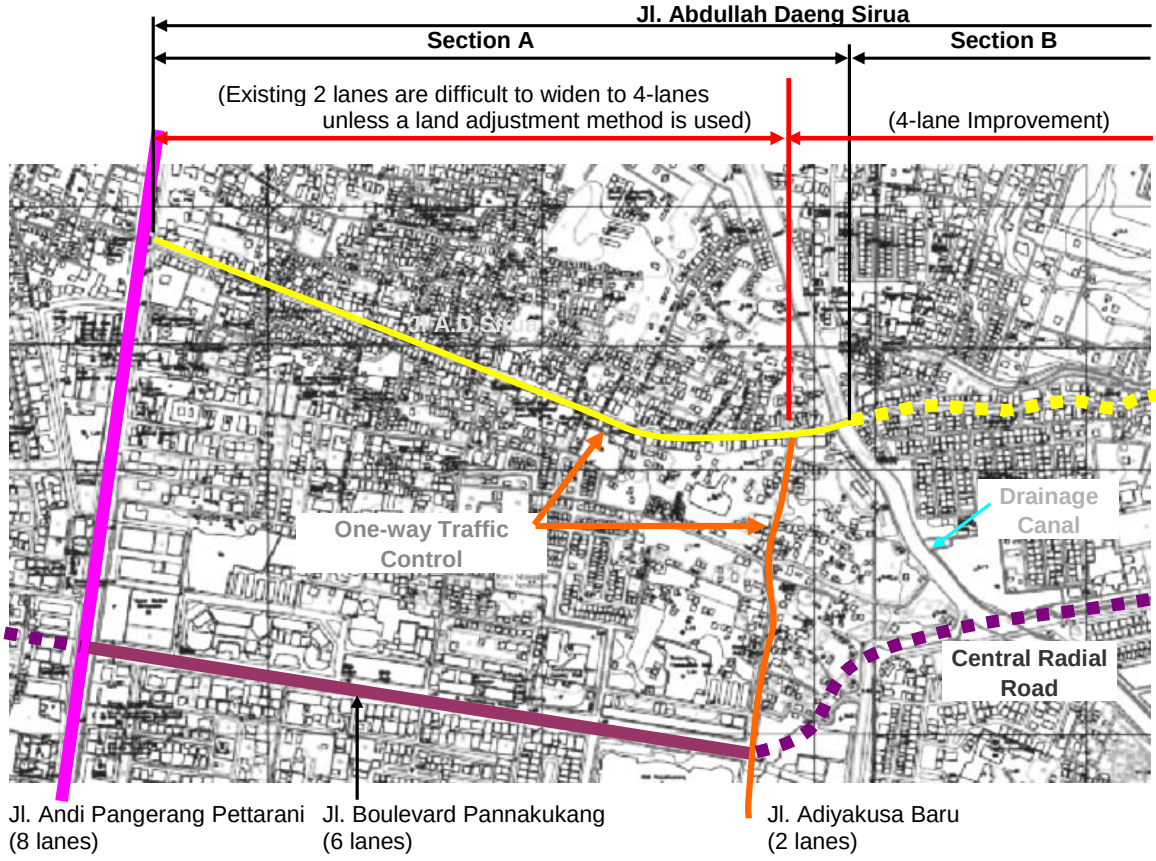
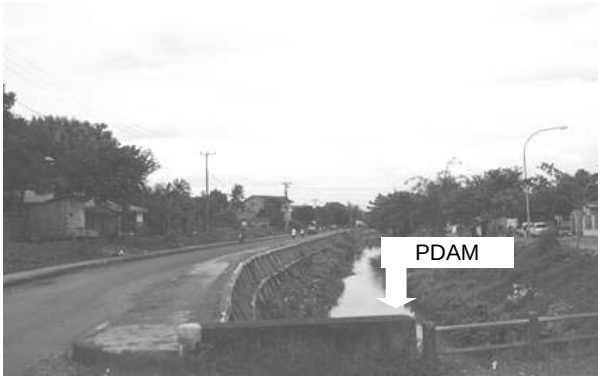


Figure 7.7.4 Road Improvement Plan for Section A

(2) Section B (Penampu Canal– Poros Road)

The existing road in Section B (2.5 km in length) is located on the south side of the PDAM canal (water supply canal from the Maros River). A new 2-lane road is under construction by Makassar City on the opposite side of the PDAM canal (see following photos).

Abdullah Daeng Sirua Road (PDAM Inspection Road)



New 2-lane road at the opposite of PDAM Canal

Figure 7.7.5 On-going Road Improvement for Section B

(3) Section C (Antang Raya Road)

Section C is a short section of 0.8 km long. The proposed road is constructed by upgrading the Antang Raya Road and PDAM inspection road located opposite the PDAM canal (water supply canal). These existing roads will be improved to be a 4-lane road. The proposed road crosses the Middle Ring Road at an at-grade intersection.

(4) Section D (Antang Raya Road – Makassar City /Kab.Maros Boarder)

Three alternative routes were studied for Section D (length 4.8 km) as indicated in **Figure 7.7.6** and **Attachment 5 in Appendix A**. Alternative 1 is a new road through a swamp and paddy field with an alignment aimed at minimizing resettlement. The planned road diverts to the left (Tallo River side) and runs along the river for about 2 km. Then, it turns to the right and meets the existing Kabupaten road before the Tallo River Bridge.

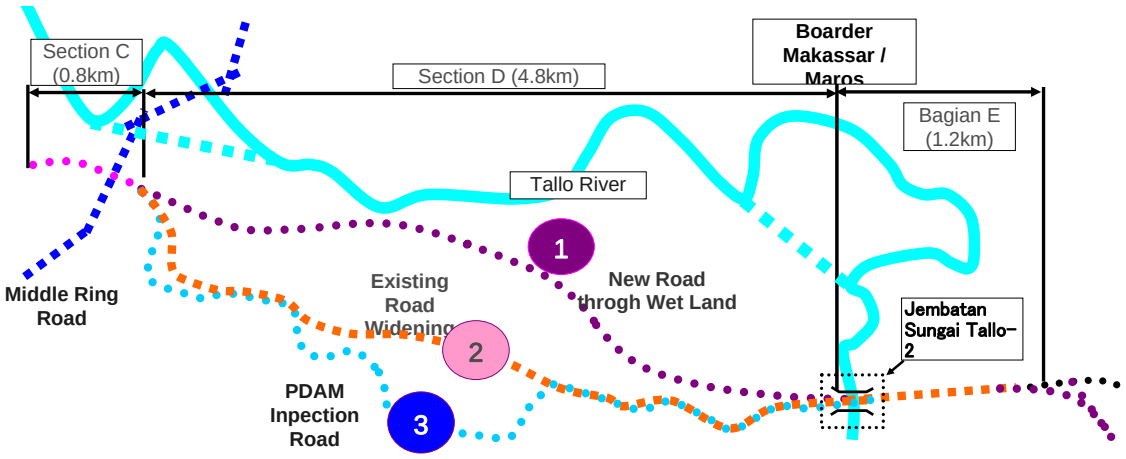


Figure 7.7.6 Alternative Road Improvement Plans for Section D

Alternative 2 is the construction of a 2-lane road partly along/on the PDAM canal[1] and partly widening existing road. There are two methods: One is to construct a new road opposite the PDAM canal (same method currently applied for Section B). The other is to construct a new road over the PDAM canal replacing it with concrete lined steel pipes (Dia.1200mm x 2 pieces) as illustrated in **Figure 7.7.7**. The latter will change the current natural condition while it is able to avoid resettlement. The Study Team recommends keeping the clean water frontage environment as much as possible.

An evaluation was made for the 3 alternative routes and the JICA Study Team recommended Alternative 2 though all alternatives are almost same in the evaluation points (refer to Table 7.7.6 as to an overall evaluation on engineering, economic and environmental aspects at the end of this subsection). Alternative 1 is very expensive as it requires weak soil countermeasures and bridges to pass swamps.

New Road at the side of PDAM Canal **New Road over the PDAM Canal**

Figure 7.7.7 Alternative Plans of New Road Construction for Section D

Alternative 3 is the new road construction on the PDAM for most of the section. Therefore, some part of the geometric alignment is poor as it will follow the PDAM alignment.

Alternative 4 is the use of the existing road without widening, which is treated as "zero option" under an environmental evaluation category.

(5) Section E (Makassar City/Kab.Maros Boarder– Mangempang)

Section E is a short section of 1.2 km long passing through paddy field and wetland. The proposed road improvement plan is to widen the existing 4.5m Kabupaten road to a 4-lane road. The road will be constructed on 3-4 m high embankments to avoid being submerged in water during floods. A new bridge over the Tallo River (see following photographs) will be constructed at the start point of this section (**Figure 7.7.8**).

[1] PDAM Canal: Water supply canal from the Maros Rover. ROW of PDM is 15 m at each side.

Figure 7.7.8 Tallo River at the Start Point of Section E

(6) Section F (Mangempang - Moncongloe)

Section F (7.1 km) is the end section of Abdullah Daeng Sirua Road. The road will be connected to a planned satellite town as suggested in Mamminasata Spatial Plan. The road meets the Mamminasa Bypass at the middle of this section. This road is a direct access to KIWA (New Industrial Area of Kabupaten Gowa) and Regional Final Disposal Site (TPA).

Two alternative routes were studied for Section F. Alternative 1 is the construction of a new road with the alignment aimed at minimizing resettlement and connected to KIWA directly. Alternative 2 is the widening of the existing Kabupaten road. Alternative 3 is the use of the existing Kabupaten road without widening (zero option). An evaluation was made for 2 alternative routes and the JICA Study Team wishes to recommend Alternative 1 as it is the most desirable plan on overall evaluation (engineering, economic and environmental aspects).

(7) Evaluation of Alternatives

The alternatives, including zero option (without project case) at each section were evaluated on the engineering, economic and environmental aspects. Summary of Multi Criteria Analysis (MCA) is summarized in Ta**ble 7.7.6** (refer to Appendixes B and C as to details).

Table 7.7.6 Summary of Evaluation of Alternatives for Abdullah Daeng Sirua Road by Section

Item	Section A			Section C		Section D			
	Alternative 1	Alternative 2	Zero Option	Alternative 1	Zero Option	Alternative 1	Alternative 2	Alternative 3	Zero Option
	Wth traffic control	Widening road	Existing road	Widening road	Existing road	New route at Swamps	New road on PDAM and Existing Road	Widening Existing road	Existing road
	1.3km	1.3km	1.3km	0.8km	0.8km	4.9km	4.8km	4.8km	4.8km
Engineering Aspects	48.0	53.0	19.1	57.9	22.1	46.2	48.3	44.6	20.9
Economic & Financial Aspects	31.5	33.0	25.5	27.0	33.0	26.4	34.3	36.7	22.6
Environmental Aspects	30.7	27.6	31.7	32.1	27.9	34.7	30.6	25.5	29.2
Total	110.2	113.6	76.2	117.0	83.0	107.3	113.1	106.8	72.8
Recommendation	O			O			O		

Item	Section E		Section F		
	Alternative 1	Zero Option	Alternative 1	Alternative 2	Zero Option
	Widening road	Existing road	New route	Widening road	Existing road
	1.2km	1.2km	7.1km	7.3km	7.3km
Engineering Aspects	52.1	27.9	58.0	44.0	18.0
Economic & Financial Aspects	32.5	27.5	38.3	28.6	23.2
Environmental Aspects	30.8	29.2	34.0	25.6	30.4
Total	115.4	84.6	130.3	98.2	71.5
Recommendation	O		O		

Note: Refer to Appendix B and C as to detailed of the MCA

7.8 Intersection Plan

7.8.1 General

Intersections are complex and severe individual locations because of many vehicular movements (through, left-turn and right-turn from each approach road) and pedestrian crossings. On the other hand, the project cost and more resettlement will be required if high-grade and over specification interchange types are applied. The study of intersection types is to control or manage the conflicts in a manner that ensures safety and efficient movement of both vehicles and pedestrians.

7.8.2 Applicable Design Standards

Design standards used are "Standard Specifications for Geometric Design of Urban Roads, March 1992", "Guideline for Geometric Design of Inter-City Roads, September 1997" and "Indonesian Highway Capacity Manual (HCM) 1997" published by DGH/MPW. The items which are not included in the above standards were referred to the Road Geometric Design Standards in Japan and the Policy on Geometric Design of Highways and Streets, AASHTO.

7.8.3 Design Traffic Volume

Intersection types are planned based on the peak hour traffic volume after 10 years from the opening of the project roads, in accordance with Indonesia road design standards. The opening of service for the F/S routes in this study is assumed to be in 2010, and the estimated future traffic volume in 2020 is adopted for the peak hour traffic volumes for the study.

7.8.4 Selection of Intersection Types

(1) Standard for Selection of Intersection Types

Table 7.8.1 shows the proposed intersection type selection criteria. Selection of intersection types is made based on the number of lanes of crossroads. The crossing with grade separation should be provided for Type I and Type II crossings with partial access control and crossing more than 4 lanes according to the Indonesian road design standards. However, grade separation requires a flyover bridge and it is very costly. Therefore, the traffic signal control type at-grade intersection was given priority as much as it can meet the traffic demand and clear traffic safety.

Table 7.8.1 Selection Criteria for Interchange, Grade Separation, and At-grade Intersection

Main Road / Crossroad	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 - Grade separations.
2 - 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 - Stop controlled intersection, or signal controlled intersection.

Based on traffic volume, existing site condition, land use plan and economic efficiency, appropriate intersection types are selected from the following lists:

* Full control Interchange
* Grade separation with access
* Grade separation without access
* At-grade intersection with signal control
* Roundabout without signal control
* At-grade intersection without signal control.

(2) Capacity of Intersection Types

At-grade intersections involve two or more different vehicular movements which intersect each other at the same road level. Their capacity cannot be obtained as simply as that for a usual road section. Traffic volumes that can pass through each intersection type do not only depend on geometry, width of approaches, and constructive and physical conditions but also on the operational control of the inflow and outflow of traffic movements from various directions. **Table 7.8.2** shows the equations for estimating capacity of each intersection type.

Table 7.8.2 Equations for Estimating Capacity of Intersection Types

Intersection Type	Equation of Capacity	Factors
At-grade Intersection (No Control)	$q_{max} = \frac{Q \times e^{-\mu \cdot t1}}{1 - e^{-\mu \cdot t2}}$	q_{max} : maximum volume of cross road vehicles that can pass (veh/h) Q : given volume of major road (veh/h) (both direction) μ : Q/3600 (veh/sec.) t1 : the minimum time gap necessary in a major traffic stream to allow crossing or merging by cross road vehicle (sec.) t2 : average headway between cross road vehicles which cross or merge as platoons
Roundabout (No control)	$q = K \times \left(\sum W + \sqrt{A} \right)$	q : total inflow volume (pcu/h) K : capacity factor (pcu/h・m) ΣW : sum of road widths of access roads (m) A : sum of additional areas due to widened access road approaches (m^2)
At-grade Intersection (Signal control)	$\lambda \leq \frac{C - L}{C}$	λ : saturation degree of intersection C : signal cycle length (sec) L : lost time in signal cycle (sec)

(3) Evaluation Criteria

Alternative intersection plans are made for major intersection and evaluated on the technical, economical and environmental aspects based on the following general evaluation criteria.

Table 7.8.3 General Evaluation Criteria for Intersection Type Selection

Evaluation Items			Full Control Interchange	Grade Separation with Access	At-grade Intersection with Signal Control	Roundabout without Signal Control	At-grade Intersection without Signal Control
Technical Aspects	Traffic Capacity	Low Volume Traffic (ADT<40000)	P	P	G	F	B
		Medium Volume Traffic (ADT4000-60000)	G	F	F	P	B
		High Volume Traffic (ADT>60000)	VG	G	F	P	B
	Stage Application		B	P	F	VG	F
	Safety		VG	G	F	P	B
	Operation and Maintenance of Facilities		VG	G	F	G	G
	Others like multiple accesses		-	G	F	F	B
Economical Aspect	Construction Cost		B	P	G	G	VG
Environmental Aspect	Resettlement		B	P	G	F	G
	Pollution		VG	G	P	F	F

Note: VG:Very Good, G:Good, F:Fair, P:Poor, B:Bad
Source:JICA Study Team