CHAPTER 4

ON-GOING AND PLANNED TRANSPORT DEVELOPMENT PROJECTS

CHAPTER 4 ON- GOING AND PLANNED TRANSPORT DEVELOPMENT PROJECTS

4.1 MAIN ACTIVITIES OF TRANSPORT AND ROAD DEVELOPMENT

4.1.1 Main Activities of Transport Development in 2008 and 2009

As presented in Chapter 5, the Approved Budget 2008 and 2009, approved by the Southern Sudan Legislative Assembly on 20th December 2007 and 23rd January 2009 respectively, have established the policy and identified the main activities for each sector including the transport sector to be pursued in 2008 and 2009, as shown in Tables 4.1.1-1 and 4.1.1-2.

The program area of road transport encompasses the following main activities.

- Policy, Regulation and Strategy Development
- Capacity Building
- Feasibility Study, Technical Assessment and Survey
- Maintenance
- De-Mining, Rehabilitation and Construction
- Installation of Inspection Facility

The main activities for air, river and rail transport comprise:

- Upgrading of Juba Airport and Five State Airstrips
- Construction of Shipyard (in 2008) and Purchase of Two River Barges (in 2009)
- Feasibility Study for Rail Transport (in 2008)

4.1.2 On-Going and Proposed Road Projects

Table 4.1.2-1 shows the summary of road contracts under the Ministry of Transport and Roads as of 2008. The number of existing contracts, proposed projects and donor projects are 32, 7 and 7 respectively.

Among the existing contracts, there are four projects in Juba, namely; Juba Urban Roads LOT 1 (30km, contracted in 2006 initially and 2009 renewed), LOT 2 (35km, contracted in 2006 initially and 2009 renewed), Juba Ring Roads (20km, contracted in 2007) and Presidential Residence Roads (3km, contracted in October 2008 and completed in April 2009).

Among the above projects, the status of Juba Urban Roads (Emergency Road Rehabilitation Project) LOT 1 and LOT 2 and Presidential Residence Roads Project is given in Chapter 4.3.2 below.

Table 4.1.1-1 Main Activities of Transport Development in 2008 Budget

Unit: Million SDG

Program Area	Main Activities	Description of 2008 Activities.	Cost
Road Transport Development	1. Policy, Regulation & Strategy Development	• TA & Policy Studies (through MDTF). • IEC Strategy (through MDTF)	2.7 M
	2. Capacity Building	• Baseline Survey and M&E. • PMT Support Services	3.3 M
	3. Feasibility Studies, Technical Assessment and Survey	• Design of Kaya - Juba and Nadapal -Juba to Bitumen Standard • Rural Road Study of 7000KM (MDTF).	6.5 M
	4. De-mining, Maintenance, Rehabilitation and Construction	• Aweil-Mariam-Wau and NBEG State Roads.	60.0 M
		Existing GOSS Commitments • Lainya - Jambo (13.5M) • WFP Contract for Road Maintenance and De-mining (66.0M) • Kajo Keji-Juba, Faraksika-Chukudum, Wau-Kwajock-Abyei, Narus-Buma- Raad, Juba Bridge Delaunching and Launching (1.9M) **MDTF Commitment**. • Construction of Maridi-Yambio Road (UNOPS) (8.9M)	90.3 M
		GOSS New Commitments • Emergency Road Maintenance and Bridge Repairs (4.0 M) • Mvolo-AluakAluak-Akot Road (4.5M)	8.5 M
	5. Plants and Equipment	**GOSS New Commitment** • Installation of Inspection Facility	3.6M
Air, River and Rail Transport Development	1. Air Transport	• Juba Airport • 6-Airstrips	46.7M
	2. River Transport	• Juba Port	9.5M
	3. Rail Transport	• Feasibility Study	1.4M

Source: Approved Budget 2008

Table 4.1.1-2 Main Activities of Transport Development in 2009 Budget

Unit: Million SDG

Program Area	Main Activities	Description of 2009 Activities.	Cost
Road Transport Development	1. Policy, Regulation, Strategy Development &Capacity Building	• TA & Policy Studies and Implementation (through MDTF) • PMT support service (through MDTF) • Capacity building of the MTR staff	2.0 M
	2. Feasibility Studies, Technical Assessments and Surveys	• Supervision of construction Nimule-Juba Road	3.1 M
	3. Maintenance of Roads	• Maintenance of Yei-Juba, Rumbek-Tonj, Kapoeta-Juba and Juba-Bor Road by WFP	17.1 M
	4. De-mining, Rehabilitation and Construction of Roads	**Upgrade to all-weather gravel standard** • Mvolo-Aluakaluak Road (10.0 M) • Wau-Warrap Road (10.0 M) • Aweil-Mariam Road (90.0 M) • Aweil-Wau Road (23.0 M) • Aweil-Madhol-Abyei-Ameth-Mayen-Abun-Gogrial Road (53.0 M) • Juba-Lobonok-Moli Road (10.0 M) • Hiyala-Ikotos-Tseretenya-Madiope Road (6.0 M) • Wau-Raja, Juba-Terekeka-Ramchiel-Yirol-Leer, Rumbek-Mayandit, and Tambura-Wau Roads (107.0 M) • Faraksika-Chukudum, KajoKeji-Juba, and Narus-Boma Roads (by WFP) • Ayod-Waat-Akobo Road (10.0 M) • Bor-Pibor-Pochalla Road (10.0 M) • Buma-Raad Road (3.0 M) **Upgrade to bitumen standard** • Juba Urban Roads LOT-1 (10.0 M) • Juba Urban Roads LOT-2 (10.0 M)	352.6 M
	5. Installation of Inspection Facility	• Purchase and installation of inspection equipment, commissioning and training staff	2.0M
Air, River and Rail Transport Development	1.Air Transport	• Juba Airport apron and car park • 5-Airstrips	18.6 M
	2. River Transport	• Purchase of 2 river barges • Construction of fence around Juba Port	11.4 M
	3. Rail Transport	(none)	-

Source: Approved Budget 2009

Table 4.1.2-1 Summary of Road Contracts under MTR

	Road		Funding	Contractor	Work	Contract Date
Existing Contracts						
1	Yei - Juba	SS	MoTR	WFP	Maintenance	
2	Rumbek - Tonj		MoTR	WFP	Maintenance	
3	Kapoeta - Juba		MoTR	WFP	Maintenance	
4	Juba - Bor		MoTR	WFP	Maintenance	2007
5	Faraksika - Chukudum		MoTR	WFP	Construction	
6	Kajo-Keji - Juba		MoTR	WFP	Construction	
7	Narus-Boma		MoTR	WFP	Construction	
8	Lanya-Jombo	C	MoTR	Payli	Construction	2007
9	Mvolo - AluakAluak	SS	MoTR	Payil	Construction	2008
10	Aweil-Miriam	SS	MoTR	Eyat	Construction	2006
11	Aweil-Wau	SS	MoTR	Eyat	Construction	2007
12	Aweil-Madhol-Abyei- Amenth-Mayen-Abun-Gogrial	SS	MoTR	Eyat	Construction	2008
13	Juba-Lobonok-Moli	SS	MoTR	Kit	Construction	2008
14	Buma-Raad	SS	MoTR	Boma-Raad Rd Project	Construction	2008
15	Eastern Equatoria: Hiyala-Ikotos-Tseretanya-Madiope	SS	MoTR	MacDowel	Construction	2008
16	Western Equatoria: Yambio Town Roads	SS	MoTR	?	Maintenance	2008
17	Juba Urban Lot 2	MP	MoTR	CEC	Construction	2006
18	Juba Urban Lot 1	SS	MoTR	Eyat	Construction	2008
19	Warrap-Gogrial	SS	MoTR	Wun Koch	Construction	2008
20	Bor-Pibor-Pochalla	SS	MoTR	Gabicon	Construction	2008
21	Wau-Warrap	SS	MoTR	Africa Gondei	Construction	2008
22	Wau - Luonyaker - Lietnhom	SS	MoTR	*Still under contracting*	Construction	2008
23	Wau - Raja	SS	MoTR	Eyat	Construction	2008
24	Loming-Imehejek-Lafon-Torit	SS	MoTR	*Still under contracting*	Construction	2008
25	Malakal-Mabior-Bor-Juba	SS	MoTR	Poly Tech	Feasiblity	2008
26	Juba-Mundri-Rumbek-Wau-Raja Upgrading	SS	MoTR	CGGC	Feasiblity	2008
27	Faraksika-Maridi-Yambio		MDTF 1	UNOPS	Construction	2007
28	Juba-Mundri		MDTF 1	WFP	Construction	2006
29	Wau-Kwajok-Abyei		MDTF 1	WFP	Construction	2006
30	Kaya-Yei-Juba		MDTF 1		Feasiblity	2007
31	Nadapal-Juba		MDTF 1		Feasiblity	2007
32	Rural Roads Study (7000km)		MDTF 1		Feasiblity	2008
	Total					
Proposed						
1	Kaya-Yei-Juba		MDTF 2		Construction	2009
2	500km Rural Roads		MDTF 2		Construction	2009
3	Nadapal-Juba		MDTF 2		Construction	2009
4	Malakal-Nasser-Jikou		MoTR		Construction	2009
5	Tonj-Thiet-Makuac-Maper		MoTR		Construction	2009
6	Wau-Raja		MoTR		Construction	2009
7	Maintenance		MoTR		Maintenance	2009
	Total					
Donors						
1	Juba-Nimule		USAID	Louis Berger	Construction	
2	Yambio - Tambura		USAID	UNOPS	Construction	
3	Tambura - Wau		USAID/EC	UNOPS	Construction	
4	Yei-Faraksika		Japan	WFP	Construction	
5	Faraksika-Rumbek		Japan	WFP	Construction	
6	Rumbek-Yirol		Japan	WFP	Construction	
7	Wau-Wunrock		DfID	WFP	Construction	
Projects in Juba						
1	Juba Urban Roads LOT 1 (30 Km)		MTR	EYAT	Construction	2008
2	Juba Urban Roads LOT 2 (35 KM)		MTR	CEC	Construction	2006
3	Presidential Residence Roads (3 Km)		MTR	ABM	Construction	2009
4	Juba Ring Roads (20 Km dual carriageway)		Min. of Transport - GoNU	SSEC	Construction	2007

4.2 DONOR DEVELOPMENT PROGRAMS AND PROJECTS

4.2.1 Development Programs

(1) JAM Report

The Sudan Joint Assessment (JAM) was jointly executed in 2005 by the World Bank (WB) and the United Nations (UN) with aim to identify the reconstruction and development requirements for the consolidation of peace in Southern Sudan.

The programs of the Government of Southern Sudan were proposed focusing on the following key elements as set in the framework for war-to-peace transition:

- Developing physical infrastructure
- Prioritizing agriculture, and promoting private sector developments
- Restoring peace and harmony (including through access to basic service)
- Re-generating social capital
- Developing institutional infrastructure for better governance

(2) World Bank

The Multi Donor Trust Fund (MDTF) for Southern Sudan was commenced in 2006 in the framework of the Sudan Emergency Transport and Infrastructure Development Project (SETIDP), and is administered by the World Bank, primarily focusing on the following areas:

- Government capacity building
- Aid management
- Rule of law
- Health
- Education
- Water and sanitation
- Infrastructure development including transport , and
- Census

Major projects under MDTF include;

- Sudan Emergency Transport and Infrastructure Development
  (Transport and Urban Development)
- Multi Donor Education Rehabilitation Project
  (Education)
- Rapid Impact Emergency Project
  (Health ,Education ,Public Services)
- South Sudan Umbrella Program for Health System Development
  (Health)

(3) UN Work Plan

According to the "United Nations and Partners 2006 Work Plan for Sudan, United Nations (UN) November 2005", humanitarian and recovery program prepared by the United Nations and Partners is to focus mainly on the followings:

- Support for safe, voluntary and dignified cultural reintegration of IDPs and refugees
- Humanitarian assistance in Darfur and other areas of conflict
- Responding to food insecurity and development
- Assistance to recovery and development in Southern Sudan, Abyei, Blue Nile and Southern Kordofan.

(4) UNDP

The United Nations Development Program (UNDP) is implementing the following projects:

- Programs by Trust Fund Management
  - Sudan Post-conflict Community Based Recovery and Rehabilitation Program (Five year implementation period)
  - Prevention and Control of Tuberculosis as well as Control of Malaria and Prevention of HIV/AIDS
- Post Conflict Community based Recovery and Rehabilitation Program (Boreholes for water supply to be executed).

(5) WFP

The United Nations World Food Program (WFP) operates food assistance in Sudan, including food assistance to Eritrean refugees in Sudan, and improving food security in Sudan.

Other than food assistance, WFP implements special operations to rescue the transport routes for food and commodities. Emergency Road Repair and Mine Clearance of Key Transport Routes in Sudan in support of the Emergency Operation Programs are also being carried out.

Figure 4.2.1-1 prepared by UNOPS shows the location of projects being implemented by UNOPS, WFP and other organizations.

4.2.2 Infrastructure Development Projects for 2007-2010

The Donor Projects 2007-2010 compiled from the Draft Budget Sector Plan 2008-2010, December 2007, summarizes the donor projects. Among those, donor infrastructure sector projects are shown in Table 4.2.2-1.

The document is not a comprehensive list of all donor projects in operation in Southern Sudan in 2008 since this was prepared on reported information.

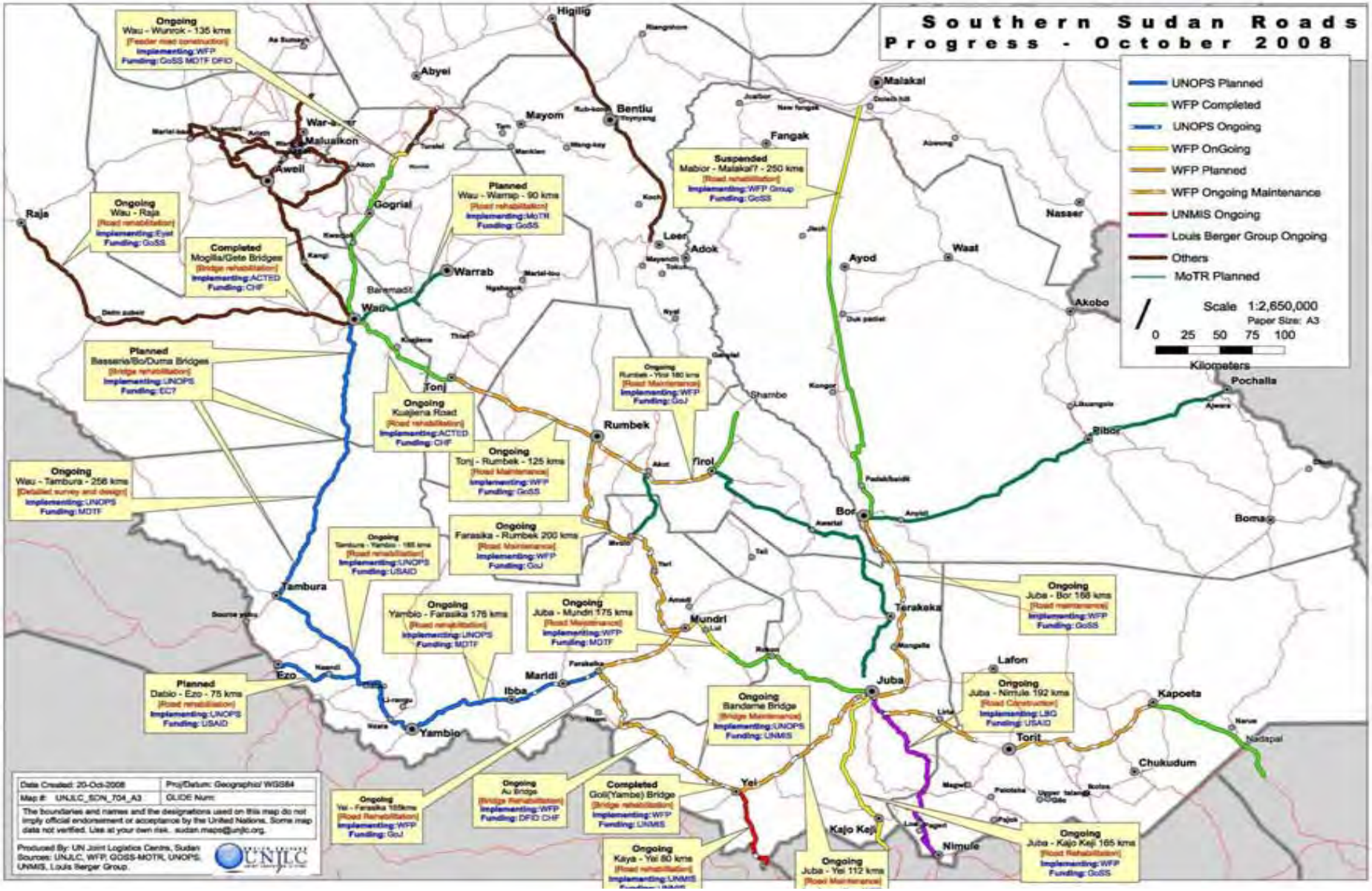


Figure 4.2.1-1 Road Projects Progress

Table 4.2.2-1 Summary of Donor Infrastructure Development Projects

PROJECT	DONOR(S)	COUNTER -PART MINISTRY	2007 ($)	2008 ($)	2009 ($)	2010 ($)
Juba Urban Transport Infrastructure and Capacity Development Study	Japan (JICA)	MTR				
Juba Urban Water Supply and Capacity Development Study	Japan (JICA)	MHPPE				
Infrastructure Services Project	USAID					
Humanitarian Assistance Projects	USAID					
Support to States (Infrastructure)	UK Netherlands, UNDP ,Others	MHPPE	300,000	500,000	500,000	
Rainwater Harvesting	USAID (OFDA)	MWRI	504,740			
SETIDP Emergency Transport & Infrastructure Project	MDTF	MHPPE	6,841,373	6,646,823	20,000,000	40,000,000
Technical Assistance	UNHabitat	MHPPE	300,000			
Water Sector Capacity Support	UK	MWRI	809,753	809,753		
Rapid Impact Emergency Project (Extension) Public Works	MDTF	MHPPE	8,760,000			
Rapid Impact Emergency Project (Extension) Commission	MDTF	MHPPE		5,500,000		

Source: Donor Projects 2007-2010

4.3 PROJECTS RELATED TO JUBA URBAN TRANSPORT

4.3.1 Sudan Emergency Transport and Infrastructure Development Project

The International Development Association (IDA) and the Government of Southern Sudan (GOSS) signed a Letter of Agreement (Agreement) that came into effect December 22, 2005 under which IDA committed to administer the Multi Donor Trust Fund (MDTF) for Southern Sudan in the framework of the Sudan Emergency Transport and Infrastructure Development Project (SETIDP), launched after the signing of the Comprehensive Peace Agreement (CPA) between the Government of Sudan and Sudan Peoples Liberation Army(SPLA).

The objectives of SETIDP are described in the Agreement are as follows:

(i) Rehabilitate and develop critical road and transport infrastructures in Southern Sudan,
(ii) Improve critical urban infrastructures in the major towns of Southern Sudan, and
(iii) Build capacity for planning, construction and sustainable operation, maintenance and management of the infrastructures in Southern Sudan.

The implementation of SETIDP is being managed through the Project Management Team (PMTs) in the MTR and the MHPPE.

(1) Juba Immediate Infrastructure Rehabilitation

Juba Immediate Infrastructure Rehabilitation is being implemented in Juba town as Phase 1 of the SETIDP. This phase consists of immediate rehabilitation of basic infrastructure including the following:

(i) Rehabilitation of priority government and public administration buildings and houses, hospital infrastructures and provision of prefabricated accommodation,

(ii) Rehabilitation of water supply system of Juba including installation of distribution network and installation of proposed water treatment plants in strategic locations,

(iii) Rehabilitation and installation of liquid and solid waste management system including collection and disposal, and

(iv) Rehabilitation and improvement of a network of 65km of urban streets in Juba to asphalt standard. (This project was canceled.)

(2) Technical Assistance Support

As a technical assistant support to the Project Management Team (PMTs), the consultant's Technical Assistance Team (TAST) was organized and tasked to achieve the following five objectives:

(i) To fill and develop the current low technical capacity of the Project Management Team including contract administration and claim resolution, in the central and state offices of the MTR and the MHPPE,

(ii) To build their capacity in investment planning and programming,

(iii) To establish and operate the financial management functions in the Ministries,

(iv) To assist the Ministries in the recruitment and training of technical staff, and

(v) To provide support to effectively implement and/or prepare follow up phase of the SETIDP.

The capacity development required to achieve the above objectives involves the following training plans:

(i) Training in project and contract management
- training in project management
- training in claims management

(ii) Training in procurement

(iii) Training in financial management

(iv) Training in investment planning

(v) Training in information system

(vi) Training in road management
- Presentation of project cycle including planning, design, contract, supervision and maintenance
- Discussion on salient elements of contracts supervision
- Programs on socio-economic software model relevant to the rural and feeder roads

(vii) Training in materials quality control and testing

(viii) Training in environmental issues

4.3.2 Emergency Road Rehabilitation Project (ERRP)

This Project aims to rehabilitate and improve 65km of urban streets in Juba to asphalt standard. Initially, this Project was planned to be implemented using the MDTF as a component of SETIDP as shown in 4.3.1 (1) (iv) above but it was failed. Therefore, the GOSS fund was appropriated for this Project. The roads include the primary and secondary roads which can be categorized as arterials streets and collector streets in terms of functional classification of urban street system.

The Project started in year 2006 by the MTR as the implementing agency with the GOSS fund. The construction period was half a year and the contractor was CEC (Italian contractor) but only about 6 km had been completed by the middle of 2008. Due to such big delay, the MTR terminated the contract in September 2008 and the project roads were divided into two segments: namely LOT-1 (30km) and LOT-2 (35km) as shown in Figure 4.3.2-1.

LOT-1 was taken over by EYAT (Sudanese contractor) with exchanging an Understanding in September 2008 and the construction works were commenced, while LOT-2 was taken over by ABM-Thai South Sudan Construction Co. Ltd. (Joint Venture of Sudanese and Thai contractors) with exchanging an Understanding in February 2009.

Both LOT-1 and LOT-2 are scheduled to be completed by the end of 2010.

Aside from this Project, the streets in the vicinity of the President's Residential Area with a total length of about 3 km, partly included in LOT-1, were divorced from this Project as Presidential Residence Roads Project and ordered to ABM-Thai South Sudan Construction Co. Ltd. The construction works were commenced in October 2008 and completed in April 2009.

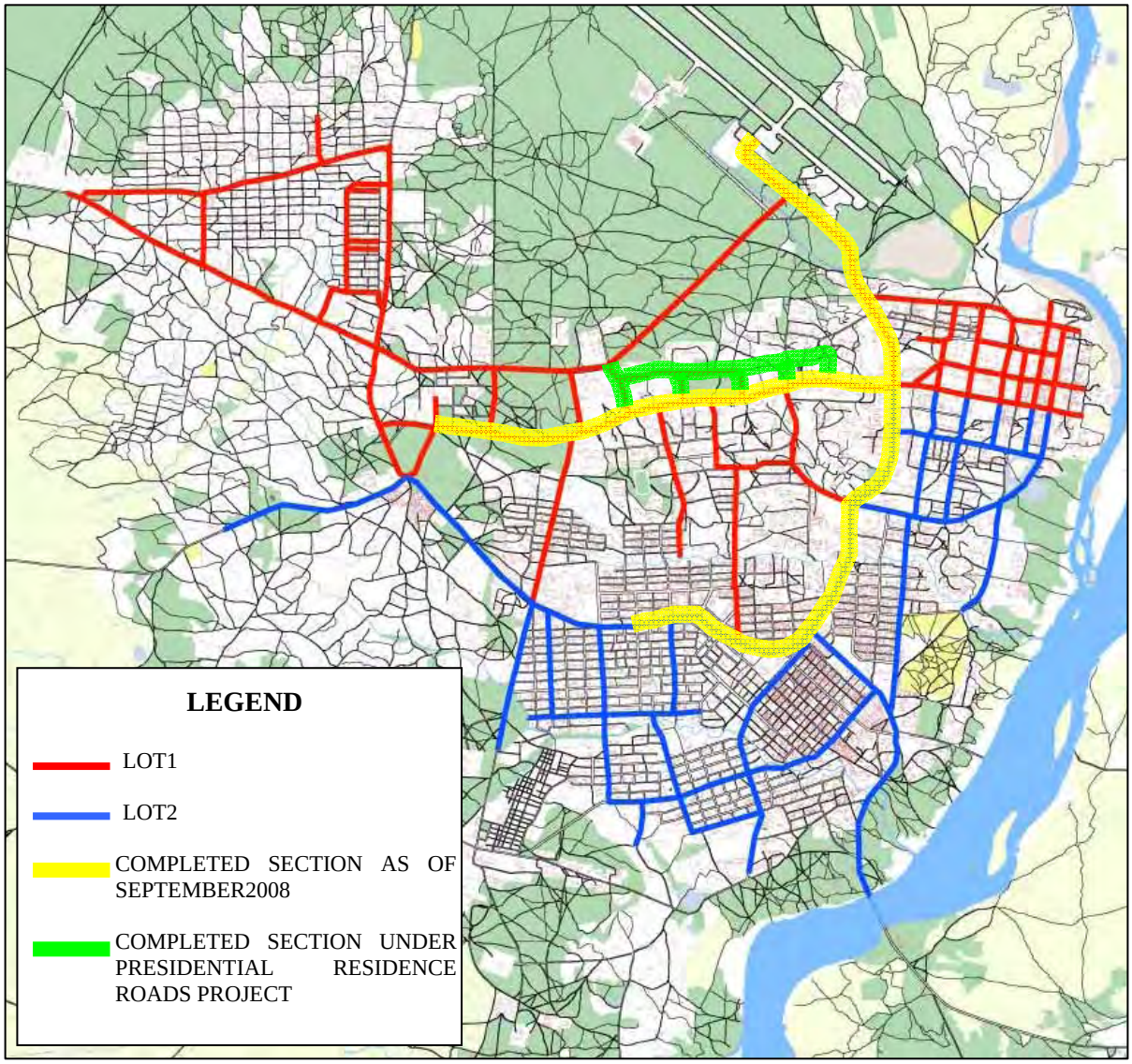


Figure 4.3.2-1 Status of Emergency Road Rehabilitation Project (ERRP)

CHAPTER 5

MAJOR PROGRAMS IN TRANSPORT DEVELOPMENT

CHAPTER 5 MAJOR PROGRAMS IN TRANSPORT DEVELOPMENT

5.1 POLICY AND PROGRAMS IN APPROVED BUDGET 2009 OF GOSS

In 2005, Southern Sudan had just emerged from a 22 year civil war that had led to huge loss of life and displacement of an estimated 4 million people. The war had wreaked enormous damage on the limited infrastructure, and vital transport routes were mined.

The Joint Assessment Mission (JAM) report of 2005 established a series of cost targets for Southern Sudan for the period of 2005-2011 in order to provide a framework for the reconstruction and development requirements for the consideration of peace, eradication of poverty and sustained human development.

The JAM report covers the entire Interim Period of the Comprehensive Peace Agreement (CPA), forecasting primarily on the First Phase from 2005-2007, with the preliminary cost estimates for the Second Phase from 2008-2011. At the mid-point in the Interim Period, revised targets and costing for the period 2008-11 was updated taking into account the progress made between 2005 and 2007.

5.1.1 Goals and Expenditure Priorities

The "Approved Budget 2009" approved by the Southern Sudan Legislative Assembly on 23rd January 2009 states that the goals of the Government of Southern Sudan, as laid down in Article 40 (1) of the Interim Constitution, are;

- Eradication of poverty,
- Attainment of the Millennium Development Goals,
- Guaranteeing the equitable distribution of wealth,
- Redressing imbalances of income, and
- Achieving a decent standard of life for the people of Southern Sudan.

The six top expenditure priorities of the Government of Southern Sudan for the period 2008-2011 are identified as follows:

1. **Security;** to develop an efficient and effective armed forces, to safeguard security and implement the CPA.
2. **Roads;** to rehabilitate road infrastructure, to promote socio-economic and private sector development.
3. **Primary health care;** to provide primary health care to improve the health status of the people of Southern Sudan.
4. **Basic education;** to provide equitable access to basic education.
5. **Water;** to increase access to safe water and sanitation.
6. **Production;** to improve rural livelihoods and income.

Table 5.1.1-1 shows the GOSS Revenue and Expenditure in year 2009, with the 2005-2008 outturns. The oil revenue accounts for 93.3 % of the total GOSS revenue. Comparing to the 2008 revenue, the oil revenue drops much because of the decline of price of crude oil. Of the total expenditure, salaries, operating and capital account for 51.0 %, 24.9 % and 24.1 % respectively.

Table 5.1.1-1 GOSS Revenues and Expenditures : 2006 - 2009

Unit: million SDG

	2005 outturn SDG equiv	2006 outturn SDG equiv	2007 outturn SDG equiv	2008 outturn (provisional)	2009 Budget
Revenue	**1,869.7**	**2,736.1**	**2,977.8**	**6,789.6**	**3,658.4**
Oil Revenue	1,869.1	2,732.9	2,964.5	6,670.9	3,413.4
Non Oil Revenue	0.6	3.2	13.3	118.7	245.0
Expenditure	**452.3**	**3,581.5**	**2,936.5**	**5,712.7**	**3,606.3**
Salaries	35.5	1,185.7	1,479.8	1,873.4	1,839.5
Operating	402.2	1,438.2	1,058.4	2,227.3	899.3
Capital	14.7	957.6	398.3	1,611.9	867.5
Balance	**1,417.4**	**-845.4**	**41.3**	**1,076.9**	**52.1**
GoNU Direct Expenditures	191.1	81.1	88.6	23.7	0
Residual/Exchange Loss	15.5	5.4	0	65.3	0
Reserves/Deficit	**1,210.8**	**-932.0**	**-47.3**	**987.9**	**52.1**
Memo Items					
Transfers to States	231.1	525.5	631.6	637.6	1,154.3
Transfers to MDTF	-	139.2	93.4	141.5	146.4

Source: Approved Budget 2009

Table 5.1.1-2 shows the 2009 budget allocation by sector. The highest budget is allocated to security sector accounting for 22.6 %, followed by infrastructure sector amounting to 889.5 million SDG and accounting for 18.5 %.

Table 5.1.1-2 2009 Budget Allocation by Sector

Unit: Million SDG

Sector	GOSS	Donors (SDG equiv)	**Total**	Sector Share
Accountability	49.6	44.9	**94.5**	2.0 %
Economic Functions	122.2	49.1	**171.3**	3.6 %
Education	291.3	92.8	**384.1**	8.0 %
Health	174.9	262.8	**437.7**	9.1 %
Infrastructure	594.5	295.0	**889.5**	18.5 %
Natural Resources	188.6	150.2	**338.8**	7.0 %
Public Administration	188.8	138.8	**327.6**	6.8 %
Rule of law	433.7	63.3	**497.1**	10.3 %
Security	1.042.3	44.4	**1,086.7**	22.6 %
Social & Humanitarian Affairs	79.9	58.6	**138.4**	2.9 %
Block Transfers to States	440.7	0	**440.7**	9.2 %
Total	**3,606.3**	**1,200.0**	**4,806.3**	**100.0 %**

Source: Approved Budget 2009

5.1.2 Activities and Budgets for Infrastructure Sector

(1) Overall Objectives

The overall objectives and activities of infrastructure sector stated in the Approved Budget 2009 are the following:

Overall Objectives:

Rehabilitate and provide infrastructure to enhance: investment, poverty reduction, economic growth and service delivery in a sustainable manner.

Activities:

Program 1; Roads and Road Transport Development
(Ministry of Transport and Roads)

Program 2; Air, River and Rail Transport Development
(Ministry of Transport and Roads)

Program 3; Housing Development and Sanitation
(Ministry of Housing, Physical Planning and Environment)

Program 4; Physical Planning and Environmental Management
(Ministry of Housing, Physical Planning and Environment)

Program 5; Development, Provision and Management of Urban Water
(Urban Water Corporation)

Program 6; Water Resources Management, Development and Utilisation
(Ministry of Water Resources and Irrigation)

(2) Budget Estimates

Table 5.1.2-1 shows the GOSS 2009 Budget Estimate for the infrastructure sector. The highest amount is provided for the transport and roads amounting to 460 million SDG or 77.4 % of the total budget of infrastructure sector, among which the capital expenditure is 444.2 million SDG.

Table 5.1.2-1 GOSS 2009 Budget Estimates for Infrastructure Sector

Unit: Million SDG

Infrastructure Sector	Salaries	Operating	Capital	Total	Share
Housing, Physical Planning & Environment	5.5	6.0	57.7	69.2	11.6 %
Transport and Roads	**7.7**	**8.1**	**444.2**	**460.0**	**77.4 %**
Urban Water Corporation	6.9	4.6	1.0	12.5	2.1 %
Water Resources and Irrigation	7.6	5.6	39.6	52.8	8.9 %
Total	**27.7**	**24.3**	**542.5**	**594.5**	**100.0 %**

Source: Approved Budget 2009

Table 5.1.2-2 shows the breakdown of the 2009 Budget Estimates for the transport and roads by program area. The road transport development amounts to 376.7 million SDG or 81.9 %.

Table 5.1.2-2 2009 Budget Estimates for Transport and Roads by Program Area

Unit: Million SDG

Transport and Roads	Salaries	Operating	Capital	Total	Share
Roads & Road Transport Development	**2.4**	**1.1**	**373.2**	**376.7**	**81.9 %**
Air, River & Rail Transport Development	4.3	0.7	25.8	30.8	6.7 %
MDTF Contribution	0	0	30.0	30.0	6.5 %
General Administration	0.9	6.3	0.3	7.4	1.6 %
States Transfers	0	0	15.0	15.0	3.3 %
Total	**7.7**	**8.1**	**444.2**	**460.0**	**100.0 %**

Source: Approved Budget 2009

Table 5.1.2-3 shows the capital details for transport and roads in 2009 Budget**.**

Table 5.1.2-3 Capital Details for Transport and Roads in 2009 Budget

Unit: Million SDG

Item	2008 Budget (Revised)	2009 Budget
Furniture & General Equipment	0	0.2
Vehicles and Other Transport Equipment	0.1	8.4
Specialized Plant, Equipment & Machinery	3.0	1.1
Preparation, Design & Supervision of Capital Works	**0.8**	**3.0**
Construction & Civil Works	**562.6**	**364.6**
Rehabilitation & Renovation of Assets	**81.4**	**22.0**
Capital Transfers to State Governments	0	15.0
Transfer to MDTF Projects	**19.7**	**30.0**
Total	**667.5**	**444.2**

Source: Approved Budget 2009

5.1.3 Roads and Road Transport Development

(1) Activities for 2009 in Approved Budget 2009

The activities for 2009 for Program 1; Roads and Road Transport Development stated in the Approved Budget are presented below:

- **Policy, Regulation, Strategy, Development and Capacity Building**
  - Technical Assistance Support Team (TAST) to PMT, providing both technical and fiduciary support and capacity building to the MTR

- **Feasibility Studies, Technical Assessment and Survey**
  - Feasibility study for upgrading of Nadapal-Juba Road
  - Feasibility study for upgrading of Kaya-Yei-Juba Road
  - Rural roads feasibility study
  - Upgrading of Juba-Nimule Road
  - Supervision of consultancy services for feasibility study and design of Yei-Faraksika-Mundri Road upgrading

- **Maintenance**
  - Reconstruction of bridges and drainage structures
  - Transfer to the States for road maintenance

- WFP contract for road maintenance and demining for Yei-Juba, Rumbek-Tonj, Kapoeta-Juba and Juba-Bor Roads

- **De-mining, Rehabilitation and Construction**
  - Upgrading to all-weather gravel standard of key roads connecting the capitals of 10 States
  - Upgrading to all-weather gravel standard of 500 kilometers of rural roads in 10 States
  - Upgrading to international bitumen standard of major trunk roads
    - Kaya-Yei-Lainya-Juba Road (MDTF)
    - Nimule-Juba Road (USAID)
    - Juba Urban Roads (Emergency Road Rehabilitation Project) LOT-1 and LOT-2
    - Juba Ring Roads
  - De-mining, rehabilitation and construction of Kajo Keji-Juba, Faraksika-Chukudum and Narus-Buma Roads
  - Construction and maintenance of Yei-Faraksika, Faraksika-Rumbek, Rumbek-Yirol and Wau-Wunrock Roads

- **Installation of Inspection Facility**
  - Supply and installation of vehicle road worthiness inspection facility

(2) Major Projects

The capital details in the Approved Budget 2009 lists the projects for preparation, design and supervision of capital works, construction and civil works, rehabilitation and renovation of assets, and transfer to MDTF project as shown in table 5.1.3-1.

Table 5.1.3-1 Major Projects Listed in Capital Details

Sub-sector	Item	Project	Cost (million SDG)
Road	Preparation, Design & Supervision of Capital Works	Consultancy services for supervision of road construction works	3.0
	Construction & Civil Works	Completion of Aweil-Miriam Road (Eyat)	90.0
		Completion of Aweil-Wau Road (Eyat)	22.6
		Completion of Aweil-Madhol-Abyei-Amenth-Gogrial Road (Eyat)	53.5
		Juba Urban Roads LOT-1 (Eyat)	10.0
		Juba Urban Roads LOT-2 (CEC)	10.0
		Completion of Mvolo-AluakAluak Road (Payii)	9.8
		Completion of Wau-Warrap Road (Africa Gondei)	10.0
		Ongoing construction of Juba-Lobonok-Moli (Kit Enterprise)	10.0
		Ongoing const. of Hiyala-Ikotos-Tseretanya-Madiope (Macdowel)	6.0
		Wau-Raja, Juba-Leer, Rumbek-Mayandit, Tambura-Wau (Eyat)	107.1
		Ayod-Waat-Akobo Road (under contracting)	10.0
		Bor-Pibor-Pichalla Road (Gabicon)	10.0
		Buma-Raad Road (Ethiopia Road Authority)	3.6
	Rehabilitation and Renovation of Assets	Maintenance of roads (WFP)	14.5
		Reconstruction of bridges and drainage structures	2.0
	Transfer to MDTF Project	Contribution to MDTF SETIDP roads component	30.0
	Sub-total		402.1
Air and Water	Construction & Civil Works	Construction of Juba airport apron and carpark	10.0
		Construction of fence for Juba Port	2.0
	Rehabilitation and Renovation of Assets	Upgrading of Yambio, Torit, Kwajock, Bor & Aweil Airstrips (WFP)	5.5
	Sub-total		17.5
Total			419.6

Source: Approved Budget 2009

5.2 EXPENDITURE PRIORITIES FOR ROADS FOR 2008-2011

5.2.1 Six Top Priorities

The “Expenditure Priority and Funding Needs 2008-2011” prepared for the 2008 Sudan Consortium, April 2008, identifies the six top expenditure priorities by assessing the contribution of the priority activities in the Budget Sector Plan to three development criteria (good governance, private sector development, improving the quality of life of the poor), and three political priorities (security, infrastructure, basic service delivery).

The Governments of Southern Sudan’s six top expenditure priorities for 2008- 2011 are:

1. **Security**
   To develop an efficient and effective armed forces, to safeguard security and implement the CPA.
2. **Roads**
   To rehabilitate road infrastructures, to promote socio-economic and private sector development.
3. **Primary Health Care**
   To provide primary health care to improve the health status of the people of Southern Sudan.

4. **Basic Education**
   To provide equitable access to basic education.
5. **Water**
   To increase access to safe water and sanitation.
6. **Production**
   To improve rural livelihoods and income.

5.2.2 Priority Roads for 2008-2011

The "Expenditure Priorities and Funding Needs 2008-2011" has set the targets for roads for 2011 and identified priority roads to be constructed before the end of the year based on the review on progress 2005-2007, as follows:

(1) Progress 2005-2007

The maintenance of peace and security has enabled the Southern Sudan to make significant progress in opening up road access and demining of key transport routes. Over 2,000 km of roads have been opened up, and public transport services are now available on almost all major routes in Southern Sudan.

However, service delivery remains extremely limited in spite of the progress made since year 2005. Southern Sudan is a huge landlocked area with a relatively scattered population and poor infrastructures and communications. This raises the cost of service delivery, and creates additional logistical challenges in ensuring that essential work takes place during the dry season. It also put a premium on the need for rapid progress in rehabilitating transport infrastructures.

(2) Targets for Roads for Year 2011

The GOSS has set the following targets for year 2011 as follows:

- Rehabilitate and upgrade roads to connect all state capitals to one another, to areas of production, Northern Sudan, and to neighboring countries.
- Increase the contracting and procurement capacity of the Ministry of Transport and Roads for both construction and maintenance.
- Develop a rural roads strategy and be ready to start its implementation.

The overall cost of meeting these targets is estimated at $1, 799 million.

The main challenge, after 20 years of war, relates to the almost complete lack of any appropriate road infrastructures in Southern Sudan. The scales of the needs are enormous. Full rehabilitation of road infrastructure will take years to complete, so prioritization of activities according to available funds is critical. In addition, the GOSS faces high unit costs of road construction due to logistical difficulties, and rising maintenance requirements, as a result of increasing traffic volumes. It also needs to enhance its institutional capacity to manage road procurements.

The main activities that have been identified to meet the targets include:

- Constructing, upgrading and maintaining 2,373km of priority roads to either double

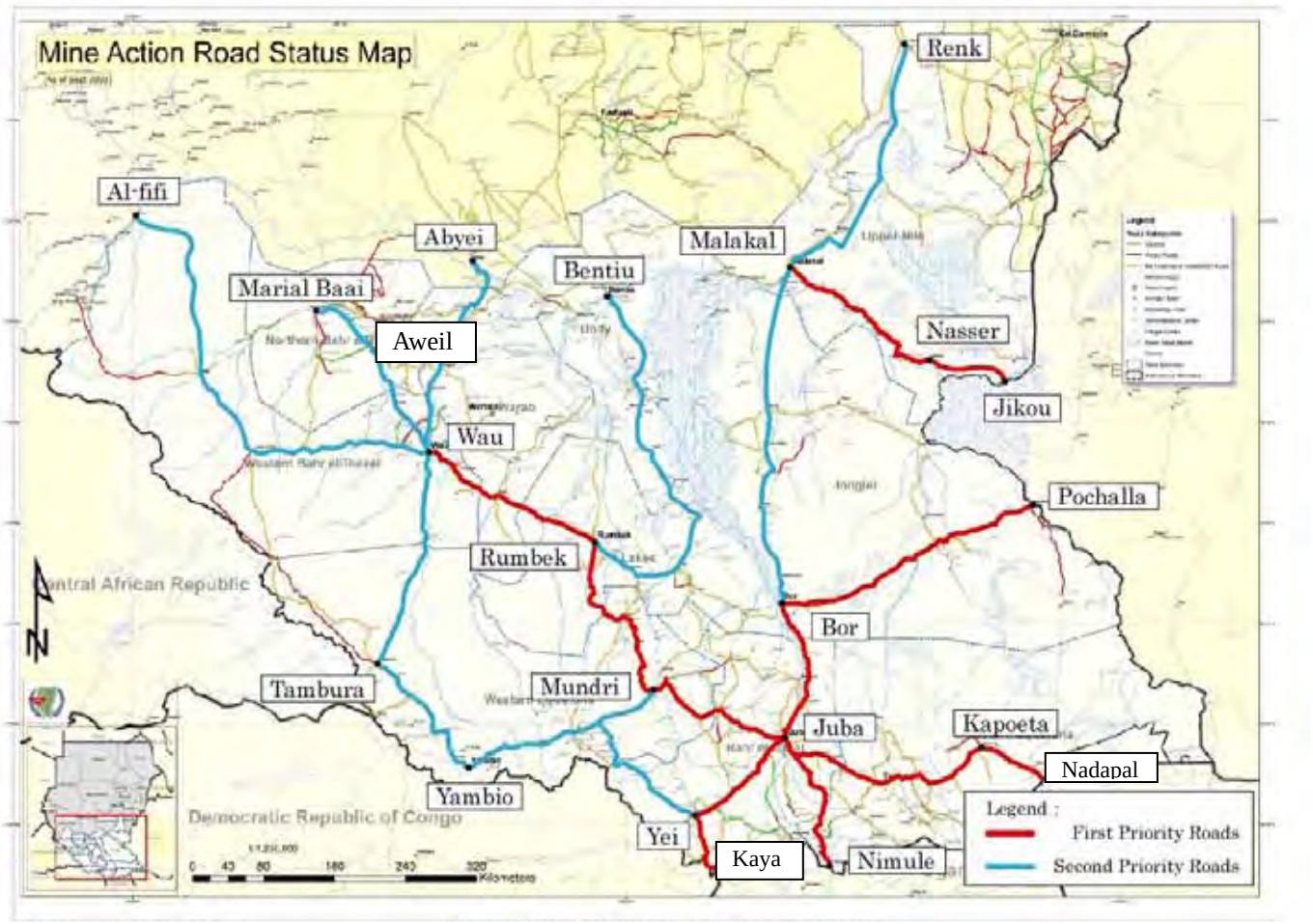
bitumen or gravel standards (first priority roads).

- Commencing a construction of a further 3,128km of roads to gravel standards (second priority roads).

Table 5.2.2-1 sets out the roads and their distances, while Figure 5.2.2-1 graphically demonstrates the location of roads.

Table 5.2.2-1 Proposed Roads for Year 2011

	Distance (km)	Cost ($m)	Standard
First Priority Roads	**2,373**	**1,047**	
Juba-Yei-Kaya	250	303	Double Bitumen
Juba-Torit-Kapoeta-Narus-Nadapal	360	106	Gravel
Juba-Mundri-Mvolo-Wau	649	191	Gravel
Nimule-Juba	195	237	Double Bitumen
Pochalla-Pibor-Bor-Juba	541	102	Gravel
Jikou-Nasser-Malakal	378	108	Gravel
Second Priority Roads	**3,128**	**747**	
Faraksika-Yambio	176	49	Gravel
Yambio-Tambura	185	52	Gravel
Wau-Aweil	150	42	Gravel
Aweil-border	120	34	Gravel
Malakal-Renk	340	95	Gravel
Rumbek-Bentiu	340	95	Gravel
Tambura-Wau	256	128	Gravel
Yei-Mundri	250	4	Gravel
Mabior-Malakal	280	79	Gravel
Wau-Abyei	318	84	Gravel
Wau-Al fiffi	713	84	Gravel
TOTAL	**5,501**	**1,794**	



Source : Study Team

Figure 5.2.2-1 Priority Roads for Year 2011

The costing for roads uses standard unit costs per kilometer for different standards of construction, as well as unit costs for maintenance and de-mining. Road construction to double bitumen standard is estimated at $1.2 million per kilometer, while gravel construction is estimated at $0.28 million per kilometer. Maintenance is estimated at $15 per kilometer, and de-mining at $5 per kilometer.

The total cost of this expenditure area amounts to $1,799 million over the period 2008-2011, as set out in Table 5.2.2-2 below:

Table 5.2.2-2 Total Cost of the Priority Roads Development (US$ Millions)

	2008	2009	2010	2011	Total
First Priority Roads	399.8	442.4	167.4	37.5	1,047.1
Second Priority Roads	0.0	0.0	294.8	452.3	747.1
Rural Roads Strategy	0.5	1.0	1.0	0.5	3.0
Procurement Capacity Building	0.4	0.5	0.5	0.5	1.9
TOTAL	400.8	443.9	463.7	490.8	1,799.1

5.3 STRATEGIC PLAN FOR PHYSICAL INFRASTRUCTURE SECTOR OF CES

5.3.1 Development Objectives and Sector Priorities

(1) CES Strategic Plan

The "Central Equatoria State (CES) Strategic Plan 2009-2011" outlines the process, and assesses the current situation, and identifies the key sector issues at the state and county levels. The plan integrates the needs and priorities of each sector and plans for six counties for the period 2009-2011.

The CES is divided into six administrative counties, 46 payams and 211 bomas. The counties are: Terekeka, Juba, Lainya, Yei, Kajo Keji and Morobo. Its capital is Juba, which is also the head-quarter of the GOSS. The CES population is about 1.1 million in 2008 according to the 2008 Census.

The CES formally called Bahr el Jebel State, lies astride the River Nile in the extreme southern part of Southern Sudan. The White Nile traverses the State from south to north. It covers a land area of 45,025km^2, of which 770km^2 is a home reserve while 756km^2 and 31,199km^2 are forests and arable land respectively.

The soil is sandy to black cotton; good drainage at higher ground and water logged at plains especially along the eastern lowlands through which the River Nile flows. It has predominantly deciduous to evergreen vegetation interspaced with economically valuable hardwoods forests, bamboo and gum Arabic, neem and mango trees.

The population's livelihood is mainly pastoralism in the northern counties of Terekeka and Juba, while in the southern counties of Lainya, Yei River, Kajo Keji and Morobo, population comprise of predominantly agriculturalists who grow a variety of food crops, including maize, cassava, sweet potatoes, dura or sorghum, groundnuts, beans.

(2) Development Objectives and Sector Priorities.

The "CES Strategic Plan 2009-2011" advocates the following physical infrastructure development objectives and sector priorities.

Physical Infrastructure Sub-Sector.

1. Housing and Construction
2. Rural Water
3. Urban Water
4. Roads and Bridges
5. Communication and Transport
6. Land and Town Planning
7. Road Transport.

Vision

A sector that is efficient, transparent, accountable and capable of delivering of services to the people of the CES.

Mission

To develop human resource and acquire necessary equipment to realize accessible all-weather roads, safe and clean drinking water, electricity and affordable housing to the people of the CES with involvement of private sector and other partners.

Development Objectives

1. To provide more efficient supply of safe potable drinking water in both urban and rural areas through improvement of water treatment plants and extensions of water networks.
2. To rehabilitate all feeder roads linking the county headquarters to rural areas, in addition to rehabilitating all airstrips and river ports.
3. To provide a master plan for all major towns.
4. To provide better and affordable housing to people in both urban and rural areas in the State.
5. To provide safe drinking water and sanitation to all rural and urban areas in the State.
6. To provide constant electricity to all major settlements and towns.

Sector Development Challenges

1. Limited financial resources for development,
2. Lack of skilled human resource,
3. Delay in the release of funds,
4. Inadequate equipment,
5. Inconsistent government policies,
6. Insecurity,
7. Lack of proper coordination and transparency with NGOs, and
8. Lack of logistics.

Sector Priorities

1. Acquisition of necessary road and bridges construction equipment,
2. Preparation of master plans for all major towns,
3. Provision of safe clean drinking water for both rural and urban settlements, acquisition of more generators and capacity building, and
4. Logistical support.

5.3.2 Overall State Goals and Activities by 2011

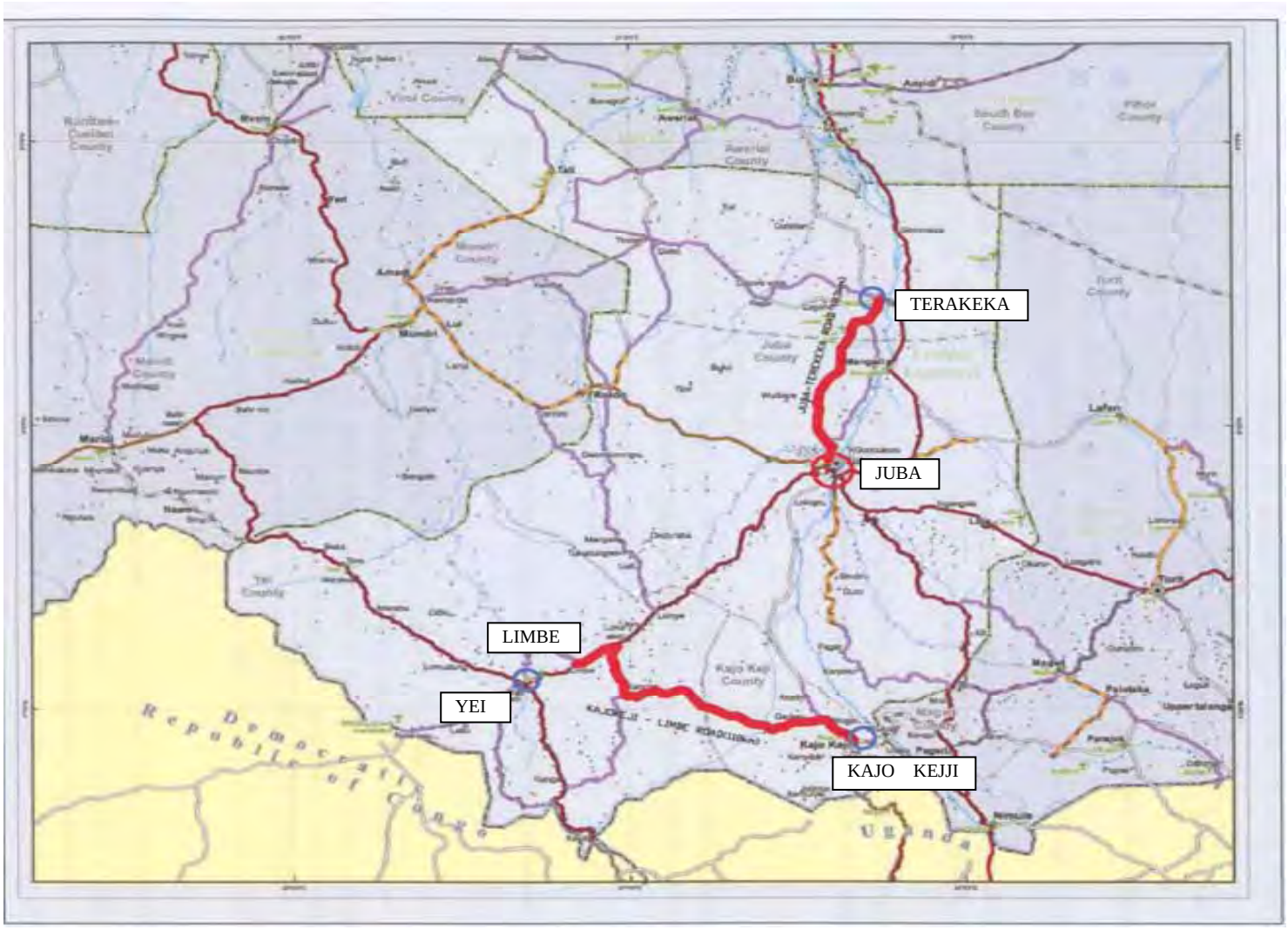
The overall state goals of physical infrastructure planned by the CES government is that by 2011, the CES will provide safe drinking water and sanitation in urban and rural areas, constant electricity in all major settlements, better and affordable housing, a rehabilitated network of rural roads and master plans for all major towns.

Table 5.3.2-1 shows the objectives and activities of physical infrastructure sector to be realized by year 2011. Figure 5.3.2-1 demonstrates roads and airstrips identified as activities of physical infrastructure to be realized by year 2011.

Table 5.3.2-1 CES Physical Infrastructure Sector Activities by Year 2011

Sub-Sector	Objectives	Activities
Housing and Construction, Survey, Lands and Town Plan	To provide master plans for major towns	- Surveying and mapping of towns using satellite imagery.
	To provide better and affordable housing	- Increase housing stock with focus on low cost housing. - Maintenance of government residences and office blocks.
Communication, Transport, Roads & Bridges	- To rehabilitate all feeder roads and bridges: - Juba town roads (31km) - Kajo Keji-Limbe Road (110km) - Juba-Terekeka Road (83km) - Rehabilitate airstrips at Yei,Terekeka and Kajo Keji - Rehabilitate river ports; Juba Port, Terekeka Port; Mangalla Port	- Acquisition of equipment, fuel, lubricants and fast moving parts. - Training of human resources - Mobilize resources - Support cars - Ferries
Urban Water	Provision of safe drinking water and sanitation to all urban areas.	1. Renovation of Yei Treatment Plant and networks. 2. Extension of water networks to areas where water services have not reached in Juba. 3. Construction of Terekeka water networks 4. Training of water engineers and technicians 5. Construction of overhead tanks 6. Installation of water laboratory & chemicals
Rural Water Development	Provision of safe drinking water and sanitation to all rural areas.	1. Drilling of 100 new bore-holes/wells in six counties; Juba (20), Yei-River (16), Terekeka (17), Lainya (16), Morobo (16), Kajo Keji (15) 2. Rehabilitation of 300 HPS; Juba (50), Yei-River (50), Terekeka (50), Lainya (50), Morobo (50), Kajo Keji (50) 3. Construction of 480 pitlatrines; Juba (80), Yei River (80), Terekeka (80), Lainya (80), Morobo (80), Kajo Keji (80). 4. Construction of 36 school latrines: Juba (6), Yei River (6), Terekeka (6), Lainya (6), Morobo (6), Kajo Keji (6).

Source : Central Equatoria State (CES) Strategic Plan 2009-2011



Source: JICA Study Team

Legend: Roads Airstrips

Figure 5.3.2-1 CES Physical Infrastructure Sector Activities by Year 2011, Roads and Airstrips

5.3.3 CES Annual Budget for 2008/2009

Table 5.3.3-1 shows the CES annual budget for years 2008 and 2009.

Table 5.3.3-1 CES Annual Budget for 2008/2009 (unit : million SDG)

	2008		2009
	Projected	Actual	Projected
Revenue			
State Sources	308.5 (82.7 %)	39.7 (37.2 %)	98.2 (43.1 %)
GOSS Grants	64.4 (17.3 %)	66.9 (62.8 %)	129.6 (56.9 %)
Total	**372.9** (100.0 %)	**106.6** (100.0 %)	**227.8** (100.0 %)
Expenditure			
Staff Salaries		92.5 (81.4 %)	163.6 (74.0 %)
Operational Cost		18.8 (16.5 %)	18.6 (8.4 %)
Capital Expenditure		2.3 (2.1 %)	39.0 (17.6 %)
Total	**392.8** (100.0 %)	**113.6** (100.0 %)	**221.2** (100.0 %)
Surplus/Deficit	19.9 (Deficit)	7.0 (Deficit)	6.6 (Surplus)

Source : Central Equatoria State Government Annual Budget F.Y 2009

The actual revenue in 2008 was much smaller than the projected amount resulting in the poor performance of the State Budget in 2008. CES Government, in its Annual Budget F.Y 2009, stated that the revenue falling and the failure of the performance of the 2008 Budget are attributed to the followings :

- Over-estimation of 2008 revenue budget, largely due to over-estimation of fees from allotment of plots,
- Over employment of unclassified personnel,
- Narrow tax base,
- Inadequate coordination and cooperation among the revenue generating units,
- Interference of some GOSS Institutes in revenue collection,
- Tax evasion by senior army officers, politicians and civil servants who are involved in business,
- Poor staffing and inadequate skilled personnel in all State institutes,
- Insecurity in some parts of the State which affected the performance of the 2008 Budget,
- Inaccessibility of some Counties and Payams during rainy season,
- Dependency on foreign food supply, and
- Temporary appointment of sizeable work force.

In 2009, a minimum figure of SDG 98.2 million represents the revenue projection of the State despite the massive resources available at the disposal of the State Government. If properly exploited, the State would have a huge surplus budget in this year. Adding the GOSS grants amounting to SDG 129.6 million, the total amount of SDG 227.8 million represents the total revenue of the State.

Table 5.3.3-2 shows the 2009 budget allocation by sector and Table 5.3.3-3 shows the details of physical infrastructure sector.

Table 5.3.3-2 CES Annual Budget Allocation for 2009

(unit : million SDG)

Sector	Staff Salaries	Operational Cost	Capital Expenditure	**Total**
1. Public Administration & Law Enforcement	112.026	8.896	16.794	**137.716** (62.2 %)
2. Accountability & Economic Functions	18.867	4.395	6.520	**29.782** (13.5%)
3. Education	13.044	0.358	3.131	**16.533** (7.5 %)
4. Health	5.069	0.599	1.752	**7.472** (3.4 %)
5. Nat. Resources & Social Development	7.663	2.227	6.037	**15.928** (7.2 %)
6. Physical Infrastructure	6.882	2.127	4.772	**13.800** (6.2 %)
Total	**163.551** (74.0 %)	**18.602** (8.4 %)	**39.006** (17.6 %)	**221.231** (100.0 %)

Source : Central Equatoria State Government Annual Budget F.Y 2009

Table 5.3.3-3 Details of 2009 Budget of Physical Infrastructure Sector

(unit : million SDG)

Sub-sector	Staff Salaries	Operational Cost	Capital Expenditure	**Total**
Directorate of Housing	1.896	1.010	0.420	**3.326** (24.1 %)
Directorate of Roads & Bridges	2.343	0.300	2.818	**5.462** (39.6 %)
Directorate of Transport & Communication	0.913	0.217	0.333	**1.463** (10.6 %)
Directorate of Rural Water	0.514	0.100	0.475	**1.089** (7.9 %)
Department of Survey	0.391	0.500	0.726	**1.617** (11.7 %)
4% Health Insurance	0.275			**0.275** (2.0 %)
8% Pension Deduction	0.551			**0.551** (4.0 %)
Physical Infrastructure Total	**6.882** (49.9 %)	**2.127** (15.4 %)	**4.772** (34.6 %)	**13.800** (100.0 %)

Source : Central Equatoria State Government Annual Budget F.Y 2009

The 2009 budget for the Directorate of Roads and Bridges amounts to SDG 5,461,568, among which SDG 2,818,280 is allocated for the capital expenditure.

5.3.4 County Annual Work Plan for 2009

The "CES Strategic Plan 2009-2011" has been formulated with the active participation of counties, civil society, and concerned organizations and drawn on community strategic priorities and activities.

Six counties have also developed County Strategic Annual Work Plan for 2009 which were reflected in the formation of the CES plan. The work plan of each county focused on improvement of working condition of employees, health services, clean water, agriculture production etc, as listed below.

- To equip offices with modern facilities for quality of work and documentation.
- To improve and enhance rule of law and legislation.
- To improve health services to enhance mortality and disease prevalence.
- To improve facility of education.
- To improve agricultural production to enhance better standard of living.
- To improve clean water source throughout the year.
- To control cattle, sheep, goats disease and introduce modern fishing system.
- To prevent environmental changes and outwork diseases.

The activities of each county on roads and road transport sectors were rather a few as shown in Table 5.3.4-1

Table 5.3.4-1 Activities in Road Transport in County Annual Work Plan 2009

Counties	Objectives	Activities	Cost (Unit: SDG)
Juba	- To facilitate means of transport for the Payams - To improve transport for the staff - Link Payams to the County H/Qs	- Purchase of 2 land cruiser pickups - Six m/bikes, twenty bicycles. - Tijor-Rokon road - Mankaro-Juba road - Purchase 3 tipper lorries, 1 excavator, 4 vans, 7 brick moulders	150,000 30,000 200,000 200,000 -
Terekeka	- To create good working condition.	- 1 feeder road - 3 motorbikes.	200,000 6,000
Lainya	- To improve staff movement, supervision and beneficiary access - To link communities to Bomas, Payams and Counties by road or air.	- 7 land cruisers - 24 motor cycles - 56 bicycles - 1 tipper lorry - Road construction equipment - Construction/ rehabilitation of 5 feeder roads	672,000 72,000 14,000 60,000 25,000 1,057,000
Yei	- To provide adequate services to the communities	- Provision of communication and transport equipment to the various units within the county	-
Morobo	- To improve working condition of employees and job performances	- Maintenance of 2 feeder roads - Purchase of 26 motorbikes & 20 bicycles	-
Kajo-Keji	- To improve working condition of employees and people in the County	- Purchase 1 grader - Purchase 1 bulldozer, 1 roller, 1 excavator and 1 loader.	500,000 1,150,000

Source : Central Equatoria State Government Annual Budget F.Y 2009

CHAPTER 6

JUBA URBAN DEVELOPMENT AND LAND USE PLAN

CHAPTER 6 JUBA URBAN DEVELOPMENT AND LAND USE PLAN

6.1 JUBA URBAN DEVELOPMENT DIRECTION

6.1.1 Expected Roles of Juba

The Juba urban area is not only a core town in the region but also the center of the Southern Sudan in terms of political, economic, social and cultural activities. Juba is expected to play the following roles:

- Role as an international city to have a hub function in international logistics,
- Role as the capital city with political and administrative center function, and
- Role as the center of economic activities to promote the development of industries in the Southern Sudan

(1) Role as an international city with transport hub function

Six international/interstate roads extend to radial direction from Juba as follows:

- Juba — Yei — Democratic Republic of the Congo
  Yei — Uganda — Kenya
- Juba — Mundri — Yambio — Central Africa
  Mundri — Rumbek
- Juba — Terakeka
- Juba — Bor — Norther Sudan
- Juba — Lafon — Kenya
- Juba — Nimule — Uganda — Kenya

These radial roads connect Juba to neighboring countries, Northern Sudan and major cities in the Southern Sudan. All these radial roads are not presently in operational condition, but they are recognized to be very important and expected to be improved. Juba, due to its advantage in location, is expected to be an international city with transport hub function.

(2) Role as the capital city

Juba shall be developed so as to fulfill the capital function. To realize it, the following are required:

- Improvement of political and administrative functions,
- Improvement of transport network, communication network and information system, and
- Creation of good urban environment.

(3) Role as the center of economic activities

Juba is expected to be the center of economic activities and to promote the development of industries in the Southern Sudan. To realize this, the following are required:

- Improvement of economic infrastructure such as transport, power supply, etc.,
- Reinforcement of market function and logistic hub function,
- Promotion of the industries utilizing domestic products,
- Introduction of modern technology, and
- Creation of favorable environment for introduction of foreign investment.

6.1.2 Development Potential/Constraint and Direction

(1) Development Potential and Constraint

Juba has a high potential for development, with some constraints on the other hand. These factors are summarized in Table 6.1.2-1.

Table 6.1.2-1 Factors Related to Development Potential

Factor	Favorable Condition Enhancing Potential	Unfavorable Condition Possibly Making Constraint	Development Direction/ Mitigation Measures
1. Geographic Location	・Situated at the strategic location to have the hub function in the international/interstate road network.	-	・Developed as logistic center in the region.
2. Natural Condition	・Vast vacant land with flat terrain usable for any land use. ・Nile River providing good scenery and relaxation places.	・Natural hazards such as Jebelkujul Mountain, Nile River. ・Marsh/swampy areas hardly usable for ordinary land use.	・Expansion of urban area toward south, southwest and northwest first, and later east. ・Utilization of Nile River as recreation area. ・Utilization of marshes/ swamps/ponds for agricultural use or environmental buffer zone.
3. Political Condition	-	・Fluid political situation hindering foreign investors having interests.	・Stabilization of political situation.
4. Legislative Condition	-	・Undeveloped laws and regulation related to economic activities like land tenure, permission/ approval system, taxation, etc.	・Establishment/improvement of laws and regulation to make economic activities easy, fair and less risky.
5. Economic Condition	-	・High price, especially industry/construction materials mainly caused by high transport cost. ・Low productivity. ・Low profitability.	・Improvement of international/interstate roads to reduce transport cost to reasonable level. ・Acquisition of managerial skill.
6. Social Condition	-	・Lack of public utilities and social services making living condition difficult. ・Unstable peace and order situation.	・Improvement of basic social infrastructure. ・Improvement of peace and order situation through upgrading of living standard and strengthening of regulation.
7. Natural Resources	・Rich oil resources. ・Abundant mining resources such as gold, uranium, precious stones, etc. ・Water resources from Nile River and water veins. ・High potential for hydraulic power generation.	-	・Promotion of industries utilizing natural resources.
8. Human Resources	・Plenty of manpower because of expected inflow of population by returning and migration.	・Many inexperienced/ unskilled people. ・Some people lacking working will.	・Promotion of industries using manpower. ・Execution of vocational training.

(2) Direction of Future Urban Development

The strategic direction of development of Juba is considered as follows:

- Juba shall be developed as a city that fully plays the expected roles as mentioned in Section 6.1.1, i.e., an international city to have a hub function in the international logistics, a capital city with political and administrative center function, and a center of economic activities to promote the development of industries in the Southern Sudan.
- It is also important to build an environmentally friendly town and make Juba an attractive city not only for residents but also foreign visitors and investors. It is recommended to secure enough recreation and green areas and to save agricultural/pastoral areas to some extent even inside the highly developed modern city with new technology.

The geographical direction of development of Juba is discussed as follows:

- Northeastward : the terrain fits agricultural/pastoral use but no other use due to swampy areas.
- Northwestward : fits for residential areas.
- Westward : fits for residential areas up to Jebelkujul Mountain.
- Southward : fits for residential areas.
- Eastward : the east side of Nile River has the following advantages for development :
  - The land suits any use such as residential, industrial, agricultural, institutional, etc. because of no serious topographic, geological and meteorological constraints for development.
  - This area can offer the proper sites for new airport and new river port. It is much easier to find the vast flat area for new airport in the east side than in the west side. Also for new river port, it is said that the navigation condition on the east side of the river is superior to the opposite side.
  - The east side is the entry point for traffic to/from Uganda and Kenya through Juba-Nimule Road and Juba-Lafon Road, from which most goods are imported.
  - This area can easily meet the demand for expansion of Juba urban area, when the west side is full.

  On the other hand, the constraint factor for development is as follows:
  - Huge investment is required to develop the east side, including bridges over Nile River, roads, water supply, power supply, sewerage and so on.

  Therefore, a full-dress development of the east side of Nile River will take place after year 2015

As a result, expected directions of Juba urban area expansion are northwestward, westward (up to Jebelkujul Mountain) and southward first, then eastward beyond Nile River.

6.2 FUTURE SOCIO-ECONOMIC FRAMEWORK

6.2.1 Population

(1) Population of Sudan

Table 6.2.1-1 shows the population of Sudan. From the table, the following are observed.

- The population of Southern Sudan increased from 1973 to 1983 at high rate, but decreased during the next decade due to IDPs. Then, it has been recovering with return movements.
- The population of Northern Sudan showed the opposite movement to the population of Southern Sudan.
- The average annual growth rate of the whole Sudan's population is 2.96% during 1973-2008, and 2.88% from 1993 to 2008.
- The share of the population of Southern Sudan increased from about 20% in 1973 to about 25% in 1983, dropped 17% in 1993 and then recovered to 21% in 2008.

Table 6.2.1-1 Past Population of Sudan

Year		1973	1983	1993	2008
Population and Share	All Sudan	14,114,000	20,598,000	25,588,000	39,154,490
	Northern Sudan	11,309,000 (80.1 %)	15,324,000 (74.4 %)	21,267,000 (83.1 %)	30,894,000 (78.9 %)
	Southern Sudan	2,805,000 (19.9 %)	5,274,000 (25.6 %)	4,321,000 (16.9 %)	8,260,490 (21.1 %)
Average Annual Growth Rate	All Sudan		3.85 %	2.19 %	2.88 %
	Northern Sudan		3.08 %	3.33 %	2.52 %
	Southern Sudan		6.52 %	-1.97 %	4.41 %

Source : Census

The future population for 2015 and 2025 is forecast on the following assumptions:

- Average annual growth rate of whole Sudan's population : 2.9 % (same as that from 1993 to 2008)
- Share of Southern Sudan's population : 25 % (recovered to 1983 value)

Table 6.2.1-2 shows the forecast future population.

Table 6.2.1-2 Future Population of Sudan

Year		2008	2015	2025
Population and Share	All Sudan	39,154,490	47,830,000	63,660,000
	Northern Sudan	30,894,000 (79 %)	35,870,000 (75 %)	47,750,000 (75 %)
	Southern Sudan	8,260,490 (21 %)	11,960,000 (25 %)	15,910,000 (25 %)
Average Annual Growth Rate	All Sudan	2.9 %	2.9 %	2.9 %
	Northern Sudan	2.5 %	2.2 %	2.9 %
	Southern Sudan	4.4 %	5.4 %	2.9 %

Source : Study Team

Figure 6.2.1-1 graphically shows the past and future population.

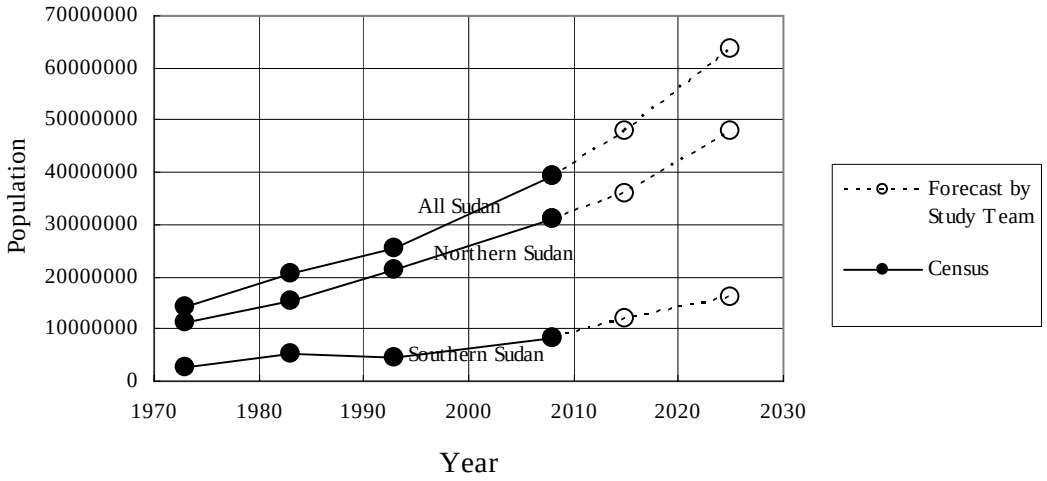


Figure 6.2.1-1 Population of Sudan

(2) Population of Juba Urban Area

As described in Section 2.3.1, the 2008 population of Juba urban area is about 260,000, including estimated 160,000 returnees. The future population is forecast as follows:

2015 Population

The 2015 population is estimated as a total of natural increase and migration plus IDP/refugee returnees.

Population tends to flow into urban areas. Table 6.2.1-3 shows the urban population of Northern Sudan. The urban population growth rate from 1993 to 2004 was high, amounting to 4.78 %, then gradually decreased thereafter. At present, Juba urban area has not developed enough and it is considered to be in the initial stage of development. Therefore, its population is expected to grow at a high rate, which is assumed to be 4.8%, equal to the urban population growth rate of Northern Sudan from 1993 to 2004. As a result, the 2015 population of Juba urban area is estimated at 260,000 x 1.048^{7} = 360,000, which is considered to include the natural increase and migration.

Table 6.2.1-3 Urban Population of Northern Sudan

		1993	2004	2005	2006
Total Population	('000)	21,267	29,146	29,949	30,767
Urban Population Rate	(%)	32.12	39.16	39.66	40.16
Urban Population	('000)	6,831	11,414	11,878	12,356
Annual Growth Rate of Urban Population (%)			4.78	4.07	4.02
		Average Annual Growth Rate from 1993 to 2006 = 4.66 %			

Source : Statistical Yearbook for the Year 2006

In addition, IDP/refugee return movement is considered to continue. As mentioned in Section 2.3.1(3), JAM estimates that approximately 4 million people were displaced from (or within) Southern Sudan, and IOM estimates that the cumulative number of returnees is approximately 1.8 million up to June 2008, accounting for 45 % of total displaced persons. Assuming that

another 45 % of total displaced persons will return from July 2008 up to 2015, number of returnees to Juba urban area is estimated to be the same as the cumulative number of returnees up to June 2008, which amounts to 160,000 (refer to Section 2.3.1 (3)).

The 2015 population of Juba urban areas is estimated as follows:

- 2008 population : 260,000
- Natural increase and mitigation : 100,000
- Returnees : 160,000
- Total : 520,000

2025 Population

If assuming the same annual growth rate of 4.8%, the 2025 population of Juba urban area will be 831,000. Further assuming that 10 % of the total displaced persons still remaining by 2015 will return up to 2025, number of returnees is estimated at 36,000. Adding the returnees, the 2025 population is forecast to be 831,000 + 36,000 = 867,000, about 870,000.

However, if the capital function will be fully developed up to 2015, the population concentration to the capital will be accelerated thereafter. In general, the population of the capital city accounts for 10 to 11 % of the total population of the country in many African countries. In case of Southern Sudan which is characterized by many medium-sized cities dispersed, the share of the population of the capital to the population of whole Southern Sudan might be less than 10 %. The share is 3.1% in 2008 and forecast to be 4.3% in 2015. Roughly assuming that the share will increase to 6.0% in 2025 from the said trend, the 2025 population of Juba urban area is estimated at :

15,910,000 (forecast population of Southern Sudan) x 6% = about 950,000.

Summary

The forecast future population is summarized in Table 6.2.1-4.

Table 6.2.1-4 Future Population

		2008	2015	2025
Population	Sudan	39,154,490(100%)	47,830,000(100%)	63,660,000(100%)
	Northern Sudan	30,894,000(78.9%)	35,870,000(75.0%)	47,750,000(75.0%)
	Southern Sudan	8,260,490(21.1%)	11,960,000(25.0%)	15,910,000(25.0%)
	Juba Urban Area (Share to Southern Sudan)	260,000 (3.1%)	520,000 (4.3%)	950,000 (6.0%)
Average Annual Growth Rate	Sudan		2.9%	2.9%
	Northern Sudan		2.2%	2.9%
	Southern Sudan		5.4%	2.9%
	Juba Urban Area		10.4%	6.2%

Source : Study Team

Juba urban area shows very high rate of population growth. The population growth from 2008 to 2015 is mainly due to return movement of IDPs expected to still continue and the one from 2015 to 2025 is based on the expectation to fulfill the expected roles of Juba as described in Section 6.1.

6.2.2 Economy

In Section 2.3.2, the GRDP and GRDP per capita in the study area in 2008 were estimated as follows, based on the rough assumption that the GRDP per capita in the study area is one third of that in whole Sudan :

- GRDP per capita in 2008 : US$530
- GRDP in 2008 : US$140 million.

The economic growth is considered to be very rapid in the stage of economic recovery. If assuming 10% annual growth of the GRDP per capita of the study area, GRDP and GRDP per capita are estimated as shown in Table 6.2.2-1.

Table 6.2.2-1 Roughly Estimated Future GRDP of Juba Urban Area

		2008	2015	2025
GRDP per Capita (US$)		530	1,030	2,670
Population		260,000	520,000	950,000
GRDP (US$ million)		140	540	2,540
Annual Growth Rate	GRDP per Capita	-	10 %	10 %
	GRDP	-	21 %	17 %

If the GDP per capita in whole Sudan grows at a rate of 3.5% p.a., it will be US$1,580, 2,010 and 2,840 in 2008, 2015 and 2025 respectively. As a result, the GRDP per capita in the study area will be about 30%, 50% and 90% of the GDP per capita in whole Sudan in 2008, 2015 and 2025 respectively, thus the gap of GRDP per capita between the study area and Sudan average is expected to gradually decrease.

6.3 LAND USE PLAN

6.3.1 Present Land Use

(1) Land Classification

Mainly from the viewpoint of residential use, land is classified as shown in Table 6.3.1-1. Land classes are characterized by the size of plot, land rent and building materials.

Table 6.3.1-1 Residential Land Classification

		Formal Residential area			Informal Residential Area
		Class 1	Class 2	Class 3/4	
Minimum parcel size		25m x 25m	20m x 20m	20m x 15m	-
Term of lease		50 years (Renewable once per 30 years)	30 years (Renewable once per 20 years)	20 years (Renewable once per 10 years)	-
Approximate annual fees per parcel (US$)		50	37.5	25	-
Chara-cteristics	Status	Permanent	Basic	Removable	Removable
	Income level of inhabitant	Upper class	Middle class	Low class	Very low class
	Typical house	Colonial English homes	Cottage homes of simple structure	Made of permanent and temporary materials mixed	Traditional round house (tukul)
	Access to public utilities	Accessible	Usually with sanitation	Limited or no sanitation	No access

Figure 6.3.1-1 shows the land type of Juba.

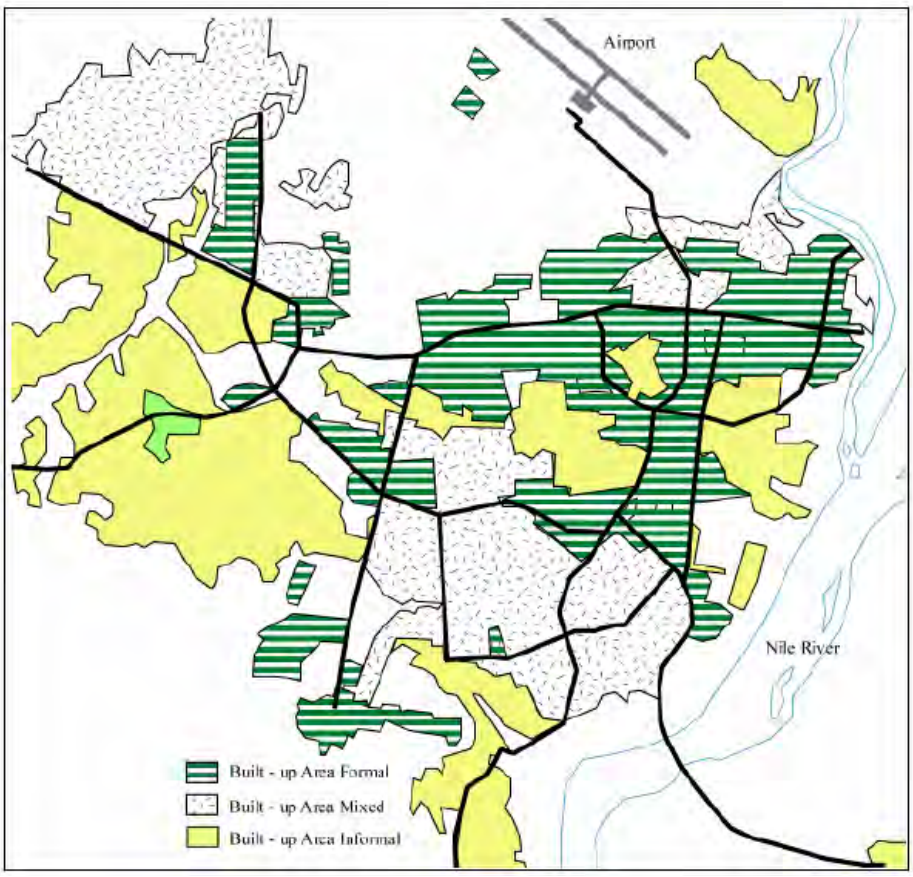


Figure 6.3.1-1 Land Type in Juba

(2) Land Tenure

At this moment, a comprehensive land registration system including provision of land rights and allocation of land to individuals, is not established yet. Up to 1970, a land registration system used to actually function. However, the records at that time were abandoned or lost during the conflict. It is therefore said that past land rights much depend on the memories of the individual leaseholders, tenants, inhabitants or personnel who worked at the local governments.

According to the information from the State Government, it was stipulated in the Land Ownership Law that the lands within the town boundary defined in 1972 belong to the Government and the Government can take privately owned land rights for public use with compensation in cash or provision of alternative land right.

"The Southern Sudan Proposed Land Bill 2007, 2nd Draft (the Southern Sudan Land Bill, 2007)" was prepared by Southern Sudan Land Commission. The Bill stipulates the land ownership as follows:

(1) All land in Southern Sudan belongs to the people of Southern Sudan and shall vest in them collectively or as individuals.
(2) Land may be acquired, held and transacted through these tenure systems: customary, freehold, and leasehold.

The Bill classifies the land as follows:

- Public Land
  Public Land is land owned collectively by all Southern Sudanese and held in trust by the appropriate level of government as determined by law, and
- Community Land
  Community Land shall vest in and be held by communities identified on the basis of ethnicity, residence or community of interest.

(3) Present Land Use

A zoning system for Juba urban area to regulate land use and induce the proper use of land is not established yet. Currently, a land administrative unit of Juba issues consent in an ad hoc manner for each land use.

The present land use in each Payam is outlined as follows:

Juba Payam is characterized by low density urban area where government offices, other institutional offices, houses, shops and small business offices intermingle. The historic old blocks are located in the eastern side. The commercial and business areas are centered at the historic old blocks and spread out therefrom. The GOSS Ministries Complex is located in the western side. The residential areas are mostly composed of Class 1 plots, while the informal settlement areas are plotted where temporary and traditional round houses (Tukul) are predominant.

Kator Payam is located in the south of Juba Payam, where markets, old Arab houses and merchant houses intermingle. Informal settlement areas with Tukul style houses are intermittently located outwards. Remarkable establishments in this Payam are Catholic Cathedral and Konyo Konyo Market.

Munuki Payam is located in the west of Juba Payam spreading out in the west of the GOSS Ministries Complex. This Payam is also characterized by the houses of relatively low income families and IDPs. Returnees have been occupying this area since the stabilization of the political condition. Custom Market, the largest market in Juba, is being transferred from the intersection of Unity Avenue and Yei Road to 1.2 km down to the south near the military area. The transference has almost been finished but still many street stalls are open and the bus terminal remains at the previous location.

The present land use is illustrated in Figure 6.3.1-2 and Table 6.3.1-2 shows the land areas by category.

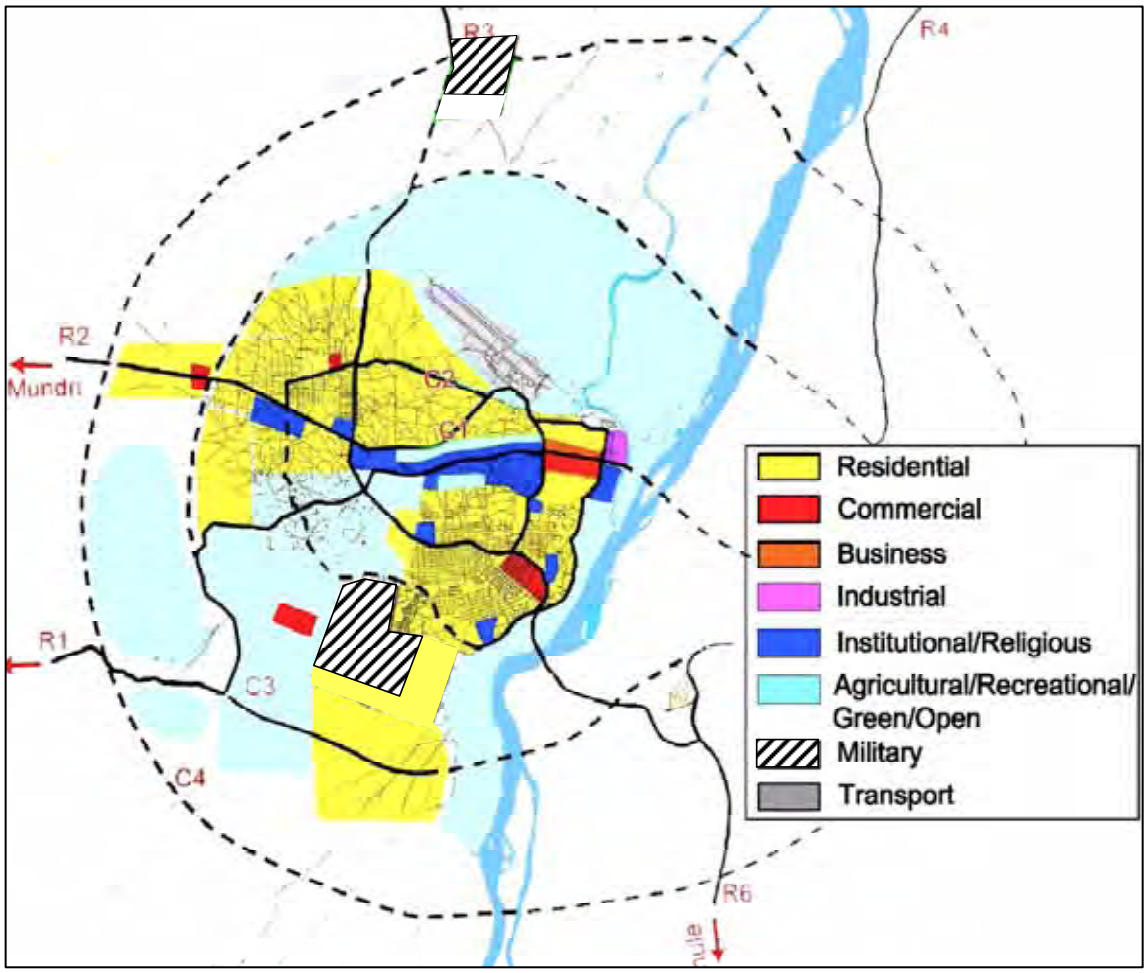


Figure 6.3.1-2 Present Land Use

Table 6.3.1-2 Present Land Use by Category

Land Use	Area (ha)				%
	Juba	Kator	Munuki	**Total**	
Residential	590	460	750	**1,800**	44.2
Commercial	20	10	10	**40**	1.0
Business	30	0	0	**30**	0.7
Industrial	10	0	0	**10**	0.3
Institutional/Religious	150	10	20	**180**	4.4
Military	0	300	0	**300**	7.4
Transport	280	60	40	**380**	9.3
Agricultural/Recreational/Green/Open	670	400	260	**1,330**	32.7
Total	**1,750**	**1,240**	**1,080**	**4,070**	**100.0**

The present land use is characterized as follows:

- Juba urban area is about 4,070 ha in area, consisting of 1,750 ha of Juba Payam, 1,240 ha of Kator Payam and 1,080 ha of Munuki Payam.
- Among the land use category, residential area has the biggest share accounting for about 44%, followed by agricultural/ green/open area with 33%.
- Commercial, business and industrial areas seem to be underdeveloped yet due to the long conflict. These areas are mostly located in Juba Town Payam.
- Other categories including institutional/religious, military and transport areas seem to be appropriate areas meeting the present demands.

6.3.2 Estimate of Future Land Demands

(1) Total Urban Area

The present urban area excluding agricultural/green/open area is about 2,740 ha and the gross population density is about 95 persons/ha. The required future urban area is estimated on the following assumptions:

- 30% of the present agricultural/green/open area is utilized for residential use in future.
- Gross population density of new urban area is 90 persons/ha, while that of the existing urban area is 95 persons/ha.

The estimate result is shown in Table 6.3.2-1.

Table 6.3.2-1 Required Future Urban Area

		2008	2015	2025
Population		260,000	520,000	950,000
Area (ha)	Present Urban Area excluding Agricultural/Green/Open Area	2,740	2,740+1,330x0.3 =3,140	3,140
	Agricultural/Green/Open Area	1,330	1,330x0.7=930	930
	Additional Urban Area excluding Agricultural/Green/Open Area	-	2,470	7,240
	Additional Agricultural/Green/Open Area	-	1,160	2,690
	Total	**4,070**	**7,700**	**14,000**
Gross Population Density (persons/ha)	Present Urban Area excluding Agricultural/Green/Open Area	95	95 (298,000 population)	95 (298,000 population)
	Additional Urban Area excluding Agricultural/Green/Open Area	-	90 (222,000 population)	90 (652,000 population)

The required future urbanized areas are estimated at about 7,700 ha in 2015 and about 14,000 ha in 2025. The 2015 urban area is equivalent to the area surrounded by the proposed Circumferential Road 3, and the 2025 urban area equivalent to the area surrounded by the proposed Circumferential Road 4 (excluding the areas of Nile River and Jebelkujul Mountain).

(2) Land Demands by Land Use Category

The future land demand by land use category are estimated based on the present land areas, on the assumptions shown in Table 6.3.2-2.

Table 6.3.2-2 Assumptions in Estimation of Land Demands by Category

Land Use	Assumption in Estimation of Future Demand based on Existing Area	Remarks
Residential	In proportion to population	Assuming that 30% of present agricultural/recreational/green /open area is converted to residential area in future.
Commercial	2 times of population growth	Considering that existing areas for these land uses seem to be too small because of present underdeveloped economic activities, the future land demand is assumed to be doubled in proportion to population / working population.
Business	2 times of working population* growth	
Industrial	2 times of working population* growth	
Institutional/Religious	Half of population growth	Considering that institutional/ religious area is not only for Juba people but also for the State and whole Southern Sudan where population growth is not so high as in Juba.
Military	No change	
Transport	In proportion to total urban area	To maintain the percentage of total urban area.
Agricultural/Recreational/ Green/Open	In proportion to total urban area	

* Working population is shown in Table 6.3.2-3.

Table 6.3.2-3 Estimated Future Working Population

	2008	2015	2025
Population	260,000	520,000	950,000
17 or More Years Old Population	133,000 (51% of population*)	265,000 (51% of population)	485,000 (51% of population)
Economically Active Population	60,000 (Economically Active Rate : 45%)	133,000 (Economically Active Rate : 50%)	267,000 (Economically Active Rate : 55%)
Working Population	**42,000** (Unemployment Rate: 30%)	**106,000** (Unemployment Rate: 20%)	**240,000** (Unemployment Rate: 10%)

* Average proportion in Southern Sudan according to Census

( ) shows the assumption.

Based on the assumptions shown in Table 6.3.2-2, future land demands by land use category are estimated as shown in Table 6.3.2-4.

Table 6.3.2-4 Estimated Future Land Demands by Land Use Category

		2008	2015		2025	
Basic Multipliers						
	Population	1.0 (260,000)	2.0 (520,000)		3.7 (950,000)	
	Working Population	1.0 (42,000)	2.5 (106,000)		5.7 (240,000)	
	Urban Area Required	1.0 (4,070 ha)	1.9 (7,700 ha)		3.4 (14,000 ha)	
Land Demand (ha)	Residential	**1,800**	(2.0 times)	**3,600**	(3.7 times)	**6,660**
	Commercial	**40**	(2x2.0 times)	**160**	(2x3.7 times)	**300**
	Business	**30**	(2x2.5 times)	**150**	(2x5.7 times)	**340**
	Industrial	**10**	(2x2.5 times)	**50**	(2x5.7 times)	**110**
	Institutional/Religious	**180**	(1.5 times)	**270**	(2.35 times)	**420**
	Military	**300**	(1.0 times)	**300**	(1.0 times)	**300**
	Transport	**380**	(1.9 times)	**720**	(3.4 times)	**1,290**
	Agricultural/Recre-ational/Green/Open	**1,330**	(nearly 1.9 times)	**2,450**	(nearly 3.4 times)	**4,580**
	Total	**4,070**		**7,700**		**14,000**

( ) shows the multiplier to the area in 2008

6.3.3 Proposed Land Use Plan

(1) Basic Considerations

As mentioned in 6.1, Juba is expected to be a modern city with sufficient urban functions to play a role as political, economic and social activities center, including politics, industry, culture, education, health, recreation, etc. Major points considered in land use planning are as follows:

1) Provision of adequate transport facilities as a transport hub of the region

Adequate spaces for transport facilities including international/interstate roads, urban roads, airport and river port shall be secured and their location shall be taken into account in land use planning.

- Juba is situated at the strategic location to perform the hub function in the international/interstate road network. Their routes shall be taken into account.
- The arterial road network within the urban area forms a frame of urban structure and has an effect of inducing intended land use. The urban road network shall be planned in harmony with land use plan and vice versa.
- A plan to construct a new international airport shall be taken into account in land use planning.
- A plan to construct a new river port on the eastern bank of Nile River shall be taken into account.

2) Appropriate distribution of land for each land use category meeting the demand

The land demand for each land use category was discussed in Section 6.3.2 (2). These lands shall be properly distributed aiming at the maximum efficiency of urban functions. Basic considerations in the distribution are as follows:

- **Residential areas** : maintaining the existing areas and developing new settlement areas

in the south and west of the present urban area around the proposed Circumferential Road 3 at first, and then further outside up to the proposed Circumferential Road 4 and in the east side of Nile River.

- **Commercial areas** : maintaining and expanding the existing market areas (Juba, Konyo Konyo, Custom, Munuki, Gudele, etc.), planning a new commercial center in the east side of Nile River and scattering neighborhood commercial areas in the residential areas.
- **Business areas** : forming a new central business district (CBD) at Nyakuron Central area.
- **Industrial areas**: locating along west side of Nile River and east side in future.
- **Institutional/religious areas**: Preserving the existing areas and expanding around there.

3) Reservation of enough areas for green and recreation to make Juba a comfortable and pleasant city

Juba is blessed with natural resources such as abundant green areas and Nile River. To take this advantage, it is recommended to make Juba a unique city, comfortable, pleasant and environmentally friendly. To attain this, enough spaces for green and recreation areas are planned along Nile River and in the suburbs, maintaining the present population density that is rather low comparing with other big cities in the world.

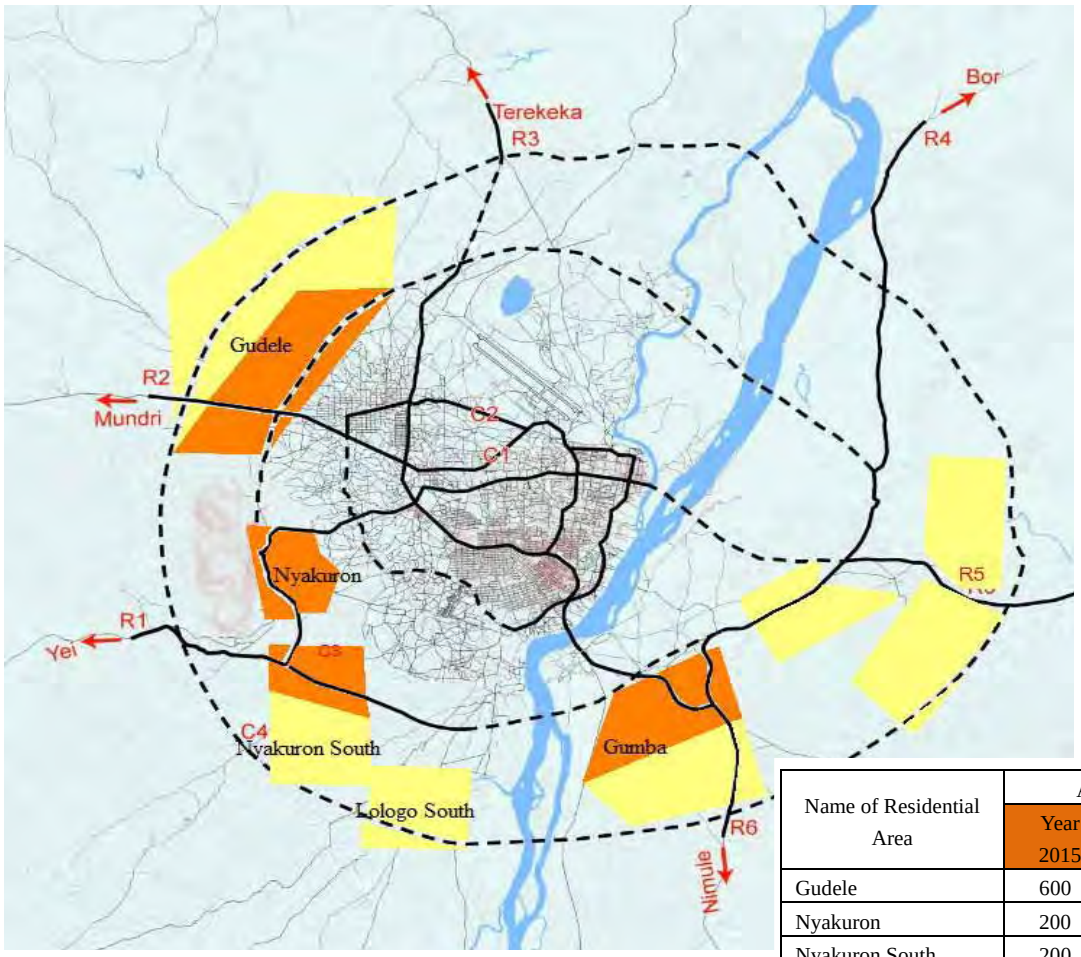
4) Proper use of areas in east side of Nile River

Since as mentioned in Section 6.1.2 (2), the east side of Nile River has a big potential for development but huge amount of investment is required for the development, a full-dress development of the east side of Nile River will take place after year 2015.

(2) Distribution of Urban Functions

1) Residential Area

The land demand for residential area is estimated at 3,600 ha in 2015 and 6,660 ha in 2025 while the existing residential area is 1,800 ha. Assuming that 30% of the present agriculture/recreation/green/open area is converted to residential area by 2015, the converted area will be approximately 400 ha and additionally required residential area is about 1,400 ha in 2015 and further 3,100 more ha in 2025. The candidate areas are shown in Figure 6.3.3-1. These areas have been already developed partly, but still with low density. They will be fully developed by 2015/2025.



Name of Residential Area	Area (ha)	
	Year 2015	Year 2025
Gudele	600	900
Nyakuron	200	-
Nyakuron South	200	300
Lologo South	-	300
Gumba	400	400
East Side of Nile River (Other than Gumba)	-	1,200
Total	1,400	3,100

Figure 6.3.3-1 Proposed New Residential Areas by 2015/2025

2) Commercial Area

There are two types of commercial areas: district commercial areas and neighborhood commercial areas.

The district commercial area is a wide place where commercial entities congregate, usually at one place per district. Existing market areas will be expanded and new district commercial areas will be developed, including:

- Existing : Present Juba Market and its surrounding area*
  Present Konyo Konyo Market and its surrounding area
  Present Custom Market and its surrounding area
  Present Munuki Market and its surrounding area
  Present Gudele Market and its surrounding area
- New : Area surrounding intersection of Bor Road and Lafon Road

* It is proposed to call this area “Central Commercial District”. It will be used as commercial area mixed with business entities.

The neighborhood commercial area is a shopping area to serve neighborhood community to purchase mainly daily food and consumer goods. The neighborhood commercial areas will be scattered in residential areas occupying a part of residential areas.

3) Business Area

A new central business district (CBD) is planned to be formed at Nyakoron Central with an area of about 300 ha. This area is convenient for traffic, situated between Circumferential Road 1 and Circumferential Road 2, and close to the GOSS Ministries Complex.

Aside from the central business district, business entities will be located in the district commercial areas mingling with commercial entities.

4) Industrial Area

An industrial area is planned at the riverside where the old river port was located, taking advantage of facilities for river transport.

In the future after 2015, an extensive industrial estate is planned on the eastern side of Nile River, premised on the construction of a new river port on the east bank of Nile River. This can afford to accommodate the future demand for industrial development such as agro-processing, textile, wood product, heavy industry, etc.

5) Institutional/Religious Area

At present, government buildings and aid agency offices are concentrated along May Street. These areas will be preserved and expanded behind them.

Juba University owns large areas around the present main campus on the north side of Unity Avenue and has a plan of constructing teaching hospital, technical school, conference center and staff residences. These areas will be preserved.

Many Catholic churches and Islamic mosques are located around the existing urban area. They shall be preserved. New religious locations will be secured in newly urbanized areas.

6) Military Area

The military base in Kator is planned to move to the new area located along Radial Road 3 (Juba-Terekeka Road), about 5.5 km north of the GOSS Ministries Complex. The present site will be donated to Juba University (to be used for School of Medicine) where the existing hospital will be utilized for medical education facilities.

7) Transport Area

Adequate spaces for transport facilities including roads, airport and river port shall be reserved.

Spaces for roads are secured in accordance with the road network development plan discussed in Part II. The area for the new international airport is planned in the eastern side

of Nile River and the place for the new river port is considered on the east bank of Nile River.

8) Green/Recreation/Park Area

To make Juba a unique city, comfortable, pleasant and environmentally friendly, enough spaces for green and recreation areas are planned.

The west riverside of Nile River is planned to be a green area with promenades and rest facilities to make it a symbolic place of Juba. This green corridor will serve as an eco-corridor of the city.

Vast recreation areas are planned at the following locations:

- at the north side of the airport,
- along Yei Road on the south of Jebelkujul Mountain, and
- outside of Circumferential Road 4 on the east side of Nile River.

(3) Proposed Land Use Plan

Proposed land use maps for years 2015 and 2025 are shown in Figure 6.3.3-2 and Figure 6.3.3-3 respectively.

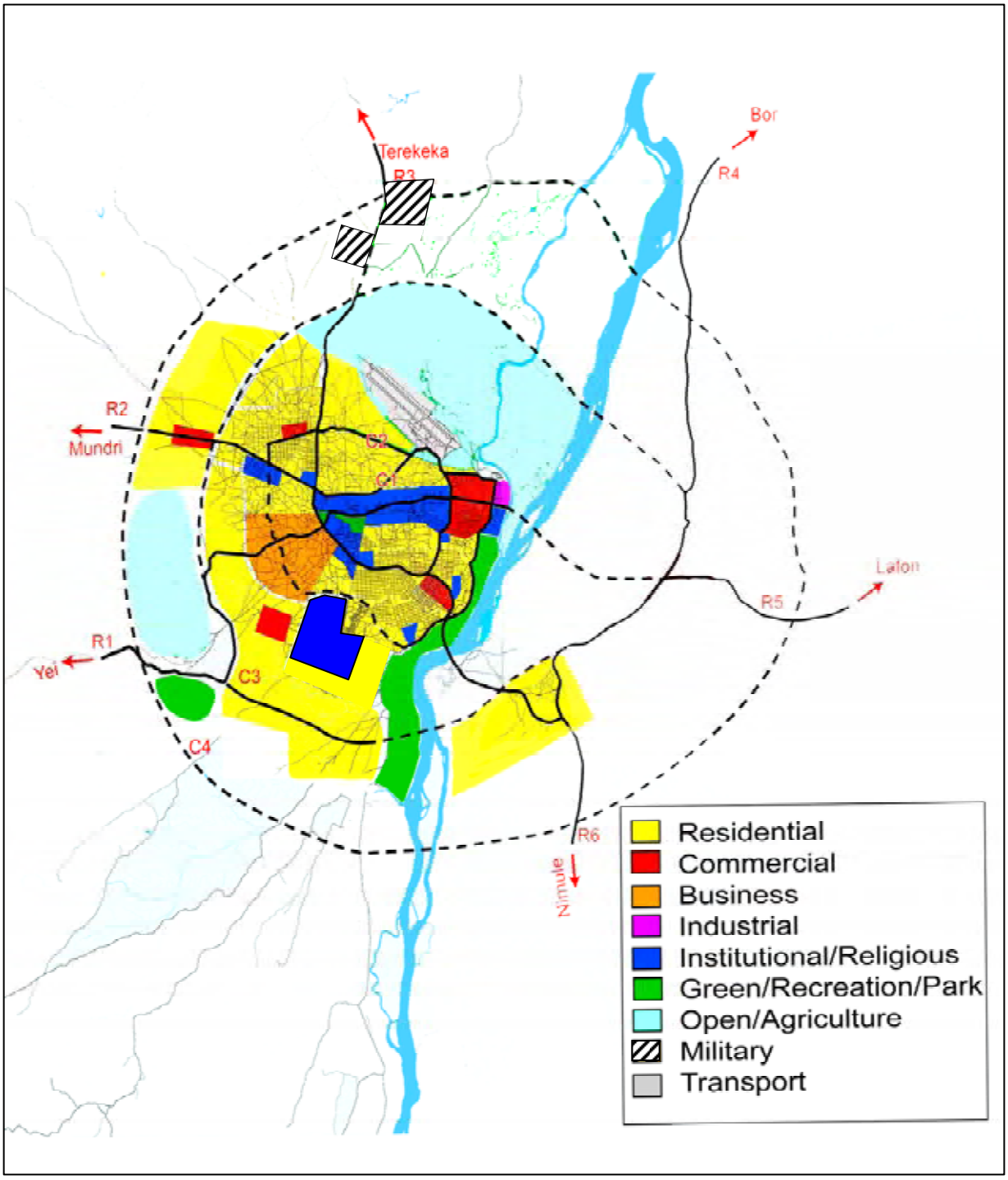


Figure 6.3.3-2 Proposed Land Use for 2015

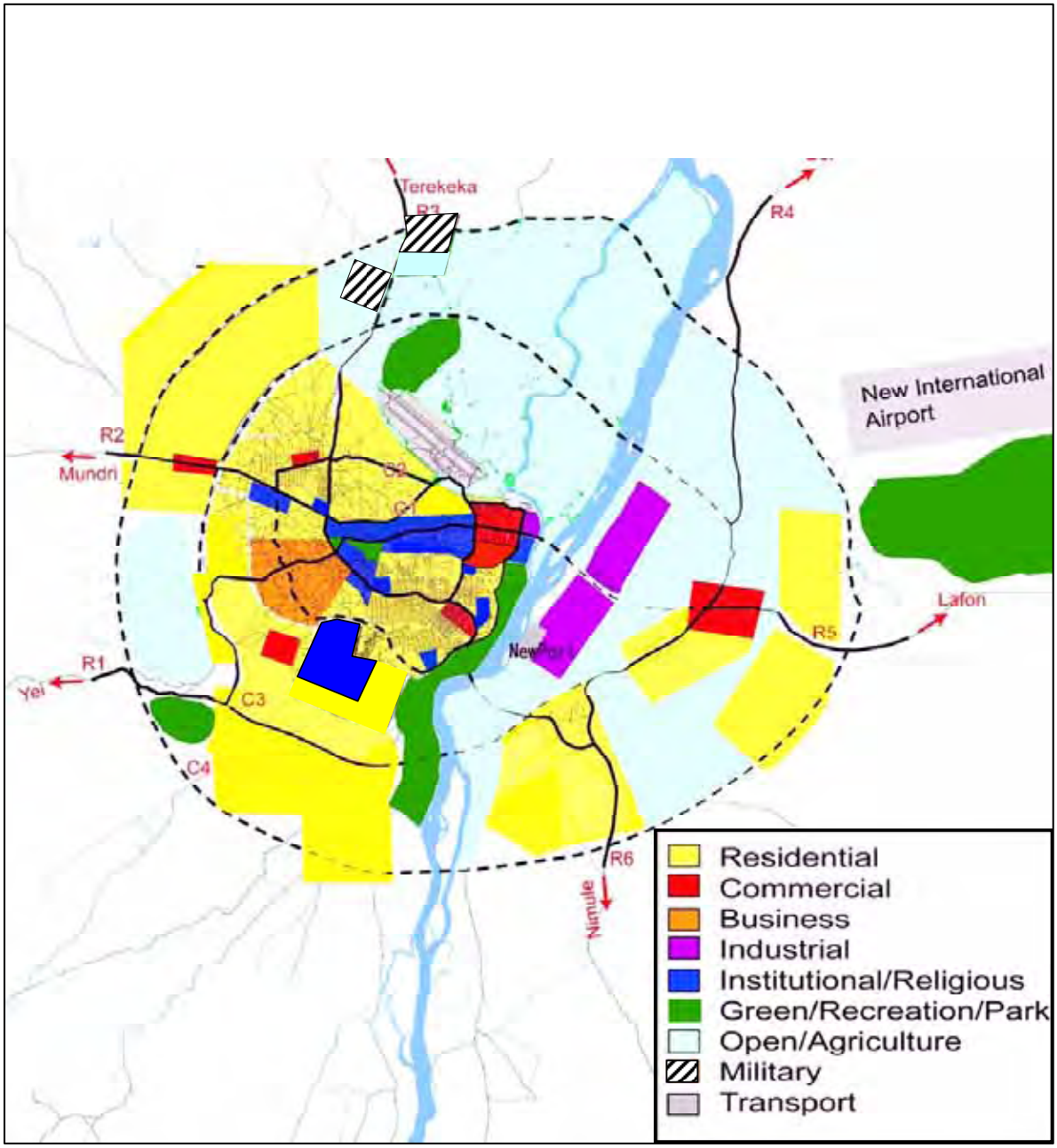


Figure 6.3.3-3 Proposed Land Use for 2025

PART II

URBAN TRANSPORT DEVELOPMENT MASTERPLAN

CHAPTER 7

TRANSPORT DEVELOPMENT POLICY AND TARGET

CHAPTER 7 TRANSPORT DEVELOPMENT POLICY AND TARGET

7.1 APPROACH

Figure 7.1-1 demonstrates the procedural flow of transport master plan formulation, which is briefly discussed below.

(1) Assessment of Future Transport Issues

The present transport issues were identified and future issues were envisaged based on the assessment of present transport situation and issues and analysis on the future traffic demand in the target year of 2015 and 2025.

(2) Future Land Use Plan and Socio-Economic Framework

The development pattern of urban structure were proposed taking into consideration the estimated land demands and distribution of urban function. It was then used as the basis of formulation of future socio-economic framework.

(3) Transport Infrastructure Development Policy, Strategy and Target

The Government of Southern Sudan through the Ministry of Transport and Roads have formulated and authorized transport sector policy and strategic plan which is adapted as the basic policy of the Study. Consequently the sector policy for road network development and public transport development, and transport management and maintenance system development are established.

The strategy and target are proposed in accordance with the basic policy to technically draw up the direction of the Study.

(4) Transport Sector Development Plan

In line with the proposed transport development strategy, the detailed plan for each sector is prepared. In preparing the Sector Plans, the environmental and social consideration on projects proposed in the Sector Plans are worked on, and mitigating measures are examined in cases where negative impacts are likely to exist.

(5) Overall Implementation Plan

The practical implementation plan involving each sector is prepared as a guide of the actual implementation considering the implementation capacity of responsible agencies including institutional, human and financial resources, as well as project implementation priority and constraint.

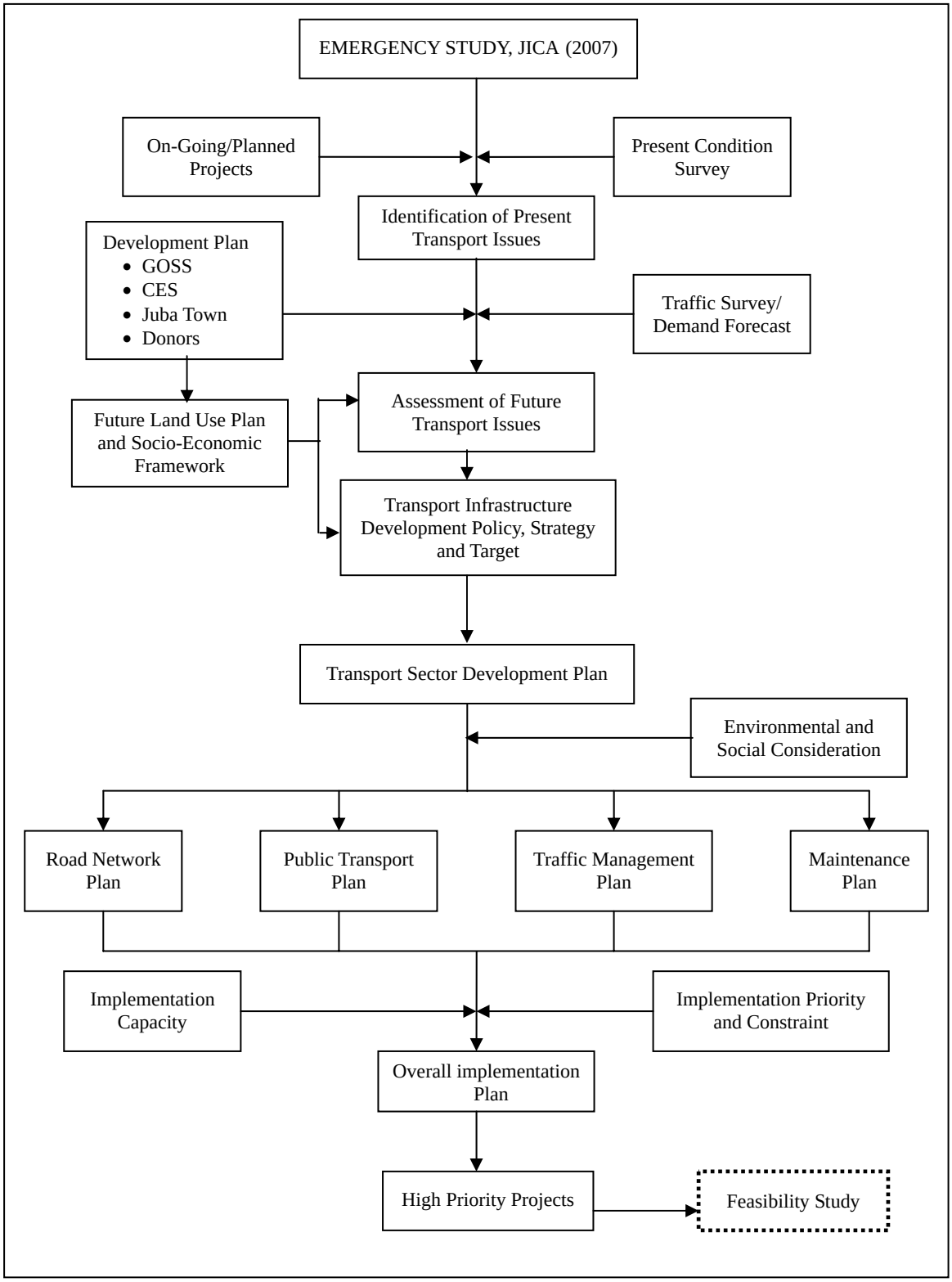


Figure 7.1-1 Procedure of Transport Master Plan Formulation

7.2 TRANSPORT DEVELOPMENT POLICY AND OBJECTIVE OF MTR

7.2.1 Transport Sector Policy

The Ministry of Transport and Roads (MTR) has prepared a transport sector policy in October 2007, with a clear vision, mission, policy objectives and implementation strategy for its role in achieving the GOSS objectives. It is emphasized that the growth of transport sector will integrate economic development in Southern Sudan. Expanded transport capacity at all levels will provide a long term benefit of an improved regional transport system.

The transport infrastructure in Southern Sudan, comprises all physical elements upon which transport operation takes place. It includes roads, railways, airports and river transport. The establishment and maintenance of those infrastructures, particularly the road network, is a fundamental requirement of a functioning land transport system. Such a system is essential for the development of the productive sectors of the economy, and for the development of trade, social services and security in the region.

The policy statement is demonstrated in the transport sector policy, as summarized below.

Vision

The vision of the Ministry of Transport and Roads is to develop a safe, secure and efficient transport system for the prosperous Southern Sudan.

Mission

The mission is to serve the people of Southern Sudan by ensuring a fast, safe, efficient, accessible, convenient and affordable intermodal transport system that meets the vital national interests and enhances the quality of life of the people today and its future.

Key Policy Factor

Key policy factors for measurement of the effectiveness of transport sector delivery will be: accessibility, mobility, safety, quality of life, system preservation, management and productivity, and organization excellence.

- **Accessibility**: Accessibility through transportation system and services is provided for people living in remote and isolated parts of the country enabling them to benefit from national socio-economic development.
- **Mobility**: Innovative management of the transportation system and services improves mobility ensuring that people and goods can move efficiently.
- **Safety**: Safety is maximized for users of transport services through infrastructure improvements, traffic safety laws enforcement, and information activities.
- **Quality of Life**: Social, economic and environmental concerns are balanced in transportation programs and projects that improve the quality of life in Southern Sudan.
- **System Preservation**: A “maintenance first” commitment guides the management of our assets and process with funding and resources prioritized for the preservation and betterment of all systems and services.
- **Management and Productivity**: Maximize performance across the organization to make

better use of scarce resources and improve the effectiveness and efficiency of the products and services that provide for citizen of Southern Sudan.

- **Organization Excellence**: Advance the ability of the Ministry of Transport and Roads and participating institutions to manage for results and innovation.

7.2.2 Transport Sector Objectives

The followings are the extracts from the Transport Sector Policy, focusing on notable policies in preparing Juba Urban Transport Master Plan.

(1) Overall Policy Objectives

The Government recognizes the fact that lack of an efficient transport system impacts negatively on the performance of the economy. At this end the Government will be committed to ensure that the transport sector performs its role as a catalyst in the social and economic development process of Southern Sudan. Participation of the private sector in the development of the transport sector is a key policy objective that will be pursued by the Government.

- Improve mobility in the rural areas through the promotion of the use of appropriate means and modes of transport.
- Contribute to job creation and income generation and provide equal opportunities for men and women in transport sector.
- Ensure safety standards in all modes of transport by enforcing appropriate safety measures under an improved management regime.
- Provide links with the states and neighboring counties.
- Recognize and account for environmental concerns, within the transport sector in line with the national environmental action plan.

(2) Road Infrastructure

The policy is to construct modern roads that will connect various parts of Southern Sudan internally and link them as well to the outside world.

An on-going program of emergency road repairs is being pursued. Major road repair works will continue on many roads, while a vital emergency roads project is planned for Juba and other urban centers.

- Maintain, rehabilitate, improve and construct roads in order to ensure improved accessibility and minimize road transport costs. Higher priority will be given to the prime routes linking Southern Sudan to neighboring countries, State capitals, and other urban and population centers.
- Establish appropriate standards for road design and construction.
- Establish appropriate road institutions that include road agencies, road boards, and road councils.
- Ensure that environmental and safety concerns are adequately addressed in the design, rehabilitation and maintenance of roads.

(3) Road Transport

The specific objectives of road transport are stipulated, among others, as follows:

- Create capacity commensurate with transport requirement of the economy by allocation of sufficient resources in the roads transport sector.
- Establish adequate legislation and institution for enforcement and better organization and efficient delivery of transport services.
- Ensure safety and security by enforcing law that relates to them.

(4) Rural Travel and Transport

- Improve the planning, management and financing of rural road transport as well as upgrading road infrastructures such as community roads, paths, tracks and footbridges through community participation.
- Facilitate the introduction and promotion of appropriate motorized and non- motorized means of transport aimed at improved mobility in rural areas.

(5) Non-motorized and Intermediate Means of Transport

Large number of residents in rural and urban areas meets their daily travel needs by walking.

- Reduce rural and urban transport burden and travel time.
- Reduce conflicts between motorized and non-motorized transport in urban and market centers to improve safety and reduce congestion.
- Incorporate in planning and policy development of non-motorized transport.

(6) Air Transport

The policy is to repair and maintain all major airports and airstrips that have been used. Priority in the immediate planning period will go to Juba airport with view to bringing it up to international standard. Other airports include: Wau, Malakal and Rumbek.

- Construct, rehabilitate and maintain Juba Airport and other selected airports into international standards.
- Encourage partnership between local and international air transport operators.

(7) River Transport

The River Nile is now seriously silted up and its transportation capacity curtailed. River ports like Juba, Mongalla, Bor, Adok, Shambe, Malakal and Renk will be initially rehabilitated or developed because of a huge investment required.

(8) Railways

A feasibility study is proposed to examine the needs of rehabilitation of the Wau-Aweil-Babanusa Railway, and a construction of a railway line connecting Juba to Mombasa either through Uganda or western Kenya. The study will also consider rail linkage with Congo, linking Juba-Yei-Lasu with Kisangani in order to gain access to Atlantic and open up its market to Southern Sudan.

7.2.3 Transport Development Projects Implementation Strategy

The transport policy framework stipulated in the Transport Sector Policy covers the five year period 2007-2011 with a two phase implementation strategy. After establishment of the Ministry of Transport and Roads in October 2005, the effective process for the recovery started thereafter immediately in 2006.

(1) Recovery Phase (2007-2008)

The initial phase is a recovery program phase started in 2006, and focused on establishing the required capacity within both public and private sectors to undertake and manage the construction and maintenance program especially in roads, airports, river and railways.

Specific issues for the recovery period include:

- Sustenance of past and on-going improvements to secure improvements on roads and airports infrastructures and systems by putting initial contracts for maintenance.
- Establishing the institutional structures in both GOSS and private sectors to implement a well-conceived investment program.
- Capacity building, skill development and training in both the public and private sectors.
- Rehabilitate and develop the roads, rivers, air and railway transport systems as a basic for opening up and developing the economy in Southern Sudan, expanding local jobs and incomes, and for consolidating and sustaining peace.
- Establish the transport policy.

(2) Development Phase (2009-2011)

The longer term task of accelerating development entails enhancing the project activities started in the recovery phase and establishing a fully functioning transport system.

Specific issues for the development phase include;

- Establishing legislative framework for the institutions for implementation, operation, management and regulation in roads, air, rail and river transport.
- Continuing the process of developing private and public capacity in the management, building, maintenance, operation of transport infrastructures and transportation services.
- In particular, the process of encouraging the development of small and medium sized contracting companies.
- An appropriate emphasis on labor-based system for the construction and maintenance works to promote development of both management and building skills among small local enterprises in the relevant areas especially in roads.
- Institutions and policy issues will be reviewed on on-going basis and any necessary reforms will be implemented as the need arises.
- The social and economic impact of developing the transport network will be carefully monitored, with an effort to draw policy implications for investment programs.

7.3 STRATEGIC PLAN FOR ROAD SECTOR OF MTR

7.3.1 Constraints to Road Development

Transport sector in Southern Sudan consists of 4 major modes namely; roads, railway, inland water and air transports. The road sector is important in the trade with east and central African countries.

The current road network is overseen by the Ministry of Transport and Roads, Ministry of Physical Infrastructure in the States and County Authorities.
The Strategic Plan for road sector prepared by the MTR, July 2006, revealed that the main reasons for lack of road development and weak road maintenance are as follows:

- Long running civil war spanning over twenty years,
- Neglect of the Southern by the Government of the North,
- Lack of institutional structures in SPLM/ GOSS,
- Inadequate technical capacity (lack of skilled personnel and absence of private sector investments),
- Mining of road network,
- Uncoordinated planning,
- Inadequate funding,
- Difficulties in the execution of road works (contract management, dispute resolution),
- Inadequate trained staff,
- Inadequate planning framework, and
- Pavement overloading by heavy goods vehicles.

7.3.2 Steps for Implementation of Strategic Plan

The Strategic Plan of the MTR prescribes that the strategy to be followed by the GOSS in achieving a sustainable development and maintenance of the road sector involves the following steps.

- De-mining
- Establishment of appropriate institutions
- Management of road network
- Training needs
- Funding
- Equipment policy
- Material testing
- Contracting policy
- Gender equity
- Environmental and social impact assessment
- Road traffic safety
- Monitoring and evaluation

(1) De-mining

The construction, rehabilitation and maintenance costs for roads affected by mines should provide a percent for de-mining. This arrangement would be mandated in the contract document together with a provisional fund for de-mining.

(2) Establishment of Appropriate Institutions

The institutional arrangement for both funding and management needs to be clearly specified. It is proposed that a system of autonomous agency be established to manage the road infrastructure, finances and operations. These agencies will fall under the aegis and overall policy direction of the MTR. They include the followings:

- Southern Sudan Road Board (SSRB):
  Responsible for fund management.
- Southern Sudan Road Agency (SSRA):
  Responsible for administration, control, development and maintenance of interstate and international roads.
- State Road Agency (SRA):
  Responsible for administration, control, development and maintenance of primary and secondary state roads.
- Southern Sudan Urban Road Agency (SSURA):
  Responsible for management, control, development and maintenance of all roads within the areas of the agency of city, municipal and town councils in Southern Sudan. The agency is empowered among others, to define the urban road network, its sub-divisions based on consideration of national interest and functional classification scheme determined by the agency.
- Southern Sudan County Road Agency (SSCRA):
  Responsible for administration, control, development and maintenance of secondary roads and below, and small town roads.
- Road Traffic and Safety Management Unit (RTSMU):
  Taking charge of coordination and management of road safety activities and the development of traffic policy and standards.

(3) Management of Road Network

The road management entails the following:

- Classification of the road network
  The road network will be classified in order of importance based on their functions and should take the order of International/Interstate roads, State roads and County roads. Each category of classification will have specific standard for both construction and maintenance.
- Road inventory
- Road condition survey
- Non-motorized traffic
  Non-Motorized and Intermediate Means of Transport (NMIMT) will be developed and provided in designated roads irrespective of their use by motorized transport.
- Roads standards and specifications
- Information management systems
- Prioritization of projects and activities
- Axle load control

(4) Training Needs

- Policy training for top echelons
- Business training for contractors
- Technical training for managers and supervisors.

(5) Funding

Road user charges primarily generated from fuel levies are to be used for maintaining the roads.

(6) Equipment Policy

All works will be contracted out. However, the MTR will determine an optimum fleet capable of servicing emergency situations.

(7) Material Testing

Material division of SSRA or SRA will address the suitability of materials and applications during the execution of works, and quality assurance.

(8) Contracting Policy

The following contracting policies are emphasized.

- Short form of contract
  This type of contract is recommended for construction work of relatively small capital value or repetitive work e.g. routine maintenance in a given period.
- Performance-based contract for management and maintenance of roads
- Design and build contract
- Work supervision services
  Experienced engineering firms are engaged for work implementation, by procuring through Quality- and Cost-Based Selection (QCBS).

(9) Gender Equity

- Gender mainstreaming into project planning and implementation.
- Opportunity for training and employment in road programs.

(10) Environmental and Social Impact Assessment

An Environmental Impact Assessment (EIA) will be carried out for all rehabilitation and construction works including social impacts, mitigation plan and resettlement action plan.

(11) Road Traffic Safety

- Improve institutional management
- Improve road safety
- Enhance road traffic discipline

(12) Monitoring and Evaluation

- Establish an M&E system for feedback.
- Establish a special committee for key stakeholders to design and commission M&E.
- Establish standard format for data collection and reporting.

7.3.3 Plan Implementation Schedule

The period for the strategic plan implementation proposed by the MTR is from June 2006 - June 2011. The MTR will review the progress of the programs after years (June 2008) and adjust it accordingly.

The estimated costs during the Strategic Action Plan are set out in Table 7.3.3-1.

Table 7.3.3-1 Costs of Road Projects

Unit in US$ Million

ID	Project	Cost-Phase 1	Cost-Phase 2	Total Cost
Road 1	Renk to Malakal	15.0	75.0	90.0
Road 2	Main roads in the Southern Sudan [2)]	61.4 [1)]	400.0	461.4
Road 3	Emergency rehabilitation; Southern Sudan	89.0	-	89.0
Road 5	Road development in other war-affected areas	0.2	64.0	64.2
Road 6	Rural roads; Southern Sudan [3)]	1.1 [1)]	69.0	70.1
Road 7	Road maintenance; Southern Sudan [2)]	5.1	20.4	25.5
Road 8	Ta to GOSS [1)]	2.3	2.2	4.5
Road 10	Ta to local construction industry [1)]	0.6	-	0.6
Total		**119.5**	**751.4**	**870.9**

Source: Strategic Plan for Road Sector, MTR, July 2006

Note:

1) Technical
2) The much more challenging program mentioned under the description of Road 2 would increase the total cost of Road 2 to about US$ 2,330 million and the Road 7 project to about US$ 54 million for the six year period (US$ 400 million per year).
3) The total size of this program is likely to be increased based on further studies to be done during Phase 1.

7.4 PROPOSED URBAN TRANSPORT DEVELOPMENT STRATEGY AND TARGET

7.4.1 Present Urban Transport Issues

The present conditions of Urban Transport Infrastructure are discussed in Chapter 3. The Transport Sector Policy of the MTR reviewed the specific issues for the recovery period (2007-2008) and identified the development issues for the development phase (2009-2011) as reported in Sections 7.2.and 7.3 of Chapter 7.

Based on these reviews, the transport issues are assessed as follows.

Urban Structure

- No land use plan, no physical infrastructure plan and lack of land use control.
- Urban sprawl due to fast and disorganized land development.

Road Network

- Undeveloped or inefficient road network to induce urban development due to inadequate planning framework.
- Not hierarchical road network system.
- Substandard international/interstate/arterial road corridor.
- Traffic congestion due to inadequate transport facilities and road network function.
- High vehicle operating and transport costs due to deteriorated road condition.

Public Transport

- Disorganized public transport system such as buses, mini-buses and motorbike taxis.
- Lack of facilities for public transport.

Traffic Management

- Poor enforcement and education on traffic regulations due to lack of traffic management system.
- Increase in traffic accidents with increasing motor vehicles.

Institution

- Lack of institutional structures in the GOSS and States.
- Inadequate technical capacity including level of skilled personnel and absence of private sector investments.

Environment

- Poor air quality due to poor road condition.
- Lack of space for non-motorized transport.
- Poor roadside amenity and city environment due to lack of drainage facility, sidewalks, etc.

If these transport issues will not be properly addressed, the socio-economic activities of people in the influenced areas will be critically restricted due to uncommonly inconvenient means of transport and extremely high transport cost. The city environment will be seriously aggravated because of increasing level of air and noise pollution and escalating slum population. Thus, the socio-economic development of Juba City as well as Southern Sudan will be severely hampered. Therefore the present urban transport system shall be improved at the earliest time possible.

7.4.2 Proposed Urban Transport Development Strategy

The Government of Southern Sudan recognizes the transport sector as a catalyst of rapid economic growth and reconstruction, poverty eradication and wealth creation for Southern Sudan. To enable the transport sector to effectively play its role, the Ministry of Transport and Roads formulated the Transport Sector Policy in 2007 and Strategic Plan for Road Sector in 2006 as presented in Sections 7.2.and 7.3 of Chapter 7, respectively.

In compliance with the synopsis of the policy and strategic plan related to urban transport, the Juba Urban Transport Strategy is proposed as discussed hereunder.
Table 7.4.2-1 shows the proposed strategy in this Study with the existing issues, vision and policy.

(1) Vision

- Economic Growth
  To provide transport infrastructure to stimulate investment, leading to poverty eradication and enhanced economic growth.
- Quality of life
  To develop a safe, secure and efficient transport system, enhancing the quality of life of people.
- Transport Hub in the Region
  To initiate world-class transport system as the hub in the region.

(2) Policy

- Institution
  To establish appropriate institutional framework for urban transport system.
- Capacity
  To develop public and private sector capacity for construction, maintenance and operation of urban transport infrastructure.
- Finance
  To establish sustainable institutional and financial mechanism for development and maintenance of urban transport infrastructure.
- Special Policies
  - Labor-based system for construction and maintenance,
  - Road traffic safety,
  - Gender equity, and
  - Environmental and social consideration.

(3) Strategy

Institution

Strategy 1: Legal and Regulatory Framework on Urban Infrastructure Development

The streamlined legal, institutional and regulatory framework shall be established to define clear management responsibility, appropriate planning approach, and sustainable financial mechanism. The system for effective enforcement on traffic regulation and systematic education on traffic regulation shall be also established for road traffic safety.

Strategy 2: Roles of Public and Private Sectors

The roles and responsibilities of the central government and local government as well as private

Table 7.4.2-1 Proposed Urban Transport Development Strategy

Existing Issues	Vision	Policy	Strategy
Urban Structure •No land use plan, no infrastructure plan and lack of land use control •Urban sprawl **Road Network** •Undeveloped/inefficient road network to induce urban development •Not hierarchical road network system •Substandard international/interstate/ arterial roads corridor •Traffic congestion due to inadequate transport facilities and road network function •High vehicle operating and transport costs due to deteriorated road condition **Public Transport** •Disorganized public transport system •Lack of facilities for public transport **Traffic Management** • poor enforcement and education on traffic regulations •Increase in traffic accidents **Institution** •Lack of Institutional structures •Inadequate technical capacity **Environment** •Poor air quality •Lack of space for non-motorized transport •Poor roadside amenity and city environment	**Economic Growth** • To provide transport infrastructure to stimulate investment, leading to poverty reduction and enhanced economic growth **Quality of Life** • To develop a safe, secure and efficient transport system, enhancing the quality of life of people **Transport Hub in Region** • To initiate world-class transport system as the hub in the region	**Institution** • To establish appropriate institutional framework for urban transport system **Capacity** •To develop public and private sector capacity for construction, maintenance and operation of urban transport infrastructure **Finance** •To establish sustainable institutional and financial mechanism for development and maintenance of urban transport infrastructure. **Special policies** • Labor-based system for construction and maintenance works •Road traffic safety •Gender equity •Environmental and social consideration	**Institution** 1. Legal and Regulatory Framework on Urban Infrastructure Development 2. Roles of Public and Private Sectors **Road Development** 3. Immediate Rehabilitation of Existing Roads 4. Administrative and Functional Classification of Roads 5. Development of Hierarchical Road Network System 6. Establishment of Appropriate Standards for Roads Engineering 7. International Level of Improvement **Public Transport** 8. Policy and Regulation of Public Transport Operation 9. Promotion of Bus Transport 10. Provision of Bus Transport Infrastructure **Traffic Management** 11. Development of Traffic Policy and Regulation on Management 12. Enforcement of Traffic Law and Regulation 13. Education of Traffic Rule and Safety Behavior **Specific Issues** 14. Development of Non-motorized Transport Facility 15. Consideration on Environmental and Social Impacts 16. Human Resource Development

sector shall be clearly clarified for construction, maintenance and operation of urban transport infrastructure.

Road Development

Strategy 3: Immediate Rehabilitation of Existing Roads

The present condition of roads is a serious impediment to socio-economic activities of people in Juba which negatively impacts the economic growth. The immediate rehabilitation of existing roads in Juba urban area is in urgent need.

Strategy 4: Administrative and Functional Classification of Roads

The administrative classification of Roads is mandatory to define the roles and responsibilities of government agencies. The functional classification of roads is also required to form the hierarchical road network system to provide specific levels of efficient transport infrastructure and services.

Strategy 5: Development of Hierarchical Road Network System

The hierarchy of road network system composed of arterials, collectors and local streets shall be systematically developed.

A radial-circumferential type road network is recommended in order to address the mobility and accessibility needs depending on areas which roads traverse. This road network type can contribute to control a harmonious land use and induce systematic urban structure development which shall be also proposed.

Strategy 6: Establishment of Appropriate Standards for Road Engineering

The appropriate standards for road planning, design, construction, maintenance and monitoring are of the essence for planning of optimum investment level and capacity development as well as assurance of work quality. The standards shall include the prioritization criteria of road investments based on both the level of economic benefits and social benefit.

Strategy 7: International Level of Improvement

Juba is the capital city of Southern Sudan, which shall be the transport hub in Region. It is, therefore, recommended that the level of transport facilities and services be superior, comparable to international standard. The modern technology in design and construction shall be employed to provide world-class urban transport infrastructure.

Public Transport

Strategy 8: Policy and Regulation of Public Transport Operation

The policy and regulation of public transport operation such as bus and taxi shall be enacted including such system as vehicle registration, transport fare, vehicle inspection for passenger safety, and designation of bus operation routes.

Strategy 9: Promotion of Bus Transport

Public passenger transport operation such as buses is optimal particularly for the transport poor, when the appropriate regulation and acceptable infrastructure are provided to promote its operation. The regulation and its enforcement, and provision of road infrastructure for road based public transport is one of the key

issues for urban transport.

To promote private sector participation in bus transport, incentives in the form of taxes, insurance, credit facilities for financing are recommended to be provided by the government.

Strategy 10: Provision of Bus Transport Infrastructure

Bus routes shall be designated, particularly on arterials and major collectors where road infrastructures and facilities such as convenient bus stops and useful terminals both for passengers and freight traffic shall be provided.

Traffic Management

Strategy 11: Development of Traffic Policy and Regulation on Management

The traffic policy, law and regulation on traffic management shall be developed and enacted for road safety activities which may be taken charge by the Road Traffic and Safety Management Unit to be created. The respective roles and responsibilities of the Unit shall include the financing of traffic management among others.

Strategy 12: Enforcement of Traffic Law and Regulation

The enforcement of traffic law and regulation shall be improved and pursued. Traffic officers in charge of traffic regulation enforcement shall be sternly trained to obey the professional ethics, providing training equipment, materials and favorable conditions of employment.

Strategy 13: Education on Traffic Rule and Safety Behavior

The awareness of the need for better road safety behavior among the road users through publicity and education shall be developed and promoted. Awareness campaigns on road safety shall be conducted, and education of children in schools shall be encouraged.

Specific Issues

Strategy 14: Development of Non-Motorized Transport Facility

The use of motor vehicle is generally limited and largely unaffordable to the transport poor. Given the important need to reduce travel time and burden, Non-Motorized and Intermediate Means of Transport (NMIMT) infrastructures shall be developed and provided in designated roads. The infrastructures and facilities including footpaths, bicycle lanes, and ramps for the disabled shall be incorporated in road planning and construction, and be eligible for financial support from the road agencies.

Special attention shall be given to reduce conflicts between motorized and non-motorized transport in urban and market centers to improve safety and reduce congestion.

Strategy 15: Consideration on Environmental and Social Impacts

The enacted legislation and guideline on environmental management shall be strictly observed. Physical planning for urban transport shall ensure that environmental issues are explicitly included as a part of road design decision. There is need for explicit and up-front consideration to anticipate, manage and mitigate potential environmental and social problems.

The Strategic Approach on environmental and social impact assessment is recommended. This Approach requires stakeholder participation and meetings during road planning phase to assess possible impacts, and come up with an acceptable solution on any negative impact. This process shall be publicly announced. The discussion shall include natural environmental degradation, land acquisition, resettlement plan, and gender involvement, among others.

Strategy16: Human Resource Development

The road sector faces a serious shortage of trained and experienced manpower. The development of public and private capacities in the management, planning, construction, maintenance and operation of transport infrastructures and transport services is urgently needed. These include administrative and business management expertise both within the government and business sectors.

The in-service and on-the-job training programs are recommended to challenge the immediate needs of developing the necessary capacity. The program shall be incorporated in all phases of road project implementation to deal with the full spectrum of training and human resource development in both the public and private sectors.

7.4.3 Proposed Transport Development Target

(1) Basic Concepts

The highway and street network plays a major role in providing the travel mobility and access to property. Access is a fixed need for every area served by the highway system. Mobility is provided at the service level. Mobility can incorporate several qualitative elements, such as riding comfort and absence of speed changes, but the most basic factor is operating speed or trip travel time which may be terms of congestion.

The appropriate degree of congestion that should be used in planning highway improvements is determined by merging the desire of the motorists against availability of means for satisfying these desires. The degree of congestion that should not be exceeded during the design year on a proposed highway can be realistically assessed by determining the operating conditions that the majority of motorists will accept as satisfactory or acceptable degree of congestion.

Based on the concepts mentioned above, the targets of urban transport development plan are proposed in accordance with the guidelines of the Highway Capacity Manual (HCM)

(2) Level of Service by Highway Class

HCM defines 4 urban classes based on street function and design as shown in Table 7.4.3-1.

Table 7.4.3-1 Urban Street Class Based on Functional and Design Categories

Design Category	Functional Category	
	Principal Arterial	Minor Arterial
High Speed	I	N/A
Suburban	II	II
Intermediate	III	III or IV
Urban	IV	IV

Table 7.4.3-2 lists the criteria on Level of Services (LOS) of urban streets based on average travel speed and urban street class. It should be noted that if the demand volume exceeds capacity at any point on its street (volume capacity ratio, V/C>1), the average speed might not be at a good measure. The general definition of LOS is shown in Table 7.4.3-3.

Table 7.4.3-2 Level of Service by Class

Urban Street Class	I	II	III	IV
Signal Density (signal/km)	0.5	2	4	6
Range of free flow speeds (FFS)	90 to 70km/h	70 to 55km/h	55 to50 km/h	50 to 40km/h
Typical FFS	80km/h	65km/h	55km/h	45km/h
LOS	Average Travel Speed(km/h)			
A	>72	>59	>50	>41
B	>56-72	>46-59	>39-50	>32-41
C	>40-56	>33-46	>28-39	>23-32
D	>32-40	>26-33	>22-28	>18-23
E	>26-32	>21-26	>17-22	>14-18
F	≤26	≤21	≤17	≤14

Source: HCM

Table 7.4.3-3 Definitions of Levels of Service

General Level of Service	General Operating Conditions	Characteristics	Speed
A	Free Flow	Completely unimpeded operation Control delay at signal intersection is minimal	100%
B	Reasonably Free Flow	Only slightly restricted Control delay is not significant	70%
C	Stable Flow	More restricted Longer and adverse signal co-ordination	50%

Source: HCM

(3) Proposed Targets

The LOS and average travel speed as the indicators of targets by each road class are shown in Table 7.4.3-4.

Table 7.4.3-4 Proposed Targets by Street Class

Design Category	Road Class	Class	LOS	Average Travel Speed(km/h)
High Speed	International Highway	I	B [1)]	60
Urban	Principal Arterials (Radial and Circumferential Road)	II	C	40
Urban	Minor Arterials (Arterials other than above)	III	C	30
Urban	Collectors and others	IV	D	20

Note: [1)] LOS for the International Highway in rural and sub-urban area is proposed B and average travel speed more than 60km/h.

CHAPTER 8

TRAFFIC DEMAND FORECAST

CHAPTER 8 TRAFFIC DEMAND FORECAST

8.1 PRESENT TRAFFIC

8.1.1 Traffic Survey

To study the present traffic pattern and existing problems, and to estimate the future traffic demand required for the formulation of the future urban transport plan, the traffic surveys as shown in Table 8.1.1-1 were conducted. Figure 8.1.1-1 shows the traffic survey locations.

Table 8.1.1-1 Contents of Traffic Survey

Item	Number of survey locations	Survey time	Survey method
Roadside traffic count	8	16 hours on 2 consecutive days	Manual count of traffic volume by direction and by vehicle type
	5	24 hours on 2 consecutive days	
Roadside OD survey	8 (same as those for roadside traffic count	16 hours on 2 consecutive days	Interview of drivers on: - Vehicle type - Origin and destination - Trip purpose - Number of passengers - Cargo item and volume
Intersection traffic count	8	morning and evening peak hours (3 hours each) on 2 consecutive days	Manual count of traffic volume by direction and by vehicle type
Travelling speed survey	7 routes (about 5 km long)	3 times per day (morning, daytime and evening) on 2 consecutive days	Floating car method on the following survey items: - Time of passing at check points - Cause of delay/stoppage if any
Bus service survey	Major three bus terminals (Custom, Juba, Konyo -konyo)	200 samples on weekdays	Hearing from passengers on: - Frequency of taking busses - Purpose of taking busses - Problems on bus services - Requests for improvement of bus services

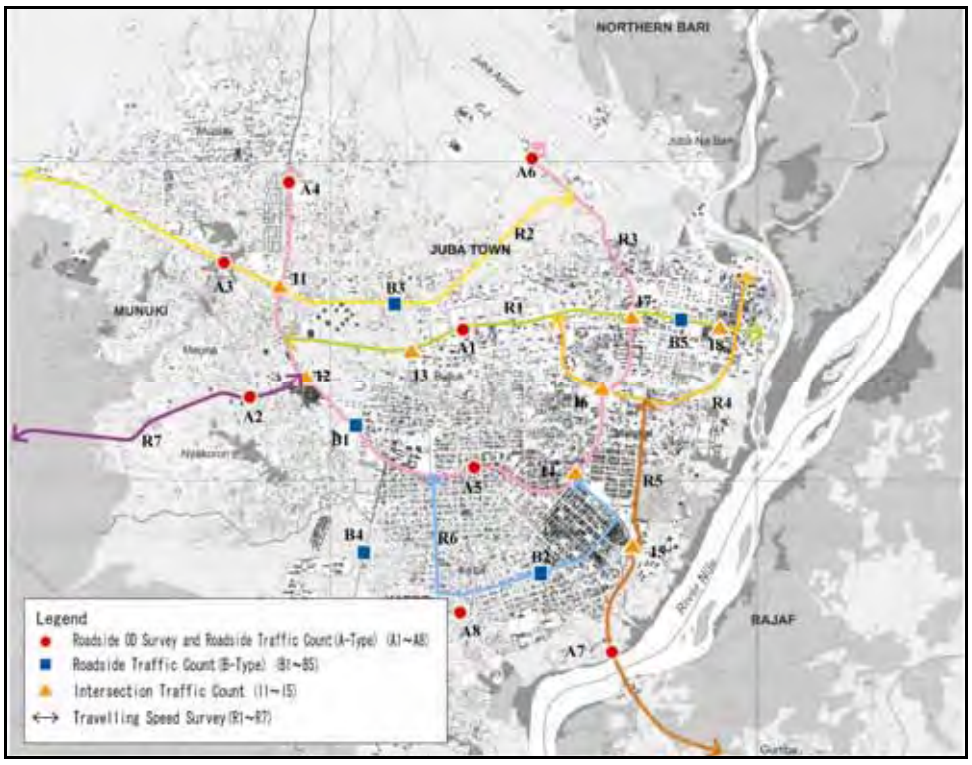


Figure 8. 1.1-1 Traffic Survey Locations

8.1.2 Zoning System

The zoning system is shown in Figure 8.1.2-1 and Table 8.1.2-1, 8.1.2-2.

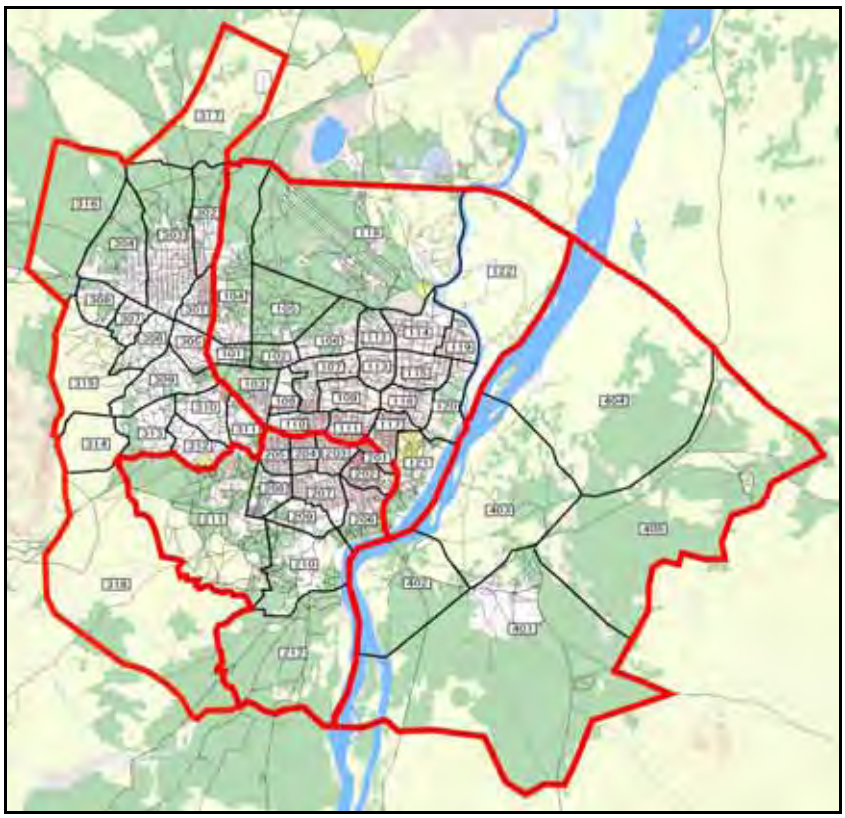


Figure 8.1.2-1 Zoning System of the Study Area

Table 8.1.2-1 Zoning System Inside the Study Area

No.	Zone Code	Name	Payam
1	101	GOSS Government Ministries with Nakasongola Community	Juba Town
2	102	Foreign Missions with Grass Land	
3	103	University of Juba with Nyakama Community	
4	104	Grasslands with Tongping Community	
5	105	Mostly Grasslands	
6	106	Ministerial Quarters,Amarat Community	
7	107	Foreign Missions with 1st Class Residences	
8	108	Buluk, Zendia Thoura Communities	
9	109	Game and Commercial Communities	
10	110	University of Juba with Mayo Community	
11	111	Azala and Neem Community	
12	112	New Business District	
13	113	Dressers Line Community	
14	114	Jalaba and Gabat Community	
15	115	Central Business District including Police Quarters	
16	116	Cinema and Missia Community	
17	117	Malakal Community	
18	118	Airport and Glasslands	
19	119	Jabel Nyoka	
20	120	West Bank of Nile River (North)	
21	121	West Bank of Nile River (South)	
22	122	North Bank of Nile River (North)	
23	201	Konya Konya Market	Kator
24	202	Malakia Area	
25	203	Aklabara A Area	
26	204	Aklabara B Area	
27	205	Aklabara C Area	
28	206	Kator(East) & Kassava	
29	207	Kator(Central)	
30	208	Kator(West)	
31	209	Miro	
32	210	Lologo	
33	211	Military Camp Area	
34	212	Lologo(New Development Area)	
35	301	Kuwait & Munuki Island	Munuki
36	302	Muniki A	
37	303	Muniki B	
38	304	Muniki C	
39	305	Mauna(East)	
40	306	Darsalam	
41	307	Jebel	
42	308	Seminary	
43	309	Mauna & Nyakoron(West)	
44	310	Nyakoron(North)	
45	311	Nyakoron(East)	
46	312	Nyakoron(South)	
47	313	Nyakoron(West)	
48	314	Nyakoron New Urban Development Area	
49	315	Jebel New Urban Development Area	
50	316	Gudele New Urban Development Area(West)	
51	317	Gudele New Urban Development Area(North)	
52	318	Nykoron New Urban Development Area(South)	
53	401	Gumba	Rejaf
54	402	East Bank of Nile River (South)	
55	403	East Bank of Nile River (Center)	
56	404	East Bank of Nile River (North)	
57	405	Rejaf Development Area	

Table 8.1.2-2 Zoning System Outside of the Study Area

No.	Zone Code	Payam	County	State / Country
58	501	Mangalla	Juba County	Central Equatoria
59	601	Lirya		
60	701	Rokon		
61	801	Lobonok		
62	901	Northern Bari		
63	1001	Wonduruba		
64	1101	Lokiliri		
65	1201	Dolo		
66	1301	Bungu		
67	1401	Ganzi		
68	1501	Tijor		
69	1601	Gondokoro		
70	2001		Tekekeka County	
71	2002		Kajo keji County	
72	2003		Lainya County	
73	2004		Morobo County	
74	2005		Yei County	
75	3001		Lafon, Torit, Nimule	Eastern Equatoria
76	3002		Mundri,Maridi	Western Equatoria
77	3003		Bor,Pochalla	Jonglei
78	3004		Malakal	Upper Nile
79	3005		Rumbek	Lakes
80	3006		Lwacjok	Warrab
81	3007		Aweil	Northern Bahr El Ghazal
82	3008		Wau	Western Bahr El Ghazal
83	3009		Bentiu	Unity
84	3010		Khartum	Noth Area of Sudan
85	3011			ETHIOPIA
86	3012			KENYA
87	3013			UGANDA
88	3014			CONGO
89	3015			CENTRAL AFRICA

8.1.3 Result of Traffic Survey

(1) Traffic Count

1) Daily Traffic Volume

Figure 8.1.3-1 shows the daily traffic volume. The 16hr. traffic count data at 8 stations were converted from 16hr. to 24hr. traffic volume. Daily traffic volume of each station by vehicle type is shown in Table 8.1.3-1 and Table 8.1.3-2.

The streets with high MT (Motorized Transport) are as follows.

- May Street 16,256 (vehicles/day)
- Yei Road near Custom Market 12,550 (vehicles/day)
- Unity Avenue 11,515 (vehicles/day)
- May Street near Traffic Police 10,566 (vehicles/day)

The street with the highest NMT (Non Motorized Transport) is Yei Road near Custom Market; the number of NMT is 4371.

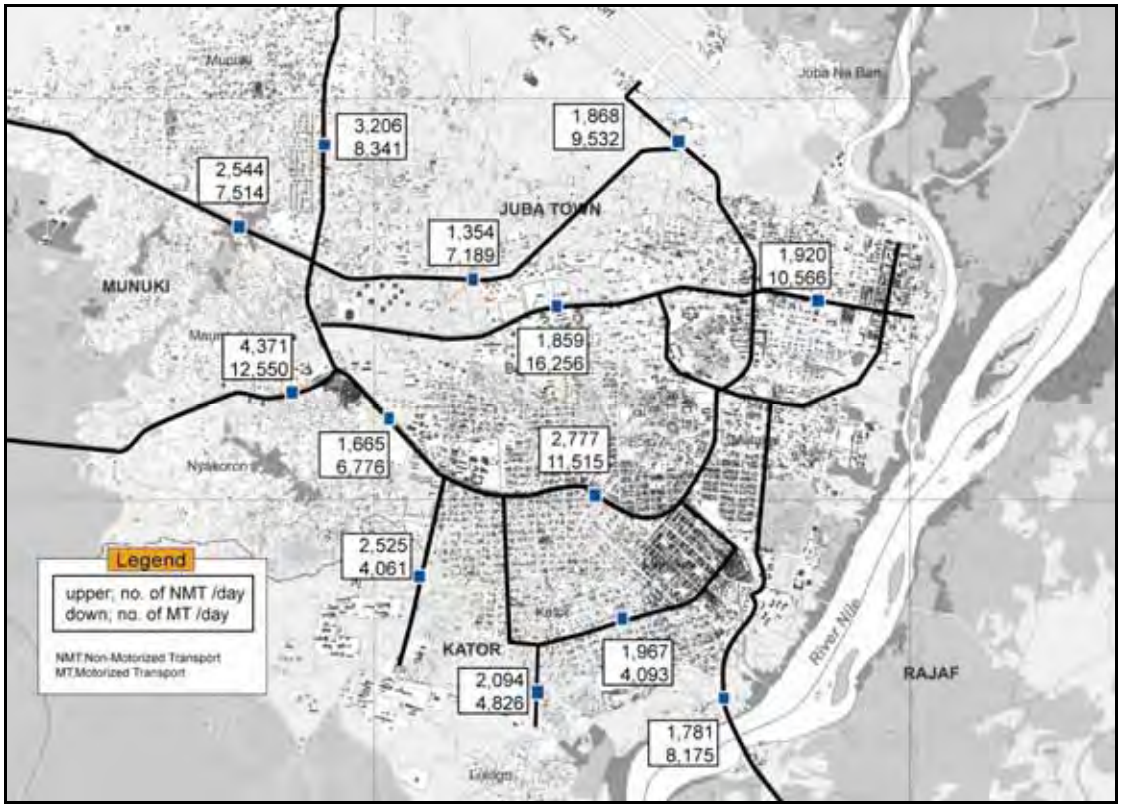


Figure 8.1.3-1 Daily Traffic Volume

2) Traffic by Vehicle Category

Traffic volume by vehicle category along major roads is illustrated in Figure 8.1.3-2. From the figure, the traffic characteristics can be clarified as follows;

- The share of Motorcycle (M/C) is the highest, 25~50% of all vehicles. The share of Passenger Car is also relatively high, 15~36% of all vehicles.

- The share of Mini Bus with Unity Ave.(Sta.A5) and May Street(Sta.B5) is approximately 30% and are higher than that with other roads.

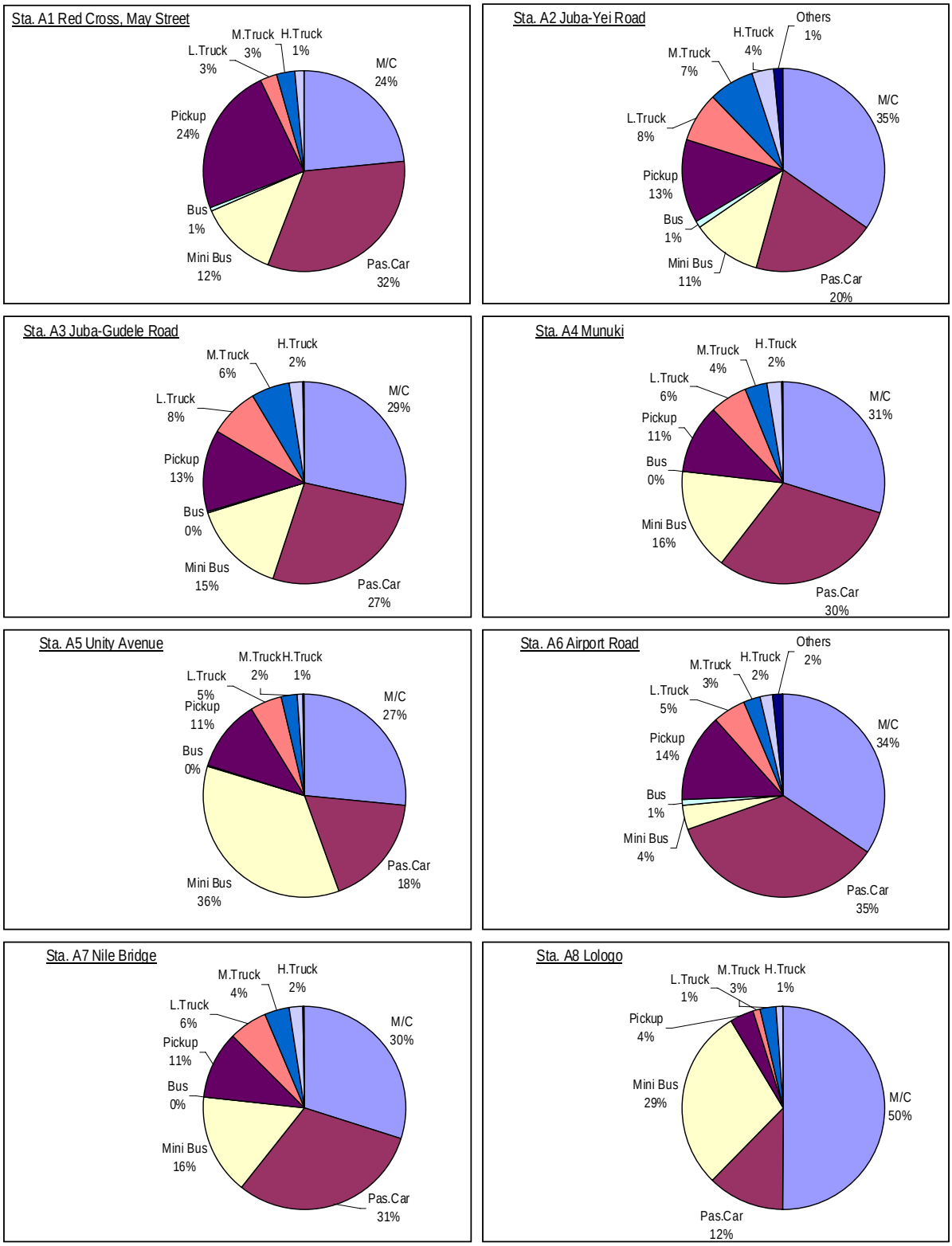


Figure 8.1.3-2(1) Traffic Composition by Road (Sta. A1~A8)

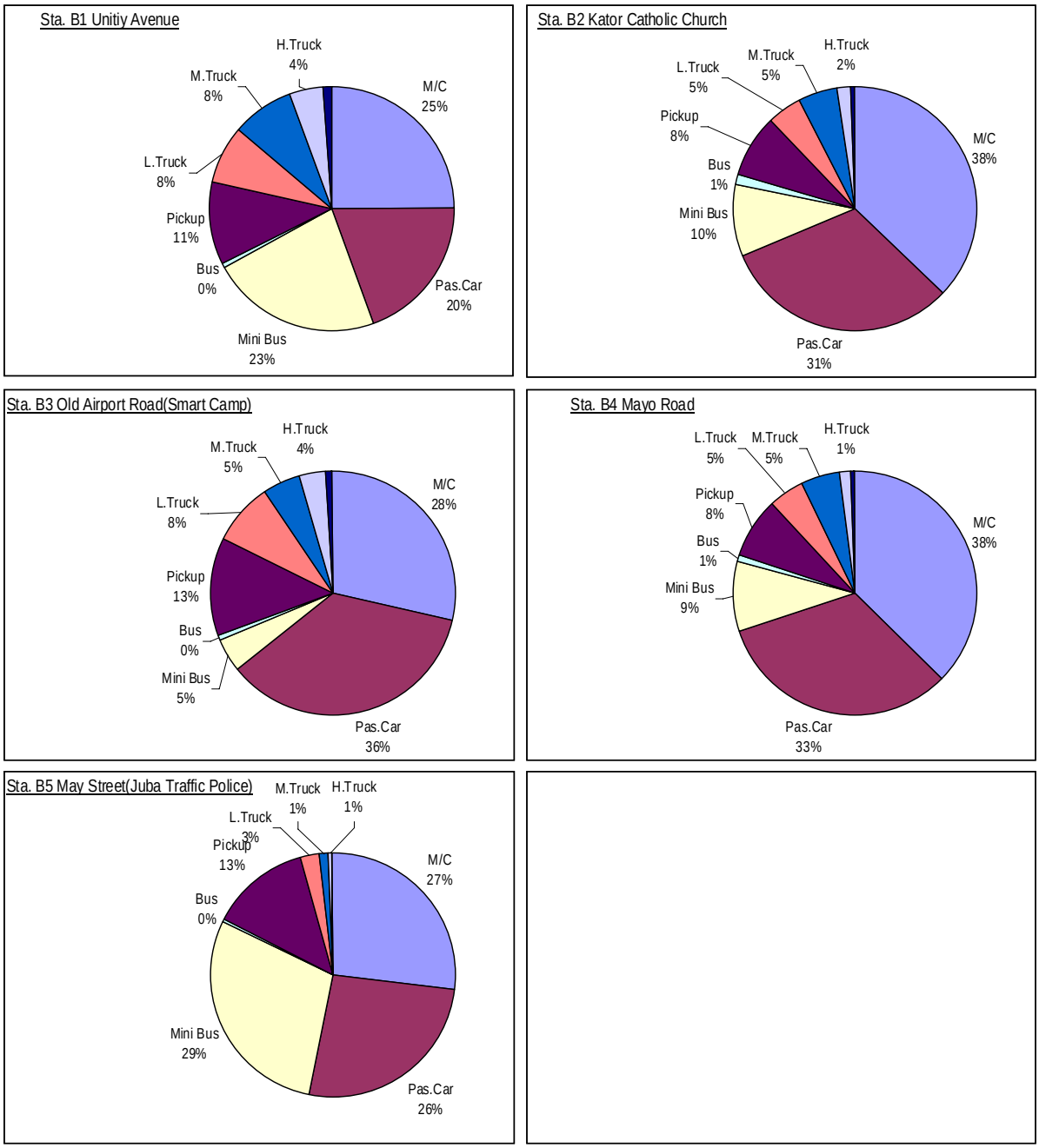


Figure 8.1.3-2(2) Traffic Composition by Road (Sta. B1~B5)

3) Hourly Traffic Volume

Hourly variation of traffic volume along major roads is illustrated in Figure 8.1.3-3(1) ~ (4) and Figure 8.1.3-4(1) ~ (3).

- The peak hours of motorized traffic are found in the morning (8:00-10:00) and evening 17:00-18:00.
- The peak hour of NMT(non motorized transport) is mainly morning hours (8:00-9:00).

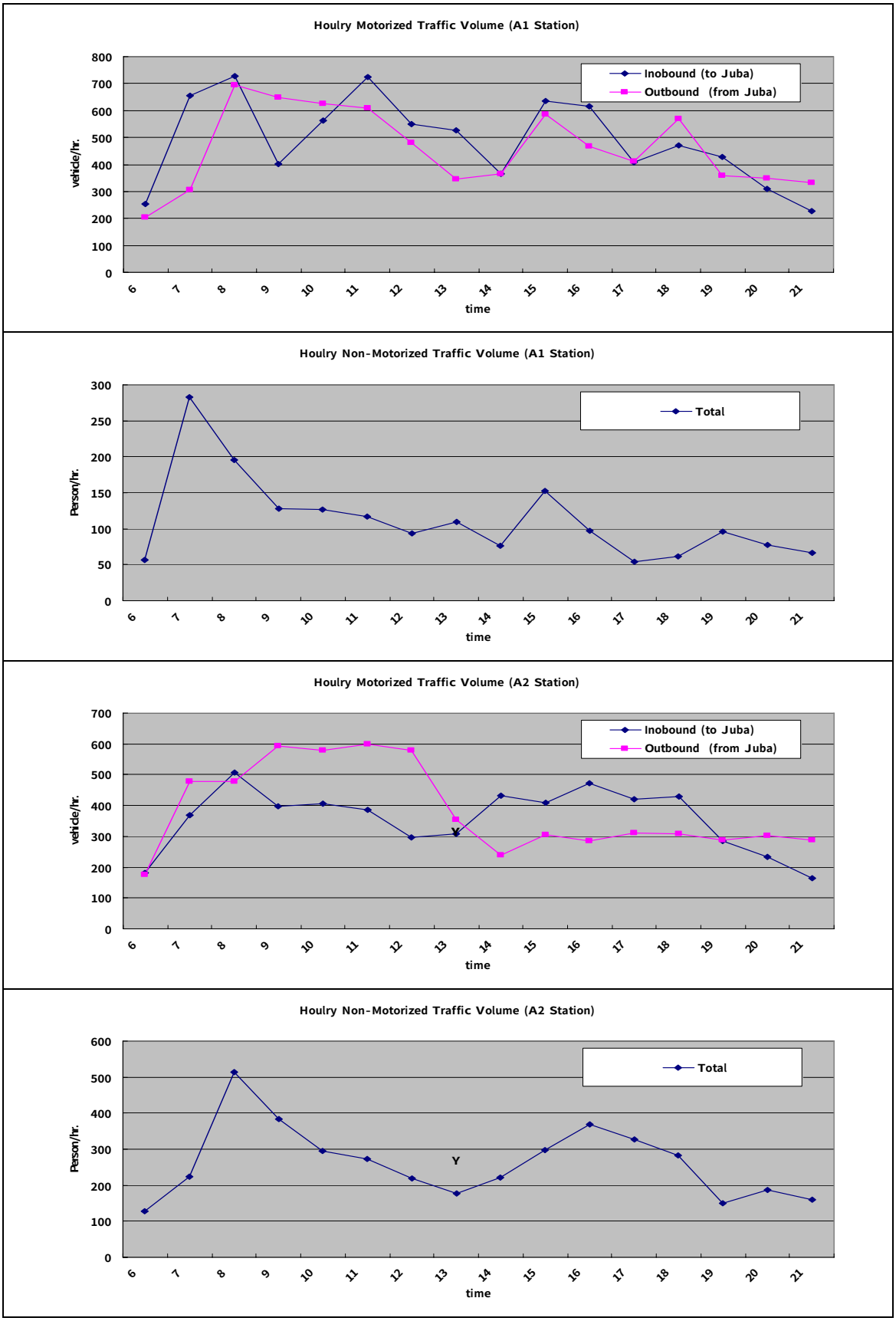


Figure 8.1.3-3(1) 16hr. Hourly Traffic Volume

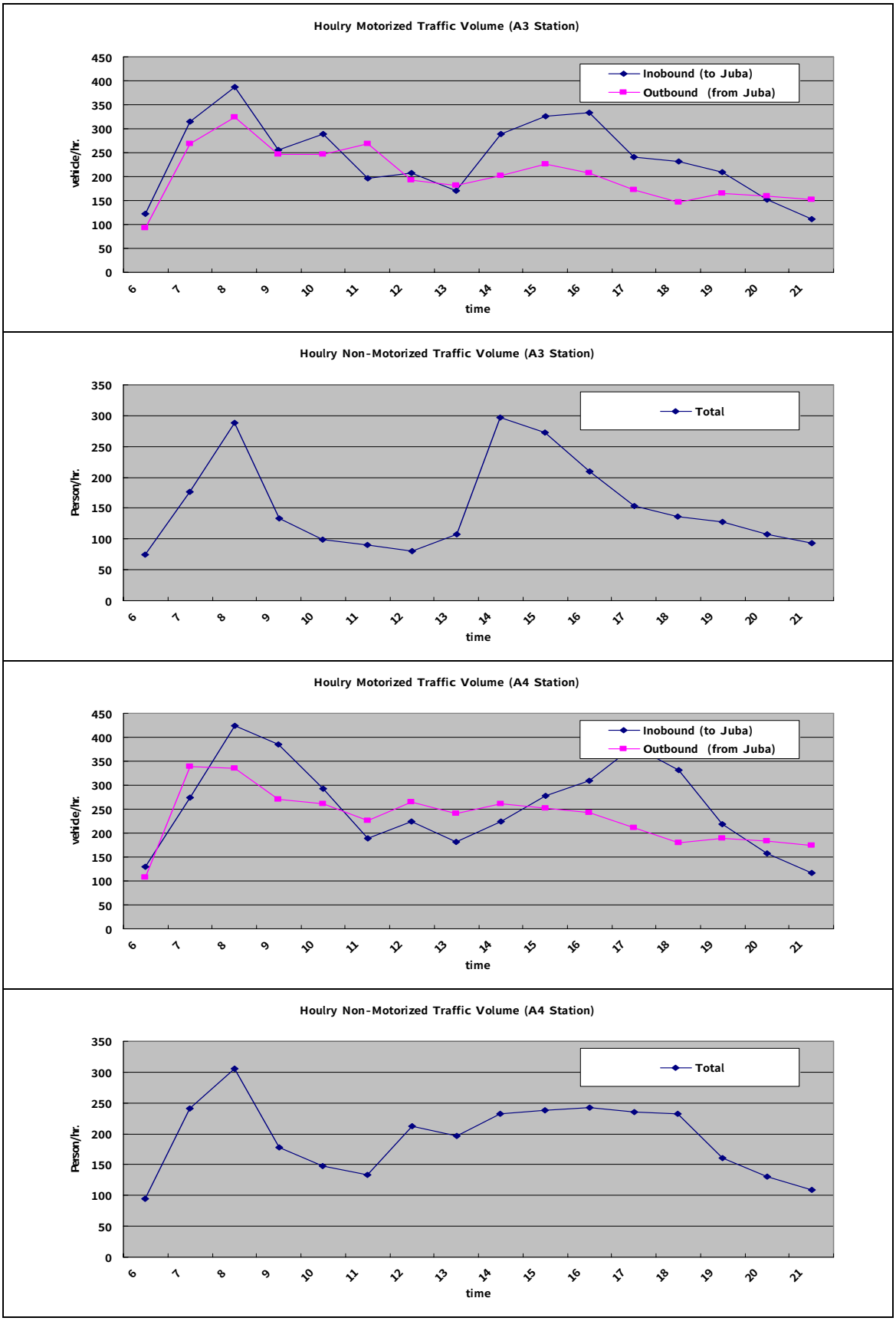


Figure 8.1.3-3(2) 16hr. Hourly Traffic Volume

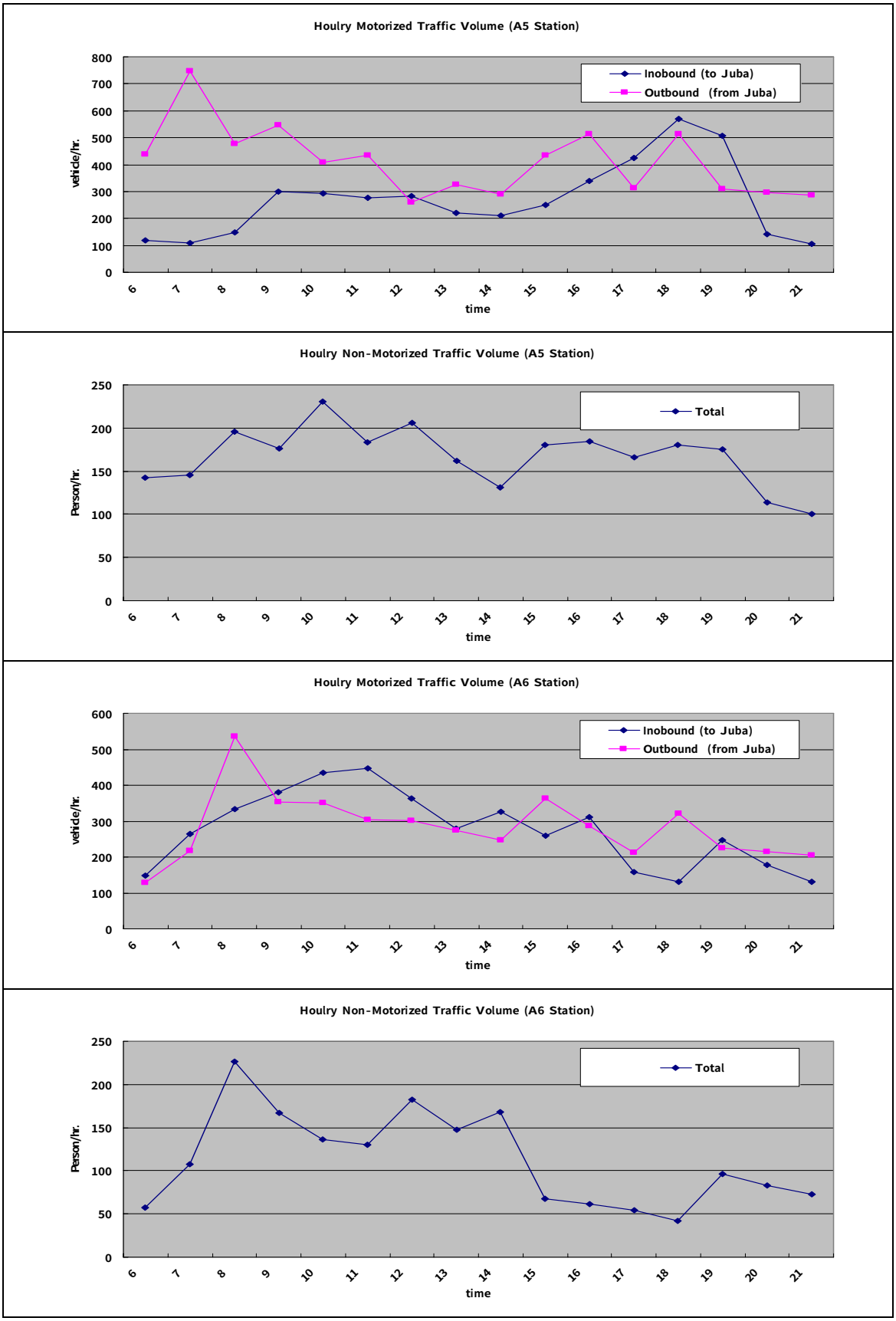


Figure 8.1.3-3(3) 16hr. Hourly Traffic Volume

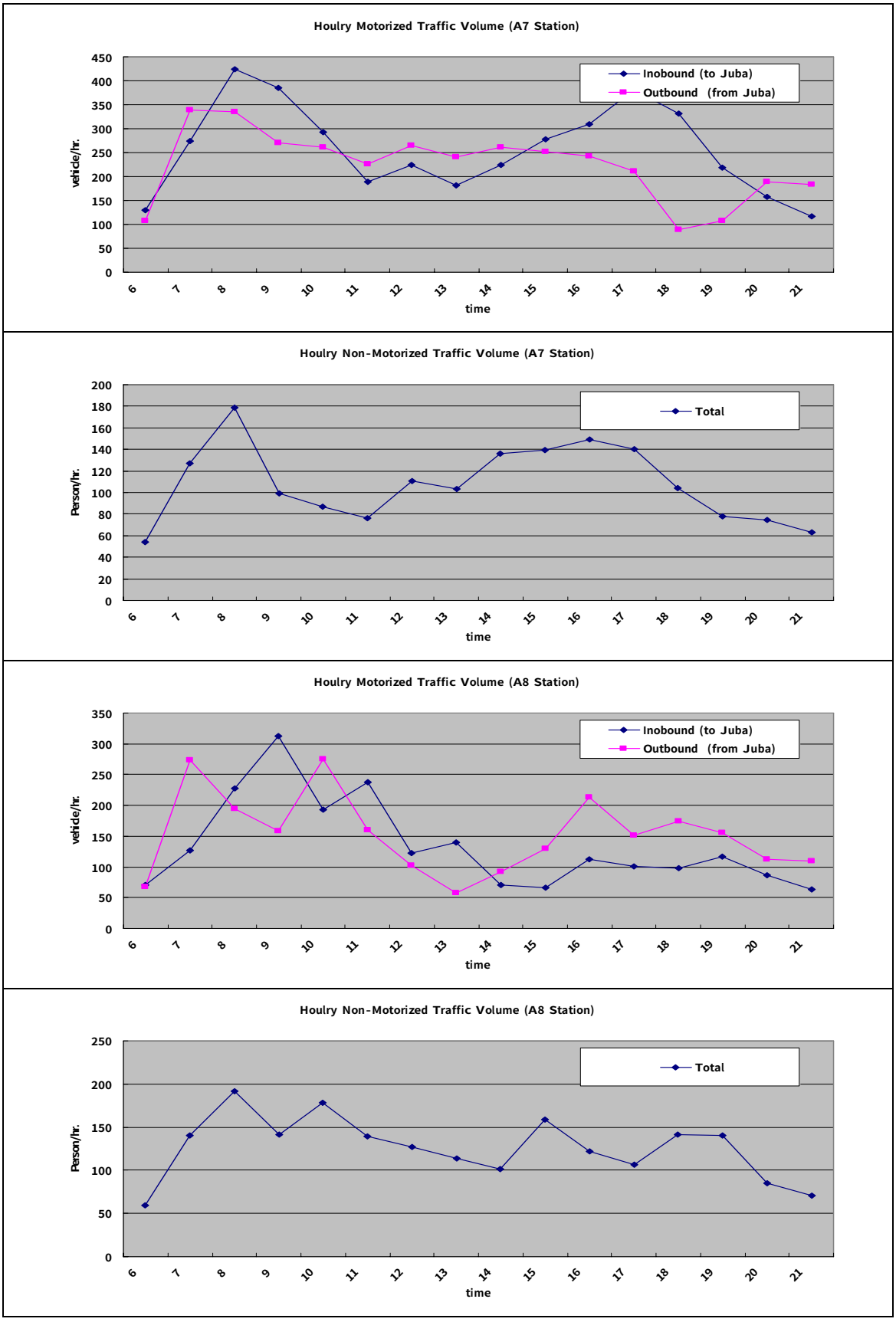


Figure 8.1.3-3(4) 16hr. Hourly Traffic Volume

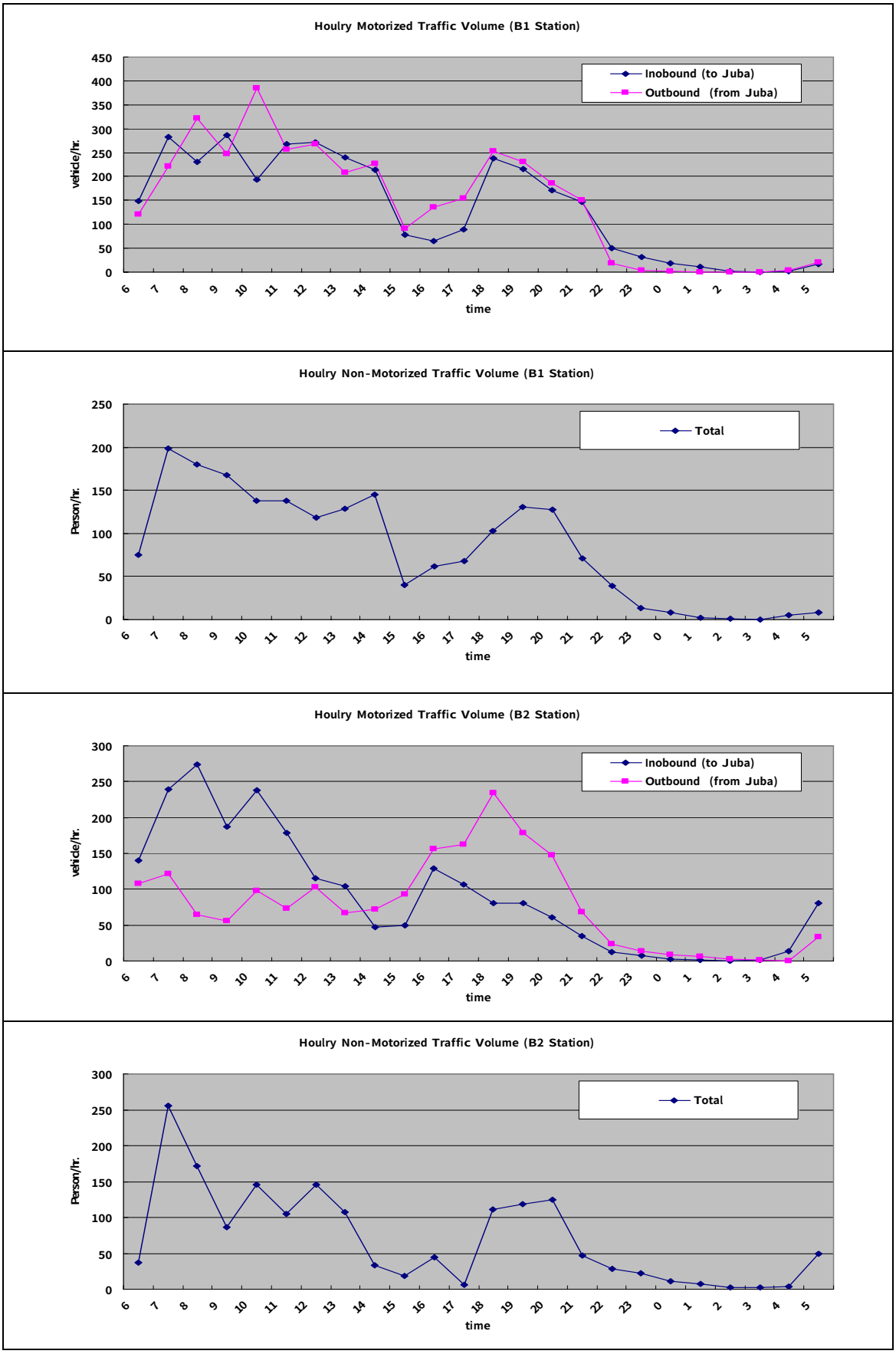


Figure 8.1.3-4(1) 24hr. Hourly Traffic Volume

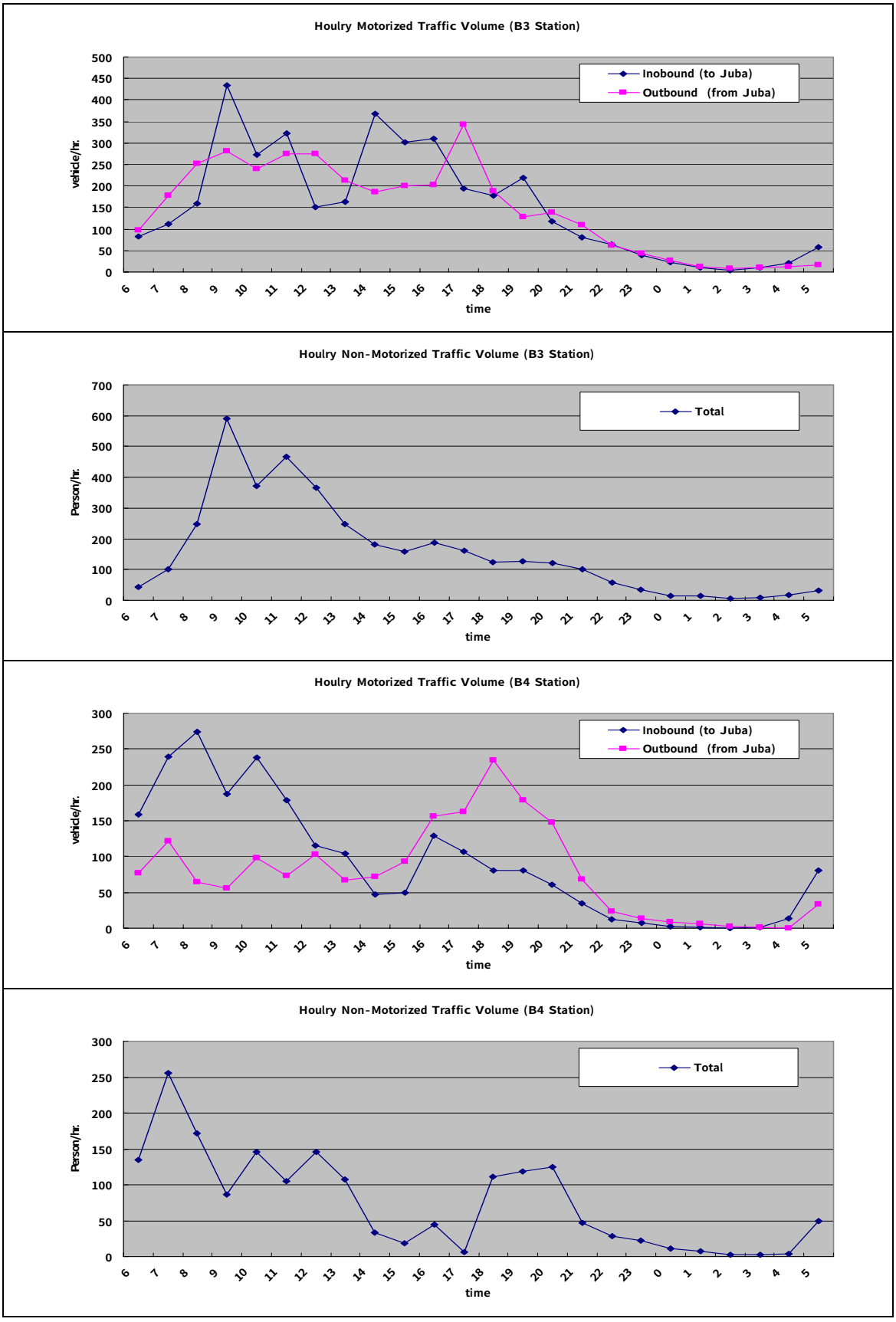


Figure 8.1.3-4(2) 24hr. Hourly Traffic Volume

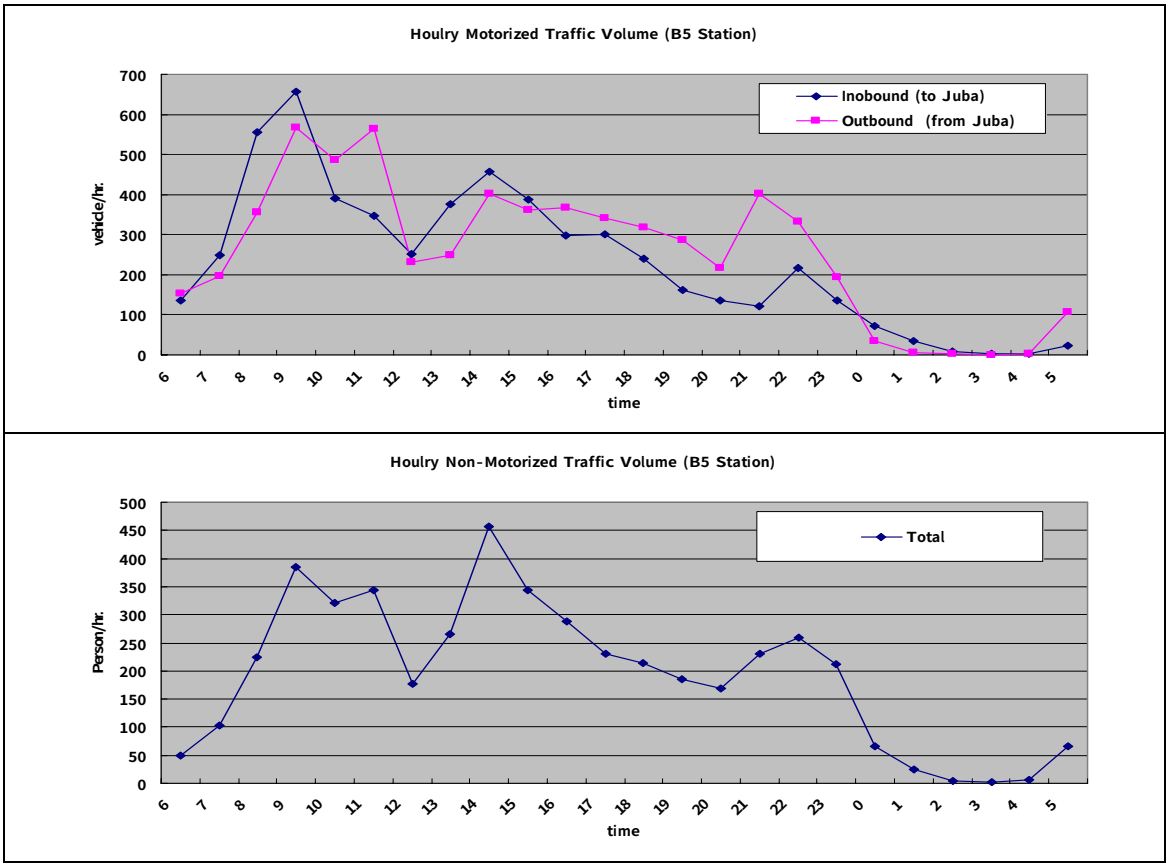


Figure 8.1.3-4(3) 24hr. Hourly Traffic Volume

Conversion rate from 12hr counts (7a.m. to 7p.m.) to 24hr is 1.30. It is the weighted mean of the five (5) 24hr observed traffic count stations, as shown in Table 8.1.3-1.

Table 8.1.3-1 Conversion Rate (24h/12h rate)

Station No.	Station	Motor cycle		Car		Bus		Truck		Weighted Mean
		Conv. R	Veh. No.	Conv. R	Veh. No.	Conv. R	Veh. No.	Conv. R	Veh. No.	
B-1	Unity Ave.	1.35	1,685	1.34	1,414	1.50	1,554	1.13	2,123	1.30
B-2	Kator Catholic Church	1.26	1,514	1.32	1,297	1.70	438	1.36	824	1.34
B-3	Smart Camp,Old Airport Road	1.26	2,047	1.19	2,634	1.31	355	1.28	2,153	1.24
B-4	Mayo Road	1.27	1,520	1.36	1,332	1.62	419	1.30	790	1.33
B-5	Juba Traffic Police	1.26	3,148	1.36	3,098	1.26	3,449	1.42	2,048	1.31
Weighted Mean		1.28	9,914	1.30	9,775	1.36	6,215	1.28	7,938	1.30

Car : private car and others
Bus : minibus and bus
Truck : pickup, light truck, medium truck, heavy truck/ trailer

(2) Roadside Origin-Destination (OD) Survey

1) Traffic by Trip Purpose

Trip purpose is estimated through the OD data as illustrated in Figure 8.1.3-5. Of the total car trips, 53.8% were 'Business' trips, 20.8% were 'To Home' trips and 15.9% were 'To Work' trips. 'Social' trips accounted for 3.3% while 'Shopping' trips amounted to 4.1%.

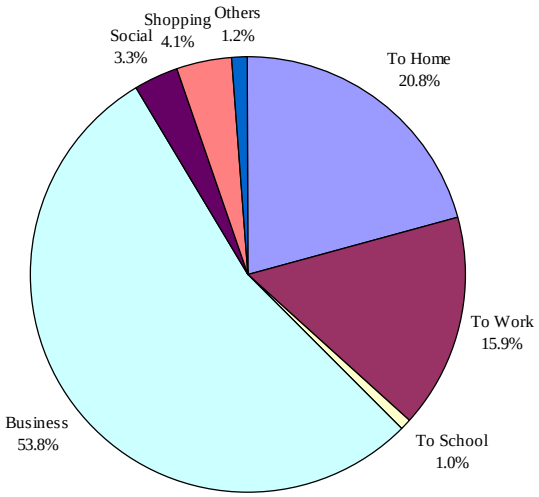


Figure 8.1.3-5 Trip Purpose

2) Average Number of Passengers by Vehicle Category

Vehicle OD is linked to passenger OD through the average number of passengers on board by vehicle type (i.e. vehicle occupancy rate). Table 8.1.3-2 shows the average number of passenger on board by vehicle type.

Table 8.1.3-2 Vehicle Occupancy

Vehicle Type	Occupancy	No. of Observed
Motor Cycle	1.5	327
Passenger Car	3.7	438
Minivans	12.2	507
Bus	42.5	103
Pickup	3.7	351
Light Truck	3.8	394
Medium Truck	4.2	263
Heavy Truck/Trailer	3.6	190
Others	2.5	84

As for the average number of passengers by vehicle category, 1.5 for Motor Cycle, 3.4 for Car and 17.3 for Bus are used in this Study as shown in Table 8.1.3-3.

Table 8.1.3-3 Average Number of Passengers on Board by Vehicle Category

Vehicle Category	Type of Vehicle	(Person /veh.)
MOTOR CYCLE	Motor Cycle	1.5
CAR	Private Car, Others	3.4
BUS	Minivans, Bus	17.3
TRUCK	Pickup, Light Truck, Medium Truck, Heavy Truck/Trailer	3.8

3) Traffic by Type of Commodity

Based on statistics of commodities in Sudan, three representative commodity items were selected in this Study. They are Food Products, Ores and Construction Materials, and Industrial Products. Other commodities not included in the first two categories are considered to include in the third. The results are summarized in Table 8.1.3-4.

- Total commodity volume in Juba is estimated at approximately 120 thousand ton by Truck.
- On average, the commodity volume of 'Food Products' and 'Ores and Construction Materials' have almost the same shares: 41.2% and 47.4% respectively, while 'Industrial Products and Others' accounts for 11.6%.

Table 8.1.3-4 Traffic by Commodity Type

(ton/day)

	Food Product	Ores and Construction Materials	Industrial Product and Others	**Total**
Pickup	1,364	1,077	350	**2,791**
Light Truck	8,621	8,265	1,180	**18,066**
Medium Truck	15,059	16,917	2,930	**34,906**
Heavy Truck/Trailer	24,684	30,943	9,131	**64,757**
Total	**49,727**	**57,202**	**13,590**	**120,520**
Share	**41.2%**	**47.4%**	**11.6%**	**100%**

4) Average Loading by Type of Truck

Vehicle OD is linked to commodity OD through the average weight loaded by type of truck. Table 8.1.3-5 shows the average weight loaded by type of truck. The net average loaded volume by truck is 5.5 ton.

Table 8.1.3-5 Average Loading by Type of Truck

(Unit: tons/truck)

		Food Product	Ores and Construction M.	Industrial P. and Others	Gross Average Loading *	Net Average Loading **
Pickup	Ave. Loading	1.6	1.5	2.3	1.6	1.0
	No. of Vehicles	49	48	10	107	
L. Truck	Ave. Loading	3.6	5.1	3.3	4.2	2.5
	No. of Vehicles	125	118	13	256	
M. Truck	Ave. Loading	10.7	8.7	9.1	9.6	5.8
	No. of Vehicles	101	112	26	239	
H. Truck	Ave. Loading	21.2	19.8	22.0	20.6	12.3
	No. of Vehicles	51	84	25	160	
Average	**Ave. Loading**	**8.4**	**9.6**	**11.9**	**9.2**	**5.5**
	No. of Vehicles	**326**	**362**	**74**	**762**	

* Empty trucks are excluded.

** Empty trucks are included.

(3) Traveling Speed Survey

Table 8.1.3-6 presents the results of average travel speed on each route. At present, although serious traffic congestion are not seen in every route, the average travel speed of unpaved road in bad condition (R4, R6) is less than 20 km/h, while the average speed in Route 3(Airport Road and Unity Avenue) is relatively high at about 30km/h since most of roads are paved.

Table 8.1.3-6 Routes of Travel Speed Survey

Route	Road	Section	Length (km)	To Juba			From Juba Town		
				Morning	Noon	Evening	Morning	Noon	Evening
R1	May St.	Old Custom RA-JICA	4.4	22.6	22.8	22.9	19.0	18.2	19.7
R2	Old Airport Rd. & Gudele St	Gudele-JCT Airport	7.6	28.4	28.5	27.8	28.6	28.6	26.8
R3	Airport Rd. & Unity Av.	Airport-Muniki	6.9	31.4	31.2	30.1	28.4	29.7	25.0
R4	Addis Ababa Rd.	Port- jct May st.	3.0	11.6	11.4	12.2	11.9	12.2	11.8
R5	Nyigilo St.	Juba-Gumba	4.8	24.3	24.0	23.9	23.2	22.1	22.8
R6	Tombura St.		3.3	15.3	15.3	15.3	16.0	15.5	15.8
R7	Yei Rd.	Custom Mkt - MTR office	5.9	22.7	22.1	22.5	22.6	21.7	21.8
Average			35.8	24.2	24.1	23.8	23.2	23.0	22.0

The travel speed survey results are illustrated in Figures 8.1.3-6.

Morning

Noon

Evening

Figure 8.1.3-6 Travel Speed and Congestion

(4) Bus Service Survey

1) Characteristics of Public Transport Users

Table 8.1.3-7 shows the distribution of the respondents. The total number of samples is 251.

Table 8.1.3-7 Respondents

Survey Location	Respondents
1.Konyo-konyo Market	83
2.Juba Town	91
3.Custom Market	77
Total	**251**

Figure8.1.3-7~Figure8.1.3-11 shows the general information of respondents.

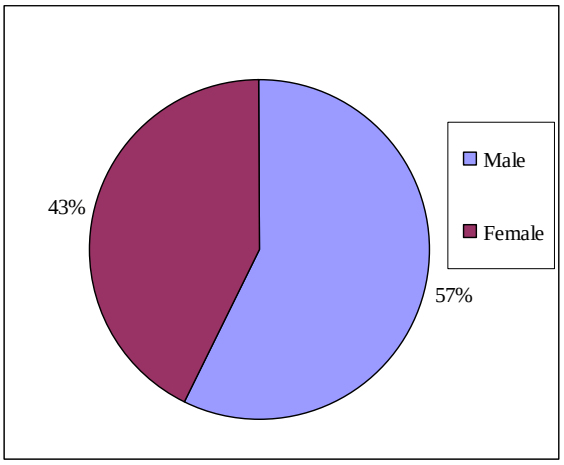


Figure 8.1.3-7 Sex

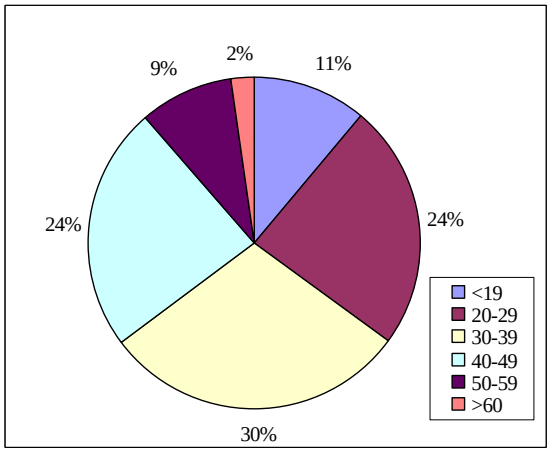


Figure 8.1.3-8 Age

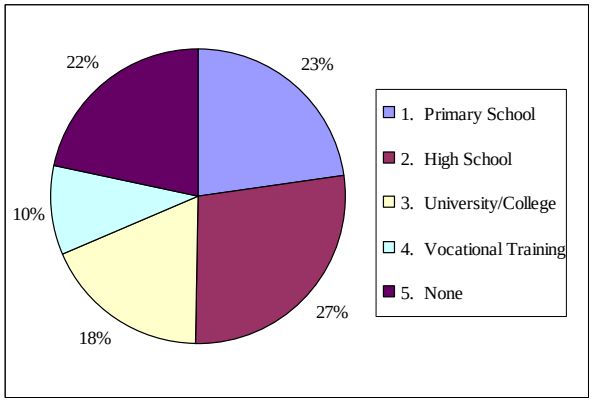


Figure 8.1.3-9 Education Background

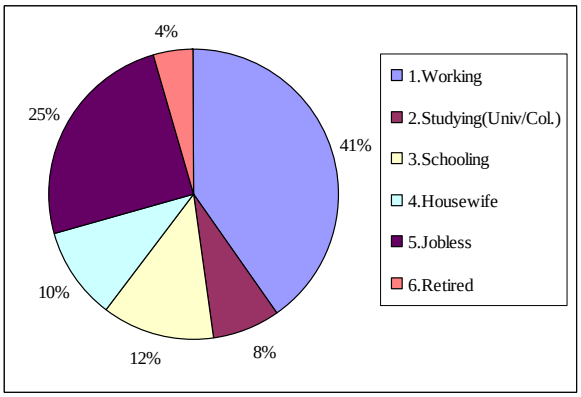


Figure 8.1.3-10 Working Status

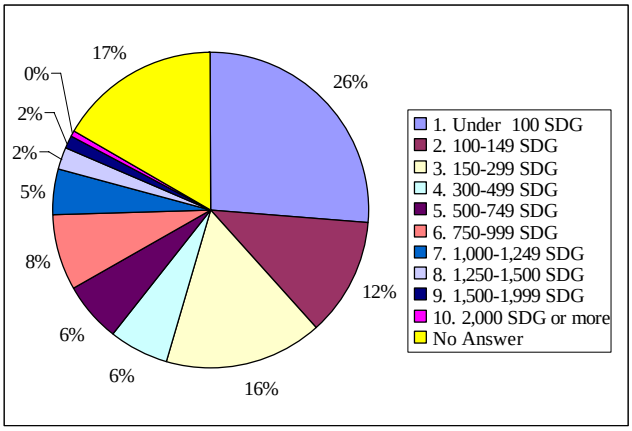


Figure 8.1.3-11 Income Level

Figure 8.1.3-12 illustrates the distribution of the public transport by the trip purpose. Of the total bus users trips, 32% were 'Work' trips, 19%were 'School' trips and 18% were 'To Home' trips. Since this interview survey was conducted mainly during morning and noon, 'To Home' trips are considered to be less than actual.

Figure 8.1.3-13 shows the frequency of bus usage. About half of the bus passengers take bus everyday.

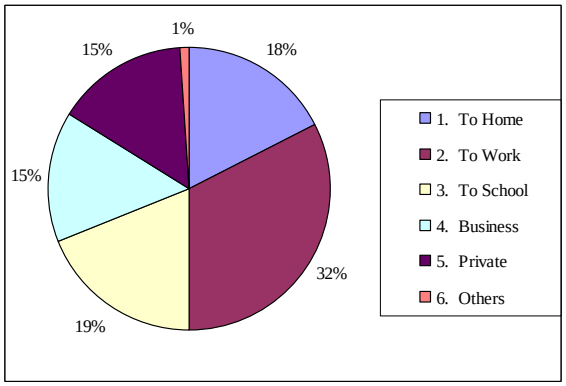


Figure 8.1.3-12 Trip Purpose

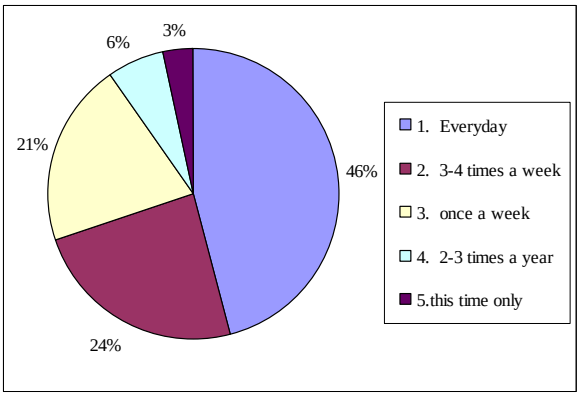


Figure 8.1.3-13 Frequency of Bus Usage

2) Opinion on Bus Service

Figure 8.1.3-14 shows the assessment of present bus service. Nearly 80% of respondents assess the present bus service on travel time/speed, waiting time and fare as good or fair, while 60-70% of passengers assess the air quality, noise level and feeder service as bad or very bad. They are not comfortable with the air dust and vehicle exhaust coming from open window.

Most of respondents do not complain about fare.

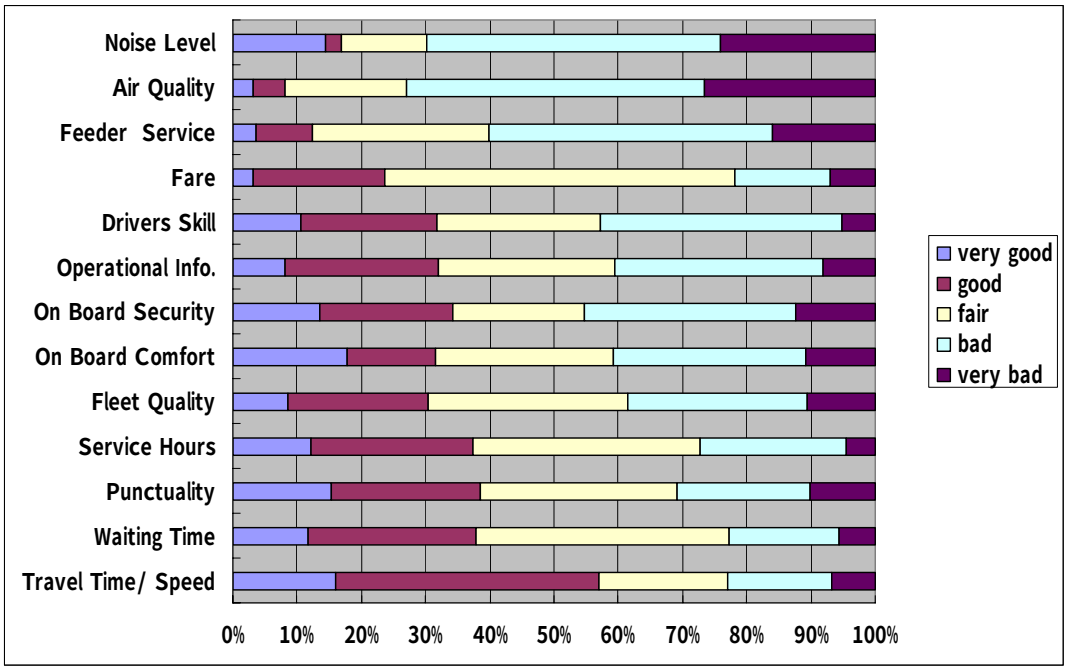


Figure 8.1.3-14 Assessment of Present Bus Service

Figure 8.3.1-15 shows the opinion on improvement of the bus service. Above 50% of all items are assessed to be important to be improved. 'Improvement of accessibility to bus terminal/stop', 'Improvement of regularity/punctuality' and 'Parking space at the bus terminal' are higher than others.

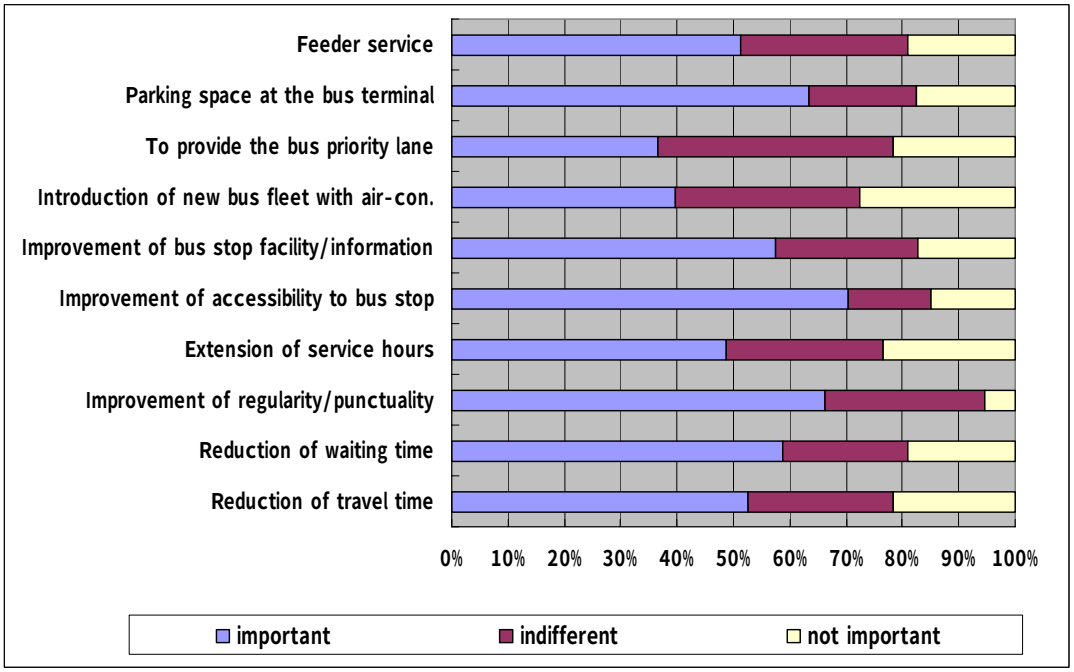


Figure 8.1.3-15 Opinion on Improvement of the Bus Service

8.2 Future Traffic

8.2.1 Methodology

(1) Four Steps Approach

As a basis of transport investment decision, the urban area throughout Juba is necessary to be considered in comprehensive, cooperative and continuing transportation planning process. One of the significant elements in the transportation planning process is the projection of future transportation demand. The most accepted method of projecting future transportation demand and evaluating investment strategies to serve the demand is the use of travel demand forecasting models. The models utilize the socio-economic data presented in Chapter 6 to estimate travel demand coupled with a simulation of the transportation system to represent transportation supply. The mathematical travel models, together with the socio-economic data and the network, simulate the ability of the transportation system to serve the estimated demand.

The popular travel models used in the world include the following four basic steps or components:

- Trip Generation/Attraction Model - the prediction of trips produced at and attracted to each zone;
- Trip Distribution Model - the prediction of origin-destination flows, represented by distribution of trip ends by trip generation;
- Modal Split Model - the estimation of percentages of trip flows made by each transportation mode; and
- Traffic Assignment - the allocation of trips to routes in the transportation network.

Figure 8.2.1-1 shows the flow of transport demand forecast in four steps approach.

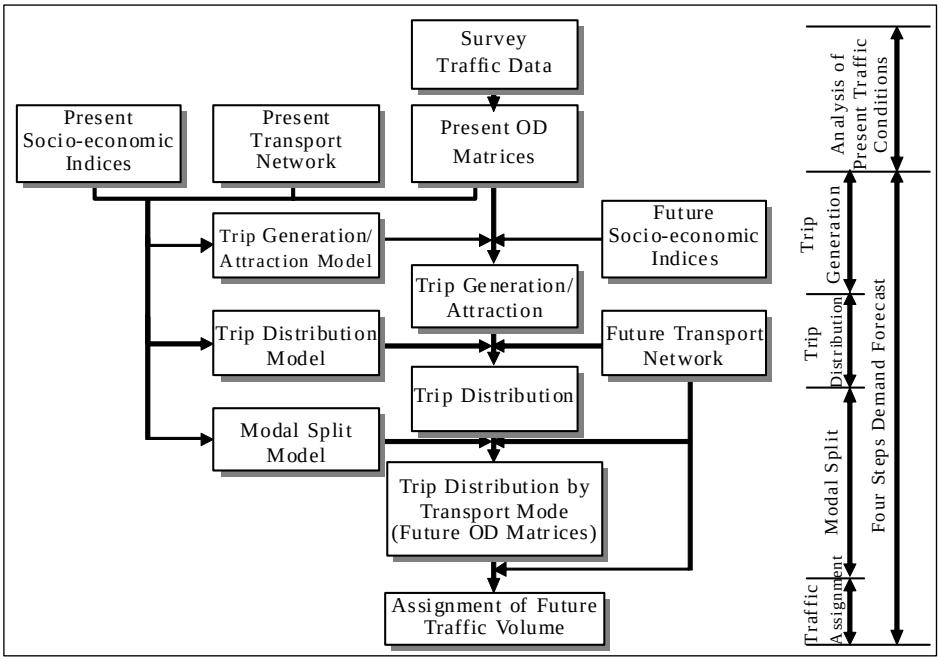


Figure 8.2.1-1 Flow of Transport Demand Forecast

(2) Zone System in the Study Area

The model predicts trips over the transportation network based on attributes of traffic analysis zones developed in Section 8.1.2 of Chapter 8. Zonal attributes used in trip generation include Population and Land Use.

Inside and outside of the Study Area are divided into 57 zones (Zone Numbers 1 to 57) and 32 zones (Zone Numbers 58 to 89) respectively as shown in Figure 8.1.2-1 and Tables 8.1.2-1 and 8.1.2-2.

(3) External Zone Transportation Demand

Traffic that enters or leaves the modeling area around its perimeter is not specifically included in four steps approach as outlined above. The modeling area contains some locations where the road network connects with the “outside modeling area”. At these locations, the internal/external interactions must be taken into account.

Traffic count data from the cordon line survey at the perimeter of the modeling area provides the total volume of traffic that constitutes the internal/external interaction, although some traffic at these locations merely passes through the modeling area without an internal origin nor destination. Those “pass-through” trips are called external-external (E-E) trips, the remaining traffic has an internal origin or destination and are classified as either external-to-internal (E-I) or internal-to-external (I-E) trips.

(4) Modeling and Forecasting Tools

In all steps of travel model calibrations and demand forecast, JICA STRADA system and EXCEL spread sheet are employed. JICA STRADA is a software tool for the planning, managing, and analyzing of transportation systems. The software provides a set of tools for travel demand modeling as well as graphical presentation of the inputs and outputs. JICA STRADA system is applied also for simulation of travel time and cost. The forecast of trip generation/attraction, trip distribution and traffic assignment is computed by JICA STRADA system, while modal split is estimated simply by using Excel spread sheet, since the enough data for modal split are not available.

(5) Travel Mode Classifications

To get enough samples for securing the accuracy in the modal split stage, the travel modes used in the roadside interview survey are grouped into four categories as shown in Table 8.2.1-1.

Table 8.2.1-1 Travel Mode Category in Demand Forecasting

Travel Mode Category in Roadside Interview Survey		Travel Mode Category in Demand Forecasting	
1	Motor Cycle	1	MOTOR CYCLE
2	Passenger Car	2	CAR
3	Others		
4	Minibus(Minivan)	3	BUS
5	Bus		
6	Pick up	4	TRUCK
7	Light Truck		
8	Heavy Truck		
9	Heavy Truck		

8.2.2 Forecast of Trip Generation and Attraction

(1) Modeling Trip Generation and Attraction

The objective of trip generation and attraction model is to forecast the number of trips that will start and arrive in each traffic zone within the study area. The linear regression models by trip purpose are adopted in the Study. The model parameters are calibrated as shown in Table8.2.2-1.

Gi = ai*X1i + bi*X2i + C

Aj = aj*X1j + bj*X2j + C

Where, Gi: Trip Generation in zone i

Aj : Trip attraction in zone j

X1i, X2j: Attributes in zone i, j

ai, aj, bi, bj: Coefficient

C: Constant

Table 8.2.2-1 Trip Generation and Attraction Model Parameters

Model Type	Population	Commercial Area (ha)	Business Area (ha)	Constant	Correlation
Trip Generation	0.447	2,704.8	1,662.3	944.9	0.891
Trip Attraction	0.908	2,230.2	1,183.7	-883.7	0.898

(2) Verification of Trip Generation and Attraction Models

Figure 8.2.2-1 shows the verification results between observed and estimated trips.

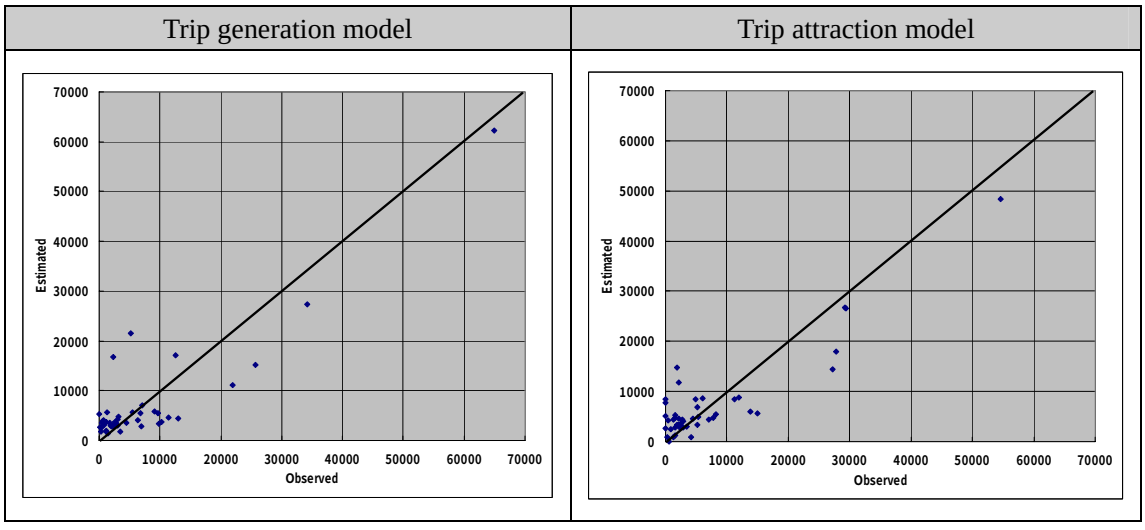


Figure 8.2.2-1 Verification of Trip Generation and Attraction Model

(3)Future Framework

Based on future socio-economic prediction in chapter 6, the future framework is summarized in Table 8.2.2-2.

Table 8.2.2-2 Future Framework

		2008	2015	2025
Population		260,000	520,000	950,000
Working Population		42,000	106,000	240,000
GRDP(US$ million)		140	540	2,540
GRDP per Capita(US$)		530	1,030	2,670
Land Demand (ha)	Residential	1,800	3,600	6,660
	Commercial	40	160	300
	Business	30	150	340
	Industrial	10	50	110
	Institutional/Religious	180	270	420
	Military	300	300	300
	Transport	380	720	1,290
	Agricultural/Recreational/Green/Open	1,330	2,450	4,580
	Total	**4,070**	**7,700**	**14,000**

(4) Future Trip Generation

Applying the future framework to the trip generation and attraction model, the total trips generated in the whole study area are forecast as shown in Table 8.2-3. The total trips will grow from 342 thousand trips in 2008 to 1,806 thousand trips per day in 2025.

Table 8.2.2-3 Future Total Trip Generation

Unit: person trips per day

	2008	2015	2025
Total Trips	342,404	960,842	1,806,396
Average Annual Growth Rate	-	15.9 %	6.5 %

(5) Future Trip Generation and Attraction by Zone

The estimated future trip generations/attractions by zone in 2008, 2015 and 2025 are presented in Table 8.2.2-4 and graphically in Figure 8.2.2-2.

Table 8.2.2-4 Trip Generation and Attraction in 2008, 2015 and 2025

Zone1	Zone2	G_2008	A_2008	G_2015	A_2015	G_2025	A_2025
101	1	1,099	1,603	18,835	13,495	18,835	13,495
102	2	1,430	593	18,066	11,939	18,066	11,939
103	3	490	803	2,992	3,263	3,812	4,921
104	4	3,173	5,163	5,782	8,912	7,717	12,830
105	5	2,579	2,132	7,683	12,761	7,683	12,761
106	6	3,456	4,177	14,905	12,092	20,822	17,518
107	7	34,542	3,408	14,964	12,211	20,904	17,685
108	8	10,268	4,503	4,323	5,958	4,323	5,958
109	9	5,528	6,063	6,884	11,143	6,884	11,143
110	10	6,884	2,309	3,291	3,867	3,291	3,867
111	11	3,037	14,915	5,015	7,358	5,015	7,358
112	12	2,242	2,864	19,861	15,573	73,957	60,178
113	13	4,456	7,021	42,878	36,267	74,913	62,114
114	14	5,267	27,847	42,203	34,899	48,219	40,528
115	15	64,998	77,910	108,636	87,008	163,376	132,918
116	16	2,777	2,755	4,257	5,822	4,257	5,822
117	17	9,812	2,813	17,265	14,685	20,589	17,047
118	18	6,421	8,276	19,872	17,781	23,121	22,175
119	19	7,062	5,367	1,823	894	2,174	1,605
120	20	25,695	2,187	1,929	1,110	2,323	1,907
121	21	1,140	1,290	2,082	1,420	2,537	2,341
122	22	0	0	945	0	945	0
201	23	12,595	27,291	65,812	54,607	65,812	54,607
202	24	6,806	4,836	55,614	50,191	72,237	62,005
203	25	21,899	11,962	11,574	9,716	19,886	15,622
204	26	2,175	1,810	3,619	4,531	20,242	16,345
205	27	2,342	1,843	20,914	17,705	20,914	17,705
206	28	1,212	1,639	4,477	6,269	4,477	6,269
207	29	11,373	29,293	27,469	25,669	27,469	25,669
208	30	2,032	1,605	3,248	3,780	3,248	3,780
209	31	1,720	1,356	4,267	5,843	4,267	5,843
210	32	13,054	13,809	10,437	18,338	14,234	26,027
211	33	1,862	5,181	57,655	49,013	58,699	51,129
212	34	0	0	9,802	17,052	42,724	83,717
301	35	404	403	4,155	5,617	4,155	5,617
302	36	2,627	2,107	61,589	51,368	62,969	54,161
303	37	9,609	11,175	6,719	10,809	9,029	15,487
304	38	639	63	4,709	6,739	4,709	6,739
305	39	830	2,515	3,697	4,688	3,697	4,688
306	40	770	1,555	4,787	6,897	38,034	30,525
307	41	9,139	7,823	2,987	3,252	36,234	26,879
308	42	353	357	2,035	1,324	2,471	2,207
309	43	1,255	11	23,417	22,774	48,352	40,494
310	44	34,191	29,363	69,320	61,712	102,567	85,340
311	45	2,999	2,332	3,573	4,437	45,131	33,972
312	46	3	11	6,354	10,070	6,354	10,070
313	47	159	65	3,105	3,490	3,969	5,239
314	48			8,060	13,525	10,907	19,288
315	49			51,471	58,037	57,537	70,321
316	50			22,463	42,690	53,569	83,830
317	51			17,733	33,111	24,448	46,709
318	52			5,142	7,615	24,448	46,709
401	53			19,757	20,976	81,399	107,715
402	54			3,589	4,470	28,150	54,206
403	55			945	0	140,353	118,462
404	56			945	0	103,074	108,518
405	57			945	0	21,930	41,610
Total		**342,404**	**342,404**	**960,842**	**960,842**	**1,806,396**	**1,806,396**

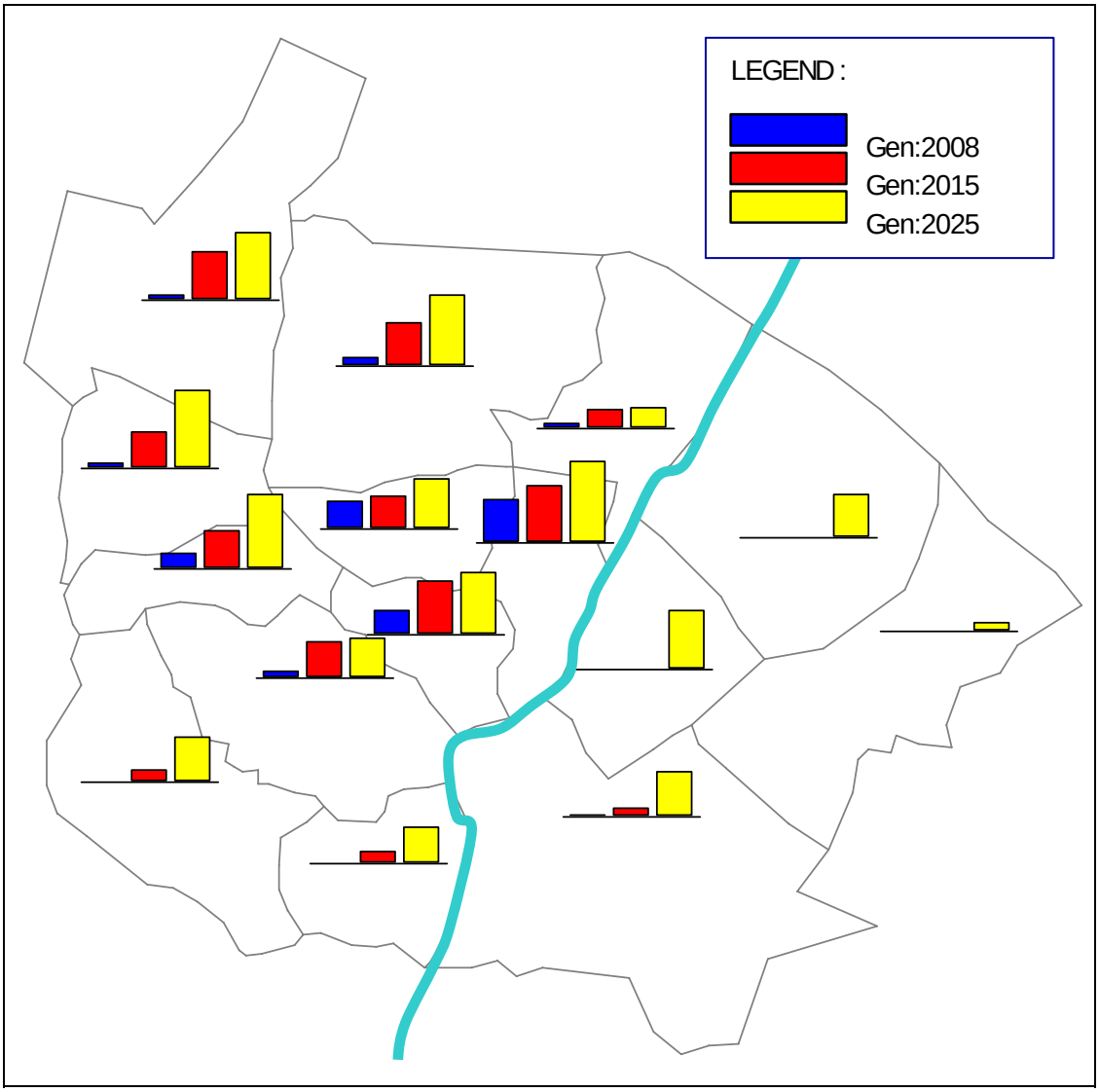


Figure 8.2.2-2 Trip Generation in 2008, 2015 and 2025

8.2.3 Forecast of Trip Distribution

Trip distribution is the second step in the travel demand modeling process. Trip generation/attraction (the first step) provides methodology for estimating trip generations and attractions for each trip purpose at each zone, while the trip distribution is the process that links the generations to attractions for each zone pair.

(1) Building Trip Distribution Model

In this Study, the gravity model for inter-zonal trips and the trip rate model for intra-zonal trips are applied for trip distribution forecast, as shown in following equations.

Inter-zonal trip $Xij = K * Oi^{\alpha} * Dj^{\beta} / Tij^{\gamma}$

Where; Xij: inter zonal trip distribution from zone i to j
Oi: trip generation in zone i
Dj: trip attraction in zone j
Tij: travel time from zone i to j (hr)
K, α, β, γ: model parameters

To balance a sum of trip distribution in certain zone, the doubly-constrained method is applied after estimation of each distribution by the gravity model. This type of model is also known as *Fratar Balancing*. The forecast matrix should be such that the sum of each trips generated per zone is within a given convergence criterion of the corresponding forecast generation for that zone, and the sum of each trips attracted per zone is within a given convergence criterion of the corresponding forecast attraction.

Calibration results of the gravity models before applying the doubly-constrained method are shown in Table 8.2.3-1.

Table 8.2.3-1 Inter-Zone Trip Distribution Model Parameters

α	β	γ	K	Correlation Coefficient
0.4578	0.4481	-0.2468	0.02413	0.638

(2)Verification of Trip Distribution Models

Figure 8.2.3-1 shows the difference between observed and modeled numbers of trips by trip length for verification of the model.

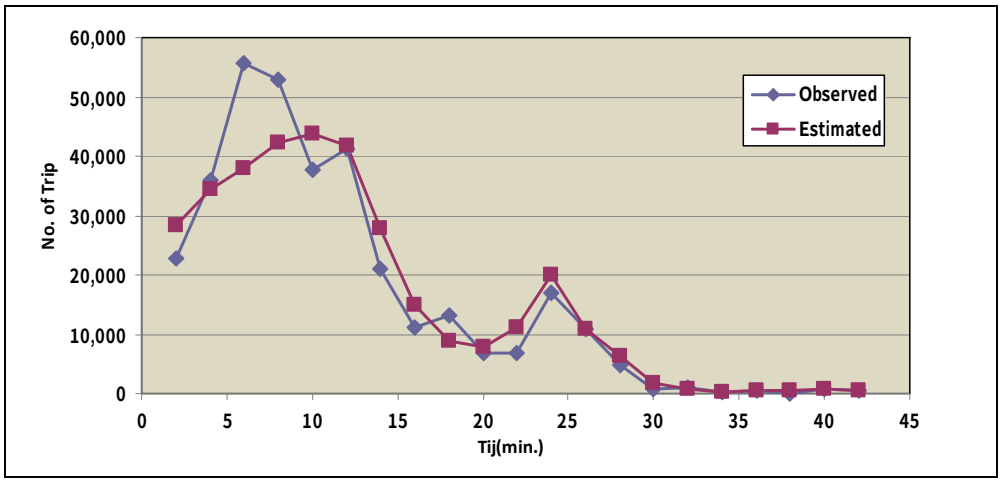


Figure 8.2.3-1 Verification of Trip Distribution Model

(3) Future Trip Distribution

Based on the trip distribution in 2008, 2015 and 2025, the desired lines that show the trip distribution and interaction among zone pairs are prepared as shown in Figure 8.2.3-2.

(Year 2008)

(Year 2015)

(Year 2025)

Figure 8.2.3-2 Desire Line of Total Trips in 2008, 2015 and 2025

8.2.4 Forecast of Modal Split

Modal split models are used to analyze and predict the choices of the transportation modes made by individuals or groups of individuals. In this Study, it is difficult to formulate the modal split model due to lack of indicators such as the number of vehicle registration.

Study Team assumed the future modal share of person trips as shown in Table 8.2.4-1 in consideration of the following :

- Motorcycles has been increasing drastically in recent years. This trend is considered to continue in the future. The 2025 share of motorcycle is assumed to be almost double of the present share (7% in 2008 to 13% in 2025).
- Regarding the share between car and bus, the car share tends to increase as the average income grows.

Table 8.2.4-1 Future Modal Share

	Motorcycle	Car	Bus	TOTAL
Year 2008	24,668	48,698	269,038	342,404
	7%	14%	79%	100%
Year 2015	96,084	153,735	711,023	960,842
	10%	16%	74%	100%
Year 2025	234,831	325,151	1,246,413	1,806,395
	13%	18%	69%	100%

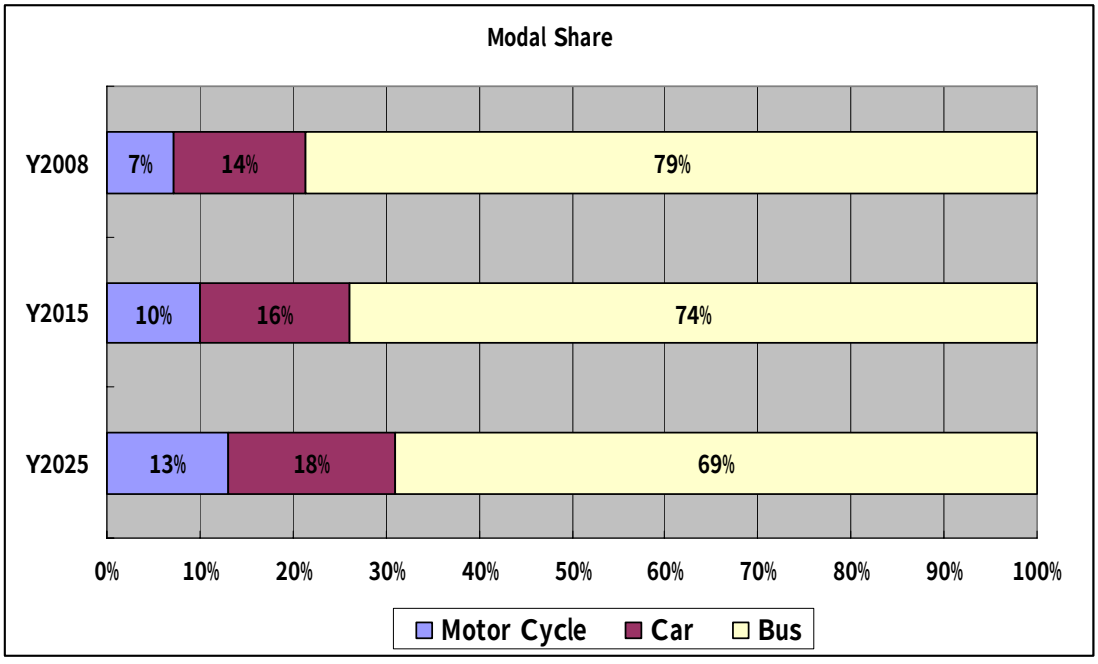


Figure 8.2.4-1 Future Modal Share

8.2.5 Traffic Assignment

The traffic assignment process allocates the vehicle traffic to individual roadway links. This step takes as input a matrix of flows (vehicles) that indicate the volume of traffic between origin and destination pairs.

(1) Assignment Method

Various assignment techniques are used ranging from manual methods to complex iterative procedures by computer programs. The method used in this Study is the capacity restraint assignment which is the most straightforward for use in network models and the most efficient particularly where the number of zones in the trip matrix is big. This assignment technique is based on the volume - speed relationship. The flow chart of the applied methodology is shown in Figure 8.2.5-1.

In this assignment technique, the required travel time for each link according to its volume - speed relationship is calculated and the fastest routes between each origin and destination is determined by evaluating the consuming time on links, and the trips between the given origin and destination are assigned to the fastest route. As congestion increases till a certain level, alternative routes are introduced to handle the unassigned traffic. Zone-to-zone routing which is the fastest path is built, and the trips are assigned to these optimum routes.

Since the link travel time varies with the traffic volume using that link, the OD tables are divided to apply the iteration procedure on five stages. At each iteration, the travel time of each link is re-calculated based on the current link loadings and the shortest routes are re-estimated. The accumulated assigned traffic volume gives the total traffic volumes on the network.

The JICA STRADA is used to estimate traffic volumes.

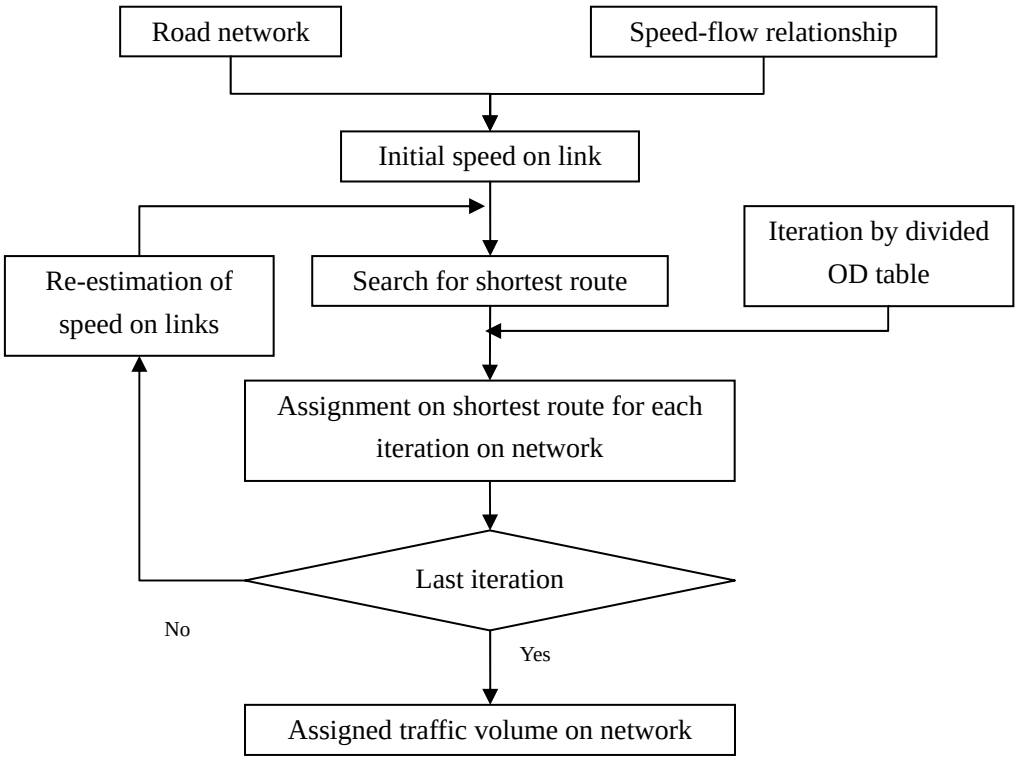


Figure 8.2.5-1 Traffic Assignment Procedure

(2) Vehicle Occupancy Rate and Passenger Car Unit

The trips by trip purpose in the trip generation/attraction step and trip distribution step are in terms of person trips, while in the traffic assignment step, the vehicle trips are dealt with. The vehicle occupancy rates are used to convert from person trips to vehicle trips. The passenger car units (PCU) are used to estimate the travel speed of each link. The vehicle occupancy rates and the passenger car units are obtained from the Roadside Interview Survey as shown in Table 8.2.5-1.

Table 8.2.5-1 Occupancy Rate and Passenger Car Unit (PCU)

Mode	Auto Occupancy Rate	Passenger Car Unit
Motor Cycle	1.5	0.33
CAR	3.4	1.00
BUS	17.3	1.01
TRUCK	-	1.38

(3) Volume-Speed Relationship

The volume - speed relationship is estimated on the following assumptions:

- When traffic volume is less than 0.3 times capacity (Q), the vehicle speed is the free flow speed (Vmax).
- As the traffic volume increases, the speed decreases gradually until the volume reaches the capacity. When the volume is equal to or more than the capacity, the speed is 0.1 times Vmax.

The volume – speed relationship used in the traffic assignment procedure is shown Figure 8.2.5-2. The free flow speed and capacity by road type are shown in Table 8.2.5-2.

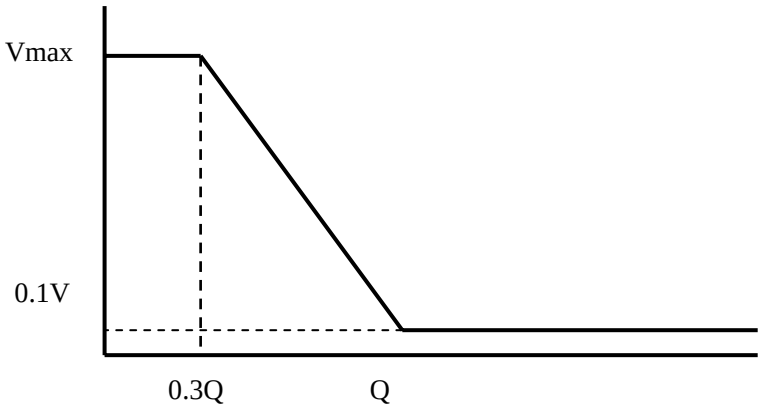


Figure 8.2.5-2 Volume - Speed Relationship

Table 8.2.5-2 Free Flow Speed (Vmax) and Capacity (Q) by Road Type

Location	Carriageway	Lane	Surface	Vmax	Q
Urban	Divided	6	Paved	60	75000
		4	Paved	50	50000
	Undivided	6	Paved	50	60000
		4	Paved	45	40000
		2	Paved	40	20000
		2	Unpaved	20	10000
Suburban & Rural	Divided	6	Paved	60	90000
		4	Paved	60	60000
	Undivided	4	Paved	50	50000
		2	Paved	45	30000
		2	Unpaved	30	10000

(4) Calibration of Traffic Assignment Result

By comparing the assigned traffic volume with the traffic count results at 13 traffic survey stations, the result of the traffic assignment is examined if trips are assigned in a realistic pattern well matching to the actual situation or not. This comparison between the counted traffic and assigned traffic at individual sites is done by the Mean Absolute Difference (MAD) ratio1. The value of the MAD ratio is 0.11, which is considered to reflect a good simulation, i.e. the assignment accurately replicates the actual traffic in year 2008. The comparison between the observed and assigned traffic is shown in Figure 8.2.5-3.

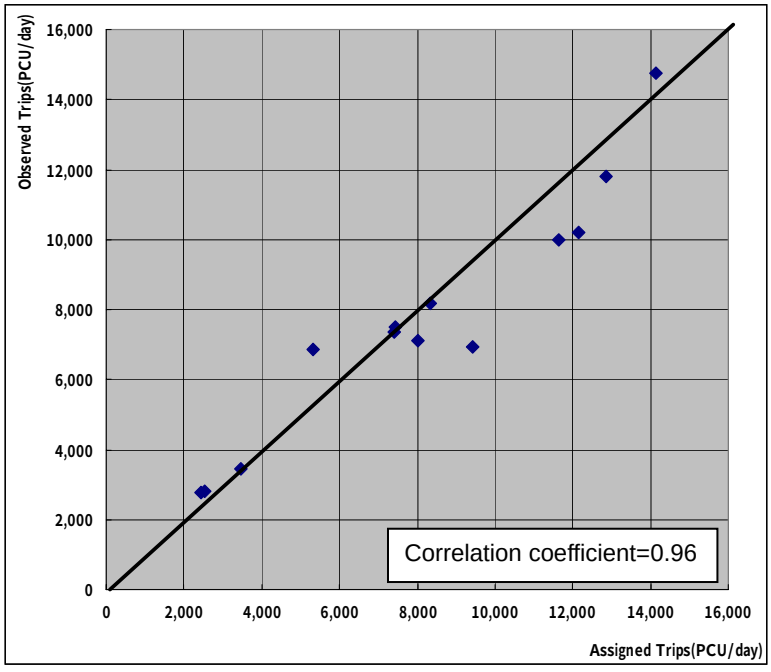


Figure 8.2.5-3 Comparison between Observed and Assigned Traffic at Individual Sites

[1] MAD Ratio is defined by the following formula: MAD Ratio $= \sum \left| \frac{count - assignment}{assignmet} \right| / n$

where n is the number of observations.

8.2.6 Assessment of Present Transport Network

For the purpose of the transport planning, the traffic condition in the future is estimated in case that no improvement would be made, which is called “Do-Nothing” case analysis. The traffic assignment results in 2008 and in 2015 and 2025 in Do-Nothing case are shown in Figures 8.2.6-1 to 8.2.6-3 and summarized in Table 8.2.6-1.

Table 8.2.6-1 Vehicle Assignment Results in Do-Noting Case

	Year 2008	Year 2015	Year 2025	Ratio 2025/2008
Total Vehicle Trips (PCU)	83,895	238,445	500,123	5.96
PCU-km	454,440	1,326,903	3,313,184	7.29
PCU-Hour	23,723	137,729	641,408	27.04
Volume / Capacity	0.38	1.11	2.78	7.31
Average Speed (km/h)	19.2	9.6	5.2	0.27

It is apparent that the important corridors will become heavily congested in the future. The following points are noted:

(1) Traffic Indicator

The future traffic situation is evaluated by the changes in number of vehicle trips, PCU-hr, PCU-km and average speed.

The vehicle trips are forecast to increase from 83,895 trips in 2008 to 500,123 in 2025 with a growth of about 6 times. The PCU-hr and PCU-km also increase, especially the PCU-hr increases from 23,723 PCU-hr in 2008 to 641,408 in 2025 with a growth of about 27 times. As a result, the average travel speed will decrease from 19.2 km/hr in 2008 to 5.2 km/hr in 2025, facing an economically and environmentally serious situation.

(2) Traffic Congestion

The volume to capacity ratio (V/C) is calculated to evaluate the road congestion. The average V/C in 2008 is 0.38, which is a fairly good value, while the traffic in 2025 will be at an unacceptable level with the average V/C of 2.78.

(3) Summary

If no countermeasures against traffic congestion are implemented in the transport sector, the level of service of the road network will become terrible situation. Appropriate countermeasures to decrease car traffic and increase public mode transport as well as the road network improvement to increase the capacity are necessary in near future.

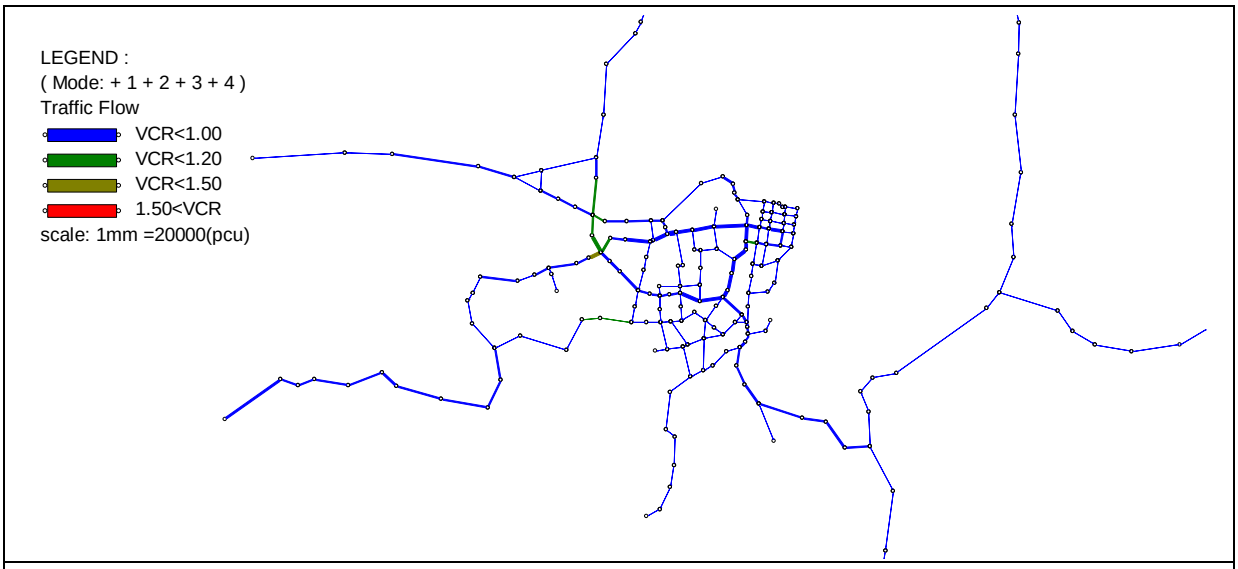


Figure 8.2.6-1 Traffic Assignment Result in Existing Case in 2008

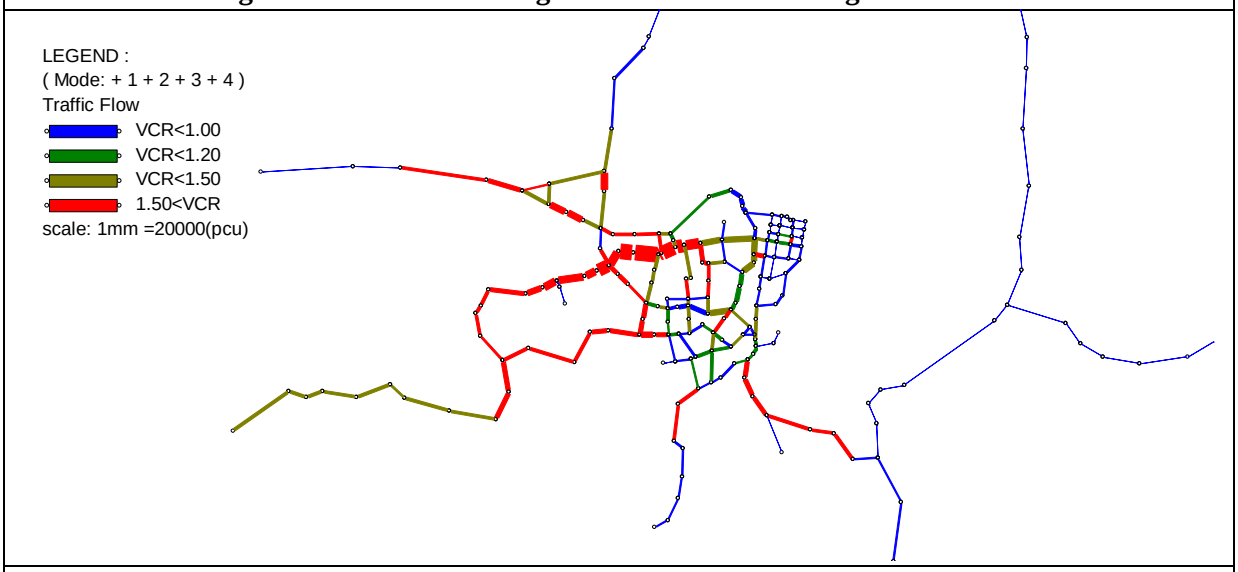


Figure 8.2.6-2 Traffic Assignment Result in Do-Nothing Case in 2015

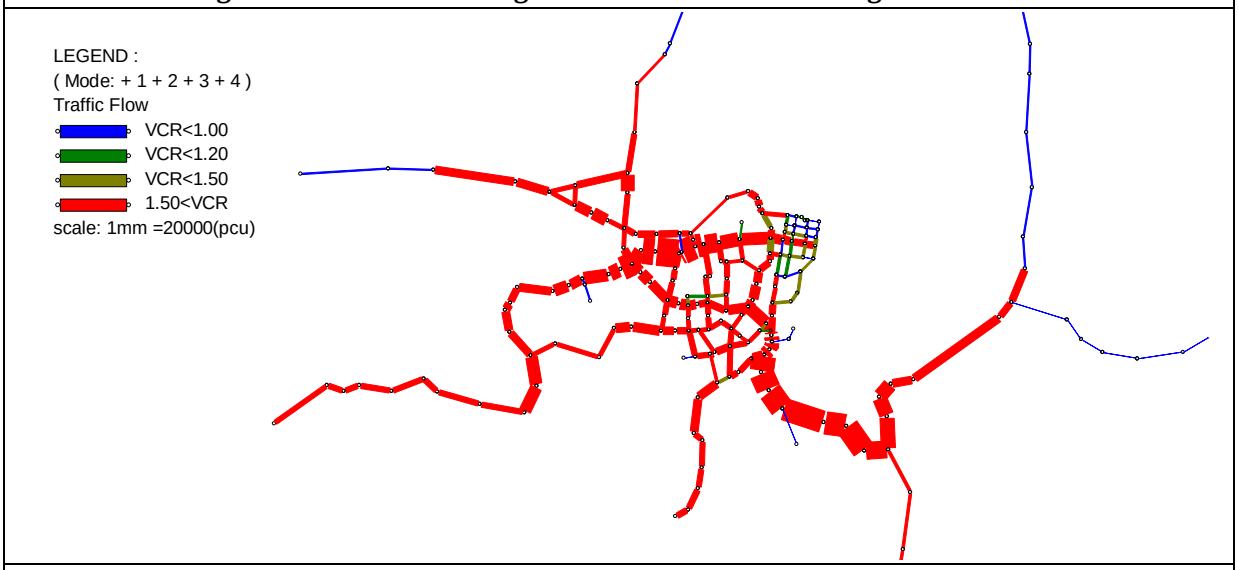


Figure 8.2.6-3 Traffic Assignment Result in Do-Nothing Case in 2025

CHAPTER 9

ROAD NETWORK DEVELOPMENT PLAN

CHAPTER 9 ROAD NETWORK DEVELOPMENT PLAN

9.1 STUDY METHODOLOGY

(1) Study Procedure

The process of the study to formulate the road network development plan is shown in Figure 9.1-1.

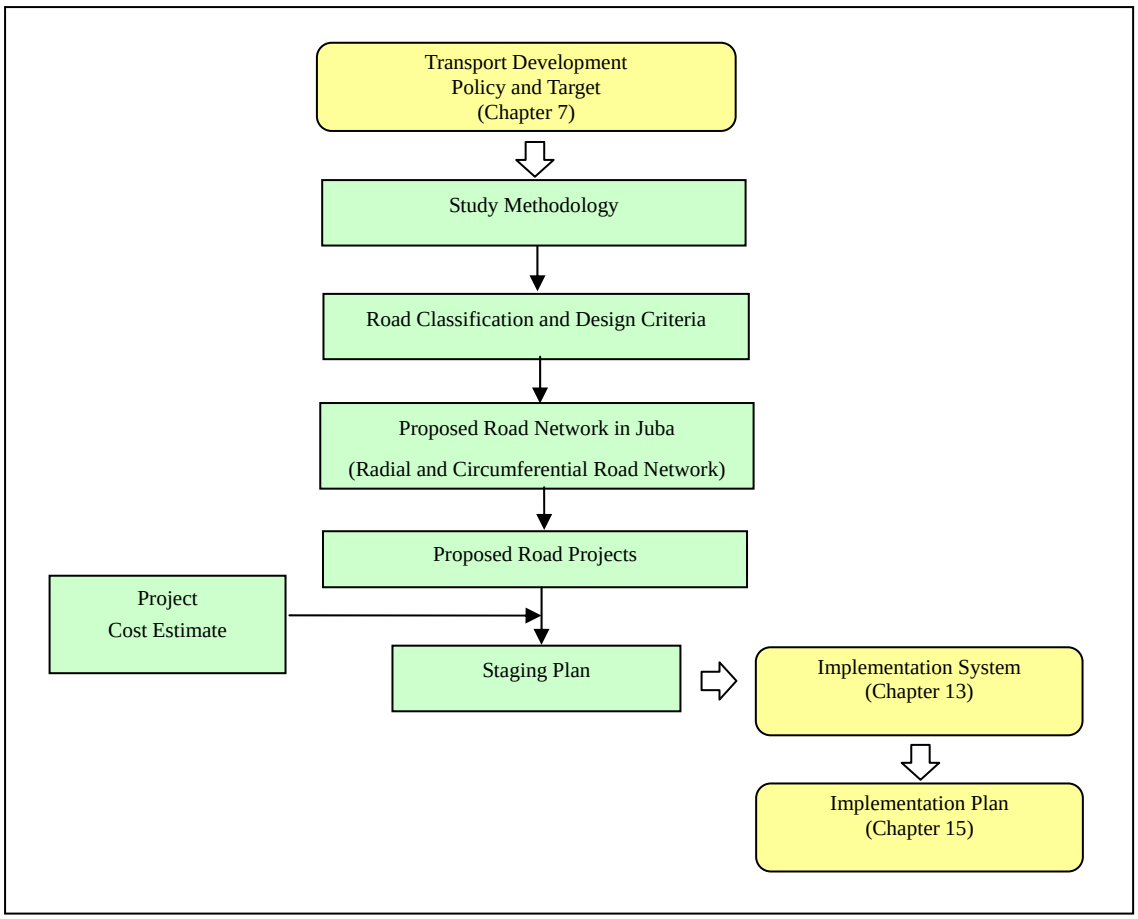


Figure 9.1-1 Study Procedure

(2) Planning Concept

Road Development Strategy which is shown in Chapter 7.4.2 is as follows.

- Immediate rehabilitation of existing roads
- Administrative and functional classification of roads
- Development of hierarchical road network system
- Establishment of appropriate standards for road engineering
- International level of improvement

To realize the above strategy, the basic direction of road network development plan is as follows:

1. Introduction of radial and circumferential road network system

2. Hierarchical and functional road network
3. Maximum utilization of existing network
4. Inducement of proper urbanized area expansion
5. Harmonized development with public transport

9.2 ROAD CLASSIFICATION

(1) Administrative Road Classification

The administrative road classification in the Southern Sudan is shown in Table 9.2-1.

Table 9.2-1 Administrative Road Classification

Administrative Road Classification	Responsible Organization
International/Interstate Road	GOSS, ministry of Transport and Roads (MTR)
State Road	State, Ministry of Physical Infrastructure (MOPI)
County Road	County

(2) Functional Road Classification

Road classification in urban area is not clear in the Southern Sudan at present. To formulate the road network develop plan, definition of functional road classification is needed.

According to "A Policy on Geometric Design of Highways and Streets" published by the American Association of State Highway and Transportation Officials (AASHTO), the roads in urbanized areas are classified into the following four categories:

- Principal Arterial Streets,
- Minor Arterial Streets,
- Collector Streets, and
- Local Streets.

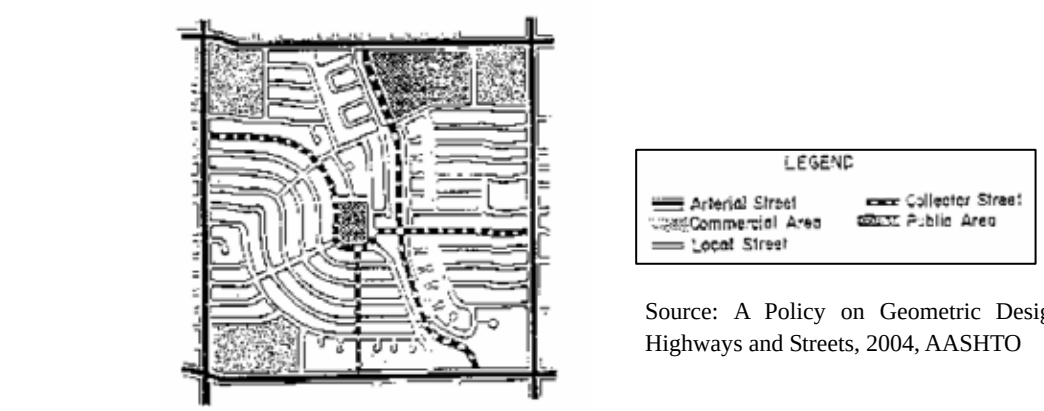
Functional highway systems in urban areas are defined as shown in Table 9.2-2.

Table 9.2-2 Definition of Urban Road Classification in AASHTO

Functional Classification	Definition
Principal Arterial	Service to the major centers of activity of urbanized areas, the highest volume corridors and the longest trip. The principal arterial should be integrated both internally and between major rural road connections.
Minor Arterial	Trips of moderate length at a somewhat lower level of travel mobility than principal arterial.
Collector	Land access service and traffic circulation within residential neighborhood and commercial and industrial areas.
Local	The lowest level of mobility and usually contains no bus routes. Service to though traffic movement usually is deliberately discouraged.

Source: A Policy on Geometric Design of Highways and Streets, 2004, AASHTO

A schematic illustration of a functionally classified suburban street network is shown in Figure 9.2-1



Source: A Policy on Geometric Design of Highways and Streets, 2004, AASHTO

Figure 9.2-1 Schematic Illustration of a Portion of a Suburban Street Network

This Study proposes to classify the urban streets as shown in Table 9.2-3, basically following the AASHTO's classification with simplicity.

Table 9.2-3 Functional Classification Proposed for this Study

Class	Function	Corresponding AASHTO's Classification
Arterial Streets	Trunk roads serving as primary distributers and district distributers.	Principal Arterial Streets
		Minor Arterial Streets
Collector Streets	Roads serving as local distributors	Collector Streets
Local Streets	Roads providing local access.	Local Streets

9.3 STANDARD CROSS-SECTIONS

(1) Design Criteria

The proposed functional road classification and design criteria are shown in Table 9.3-1. It is recommended to consult the following manuals/guidelines for the details of design.

- Geometric Design Manual, Ministry of Transport and Roads, Government of Southern Sudan 2006
- A Policy on Geometric Design of Highways and Streets, the American Association of State Highway and Transport Officials (AASHTO)
- Road Structure Guidelines, Japan Association of Roads, February 2004
- Bridge Design Manual, Ministry of Transport and Roads, Government of Southern Sudan 2006
- Drainage Design Manual, Ministry of Transport and Roads, Government of Southern Sudan 2006
- Pavement Design Manual, Ministry of Transport and Roads, Government of Southern Sudan 2006

- Guide for Design of Pavement Structure, AASHTO
- Highway Capacity Manual, Fourth Edition, Transportation Research Board, National Research Council, Washington DC

Table 9.3-1 Proposed Road Functional Classification and Design Criteria

	Arterial Streets	Collector Streets	Local Streets	Remarks
Function	- Intercity trunk road - Primary distributer - District distributor	Access road connecting to local streets and local distributor.	Other minor roads for local access.	
Flow Condition	Possibly uninterrupted flow except at intersection	Interrupted flow	Interrupted flow	
Design Traffic by lane (ADT)	10,000-12,000	10,000-12,000 (9,000 in case of 2-lane)	9,000 in case of 2-lane	
Design Speed (km/h)	60, 50	60, 50, 40	50, 40, 30	
Target Speed (km/h)	40	30	20	
Level of Service	C	D	D	
Lane Width (m)	3.6	3.3	3.0	
Median (m)	3.6-5.4	3.0-4.8	-	
Multi-purpose Lane [1] (m)	3.5	3.5	3.0	
Bicycle Lane (m)	2.0	2.0	If required	
Shoulder (m)	1.2	0.6-1.2	0.5	Preferably paved shoulder
Greenbelt [2] (m)	2.0-4.0	1.0-3.0	If required	Preferably 3.0m wide
Sidewalk [3] (m)	2.0-3.0	2.0-3.0	2.0-3.0	3.5 m for high traffic

Note:

[1] ***Multi-purpose Lane***

This lane is intended to provide exclusive space for bus bays, on-street parking, use of slow moving vehicles such as bikes and bicycles, etc., depending on location and necessity. Parking and loading/unloading zones have to be limited to the place more than 50m before and after intersections.

[2] ***Greenbelt***

A 2.0-4.0m greenbelt space for trees and vegetation is provided between traveled way and sidewalk to secure the safety of pedestrians and enhance the aesthetic value of the road and environment.

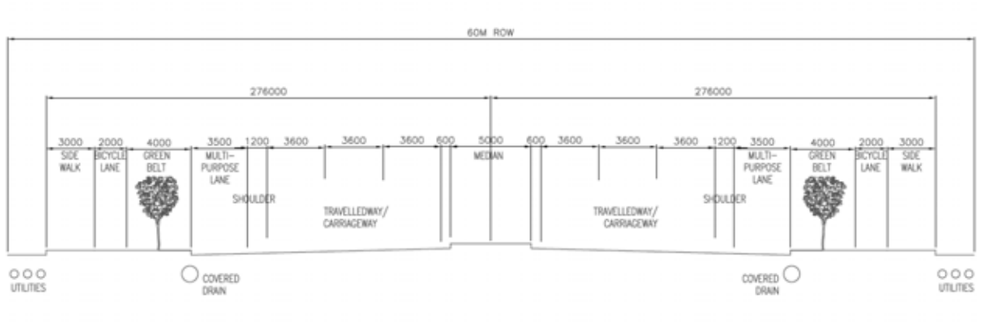
[3] ***Sidewalk***

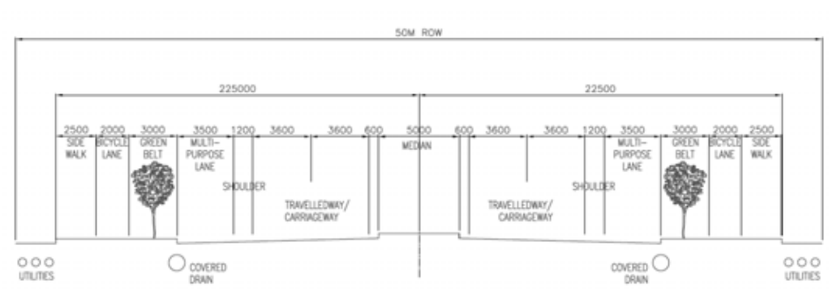
Sidewalk with a width of 2.5-3.0m are proposed to accommodate pedestrians and non-motorized transport (NMT) modes. In the design of sidewalks, the requirements for physically challenged people (PCP) shall be taken into consideration.

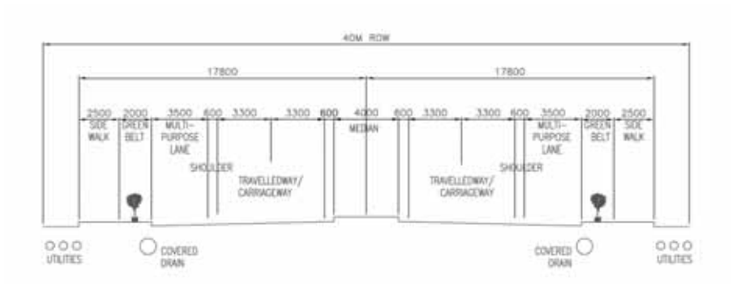
(2) Standard Cross-sections

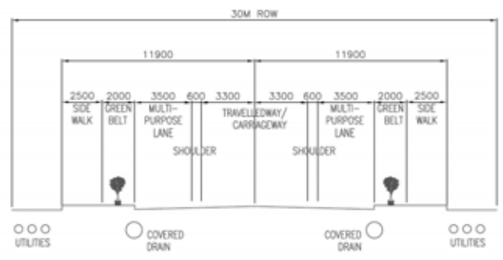
Typical cross-sections proposed for each class of road are shown in Table 9.3-2. The service utilities shall be contained within the limits of the right-of-way.

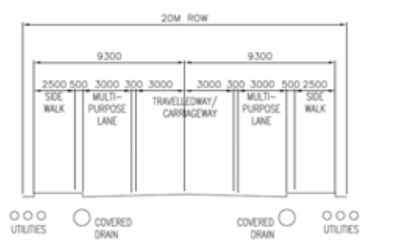
Table 9.3-2 Proposed Standard Cross Sections

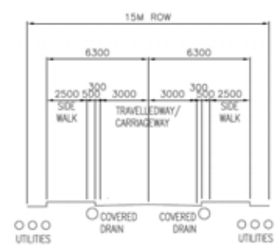
<table>
<tr>
<td>Arterial Street</td>
<td>6 – lane
 

<u>TYPICAL CROSS SECTION 1 : ROW=60M</u></td>
<td>4 – lane
 

<u>TYPICAL CROSS SECTION 2 : ROW=50M</u></td>
</tr>
<tr>
<td>Collector Street</td>
<td>4 – lane
 

<u>TYPICAL CROSS SECTION 3 : ROW=40M</u></td>
<td>2 – lane
 

<u>TYPICAL CROSS SECTION 4 : ROW=30M</u></td>
</tr>
<tr>
<td>Local Street</td>
<td>2 – lane
 

<u>TYPICAL CROSS SECTION 5 : W/PARKING LANE</u></td>
<td>2 – lane
 

<u>TYPICAL CROSS SECTION 6 : W/O PARKING LANE</u></td>
</tr>
</table>

9.4 ROAD ANCILLARY FACILITIES

As road ancillary facilities, traffic signs, road marking and street lighting are introduced as follows.

(1) Traffic Signs

The safety and efficiency of a road depends to a considerable degree on its geometric design. However, physical layout must also be supplemented by effective traffic signs as a means of informing and warning drivers, and controlling drivers. Design of traffic sign and road marking is an intricate part of the design process.

Traffic signs are of three general types:

- Regulatory Signs; indicate legal requirements of traffic movement
- Warning Signs; indicate conditions that may be hazardous to road users
- Informatory Signs; convey information of use to the driver

(2) Road Marking

The function of road marking is to encourage safe operation. Road markings either supplement traffic signs and marker post or serve independently to indicate certain regulations or hazardous conditions.

There are three general types of road marking: pavement marking, object markers, and road studs.

Pavement Markings	Consist of centerlines, lane lines, no overtaking lines, edge lines, etc. Nighttime visibility of these marking can be markedly improved by mixing small glass beads into the paint or thermoplastic before applying it to the road surface.
Object Markers	Physical obstructions in or near the carriageway should be removed in order to provide the appropriate clear zone. Where removal is impractical, such objects should be adequately marked by painting or by use of other high-visibility material. Where the object is in the direct line of traffic, the obstruction and marking thereon should be reflectorized.
Road Studs	Road studs are manufactured plastic objects incorporating reflectorized patches. Hybrid marking consisting of both reflective road markings and reflective studs can be useful for night time driving in unlit areas. They are generally placed along the centerline of the road, in the middle of the “broken-line” portion of the marking, for added demarcation. The studs can also be used to give an audible and tactile warning of crossing any line that incorporates them, such as a pedestrian crossing.

(3) Street Lighting

Street lighting is provided to improve the safety of a road. Statistics indicate that the nighttime accident rate is higher than during daylight hours, which, to a large degree, may be attributed to impaired visibility. In urban areas, where there are concentrations of pedestrians and junctions, fixed source lighting tends to reduce accidents.

To minimize the effect of glare and to provide the most economical lighting installtion, luminaries should be mounted at a height of at least 9 meters. High mounted luminaries provide greater uniformity of lighting and mounting height of 10 to 15 meters are frequently used. High mast lighting (special luminaries on masts of 30 meters) is used to illuminate large areas such as intersections. This type of lighting gives a uniform distribution of light over the whole area and thus illuminates the layout of the intersection.

Lighting columns should be placed behind vertical kerbs whenever practical. The appropriate distance is 0.5m behind the kerb for roads with a design speed of 50 km/h or less, and 1.2m or greater for roads with a design speed of 80 km/h or greater. Where poles are located within the clear zone, regardless of distances from the edge of the carriageway, types of poles should not be used on roads in densely populated areas, particularly with sidewalk. When struck, these poles may collapse and cause injury to pedestrians or damage adjacent property. Because of lower speeds and parked vehicles on urban roads, there is much less chance of injuries to vehicle occupants from striking fixed poles as compared to higher speed roads.

On dual carriageways, lighting may be located either in the median or on the right hand side of each carriageway. However, with median insulation, the cost is generally lower and illumination is higher on the high-speed outer lanes. On median installations, dual mast arms should be used, for which 12-15 meter mounting height are favored.

These should be protected with a suitable safety barrier. On narrow medians, it is preferable to place the lighting poles so that they are integral with the median barrier.

When it is intended to install highway lighting in the future, providing the necessary conduits/ ducts as part of the initial road construction can effect considerable saving.

9.5 PROPOSED ROAD NETWORK DEVELOPMENT

9.5.1 Mapping

In the "Emergency Study on the Planning and Support for Basic Physical and Social Infrastructure in Juba Town and the Surrounding Areas" conducted by JICA during 2006-2007, the topographic map was prepared based on the satellite image taken in January 2004. Since then, Juba urban area has rapidly been developing, resulting in a big change in buildings, roads, land use, etc. Therefore, the updated map is of vital need to make a reliable study reflecting the later condition. In this Study, topographic maps were prepared as follows:

(1) Satellite Image

The satellite image shown in Table 9.5.1-1 was used as input data for preparation of topographic map.

Table 9.5.1-1 Specifications of the Satellite Image

Item	Specification
Type of Satellite Image	GeoEye-1 (GeoRPC)
Type of Data File	Geo tiff
Image Resolution	0.5 m
Acquired Date	16 March 2009
Area	784 sq.km (28km x 28km)
Map Projection	UTM (Universal Tranverse Mercator), Zone 36 North
Reference System and Ellipsoid	WGS84 (World Geodetic System 1984)

(2) Mapping

The mapping was made as shown in Table 9.5.1-2.

Table 9.5.1-2 Specifications of Mapping

Item	Specification
Mapping Area	784 sq.km (28km x 28km)
Application Software	Mapinfo (Mapinfo Corporation)
Layer	1. Road 2. River 3. Building 4. Ferest/Grove/Woodland 5. Cultivated Field 6. Grassland 7. Bush 8. Marsh
Vertical Datum	Mean Sea Level (MSL) The contour lines are created using DEM(SPOT-DEM) from "Emergency Study on the Planning and Support for Basic Physical and Social Infrastructure in Juba Town and the Surrounding Areas".

(3) Produced Topographic Maps

Using the data prepared in (2) above, 5 kinds of maps shown in Table 19.5.1-3 were prepared.

Table 9.5.1-3 Produced Maps

Title	Description	Scale	Area Covered
1 Map of Juba Urban Area	Existing condition not including proposed road network	1/10,000	9.36km x 7.66 km
2 Map of Juba Urban Area	- do -	1/30,000	22km x 27km
3 Road Network Concept of Juba Urban Area	Existing condition with proposed road network	1/10,000	9.36km x 7.66 km
4 Road Network Concept of Juba Urban Area	- do -	1/30,000	22km x 27km
5 Satellite Image	Satellite image with proposed road network	1/15,000	16.755km x 24.87km

(4) Road Length Measurement

Using the data prepared in (2) above, the length of existing roads are measured (see Chapter 9.5.3)

9.5.2 Proposed Road Network

(1) Principles for Road Network Improvement Plan

- To establish a hierarchical and functional road network.
- To form a radial and circumferential road system.
- To guide and coordinate the future land use plan to avoid sprawling suburban development.
- To utilize existing roads as much as possible.

(2) Proposed Road Network

The proposed road network in Juba urban area is shown in Figure 9.5.2-1. The road network is composed of arterial streets, collector streets and local streets.

i. Arterial Streets

It is proposed to form an arterial road network of radial and circumferential type. Radial Roads are major arterials from the center of Juba urban area to outer areas in radial direction connecting to major interstate/international roads, while Circumferential Roads are major distributers connecting Radial Roads. Radial Roads consist of six roads: R-1 to R-6, and Circumferential Roads consist of 4 roads: C-1 to C-4.

ii. Collector Streets

Collector Streets are local distributers inside the blocks divided by radial and circumferential roads.

iii. Local Streets

Local streets are roads providing local access.

Nile River Bridges

The proposed road network includes 6 bridges crossing Nile River, all along arterial streets, which are C-3 South and North, C-4 South and North, R-5 and R-6(existing).

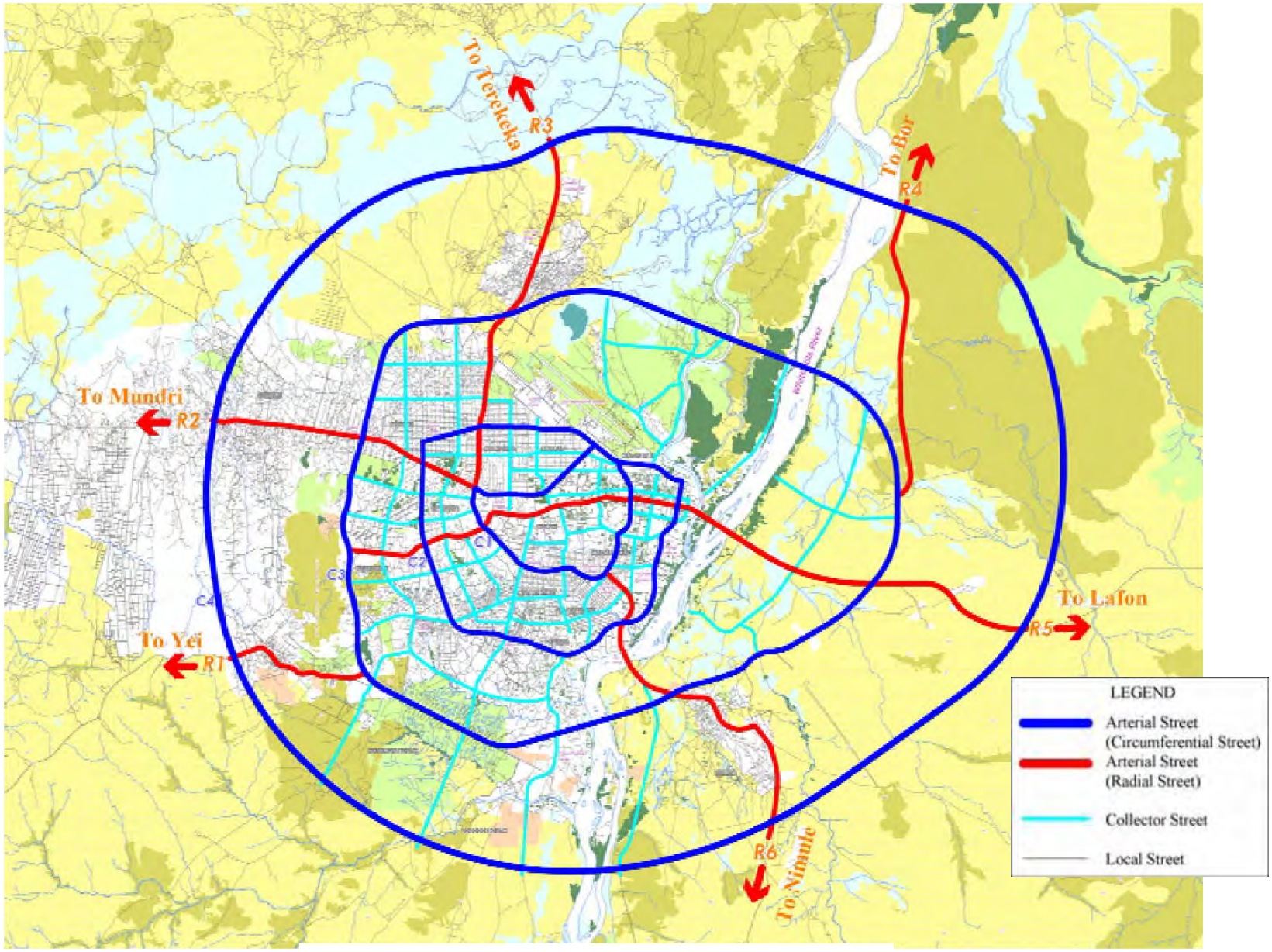


Figure 9.5.2-1 Proposed Road Network in Juba Urban Area

9.5.3 Existing and Planned Road Length

The existing and planned road length is measured/estimated as followed:

- Existing road length is measured from the topographic map as mentioned in 9.5.1(4).
- Length of Arterial Streets are also measured from the topographic map with proposed road network.
- Length of future collector and local streets are estimated taking into consideration the topography, existing/future land use and existing road density.

Table 9.5.3-1 shows the existing and planned road length of arterial streets by section shown in Figure 9.5.3-1, and Table 9.5.3-2 shows the existing and planned road length of collector and local streets by block shown in Figure 9.5.3-2.

Tables 9.5.3-1 Road Length (Arterial Streets)

Circumferential Road				Radial Road			
Road	Section (Figure 9.5.3-1)	Road Length * (km) Existing	Future	Road	Section (Figure 9.5.3-1)	Road Length * (km) Existing	Future
C-1	C1-1	0.91	0.91	R-1	R1-1	0.38	0.38
	C1-2	2.98	2.98		R1-2	1.33	1.33
	C1-3	0.62	0.62		R1-3	1.67	1.67
	C1-4	0.86	0.86		R1-4***	(1.20)	(2.67)
	C1-5	0.86	0.86		R1-5	3.07	3.07
	C1-6	0.87	0.87		Sub-total	6.45	6.45
	C1-7	1.91	1.91	R-2	R2-1	1.21	1.21
	C1-8	1.13	1.13		R2-2	1.41	1.41
	Sub-total	10.14	10.14		R2-3	3.16	3.16
C-2	C2-1	0.00	1.74		Sub-total	2.62	5.78
	C2-2	1.68	1.68	R-3	R3-1	1.30	1.30
	C2-3	2.54	2.54		R3-2	2.52	2.52
	C2-4 **	(0.62)	(0.62)		R3-3	3.91	3.91
	C2-5	0.00	1.42		Sub-total	7.73	7.73
	C2-6	0.00	0.55	R-4	R4-1	6.34	6.34
	C2-7	0.00	0.65		Sub-total	6.34	6.34
	C2-8	0.00	2.33	R-5	R5-1	2.99	2.99
	C2-9	1.44	1.44		R5-2	1.00	1.00
	C2-10	1.35	1.35		R5-3	0.00	0.46
	C2-11	0.00	2.96		R5-4	0.00	0.52
	Sub-total	7.01	16.66		R5-5	0.00	3.54
C-3	C3-1	0.72	2.46		R5-6	3.47	3.47
	C3-2	1.60	4.71		Sub-total	7.46	11.98
	C3-3	0.00	5.08	R-6	R6-1	1.35	1.35
	C3-4	0.00	1.64		R6-2	0.77	0.77
	C3-5	0.00	3.64		R6-3	1.34	1.34
	C3-6	1.98	1.98		R6-4	4.24	4.24
	C3-7	3.20	4.94		Sub-total	7.70	7.70
	C3-8	0.00	1.65	Total		38.30	45.98
	C3-9	0.00	0.94				
	C3-10	0.45	2.04				
	C3-11	2.47	2.48				
	C3-12	1.20	2.67				
	Sub-total	11.62	34.23				
C4	C4-1	0.00	5.11				
	C4-2	0.00	9.89				
	C4-3	0.00	5.38				
	C4-4	0.00	1.84				
	C4-5	0.00	0.56				
	C4-6	0.00	10.62				
	C4-7	0.00	6.73				
	C4-8	0.00	3.83				
	C4-9	0.00	1.62				
	C4-10	0.00	2.25				
	C4-11	0.00	5.66				
	Sub-total	0.00	53.49				
Total		28.77	114.52				

Note : * Road length includes the length of Nile River Bridges.
** Section C2-4 overlaps with C1-3.
*** Section R1-4 overlaps with C3-12.

Tables 9.5.3-2 Road Length (Collector and Local Streets)

Block (Figure 9.5.3-2)		Area (km^2)	Road Length (km)						Road Density (km / km^2)					
			Collector Streets		Local Streets		Collector+Local		Collector Streets		Local Streets		Collector+Local	
			Existing	Future	Existing	Future	Existing	Future	Existing	Future	Existing	Future	Existing	Future
Inside C-1	C1-1	2.09	5.27	5.27	21.50	21.50	26.77	26.77	2.52	2.52	10.29	10.29	12.81	12.81
	C1-2	3.50	5.13	5.13	49.32	49.32	54.45	54.45	1.47	1.47	14.09	14.09	15.56	15.56
	Sub-total	5.59	10.40	10.40	70.82	70.82	81.22	81.22	1.86	1.86	12.67	12.67	14.53	14.53
Between C-1 and C-2	C2-1	1.50	3.57	3.57	2.84	15.00	6.41	18.57	2.38	2.38	1.89	10.00	4.27	12.38
	C2-2	1.03	2.14	2.14	17.48	17.48	19.62	19.62	2.08	2.08	16.97	16.97	19.05	19.05
	C2-3	2.81	6.32	6.32	44.07	44.07	50.39	50.39	2.25	2.25	15.68	15.68	17.93	17.93
	C2-4*	0.78	3.12	3.12	4.29	4.29	7.41	7.41	4.00	4.00	5.50	5.50	9.50	9.50
	C2-5*	0.71	4.00	4.00	6.23	6.23	10.23	10.23	5.63	5.63	8.77	8.77	14.41	14.41
	C2-6	1.29	2.24	2.24	12.62	12.62	14.86	14.86	1.74	1.74	9.78	9.78	11.52	11.52
	C2-7	3.58	8.06	8.06	61.49	61.49	69.55	69.55	2.25	2.25	17.18	17.18	19.43	19.43
	C2-8	3.18	7.70	7.70	23.79	38.16	31.49	45.86	2.42	2.42	7.48	12.00	9.90	14.42
	Sub-total	14.88	37.15	37.15	172.81	199.34	209.96	236.49	2.50	2.50	11.61	13.40	14.11	15.89
Between C-2 and C-3	C3-1	3.44	5.40	5.40	22.81	27.52	28.21	32.92	1.57	1.57	6.63	8.00	8.20	9.57
	C3-2	5.82	9.74	9.74	36.17	46.56	45.91	56.30	1.67	1.67	6.21	8.00	7.89	9.67
	C3-3	12.98	12.29	12.29	48.91	48.91	61.20	61.20	0.95	0.95	3.77	3.77	4.71	4.71
	C3-4	6.54	3.45	3.45	0.00	3.27	3.45	6.72	0.53	0.53	0.00	0.50	0.53	1.03
	C3-5	10.79	6.69	6.69	0.13	16.19	6.82	22.88	0.62	0.62	0.01	1.50	0.63	2.12
	C3-6	1.88	0.00	0.00	4.55	9.40	4.55	9.40	0.00	0.00	2.42	5.00	2.42	5.00
	C3-7	8.56	3.81	3.81	4.75	42.80	8.56	46.61	0.45	0.45	0.55	5.00	1.00	5.45
	C3-8	1.25	0.54	0.54	1.12	2.50	1.66	3.04	0.43	0.43	0.90	2.00	1.33	2.43
	C3-9	5.11	5.21	5.21	18.88	30.66	24.09	35.87	1.02	1.02	3.69	6.00	4.71	7.02
	C3-10	7.32	9.52	9.52	35.83	43.92	45.35	53.44	1.30	1.30	4.89	6.00	6.20	7.30
	C3-11*	0.69	0.20	0.20	3.45	3.45	3.65	3.65	0.29	0.29	5.00	5.00	5.29	5.29
	Sub-total	64.38	56.85	56.85	176.60	275.18	233.45	332.03	0.88	0.88	2.74	4.27	3.63	5.16
Between C-3 and C-4	C4-1	15.45	0.00	8.44	11.48	30.90	11.48	39.34	0.00	0.55	0.74	2.00	0.74	2.55
	C4-2	22.10	0.00	13.90	20.16	88.40	20.16	102.30	0.00	0.63	0.91	4.00	0.91	4.63
	C4-3	15.76	0.00	8.13	13.67	31.52	13.67	39.65	0.00	0.52	0.87	2.00	0.87	2.52
	C4-4	8.17	0.00	1.79	0.00	4.09	0.00	5.88	0.00	0.22	0.00	0.50	0.00	0.72
	C4-5	6.10	0.00	1.86	0.00	3.05	0.00	4.91	0.00	0.30	0.00	0.50	0.00	0.80
	C4-6	24.61	0.00	15.13	2.10	49.22	2.10	64.35	0.00	0.61	0.09	2.00	0.09	2.61
	C4-7	16.22	0.00	11.08	9.35	32.44	9.35	43.52	0.00	0.68	0.58	2.00	0.58	2.68
	C4-8	10.60	3.63	7.04	5.96	42.40	9.59	49.44	0.34	0.66	0.56	4.00	0.90	4.66
	C4-9	15.30	6.15	11.25	7.60	61.20	13.75	72.45	0.40	0.74	0.50	4.00	0.90	4.74
	C4-10	3.84	1.86	3.25	7.63	15.36	9.49	18.61	0.48	0.85	1.99	4.00	2.47	4.85
	Sub-total	138.15	11.64	81.87	77.95	358.58	89.59	440.45	0.08	0.59	0.56	2.60	0.65	3.19
Total		223.00	116.04	186.27	498.18	903.92	614.22	1090.19	0.52	0.84	2.23	4.05	2.75	4.89

* CCD

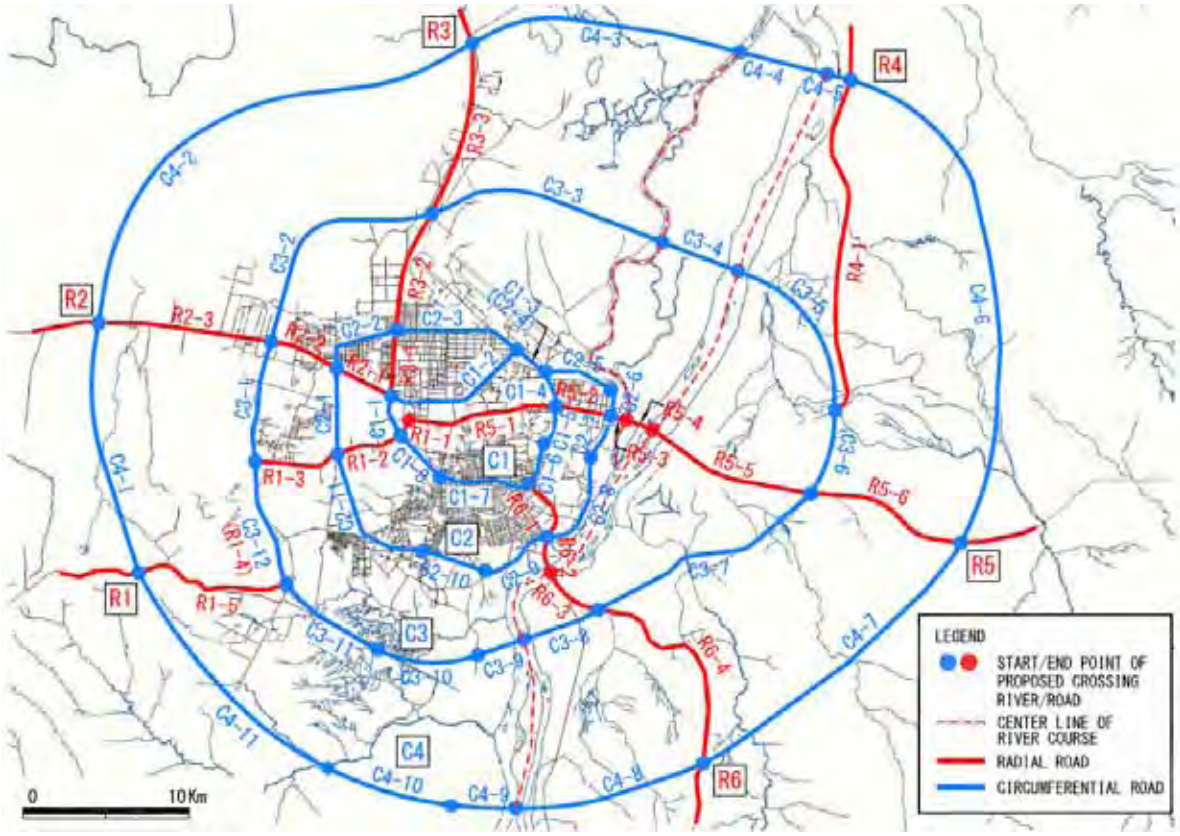


Figure 9.5.3-1 Sectioning of Arterial Streets

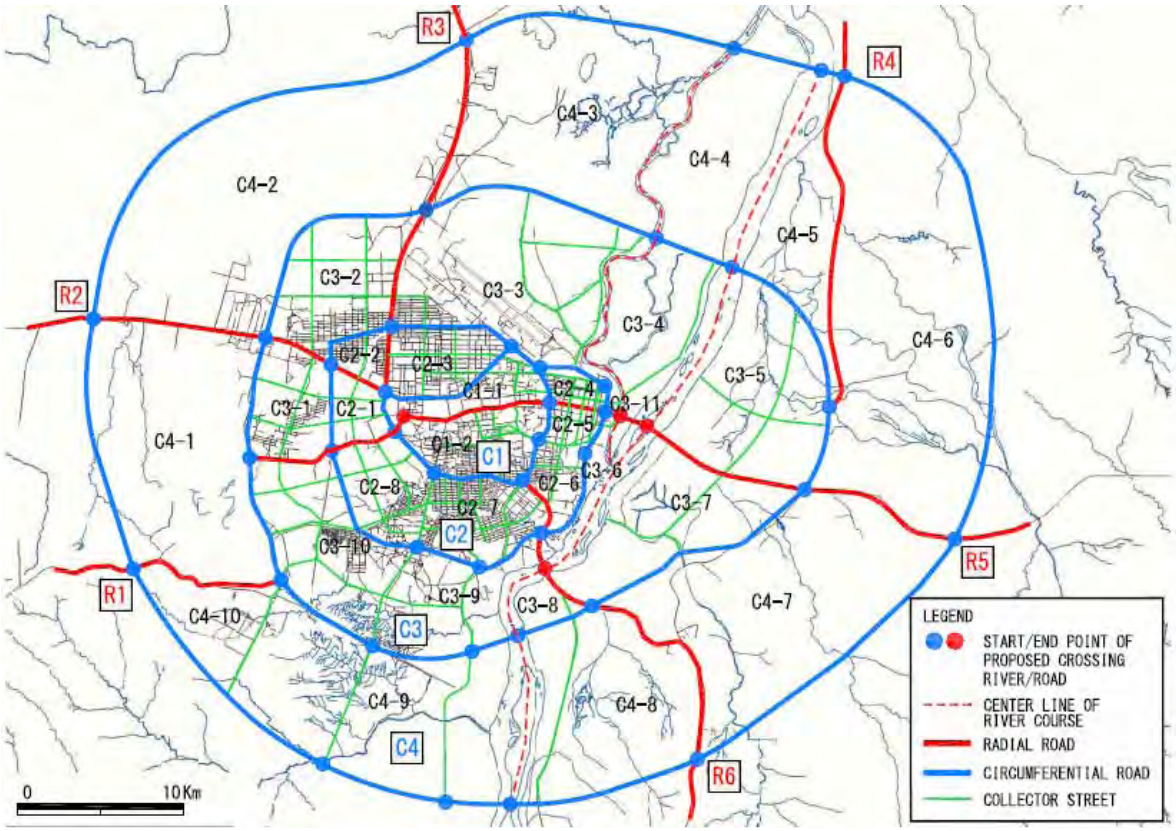


Figure 9.5.3-2 Blocks of Collector/Local Streets

9.6 IDENTIFICATION OF REQUIRED ROAD IMPROVEMENT

(1) Staging Improvement Scheme

Number of Lanes

The standard cross-sections shown in Table 9.3-2 are considered to be the ultimate sections. Due to limitation of available fund, a staging implementation is proposed as follows:

- Arterial Streets : 4 lanes in initial stage → 6 lanes in ultimate stage
- Collector Streets : 2 lanes in initial stage → 4 lanes in ultimate stage
- Local Streets : 2 lanes (no ultimate stage with regard to number of lanes)

However, it is strongly recommended to acquire the right-of-way necessary for the ultimate stage, in advance at the initial stage.

Type of Improvement

To complete the proposed road network in the shortest period within the limited available fund insufficient to construct all roads with asphalt pavement, the following four types of staging improvement are considered.

1) AC : Construct asphalt paved road from the beginning.
2) GR⇒AC : Initially construction gravel road and later upgrade to asphalt paved road.
3) RS⇒AC : Initially construct resurfaced road and later upgrade to asphalt paved road.
4) RS⇒GR⇒AC : Initially construct resurfaced road and later upgrade to gravel road then asphalt paved road finally.

Note : RS(resurfacing) : minimum works necessary to make road passable for motorized vehicles, including smoothening of existing road surface, placement and compaction of thin layer of gravel, and provision of low level drainage facilities (earth ditches and pipe culverts)

Proposed improvement plan by road class is shown in Table 9.6-1.

Table 9.6-1 Proposed Staging Improvement Scheme

Functional Road Class	Standard Number of Lanes	Improvement Type
Arterial Streets	Initial Stage :2 or 4 Ultimate Stage : 4 or 6	AC
Collector Streets	Initial Stage :2 Ultimate Stage : 4	AC
Local Streets	2	AC, GR⇒AC, RS⇒AC or RS⇒GR⇒AC depending on available fund and importance of road

(2) Identification of Necessary Improvement Works

Table 9.6-2 shows the necessary improvement works to complete the road network shown in Figure 9.5.2-1.

Table 9.6-2 Necessary Improvement Works

Project Component	Improvement Type	Number of Lanes (Initial Stage)	Project Type		Remarks
			Widening and Improvement of Existing Road (km)	New Construction (km)	
1. Arterial Streets (Circumferential Roads)					
1.1 C-1	AC	2	10.14	-	On-going
1.2 C-2	AC	2	7.01	9.65	
1.3 C-3	AC	2	11.62	21.36	
1.4 C-4	AC	2	-	52.24	
2. Arterial Streets (Radial Roads)					
2.1 R-1	AC	2	6.45	-	
2.2 R-2	AC	2	2.62	3.16	
2.3 R-3	AC	2	7.73	-	
2.4 R-4	AC	2	6.34	-	
2.5 R-5	AC	2	7.46	3.60	
2.6 R-6	AC	2	7.70	-	On-going
3. Collector Streets					
3.1 Central Commercial District (CCD)	AC	2	7.32	-	Partly on-going
3.2 Inside C-1	AC	2	10.40	-	
3.3 Between C-1 and C-2	AC	2	30.03	-	
3.4 Between C-2 and C-3	AC	2	56.65	-	
3.5 Between C-3 and C-4	AC	2	11.64	(70.23)	
4. Local Streets					
4.1 Central Commercial District (CCD)	AC GR⇒AC	2 2	5.60 8.37	-	Partly on-going
4.2 Inside C-1	AC GR⇒AC RS⇒AC	2 2 2	14.16 14.16 42.50	-	Partly on-going
4.3 Between C-1 and C-2 (excluding CCD)	AC GR⇒AC RS⇒AC	2 2 2	64.91 64.92 32.46	(26.53)	
4.4 Between C-2 and C-3 (excluding CCD)	AC GR⇒AC RS⇒AC RS⇒GR⇒AC	2 2 2 2	25.97 60.60 17.32 69.26	(98.58)	
4.5 Between C-3 and C-4	AC GR⇒AC RS⇒AC RS⇒GR⇒AC	2 2 2 2	7.80 23.39 15.58 31.18	(280.63)	
5. Nile River Bridges					
5.1 C-3 (South)		2	-	0.56	
5-2 C-3 (North)		2	-	0.69	
5-3 C-4 (South)		2	-	0.70	
5-4 C-4 (North)		2	-	0.55	
5-5 R-5		2	-	0.92	
5-6 R-6		2	-	-	Existing
Total			681.29	93.43	

Note: New construction of Collector and Local Streets is excluded from the road network development plan.

9.7 PROJECT COST ESTIMATE

(1) Unit Project Cost

Construction Cost

Based on the cost of on-going projects and the quoted cost to the contractors which have the work experiences in Juba, the unit construction cost is estimated as shown in Table 9.7-1.

Table 9.7-1 Unit Construction Cost by Type of Work

Road Class	Improvement Works						Construction Cost per km (US$ million)		
	Number of Lanes (Ultimate Stage)	Pave-ment Type	Width of Major Cross-sectional Elements (m)				Full Const-ruction	Stage Construction	
			Travelled Way	Multi-purpose Lane	Sidewalk + Greenbelt	Medi-an		Initial Stage	Ultimate Stage
Arterial	6-lane	AC	25.2	7.0	15.0	5.0	7.6	(4-lane) 6.1	(6-lane) 1.7
	4-lane	AC	18.0	7.0	15.0	5.0	5.9	(2-lane) 4.7	(4-lane) 1.3
Collector	4-lane	AC	15.6	7.0	9.0	4.0	5.1	(2-lane) 4.1	(4-lane) 1.2
	2-lane	AC	7.8	7.0	9.0	-	3.4	-	-
Local	2-lane	AC	6.6	6.0	6.0	-	2.0	(GR) 1.3	(AC) 0.9
	2-lane	GR	6.6	6.0	6.0	-	1.3	(RS) 1.1	(GR) 0.4
	2-lane	RS	6.6	6.0	6.0	-	1.1	-	-
	2-lane	AC	6.6	-	6.0	-	1.8	(GR) 1.2	(AC) 0.8
	2-lane	GR	6.6	-	6.0	-	1.2	(RS) 1.1	(GR) 2.8
	2-lane	RS	6.6	-	6.0	-	1.1	-	-

Note : AC=asphalt concrete, GR=Gravel, RS=Resurfacing
Source : Study Team

Engineering Design and Construction Supervision Costs

Detailed design cost is estimated at 4% of construction cost and construction supervision cost at 8% of construction cost.

Land Acquisition and Compensation Cost for Relocation

Since the land value and compensation cost vary very much depending on the area and the policy of GOSS Government, it is proposed to estimate land acquisition and compensation costs during the feasibility studies.

(2) Estimated Construction Cost

The construction costs of necessary works to complete the proposed road network are roughly estimated as summarized in Table 9.7-2.

Table 9.7-2 Estimated Construction Cost

Project Component	Pavement Type	Number of Lanes	Length * (km)	Construction Cost ** (US $ million)	Remarks
1. Arterial Streets (Circumferential Roads)					
1.1 C-1	AC	2	10.14	25.40	Initial Stage
1.2 C-2	AC	2	16.66	74.61	Initial Stage
1.3 C-3	AC	2	32.98	155.01	Initial Stage
1.4 C-4	AC	2	52.24	245.53	Initial Stage
2. Arterial Streets (Radial Roads)					
2.1 R-1	AC	2	6.45	29.48	Initial Stage
2.2 R-2	AC	2	5.78	24.50	Initial Stage
2.3 R-3	AC	2	7.73	33.47	Initial Stage
2.4 R-4	AC	2	6.34	29.80	Initial Stage
2.5 R-5	AC	2	11.06	43.20	Initial Stage
2.6 R-6	AC	2	7.70	8.42	Initial Stage
3. Collector Streets					
3.2 Central Commercial District (CCD)	AC	2	7.32	30.00	
3.2 Inside C-1	AC	2	10.40	42.60	
3.3 Between C-1 and C-2	AC	2	30.03	123.10	
3.4 Between C-2 and C-3	AC	2	56.65	232.30	
3.5 Between C-3 and C-4	AC	2	11.64	47.72	
4. Local Streets					
4.1 Central Commercial District (CCD)	AC GR⇒AC	2 2	5.60 8.37	11.20 18.42	
4.2 Inside C-1	AC GR⇒AC RS⇒AC	2 2 2	14.16 14.16 42.50	28.33 31.15 101.98	
4.3 Between C-1 and C-2 (excluding CCD)	AC GR⇒AC RS⇒AC	2 2 2	64.91 64.92 32.46	129.84 84.39 77.90	
4.4 Between C-2 and C-3 (excluding CCD)	AC GR⇒AC RS⇒AC RS⇒GR⇒AC	2 2 2 2	25.97 60.60 17.32 69.26	51.95 133.32 41.60 166.23	
4.5 Between C-3 and C-4	AC GR⇒AC RS⇒AC RS⇒GR⇒AC	2 2 2 2	7.80 23.39 15.58 31.18	15.59 30.40 37.42 74.88	
5. Nile River Bridges					
5.1 C-3 (South)		2	0.56	61.60	Initial Stage
5-2 C-3 (North)		2	0.69	77.30	Initial Stage
5-3 C-4 (South)		2	0.70	77.87	Initial Stage
5-4 C-4 (North)		2	0.55	60.68	Initial Stage
5-5 R-5		2	0.92	99.42	Initial Stage
Total			774.72	2556.61	

Note: * Length : excluding new construction of Collector and Local Streets.

** Construction Cost : Road construction cost only, not including cost of construction of other bridges than Nile River Bridges, right-of way acquisition and compensation costs, and detailed design and construction supervision costs.

9.8 PROJECT IMPLEMENTATION FRAME AND TRAFFIC CONDITION

(1) Prioritization Procedure

Implementation Terms

The project implementation terms are defined as follows:

- Short Term 2009-2015(7 years)
- Medium Term 2016-2020(5 years)
- Long Term 2021-2025(5 years)

Prioritization Factors

The road development projects are prioritized principally from the following four aspects.

Planning Aspect ・ Compatibility with the National Development Plan ・ Impact on Socio-economic Activities ・ Maturity and status of on-going and committed project ・ Requirement of social consideration (poverty reduction) on project implementation	**Environmental Aspect** ・ Effect on health in terms of its high impact in mitigation of air pollution ・ Social impacts with limited need for land acquisition and resettlement schemes ・ Natural Impact with limited negative effects on nature, flora and fauna ・ Social acceptance by affected peoples and user group
Technical Aspect ・ Urgency based on degree and scale of problems ・ Improvement scale and the size of the project ・ Function and role in road network ・ Technical difficulty and requirement for special structures or measures	**Benefit Aspect** Traffic demand to handle high traffic volumes with level of service ・ Cost scale with high priority for low cost projects ・ Relative benefit scale that is assessed by the share of the project's to the total benefit

(2) Project Implementation Frame

Based on the result of the prioritization, the implementation frame is proposed in this Study as shown in Table 9.8-1.

Table 9.8-1 Project Implementation Frame

	Short Term (2009-2015)	Medium Term (2016-2020)	Long Term (2021-2025)	Beyond 2025
1.Circumferencial Road Improvement	C-1 (on-going) C-2 C-3 (South)	C-3 (West)	C-3 (East & North)	C-4
2.Radial Road Improvement	R-1 (inside C-2) R-2 (inside C-2) R-3 (inside C-2) R-5 (inside C-2) R-6	R-1 (C-2～C-3) R-2 (C-2～C-3) R-3 (C-2～C-3) R-5 (C-2～C-3)		R-1 (C3～C4) R-2 (C3～C4) R-3 (C3～C4) R-4 R-5 (C3～C4)
3.Collector Street Improvement	Inside CCD Inside C-1 C-1～C-2 (35%)	C-1～C-2 (65%) C-2～C-3 (50%)	C-2～C-3 (50%) C-3～C-4 (70%)	C-3～C-4 (30%)
4.Local Street Improvement (Initial Phase)	Inside CCD Inside C-1 (50%)	Inside C-1 (30%) C-1～C-2 (50%)	Inside C-1 (20%) C-1～C-2 (50%) C-2～C-3 (70%)	C-2～C-3 (30%) C-3～C-4
5.Construction of Nile River Bridge	C-3(South)	R-5	C-3(North)	C-4 (South) C-4 (North)

Most of the roads in urban areas pass through the residential areas. It is important to minimize the damage to the communities and environment when widening existing roads and constructing new roads by taking appropriate mitigation measures. It is therefore recommended to conduct consultations with the stakeholders and comprehensive EIA.

(3) Traffic Demand Forecast in With-Project Case

Traffic volume was estimated assuming that the projects are implemented in accordance with the proposed implementation frame (with-project case). The summary of the traffic forecast is shown in Table 9.8-2.

Table 9.8-2 Summary of Traffic Assignment in With-Project Case

	Year 2008	Year 2015 W/Project	Year 2025 W/Project	Ratio 2025/2008
Total Vehicle Trips (PCU)	83,895	238,445	500,123	5.96
PCU-km	454,440	1,296,723	3,430,968	7.55
PCU-Hour	23,723	42,119	113,634	4.79
Volume / Capacity	0.38	0.40	0.49	1.29
Average Speed (km/h)	19.2	30.8	30.2	1.57

Figure 9.8-1 shows the traffic volume in 2008, while Figures 9.8-2 and 9.8-3 show the forecast traffic volume in 2015 and 2025 respectively in with-project case. The volume to capacity ratio in 2008 is 0.38 in average and it is estimated to slightly increase to 0.40 and 0.49 in 2015 and 2025 respectively. Average travel speed in the whole network will increase in the future because of road paving. Thus, if the projects are implemented in accordance with the proposed implementation frame, it is possible to keep the traffic condition in the future at almost same level as present although traffic volume will drastically increase in the future.

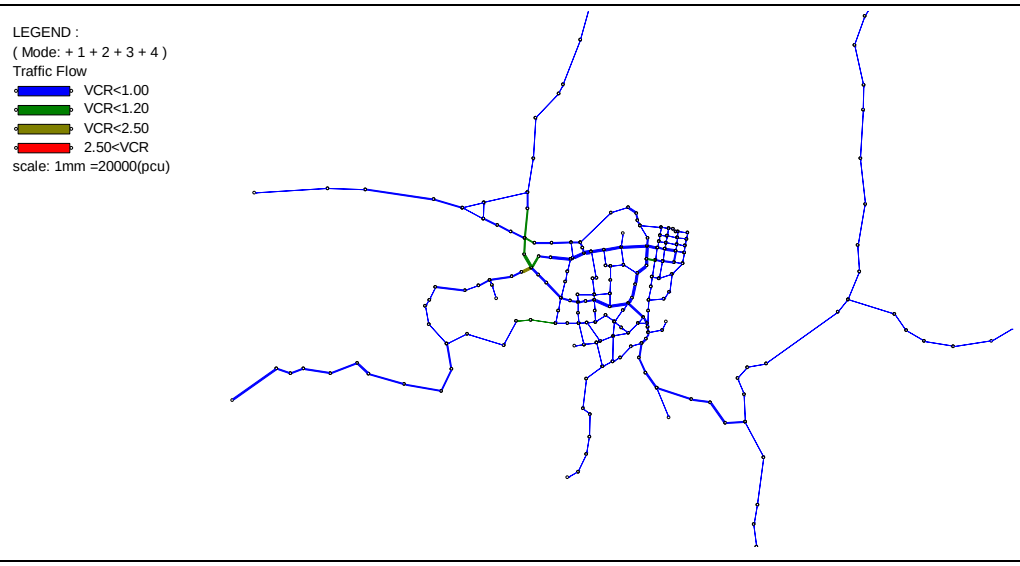


Figure 9.8-1 Traffic Assignment Result in Existing Case – Year 2008

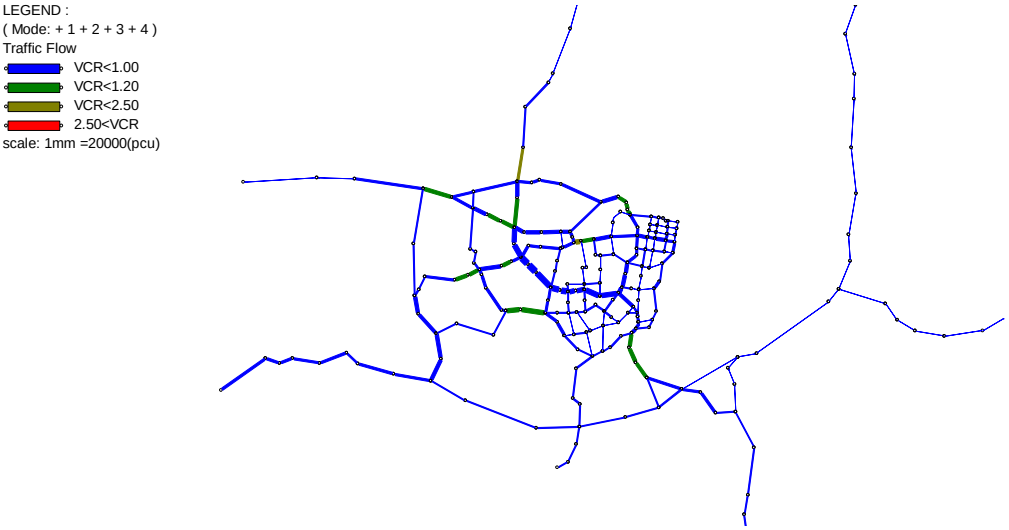


Figure 9.8-2 Traffic Assignment Result in With-Project Case – Year 2015

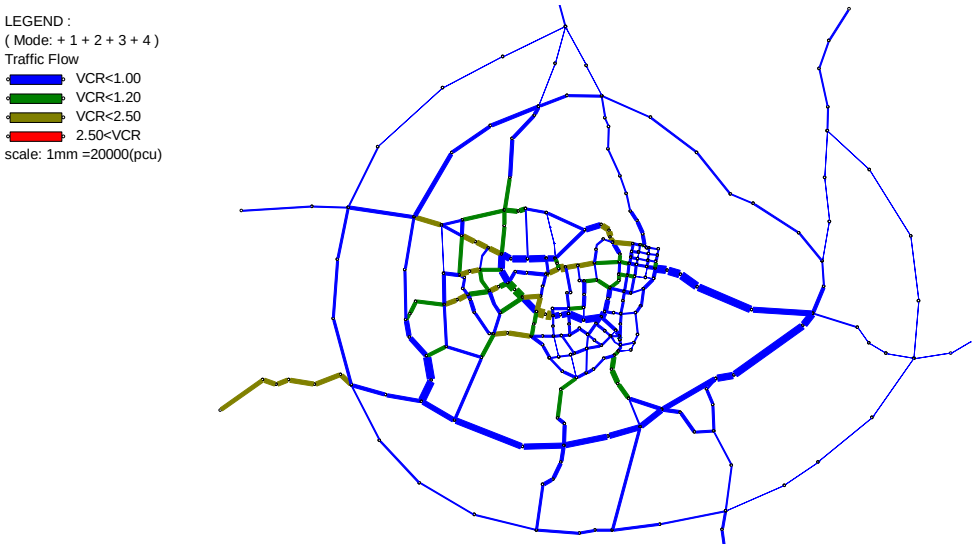


Figure 9.8-3 Traffic Assignment Result in With-Project Case – Year 2025

CHAPTER 10

PUBLIC TRANSPORT DEVELOPMENT PLAN

CHAPTER 10 PUBLIC TRANSPORT DEVELOPMENT PLAN

10.1 PLANNING CONCEPT

10.1.1 Problems with Present Bus/Taxi Services

(1) Problems with Present Bus Services

City Bus

- Minivans are mainly operated as city bus in Juba. The number of registered minivans including commercial trucks is 513. Since minivans and commercial trucks are combined in registration, the actual number of minivans alone operated as public transport in Juba is not known.
- Although the Department of Communication and Transportation of MOPI in CES is responsible for controlling public transport within the State, it does not function well.
- Laws/regulations on licensing for operation of buses are not established yet. Buses are presently operated arbitrarily.
- According to bus service interview survey, bus passengers are not satisfied with "**feeder-bus service**", "**air quality**" and "**noise level**". They assessed that the "**regularity/punctuality**" and "**accessibility to bus terminal/bus stop**" are priority areas to be improved in the bus services.
- Many minivans waiting for passengers occupy the road near the market disturbing the passage of other vehicles as most minivans wait until the seats become full.

Interstate/ International Bus

- The Department of Transport and Safety, MTR is responsible for controlling the interstate/international bus operation. Currently there is a temporary interstate/international bus terminal near Custom Market which is unpaved without building for waiting passengers.
- If CES provides the land for interstate/international bus terminal, the MTR would like to construct a new bus terminal.

Necessary Measures for Improvement

- *A registration system and designated routes for city bus shall be introduced.*
- *A new city bus system should be introduced with improved bus terminals.*
- *The accessibility to the bus terminals shall be improved.*

(2) Problems with Present Taxi Services

- There is no registration system and responsible organization to control the taxi operation. There are two types of taxi: sedan and motorcycle, but no data on the number of taxies presently operating.
- As the number of motorbike taxis increases, motorbike's traffic accidents are increasing due to many unlicensed drivers and bad road conditions for the motorbike.

Necessary Measures for Improvement

- *A registration system and designed zones for motorbike taxis shall be introduced.*
- *The motorbike taxi as a feeder transport mode to buses shall be restructured.*

10.1.2 Planning Directions for Public Transport Development

Based on the direction of the future urban development towards the west and the south, the future population, the traffic demand and the basic concept of the urban transport master plan, the planning directions for public transport development are summarized below.

Administration and Institution

- Public transport administration system shall be established/strengthened, including policy making, planning, route designation and registration/licensing.

Structure of Public Transport System

- Considering the urban environment and future increase of public transport demand, the share of the para-transit such as motorcycle taxi shall be decreased by shifting it to other modes which are more effective in a smooth manner as much as possible. Thus, a harmonized comprehensive public transport system should be developed between the main pubic transport mode and the para-transit mode.
- Considering the urban size and characteristics of existing transport facilities, the minivans shall be adopted as the main public transport mode in Juba. At the same time, a new environmentally friendly and distinctive public transport mode should be introduced as a trunk public transport system along the major public transport corridor.
- Considering the characteristics and role of the para-transit mode in a transport system, the existing para-transit modes such as motorbike taxies should be converted mainly into feeder modes to buses.
- The improvement of the transport environment such as improvement of running condition of roads will encourage the shift from motorcycle use including motorbike taxi, to public transport as well as to non-motorized mode such as bicycles or walking. This is an indirect countermeasure for public transport improvement.

Vehicle Registration

- In order to control the safety and orderly operation of public transport, it is necessary to establish a vehicle registration system for public transport and safeguard the interests of the commuting public.

Designation of Bus Routes

- An appropriate bus routes shall be designated to establish an efficient public transport system, systematically integrating international/interstate bus, city bus and short-trip taxi according to their individual functions.

The proposed future public transport system in Juba is shown in Figure 10.1.2-1.

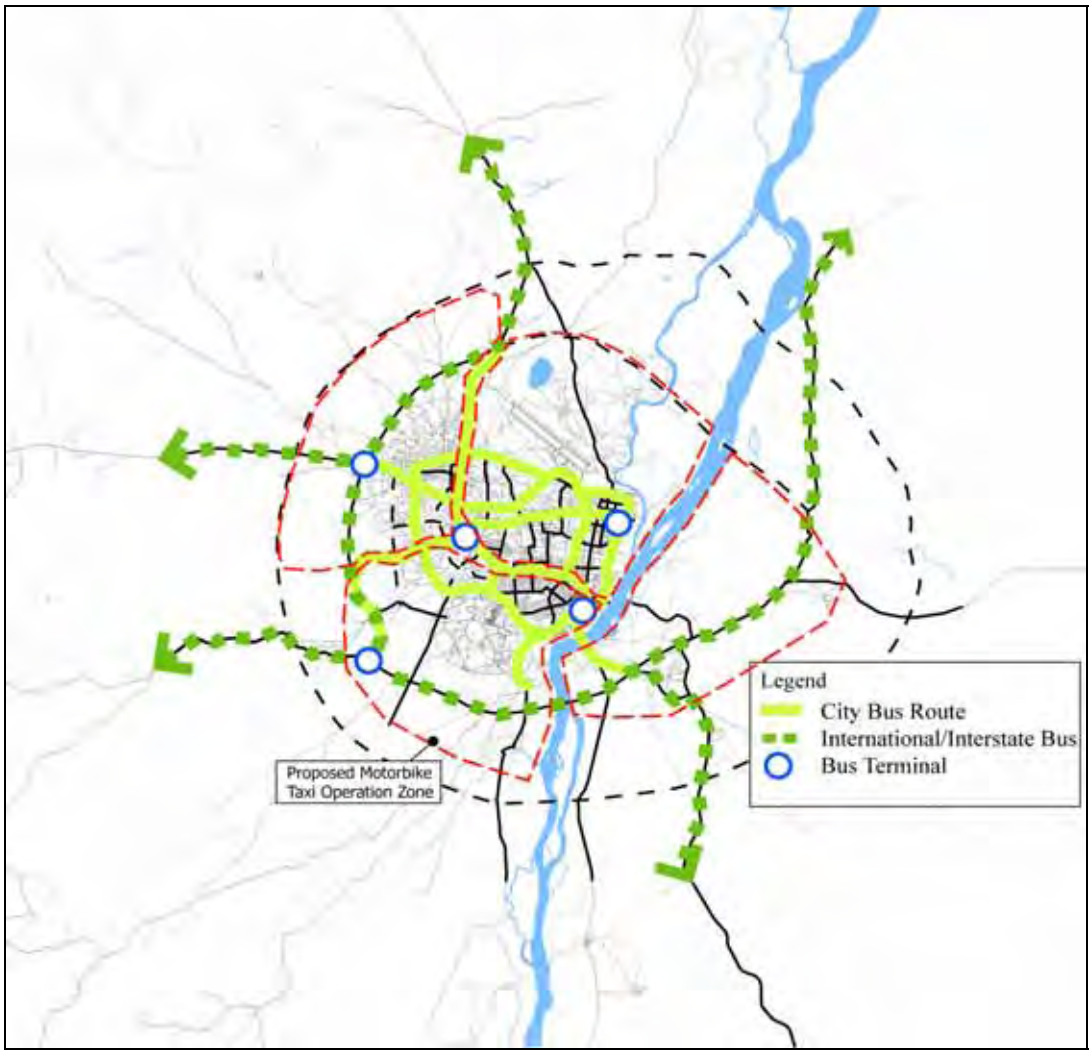


Figure 10.1.2-1 Proposed Future Public Transport System in Juba

10.2 ADMINISTRATIVE / INSTITUTIONAL SYSTEM

As described above, the existing organization of public transport in Juba is not yet fully functional. It is therefore necessary to strengthen existing institutions and establish new organizations that will be responsible for the development of public transport in Juba. The following is thus recommended:

Establishment of the Directorate of Public Transport in MTR

Function: - Public transport policy making, and
- Planning, administration and construction of public transport facilities(bus stop/terminal).

Strengthening of the Directorate of Communication and Transportation in MOPI

Function: - Bus and taxi registration/licensing,
- Standardization of fare,
- Designation of bus route and motorbike taxi limited zone system, and
- Vehicle inspection.

10.3 PUBLIC TRANSPORT DEMAND ESTIMATE

(1) Present Bus Demand

Since minivans are currently not controlled in Juba, there is no designated minivan route. Based on the present OD matrix, the bus (minivan and large bus) volume is estimated as shown in Figure 10.3-1.

- The roads with high bus volume are Unity Avenue and May Street.

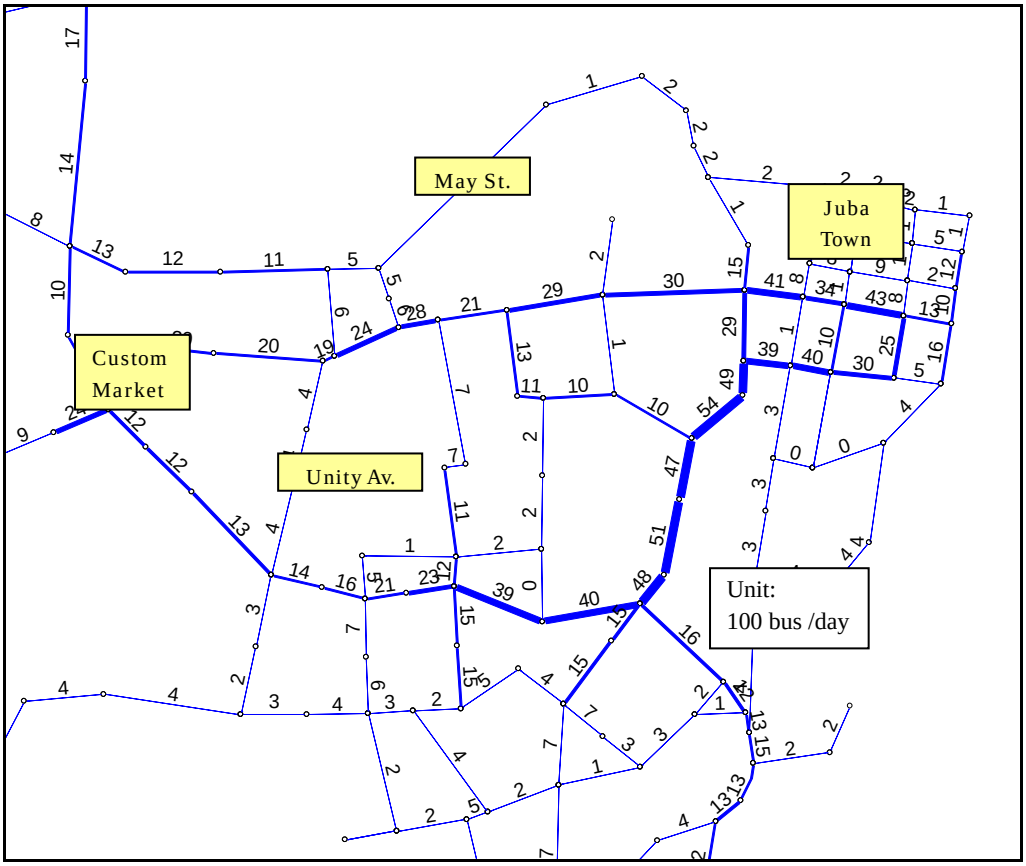


Figure 10.3-1 Estimated Bus Volume (2008)

According to the results of bus users' interview survey in Juba, Konyo-konyo and Custom Markets, the present major minivan routes are as follows.

Present Major Minivan Routes in Juba	
• Juba Town – Custom Market	• Juba Town – Munuki
• Juba Town – Konyo konyo	• Custom Market – Gudele
• Juba Town – Logogo	• Custom Market – Munuki
• Juba Town – Malakia	• Konyo konyo – Malakia

The interview result is almost consistent with traffic flow shown in Figure 10.3-1.

(2) Future Bus Demand

The future minivan demand is estimated as shown in Table 10.3-1. The number of minivans operating in Juba is currently around 600 units and is expected to increase to 1,900 units in 2015.

Figure 10.3-2 shows the estimated bus volume in 2015.

Table 10.3-1 Future Minibus Demand in Juba

Year	No. of minivan trips per day	Round trip operation per vehicle per day	No. of operated minivans
Y 2008	11,986	10	600
Y2015	38,000	10	1,900
Growth Rate(Y2015/Y2008)	3.17	-	3.17

Note; Study Team Estimation

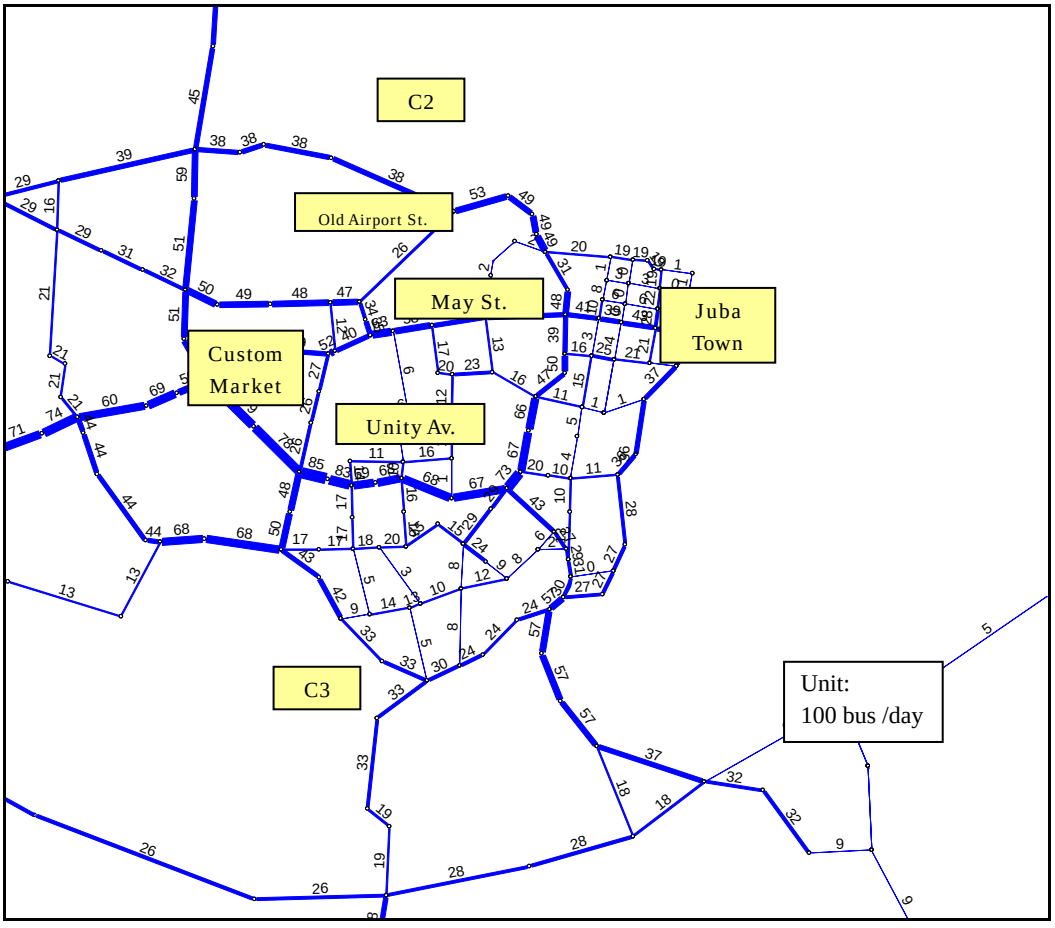


Figure 10.3-2 Future Bus Volume (2015)

It is estimated that the Old Airport St. and C-2 Road, in addition to Unity Ave. and May St., will be mainly utilized by minivans in year 2015.

10.4 PROPOSED BUS SYSTEM

10.4.1 Bus Network Improvement Plan

As previously mentioned, there is currently no bus route network in Juba. Therefore, it is necessary to establish legislation on licensing to operate bus, and to select the optimum public transport routes by CES based on the user needs and demand. The network is composed of the following three categories according to bus demand:

- Principal Arterial Route
- Arterial Route
- Secondary Route

Figure 10.4.1-1 shows the proposed future bus network. In addition, it is required to formulate the feeder bus route network in consideration of user needs.

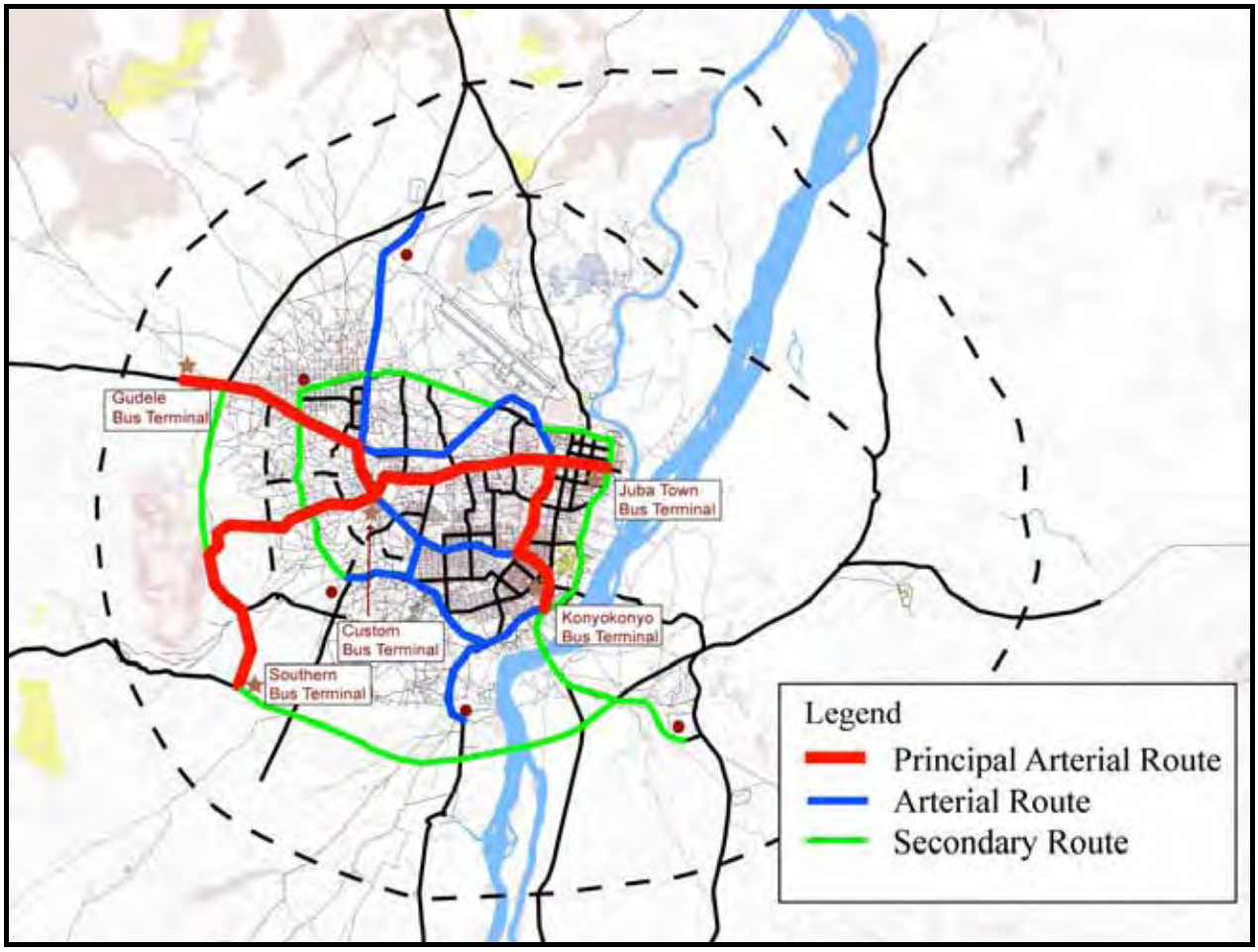


Figure 10.4.1-1 Proposed Future Bus Network Plan

10.4.2 Bus Terminal Improvement Plan

In addition to the designation of the bus routes, improvement/construction of bus terminals and bus parking areas is important including improvement of connecting function between different routes and different public transport modes.

Based on the results of the future bus demand estimate, 4 bus terminals and (6) bus parking areas are proposed as sown in Figure 10.4.2-1. Among the bus terminals, three terminals located at Juba Town, Custom and Konyo-Konyo Markets are existing, and a new bus terminal is proposed (Southern Bus Terminal) to be located in the junction of C-3 Road and Yei Road.

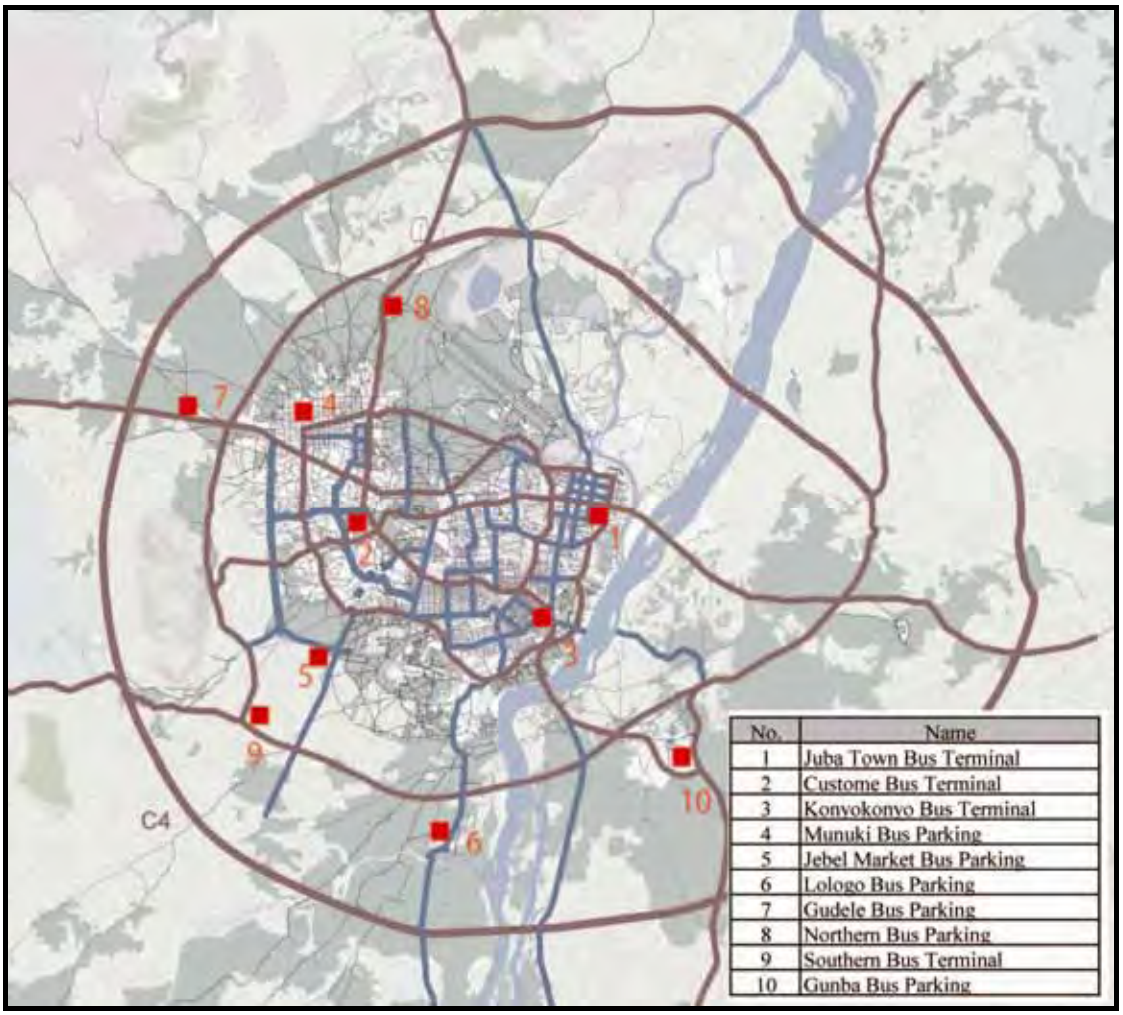


Figure 10.4.2-1 Location of Proposed Bus Terminals and Bus Parking Areas

10.4.3 Staging Plan

Considering the present minivan system, the change of public transport demand and investment possibility, it is necessary to introduce a staging plan for the future bus/minivan transport plan.

An outline of the staging plan along major streets is proposed as given below and conceptually illustrated in Figure 10.4.3-1.

(1) Short Term

Establish laws and regulations on licensing buses and re-structuring bus routes.

(2) Medium Term

Restrain the long distance minivan routes at the urban fringe and develop a transfer terminal at

this point and introduce the bus route inside the urbanized area. Along with the improvement/ development of the bus stops/terminals, strict enforcement of regulations pertaining to loading/unloading shall be imposed.

(3) Long Term

All public transport routes along the major roads in the urbanized area shall be bus routes refraining from passage of para-transit mode. New types of bus services shall be introduced.

It is necessary to implement various bus priority measures such as bus priority/exclusive lanes, express bus and park and bus ride systems for the preparation of various bus services in favor of the public transport users.

One of the effective measures for bus services is the introduction of various kinds of operations along major transport corridors, as shown in Figure10.4.3-2. The existing and future bus/minivan fleet size is shown in Figure 10.4.3-3.

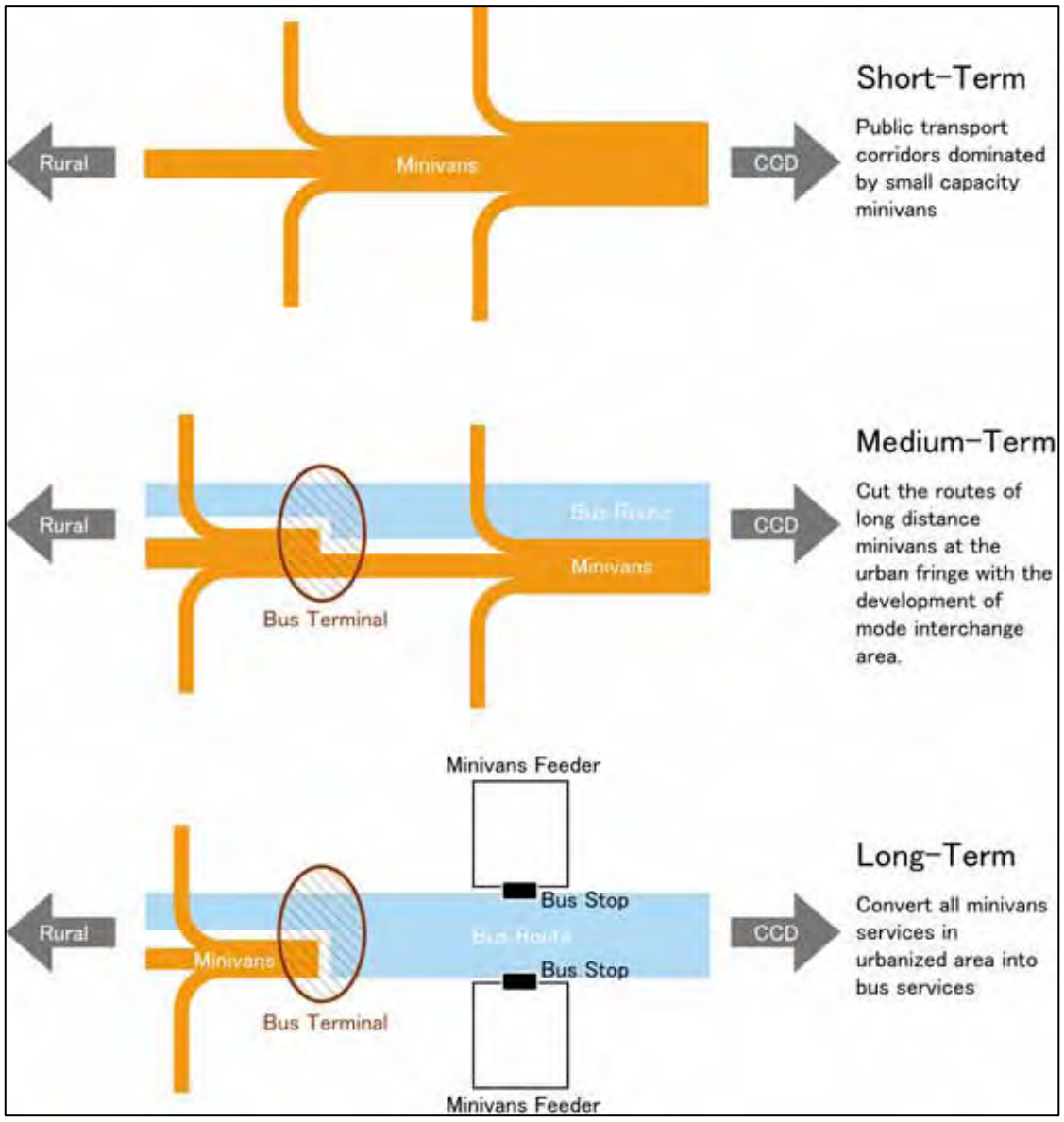


Figure 10.4.3-1 Staging Plan of Public Transport

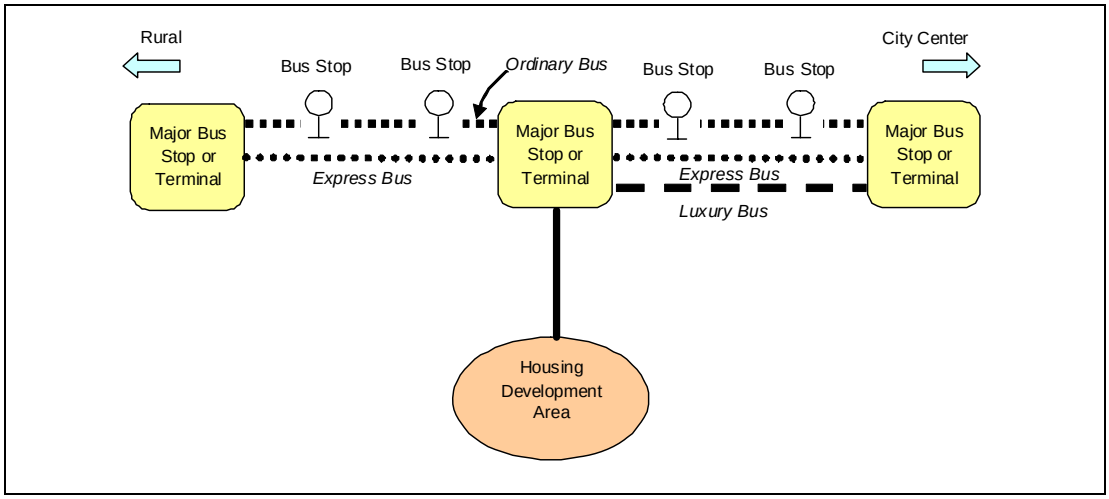


Figure 10.4.3-2 Various Bus Services

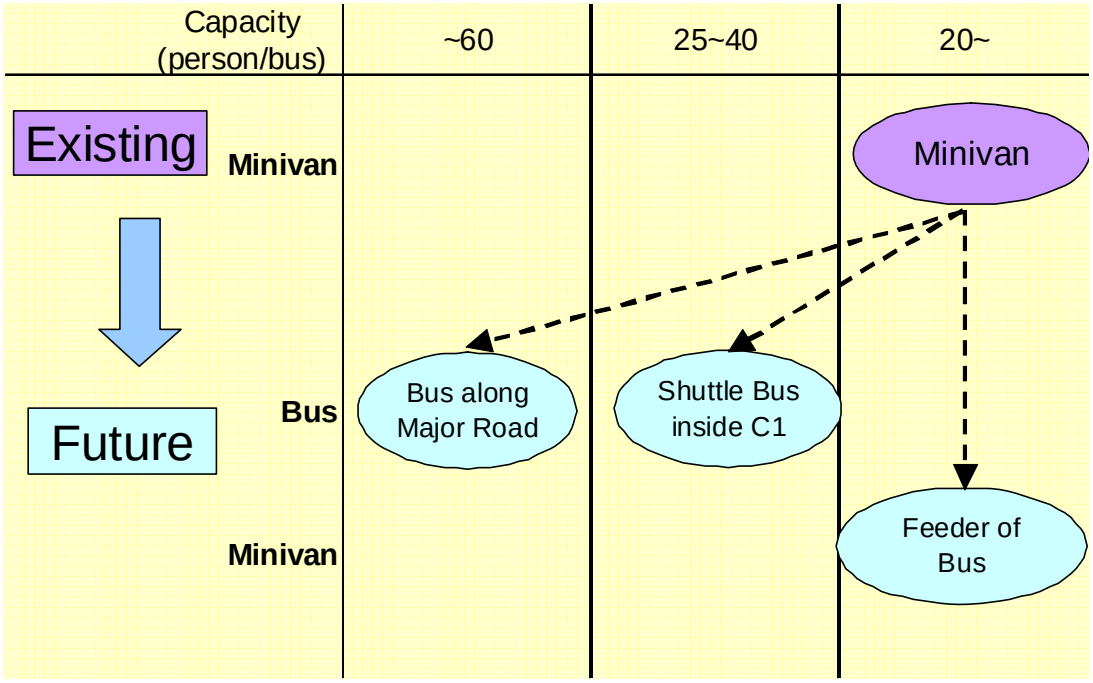


Figure 10.4.3-3 Bus/Minivan Fleet Size and Type

10.5 PROPOSED TAXI SYSTEM

(1) Review of Current Situation

There are other public transport modes than minivans, which are taxi, motorbike taxi and walking. These modes are being used depending on the type of trip and the user class. Table 10.5-1 shows the selection of the public transport mode other than bus, identified by observation.

Table 10.5-1 Selection of Public Transport Mode Other than Bus

Mode	Main User (Passenger)	Type of Trip	Remarks
Taxi	Middle Income Level	On Demand Use, Middle or Long Trip, Available in all weather condition	Fare is not fixed; based on the negotiation between taxi driver and passenger. In normal case, the fare within the city is 40 SDG.
Motorbike Taxi	Low Income Level	On Demand Use, Short or Middle Trip Available in the fine weather condition	Much cheaper than taxi; fare is also based on the negotiation. In normal case, the fare within the city is 3-5 SDG.
Walking	Low Income Level	On Demand Use, Short Trip Available in all weather condition	Free of charge

Case in Uganda

In Kampala City, Uganda, motorbike taxis are not allowed to make their services on major roads. Their services can be made only on feeder roads. Mini buses and large buses make their services on major roads. The policy creates a scenario where passengers are forced to change the transport mode when they arrive at the junctions with major roads, which contributes to easing traffic congestion on major roads and decreasing the number of traffic accidents.

(2) Basic Concept for the Improvement Plan

1) Control of Motorbike Taxis

The promotion of the use of public transport would contribute to easing traffic congestions. However, an observation in Asian countries shows that the number of motorbikes increases making the motorbikes to become the main actor in transporting people and creating traffic congestions due to their unregulated driving behaviors. The same phenomenon is predicted in Juba if no control is given to the motorbikes. As for the motorbike taxi, it has been a cause of traffic congestion in Juba as mentioned above.

In order to improve and avoid such situation, some limitations to their service shall be introduced.

2) Increase and Enhance Safety

As mentioned above, there are some violations related to traffic safety committed by motorists/road users because of lack of proper facilities and regulations. The plan shall consider the appropriate provision of necessary facilities and regulations, taking into account the importance of none disturbance to the growth of economic activities.

(3) Service Limitation

To comply with the above-mentioned concepts and referring to the case in Kampala, the limitation for the public transport modes other than bus is proposed as shown in Table 10.4-2.

Table 10.5-2 Service Limitation for Public Transport Mode Other than Bus

Mode	Service Limitation
Taxi	No Limitation.
Motorbike Taxi	Prohibit operation on major arterial roads in urbanized area.
Walking	No Limitation.

Motorbike taxi shall play the role of feeder transport mode to the bus. Motorbike taxi shall be banned along major arterial roads, except crossing main intersections of major arterial streets.

Motorbike Taxi Operation Zone System

To reduce the traffic in the urbanized area and realize a smooth city bus service operation, the limited operational zone system of motorbike taxi is proposed to be introduced as shown in Figure 10.1.2-1 which includes three motorbike taxi operation zones. However the complete structure of this zone system will be introduced after year 2015 when the improvement of local streets in the urbanized area will be completed.

Licensing System

The licensing system for the motorbike taxi operation should be established. For example, motorbike taxi drivers shall wear the prescribed colored uniform coded according to the three designated operational zones.

(4) Provision of Facilities

When the service limitation shown in Table 10.5-2 is introduced, there will be a need for the improvement of transit points between the modes. Therefore, the pool space for the modes which provide the service to the feeder side and the facility for the passengers who transfer to next transport mode shall be provided.

(5) Establishment of Rules and Regulation

In order to contribute to easing the traffic congestion and enhance road safety, it is important to clarify the functional assignments of each transport mode and establish the rules and regulation. It is difficult to control the operations of each mode without the establishment of such rules and regulation since they are operated by the private sector.

As the pooling spaces are proposed above, the legalization of no loading/unloading at certain areas and provision of parking areas shall be introduced at the same time. Parking control is essential to areas with high concentration of people and goods and monitoring of parking control should be done by the taxi organizations together with police.

10.6 COST ESTIMATE

The construction cost of bus terminals and bus parking areas is roughly estimated as shown in Table 10.6-1. The estimated cost amounts to about 34 million US dollars.

Table 10.6-1 Cost Estimate of Bus Terminals and Bus Parking Areas Construction Project

1. Bus Terminal

Item	Quantity/location	Unit Cost (US$/sq. m.)	Number of locations	Amount (US$)
1.1 Land (100m x 100m)	10,000 sq. m.	300	4	12,000,000
1.2 Terminal Building (30m x 50m)	1,500 sq. m.	1,000	4	6,000,000
1.3 Terminal Parking	8,500 sq. m.	200	4	6,800,000
Sub-total				24,800,000

2.Bus Parking Area

Item	Quantity/location	Unit Cost (US$/sq. m.)	Number of locations	Amount (US$)
2.1 Land (30m x 100m)	3,000 sq. m.	300	6	5,400,000
2.2 Waiting Area/Shed (4m x 100m)	400 sq. m.	300	6	720,000
2.3 Parking Area	2,600 sq. m.	200	6	3,120,000
Sub-total				9,240,000
Grand Total				**34,040,000**

CHAPTER 11

TRAFFIC MANAGEMENT SYSTEM DEVELOPMENT PLAN

CHAPTER 11 TRAFFIC MANAGEMENT SYSTEM DEVELOPMENT PLAN

11.1 PLANNING CONCEPT

One of the advantages of traffic management is to implement various countermeasures to alleviate the transportation problems in a short term and at low cost. The necessity of traffic management is summarized as follows:

(1) Existing traffic facilities in Juba urban area are not used effectively at present. If traffic management and operation were improved, it would contribute to the effective use of existing facilities and traffic capacity would substantially increase.

(2) Traffic management in Juba urban area in road facilities, traffic operation and traffic safety plan is still at the developing stage. Modernization of traffic management and operation is necessary for the city to become an international city in the future.

(3) The aim of traffic management is to assure safe, comfortable and speedy traffic movement. Among these aims, traffic safety is the fundamental requirement for the citizens.

11.1.1 Present Traffic Problems

At present, traffic congestions are sometimes observed in some junctions and central city areas and traffic accidents are noted to be increasing. Examinations of causes of the problems are necessary to formulate a traffic management plan. They are summarized as follows:

(1) Traffic engineering and technical aspect:

- Disorderly traffic flow due to the mixed traffic
- Inefficient traffic processing way at roads and junctions
- Undeveloped traffic facilities at junction
  - Inadequate geometric configuration
  - Insufficient traffic safety facilities
  - Insufficient pedestrian crossing aspect:
- Inadequate traffic regulations

(2) Traffic safety aspect:

- Insufficient traffic safety education
- Lack of drivers' discipline to observe traffic regulations
- Inconsistent traffic enforcement

11.1.2 Objective of Traffic Management Plan

The objective of the traffic management plan is to prepare comprehensive measures to provide a safe, smooth and comfortable traffic environment for road users. The measures should be prepared based on a careful study of the traffic problems currently occurring and expected to occur in the future in order to cope with these problems.

11.1.3 Basic Direction of Traffic Management Measures

Traffic problems have been becoming more pronounced year after year. Implementation of remedial measures is an urgent matter. In particular, the implementation of balanced 3-E measures (Traffic Engineering, Education and Enforcement) is a key. The 3-E concept applicable to Juba urban area is summarized below.

(1) Measures of Traffic Engineering

- Improvement of Junction and Road Section

  It is important to increase traffic capacity by improving intersections since the most serious factor to disrupt main traffic flow is the low traffic capacities of junctions. In addition, improving traffic facilities and the traffic operation system of roads are necessary so that the obstructions to traffic flow are eliminated and smooth traffic flow is achieved.

- Installation of Traffic Signal

  As there is no junction operated by traffic signals in Juba, some are controlled manually by traffic police during peak hours. To improve the traffic flow at junction, traffic signal installation is important. This measures will contribute to a decrease in traffic congestion at junctions.

- Setting up Traffic Accident Data Management System

  To decrease traffic accident efficiently, it is very important to prepare effective remedial measures based on traffic accident analysis. Setting up a traffic accident data management system which records detailed information is in a vital requirement.

(2) Promotion of Traffic Education

One of the reasons for the increase in traffic accidents is undisciplined behavior of the drivers and pedestrians. Thus the promotion of traffic safety and traffic education is an essential task.

(3) Strengthening of Traffic Enforcement

At present, drivers' observance and attitude to traffic regulations are extremely poor. Strengthening of traffic enforcement is necessary.

11.2 ADMINISTRATIVE/INSTITUTIONAL SYSTEM

(1) Re-organization of Existing Agencies Concerned

To adequately implement the traffic management, it is necessary to strengthen/establish the required institutions. Although traffic is currently managed by the Department of Traffic Police in the Ministry of Internal Affairs, MTR and CES need to be involved in the traffic management in Juba.

The establishment or re-organization of existing agencies of traffic management is proposed as follows with their respective functions.

Strengthening of the Directorate of Road Transport and Safety, MTR

- Road transport policy, planning and administration
- Installation of traffic safety facilities.

Strengthening of the Directorate of Communication and Transportation, MOPI

- Road safety planning and administration
- Installing the traffic safety facilities

Reinforcement of Traffic Police

- Establishment of education system for traffic police
- Strengthening of traffic rule enforcement

(2) New Institutional Framework

The study of institutional framework for road funding and management recommended MTR to establish the following road board, agency and unit.

- SSRB: Southern Sudan Road Board
- SSRA: Southern Sudan Road Agency
- SRA: State Road Agency
- SSURA: Southern Sudan Urban Road Agency
- SSCRA: Southern Sudan County Road Agency
- **Road Traffic and Safety Management Unit (RTSMU)**

Based on the institutional system recommendation, the parliament in the Southern Sudan has examined the establishment of Road Agency.

The Road Traffic and Safety Management Unit (RTSMU) will control traffic management in Juba.

The assumed roles of RTSMU are as follows:

- RTSMU will take charge of the coordination and management of road safety activities in Southern Sudan. RTSMU will also be in charge of the development of traffic policy and standards.
- Establish systems for collecting road accident data.
- Programs for controlling speed, alcohol and drugs related offences as well as overloading vehicles should be given special attention.
- Promote the role of traffic officers – establish a traffic academy for training of traffic officers, set out career development opportunities and establish favorable condition of employment for traffic officers.
- Provide training, equipment and materials for the police for collection of data on accidents.

11.3 TRAFFIC ENGINEERING MEASURES

11.3.1 Road Improvement and Traffic Operation

In the urban areas in general, most of the congestions as well as traffic accidents usually occur at the intersections rather than at the road sections. In case of Juba urban area, congestion is observed also at road sections. Thus, if obstructions at road section are eliminated or reduced, a smoother traffic flow and the decrease in traffic accidents can be expected. The efficient measures are as follows:

(1) Pavement markings

Pavement markings are an important traffic facility in addition to a good road surface for the smooth flow of traffic. A yellow centerline contributes toward preventing disorderly traffic, by showing clearly the drivers which lane to drive and preventing from driving on the opposite-lane. Pavement markings have to be introduced at least to all arterial streets in Juba urban area. The usable period of the markings is short. Even if plastic material is used, the markings deteriorate and become unclear in about 1 to 2 years. Therefore, regular maintenance is required in order to keep the pavement markings in good condition.

(2) Exclusive left turn lane

Exclusive left turn lanes need to be provided for the roads where the demand of left turning vehicles are high otherwise posing an obstruction to through traffic. The traffic capacity and safety are expected to be improved much by providing exclusive left turn lanes. At major intersections, it is recommended that left turn vehicles be controlled by providing an exclusive left turn lane with a left turn signal as shown in Figure 11.3.1-1. If congestion still occurs even if such control is implemented, then left turn prohibition should be considered.

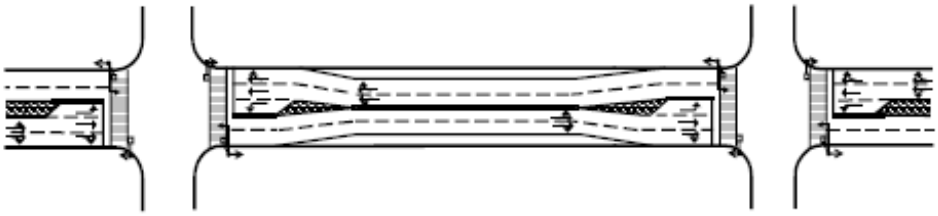


Figure 11.3.1-1 Intersection with Exclusive Left-turn Lanes

(3) Raised median

Raised medians provide a higher level of traffic safety and improve operations for through traffic on multi-lane street. The western section of May street is provided with raised median. The benefits of the medians are:

- physically separating opposing traffic,
- restricting access to/from the arterial,
- providing pedestrian refuge areas.

Raised medians of May Street

The use of raised medians along multi-lane arterial streets will be highly beneficial in Juba urban area as it is possible to restrict both driving on the opposing lane and left-turning to/from

a minor intersecting road or drive-way. However, in case the arterial street has limited width and more efficient use of the street is necessary, the raised median can be removed when driving discipline improves and thus the raised median becomes unnecessary.

(4) Sidewalk and crosswalk

Sidewalks are provided in the urbanized area in principle, but sometimes they have breaks and sidewalk maintenance is not adequately carried out. Pedestrians have to walk on the roadway in case that sidewalks are not continuous and are obstructed. It is recommended to improve sidewalks and eliminate the obstructions to provide continuous walkway. If it is difficult to implement this in a short period due to time and financial constraints, a gradual or step by step implementation is recommended.

Zebra markings are currently used for crosswalks in some arterial streets. However, only pavement marking is not sufficient. Additional measures shall be provided, such as:

- Crosswalk signs on an arm pole
- Pavement markings to clearly indicate the stop lines
- Lighting for night time
- Illuminated signs for night time

(5) Treatment at roundabout

The roundabouts are often seen in Juba urban area but in most cases the radii of the islands are too small resulting in low traffic capacities. Signal control is recommended to be introduced to roundabouts, wherever possible.

(6) Prohibition of parking in and near junctions

The traffic law restrains the parking in/around junctions. It is recommended to install yellow curb markings around junctions in order to clearly indicate parking prohibitions.

11.3.2 Intersection Operation Plan

(1) Study Approach

Although there are only a few roundabouts/intersections which face serious traffic congestions at this moment, many intersections will become bottlenecks and black spots of the network in the future. Among these, the Study Team selected 11 major intersections (see Figure 11.3.2-3) for study. The methodology for selection of these intersections and preparation of proposed improvement measures are illustrated in Figure 11.3.2-1.

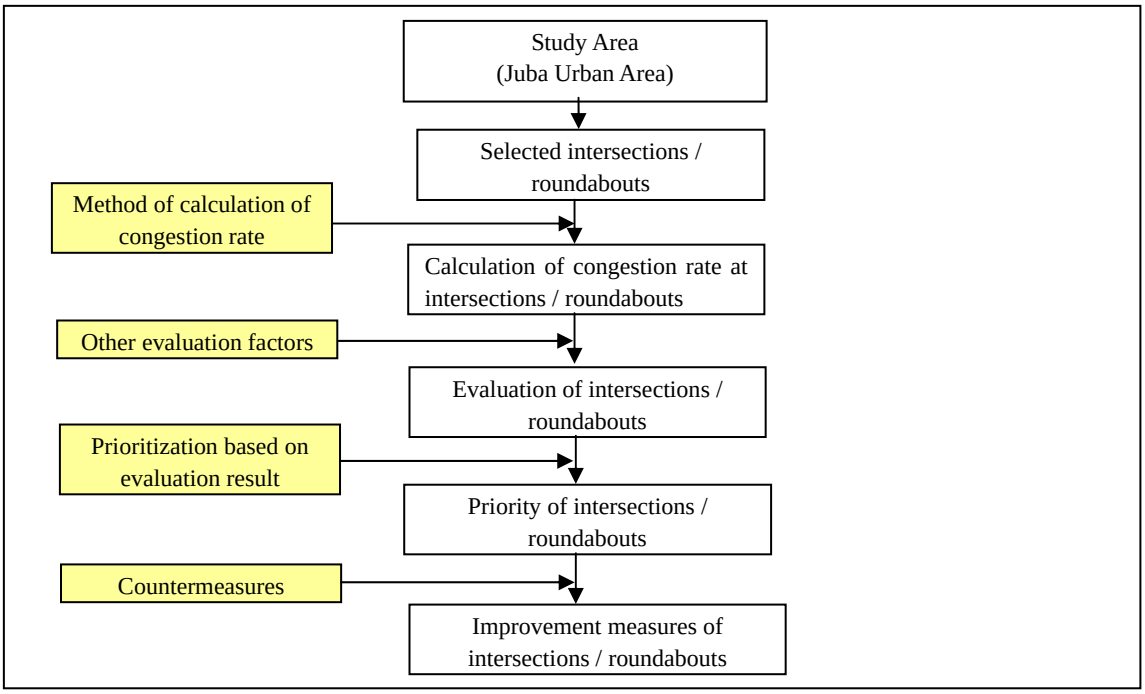


Figure 11.3.2-1 Study Approach

(2) Alternative Type of Intersection

Generally, there are two types of junctions in Juba urban area, namely intersections (non-roundabout) and roundabouts. Currently all of the junctions are non-signalized. In the future, it will be necessary to install traffic signal in some of those junctions. Figure 11.3.2-2 shows intersection improvement types.

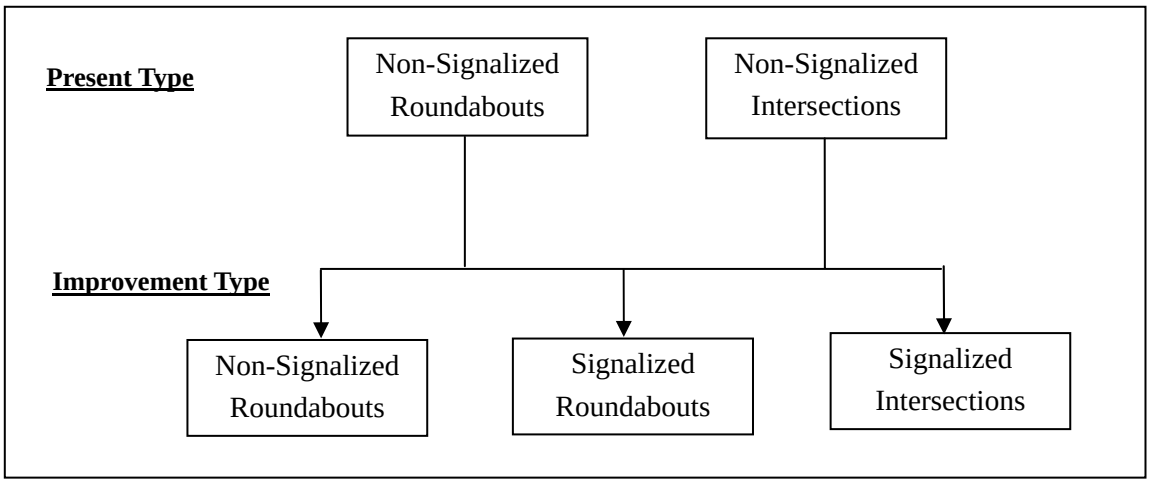


Figure 11.3.2-2 Major Intersection Improvement Types

Advantages and disadvantages of converting the physical configuration of junctions from one type to another are shown in Table 11.3.2-1. The factors for the comparison are necessity of installation of signal system, scale of required civil works, impacts on traffic congestion and traffic accident.

Table 11.3.2-1 Advantages and Disadvantages of Intersection Improvement Type

From	Non-Signalized Intersection		Non-Signalized Roundabout	
To	Non-Signalized Roundabout	Signalized Roundabout	Signalized Intersection	Signalized Roundabout
Civil Works	Maximum (requires enough space for circular lanes as well as approach and exit lanes)		Moderate (require space for exclusive left turn lane on approach lane)	Minimum or Not Required
Signal System	Not Required	Required (at least 4-phase system)	Required (at least 2-phase system)	Required (at least 4-phase system)
Reduction of Traffic Congestions	Medium (if volume does not exceed capacity yet) to Minimum (if volume already exceeds capacity)		Maximum (if volume does not exceed capacity yet) to Medium (if volume already exceeds capacity)	Minimum (if volume already exceeds capacity)
Reduction of Traffic Accident	Medium	Maximum	Medium	Maximum

(3) Evaluation

The intersections and roundabouts are evaluated on the basis of traffic situation, geometric design, environmental and social impacts, operation and maintenance and traffic safety.

Firstly, the Study Team has applied rough Volume-Capacity Ratio (VCR) analysis. This method is based on the present traffic volume in any given peak hour versus the capacity of junction based on the number of lanes applicable. The following are the evaluation procedure in this analysis;

- The daily traffic volume was converted to peak hour volume by simply applying assumed peak hour ratio of 0.10 (based on the traffic survey result).
- Assumed capacity of carriageway (approach lane and exit lane) is fixed at 1,500 PCU (Passenger Car Unit) per hour per lane for the intersection. For the roundabout, assumed capacity of circular lane is fixed at 2,000 PCU per hour per lane.
- For roundabout, the capacity of junction is determined by the number of circular lanes, and traffic volume passing through the intersection is determined by the sum of entering traffic from all approach legs.
- For intersection (non-rounabout), the capacity of junction is determined by the number of approach lanes, and traffic volume passing through the intersection is determined by the sum of higher entering traffic between corresponding opposed legs (i.e. either north or south bound traffic whichever is higher, plus either east or west bound traffic whichever higher).

The present traffic data is shown in Table 11.3.2-2. The evaluation results are shown in Table 11.3.2-3. According to this rough VCR analysis, junction of Unity Ave.-May St.(No.5) has the highest VCR(1.10). Old Custom Market (No.1) and Junction of Unity Ave.-Old Airport St.(No.10) are higher than 1.0. Based on this result, these junctions are recommended to be changed from roundabout to signalized intersection for smooth traffic flow during peak hour.

Table 11.3.2-2 Present Traffic of 11 Selected Junctions

Unit: 100PCU

Type	No.	Name	No. of legs	North	South	West	East	Section Total
R/A	1	Old Custom Market	4	109	80	124	102	415
	2	Junction with May St. –Juba uni. Road	4	60	40	74	71	245
	4	Junction with Unity Ave.-Addis Ababa St.	4	125	114	24	24	287
	5	Junction with Unity Ave.-May St..	4	59	111	153	118	441
	8	Juba Town Market Roundabout	4	4	9	47	47	107
	10	Junction with Unity Ave.- Old Airport St.	4	107	102	96	101	406
	11	Legislative Assembly Roundabout	4	20	102	40	109	271
I/S	3	Junction with Unity Ave.-Torit Rd.	3	113	122	77		312
	6	Junction with Addis Ababa St.	3		28	14	28	70
	7	Konyo Konyo Market	4	81	85	18	18	202
	9	Junction with May St.- Juba Uni. Rd.	3		60	115	182	357

Note; The location of the selected junctions are shown in Figure 11.3.2-3.
PCU (Passenger Car Unit), R/A (Roundabout), I/S(Intersection)

Table 11.3.2-3 Result of Evaluation for 11 Selected Junction Based on Present Traffic

Type	No.	Name	No. of legs	Roundabout		Intersection					Recommended Configuraltion	Remarks
				No. Circular Lanes	VCR	No. of Approach & Exit Lanes				VCR		
R/A	1	Old Custom Market	4	2	1.04	2	2	2	2	0.77	I/S	With Signal
	2	Junction with May St. –Juba uni. Road	4	2	0.61	2	2	2	2	0.45		
	4	Junction with Unity Ave.-Addis Ababa St.	4	2	0.72	2	2	2	2	0.50		
	5	Junction with Unity Ave.-May St..	4	2	1.10	2	2	2	2	0.88	I/S	With Signal, Left turn lane will be needed.
	8	Juba Town Market Roundabout	4	1	0.54	2	2	2	2	0.19		
	10	Junction with Unity Ave.- Old Airport St.	3	2	1.02	2	2	2	2	0.70	I/S	With Signal
	11	Legislative Assembly Roundabout	3	2	0.68	2	2	2	2	0.70		
I/S	3	Junction with Unity Ave.-Torit Rd.	3	2	0.78	2	2	2		0.67		
	6	Junction with Addis Ababa St.	3	1	0.35	2	2	2	2	0.18		
	7	Konyo Konyo Market	3	2	0.51	2	2	2	2	0.34		
	9	Junction with May St.- Juba Uni. Rd.	3	2	0.89	2	2	2	2	0.81		

Note: R/A (Roundabout), I/S (Intersection)

The evaluation results based on estimated traffic in year 2015 are shown in Table 11.3.2-4. According to this rough VCR analysis, VCR of many roundabouts are higher than 1.0. Some intersections such as Junction of Unity Ave.-Torit(No.3) and Junction of May St.-Juba University Rd.(No.9) are also higher than 1.0. These intersections require the installation of traffic signal and additional lane or exclusive left turn lane.

Table 11.3.2-4 Result of Evaluation for 11 Selected Junction Based on Future Traffic (2015)

Type	No.	Name	No. of legs	Roundabout		Intersection					Recommended Configuraltion	Remarks
				No. Circular Lanes	VCR	No. of Approach & Exit Lanes				VCR		
R/A	1	Old Custom Market	4	2	2.22	4	4	2	2	1.11	I/S	With Signal, Left turn lane will be needed.
	2	Junction with May St. –Juba uni. Road	4	2	2.33	2	2	4	4	1.13	I/S	With Signal, Left turn lane will be needed.
	4	Junction with Unity Ave.-Addis Ababa St.	4	3	0.81	2	4	2	2	0.72		
	5	Junction with Unity Ave.-May St..	4	2	1.50	2	2	2	2	1.10	I/S	With Signal, Left turn lane will be needed.
	8	Juba Town Market Roundabout	4	1	0.84	2	2	2	2	0.30	I/S	
	10	Junction with Unity Ave.- Old Airport St.	3	3	1.52	4	4	2	4	1.14	I/S	W Signal,Left turn lane will be needed.
	11	Legislative Assembly Roundabout	3	2	0.79	2	2	2	2	0.79		
I/S	3	Junction with Unity Ave.-Torit Rd.	3	2	1.81	4	4	2		1.05	I/S	With Signal, Left turn lane will be needed.
	6	Junction with Addis Ababa St.	4	1	0.71	2	2	2	2	0.41		
	7	Konyo Konyo Market	4	2	1.00	2	2	2	2	0.80		
	9	Junction with May St.- Juba Uni. Rd.	3	2	1.13		2	2	2	1.09	I/S	With Signal, Left turn lane will be needed.

Note: R/A (Roundabout), I/S (Intersection)

(4) Preparation of Countermeasures

The countermeasures necessary for these intersections are as follows:

- Geometric improvement
- Installation and improvement of traffic signal
- Pavement Marking
- Traffic Signs

Table 11.3.2-5 shows the countermeasures for intersection improvement.

Table 11.3.2-5 Countermeasures for Intersection Improvement

No.	Name	No. of legs	Present Configuration	Priority	Countermeasures			
					Do Nothing (only pavement marking, sign)	R/A to R/A with traffic signals	R/A to I/S with traffic signals	I/S to I/S with traffic signals
1	Old Custom Market	4	R/A	I			O	
2	Junction with May St. –Juba uni. Road	4	R/A	II			O	
3	Junction with Unity Ave.-Torit Rd.	3	I/S	II				O
4	Junction with Unity Ave.-Addis Ababa St.	4	R/A	III	O			
5	Junction with Unity Ave.-May St..	4	R/A	I			O	
6	Junction with Addis Ababa St.-	3	I/S	III	O			
7	Konyo Konyo Market	4	I/S	III	O			
8	Juba Town Market Roundabout	4	R/A	II	O			
9	Junction with May St.- Juba Uni. Rd.	3	I/S	II				O
10	Junction with Unity Ave.- Old Airport St.	4	R/A	I			O	
11	Legislative Assembly Roundabout	4	R/A	III	O			

Note: R/A (Roundabout), I/S (Intersection)

Regarding the timing of implementation, it is proposed that three phases are introduced as shown in Table 11.3.2-6 and Figure 11.3.2-3.

Table 11.3.2-6 Proposed Implementation Phase

Term	Phase	No. of Intersection Improvements
Short Term	Phase I (2009-2012)	3 (No.1,5,10)
	Phase II (2013-2015)	4 (No.2,3,8,9)
Medium Term	Phase III (2016-2020)	4(No.4,6,7,11)

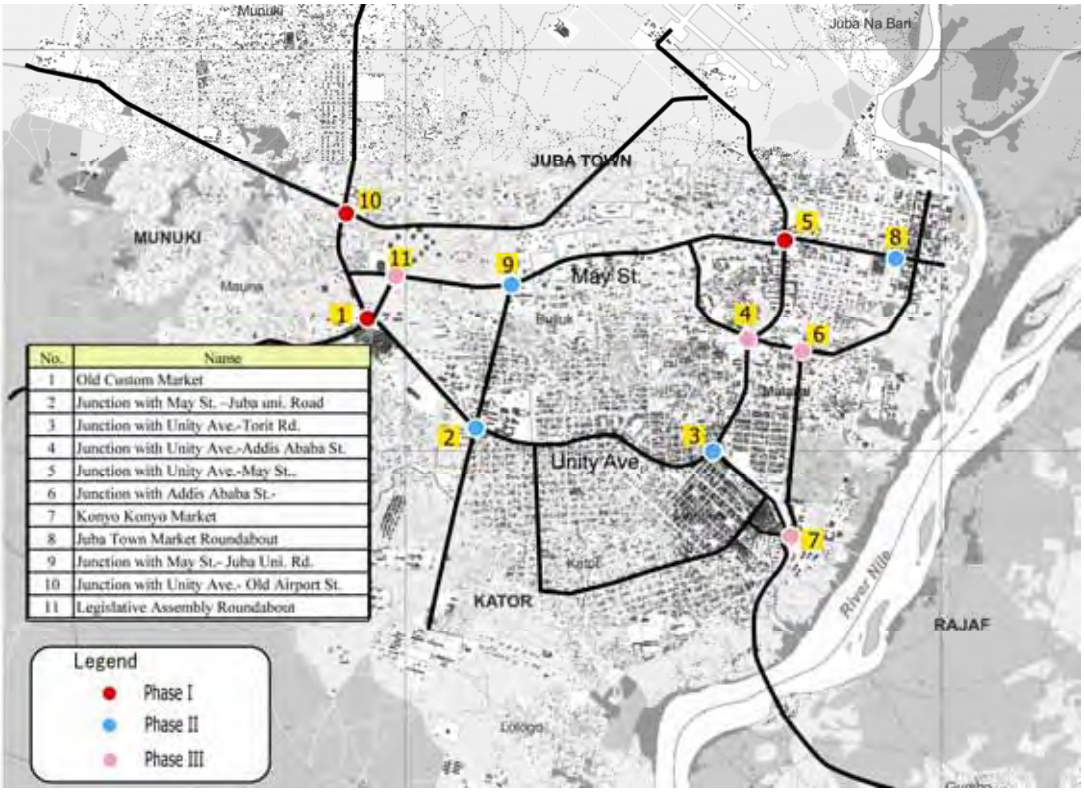


Figure 11.3.2-3 Junctions to be Improved in Phase I to Phase III

It is noted that the purpose of this analysis is to give a rough idea on the implementation plan of intersection improvement. The detailed study of countermeasures is necessary by checking the peak hour's traffic volume and queue length of each junction before junctions are improved. Especially, the Junction of Old Custom Market (No.1) and the Junction of Unity Ave.-Old Airport St.(No.10) will be constructed as roundabout in the on-going Emergency Road Rehabilitation Project. It is recommended to check the peak volume and capacity of the above two junctions after the Emergency Road Rehabilitation Project is completed.

11.3.3 Traffic Management Plan in Juba

(1) Parking Control in Central Commercial District

Although there is no observed serious traffic problem in the Central Commercial District (CCD)

except at intersections, there are many conflict flows due to narrow road width and on-street parking. A parking control policy in CCD will be needed.

Basic Policy of Parking Control

- Roadside parking on roads in the CCD is allowed at present. However parking at the commercial area along May Street should be prohibited to prevent reduction of the traffic capacity and traffic accident. Roadside parking at restricted areas other than May Street should also be prohibited and/or charged, otherwise options of off-street parking have to be adopted in near future.
- In the residential areas, roadside parking for residents will be allowed, except in the collector streets in order to secure enough road width for public and emergency vehicles.
- On the other hand, the width of community roads is too narrow to accept roadside parking as well as to secure space for dual-way traffic. In this view, these streets may be subjected to form one-way carriageway with regulatory signs.

Countermeasures for Improvement of Parking System for Private Cars

・Parking Control by Enforcement

- Prohibition of Parking at Intersections – prohibition of roadside parking at least within 30m from intersection. Besides, regulatory signs and marking should also be provided.
- Prohibition of Parking on the Arterial and Collector Streets – in order to secure the road width for public and emergency vehicle traffic, roadside parking should be prohibited on the Arterial and Collector Streets. Accordingly road markings and regulatory signs should be provided.

・Elimination of On-street Parking

In the future, on-street parking shall be eliminated to secure traffic capacity. Prior to the prohibition of the roadside parking in the future, off-street parking facilities should be developed.

- Introduction of Multi-storied Car Parking Building

  As for the type of the parking facilities, the multi-storied car parking is recommended from the view point of the construction cost and land acquisition.

- Establishment of New Building Code

  Considering the existing sub-standard buildings and the expected future chronic shortage of parking spaces and auto parking infringing on road traffic and pedestrian ways, it will be necessary to make amendment of the Building Codes for the preservation of parking space in individual properties, especially in the CCD. The size of the parking space within each property should be carefully determined depending upon the total space and the purpose of usage of each building.

11.3.4 Other Traffic Management Plan – Traffic Demand Management

One of the effective countermeasures to improve traffic conditions in CCD is the early introduction of new parking policies and measures. However, this measure may not be the final solution to traffic congestion in CCD in the future.

Based on the typical measures of traffic demand management implemented elsewhere in the

world, the following are considered to be the applicable measures to CCD in the future.

Traffic Demand Management

1) Introduction of New Parking Policies and Measures
   Introduction of the parking fee collection system to minimize the parking time in CCD area; and construction of multi-storied parking buildings.
2) Shifting from Private Vehicles to Public Transport
   In the future, number of private cars will increase and traffic congestion will worsen in CCD . Almost all private cars carry only a few or no passengers excluding driver in the moving around CCD. Policy and measures for shifting from private vehicles to public transport is necessary.
3) Restriction of the vehicles entering CCD
4) Introduction of Park and Bus Ride System
5) Introduction of Staggered Working Hours
   The peak hour during which a large number of vehicle trips are attracted to CCD occurs three times a day: at morning time when going to the offices, at lunch time and during the evening time when going back home. High concentration is especially observed at morning time causing traffic congestion along May street. If staggered working hour will be introduced to the CCD, the traffic volume at important road sections will decrease.

11.3.5 Special Remarks

(1) Preparation of Uniform Traffic Control Device Deployment Guidelines

There is no traffic control device such as traffic sign, road marking and marker post in Juba urban area. MTR is now in the process of preparing the standard drawings of traffic signs, road markings and marker posts. When this guideline is completed, it should be regularly and repeatedly reviewed, updated and improved to reflect the current traffic situation in Southern Sudan. For all road users, uniform standards in the deployment of various traffic control devices are necessary.

(2) Cooperative Efforts of Traffic Management Related Agencies

Traffic management cannot be entirely undertaken by MTR alone. Cooperation with other agencies such as Police Agency and others like Ministry of Education, Ministry of Social Welfare is essential. The active involvement of the private sector such as driving schools, insurance companies and emergency/first-aid hospitals is also needed.

11.4 TRAFFIC SAFETY EDUCATION AND TRAFFIC ENFORCEMENT

It is of vital need to introduce/improve the traffic safety education and traffic enforcement thoroughly to prevent traffic accidents from increasing in the near future. The following are the proposed countermeasures to decrease the traffic accidents in consideration of the traffic characteristics and behavior in Juba.

(1) Introduction of a System for Traffic Accident Data Collection and Analysis

Currently, traffic accident data is collected manually and individually by traffic police. This is not an appropriate way to conduct traffic engineering analysis for formulating effective countermeasures to reduce traffic accident. Therefore, it is necessary to introduce a system for traffic accident data collection and analysis.

This traffic accident data system may be prepared by the Road Traffic and Safety Management Unit (RTSMU) in case it is established.

(2) Implementation on Periodical Traffic Safety Campaign

Traffic safety campaign is one of the most effective countermeasures in reducing traffic accidents. Periodical implementation of these campaigns at national and district levels is drsirable.

(3) Traffic Safety Education to Schoolchildren

The introduction of traffic safety education to the school curriculum is worth doing, not only for their own safety but also for the experience that will positively influence their behavior in the future as vehicle drivers. They will also exert a large influence over the traffic behavior of their family members.

(4) Strengthening the Traffic Enforcement by the Traffic Police

It is more effective to select certain regulations and enforce them at a selected time period, day of week etc. rather than trying to enforce all the rules simultaneously. This method of selective enforcement gives a greater impression to drivers and is easier for the enforcement officers to perform their duties.

In selecting the regulations to be enforced deliberately, violations causing traffic accidents that most frequently occur are listed based on analysis of traffic accidents data and then given a priority ranking. Those with high priority will then be selected for concentrated enforcement items.

Based on the site observations, it is recommended to select the concentrated violations from the following:

1) Ignoring traffic rules,
2) Ignoring controls by traffic police at junctions, and
3) Illegal on-street stopping/parking near junctions, especially for minibus.