CHAPTER 7

TOWN DEVELOPMENT STRATEGY AND SOCIO-ECONOMIC FRAMEWORK

CHAPTER 7 TOWN DEVELOPMENT STRATEGY AND SOCIO-ECONOMIC FRAMEWORK

7-1 SOCIO-ECONOMIC FRAMEWORK IN YEAR 2017

7-1-1 Population Framework in 2017

As mentioned in Chapter 2-2-2, the existing statistical materials about the population of Bujumbura city are not reliable. Before examining the population framework in 2017, it is necessary to advance a study in consideration of the following three matters.

1) UNFPA, EU, WB adoption value

Other donors estimate the population growth rate of the whole country of Burundi to be 2.3% a year based on the population dynamics in recent years. However, in Burundi, population movement from the villages to the cities continues, and it is thought that the population growth rate in Bujumbura city is higher than the above-mentioned estimated increase rate.

2) The policy objective value about urban population

The GOB and Ministere de Traveaux Public et Equipement have established a policy to promote urban development in other cities rather than Bujumbura city. The policy intends to lead the increasing urban population to the other local cities and to moderate the pressures over the population of Bujumbura city.

The target rate of the urban population growth for the entire country of Burundi is estimated to be 6 to 7% a year. Bujumbura city is appropriately assumed to have the increased rate of 3.0-3.5 a year from the viewpoint of nationwide population distribution.

3) Population growth trend in Bujumbura city

Based on the result of real number investigation mentioned in Chapter 2-2-2, the annual average population growth rate of Bujumbura city from 1991 to 2007 is approximately 4.9% a year. However, the city area had been continued to expand during this period, and so such influence is reflected in this growth rate. Since there are limited possibilities that the same rate of city expansion will continue in future, an actual population growth rate is expected to be less than this value.

In consideration of the above three points, Bujumbura city population growth rate were set up as 3.0% and 3.5% a year from 2007 to 2017. When population growth rate is 3.0%/year, the population of the Bujumbura city in 2017 would become about 736,000 persons, and when the growth rate is 3.5% a year, it would becomes about 773,000 persons.

Furthermore, the expected problems in present urban condition for each commune were examined according to these growth rates. The population growth rate for each commune in Bujumbura city shows great variations after 1991. The estimated variation ranges between 1.9 to 5.5%. The increase in population in the commune with high growth rate is caused by social effects, such as new development of housing sites. Unless development in present scale continues, it is not thought that a high population growth rate will continues. Moreover, assumption of the population growth rate of 3.5%/year was also considered and observed that the areas might face the problems of urban environment, such as overcrowding condition.

From the findings of the above examinations, the population growth rate by 2017 was set up to be 3.0%/year.

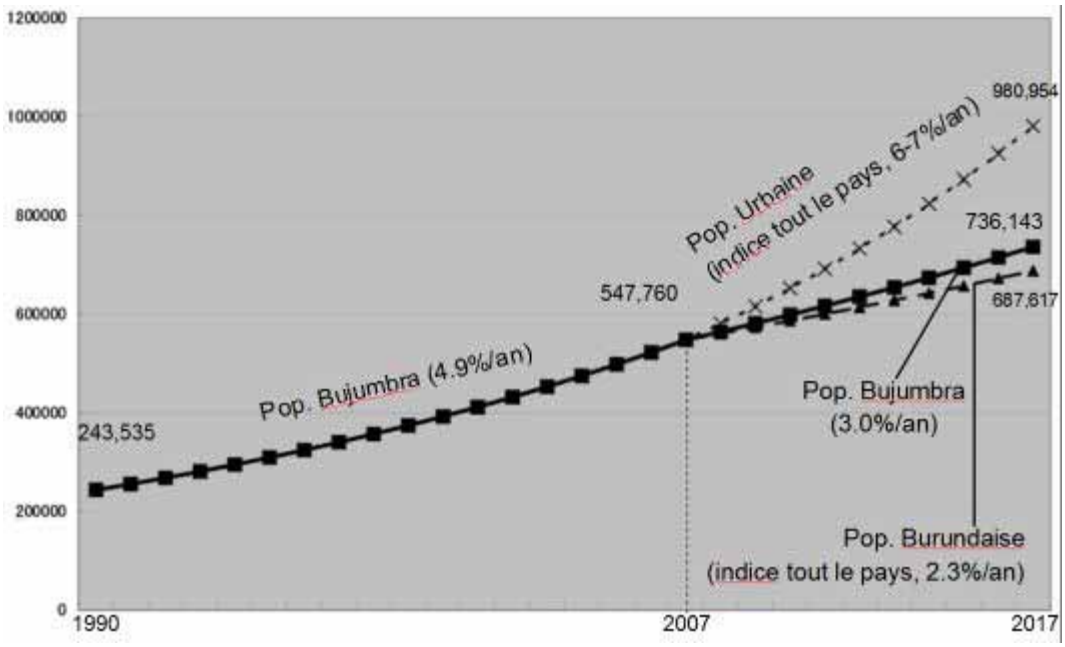


Figure 7.1.1 Population Framework in 2017

7-1-2 Labor Force and Working Population by Sector

(1) Industrial Location in Bujumbura

According to the industrial survey report which was compiled by the Industrial Association of Burundi (AIB) in February, 2003, 103 out of 115 industries in the formal sector are located in Bujumbura, and the remaining 12 companies are located at RUMONGE, KAYANZA, NGOZI, and GITEGA. That means 90% of the total companies in Burundi is concentrated in Bujumbura. Among these, agro & food processing industry is accounted to be 30% as the most prominent sector, and subsequently the next is wood & paper industry followed by chemical industry. In Bujumbura, 80% of the industries are located at ROHERO Commune, and the rest are along the following avenues, shown in Table 7.1.1.

- Avenue du 1st November
- Avenue de Phare
- Avenue de la Tanzanie
- Avenue d'Uvirg
- Avenue du People Murundi
- Chaussee du prince louis Rwagasore
- Avenue de l'OUA
- Avenue de la Mission
- Avenue des Usines

Table 7.1.1 Location of Industries by Kind in Bujumbura

Name of Community	Kind of Industry						
	Agro & Food Processing	Textile & Leather	Wood & Paper	Chemical	Metal & Fabrication	Others	Total
Buterere	2					1	3
Kinama							
Cibitoke							
Kamenge							
Ngagara		1					1
Gihosha	1						1
Buyenzi			2				2
Bwiza	2		1			1	4
Nyakabiga							
Rohero	25	5	19	18	8	12	87
Kinindo	1						1
Musaga		1					1
Kanyosha							
Total	**31**	**7**	**22**	**18**	**8**	**14**	**101**

Note: 2 units are closed down among 103 industries.
Source: Rapport "Les Industiries et Unites de Production du Burundi", Fevrier 2005

(2) Industrial Structure and Employment

Agro and food processing industries are the major industries in Burundi and accounted for more than 70% of total industrial production. Major industrial production items are beer, fizzy drinking, milk, sugar, cotton, oil, cigarette, tea, coffee, juice, flour, etc. Coffee and tea are the predominant crops of Burundian export, and Europe and Asia are their main destinations.

The second largest industries are the textile and leather industries which are producing blanket and material. The third are chemical industries which are producing paint, insecticide, oxygen, polyethylene films, toilet soap, mattress, match, pharmaceutical products, plastic rack, package and propylene bag. The fourth are wood and paper industries which are producing towel, toilet paper and carton packing.

Table 7.1.2 Production by kind of Industry (Million FBu)

Kind of Industry	1997	1998	1999	2000	2001	
					Amount	Share
Agro & Food processing	30.96	40.37	52.69	54.57	55.29	73.5%
Textile and Leather	3.42	5.36	7.39	5.05	7.56	10.1%
Chemical Industry	1.90	3.09	3.53	3.92	4.58	6.1%
Wood and Paper	1.41	1.90	1.92	1.90	2.31	3.1%
Metal & Fabrication	0.26	0.64	0.96	1.07	1.39	1.9%
Other Industry	0.83	2.40	2.33	3.06	4.01	5.3%
Total	**38.80**	**53.78**	**68.84**	**69.58**	**75.16**	**100%**

Note: Prepared by the JICA Study Team
Source: Rapport “Les Industiries et Unites de Production du Burundi”, Fevrier 2005

(3) Informal Sector

In addition to 115 formal sector industries, the said survey also covered about 375 business units in the informal sector. According to the result of the survey, 241 units (64%) are located in Bujumbura, and the remaining units are located in the rural areas. Although many units among these informal sectors run crafts businesses the numbers of employees per unit were found to be two to four persons. In that regard the whole informal sector, is estimated to absorb the employees of around 12,500 persons. Thus, the informal sector is quite important for creation of jobs. According to the survey, 133 units (55%) in the informal sector located in Bujumbura run crafts businesses.

The Agro and food processing industries, textile and leather industries are all together the prominent industries in Burundi for creation of employment. They are accounted for about 70%

of total number of employment in the formal sector at the year 2003 as shown in Table 7.1.3.

80% of the total number of employees is formed by three categories of employee namely skilled labor, semiskilled labor and workers by professional categories. The survey presents that many companies have foreigners in the top management staffs (refer to Table 7.1.4).

Table 7.1.3 Number of Employment by Kind of Industry (2003)

Kind of Industry	Number of employment	%
Agro & Food processing	2,966	41.6
Textile and Leather	2,054	28.8
Wood and Paper	882	10.3
Chemical Industry	735	1.9
Other Industry	359	5.0
Metal & Fabrication	139	1.9
Total	**7,135**	**100%**

Note: Prepared by the JICA Study Team
Source: Rapport "Les Industiries et Unites de Production du Burundi", Fevrier 2005

Table 7.1.4 Employment Numbers per Professional Categories and Nationality

Professional categories	Burundians	Foreigners	Total
Managerial staff	368	28	396
Classed managerial staff	257	92	349
Highly skilled labor	780	14	794
Skilled labor	2,261	10	2,271
Semiskilled labor	1,349	6	1,355
Maneuver	1,968	2	1,970
Total	**6,983**	**152**	**7,135**

Note: Prepared by the JICA Study Team
Source: Rapport "Les Industiries et Unites de Production du Burundi", Fevrier 2005

(4) Necessity of Employment Opportunity Expansion

Although it is not officially announced the present unemployment rate in Bujumbura and Burundi, is estimated to be 23% (an average unemployment rate of men-and-women) according to the result (refer to Appendix 2: "Outputs of Community Survey") of survey carried out by ISTEEBU recently. The outputs represent quite high ratio of unemployment. This situation requires urgent creation of employments opportunities to the jobless people, since 3% of increase in population is predicted every year; and by 2017 the population is predicted to be

about 740,000persons. The work force (people aged from 16 to 60 years) is about 60% of the population and it is presumed that about 440,000 persons are in need of any kind of jobs. Therefore it is necessary to create employment opportunities which will absorb the new labor force emerging as well as the present jobless people.

Even if the number of employees in the informal sector is limited as mentioned above, it is presumed that about 8,750 persons including the number of workers in the mining and energy sectors (Mining: 481 persons, Electricity: 1,134 persons) will be employed. The result indicates that the job opportunity in the secondary industries is quite small at present. For this reason, the agricultural sector is expected to provide job opportunities since it has great possibility to expand from the present employment condition, even though it is estimated that about 1 million people are there in this sector at the present. Due to the said expansion the unoccupied work force would be absorbed in this sector. Although the job situation in the construction sector is not clear, however, infrastructures development is needed as a whole. Construction sector occupies 27% of the secondary industry and contributed about 5.4% of total GDP in 2005. Since this field is a bigger sector than the handicrafts, construction sector is expected to create employment opportunities.

7-1-3 Economic Indicators

(1) The PRSP

The PRSP was finalized and published in September 2006. It presents medium and long-term development visions for Burundi and sets poverty reduction targets consistent with the Millennium Development Goals (MDGs). The PRSP is built around the following principles:

(i) refocusing the role of the state to favor private sector development;
(ii) maintaining peace and security;
(iii) capacity building;
(iv) resuming economic growth;
(v) strengthening community involvement;
(vi) affirming the central role of women; and
(vii) promoting a new partnership with donors

(2) Macroeconomic Objectives in Burundi

IMF (International Monetary Fund) released the following macroeconomic target and financial management policy by IMF Country Report No. 07/113, (March 2007).

The Report stated that Burundi's strategy for 2007 is to continue macroeconomic stabilization, overcome the delays in implementing some structural reforms, and continue the strengthening of public finance management and the reorientation of expenditure. Structural reforms are focused on improving the business climate, re-launching the privatization process, and reinforcing good governance. The economic program targets continued real economic growth on the order of 5-5.5% in 2007, principally reflecting the positive impact of the structural reforms, while containing inflation. Monetary policy will continue to be based on a managed floating exchange rate regime, with reserve money as the nominal anchor. The external current account deficit, including grants, is expected to increase slightly from 13.6% of GDP in 2006 to 15.3% in 2007.

The external current account deficit, including grants, was expected to widen further in 2006, although by less than projected, on account of the impact of lower-than-expected coffee exports and continued strong growth in imports (Table 2). Gross official reserves fell steadily through November, leaving reserve for imports of not more than 3.2 months only.

Real GDP growth is projected to hold at 6.6% and continued to 2010 on broad-based recovery, especially in trade, construction, and services. Average inflation is expected to remain in the low single digits as liquidity management improves further and bank financing of the budget is limited.

The sectoral programs and macroeconomic framework are oriented around four strategic axes: i) the improvement of governance and security, ii) the promotion of sustainable and equitable economic growth, iii) the development of human capital, and iv) combating HIV/AIDS.

Table 7.1.5 Burundi: Selected Economic and Financial Indicators, 2004 - 10

Table 1. Burundi: Selected Economic and Financial Indicators, 2004–10

	2004	2005	2006		2007	2008	2009	2010
	Actual		Prog.	Est.	Prog.	Projections		
			IMF Country Report No. 06/311					
	(Annual percentage change, unless otherwise indicated)							
National income and prices								
Real GDP growth	4.8	0.9	6.1	5.1	5.5	6.6	6.6	6.6
GDP deflator	8.3	16.6	4.8	3.3	4.6	4.0	4.0	4.0
Consumer prices (period average)	8.0	13.4	2.5	2.8	4.2	4.0	4.0	4.0
Consumer prices (end of period)	11.8	1.1	8.7	9.2	4.1	4.0	4.0	4.0
External sector								
Exports, f.o.b. (U.S. dollars)	27.5	19.5	22.5	6.4	15.1	24.5	16.9	15.0
Imports, f.o.b. (U.S. dollars)	16.1	60.5	31.8	19.6	17.2	5.4	5.3	6.9
Export volume	-10.9	-1.6	22.1	4.7	7.0	27.7	17.2	15.1
Import volume	3.9	46.7	26.9	1.3	15.9	4.9	8.7	9.9
Terms of trade (deterioration = –)	28.1	11.0	-3.3	-14.0	6.4	-2.9	3.0	2.7
Real effective exchange rate (annual average; depreciation = –) [1]	-3.0	10.1	...	-4.5	...	...	...	...
General government								
Revenue	8.0	17.1	5.5	3.7	13.8	12.5	11.3	12.4
Total expenditure and net lending (commitment basis)	29.6	8.7	26.2	19.9	15.2	3.6	9.8	13.0
Noninterest current expenditure (excl. demobilization and elections)	9.5	5.8	51.2	21.5	25.6	17.1	12.7	5.4
	(Change in percent of beginning of period M2, unless otherwise indicated)							
Money and credit								
Net foreign assets	-4.1	15.7	-1.3	-7.7	-1.4	...	...	...
Domestic credit	39.8	0.6	22.9	39.9	12.9	...	...	...
Government	34.8	8.1	8.2	13.2	0.4	...	...	...
Private sector	5.0	-6.6	14.7	26.0	12.5	...	...	...
Money and quasi money (M2)	16.7	26.0	20.5	9.6	12.4	...	...	...
Income velocity (=ratio of GDP to M2; end of period)	3.6	3.4	3.1	3.3	3.3	...	...	...
Reserve money (12–month growth rate)	37.2	32.7	10.5	4.4	11.6	...	...	...
Central bank refinancing rate (percent; end of period)	14.5	14.5	...	14.5	...	...	...	...
Commercial bank lending rate (percent; medium term; period average)	19.5	19.2	...	18.4	...	...	...	...
	(Percent of GDP, unless otherwise indicated)							
General government								
Revenue (excluding grants)	20.1	20.0	19.0	19.1	19.7	20.0	20.1	20.3
Total expenditure and net lending	39.8	36.8	41.8	40.6	42.4	39.6	39.2	40.0
Primary budget balance (excluding foreign-financed projects)	-3.5	-1.7	-8.9	-6.1	-6.6	-6.2	-6.2	-5.8
Overall balance (commitment basis)								
Excluding grants	-19.7	-16.8	-22.8	-21.5	-22.7	-19.6	-19.1	-19.6
Including grants [2]	-4.9	-6.2	-0.4	-2.2	0.7	-1.7	-1.0	-1.0
Saving and investment [2]								
Current account balance [3]	-8.1	-10.4	-17.5	-13.6	-15.3	-13.1	-13.3	-13.8
Current account balance, excluding official transfers	-25.5	-34.2	-37.9	-36.8	-37.5	-33.3	-31.3	-29.8
Gross investment	13.3	10.8	16.1	16.6	17.9	18.6	19.1	19.5
Government	10.3	6.5	9.6	8.6	8.9	9.1	9.4	9.5
Private	3.0	4.2	6.5	8.0	9.0	9.5	9.8	10.0
Domestic saving	-12.2	-23.4	-21.8	-20.3	-19.5	-14.7	-12.1	-10.3
Government	-9.4	-10.2	-13.2	-12.9	-13.8	-10.5	-9.8	-10.1
Private	-2.8	-13.2	-8.6	-7.3	-5.8	-4.2	-2.4	-0.2
Gross national saving	5.2	0.4	-1.4	2.9	2.6	5.5	5.8	5.8
Government	-3.4	-3.4	3.3	0.9	0.6	-1.4	-1.2	-1.2
Private	8.6	3.8	-4.7	2.0	2.0	6.9	7.0	7.0
	(Millions of U.S. dollars, unless otherwise indicated)							
External sector								
Current account, including grants [2]	-54.0	-83.1	-166.8	-123.8	-159.9	-144.5	-160.0	-179.3
Overall balance of payments [2]	11.0	22.2	4.7	-15.3	4.3	40.8	17.6	3.5
Gross official reserves (end of period)	67.2	112.7	145.0	131.0	159.5	172.1	188.9	186.5
Gross official reserves (months of imports of the following year)	2.2	3.1	3.3	3.2	3.6	3.7	3.8	3.9
Debt-service ratio (scheduled; percent of exports; before HIPC and MDRI relief) [3]	109.2	47.1	46.5	53.8	37.5	31.6	30.9	29.8
Debt-service ratio (actual; percent of exports; after HIPC and MDRI relief) [3]	99.8	33.4	13.4	17.5	2.0	1.1	1.8	4.2
Stock of debt	1,384.1	1,422.8	1,457.9	1,442.8	1,452.8	412.1	419.3	421.5
External payments arrears	78.7	52.5	0.0	49.9	0.0	0.0	0.0	0.0
Memorandum items:								
GDP at current market prices (billions of Burundi francs)	732	861	957	935	1,031	1,142	1,267	1,405

Sources: Burundi authorities; and IMF staff estimates and projections.

[1] As of November 2006.

[2] Assumes financing gap is covered by grants in 2007–15 and by 50 percent grants thereafter.

[3] The decision point was reached on August 5, 2005, and it is assumed that the HIPC completion point will reach by the end of 2007.

Source: IMF Country Report No. 07/113, March 2007

Table 7.1.6 Burundi: Balance of Payments, 2005 - 10

Table 2. Burundi: Balance of Payments, 2005–10 [1]

	2005	2006		2007	2008	2009	2010
	Actual	Prog.	Est.	Projections			
		IMF Country Report No. 06/311					
	(Millions of U.S. dollars)						
Current account	-83.1	-166.8	-123.8	-159.9	-228.2	-250.9	-271.2
(excluding official transfers)	-273.4	-361.5	-334.2	-375.0	-367.5	-375.1	-388.1
Trade balance	-181.8	-244.7	-225.1	-265.2	-266.0	-269.8	-280.1
Exports, f.o.b.	57.2	70	60.8	70.0	87.2	101.9	117.3
Of which: coffee	40.5	50.7	43.5	54.3	54.9	58.8	62.9
Imports, f.o.b.	-239.0	-314.7	-285.9	-335.2	-353.2	-371.8	-397.4
Of which: petroleum products	-38.3	-52.6	-49.8	-56.0	-62.7	-66.4	-70.1
Services (net)	-89.5	-110.4	-107.6	-110.9	-115.6	-122.0	-126.4
Income (net)	-19.3	-25.6	-20.7	-20.1	-9.6	-9.7	-9.7
Of which: interest on public debt (including IMF charges)	-11.4	-12.8	-12.8	-12.2	-1.6	-1.7	-1.7
Current transfers (net)	207.6	213.9	229.6	236.3	163.0	150.6	145.0
Private (net)	17.3	19.2	19.2	21.2	23.7	26.4	28.1
Official (net)	190.3	194.7	210.4	215.1	139.3	124.2	116.9
Of which: program grants	37.9	103.4	64.8	83.0	0.0	0.0	0.0
Capital account	26.2	131.2	75.7	118.8	1,149.5	112.4	124.4
Of which: HIPC relief	7.4	35.7	35.7	39.4	992.6	0.0	0.0
Of which: MDRI grant	...	...	0.0	0.0	61.6	0.0	0.0
Financial account	66.6	40.3	32.8	38.9	-964.2	65.3	58.4
Direct investment	15.0	8	8.0	15.0	17.3	19.8	22.8
Medium- and long-term official loans (net)	37.7	0.2	-1.0	-11.1	-1,009.6	11.1	11.1
Disbursements	69.3	40.4	39.2	21.5	16.5	11.5	11.5
Project loans	43.1	40.4	39.2	21.5	16.5	11.5	11.5
Program loans	26.2	0	0.0	0.0	0.0	0.0	0.0
Amortization (excluding IMF)	-31.6	-40.2	-40.2	-32.6	-1,026.1	-0.4	-0.4
Other investment	13.9	32.1	25.8	35.0	28.1	34.3	24.5
Errors and omissions	12.5	0.0	0.0	0.0	0.0	0.0	0.0
Overall balance	22.2	4.7	-15.3	-2.2	-42.9	-73.2	-88.4
Financing (increase in assets = –)	-22.2	-4.7	15.3	-4.3	-40.8	-17.6	-3.5
Net change in official foreign reserves (increase = –)	-31.0	-3.6	18.0	-6.9	-43.8	-20.6	-6.5
Gross official reserves	-45.5	-32.3	-18.4	-28.4	-12.7	-16.8	2.4
Liabilities to IMF, net	17.2	30.7	24.6	21.5	-31.1	-3.9	-8.8
Other, net	-2.7	-1.9	11.8	0.0	0.0	0.0	0.0
Change in arrears (increase = +)	-22.2	-5.6	-5.2	-49.9	0.0	0.0	0.0
Exceptional financing [2]	31.0	4.5	2.5	52.5	3.0	3.0	3.0
Financing gap [2]	0.0	0.0	0.0	6.5	83.7	90.9	91.9
		(Percent of GDP, unless otherwise indicated)					
Memorandum items:							
Trade balance	-22.7	-25.6	-24.8	-26.5	-24.1	-22.5	-21.5
Current account [2]	-10.4	-17.5	-13.6	-15.3	-13.1	-13.3	-13.8
Of which: excluding current official transfers	-34.2	-37.9	-36.8	-37.5	-33.3	-31.3	-29.8
Gross official reserves							
Million of U.S. dollars	112.7	145.0	131.0	159.5	172.1	188.9	186.5
Months of following period's imports, c.i.f.	3.1	3.3	3.2	3.6	3.7	3.8	3.9
Imports							
Growth rate	60.5	31.8	19.6	17.2	5.4	5.3	6.9
Percent of GDP	29.9	33.0	31.5	33.5	32.0	31.0	30.5
Exports							
Growth rate	19.5	22.5	6.4	15.1	24.5	16.9	15.0
Percent of GDP	7.1	7.3	6.7	7.0	7.9	8.5	9.0
Debt-service ratio (percent of exports of goods and services)							
Scheduled current maturities (including IMF)	47.1	46.5	53.8	37.5	31.6	30.9	29.8
Actual debt service (including IMF; after HIPC and MDRI)	33.4	13.4	17.5	2.0	1.1	1.8	4.2
Exchange rate (Burundi francs per U.S. dollar; period average)	1,075	...	1,029	...	...	...	...
Nominal GDP (millions of U.S. dollars)	800.5	954.6	908.0	1,000.7	1,103.9	1,199.3	1,303.0

Sources: Burundi authorities; and IMF staff estimates and projections.

[1] Compiled in accordance with *Balance of Payments Manual, 5th edition*.

[2] Includes the March 2004 Paris Club rescheduling on Naples terms, and assumes rescheduling is of current debt service and arrears to non-Paris Club creditors at

(3) Estimated Economic Indicator in Bujumbura

There is no data available on GRDP (Gross Regional Domestic Product) of Bujumbura. Economic growth is assumed on the following conditions.

- A future GDP is assumed at the fixed price (the present growth rate) of 2007.
- IMF presumes the GDP growth rate of the whole Burundi to be 6.6% up to year 2010 while the World Bank presumes GDP growth rate of 6.0% per annum. Therefore, it is assumed that the real growth rate be 6.0% up to year 2017.
- For reference it is also assumed that GDP growth rate to be computed from the values of the industry based growth rates of eight-year from 1998 to 2005. As a result, it was found out that the growth rate of secondary industry is the highest. Although the primary industry occupies 54% of GDP, the growth rate is in the position of almost levelling off. The past track record is made to reflect also the future prediction.
- The GDP contribution ratio of primary industry in Bujumbura could be 7.2% according to the population ratio.
- For the GDP contribution ratio of secondary industry in Bujumbura, Manufacturing and Handicrafts sector contributes 90% while the contribution of Construction and a Mining sector is 7.2% according to population.
- As for the GDP contribution ratio of tertiary industry in Bujumbura, according to a population ratio, Public services sector contributes 7.2% and Transport and communications, Commerce, and Other Services sectors contribute 60%, because these industries are concentrated in Bujumbura city.

From the above, the growth rate in Bujumbura is to be between 7.9% and 8.1% against 6.0%, which is the average forecasted growth rate in the whole country by the year 2017. GRDP of Bujumbura will occupy about 25% of GDP. In addition to that, though the secondary sector is the smallest in Burundi, it will provide the largest share of about 50% of GRDP in Bujumbura. The primary sector, being the largest sector of Burundi, will provide the smallest share of about 15% of GRDP in Bujumbura.

Regarding GRDP per capita (about FBu434,000) in Bujumbura, it is as higher as about 3.3 times of the average GDP per capita (about FBu136,000) in Burundi in the year 2007 (refer to Table 4.1.8 and 4.1.9).

Table 7.1.7 GRDP and Share by Sector in Bujumbura at 2007

GDP Composition	Economic Performance in Burundi (1998-2005)		Estimated Share of Sector	Estimated Growth Rate per Year	Estimated GRDP in Bujumbura	
	Real Growth Rate per Year	Average Share of Sector			Current 2007 Prices (billion FBu)	GRDP Share (%)
Primary sector	- 1.0%	54.0%	48%	3.5%	35.6	15.0%
Secondary sector	5.2%	14.6%	20%	9.0%	117.3	49.3%
Tertiary sector	4.8%	31.4%	32%	8.0%	84.7	35.7%
Total	1.7%	100%	100%	6.0%	237.6	100%

Note: 1) prepared by the JICA Study Team
2) US 1 dollar is equivalent to FBu 1,029 estimated by IMF staff.

Table 7.1.8 Estimated Economic Indicators in Bujumbura

	Indicator	Unit	2007	2012	2017
Burundi	GDP at 2007 prices	Billion of FBu	1,031.0	1,379.7	1,856.8
	Real GDP growth	% per year	6.0%		
	Population	Number	7,605,000	8,479,177	9,453,838
	Population growth rate	% per year	2.2%		
	GDP per capita	(FBu)	135,569	162,718	196,409
		(US$)	131.7	158.1	190.9
Bujumbura	GRDP at 2007 prices	Billion of FBu	237.6	347.34	510.8
	Share of GRDP	%	23.0%	25.2%	27.5%
	GRDP Growth Rate	%	7.9%	8.0%	8.1%
	Population	Number	547,760	635,004	736,143
	Population growth rate	% per year	3.0%		
	GRDP per capita	FBu	433,842	546,871	693,931
		US$	421.6	531.5	674.4

Note: 1) prepared by the JICA Study Team
2) US 1 dollar is equivalent to FBu 1,029 estimated by IMF staff.

7-2 ESTIMATION OF LAND DEMANDS

7-2-1 Existing Land Use Situation

(1) Residential

Examination on cartier level, which is a subordinate administration level under a commune, shows that there exists very good residential districts which have population density below 50 persons/ha. On the other hand, cartier with very high population density such as 600 persons/ ha also exists. In these areas, sufficient public space and public facilities are not arranged, and those have problems in the service level of living environment. Moreover, there is possibility that it causes problem related to disaster prevention and sanitation. Although the residential population density is high, most of the buildings are one-story type and only a few are 2 storied.

The residential areas which have problems at present as mentioned above need to moderate and control inflow of population henceforth. Moreover, it is necessary to improve city environmental qualities by enforcing redevelopment projects in the block or district level.

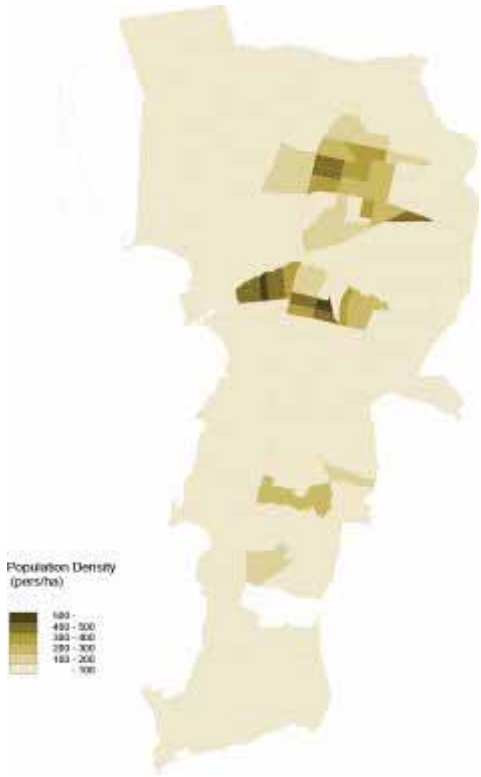


Figure 7.2.1 Current population density by cartier

(2) Business, commercial

Business institutions and commercial establishments are located in the Rohero area which is the city central part at present. Moreover, some organizations parts are also located in part of Gihosha commune, which has been formed into a sub city center in the northern area. Any other service (business/commercial) and employment districts for residents hardly exists in other communes except the above mentioned areas.

In the present employment structure, district surface area and building capacity is balanced. But thinking about the expected increase in the urban population in future, the conversion process of industrial and employment structures, to real estate which will stock more than the present will be required. Moreover, it is necessary to prepare business and commercial lot corresponding to the expansion of the city area in future.

The current situation of the land use for business and commercial facilities and their presumed floor area are shown in table7.2.1.

Assuming 60% of present population (about 550,000 persons) as working population, the floor area per one labor force will be 4.7 sqm/person. This figure is small compared to the standard office floor area (per one labor 10.0sqm). In the process of modernization of industry and labor working environment, it will be necessary to improve this situation in the future.

The commercial floor surface, at present condition, is calculated as 2.0sqm per one person, which means that the floor surface is sufficient as compared with the standard amount of planning index (1.0 sqm/pers).

The commercial demand for neighbourhood level and district rayon level is satisfied by district centers established in each commune and the shops at the site of mix use. On the other hand, commercial/business district and mix use lot (commercial/institutional) which deals with special goods shops and services are limited almost in the city central areas of Rohero commune.

Table 7.2.1 Business, commercial facilities, presumption floor surface

Land use category	Plottage (ha)	Presumed building coverage (%)	The number of presumed floors	Presumed floor surface ratio (%)	Presumed total floor surface (sqm)
Office / business use					
Commercial / business	50.0 *1	60	2	120	600,000
government	88.04	30	2	60	528,240
Mix use (Commercial / institutional)	47.13	60	1.5	90	424,170
Total					1,552,410
Commercial use					
Commercial / business	50.0	60	1	60	300,000
District Center	13.86	90	1	90	124,740
Mix use (Residence / Commercial)	170.03	20	1	20	340,060
Mix use (Commercial / institutional)	47.13	60	1	60	282,780
Total					1,047580

*1: half of the applicable land use category was considered for office use, and the other half was considered for commercial use.

(3) Industrial

Industrial zone located in the northern part of the city has an area of about 330 ha(s). An unused lots and an extended area are located in the neighbourhood of the current industrial lot, where about 100 ha(s) can be developed. In addition, the industrial factories are being located along the airport access road and near the port.

Under the present circumstances, many lots for factory are not yet been used even if the development works of the factories have been completed.

Due to the urge of continuous development of the country hereafter, it is necessary to increase job facilities in the industrial field. Therefore, it is indispensable to aim at the installation of industrial structure, modernization, and improvement of electric power supply.

At present, the total area of industrial lot is about 506ha and the plottage per capita is 0.92 sqm/per.

Although it is necessary to take into consideration the employment structure and the

employment situation of a factory in future, it is rather important to plan so that it may raise the average area per capita than present.

(4) Mixed use

In the master plan of 1982, the land use classifications were roughly categorised into: the residential area, the business-use area, and the industrial area. However, an actual land use situation shows that the small-scale commercial-cum-residences are established in the housing lot, or residence with cottage industrial studio also exists in the high density residential areas. Buildings which perform these compound uses must be categorised as the residence of mixed use and it is desirable to draw up a future land use master plan.

The study team observed the above-mentioned land use pattern in Bujumbura, however the team didn't find any existence of statistical material regarding the land use classification at present. For this reason, gathering of data from now on through numerical observation will be needed to have an actual land use situation.

7-2-2 Future Urbanised Areas

It has already been mentioned that the suitable areas for the future development of Bujumbura city are limited in the northern, the southern, and the steep-range-of-hills region of the eastern part.

The northern part area is positioned as the most important area for development in the master plan of 1982. Under this master plan, the present Cibitoke, Kamenge, and the northern area adjacent to the city are intended to be developed for housing purpose.

From the viewpoint of preservation of environment, in recent years the northern part area is recognized as the green tract of land and farmland and so this area should be controlled for development. Although this study expects that the adjacent regions of Bujumbura outskirts would be urbanized in near future, it sets up the urbanizing areas' limits as the present administration boundary.

The mountain ranges are just on the back of the hilly terrain on the eastern part. Such mountain land, left abundant for vegetation, is thought that its soil can hold enough water and the foundation is stable. However, there remains a possibility of disaster like landslide that might occur at the time of torrential rain.

For this reason, this study adopts a rule that a sloping ground lesser than the degrees of 1/3

slant, stabilized in natural condition, can be developed[1]. The sloping areas and typical levelling model at present condition in Bujumbura city are shown in figures 7.2.2 and table 7.2.2.

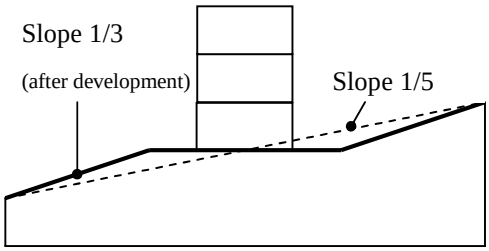
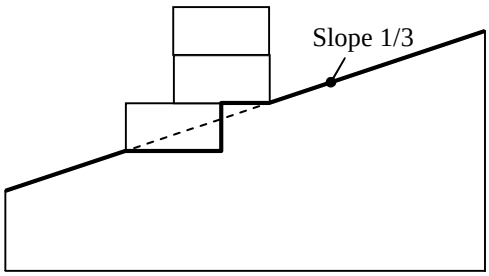
In the master plan of 1982, because of the distance from the existing industrial area, the southern part areas (Kanyosha etc.) of the Bujumbura city were not considered as the region for urbanization. However, development projects are under going in recent years in this region. Moreover, construction of public facilities, such as a stadium, is also underway.

This study positions the southern part area of the city as an important area for advanced future urbanization. Housing development is recommended in the district; however careful consideration of the natural coastal environment of Lac du Tanganika should be given paramount importance. Moreover, the district area is compatible to replace most kind of businesses and employment from central Bujumbura city area by arranging and establishing new industry, business and commercial functions. This district has a possibility of becoming an urban development zone of new kind in Bujumbura city.

[1] *Although examination of land use was studied for the land having a degree of slant of 1/3 or less, it turned out that development of land having the degrees of slant of 1/5 is enough for future capacity. Finally, the master plan limits the development of site to a degree of slant of 1/5 or less.*

Figure 7.2.2 Sloping Area in Bujumbura City (Present Condition)

Table 7.2.2 Land levelling model classified by slanting degree

Slanting degree	Area	Leveling model	Present condition, remarks
0 to 20 % (0 to 1/5)	10,277.8 ha		Almost all the urbanized area of a Bujumbura city is located within a degree of slant of less than 1/5.
20 to 33 % (1/5 to 1/3)	408.7 ha		A part of residential area of the western Rohero has a slope of 1 / 5 - 1/3. The roads must be planned in consideration of slanting lope. The land use efficiency is worse.
Over 33% (over 1/3)	291.4 ha	Unsuitable for development	There exists some buildings located at a hillside on a steep slope

7-2-3 Population Distribution Plan

The planned target population of Bujumbura city in 2017 has been determined to be 736,000 persons as described in 7-1-1. The increase of about 188,300 persons is assumed from the present population of year 2007.

The study compares the following two cases of the population distribution calculation for each commune which correspond to this population increase. .

(1) Scenario A

First, habitable areas and areas which can be urbanized were calculated for each commune. Moreover, population distribution was calculated according to the development acceptance capacity for every commune and also to the population increase trend in recent years. The present circumstances also take into consideration the following conditions.

- The communes which are judged to be populated by more than 200 persons/ha are in an overcrowded situation. These areas were positioned as the areas which should control the increase in population in future. The increase in population to be generated from now on is recommended to be shifted into other areas, other than the present populated communes like Cibitoke, Kamenge, Buyenzi, Bwiza and Nyakabiga.

- For the unpopulated communes, twice of the present population density or 100 person / ha was set up as habitable density, and thus the acceptance capacity was calculated.

(2) Scenario B

In addition to the contents of the scenario A and in consideration of the following circumstances, the distribution of population to some part of communes was revised.

- Buterere: Since it was a rural area till recent years, it has much space for development. As a result, there is a tendency of accepting the excessive calculation. For this reason, it is appropriate to set up the population growth rate according to an increase-in-population trend in recent years (+5.5%/year).

- Ngagara: As a result of recent expansion of residential area section, the calculated trend of the population growth rate is in the tendency of becoming high. Since there is little land which can be developed hereafter, an average population growth rate is set for the commune.

- Kanyosha: The size of land area for urbanization development is quite big here. Some

development projects have already been started. It is expected that this commune will mainly accept the increase of population in Bujumbura city henceforth.

The study compares and examinations both the above-mentioned cases. It is therefore judged that the population distribution by the Scenario B is reconciling with the development trend of Bujumbura city in recent years, and also with the development policies by the administration.

Table 7.2.3 Population distribution plan

Commune	Scenario A		Scenario B	
	Estimated Population in 2017	Growth 2007 to 2017	Estimated Population in 2017	Growth 2007 to 2017
Buterere	68,316	+34,816	59,993	+26,493
Kinama	91,260	+29,837	91,260	+29,837
Cibitoke	70,263	0	70,263	0
Kamenge	42,068	0	42,068	0
Ngagara	25,166	+3,265	25,166	+3,265
Gihosha	76,555	+25,712	76,555	+25,712
Buyenzi	47,413	0	47,413	0
Bwiza	37,763	0	37,763	0
Nyakabiga	24,345	0	24,345	0
Rohero	19,834	+5,123	19,834	+5,123
Kinindo	31,274	+9,177	31,274	+9,177
Musaga	98,979	+20,438	98,979	+20,438
Kanyosha	102,908	+60,016	111,231	+68,339

7-3 PLANNED DISTRIBUTION OF URBAN FUNCTIONS

7-3-1 Strategy for Spatial Structure

In setting up a better image of future Bujumbura city, the following points are to be considered as the strategy for the developing commitment.

(1) Environmental improvement in urban district

There exist some overcrowded residential areas in the city which are not desirable for living in consideration of its safety and sanitation. In the short term, a new population influx into these congested areas should be controlled. In the long term, integration of land use and its higher utilization should be promoted, at same time the improvement of city environment within these areas might be carried out in advance.

(2) Promotion of development in new city area

In order to correspond with the increase in future urban population, development of new city areas should also be promoted. Considering the size of a plot, the land areas of the housing sites built now in Bujumbura city are too large, and tend to be expensive as a result. For improving the urban environment in the city area, it is necessary to set up the plot size and building of residences which could also be rented or purchased by the low and middle income earners.

It is necessary to prepare and supply small scale housing plots and living accommodations which are easy to posses or use, such as apartment houses, for development of a new city area. Moreover, for accepting population inflow in a new city area or in the overcrowded areas of old city quarters, promoting construction of public residences is recommended as one of the solutions.

The project is concerned not only with the development for these areas, but also the urban environmental improvement of the whole Bujumbura city.

(3) Formation of safe living environment

At present, in Bujumbura city, since the land available for habitation and housing purpose are not enough, some residences are built on inclining land along the rivers and on the steep inclined mountain land. In order to prevent the disaster to be caused by heavy rain, a new town is required to be planned in the area where safety would be secured through land development. Therefore arrangement and development of housing in those dangerous areas should be limited.

Also it is required to preserve the mountains slope area and land along the rivers as protected green zones areas.

(4) Innovation of ring cluster roads network

The main transportation network of Bujumbura city at present is constituted by the national highways radiantly extended from the city central area, and a beltway which surround the central part. For this reason, all traffic accessed from outside of city, concentrate in the limited area of the central part, thus causing heavy traffic congestion. Moreover, the trunk roads serve both district as well as regional traffic services. So there occur serious safety problem when normal vehicular traffic, pedestrian, and bus services become complicated.

In order to avoid this situation, a ring cluster roads network is imposed into the future city development plan so that the traffic congestion in the trunk roads and district roads at the central area would be moderated. In addition to the existing beltway enclosing the central city area, ring roads enclosing the northern city area, the southern city area, and the proposed new southern area will form the transportation network of the whole Bujumbura city.

The land use plan will be designed according to these new transportation structures of ring roads.

(5) Formation of subcenters

In order to control the functional concentration in a central district and to urge for equilibrium development of the whole city, a part of business and commercial function will be distributed into the newly planned subcenters. These subcenters are planned to be located in the northern and southern parts in connection with the above policy.

At present, Musaga area, where some of the government functions have already been relocated, is positioned as a subcenter in the northern area. The area is required to promote redevelopment of its surrounding area in the long term plan to attract more business and commercial functions in this area.

A subcenter on the south is to be introduced in Kanyosha area in accordance with its newly improved urban development. It is required to improve the environment in the old areas to secure new residents' working opportunity as well as to increase the attraction in the newly developed areas.

(6) Improvement and setting up infrastructure facilities

Corresponding to the city area expansion in southern part, required infrastructure facilities

should be prepared and required land lots be reserved beforehand.

In the existing city area, the improvement of the service level by expansion of the facilities is necessary. About water supply and sewage network, the long-term service range needs to be expanded. In the short term, the improvement on the health situation of the whole city area by expansion of water service and introduction of summary sanitation facility system are recommended.

(7) Development of agriculture in suburban areas

The paddy fields with the provision of the irrigation equipments are located in Buterere area in the northern part. These agricultural land and the existing colonies here should be preserved as much as possible. Environmental improvement in this area through limiting development works in the circumference areas of the colonies, and without use of any agricultural land is recommended.

(8) Preservation of natural environment

The following areas have been identified as lots which should be controlled for residential use; instead it should be reserved for tree planting. As a result, the unplanned residence in dangerous area can be controlled, and so the safety of residence is secured.

- Sloping lands with 1/3 or more slope

- River slope and a dry riverbed (50~100m in width)

Moreover, among newly developed areas, a land strip less than or equal to 200m from coasts of Lac du Tanganika is to be selected as the recreational green land, and recommended to be the place for public-use in principal.

A green network will be formed in the whole city area through the above-mentioned two development policies.

7-3-2 Distribution of Urban Functions

The urban-function arrangement in future development of Bujumbura city is planned as shown in figure 7.3.1.

(1) Residential area

Supply of small and middle-scale housing plots and apartment type buildings after development of new city areas are planned for inflow population. Arrangement of residences through public rental housing is also planned.

For an overcrowded area of the existing city, population influx should be controlled and plan for urban redevelopment and land readjustment projects are suggested. Renovation of buildings, environmental improvement in the area, and advanced use of land should be promoted.

(2) Commercial, business area

Advanced use of the land of the central city area should be promoted.

For functional distribution into the whole city, subcenter formation in the north and south areas are recommended.

(3) Industrial area

In accordance with the proposed new city development strategy, industrial plots should be kept reserved beforehand, and promotion of new industrial facilities is necessary.

Improvement of districts' environment should be accelerated by setting up of mixed-use area and integration of cottage industrial facilities.

(4) Public service

It is also necessary to reserve, on a suitable scale, some lots in advance for installation of new public facilities in accordance with the demand of a new city area.

As for existing city areas, improvement and upgrading of the existing facilities are recommended in accordance with the progress of district's redevelopment projects.

(5) Farm land

Aiming at the symbiosis of a city and a farm village, the master plan advances a policy for environmental improvement of an area through preserving the farmlands in suburbs as much as possible.

(6) Green area

The green lands along the rivers and the lakefront and green-tract-of-land preservation on mountain slope are advised. By these options, city safety as well as provision of green land network would be secured.

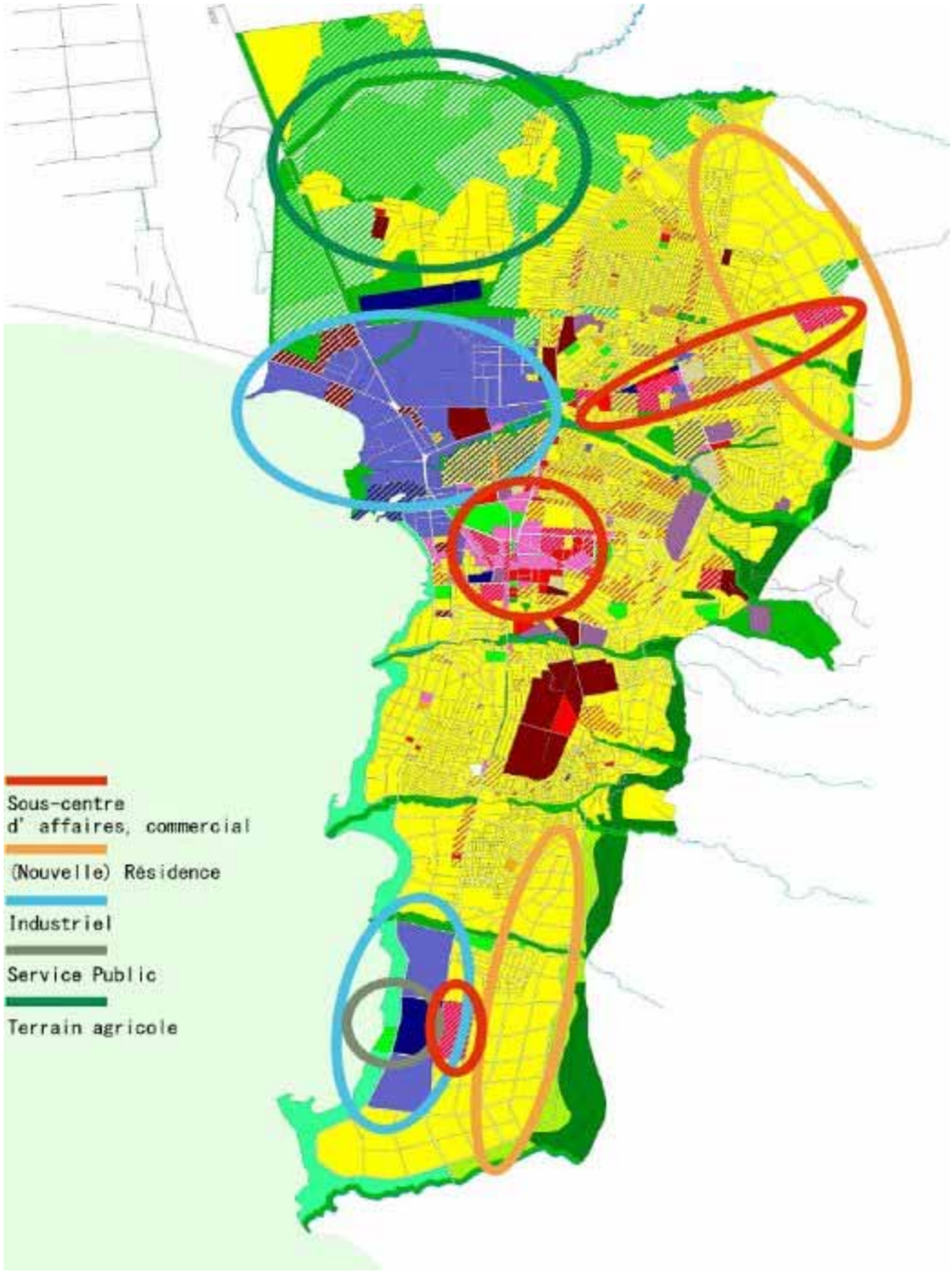


Figure7.3.1 Urban-function arrangement in future development of Bujumbura City

7-3-3 Future Land Use Demand Projection

(1) Examination procedure

Planning process of urban master plan and a set-up of land use capacity are performed according to the procedure shown in Figure7.3.2.

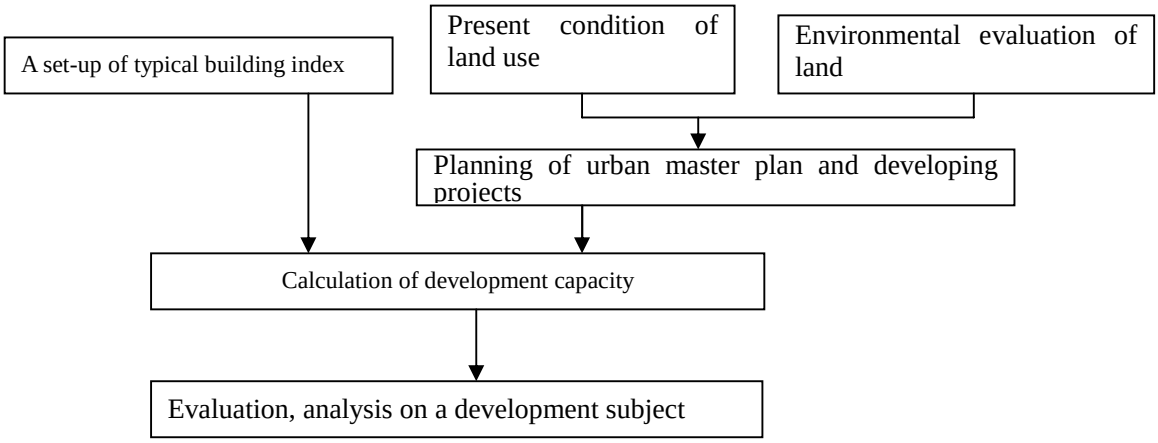


Figure 7.3.2 Evaluation Process on Future Land Use Projection

(2) A set-up of typical building index

1) Residential building

The assumed three scale type of the standard residence is shown in table 7.3.1 for the future residential development.

Most constructed houses which exist in Bujumbura city are bungalows (one-story houses). The building coverage ratio in the densely-populated communes is over 50%. The building coverage ratio in the residential zone in the other commune which also has many residential sections is about 10 to 20% of low development density.

Table 7.3.1 Typical Residence type for Future development

Housing type	Building coverage ratio (%)	Typical number of stories	Floor surface ratio (%)
Low density	40	1 or 2 floors	80 (maximum)
Middle density	60	1 or 2 floors	120 (maximum)
Upper density	60	3 or 4 floors	200 (maximum)

2) Mix use building

It is assumed that the compound use residential building that has small-scale store, the

restaurant, or cottage industrial studio will be remodelled to multilayer building in the future.

The building floor surface corresponding to each use is as shown in table 7.3.2.

Table 7.3.2 Assumed mix use building type for future development

Land use category	Building coverage ratio (%)	Typical number of stories	Floor surface ratio (%)	Composition of floor area use
Mix Use (Residence/ Commercial)	70 maximum	2 floors	140 (maximum)	1 floor for residence (70%) 1 floor for Commercial (70%)
Mix Use (Residence/ Industry)	70 maximum	2 floors	140 (maximum)	1 floor for residence (70%) 1 floor for industry (70%)

3) Commercial building

The following building scale is assumed for the building of commercial use and business function.

Table 7.3.3 Assumed commercial / business use building type for future development

Land use category	Building coverage ratio (%)	Typical number of stories	Floor surface ratio (%)
Commercial/ Business	80	3 or 4 floors	400 (maximum)
Mix Use (Commercial/ Institutional)	75 to 80	3 or 4 floors	400 (maximum)
District Center	100	1 or 2 floors	200 (maximum)

(2) Evaluation on future plan, developing index

1) Future urban developing plan

The proposed future urban development master plan is shown in Figure 7.3.2, and the corresponding areas based on the plan are shown in Table 7.3.3, and the details are shown in Table 7.3.4.

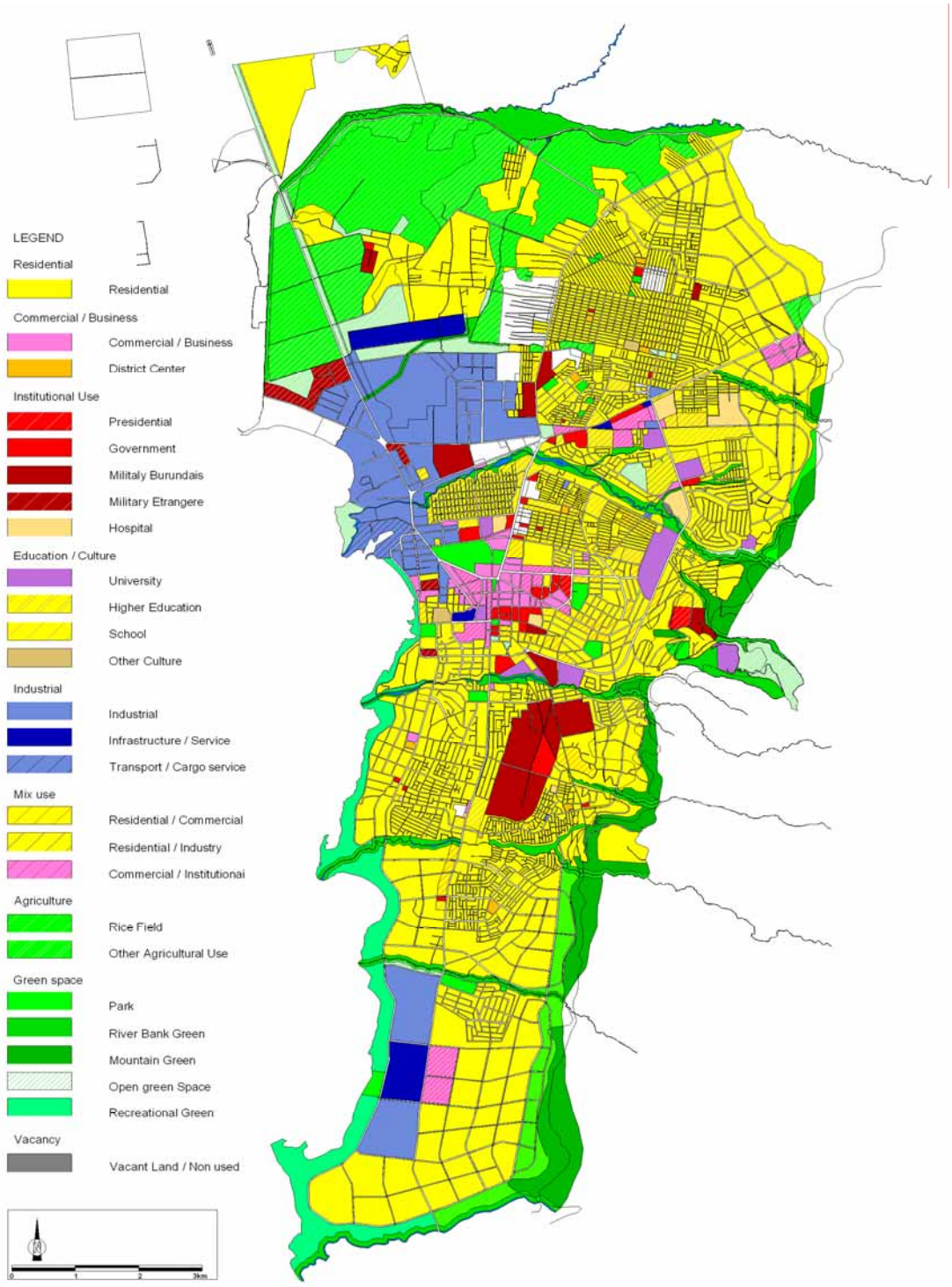


Figure7.3.3 Proposed Urban Development Master Plan

Table 7.3.4 Land use of Bujumbura city (future city master plan)

Land use Category	Surface (ha)	Ratio (%)	Land use Category	Surface (ha)	Ratio (%)
1. Residence	**4,734.0**	**43.1**	**6. Mix Use**	**409.9**	**3.7**
1.1 Residential *	4,425.5	40.3	6.1 Residential / Commercial	181.6	1.7
1.2 Higher Education *	80.1	0.7	6.2 Residential / Industry	91.7	0.8
1.3 School *	159.6	1.5	6.3 Commercial / Institutional	136.6	1.2
1.4 Culture *	10.7	0.1	**7. Agriculture**	**1,339.2**	**12.2**
1.5 Hospital *	58.1	0.6	7.1 Rice Field	894.1	8.1
2. Commercial/ Business	**113.8**	**1.0**	7.2 Other Agricultural Use	445.1	4.1
2.1 Commercial/ Business	98.2	0.9	**8. Green Space**	**1,620.8**	**14.8**
2.2 District Center	15.6	0.1	8.1 Park	112.2	1.0
3. Institutional Use	**413.9**	**3.8**	8.2 River Bank Green	509.4	4.6
3.1 Presidential	15.8	0.1	8.3 Mountain Green	381.1	3.5
3.2 Government	87.7	0.8	8.4 Open Green Space	277.1	2.5
3.3 Burundi Military	243.8	2.2	8.5 Recreational Green	341.0	3.1
3.4 Foreign Military	66.6	0.6	**9. Others**	**172.6**	**1.6**
4. Education / Culture	**108.5**	**1.0**	9.1 Vacant Land	0.0	0.0
4.1 University	108.5	1.0	9.2 Others	3.2	0.0
5. Industrial	**969.6**	**8.8**	9.3 reserve for future development	169.4	1.5
5.1 Industrial	805.9	7.3	River / water surface	60.5	0.55
5.2 Infrastructure / Service	124.5	1.1	Road	1,102.4	10.0
5.3 Transport / Cargo service	39.2	0.4	**Total**	**10,984.6**	**100.00**

* The area of the existing institution is filled in as that of the public facility in the residential area. As for the area of the institution installed by future development, its area will correspond with part '1.1 residential' in Residence land use category. .

2) Residential

a) Outline of planning

In the future residential areas plan of Bujumbura city; the following principles are set up according to the current land use situation.

- Inflow population must be controlled on the already overcrowded areas. The improvement of the area's land use is already been attained promoting the environmental management by district development authorities.

- More complex use is considered about the low layer residential areas located in the city central part, according the demand of other land use such as for commerce and business. Construction of apartment houses etc. and realization of more developed land use plans

are recommended.

- The population of about 140,000 persons is targeted to be supplied with housing in the future development area. For a planned population density of 150 persons/ha on average, the new development area of about 1,000ha is required for it.

b) Evaluation

The public service facilities are required to be incorporated in the development plan of the land classified as a residential zone in conjunction with the housing construction lots development. In this proposal plan, the future public service lot and park lot are included into the land use classification categorized as 'residential'.

The contents in Table 7.3.5 are assumed to be the development index for a residential section. Moreover, the planed surface area based on the detailed classification of the housing lot by each commune is shown in Table 7.3.6.

Table 7.3.5 Planning index for residential zone in future urbanised area

Urban residential greenery	12 m²/p
Roads and other hard surface	15% of total area
Community facilities	5% of total area

Table 7.3.6 Detailed planning index for residential zone in future urbanised area (based on communes)

Commune	Gross Residential area (including Mix use with residence)	Community facility			Park			Net Residence area	
		Required	Existing or Planed Area	Newly Developing Area	Required	Existing or Planed Area	Newly Developing Area	Residence	Mix use
Buterere	467.0	23.3	0.0	23.3	72.0	147.3	-	443.6	0.0
Kinama	678.5	33.9	9.6	24.4	109.5	6.2	103.3	544.0	6.9
Kamenge	208.2	10.4	1.7	8.8	50.5	3.2	47.3	134.3	17.8
Cibitoke	179.4	9.0	4.3	4.7	84.3	0.0	(84.3)	168.7	6.1
Ngagara	134.0	6.7	35.5	-	30.2	57.0	-	130.6	3.4
Buyenzi	71.5	3.6	21.6	-	56.9	0.2	(56.7)	0.0	71.5
Gihosha	494.0	24.7	130.6	-	91.9	33.4	58.5	405.6	29.9
Bwiza	87.7	4.4	12.3	-	45.3	0.0	(45.3)	72.3	15.4
Nyakabiga	58.4	2.9	29.5	-	29.2	0.0	(29.2)	36.7	21.7
Rohero	488.0	24.4	29.4	-	23.8	149.8	-	417.3	70.7
Kinindo	407.9	20.4	14.4	6.0	37.5	67.9	-	401.9	0.0
Musaga	322.1	16.1	17.5	-	118.8	0.2	(118.6)	304.1	18.0
Kanyosha	1102.1	55.1	2.2	52.9	133.5	265.1	-	1037.3	11.9

Notes: The number in a parenthesis means that there is difficulties in reserving lots which means other development procedure will be required.

i) Housing development capacity

The land use for residential area in every commune is shown in Table 7.3.7. If all communes will introduce multilayer housing construction in the future, housing floor area of about 20 square meters/person will be attained.

In Buyenzi commune where population density is high at present, there exist much mixed land use consisting of cottage industrial workshops. Per capita housing floor area will be about 10 square meters in case in the future all building will made two storey buildings.

The critical subject is how to advance the district strategy on the issue of redevelopment of the above-mentioned multilayer building considering the economic level of each commune.

Table 7.3.7 Planning Index for residential zone in future urbanised area

commune	Housing type (%)			Housing floor in residential area (1,000sqm)	Housing floor in mix use area (1,000sqm)	Housing floor surface total (1,000 sqm)	Floor surface per person. (sqm/pers)
	Low layer	Middle layer	Multilayer				
Buterere	100	0	0	3548	0	3548	59.2
Kinama	100	0	0	4351	48	4400	48.2
Kamenge	100	0	0	1074	124	1199	28.5
Cibitoke	70	20	10	1686	42	1729	24.6
Ngagara	100	0	0	1044	23	1068	42.5
Buyenzi	100	0	0	0	500	500	10.6
Gihosha	100	0	0	3244	209	3453	45.1
Bwiza	70	20	10	723	107	830	22.0
Nyakabiga	70	20	10	367	151	518	21.3
Rohero	100	0	0	3338	495	3833	193.3
Kinindo	100	0	0	3215	0	3215	102.8
Musaga	100	0	0	2432	125	2558	25.9
Kanyosha	100	0	0	8,298	83	8,381	75,4

ii) Public facilities

The site distribution plan of the required public facility area in future development is shown on Table 7.3.7.

In the future main development sites, it is necessary to reserve site for these facilities in advance. According to the proposed master plan, there exist enough sites. However, considering the present condition of public facilities such as school, health institution, etc. in Bujumbura, much of its building and equipments are decrepit and insufficient. When reserving the sites for these facilities, the renewal of equipment and quality enhancement are required, and the resources for the purchase of construction materials will be also a current issue.

iii) Park

Planned area required for each commune is shown in Table 7.3.8 on the assumption that the park lot of 12sqm per capita can be secured.

However, in consideration of the existing city area the achievement of this goal is very difficult. As a result, the following aforementioned contents for this particular circumstance in Bujumbura city have to be taken into consideration, and the further study of the detailed plan will be required.

- In this study, 12sqm per capita was set up as a planning index for park site from the status of the modern big cities in the world. It is thought that the scale of a Bujumbura city is too small compared with these cities, and the city is surrounded by natural environment and farm village environment. So, planning target index number can be set low as compared with other big cities.

- However, it will be required to define the mechanism of establishing the green areas which will be considered as a park in the urban area and its conservation, in order to prevent aggravation of the living environment by superfluous development.

- For communes where many difficulties are prospected for reservation of a park lot in future development, it is a realistic solution to utilize the surrounding dry riverbed, mountain forest area, and the vacant lot to be an area for park and open space.

In communes with high density developed areas (Cibitoke, Buyenzi, Bwiza, Nyakabiga, Musaga) in Bujumbura, the above-mentioned redevelopment and environmental treatment is needed not only for recreational purposes but also from the viewpoint disaster prevention. At first, it is required to secure the existing open space as widely as possible for future open green space and to control illegal development and urbanization. Also further urban redevelopment projects to raise land use efficiency and to produce an open space may be considered.

2) Business, commercial

The following two viewpoints are required for the developments in commercial and business areas in the long run.

- In the business districts of a central city area, the advanced and highly use of land and multiple uses of buildings is required. Redevelopment of urban environment is aimed at in accordance with this.

- The business and commercial sub-center are planned to be in the northern and southern part of the city area. The scale of each sub-center has be set to be about 1/4~1/3 of the existing central city area.

The view of building (institution) capacity, scale, and area distribution is shown in table 7.3.9. The section of area and their estimated population classification by area are indicated in

figure 7.3.3.

Table 7.3.8 Planning Index for business / commercial zone in future urbanised area

Classification of building use	Building floor planning index	Land use plan
Commercial (Neighbourhood Level)	0.30 sqm/p	The community center for every commune and an individual store (services offered by individual shops in mix use area) bear a role.
(District rayon level)	0.30 sqm/p	
(City center)	0.35 sqm/p	According to three geographic divisions, a central district is set up and service is provided.
Business	10 sqm/labour	

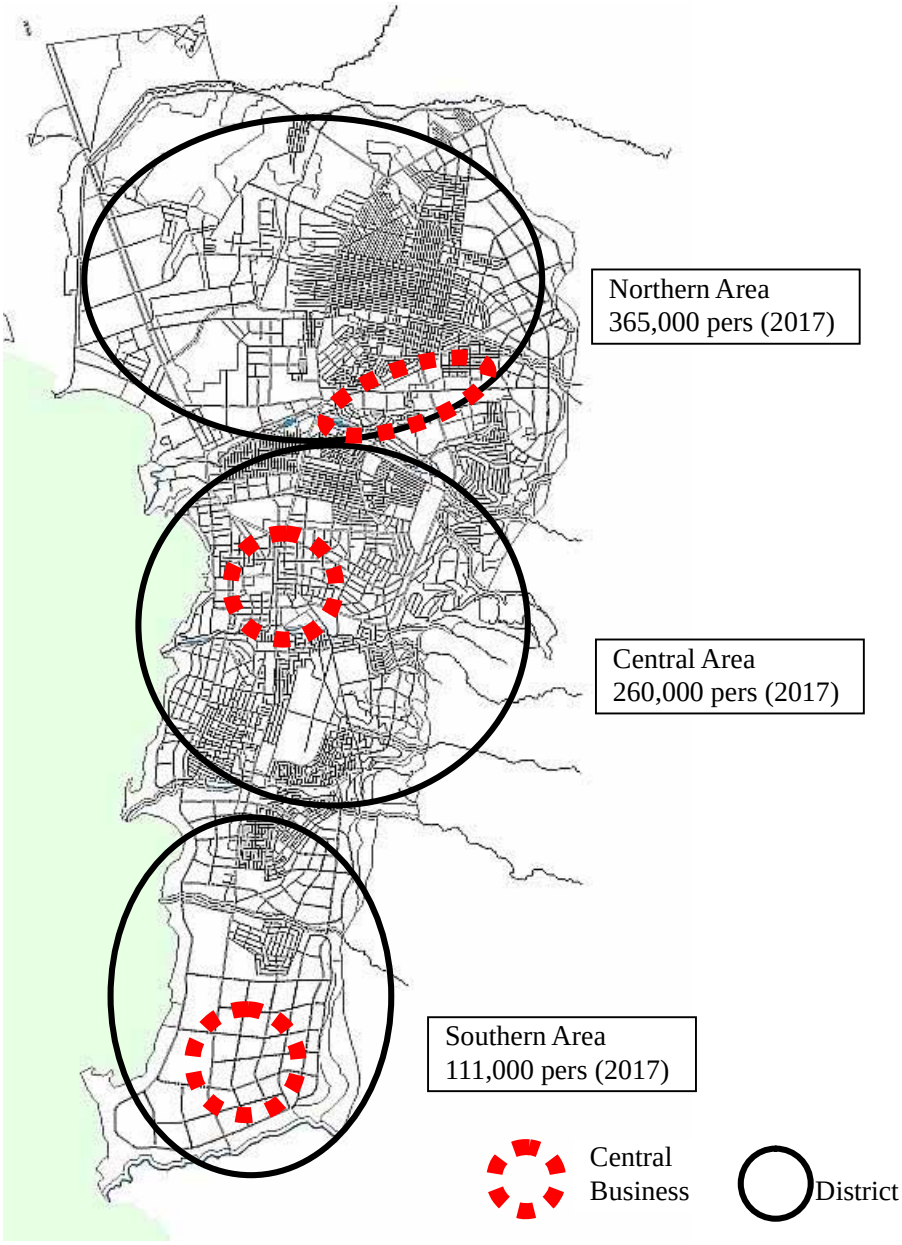


Figure 7.3.4 Zoning for study of Commercial / Business Facilities

The evaluation of the proposed master plan is as follows.

i) Central Business District, Sub Centers

The office demand and commercial establishment demand balance of each district based on 3 geographic divisions of figure 7.3.3 are as shown in table 7.3.9.

Estimated population in future and land use plan are balanced in the entire Bujumbura city.

It is prospected that shortage of lots will not happened at the site of commercial use and an office use if 100% rebuilding of floor area ratio is recommended.

Considering about each area in the subcenters, the functional distribution of the areas accompanying new urban development in Northern and Southern Areas serves as a long-term subject. In this case, the source-of-revenue reservation accompanying site development and institution building is needed. According to the future situation of changes of industrial structure of Burundi, transformation of employment situation and overcrowded circumstance in Rohero area is necessary to enhance the redevelopment of each district gradually.

Table 7.3.9 Prospected building surface business/commercial zone in future urbanised area

Area	Institution floor area demand (1,000sqm)			Lot surface (ha)
	Central commercial establishment	Office	Sum total	
Northern Area	128	2,192	2,320	78.5
Central area	91	156	247	201.7
Southern Area	39	667	706	42.3
Total	258	3,015	3,273	322.5

ii) District Commercial Facilities

Regarding the commercial service facilities of Neighbourhood level and District rayon level, the supply capacity of service is sufficient in accordance with the present land use. However, the present small-scale commercial establishment is pre-modern style, and its land use efficiency is also very low.

In the future, as for the increase in efficiency of land use, the land use conversion demand to other industries will be highly recommended by changing the high relaxation and employment structure. In the existing highly densely-populated area, the improvement of building will have to be advanced in accordance with the district improvement and urban redevelopment.

3) Industrial

In the master plan of 1982, for a planed population of 707,000, the industrial lot of 700ha was required in the whole Bujumbura city. For that purpose, it was said that, in addition to the present site of Cartier Industrielle, the site of about 200~300ha would be needed. Out of these, half of the required lots will be arranged in the southern part area as industrial lots for new industries.

About the demand of the remaining industrial installation, it was assumed that industrial installations of the cottage industry type would mainly be updated gradually. Redevelopment

of the mixed type used lots of the old city area and developments in neighbourhood areas of Bujumbura city are considered in the long run, uniting with the degree of conversion of industrial structure.

The balance of industrial lots is shown in Table 7.3.10. On the proposed plan, the increase of industrial lot per capita to about 20% was aimed to correspond with the situation of the future increased population.

Table 7.3.10 Planning Index for industrial zone in future urbanised area

	Industrial lot (ha)	Population	Industrial lot area per capita	Corresponding labor force *
Present condition	506	548,000	9.2 sqm / pers	25,300
Forward planning	805	736,000	10.9 sqm / pers	40,250

* : these numbers are assumed based on the working population for industrial lot of 1ha per 50 persons.

4) Infrastructure facilities

Corresponding to the future increase in population, installation of the infrastructure facilities in southern Bujumbura city will be needed. Among these, it is required to reserve beforehand the lots for transformer substation and sewage treatment plant for which the big scale lots are required.

5) Others

In the south of Kanyosha, 169.4ha was planned as a future development lot. However in the long run, in case of redevelopment project in the existing city area, the use of compensation when changing the purpose of any structure/facility etc. have to be assumed.

Table 7.3.11 Future land use in Bujumbura (detail, 2017)

	Residential		Commercial/Business			Institutional						Education				Industrial			
	Residential	Total	Commercial/Business	District Center	Total	Presidential	Government	Military Burundais	Military Etrangere	Hospital	Total	University	Higher Education	School	Other Culture	Total	Industrial	Infrastructure / Seevice	Transport / Cargo service	Total
01 Buterere	467.0	467.0	0.0	0.0	0.0	0.0	1.7	7.6	54.2	0.0	63.5	0.0	0.0	0.0	0.0	0.0	110.8	57.7	0.0	168.5
	22.7%	22.7%	0.0%	0.0%	0.0%	0.0%	0.1%	0.4%	2.6%	0.0%	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	5.4%	2.8%	0.0%	8.2%
02 Kinama	671.6	671.6	0.0	2.2	2.2	0.0	1.9	2.5	0.0	0.0	4.4	0.0	0.0	9.6	0.0	9.6	0.0	0.0	0.0	0.0
	60.3%	60.3%	0.0%	0.2%	0.2%	0.0%	0.2%	0.2%	0.0%	0.0%	0.4%	0.0%	0.0%	0.9%	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%
03 Kamenge	190.4	190.4	0.0	1.4	1.4	0.0	0.6	0.0	0.0	0.0	0.6	0.0	0.0	1.7	0.0	1.7	3.2	0.0	0.0	3.2
	72.9%	72.9%	0.0%	0.6%	0.6%	0.0%	0.2%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.6%	0.0%	0.6%	1.2%	0.0%	0.0%	1.2%
04 Cibitoke	173.4	173.4	0.0	1.0	1.0	0.0	0.5	0.0	0.0	0.0	0.5	0.0	0.0	0.6	3.7	4.3	0.0	0.0	0.0	0.0
	64.6%	64.6%	0.0%	0.4%	0.4%	0.0%	0.2%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.2%	1.4%	1.6%	0.0%	0.0%	0.0%	0.0%
05 Ngagara	130.6	130.6	2.3	1.8	4.1	0.0	0.2	50.8	5.3	0.0	56.3	0.0	26.8	8.7	0.0	35.5	452.1	0.0	0.0	452.1
	14.9%	14.9%	0.3%	0.2%	0.5%	0.0%	0.0%	5.8%	0.6%	0.0%	6.4%	0.0%	3.0%	1.0%	0.0%	4.0%	51.4%	0.0%	0.0%	51.4%
06 Buyenzi	0.0	0.0	0.0	1.8	1.8	0.0	9.4	0.0	0.0	5.5	14.9	6.3	7.8	8.3	0.0	22.4	51.7	0.0	37.7	89.4
	0.0%	0.0%	0.0%	0.7%	0.7%	0.0%	3.9%	0.0%	0.0%	2.3%	6.1%	2.6%	3.2%	3.4%	0.0%	9.2%	21.2%	0.0%	15.5%	36.7%
07 Gihosha	464.1	464.1	6.5	0.0	6.5	0.0	17.0	0.0	0.0	46.5	63.5	25.5	32.7	51.4	0.0	109.6	2.5	3.7	0.0	6.1
	47.7%	47.7%	0.7%	0.0%	0.7%	0.0%	1.7%	0.0%	0.0%	4.8%	6.5%	2.6%	3.4%	5.3%	0.0%	11.3%	0.3%	0.4%	0.0%	0.6%
08 Bwiza	72.3	72.3	5.2	1.3	6.5	0.0	4.9	0.0	0.0	0.0	4.9	0.0	0.0	12.3	0.0	12.3	1.1	0.0	0.0	1.1
	49.0%	49.0%	3.5%	0.9%	4.4%	0.0%	3.3%	0.0%	0.0%	0.0%	3.3%	0.0%	0.0%	8.3%	0.0%	8.3%	0.8%	0.0%	0.0%	0.8%
09 Nyakabiga	36.7	36.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	21.7	0.0	29.5	0.0	0.0	1.0	1.0
	31.1%	31.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.6%	18.4%	0.0%	25.0%	0.0%	0.0%	0.9%	0.9%
10 Rohero	417.3	417.3	80.1	0.0	80.1	15.8	32.5	27.0	7.1	4.0	86.4	76.7	3.2	15.7	6.5	102.1	31.9	5.7	0.0	37.5
	32.2%	32.2%	6.2%	0.0%	6.2%	1.2%	2.5%	2.1%	0.5%	0.3%	6.7%	5.9%	0.2%	1.2%	0.5%	7.9%	2.5%	0.4%	0.0%	2.9%
11 Kinindo	407.9	407.9	4.1	1.8	5.9	0.0	1.3	17.0	0.0	0.9	19.2	0.0	1.3	12.2	0.0	13.5	0.0	0.0	0.0	0.0
	64.4%	64.4%	0.6%	0.3%	0.9%	0.0%	0.2%	2.7%	0.0%	0.1%	3.0%	0.0%	0.2%	1.9%	0.0%	2.1%	0.0%	0.0%	0.0%	0.0%
12 Musaga	304.1	304.1	0.0	1.4	1.4	0.0	16.7	138.8	0.0	1.2	156.7	0.0	0.7	15.2	0.5	16.4	0.0	0.0	0.5	0.5
	43.0%	43.0%	0.0%	0.2%	0.2%	0.0%	2.4%	19.6%	0.0%	0.2%	22.1%	0.0%	0.1%	2.1%	0.1%	2.3%	0.0%	0.0%	0.1%	0.1%
13 Kanyosha	1,090.2	1,090.2	0.0	2.9	2.9	0.0	1.1	0.0	0.0	0.0	1.1	0.0	0.0	2.2	0.0	2.2	152.7	57.5	0.0	210.2
	47.7%	47.7%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	6.7%	2.5%	0.0%	9.2%
Total	4,425.5	4,425.5	98.2	15.6	113.8	15.8	87.7	243.8	66.6	58.1	472.0	108.5	80.1	159.6	10.7	358.8	805.9	124.5	39.2	969.6
	40.3%	40.3%	0.9%	0.1%	1.0%	0.1%	0.8%	2.2%	0.6%	0.5%	4.3%	1.0%	0.7%	1.5%	0.1%	3.3%	7.3%	1.1%	0.4%	8.8%

Table 7.3.12 Future land use in Bujumbura (detail, 2017)

	Mixed use				Agriculture			Green							Vacant				River	Road	Total
	Residential / Commercial	Residential / Industry	Commercial / institutional	Total	Rice Field	Other Agricultural	Total	Park	River Bank Green	Mountain Green	Open Green Space	Recreational Green	Total	Vacant / non use	Reserve for Future Development	Others	Total				
01 Buterere	0.0	0.0	0.0	0.0	663.3	352.8	1,016.1	0.0	118.2	0.0	147.3	0.0	265.5	0.0	0.0	0.0	0.0	7.8	77.9	2,058.3
	0.0%	0.0%	0.0%	0.0%	32.2%	17.1%	49.4%	0.0%	5.7%	0.0%	7.2%	0.0%	12.9%	0.0%	0.0%	0.0%	0.0%	0.4%	3.8%	100.0%
02 Kinama	6.9	0.0	0.0	6.9	229.9	30.6	260.5	3.8	41.5	0.0	2.4	0.0	47.7	0.0	0.0	0.0	0.0	4.2	110.1	1,113.1
	0.6%	0.0%	0.0%	0.6%	20.7%	2.7%	23.4%	0.3%	3.7%	0.0%	0.2%	0.0%	4.3%	0.0%	0.0%	0.0%	0.0%	0.4%	9.9%	100.0%
03 Kamenge	17.8	0.0	0.0	17.8	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	3.2	0.0	0.0	0.0	0.0	0.6	43.1	261.3
	6.8%	0.0%	0.0%	6.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	0.2%	16.5%	100.0%
04 Cibitoke	6.1	0.0	0.0	6.1	0.9	35.5	36.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	47.0	268.5
	2.3%	0.0%	0.0%	2.3%	0.3%	13.2%	13.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	17.5%	100.0%
05 Ngagara	3.4	0.0	4.1	7.5	0.0	26.3	26.3	9.2	17.6	0.0	47.8	0.0	74.7	0.0	0.0	0.0	0.0	6.1	91.9	879.0
	0.4%	0.0%	0.5%	0.9%	0.0%	3.0%	3.0%	1.1%	2.0%	0.0%	5.4%	0.0%	8.5%	0.0%	0.0%	0.0%	0.0%	0.7%	10.5%	100.0%
06 Buyenzi	3.2	68.3	0.0	71.5	0.0	0.0	0.0	0.0	6.3	0.0	0.2	0.0	6.4	0.0	0.0	0.0	0.0	4.3	37.5	243.8
	1.3%	28.0%	0.0%	29.3%	0.0%	0.0%	0.0%	0.0%	2.6%	0.0%	0.1%	0.0%	2.6%	0.0%	0.0%	0.0%	0.0%	1.8%	15.4%	100.0%
07 Gihosha	6.5	23.4	44.2	74.0	0.0	0.0	0.0	16.8	70.3	34.9	16.6	0.0	138.5	0.0	0.0	0.0	0.0	7.3	109.8	972.1
	0.7%	2.4%	4.5%	7.6%	0.0%	0.0%	0.0%	1.7%	7.2%	3.6%	1.7%	0.0%	14.2%	0.0%	0.0%	0.0%	0.0%	0.8%	11.3%	100.0%
08 Bwiza	15.4	0.0	0.0	15.4	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	2.0	28.2	147.7
	10.4%	0.0%	0.0%	10.4%	0.0%	0.0%	0.0%	0.0%	4.7%	0.0%	0.0%	0.0%	4.7%	0.0%	0.0%	0.0%	0.0%	1.4%	19.1%	100.0%
09 Nyakabiga	21.7	0.0	0.0	21.7	0.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	2.0	17.7	118.1
	18.4%	0.0%	0.0%	18.4%	0.0%	0.0%	0.0%	0.0%	9.7%	0.0%	0.0%	0.0%	9.7%	0.0%	0.0%	0.0%	0.0%	1.7%	15.0%	100.0%
10 Rohero	70.7	0.0	47.1	117.9	0.0	0.0	0.0	67.2	64.6	53.0	54.1	28.6	267.5	0.0	0.0	0.0	0.0	6.6	185.5	1,294.2
	5.5%	0.0%	3.6%	9.1%	0.0%	0.0%	0.0%	5.2%	5.0%	4.1%	4.2%	2.2%	20.7%	0.0%	0.0%	0.0%	0.0%	0.5%	14.3%	100.0%
11 Kinindo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	26.7	0.0	1.5	61.3	94.6	0.0	0.0	3.2	3.2	5.2	89.3	633.4
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	4.2%	0.0%	0.2%	9.7%	14.9%	0.0%	0.0%	0.5%	0.5%	0.8%	14.1%	100.0%
12 Musaga	18.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0	56.6	93.0	0.2	0.0	149.8	0.0	0.0	0.0	0.0	3.9	60.7	707.6
	2.5%	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%	0.0%	8.0%	13.1%	0.0%	0.0%	21.2%	0.0%	0.0%	0.0%	0.0%	0.6%	8.6%	100.0%
13 Kanyosha	11.9	0.0	41.2	53.2	0.0	0.0	0.0	10.1	89.2	200.2	3.9	251.1	554.5	0.0	169.4	0.0	169.4	9.5	203.9	2,287.5
	0.5%	0.0%	1.8%	2.3%	0.0%	0.0%	0.0%	0.4%	3.9%	8.8%	0.2%	11.0%	24.2%	0.0%	7.4%	0.0%	7.4%	0.4%	8.9%	100.0%
Total	181.6	91.7	136.6	409.9	894.1	445.1	1,339.2	112.2	509.4	381.1	277.1	341.0	1,620.8	0.0	169.4	3.2	172.6	60.5	1,102.4	10,984.6
	1.7%	0.8%	1.2%	3.7%	8.1%	4.1%	12.2%	1.0%	4.6%	3.5%	2.5%	3.1%	14.8%	0.0%	1.5%	0.0%	1.6%	0.6%	10.0%	100.0%

7-4 FUTURE TRAFFIC DEMAND FORECAST AND ANALYSIS

7-4-1 General

(1) Zoning

In Bujumbura city the traffic zones are divided into 21 zones, which are: 8 zones in 8 Communes, 3 zones in the CBD (Rohero), 2 zones in each of the following areas Ngagara, Kinindo, Musaga and Kanyosha , and two special zones representing the Port and the Airport. Areas outside of the city area have been divided into 6 zones, namely one zone in each of the 6 National Road directions. Therefore, total number of zone is become 27.

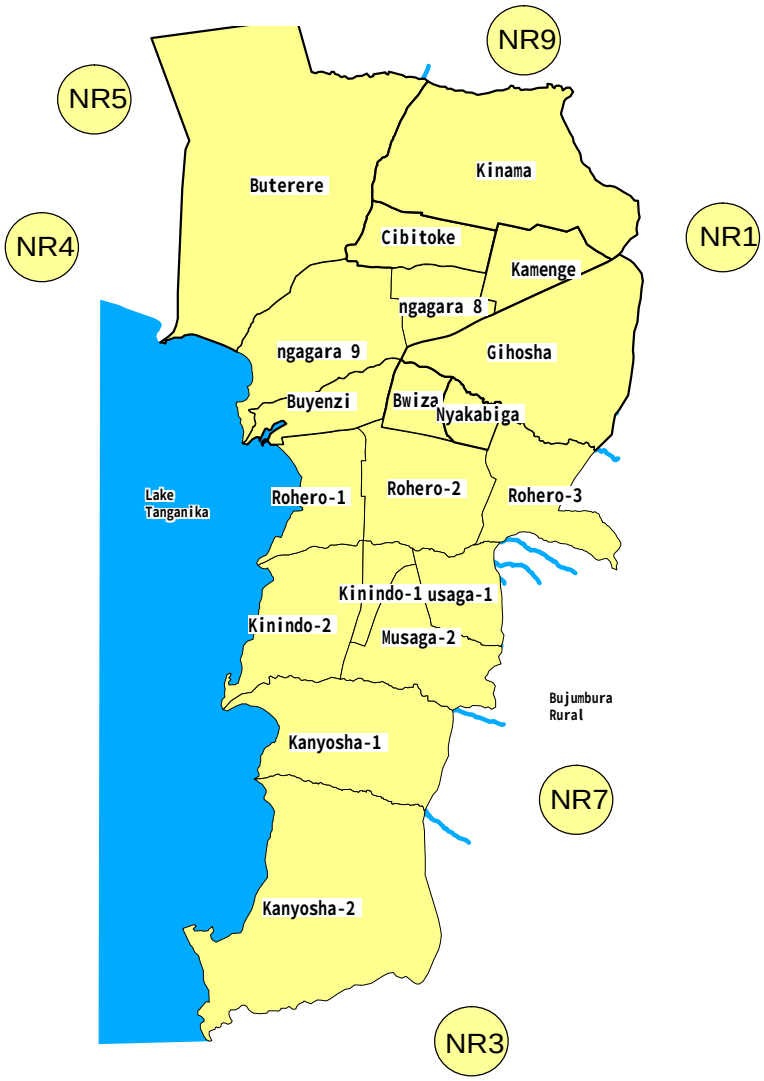


Figure 7.4.1 Zoning

(2) Definition of Car Trip

In order to evaluate the cost performance of the urban road network improvement project, and as the intention of the study is to forecast the urban road transport demand, the study will focus on vehicle trips. The study will also focus on inter-zone traffic movement except Rohero zone. Therefore, the road transport demand, which will be forecasted in the study, will not basically include the inter-zone traffic movement, but intra-zone traffic in Rohero (the city center) will be taken into consideration because there are much intra-zone traffic movement in this zone.

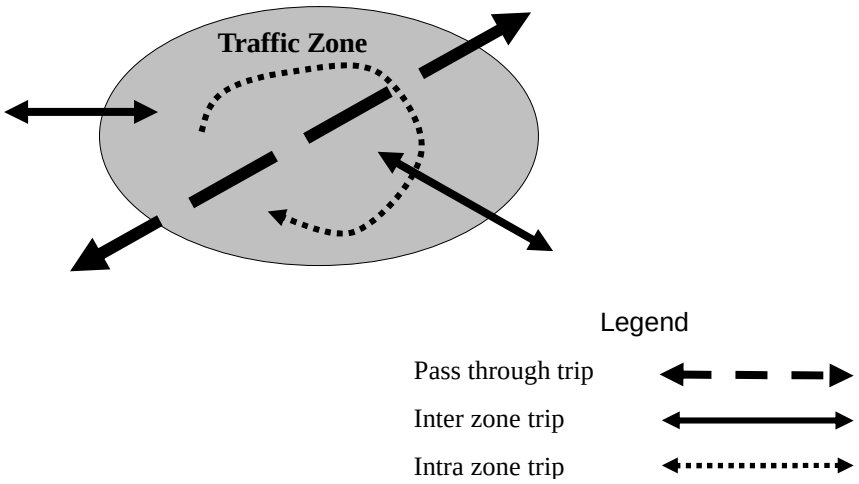


Figure 7.4.2 Kinds of Car Trips

7-4-2 Overview of Existing Transport Condition

(1) Total Number of Vehicles Running in Burundi

To use a newly imported vehicle, the user obtains a number plate issued by the Ministry of Finance and the number plate remains effective until the vehicle is disposed. The number of vehicles running in the country can be estimated from the annual record of number plate issued.

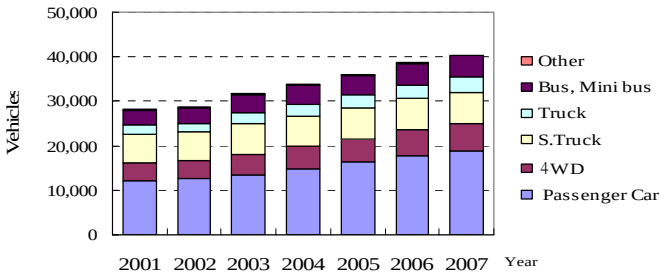


Figure 7.4.3 Trend of Vehicle Ownerships in Burundi

A linear regression analysis gives the following relation

$$V = a \times GDP + b$$

Where, V : Vehicle Ownership
GDP : Gross Domestic Products

Table 7.4.1 shows the relationship between vehicle ownership and GDP for the period from year 2001 to 2007 in Burundi.

Table 7.4.1 Relationships between Number of Vehicles and GDP

	Correlation coefficie	Slope	Intercept
Car	0.999	14.02	4,379
4WD	*0.979*	4.39	1,684
S.Truck	0.897	1.64	5,525
Truck	0.981	2.47	745
Bus, Mini bus	0.953	3.17	1,778
Other	0.645	0.06	193
Total	0.993	25.68	14,305

The correlation factor of the types of vehicles, i.e. Car, 4WD, Bus, Truck, is 0.97 on average which is very high. Again the correlation factor of the total number of vehicles is 0.993; these two factors are highly related.

The predicted future growth rates of GDP adopted by IMF and other donors are within 6.6% to 10.0% in Burundi. The JICA study team estimates 8.0% GRDP growth rate of Bujumbura city area. Based on this growth rate of GRDP, the number of cars and buses in the year 2017 will be 2.0 times of those in the year 2007, and the total number of vehicles will be 1.7 times of those in 2007.

(2) Transportation Facilities in Bujumbura City

a) Port

Bujumbura Port, on the bank of Lake Tanganyika, located in the north-west of the city, is being used by the coasting lines dealing with the trade cargo to and from Congo, Tanzania, Zambia, etc. There is no passenger's transportation mode (ie. by ships) at present.

The wharf of the port is 4.5m deep and mainly used for barges or 1,500 tonnage class ships. In addition to the Bujumbura port, there is also a land port which is the gateway of the foreign trade, and handles almost 90% of the cargo coming in and out of Burundi.

Figure 7.4.4 shows the trading cargo volumes of Bujumbura through Lake and Land Port

(Bujumbura Port) by year.

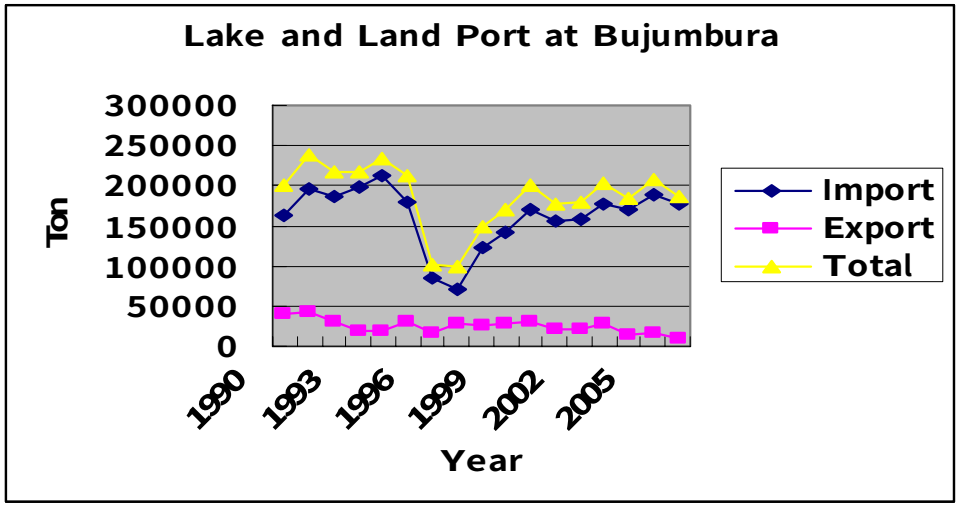


Figure 7.4.4 Volumes of Export and Import Goods at Bujumbura Port

Table 7.4.2 shows present and future traffic volumes per day using the port. The future traffic volumes were estimated by past trend data.

Table 7.4.2 Using Traffic Volumes at the Bujumbura Port per Day

	2007	2017
Cargo Volume	445	667
(Pcu)	1333	2000

Notes: 1 Cargo = 3 pcu (Passenger Car Unit)

b) Airport

The airport is located in the north of the city in-between NR-4 and NR-5; the airport is accessed mainly by using NR-5. At present, four (4) international flights are being operated every day to and from Kenya, Rwanda, etc. Annual trips, number of passengers and delivered air cargos are summarized in Table 7.4.3. The number of passengers is increasing rapidly these years.

Table 7.4.3 Using Traffic Volumes at Bujumbura Airport per Year

Year	Operation (Times)	Passenger (Parsons)	Cargo (Ton)
2002	2851	59293	2560
2003	2931	61040	2292
2004	3280	75321	3303
2005	3051	88469	3333
2006	3156	101402	2832
Growth Rate (%)	3	15	3

Table 7.4.4 shows present and future traffic volumes per day using the airport. The future traffic volumes were estimated by past trend data.

Table 7.4.4 Using Traffic Volumes at Bujumbura Airport per Day

Year	2007	2017
Passenger car	407	778
Employment	500	800
Cargo	40	53
Total Vehicles	947	1631
Pcu	1027	1738

Notes: 1 Cargo = 3 pcu (Passenger Car Unit)

7-4-3 Analyzing Traffic Count Survey and OD Survey

(1) Review of Traffic Count Survey

For each location, traffic specifications such as peak-hour factor, day-night rate and directional flow rate were calculated based on results of traffic counting survey. The day-night rates obtained in 2 (two) locations, where survey were carried out for 24 hours, were adopted in the other locations, where survey were carried out for 12 hours, in accordance with the road classification and road side classification set up in advance. The specification of each road shall be used when formulating the road capacity.

Table 7.4.5 Traffic Specifications by Road

Point No.	Road Classification	Road side classification	Traffic Volume			24hours / 12hours	24hours Peak ratio (%)	D Value
			Peak hour (vehicles)	12 hours (vehicles)	24 hours (vehicles)			
1	Primary Arterial	Suburb	175	1,659	1,724	1.04	10.2	-
2	Primary Arterial	Suburb	313	2,153	2,237	1.04	14.0	-
3	Primary Arterial	Suburb	75	788	819	1.04	9.2	-
4	Primary Arterial	Suburb	320	2,584	2,685	1.04	11.9	-
5	Primary Arterial	Urban	394	3,691	3,835	1.04	10.3	-
6	Arterial	Urban	144	1,015	1,055	1.04	13.7	-
7	Arterial	Urban	303	2,584	2,685	1.04	11.3	-
8	Primary Arterial	Suburb	153	1,266	1,315	1.04	11.6	58
9	Primary Arterial	Urban	1,501	11,843	12,304	1.04	12.2	69
10	Primary Arterial	Urban	1,943	16,851	17,507	1.04	11.1	65
11	Primary Arterial	Urban	555	5,677	5,898	1.04	9.4	57
12	Primary Arterial	Urban	2,075	12,592	13,082	1.04	15.9	74
13	Arterial	Center	2,602	24,921	36,519	1.47	7.1	65
14	Arterial	Center	493	3,601	5,277	1.47	9.3	69
15	Primary Arterial	Center	1,190	9,607	14,078	1.47	8.5	56
16	Arterial	Center	1,059	7,770	11,386	1.47	9.3	73
17	Primary Arterial	Center	1,259	11,267	16,511	1.47	7.6	61
18	Arterial	Urban	909	5,666	5,887	1.04	15.4	-
19	Primary Arterial	Urban	1,412	10,812	11,233	1.04	12.6	-
20	Primary Arterial	Urban	718	5,003	5,198	1.04	13.8	68
21	Primary Arterial	Urban	312	2,477	2,573	1.04	12.1	-
22	Primary Arterial	Suburb	145	1,025	1,065	1.04	13.6	54

Gray zone: Observed Value, Source: Summary of Traffic Count Survey

(2) Review of OD Survey

The share of access to the central area of/from each community in suburb was calculated based on OD survey carried out on screen line. The shares of the communities like Buterere, Kinama, Cibitoke, Kamenge, Ngagara and Gihosha in north, and Kinindo, Musaga and Kanyosha in the south of Bujumbura city were calculated on the assumption that Rohero, Buyenzi, Bwiza and Nyakabiga belonged to the central area. As a result, it was estimated that the share of traffic volume from the suburb is 80%. This figure shall be used to formulate the OD table.

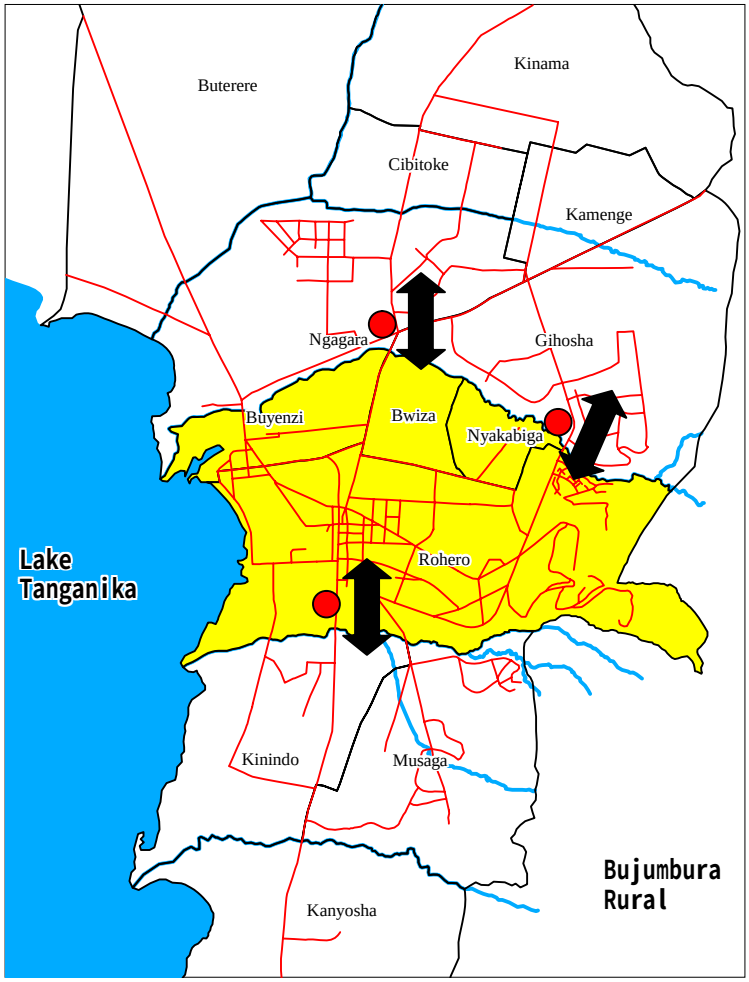


Figure 7.4.5 Target OD Survey Points

Table 7.4.6 Traffic Specification by Area

Items	Northern Communities	Southern Communities
Total Volume	29,368 (Vehicles)	10,896 (Vehicles)
To/from Central Area	23,316 (Vehicles)	8,688 (Vehicles)
Ratio	79%	80%

Source: Summary of OD Survey

7-4-4 Present Vehicle OD Matrix Development

(1) Development Procedure

To develop OD matrix from the road side OD survey, logically inter-zone movements cross the borders should be interviewed at all links. To cover all the zone borders in the study area, total of more than 50 survey stations need to be surveyed. However, the traffic survey was carried out at 4 points as road side interview stations and at 22 points as traffic counting stations, therefore, the traffic movements which will not appear in the survey results shall be covered in some other way. Figure 7.4.6 shows the present OD matrix development process for this study.

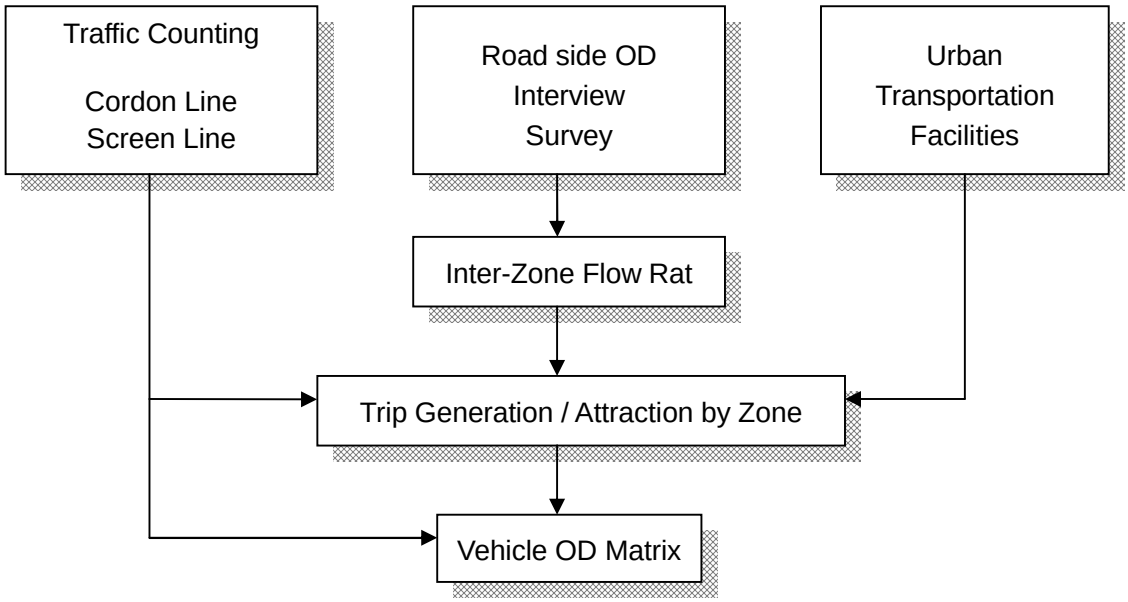


Figure 7.4.6 Present OD Matrix Development Process

(2) Present Generation and Attraction (G/A)

Present G/A volumes by zone were counted basically from the results of the traffic count survey at cordon and screen lines and OD survey at road side. As a result the following assumptions and method have been reached.

- The out zones of Bujumbura city were calculated using the result of cordon line traffic survey.
- Concentration ratio to central business area (CBA) zone from suburb used is 80% based on the result of OD survey at the road side.

- G/A of Gihosha and Ngagara zone was aggregated to one zone at first and G/A volumes of this aggregate zone was estimated at first. Then, each zone volumes were divided in proportion to each population.
- G/A Volumes of Buyenzi, Bwiza, and Nyakabiga zones were adapted for the trip ratio of Musaga and Ngagara zone which are similar in adjoining the CDA, income bracket and zone size.
- G/A volumes of Rohero zone is counted from the result of traffic count survey on screen line and concentration ratio of the G/A of Buyenzi, Bwiza and Nyakabiga zone.
- Division of the community G/A were adapted in direct ratio to the divided area.

Table 7.4.7 Present Generating/Attracting Inter-Zone Trips

Zone	Car	Mini Bus	Bus / Truck	Total Vehicles	Pcu
Buterere	2,460	650	198	3,308	4,352
Kinama	953	558	66	1,577	2,268
Cibitoke	1,694	994	118	2,806	4,036
Kamenge	1,615	1,099	167	2,881	4,314
Ngagara 1	15,847	2,890	859	19,596	24,204
Ngagara 2	6,792	1,238	368	8,398	10,374
Gihosha	11,321	928	22	12,271	13,244
Buyenzi	11,357	154	55	11,566	11,830
Bwiza	12,915	174	63	13,152	13,452
Nyakabiga	8,106	110	39	8,255	8,442
Rohero 1	50,651	9,749	2,250	62,650	76,900
Rohero 2	36,172	6,962	1,607	44,741	54,918
Rohero 3	6,321	1,217	281	7,819	9,596
Kinindo 1	4,342	639	78	5,059	5,854
Kinindo 2	10,131	1,490	182	11,803	13,658
Musaga 1	879	329	45	1,253	1,672
Musaga 2	3,513	1,317	179	5,009	6,684
Kanyosha 1	581	471	0	1,052	1,524
Kanyosha 2	388	314	0	702	1,016
Airport	908	0	40	948	1,028
Port	0	0	445	445	1,334
R4	971	32	447	1,450	2,374
R5	0	0	151	151	454
R9	295	0	152	447	750
R1	413	16	531	960	2,038
R7	255	0	148	403	698
R3	112	0	298	410	1,006
Total	188,992	31,331	8,789	229,112	278,020

Notes: 1 Mini Bus = 2 pcu, 1 Bus / Truck = 3 pcu

(3) Present OD Matrix

In making the present OD matrixes, traffic zones were classified into the following zone: the

commune zone, the airport zone, the port zone and the outside of city zone. For the case of G/A trip distribution ratio in each classified zone, the followings were adopted:

a) Commune and zones outside the city

$$Xij = \frac{(Pi)^{\alpha}}{\Sigma (Pi)^{\alpha}} \times Xj$$

The constant, α, was calculated to fit the result of OD survey at road side and estimated to be 2.1 finally.

b) Air port zone

Present OD matrix was adapted in direct ratio to the volumes of the G/A of each zone.

c) Port zone

Cargo car volume in Port zone assumed that 25% of the total volume is distributed in proportion to G/A volume in each zone, and 75% of the total volume is distributed in direct ratio of G/A volumes in each zone out of Bujumbura.

7-4-5 Future Demand Forecast

(1) Demand Forecast Process

Figure 4.4.7 shows the demand forecast process. The process is divided into model building and demand forecast. In model building, vehicle trip generation/attraction and distribution model are developed based on the present vehicle OD and inter-zone impedance.

The future traffic flow is estimated by assigning the future OD demand to the future road network.

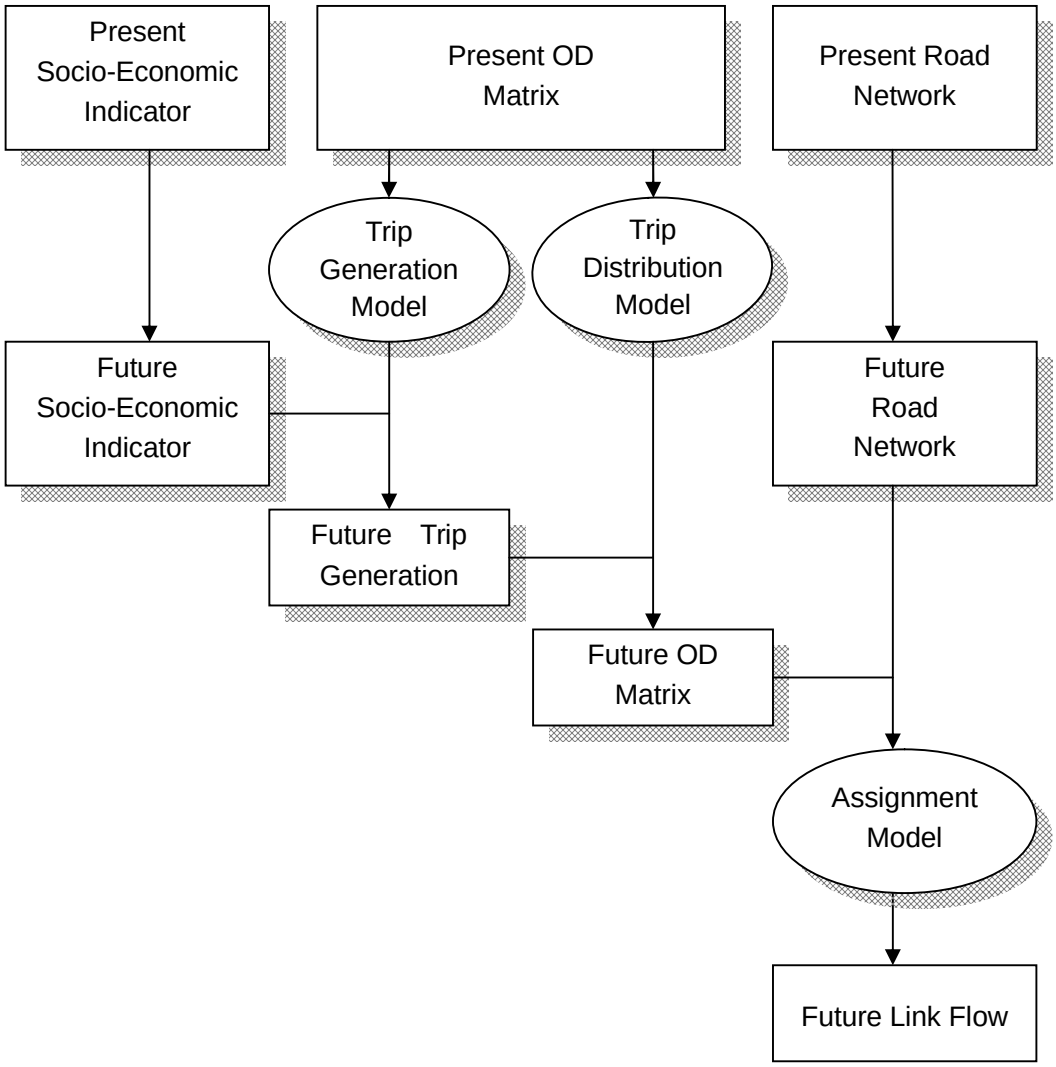


Figure 7.4.7 Demand Estimate Process

(2) Trip Generation/Attraction Model

Trip generation/attraction was estimated based on the present generating/attracting traffic, and the population. The comparison of vehicle trip generation/attraction between 2007 and 2017 is shown in Table 7.4.8 and Figure 7.4.8.

Table 7.4.8 Comparison of Vehicle Trip Generation/Attraction between 2007 and 2017

Community	Present	Future	Community	Present	Future
Buterere	4,352	10,664	Kinindo-2	13,658	24,588
Kinama	2,268	5,012	Musaga-1	1,672	3,306
Cibitoke	4,036	5,888	Musaga-2	6,684	11,444
Kamenge	4,314	6,250	Kanyosha-1	1,524	5,774
Ngagara-1	24,204	34,514	Kanyosha-2	1,016	4,028
Ngagara-2	10,374	15,730	Airport	1,028	1,738
Gihosha	13,244	32,366	Port	1,334	2,000
Buyenzi	11,830	15,620	R4	2,474	4,034
Bwiza	13,452	17,668	R5	454	770
Nyakabiga	8,442	11,618	R9	750	1,276
Rohero-1	76,900	119,194	R1	2,038	3,466
Rohero-2	54,918	86,776	R7	698	1,186
Rohero-3	9,596	16,904	R3	1,006	1,710
Kinindo-1	5,854	11,274	Total	278,020	454,798

Unit: pcu

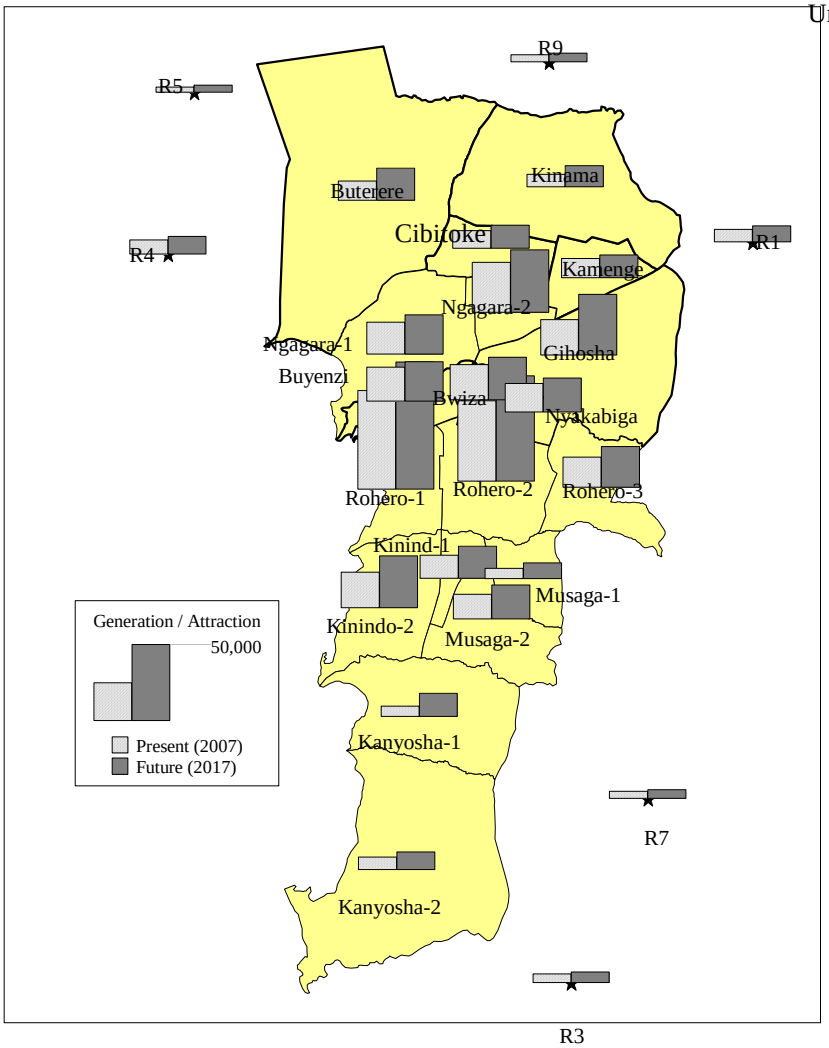


Figure 7.4.8 Comparison of Vehicle Trip Generation/Attraction between 2007 and 2017

(3) Trip Distribution

Trip distribution was applied to be the same as the present pattern.

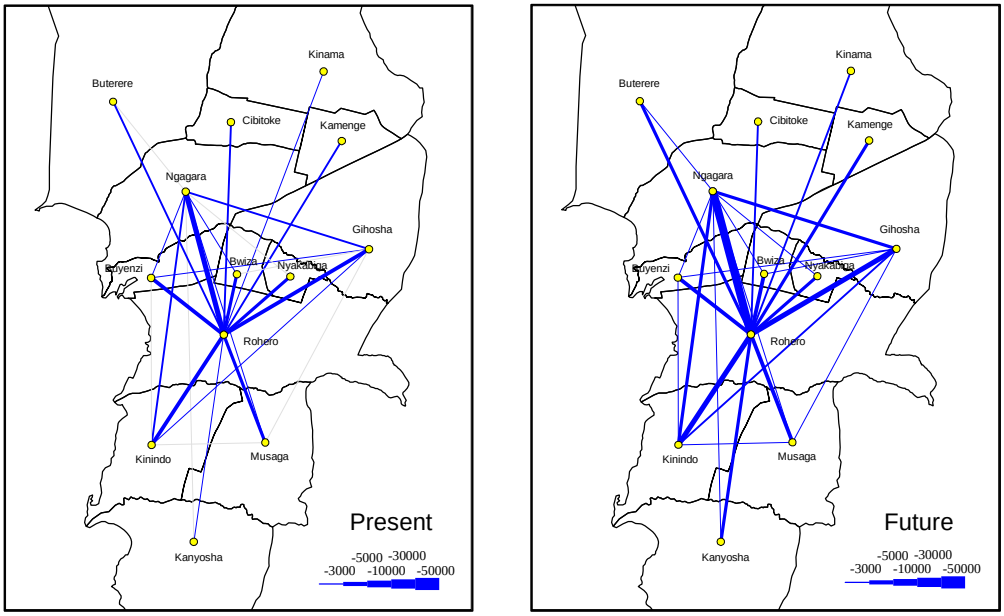


Figure 7.4.9 Trip Distribution (over 1,000Trips/day)

(4) Traffic Assignment Model

a) Network development

The road network in the study area was developed based on the road inventory survey. The roads, classified as Principal Arterial road, Arterial road and Collector road, were divided in links and subdivided into sub-links and sections, according to the conditions such as carriageway width, surface type, shoulder type and width. The sections were further sub-divided into suburban, intermediate, and urban. The total number of the sections in the network was 340.

b) Free flow speed

The free flow speed was calculated by following the formula described in Highway Capacity Manual 2000.

FFS	=	BFFS – Fls – Fn – Fa
FFS	=	estimated FFS (km/h)
BFFS	=	base FFS (km)
Fls	=	adjustment for lane width and shoulder width,
Fn	=	adjustment for number of lanes
Fa	=	adjustment for access point

c) Q-V pattern formation

Table 7.4.9 show the relationship of LOS (Level of Services), travel speed, and traffic density in Highway Capacity Manual 2000.

Table 7.4.9 Relationship of Service Level and FFS

Level of Services	Travel Speed (km/h)	Density Range (pcu/km/In)
(A)	100 - 90%	0 – 7
(B)	90 - 70%	7 – 11
C	70 - 50%	11 – 16
D	50 - 40%	16 – 22
E	40 - 25%	22 – 28
F	Less than 25%	>28

LOS of Urban Road is adapted to C, D, E and F

From those relations, maximum traffic flows of passenger cars equivalent per hour per direction on each LOS will be estimated. Also, those figures will be converted into daily traffic flows with peak-hour factor, peak ratio and directional flow rate.

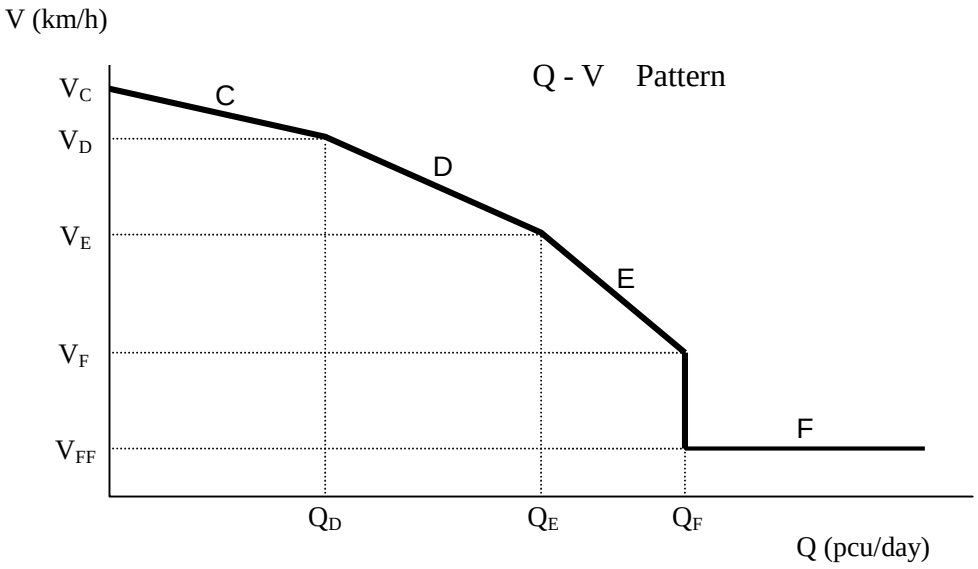


Figure 7.4.10 Q-V Model

The Q-V patterns were made based on the number of lanes, median, width of lane, lateral clearance, number of intersections and land use along the road.

Table 7.4.10 List of Q-V Type

QV No.	Road Classification	Road Side Classification	Number of Lane	Pavement Type	V_C (km/h)	V_D (km/h)	Q_D (pcu)	V_E (km/h)	Q_E (pcu)	V_F (km/h)	Q_F (pcu)	V_{FF} (km/h)	Q_f (pcu)
1	Primary Arterial	Suburb	6	Asphalt	55	45	37400	40	42900	35	44700	5	44700
2			4		55	45	25000	40	28600	35	29800	5	29800
3			2		55	45	12100	40	14800	35	15600	5	15600
4		Urban	6		55	45	29900	40	34400	35	35700	5	35700
5			4		55	45	20000	40	22900	35	23800	5	23800
6			2		55	45	9700	40	11800	35	12500	5	12500
7		Center	6		55	45	31500	40	36100	35	37600	5	37600
8			4		55	45	21000	40	24100	35	25000	5	25000
9			2		55	45	10200	40	12400	35	13100	5	13100
10	Arterial	Suburb	4		45	35	13400	30	25000	25	25700	5	25700
11			2		45	35	5800	30	12800	25	13500	5	13500
12		Urban	4		45	35	11100	30	20700	25	21300	5	21300
13			2		45	35	4800	30	10600	25	11200	5	11200
14		Center	4		45	35	12300	30	22900	25	23600	5	23600
15			2		45	35	5300	30	11700	25	12400	5	12400
16	Collector / Local	Suburb	2		45	35	5500	30	12100	25	12800	5	12800
17				Stone	35	25	4000	20	9000	15	9500	5	9500
18		Urban	2	Asphalt	45	35	4400	30	9700	25	10200	5	10200
19				Stone	35	25	3200	20	7200	15	7600	5	7600
20		Center	2	Asphalt	45	35	5300	30	11700	25	12400	5	12400
21				Stone	35	25	3900	20	8600	15	9100	5	9100
22	Local	Common	2	Unpavement	25	15	2900	10	6400	5	6800	5	6800
23			1	Asphalt	45	35	2300	30	5800	25	6700	5	6700
24				Unpavement	25	15	1200	10	3100	5	3500	5	3500

d) Assignment method

As the traffic flow is far less than the capacity and usually comparable routes exist in the urban areas, link flow was calculated by Multi-pass Assignment, searching the minimum travel time routes based on the link flow speed.

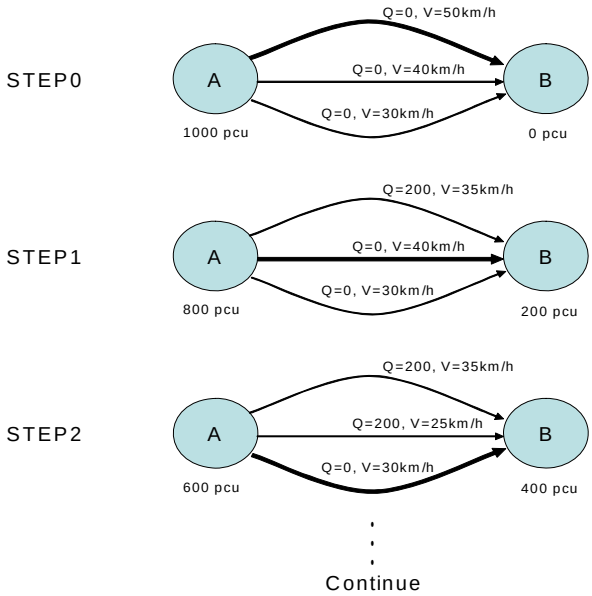


Figure 7.4.11 Simulation Mechanism of Assignment Model

e) 2017 Master Plan network configuration

The road network configuration in 2017 Master Plan was based on the future Bujumbura City Development Plan. The total network length to be improved in Bujumbura city is ------ km, of which -----km of or ------- % is subject to new construction.

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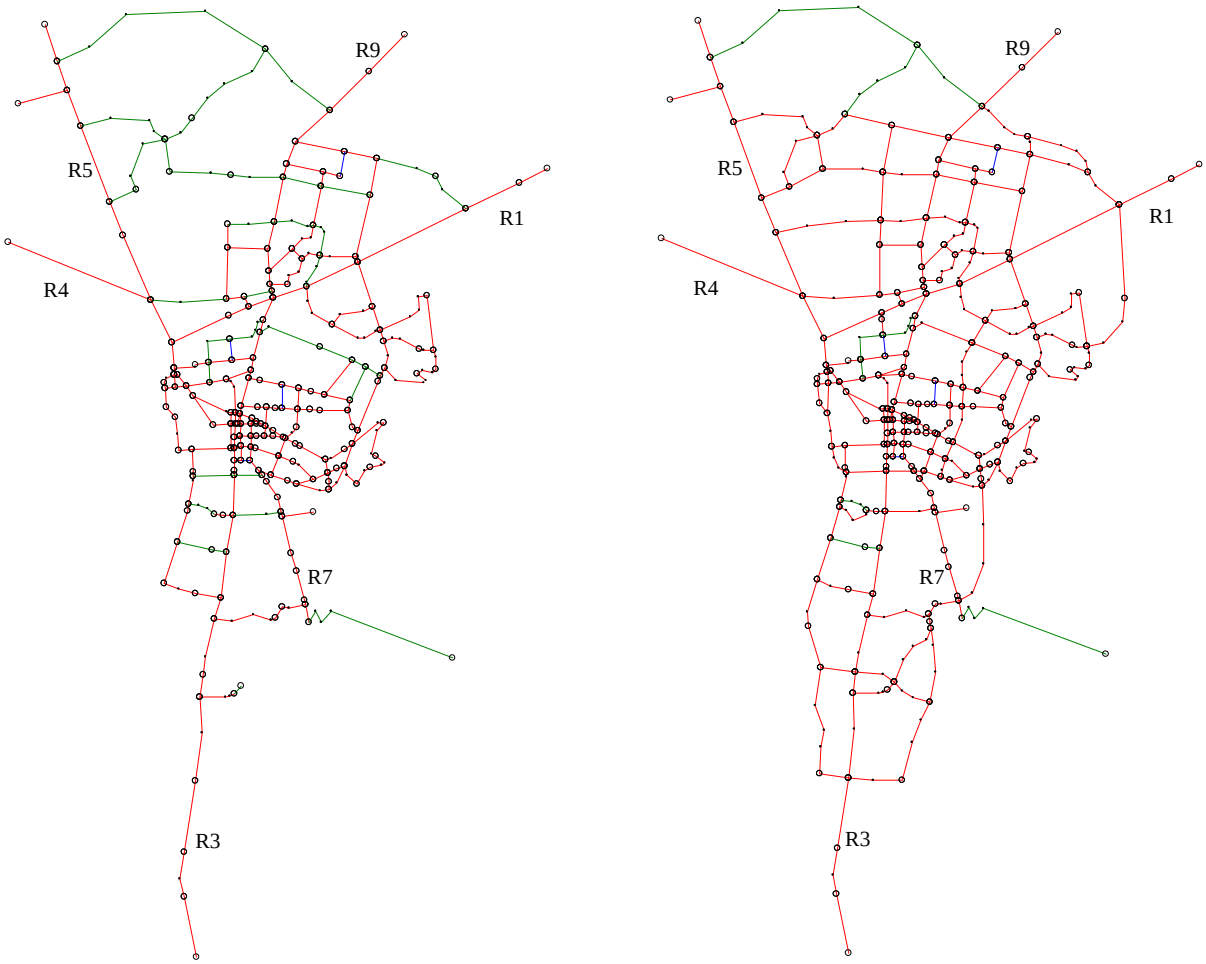


Present (2007) **Future (2017)**

Figure 7.4.12 Road Network Data of Present and Future

(5) Future Traffic Demand

a) Traffic demand-supply balance on screen line

Figure 7.4.13 shows the comparison of traffic flows at screen line in 2007 and 2017, assigned to 2017 Master Plan network, and Table 7.4.11 shows the shortage of capacity on section A-A'

and B-B' at present road network.

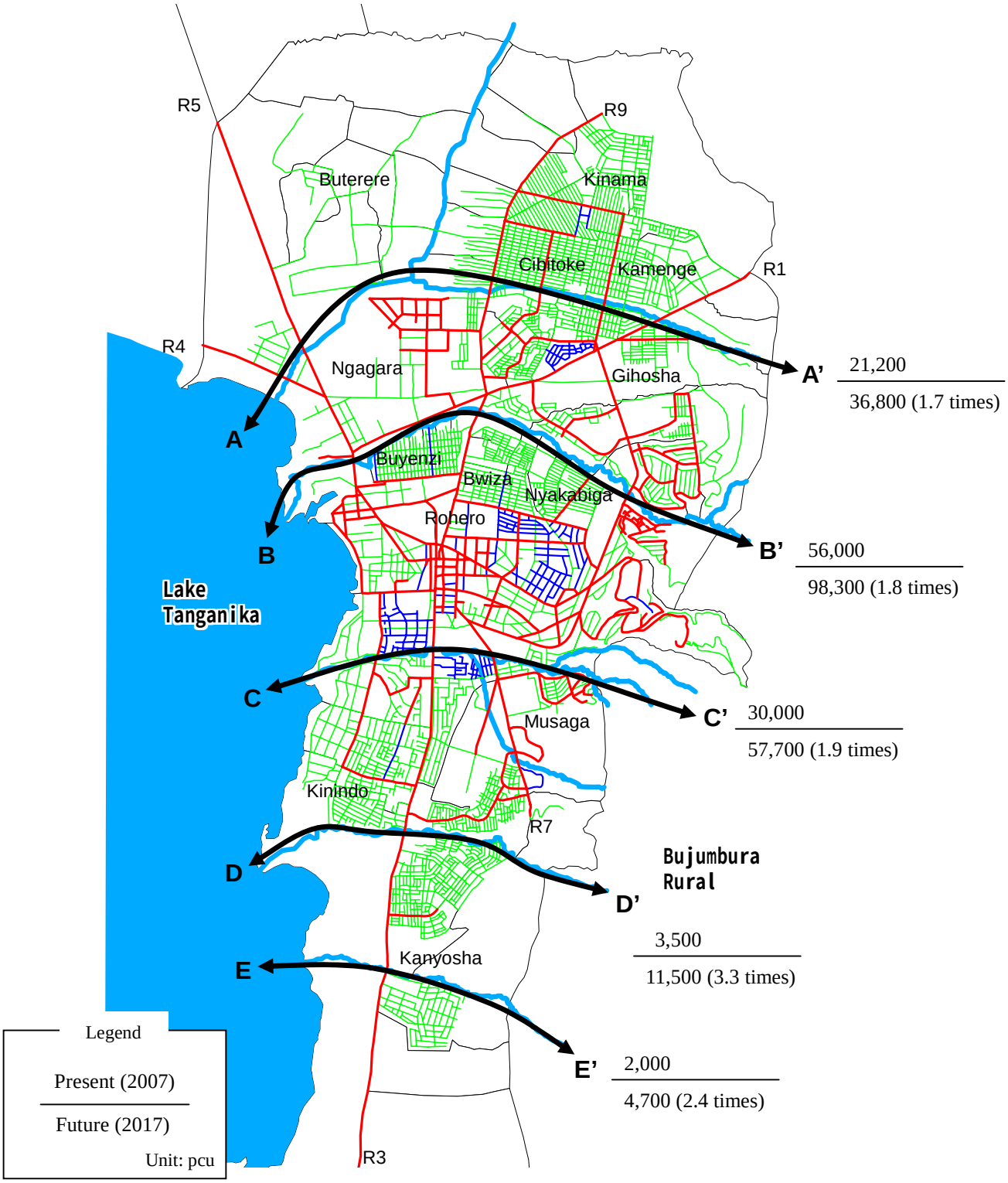


Figure 7.4.13 Comparison of Traffic flow at Screen Line between 2007 and 2017

Table 7.4.11 Traffic Demand – Supply Balance on Screen Line

	A-A' Section	B-B' Section	C-C' Section	D-D' Section	E-E' Section
Road name included in each section	・NR 4 ・NR 5 ・NR 9 ・NR 1 ・Collector road	・NR 4(NR5) ・NR 9 ・Ring road	・NR 3 ・NR 7 ・Arterial road	・NR 3 ・Arterial road ・Collector road	・NR 3
Capacity at present (pcu/day)	53,900	60,000	30,000	12,100	12,100
Present Traffic demand (pcu/day)	21,200	56,000	30,000	3,500	2,000
Balance (for present network)	Sufficient	Sufficient	**Full**	Sufficient	Sufficient
Future Traffic demand (pcu/day)	36,800	98,300	57,700	11,500	4,700
Balance (for present network)	Sufficient	**Short**	**Short**	**Full**	Sufficient

Capacity is estimated by traffic volume can run as LOS level-C in Highway Capacity Manual 2000.

b) Master Plan Flow on major roads

Figure 7.4.14 show the comparison of traffic flow volume on major road in 2007 and 2017.

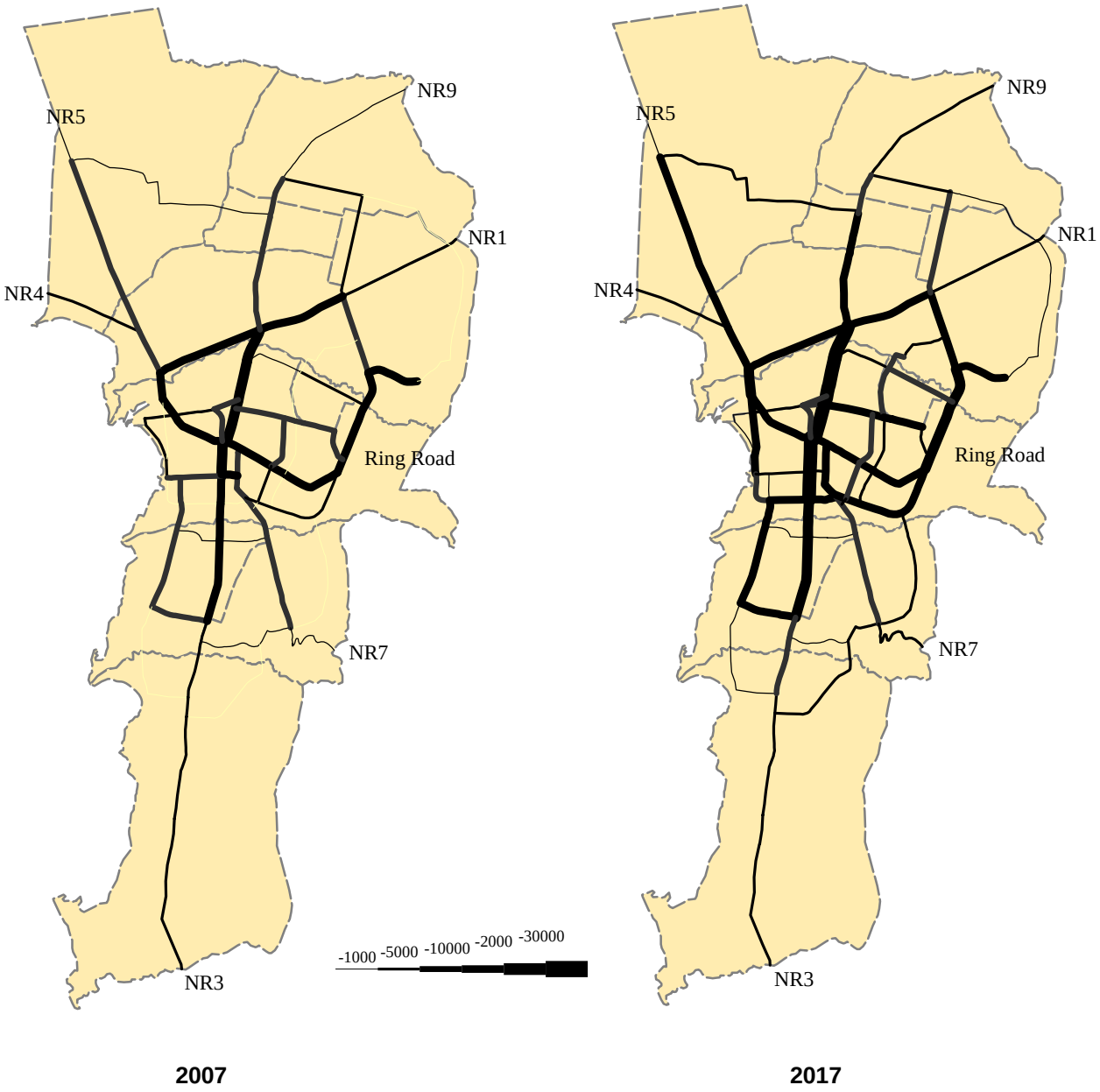


Figure 7.4.14 Comparison of Traffic Flow Volume between 2007 and 2017

7-5 SOCIAL AND ENVIRONMENTAL CONSIDERATION

7-5-1 Environmental Management System in Burundi

(1) Organization

The Ministry of Land Management, Environment and Tourism (MINATTE) established in 1989 is the main administrative body concerning environmental management in Burundi. National Commission of Environment composed of 21 members was established in 2000 and has taken the charge of governmental politics concerning the environment. The ministry has a central cabinet, two general management sections and three external institutes. According to "The Environment Code of Burundi (Law No.1/010)", the basic environmental law of Burundi, the ministry is responsible for the following matters.

- To execute national environmental policy concerning regional development
- To manage the natural forest
- To create the protected areas
- To elaborate the regulation concerning protection and management of the environment
- To elaborate a national program of environmental education
- To contribute to the international programs and conventions of environment
- To contribute to promote the tourism
- To collaborate with other concerning ministries concerning the environmental matters

Environment and Tourism Section in the Ministry is the actual administrative body to deal with the environmental matters. National Institute for Environment and Conservation of Nature manages the nature conservation.

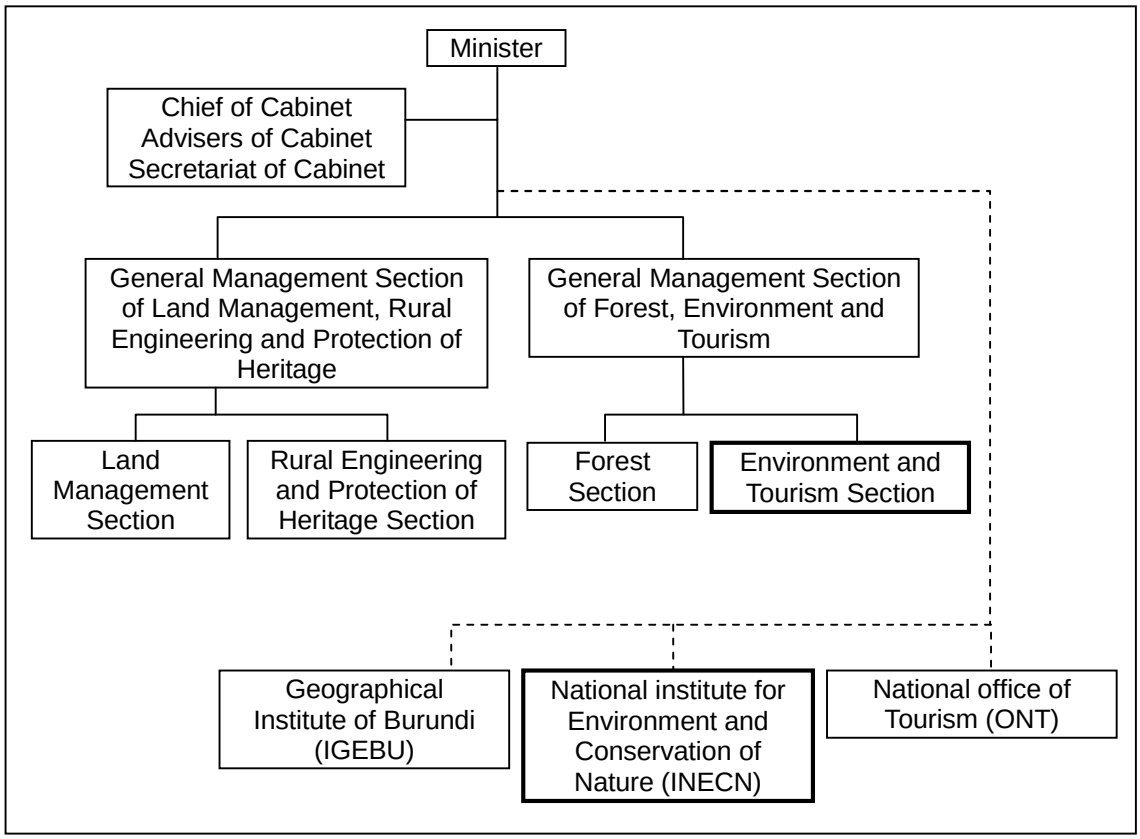


Figure7.5.1 Organization Chart of Ministry of Land Management, Environment and Tourism

(2) National Strategy

The first national environmental strategy in Burundi was prepared in 1992-93 but it was immediately outdated by the impact of the socio-political crisis on the environment at that time. The current national environmental strategy is described in "Strategie Nationale de L'Environnment au Burundi 2003 (SNEB)". The SNEB was prepared by the project BDI/96/001 (MINATTE, FAO, and UNDP) and was aimed to support the restoration and management of the environment.

The main strategies proposed in SNEB are as follows:

- The search for optimum serving as a permanent vital lead. It is more important than restoring the situation which pervaded before the crisis.
- The natural resources economy goes up through efficient usage. This means that they will have to think about estimated productivity in terms of useful production compared to rare resources used or saved as woods, fertilized land included the one used indirectly: for example the land used for production of tea includes the space taken by forestry.
- In that context, the useful production concept includes services production and goods of

environmental nature.

- Concerning institutional structures, a clear share of roles and cooperation between the structures by avoiding time losses; for instance holding many functions at the same time.

In infrastructure and transportation sector, the objectives and approaches proposed in SNEB are as follows:

Objective

- To develop the communication system in order to enhance the agricultural value and encourage the national economy with minimum environmental damage.
- To encourage the public transportation and the non-motorized transportations.
- To arrange the road works in order to manage water flux and avoid soil erosion and other environmental risks.
- To minimize the pollution and accident risks.
- To protect the works against damage caused by water or unstable land.

Approach

- Regulations for traffic safety (Technical control, Highway Code, limiting speed and driver's license)
- Education of traffic safety
- Adequate road network planning
- Conception of circulation plan aiming traffic fluidity
- Increase in public transportation service
- Environmental impact assessment
- Economic instrument to reduce transportation cost

(3) Environmental Legislation and Regulation

The Environment Code of Burundi (Law No.1/010) was promulgated in 1999 and has been enforced in June, 2000. The environment code consists of 7 titles each comprises of 2 to 6 chapters and about 163 articles. These titles are as follows:

- Title I General arrangements
- Title II Administrative organization of the environment
- Title III Protection and promotion of natural resources
- Title IV Protection and promotion of human environment
- Title V Action against pollution and nuisance
- Title VI Penal arrangements

- Title VII Final arrangements

Environmental Impact Assessment (EIA) system is mentioned in "TITLE II, CHAPTER 3 THE PROCEDURE OF IMPACT SURVEY ON THE ENVIRONMENT" of the environmental code. This chapter consists of 7 articles (Article 21~27) and explains the fundamental principals and procedure on EIA. Any other regulations and guidelines on EIA are not prepared yet. The articles request to include the following categories in the impact survey.

- Analysis of initial environmental status
- Assessment of impact on natural and human environment caused by development project
- Description of environmental mitigation measures
- Presentation of the other possible alternative solution to protect environment

Regulations on land management and acquisition are mentioned in the fundamental code (Law No.1/008, 1986 Sep.). A Law on forest management is given in the forest code (Law No.1/02, 1985 Mar.). Environmental standards for air, water, noise, emission of gas and effluent standards are not yet prepared in Burundi.

(4) Procedure of EIA

EIA guidelines on the procedures and study methods have not been prepared yet in Burundi. The local consultants to conduct an EIA study also do not exist. Therefore, the EIA studies for infrastructure development projects have been conducted by international consultants according to the guidelines of international donor such as World Bank or African Development Bank. As an example of a recent EIA study for road development projects, the EIA for National Route No. 10 (RUGOMBO – KAYANZA section) improvement project as World Bank projects was conducted by a Canadian consultant company in 2003.

(5) Procedure of Land Acquisition for Public Use

In Bujumbura city, Urbanism and Habitat Section in the Ministry of Public Works and Equipment takes responsibility for the land acquisition for public utilities such as occupation of right of way. The proponent requiring the private land submits the appreciation to Urbanism and Habitat Section. Urbanism and Habitat Section studies the content and applies for the land acquisition to the President. After the issue of the presidential approval, the specialists conduct the compensation evaluation including the questionnaire survey to the affected people. Ministerial Order (No.720/CAB/810/2003, 28th May 2003) has been prepared as the compensation

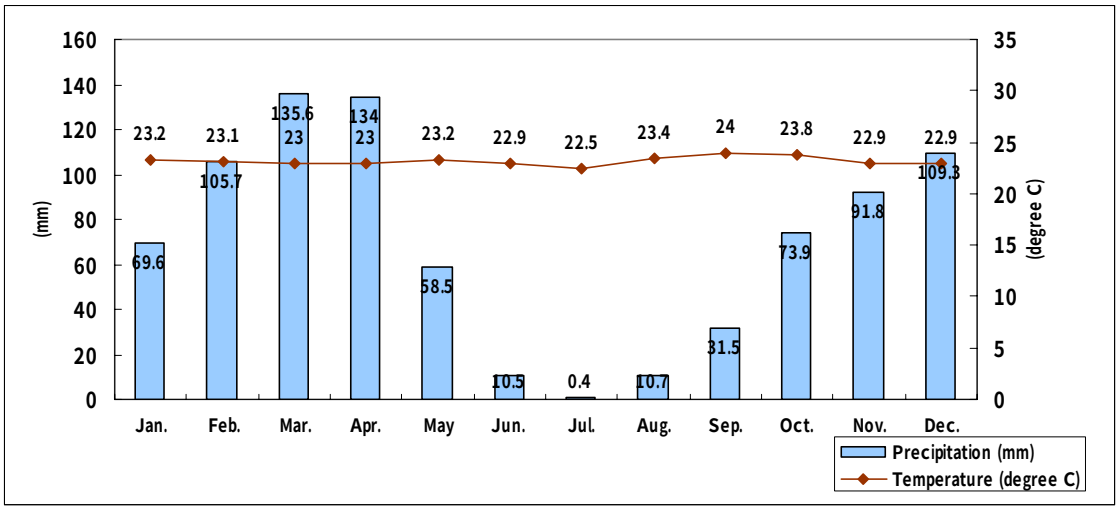
regulation.

7-5-2 Social and Environmental Characteristics of the Study Area

(1) Physical Aspect and Climate

Bujumbura with estimated population of 550,000 is the capital city and the economic center of Burundi. Located on the Imbo plain and the northeast side of Tanganyika Lake, its elevation is 770~850m. The western part of Bujumbura is flatland while the eastern part is hilly area. The natural vegetation areas are mostly wooden grasslands. However, most of the areas of Bujumbura city are developed well as build-up zones and agricultural fields, there is little natural vegetation area and no natural protected areas in the city.

The climate of Burundi is moderate tropical by altitude which varies from 773m to 2,670m. The country has a rainy season (October to May) and a dry season (June to September). The annual average precipitation in the country is 1,274mm. The annual average temperature is 23°C in the Imbo plain at about 800m elevation and 16°C on the Congo-Nile crest at above 2,000m elevation. The temperature at Bujumbura is about 23°C and does not change widely throughout a year. The annual precipitation is about 830mm. The following figure shows the monthly mean temperature and precipitation.



Source: World Weather Information Service

Figure7.5.2 - Monthly Mean Temperature and Precipitation of Bujumbura

(2) Urban Environment

In Bujumbura, 40% of the domestic waste water is being treated by a stabilization pond process in Buterere Commune located in northwest area in the city and discharged into Tanganyika Lake. The treatment system is managed by a city agency (SETEMU). The rest of the waste water flows into Tanganyika Lake without any treatment.

About 40 % of the solid waste is collected and disposed in the official dump site in Buterere Commune by SETEMU. But the equipments for garbage collection and landfill are very poor and the dump site has not any fence and hygienic protection system because of the limited budget. About 35 % of the solid waste are collected and burnt on wild dumps of each districts. The rest are disposed on personal basis.

The air and water quality data of Bujumbura are not available. However, the air pollution and water contamination in the rivers and Tanganyika Lake will be not serious because large scale pollutant sources do not exist in and around Bujumbura. The domestic waste water, other than those treated by the treatment facility, is cleaned up by the natural purification in Tanganyika Lake having a large capacity. And the mobile pollutants such as vehicle emission gas are not yet of so much volume to provoke serious air pollution.

In the future, following the increase of the number of vehicles, the use of bad-quality fuel, imported old cars and motorcycles, second-hand tires and traffic congestion may deteriorate the air pollution to a significant level.

(3) Protected Area

There are 14 protected areas such as national parks or forest reserves in Burundi. The total protected area is 4.5 % of the national land. There are no any protected areas in the study area, however Rusizi Natural Reserve is located in Bujumbura suburb. Rusizi Natural Reserve is formed in Rusizi river delta and rich in animal species (many of migratory and endemic birds, hippopotamuses, Nile crocodiles, sitatungas, tortoises, fish) and in plant species (papyrus, typha, phragmites, palm tree hyphaena, acacia). These resources are threatened by the unsustainable use and pressure of the local population. The following table and figure shows the protected areas in Burundi and the location of Rusizi Natural Reserve.

Table7.5.1 Protected Area in Burundi

NAME	SURFACE AREA (ha)	CATEGORY
Kibira	40,900	National park
Ruvubu	50,600	National park
Lac Rwihinda	425	Natural reserve
Rusizi	5,280	Natural reserve
Vyanda	4,500	Natural reserve
Bururi	3,200	Forest reserve
Monge	5,000	Forest reserve
Kigwena	500	Forest reserve
Rumonge	600	Forest reserve
Karera et Nyakazu	700	Natural monument
Gisagara	20	Protected landscape
Kinoso	2,913	Protected landscape
Mabanda/Nyanza	480	Protected landscape
Mukungu/Rukambasi	3,500	Protected landscape
TOTAL	118,618	

Source: ETAT ANNUEL DE L'ENVIRONNEMENT DU BURUNDI RAPPORT, Mai 2004

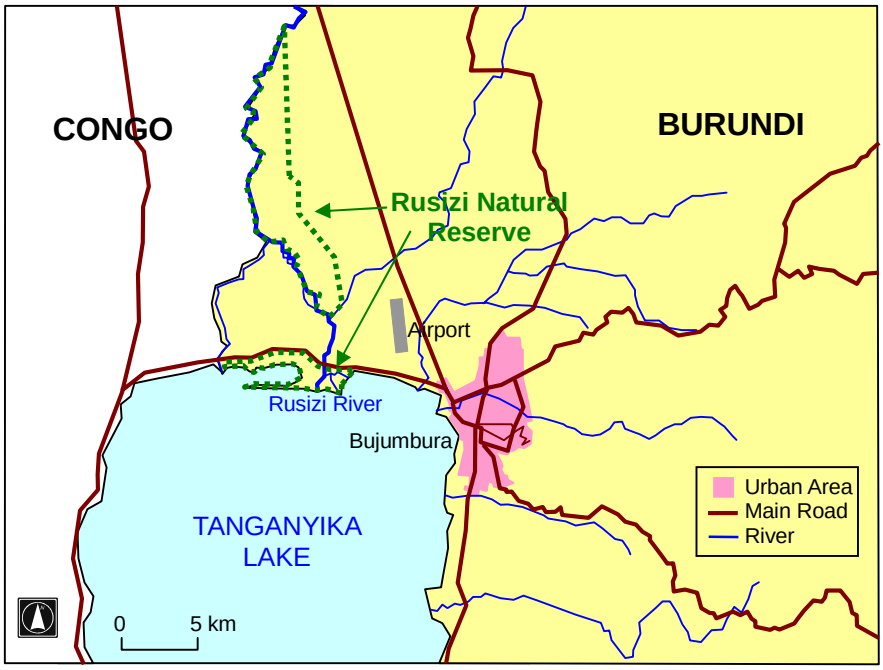


Figure 7.5.3 Location of Rusizi Natural Reserve

(4) Cultural Property

There are no any special archaeological, historical or cultural valuable zones and ancestral domains in the study area, but some historical monuments and religious facilities are built in the main road sides. The following figure shows the major historical monuments and religious facilities in Bujumbura city.

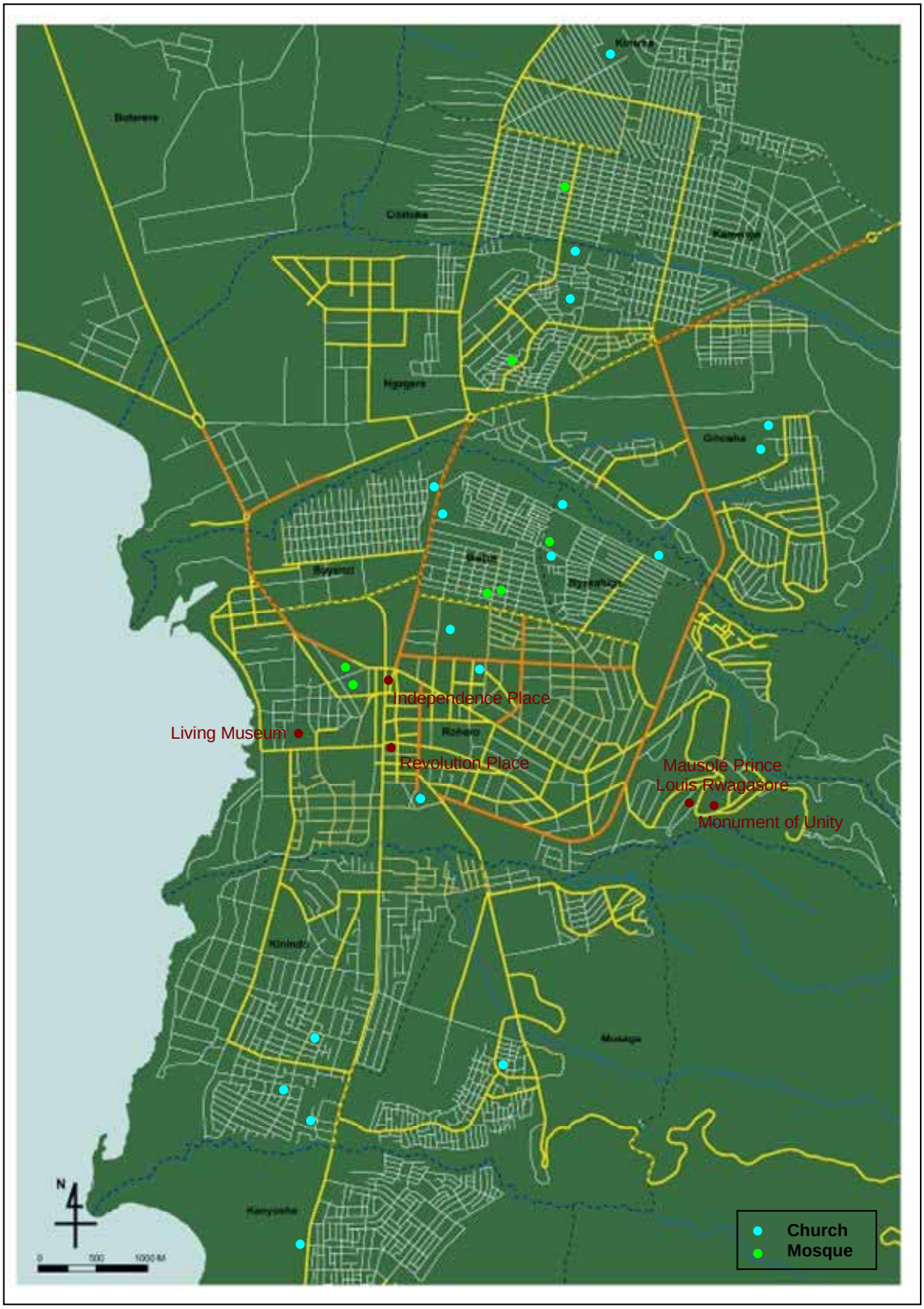


Figure 7.5.4 Location of Historical Monuments and Religious Facilities

(5) Global Warming

Global warming is a complex phenomenon depending on the green house gases from human activities. Greenhouse gases are composed of several types of gases such as carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) in the atmosphere. The following table shows the green house gas emissions of Burundi in 1998. Methane and nitrous oxide that are chiefly generated from agricultural activities, water contamination and vehicle emission are main green house gases in Burundi instead of carbon dioxide that is main green house gas in developed countries. The green house gas emissions from transport sector were equivalent to 63% of the carbon dioxide emission or 4.55 % of the total emissions of Burundi in 1998.

Table 7.5.2 Green House Gas Emissions of Burundi in 1998

(teragram/year)

Green House Gases (GHGs)	CO2	CH4	N2O	Total
GHG Emissions (without LUCF)	0.1430539	0.0449232	0.002933	
CO2 Equivalent	0.143	0.943	0.909	1.995
Percentage to Total GHGs	7.2%	47.3%	45.6%	100.0%
GHG Emissions from Transport Sector	0.0901372	0.0000192	0.0000008	
Percentage to Each GHG Emission	63.01%	0.04%	0.03%	
CO2 Equivalent	0.09014	0.00040	0.00025	0.09079
Percentage to Total GHGs	4.52%	0.02%	0.01%	4.55%

Source: KEY GHG DATA (United Nations Framework Convention on Climate Change) and 1st National Commission of Climate Change

In the future, following the development of motorization, the green house gas emissions from transport sector will increase. The Ministry of Land Management, Environment and Tourism has prepared “Plan d’Action National d’Adaptation aux changements climatiques 2007’ as the national action plan against global warming.

7-5-3 Stakeholder Meeting

(1) Stakeholder Meeting I

The first stakeholder meeting was held at the Ministry of Public Works and Equipment on 5th April, 2007 and was included the steering committee. Attended organizations are as follows:

- Ministry of Transport, Posts and Telecommunications
- Ministry of Public Works and Equipment
- Ministry of Exterior Relation and International Corporation
- Bujumbura City Council

- Road Department
- OTRACO

Contents of discussions:

JICA study team made the following presentation:

- Existing Situation of the Study
- Technical Assessment to OTRACO
- Selection of Urgent Rehabilitation Work as Pilot Project
- Population of Bujumbura and Future Development
- Purpose and Schedule of Stakeholder Meeting

Main advices and opinions from participants were as follows:

- The road condition in front of the army camp is good. The condition around bus parking is poor.
- The construction cost should be kept reasonable through discussions with the road department.
- To save the expense, the selection of construction material distributors should be considered carefully. The prices of the governmental distributors are generally cheaper than the private ones.
- The drainage planning of lake side zone should include the hydrological analyses of the upper stream area.
- Q: The estimation method of population? A: By visit survey to the communes and quarters one by one.

(2) Stakeholder Meeting II

The second stakeholder meeting including the steering committee on the Interim Report of "THE EMERGENCY STUDY ON URBAN TRANSPORT IN BUJUMBURA CITY" was held at the Ministry of Finance on 25th June, 2007. Total 33 participants including 7 members of JICA Study team attended. Attended organizations are as follows:

- Ministry of Transport, Posts and Telecommunications
- Ministry of Public Works and Equipment
- Ministry of External Relations & International Cooperation
- Ministry of Land Management, Environment and Tourism
- OTRACO
- Administrative office of Buterere Commune
- Administrative office of Cibitoke Commune

- Administrative office of Buyenzi Commune
- Administrative office of Bwiza Commune
- Administrative office of Gihosha Commune
- Administrative office of Rohero Commune
- Administrative office of Kinindo Commune
- Administrative office of Musaga Commune
- Administrative office of Kanyosha Commune
- SETEMU
- ISTEBU
- SIP
- ECOSAT
- Private Transport Agency
- JICA Burundi Office

Contents of discussions:

JICA study team explained the Interim Report of "THE EMERGENCY STUDY ON URBAN TRANSPORT IN BUJUMBURA CITY". The Main subjects are as follows:

1. Urban Transport in Bujumbura City
   - Extent of Interim Report
   - Road Network Condition
   - Traffic Count Survey Result
   - Public Transport Condition
   - Existing Problems
   - Urban Planning
   - Future Traffic Demand and Analysis
   - Social and Environmental Consideration
   - Urban Transport
2. Community-based Development
   - Results of Collected Data

Main opinions and questions from participants were as follows:

- Because the infrastructure in Bujumbura city is poor condition and developing now, installation of bus lanes may be difficult.
- The considerations of the economical capacity of Burundi and the present data analysis in Bujumbura are indispensable in the study.
- Burundian side requested more positive technical transfer on the study, especially in baseline survey methods.

- Burundian side requested continuous cooperation to implement the project in the Master Plan after the completion of the study.
- Q1: Is it possible to shift from private car users to public transportation users, any case of success?

A1: Public transportation systems have priority over private cars in some large cities in Asian countries.

- Q2: Is the economic analysis of each project included in the Master Plan?

A2: Depending on the economic analysis and present status, the immediately feasible projects and step-by-step projects will be considered in the Master Plan.

- Q3: How to manage the bicycle taxis in the future?

A3: The bicycle taxis will be reduced in the future. However, because the bicycle taxis are important local transportation mode, the Master Plan will include the bicycle taxis and suggest the traffic regulations for the bicycle taxis as countermeasures of the accidents.

- Q4: Is the future traffic demand considered the urban planning and future land use?

A4: The future traffic demand is based on the growth of population in each zone. Because the zoning is large scale, the detailed land use is not reflected in the future traffic demand.

- Q5: The private buses are the main transportation mode in Bujumbura city at the present day. Will OTRACO be able to have the enough capacity to serve the main transportation mode?

A5: The demarcation between OTRACO bus and private buses will be suggested in the Master Plan as an idea.

(3) Stakeholder Meeting III

The third stakeholder meeting was held at the Ministry of Transport, Posts and Telecommunications on 5th September, 2007. Attended organizations are as follows:

- Ministry of Transport, Posts and Telecommunications
- OTRACO
- Private Bus Association
- Bike Taxi Association (AMOTABU)
- Bicycle Taxi Solidarity (SOTAVEBU)

Contents of discussions:

JICA study team made the following presentation:

- Existing Bus Network and Passenger Movement
- Problems on Public Transport
- Bus Network Improvement Plan
- Bus Terminal Development Plan
- Proposed Other Public Transport Plan

Main opinions and questions from participants were as follows:

- The bicycle taxis are now useful transport methods for the common people. In the future also, the bicycle taxi should be developed.
- The basic data to account the construction of the proposed Bus Centre are required for the actual implementation.
- Road development projects and traffic safety facilities such as footbridges are indispensable for the improvement of public transport too.
- Other ministries and organizations are interested in this public transport improvement plan. A public consultation or stakeholder meeting to explain widely this plan will be necessary during the study period.
- Q1: How to shift the drivers of private car to public bus users?

  A1: By comfortable and punctual bus service.
- Q2: OTRACO has operated in compliance with the National policy, been managed by the government and received a public subsidy. Bus business in Burundi is not profitable except for the international routes. Under such circumstances, is the privatization of OTRACO necessary and possible?

  A2: OTRACO should be broken into a corporation for serving only in Bujumbura city and an organization for serving in nationwide areas at first. Then the corporation and the private transporters in Bujumbura should establish a new private bus company.

CHAPTER 8

URBAN TRANSPORT IMPROVEMENT PLAN

CHAPTER 8 URBAN TRANSPORT IMPROVEMENT PLAN

8-1 APPROACH (FLOW PLAN)

Following Figure 8.1.1 shows the flow plan of the Urban Transport Improvement plan.

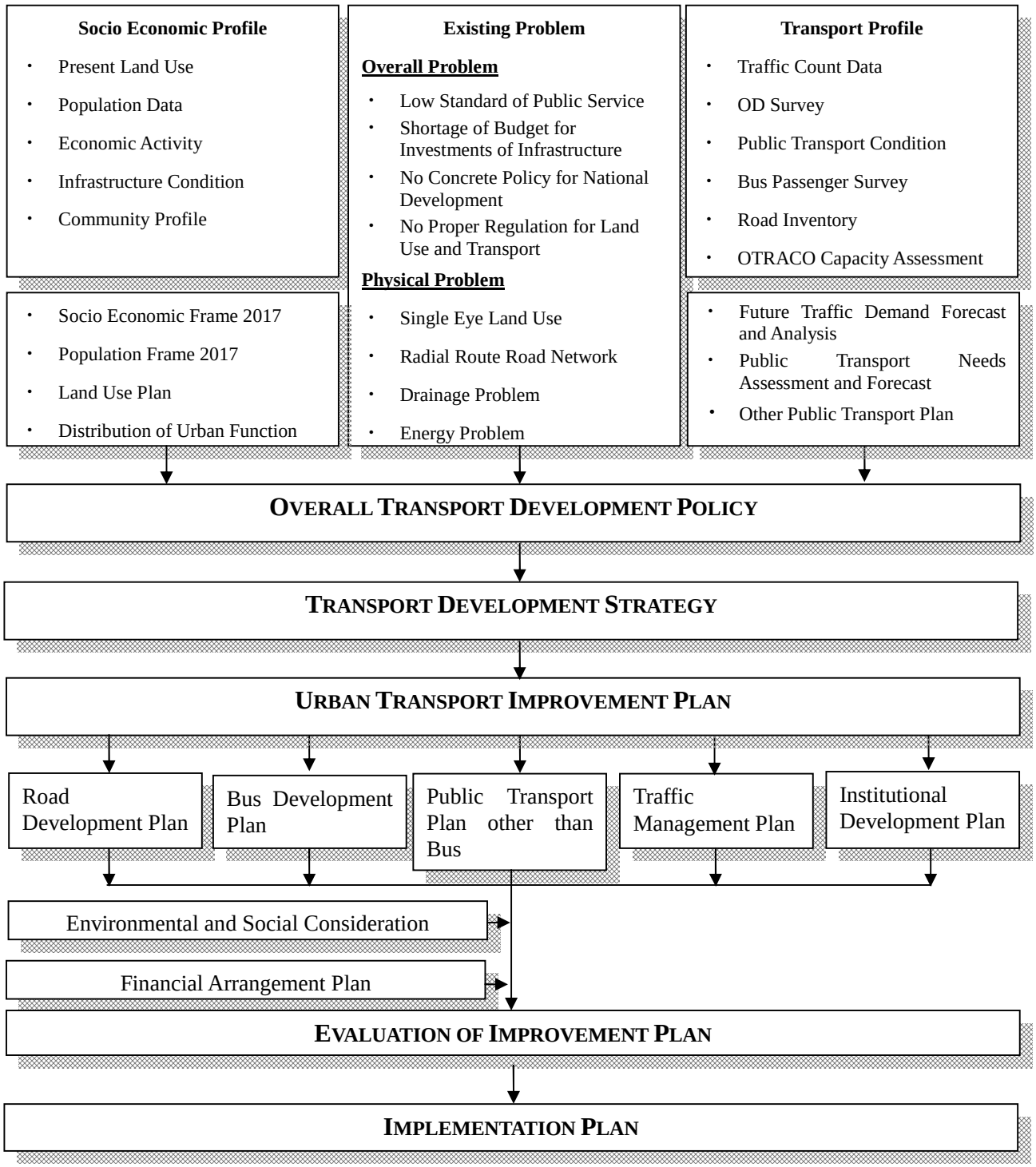


Figure 8.1.1 Flow Plan of Urban Transport Improvement Plan

Brief explanation of the above sequences is mentioned below;

(1) Socio Economic Profile

In Burundi, no future land use and development plan is available, the only authorized plan aiming to improvement the living condition of the people is the Poverty Reduction Strategy Paper of September 2006 from the Ministry of Finance, Burundi.

The existing data of the report have been collected by the study team and shown on CHAPTER 2. The data is used to set the future frame in target year 2017 on economic activity, population, land use and urban function distribution as described in CHAPTER 7. This frame is the basic material and reference for the establishment of the Overall Transport Development Policy.

(2) Existing Problem

The existing problems which are not only on transport sector but also on overall and physical issues are identified in CHAPTER 5, and the intensifying problems are analyzed in order to specify the causes. The improvement plan shall be the solution against the problems together with the consideration of the future forecast based upon the socio economic frame.

(3) Transport Profile

The transport profile includes the data and observable fact collected from sites, which is to be used in the establishment of future traffic frame. Information in terms of current situation by figures as well as qualitative facts is essential for the future traffic forecast. Bus interviews are also basic data to know the level of satisfaction of the service and demands of passengers.

(4) Overall Transport Development Policy

The Ministry of Transport, Posts and Telecommunications has established the sector programme for year 2006-2010. Referring the programme, the Overall Transport Development Policy shall be proposed with some considerations from above-mentioned paragraph (1) to (3).

(5) Transport Development Strategy

Transport Development Strategy is proposed based upon the overall policy mentioned above,

(6) Urban Transport Improvement Plan

Urban Transport Improvement Plan consists of Road Development Plan, Bus Development Plan, Public Transport Plan other than Bus, Traffic Management Plan including the NMT (Non Motorized Transport) and Institutional Development Plan. Basis of ideas on each plan shall be from the future Traffic Demand Forecast and considerations for the strategic theme. Institution development plan includes alternative working methodology for both implementation and maintenance. In terms of maintenance; feasibility of adopting RMI (Road Maintenance Initiative proposed by World Bank) is examined.

(7) Environmental and Social Consideration

The Initial Environmental Examination (IEE) shall be carried out in order to confirm impacts developed by the policy, plans and programmes, and it shall be carried out in accordance with JICA Environmental Social Consideration Guideline. The IEE shall identify the category which expresses degree of the impact. The Stake Holder meeting shall also be conducted so as to collect opinions to the policy, plans and programmes and identify peoples who may have be affected by any impacts from the programmes.

(8) Financial Arrangement Plan

Financial arrangement plan to be established shall contains preliminary cost estimate, introduction of available budget resource and alternative ideas of project implementation methodology.

(9) Evaluation of Improvement Plan

Evaluation of Improvement Plan shall be carried out by methodology of the “with and without case”. Benefit by each plan and programme shall also be estimated. In addition, priority order shall be made on each planning and component.

(10) Implementation Plan

Based upon results of the evaluation, the implementation plan shall be established, which is expressed on time bar chart. Maintenance implementation plan shall also be included in the plan for post projects.

8-2 TRANSPORT DEVELOPMENT POLICY AND CONCEPT

8-2-1 Transport Development Policy

Basically, establishment of the policy aims to identify existing problems and show the compass of the improvement, and the policy shall also include particular phenomenon which will occur during the period from present time up to the target year.

There are some existing policies which explain current situation and etc, but they are not necessarily discussing the matters of Bujumbura only.

The PRSP is the only one integrated national development programme aiming to restore and improve living standard. In the PRSP, the transport sector is identified as an important key for improvement of the isolated remote areas. The details of descriptions on the sector are extracted as follows;

- In general, the transportation sector is characterized by structurally high costs and dilapidated, poorly maintained, and infrequently replaced equipment.
- The national road system, which ten years ago was one of the sub region's best, has greatly deteriorated because of lack of maintenance. In addition, the country's weak international links (by water and by air) result in excessively high transportation costs.
- The government's objective is to improve access to remote areas in the interior of the country in order to promote development and bring populations closer to government services, basic social services, and trade centres. To reach this objective, the government's strategy is to promote a road system that is efficient in terms of both density and quality, support the development of lake, maritime, and rail transportation, and modernize air transportation.
- To that end, the government intends to rehabilitate and construct a road system and thereby interconnect all provinces with asphalt roads and expand the system of local feeder roads.

In Burundi, there are two ministries which are responsible to the transport sector.

(1) Ministry of Transport, Posts and Telecommunications

Ministry of Transport, Posts and Telecommunications is taking charge of administration of communication means such as public transport, mail and telephone lines.

The Ministry has established the Sector Policy for the year 2006-2010 which explains current conditions and problems as follows;

General

- Charged transportation system including public bus and private sector bus has been improved, however superannuation of the means is progressing; so necessity for renewal is extremely high.
- Vehicles held by OTRACO do not have the possibility to be renewed due to lack of the budget and a little financial support from the Government.
- Although the Government has introduced some measures for promotion of the investment to the sector, private transporters cannot afford to purchase new vehicle, and they have purchased second hand vehicles and the number is increasing.
- The bus fare changed with the rise of operating cost has not caught up with the rise of operating expenses.

Problem

- The current fare system is not profitable to both OTRACO and private transporters.
- There is a phenomenon of decrease of boarding rate due to low purchasing power.
- There are some existing routes on which bus is not operating because of bad road conditions.
- The rate of area coverage by the public transport services is low.
- The majority of transport means have become aged and deteriorated.
- There is no financial support by the Government on the service lines which is even considered as important in the view of public and/or social interest.
- There is no organization for the city bus service line.
- There is no proper traffic regulation to protect bus operation or to secure comfortable use.
- The life cycle of vehicles in Burundi is short compared to other neighbouring countries due to bad road condition.

- There are many vehicles with right steering wheel, which are considered inappropriate in Burundi.

Following goals are proposed so as to improve problems shown above;

Goals

- Overall Goal: To have concrete transport system that enables people to move all over the country easily

Special Goals:

- To establish and enforce the Public Transport Policy
- To organize the Public Transport Section by establishing new regional offices

(2) Ministry of Public Works and Equipments(MPWE)

Ministry of Public Works and Equipments (MPWE) is responsible for the administrations of road construction, maintenance and urban planning. The MPWE has also established the Sector Programme in May 2006. This sector programmes explains 5 years programmes for 2005-2010 on each sub sector, and its basic consideration is to have the optimum mechanism on administration and guidance for public works and the promotions in order to enhance social and economical development.

The programme explains current road conditions, as follows;

- The length of the road networks reaches 5000km, and among them approximately 1230km have been paved
- The road network is classified into 3 categories;

National Road s (RN):	National Roads of approximately 1950km long connect the principal cities of the regions and also connect the principal cities to the borders of adjacent countries.
Regional Roads (RP):	Regional Roads of approximately 2522km long connect the principal town of the districts in the region and also connect the principal towns in regions each other.
Rural Roads:	Rural Roads of approximately 2,587km long.

- The Government of Burundi have been making extreme efforts for 30 years to create the road network with tarmac standard which connects all 16 regions. However, 4 regions which are Karuzi, Cankuzo, Rushubi (Bujumbura Rural) and Mwanro have been still left from the network. Therefore an economical imbalance is found out between the regions with the network and the regions without it.

The Road Department is responsible to carry out maintenance works of the abovementioned network; however, carrying out the maintenance needs huge budget and human resources, in that regard it can be said that the current maintenance state is not sufficient.

The other roads with stretch of approximately 10,000km are maintained by each local authority, and its maintenance is normally carried out by each district department. In the regulation which refers the re-structuring of the Ministries enacted on 31st October 2005, the networks consisting of the urban and other roads are expected to be maintained by the Ministry of Public Works and Equipment (MPWE). The maintenance budget for the roads other than urban roads is obtained from the Road Funds; however, considering the existence of many important roads which connects inter-urban, the funds will not suffice the maintenance works budget for these roads. The MPWE might request financial support for the maintenance works on the roads other than urban roads from the Donors, Development programmes and NGO who had support before the civil conflict.

As the district department are considered to be key player for maintaining the road network, their department goals should be included in case of establishment of overall regional development programme.

Since the start of civil conflict in 1993, maintenance of the roads network has been forgotten and the conditions of roads have become worse gradually. Moreover, the roads network was experiencing regular bad effects from geological features, which causes ageing of structure and landslides.

It has been pointed out that other ministries and NGOs have worked out programmes regarding the studies and/or implementations of road development on their own, without any discussions with the MPWE although the MPWE is responsible for road development programmes.

The sector programme summarizes identified problems as follows;

- No data base for the existing networks
- A little participation of private sector on road development programmes

- No implementation of investigation as well as maintenance on the road networks
- Shortage of human resources for road maintenance works
- Ageing of machineries progressed due to difficulties of obtaining spare parts

8-2-2 Basic Policy

The policy on which this study stands is as follows.

(1) Coordination with existing policies

As Bujumbura is capital of Burundi, the city is expected to functions as the hub of every sort of activities such as politics, administration, economic, transport and other supplementary infrastructure. Accordingly the policy of Bujumbura's urban transport improvement plan shall comply with some considerations of nationwide development policies and plans, for that reason it shall then harmonize with above mentioned existing policies.

(2) Urban Transport Improvement Plan with consideration of long-term design

The Study will draw a rough future picture on urban transport system beyond the target year as the long-term design. The future pictures will show an optimum composition of urban transport system in Bujumbura. Based on the pictures, the Urban Transport Improvement Plan on target year 2017 shall be established with considerations of the reality and viability.

(3) Shifting to public transport from private vehicles

The Study Team has experienced and observed some problems on transport sector among major cities in eastern African countries. The biggest problem experienced is an increase of private vehicles as a result of the improvement of living standards. The private vehicles occupy the biggest part of the roads capacity at the same time they carry few passengers. Consequently they create low transport efficiency and results into traffic congestions. Shifting the traffic modes from private to public is the key concept to solve the urban transport congestion.

(4) Increase of efficiency of public transport

Since no sufficient mass transit system is in operation in Bujumbra city, mini busses takes part of major transport but it is not well organized and controlled, thus it make the traffic congestion and confusion to be more serious. In order to take an essential role in urban transport as a common means of transportation for citizens, public transport should be more efficient and sophisticated, so as to attract more passengers.

(5) TDM

As Bujumbura has already been urbanized, the space for road widening is limited in CBD area. In addition, there is geographical limitation for the introduction of new road networks due to the existence of hilly area and mountains on eastern side and Lake Tanganyika on western side. Therefore, construction of new roads due to the increasing demand one after another has limitation. Considering worldwide trend on awareness of environmental reverse impact, the TDM shall be included in the Master Plan.

8-3 TRANSPORT DEVELOPMENT CONCEPT (LONG TERM)

A period of 10 years is too short to study the infrastructure which has longer life span more than 10 years. In this study, target year is set to be 2017, but in this section, transport development concept shall deal with the long term plan beyond 2017.

The structure of transport development concept is shown in Figure 8.3.1

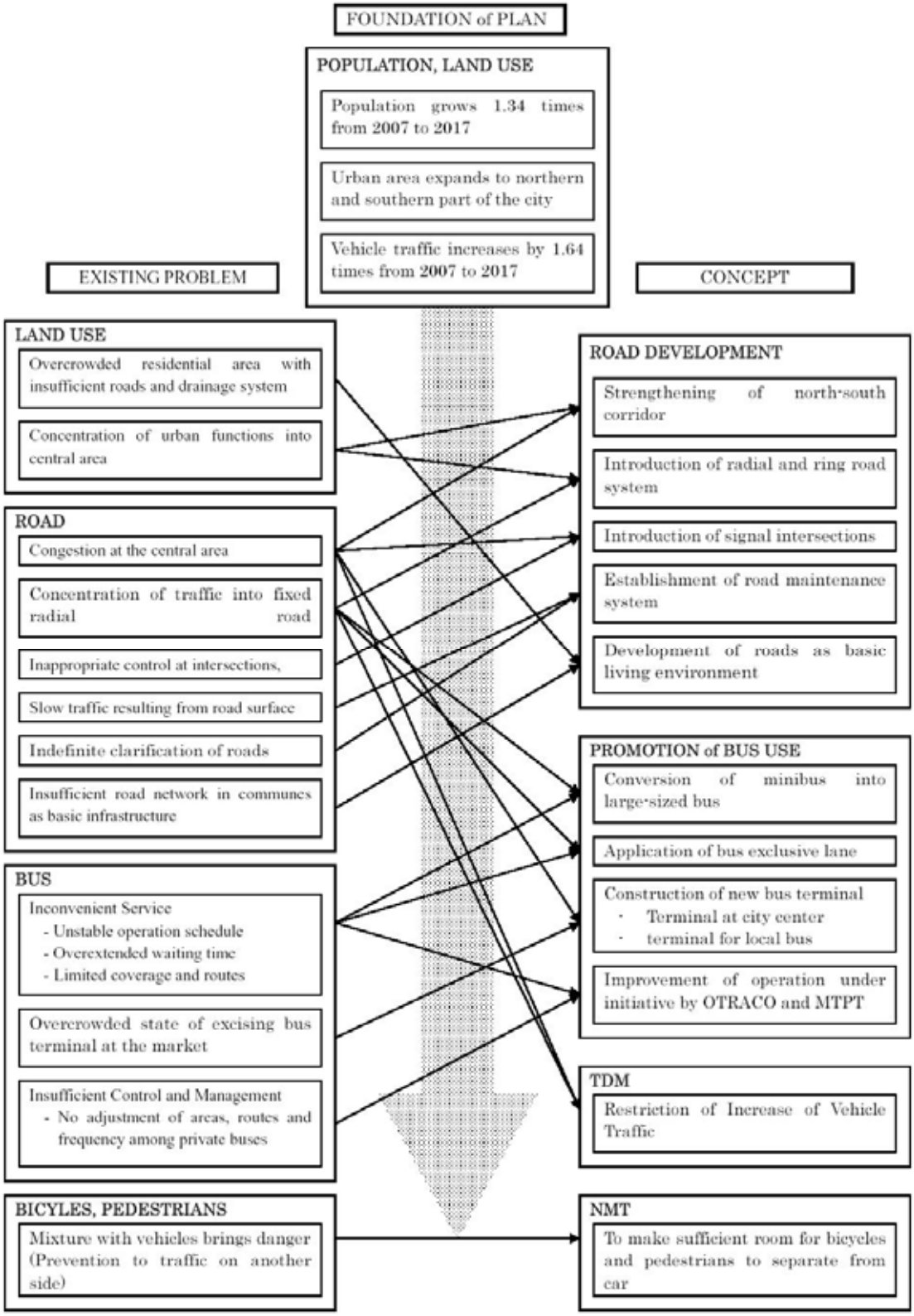


Figure 8.3.1, Urban Transport Concept

8-3-1 Road Development

(1) Strengthening of North-South Corridor

Since the urban area forms a belt-like shape, especially in southern area, urban area should be covered with multiple roads. Both the belt-like urban area and the roads which go along the urban area make the north-south corridor. Under the condition that current urbanized area of Bujumbra is extended to north and south, and the future urban expansion is expected to be in the north and south areas, the quantity of traffic flow to/from north and south directions will increase progressively. Corresponding to this traffic flow, arterial roads which constitutes north-south corridor should be strengthened.

a. Enforcement of north-south axis

Following this objective, enforcement of existing north-south axis, NR-3 and NR-9, is needed

b. Development of alternative route

A road which takes part of alternative road in corridor assists in the reduction of traffic concentration in north-south axis. This alternative road should be developed to reinforce redundancy of network as well as a substitute route.

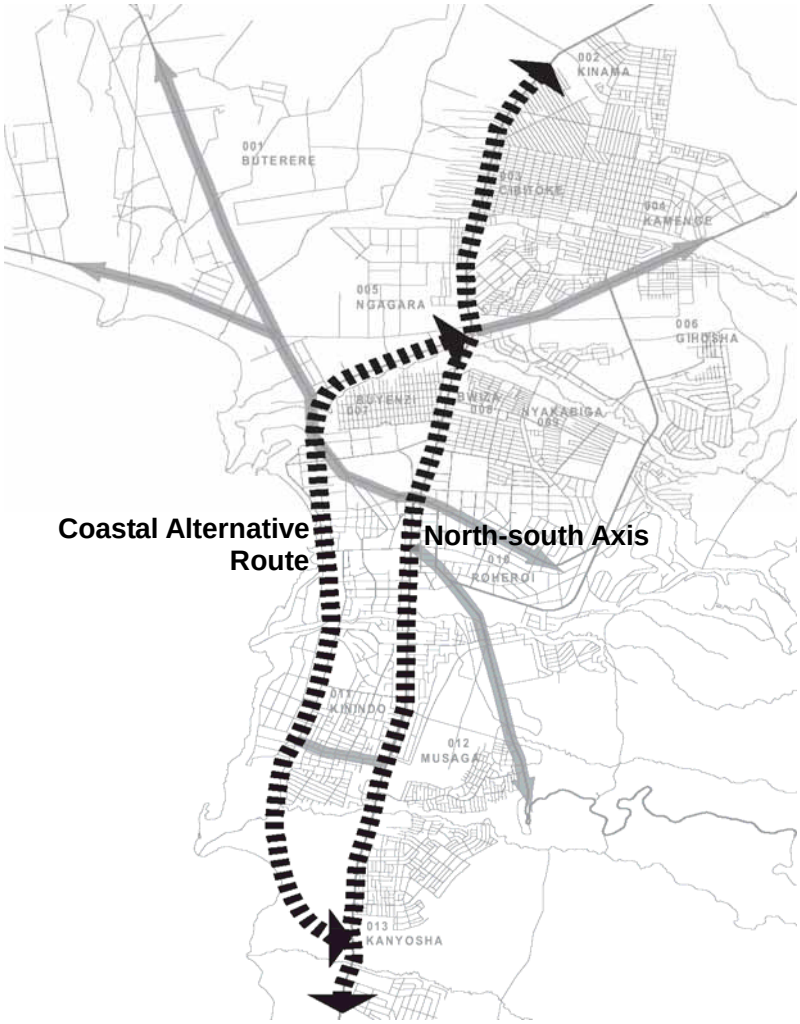


Figure 8.3.2, Strengthening of North-south Corridor

(2) Introduction of radial and ring road system

In the central area of Bujumbura, existing roads form a radial network focusing CBD area, all city activities including traffic movement concentrate into CBD. In order to disperse activities to areas adjacent to CBD, and to bypass the traffic which is not related to CBD, inner ring road surrounding CBD should be developed. In the outer side area of the town, Bld. du 28 Novembre and other roads are taking a role of outer ring road connecting radial arterial roads. But since the existing outer ring road is not completed in the western part, traffic flow passes thorough CBD on the radial arterial roads. Therefore, completion of outer ring road is necessary in the western part.

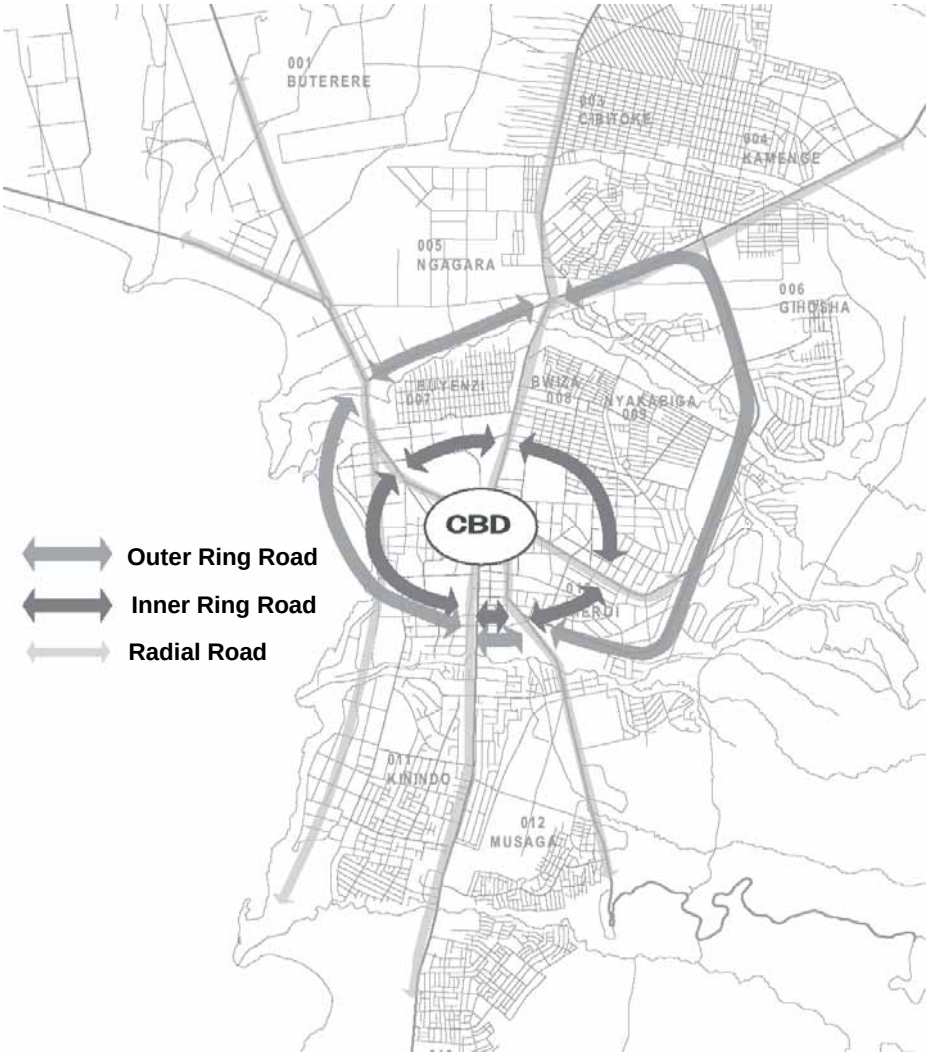


Figure 8.3.3, Radial and ring road system

(3) Introduction of signal intersections

In addition to the increasing traffic volume, intersections without proper traffic control accelerate congestion at the city centre. At present, since no traffic signal is in operation in Bujumbra city roads, heavy congestion around intersection is observed at peak hours. This has become a bottleneck to traffic particularly at the intersections on the four-lane principal arterial roads, where the traffic volume is big. Enlargement of roundabout intersection is impossible due to the limited free land along the road in the city centre, therefore signal intersection is the only alternative to be introduced.

(4) Establishment of road maintenance system

Continuous road maintenance is crucial to sustain satisfactory condition of roads. Proper maintenance of roads is implemented through systematic procedure. Such as;

- To find and keep a database for road maintenance
- To make a maintenance plan based on database
- To implement maintenance by following the maintenance plan

Consequently it is essential to establish road maintenance system.

(5) Development of roads as basic living environment

Road is a fundamental facility for living environment comprising the function as access route to each house, space for lifeline including drainage as well as open space to get sunshine and ventilation. Many regional roads in the developed area in Bujumbura are unpaved without adequate drainage facilities causing serious problems to public health. Therefore, improvement of roads including drainage in the communities' local streets should be necessary.

8-3-2 Promotion of Bus Use

(1) Conversion of minibus into large-sized bus

Since it is impossible to meet the increasing traffic vehicle demand by means of introducing new roads and widening of existing roads due to land use constraints, traffic vehicles should be converted into mass transportation vehicles. What are being operated as mass transit in the city are only buses, mostly minibuses. Since, minibuses are taking an important role as means of transportation for citizens, the capacity of single minibus looks to be small and therefore their number have increasingly becoming big to meet the passenger's demand. The increasing number causes congestion on the roads. Conversion to mass transit from passenger car or precisely from minibus to large bus is essential to enhance the efficiency of transportation.

(2) Application of bus exclusive lane

In order to promote bus use, regular operation of buses and improvement of running speed are exclusively important. To improve the running speed of a bus and to raise the superiority over a passenger car, introduction of a bus lane is necessary and effective. Since transport demand is concentrating in the direction of north and south from the city centre, a bus lane need

to be introduced in the trunk road connecting north and south. This exclusive lane will work as a route for BRT (Bus Rapid Transit).

(3) Construction of new bus terminal

In order to improve bus user's convenience, bus terminals should be built to raise the effectiveness of the whole network by means of easy connection between buses, and reduction of stoppages of buses on a road to minimize the road obstruction.

In the city, the following two type of bus terminal are required.

a. Bus terminal for urban buses:

   Since the bus terminal attached to the present market runs short of capacity, new bus terminal for city route should be constructed at the city centre.

b. Bus terminal for district buses:

   It is the terminal for district routes and international routes, and is supposed to be introduced in suburban part.

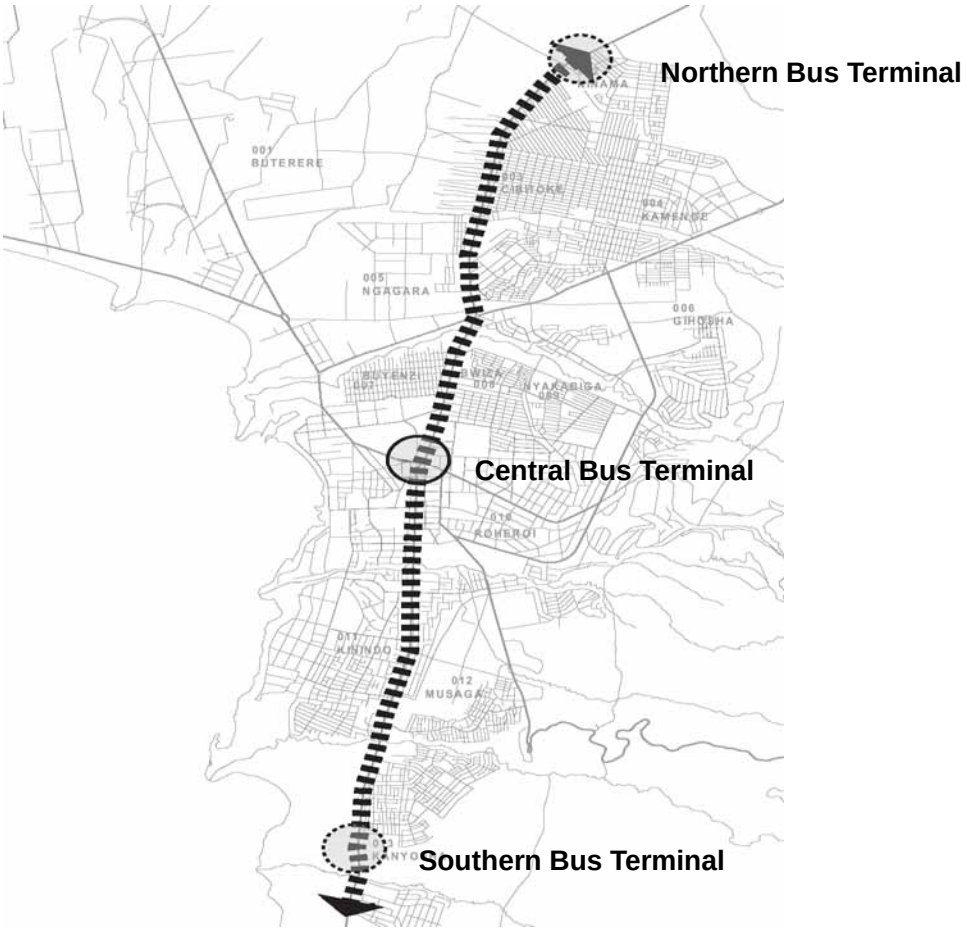


Figure 8.3.4, Introduction of BRT and establishment of New bus Terminal

Figure 8.3.5, Image of BRT on North-South axis

(4) Improvement of operation under initiative of MTPT and OTRACO

Another measure which must be taken in order to promote the use of bus is by improving the bus operations. At present, while some areas can be found without bus services, the

concentration of services can be observed on routes with high profit. Improvement of this situation should be conducted under the instruction of the Ministry of Transport, and OTRACO is called to take a lead to carry out the improvement.

8-3-3 Traffic Demand Management

- Restriction of Increase of Traffic Vehicle

In order to restrain the increasing traffic vehicles, the measure which should be performed besides promoting use of public transportation is TDM. In order to realize TDM policy in Bujumbura city, the introduction of the method such as car pool, restriction of heavy trucks and passenger cars at the central area, parking and bus ride system, etc., should be re-examined.

8-3-4 NMT

-To make sufficient room to separate bicycles and pedestrians from motor vehicles

The Bujumbura city area being collectively compared, there are many pedestrians and bicycle users. Moreover, these traffic means which is environmental friendly and which can be used by anyone will increase further in the future. The protection of Pedestrian and Bicycle users from traffic vehicles by provision of proper infrastructure to secure comfortable and safe travelling is required.

8-4 TRANSPORT DEVELOPMENT STRATEGY

In this paragraph, the strategy for realizing the concept of the foregoing paragraph is shown. The following table shows the view of a phased plan in which short term is defined as the term before 2017 and long term as the term after 2017.

Table 8.4.1, Development Strategy

	Short Term	Long Term
Period	～2017	2017～
Objectives	・ Solving urgent problems ・ Composing fundamental traffic frame for the future	・ Completion of future structure ・ Achievement of balance between demand and supply of traffic
Road Network	・ Establishment of radial and ring road pattern ・ Forming north-south corridor ・ Improvement of bottle neck ・ Stand –alone signal ・ Development of community roads	・ Widening of radial roads ・ Extension of north-south corridor ・ Widening of north-south axis ・ Improvement in lengthwise ・ System signal ・ Free access to every community
Public Transport	・ Coexistence of minibus and large bus ・ Hourly exclusive lanes in CBD ・ Expansion of OTRACO operation in urban transport ・ Route restriction for bike-taxi and bicycle-taxi	・ Shifting to large bus ・ Introduction of BRT along north-south axis (All day exclusive lanes) ・ Operation by integrated enterprises ・ No route restriction for bike-taxi and bicycle-taxi
TDM	・ Introduction of traffic demand management ・ Enhancement of carpool	・ Reinforcement of traffic demand management ・ Restriction of passenger cars in CBD ・ Park and bus ride
Pedestrian, bicycle	・ Coexistence of pedestrians and bicycles on sideways of trunk roads	・ Separation of pedestrians and bicycles on sideways of trunk roads

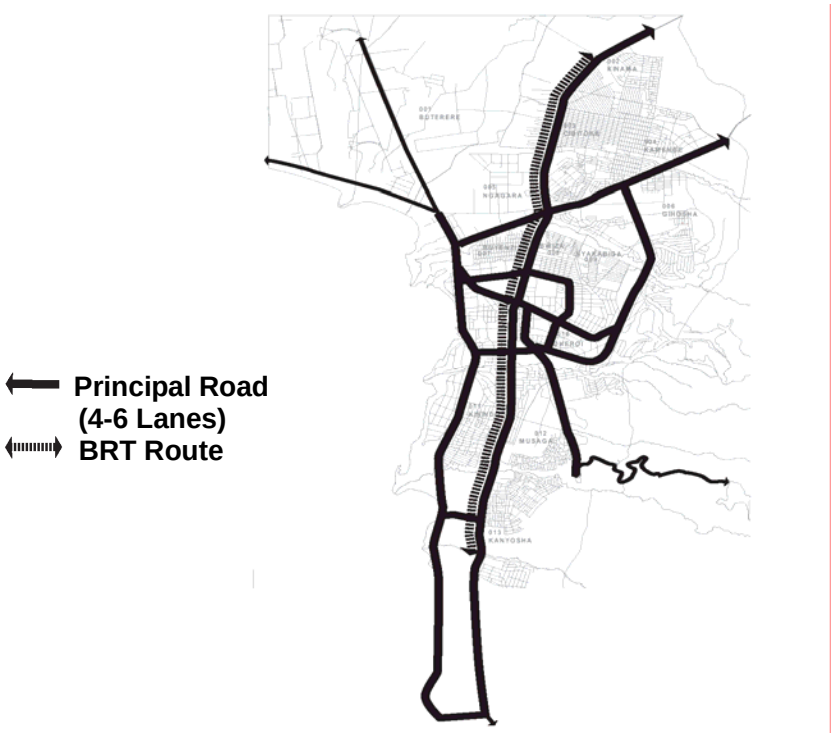


Figure 8.4.1, Transport Development Strategy in Long Term

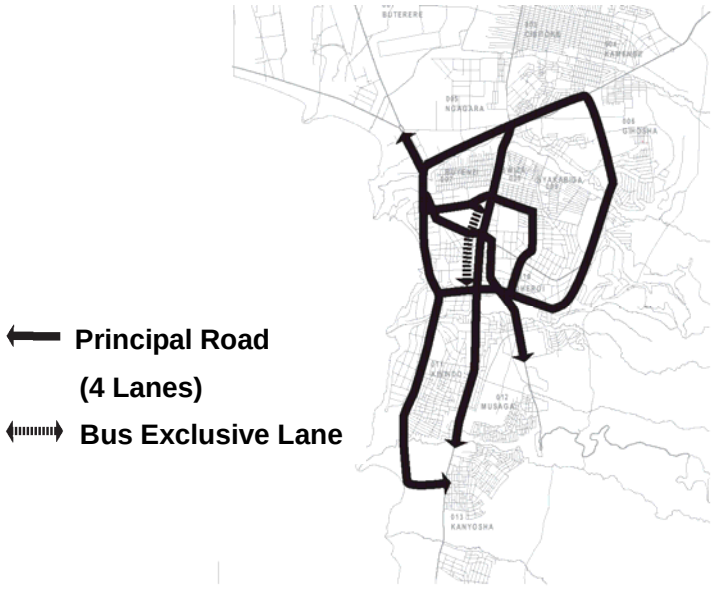


Figure 8.4.2, Transport Development Strategy in 2017

CHAPTER 9

ROAD DEVELOPMENT PLAN

CHAPTER 9 ROAD DEVELOPMENT PLAN

9-1 IMPROVEMENT POLICY

The following Road development concepts result from the viewpoint contribution of existing problems in Bujumbura city, and for the city development in future.

Concept1：Solve the traffic congestion in city centre
Concept2：Strengthen the road network to future traffic demand
Concept3：Formulation of road framework for the expansion of Bujumbura city
Concept4：Development of basic infrastructure in commune
Concept5：Support for good condition of road facilities

Project menu about road improvement is proposed under the basic policy as shown below. The detail contents of each menu are shown in next section.

- Development of **road network** in Bujumbura
- Improvement of **traffic management** in city centre
- Construction of road to assist **urban development**
- Establishment of **road maintenance** program for road facilities

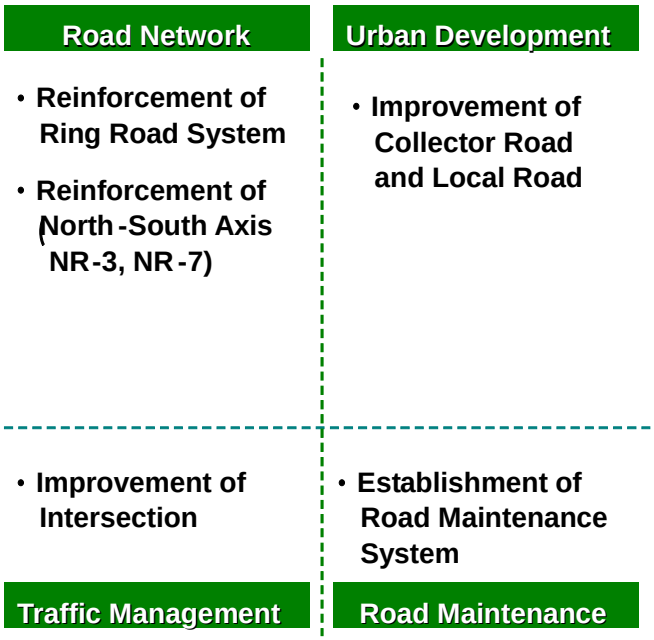


Table 9.1.1 Road Development Policy

9-2 DESIGN CONDITION

9-2-1 Definition of Classification

The future road network system in Bujumbura shall consist of roads classification in four categories. Basic function of each category is;

(1) Principal Arterial Road

- National Road connecting major cities or district to Bujumbura
- Ring road forming city central boundary in Bujumbura
- Road connecting the major urban function

(2) Arterial Road

- Road connecting districts in Bujumbura widely
- Local distributor connecting or supporting mutual principal arterial road
- Road forming the basic structure of urban area in Bujumbura

(3) Collector Road

- Access road connecting Principal arterial road or Arterial road to community

(4) Local Road

- Small road in community except the classification in above

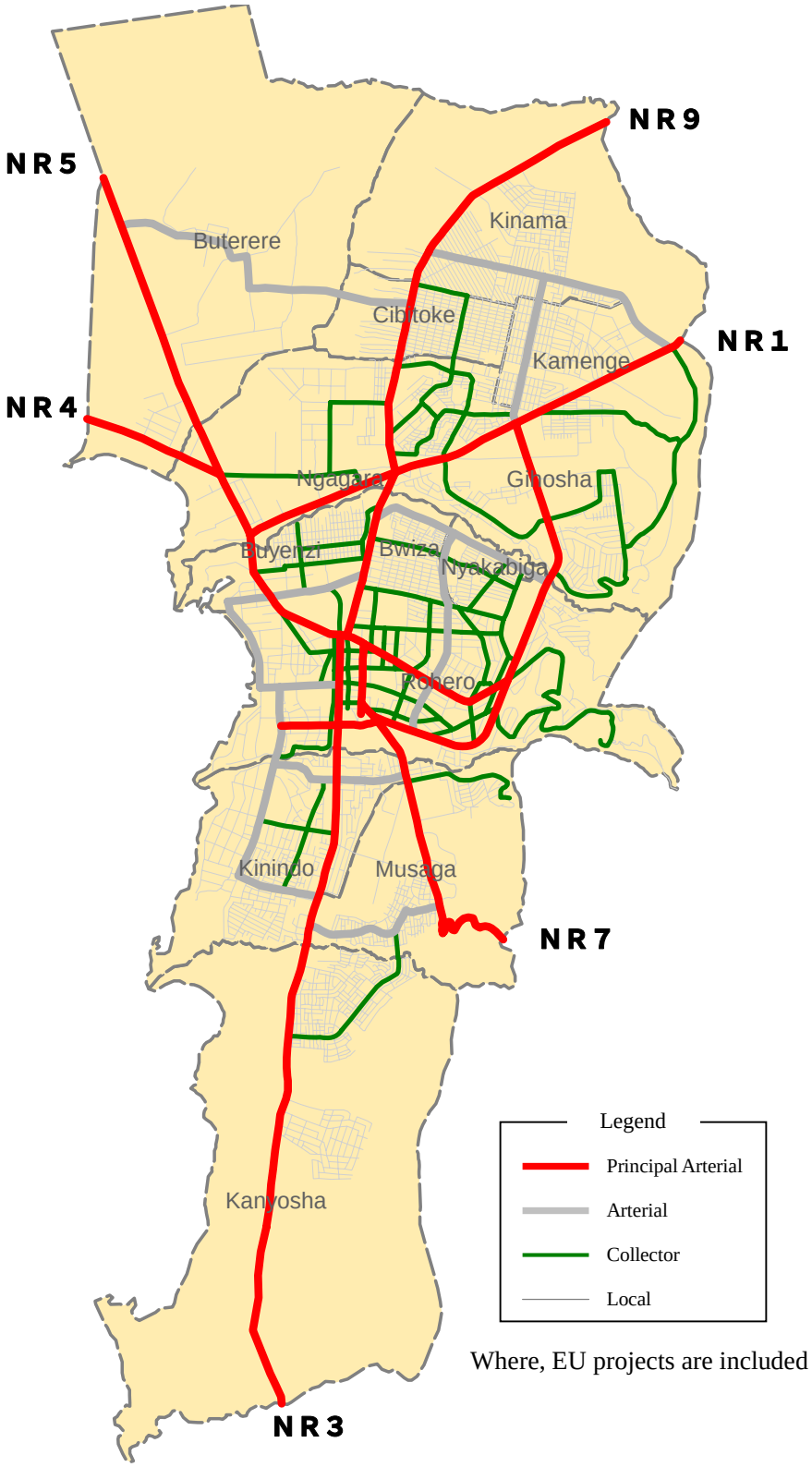


Figure 9.2.1, Road network plan and Classification in Bujumbura

9-2-2 Design Criteria

Design standard of cross-section component, design speed and so on was decided by using the Japan road guidelines from Japanese standard.

9-2-3 Composition of Cross-section

(1) Carriageway

a) Design speed

The design speed was set as follows according to each road classification based on Japan road guidelines in Japanese standard in which design speed is set to all roads except highway or expressway.

Table 9.2.1, Carriageway Width (Japanese Standard)

Road classification		Speed (km/h)	
		Normal	Special
Rural road	Class-1	80	60
	Class-2	60	50 or 40
	Class-3	60, 50 or 40	30
	Class-4	50, 40 or 30	20
	Class-5	40, 30 or 20	-
Urban road	Class-1	60	50 or 40
	Class-2	60, 50 or 40	30
	Class-3	50, 40 or 30	20
	Class-4	40, 30 or 20	-

Notes: All roads except highway

Source: Japanese road guidelines, Japan Road Association

Table 9.2.2, Width of Lane

Road Classification	Speed (km/h)	Notes
Principal Arterial	80	
Arterial	60	
Collector	50 or 40	
Local	30 or 20	include stone pavement

b) Lane width

Taking into account the current width of roads in Bujumbura (inventory survey), the width of carriageway was set as follows according to each road classification based on Japan road guidelines. The situation of road width is similar to Japanese road condition as a result of the road inventory survey, and many paved roads (mostly arterial roads) have a carriageway width of between 3.0~3.5m. According to the survey results, it does not appear that the road widths were set according to road classification.

Table 9.2.3 Width of Carriageway (Japanese Standard)

Road classification		Width (m)	Notes
Rural road	Class-1	3.50	
	Class-2	3.25	
	Class-3	3.00	
	Class-4	2.75	
	Class-5	-	No centre line
Urban road	Class-1	3.25	
	Class-2,3	3.00	
	Class-4	-	No centre line

Notes: All roads except highway
Source: Japanese road guidelines, Japan Road Association

Table 9.2.4 Width of Lane

Road Classification	Width (m)
Principal Arterial	3.50
Arterial	3.25
Collector	3.00
Local	2.75

c) Shoulder width

The width of shoulder was also set according to Japanese standard from Japan road guidelines. The principal arterial road and arterial road shoulder width was decided according to the Japanese standard of rural road class-1 and minimum standard of parking lane of urban road. The collector road and Local road shoulder width was set to 0.5m which is minimum width of shoulder in Japanese standard.

Table 9.2.5, Minimum Width of Shoulder (Japanese Standard)

Road classification		Width (m)					
		Left			Right		Tunnel
		normal	Special	desirable	normal	desirable	
Rural road	Class-1	1.25	0.75	1.75	0.50	0.75	0.50
	Class-2	0.75	0.50	1.00	0.50	0.75	0.50
	Class-3	0.75	0.50	0.75	0.50	0.50	0.50
	Class-4	0.75	0.50	0.75	0.50	0.50	0.50
	Class-5	0.50	-	0.50	0.50	0.50	0.50
Urban road	All	0.50	-	0.50	0.50	0.50	0.50

Notes: All roads except highway
Urban road have basically parking lane (minimum 1.5m)
Right shoulder is in case of dividing by anyway except the median
Source: Japanese road guidelines, Japan Road Association

Table 9.2.6, Width of Shoulder

Road Classification	Width (m)	
	Right	Left
Principal Arterial	1.50	1.00
Arterial	1.50	1.00
Collector	1.00	0.50
Local	1.00	0.50

(2) Walkway

a) Development policy for walkway, bicycle-way, and bicycle and walkway

Since pedestrian and bicycle users involve far different style and speeds than automobiles, it is basically desirable to provide exclusive spaces, however, it is not economical to provide such spaces on all roads. Therefore, it is important to base decisions on a general examination of traffic volumes, speed differences and roadside conditions, etc. between each mode.

Generally speaking, since it is dangerous for bicycles to run on carriageways and this also impedes the vehicles, the minimum requirement is to separate the two. On the other hand, in the case where pedestrians and bicycles travel in the same space, there is a risk that friction occurring between the two will adversely impact the safety and pleasantness of passage for both. Accordingly, in cases where bicycle traffic volume is extremely large, it is considered necessary to develop the bicycle exclusive lanes.

Looking at the results of the community survey, etc, the bicycle ownership rate in Bujumbura is

not very high. The household bicycle ownership rate is 6.2%, which is less than half the car ownership rate, and the bicycle commuting rate is also less than 10%.

Table 9.2.7 Ownership Rate of Bicycle, Car and Motorbike

Items	Bicycle	Car	Motorbike
Ownership Rate	6.2%	13.2%	1.3%

Source: Summary of Community Survey, JICA Study Team

Table 9.2.8 Utilization of Bicycle in Bujumbura City

Items	Bicycle	Pedestrian	Car	Bus	Others
Modal share (Work)	9.5%	52.7%	9.3%	25.4%	3.1%

Source: Summary of Community Survey, JICA Study Team

Considering these figures, it is not economical to build bicycle exclusive lanes. Accordingly, it is considered appropriate for bicycles to utilize the same spaces as cars or pedestrians. In this case, in the event where the car traffic volume is heavy and it is too dangerous for bicycles to use carriageways, it is appropriate to adopt bicycle and walkways that can be shared by bicycles and pedestrians.

In cases where bicycles and pedestrians use the same spaces but the volume of bicycle traffic is extremely small, unless there is some impediment to passage by pedestrians and bicycles, it may be desirable to adopt only somewhat walkways.

b) Road width structure

According to the results of the inventory survey in Bujumbura, walkways are mostly between 1.0~3.0m in width. Accordingly, minimum width was set upon by taking these figures and road structure criteria in Japan (walkways and bicycle and walkways).

Table 9.2.9, Minimum width of Walkway

Items	Bicycle	Pedestrian	Bicycle and Pedestrian
Width of walkway	2.0m	2.0m (1.5m)	3.0m

( ) special case

c) Development policy of walkway and bicycle-way

Based on the above points, the following development policy for walkways and bicycle-ways according to road classification is suggested. Only local residents generally use local roads in communities and traffic volumes are limited. Moreover, since these roads are basically stone paved, vehicle speeds are constrained. Accordingly, local roads shall be shared with pedestrians and, as a

rule, there shall be no provision of walkways, etc. (most existing local roads in communities are already this type). Furthermore, in cases when installing walkways, they shall basically be constructed beside roads.

Table 9.2.10 Policy of Walkway Development

Road Classification	Number of Cars	Number of Pedestrian	Walkway Style	Minimum Width	Notes
Principal Arterial	Many	Many	Bicycle and Pedestrian	3.5m (2.0+1.5)	Separate Pedestrian from car, bicycle
Arterial	Many	Many	Bicycle and Pedestrian	3.0m	Separate Pedestrian from car
Collector	Little	Little	Pedestrian	2.0m	Separate Pedestrian from car
Local	Few	Little	-	-	Not separate Pedestrian from car

More than 4 Lane Road: mount-up style, 2 lane road: flat style

Walkway is established in both sides basically

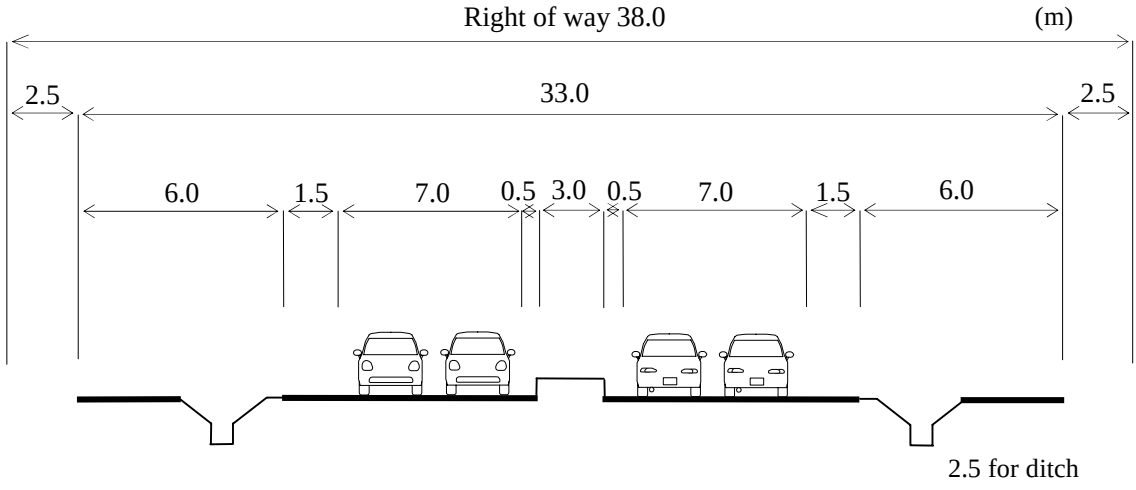
(3) Right of way

Definition of right of way in Burundi is not confirmed yet. In this study right of way is defined as follows, to take into consideration the land for utilities having width of about 2.0 – 2.5m on both road side away from the walkway or ditch especially.

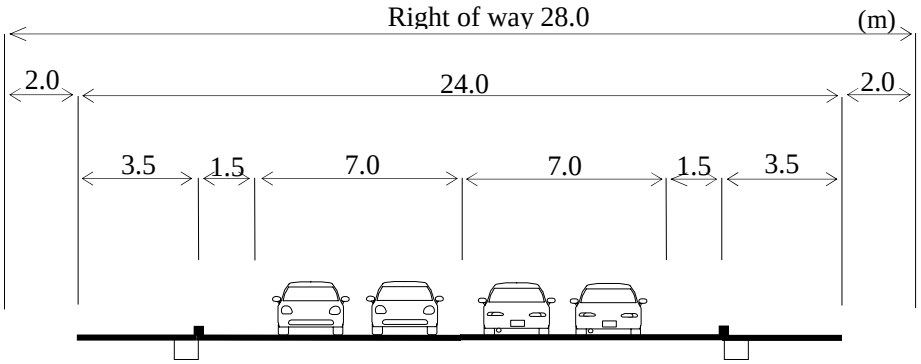
(4) Typical cross section of each road classification

a) Principal Arterial road

4 Lane Section (Desirable)

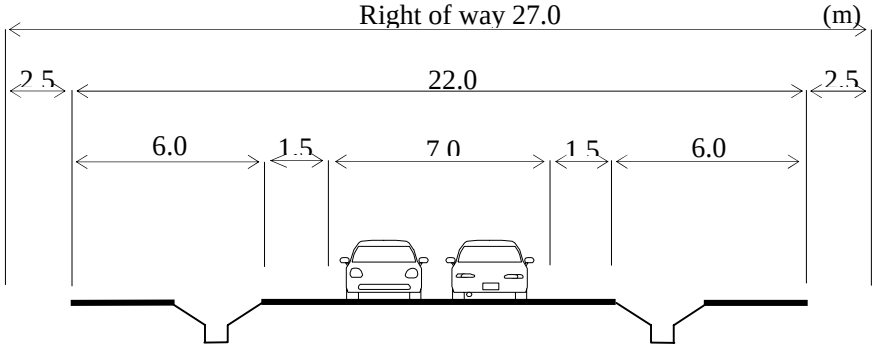


4 Lane Section (Minimum)



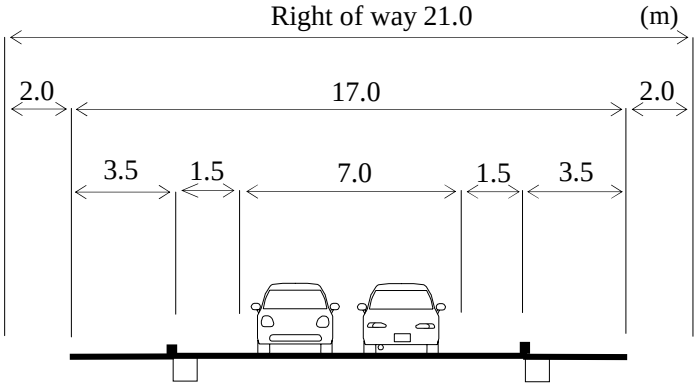
U-shaped Drain

2 Lane Road (Desirable)



2.5 for ditch

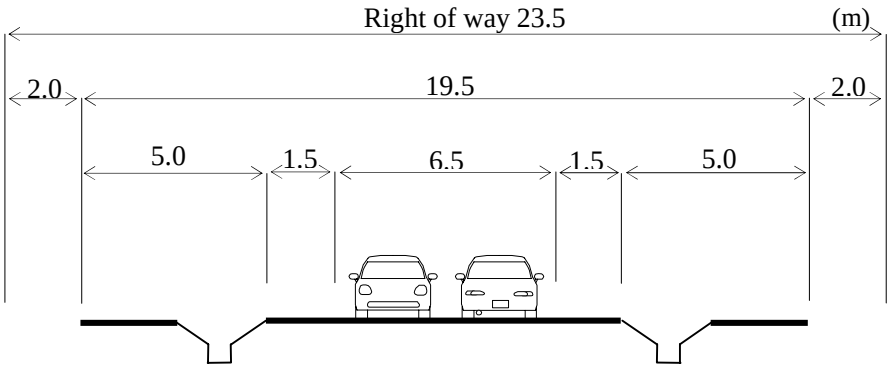
2 Lane Road (Minimum)



U-shaped Drain

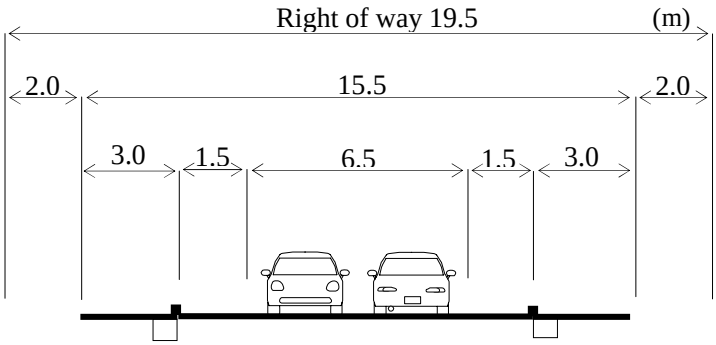
b) Arterial road

2 Lane Road (Desirable)



2.0 for ditch

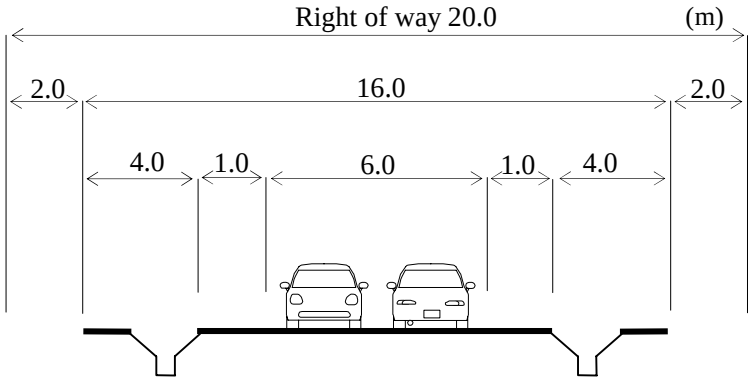
2 Lane Road (Minimum)



U-shaped Drain

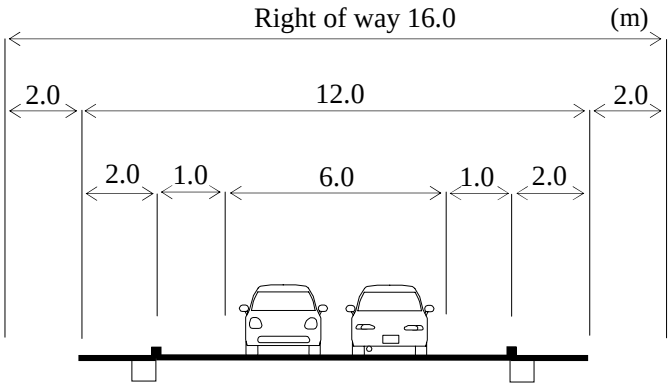
c) Collector road

2 Lane Road (Minimum)



2.0 for Ditch

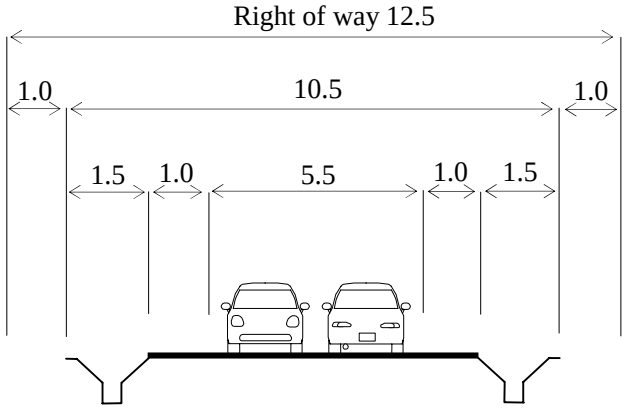
2 Lane Road (Minimum)



U-shaped Drain

d) Local road

2 Lane Road



1.5 for ditch

Figure 9.2.2 Typical cross section by road classification

Table 9.2.11 Summary of Design Criteria

	Road Classification			
	Principal Arterial	Principal	Collector	Local
Design Speed (km/h)	80	60	50 or 40	30 or 20
Design Traffic (pcu/day)	- 10,000	10,000 - 4,000	4,000 - 500	500 -
Road Reserve (minimum)	38.0 (4 lane) 27.0 (2 lane)	23.5	20.0	12.5
Lane Width (m)	33.0 (4 lane) 22.0 (2 lane)	19.5	16.0	10.5
Lane	3.5	3.25	3.0	2.75
Shoulder	1.5	1.5	1.0	1.0
Median	3.0	1.0	-	-
Walkway	3.5	3.0	2.0	-

9-3 ROAD NETWORK DEVELOPMENT

In Bujumbura City, in year 2017, the population, GRDP, and car ownership number will become 1.3, 2.1 and 1.7 times respectively of the current figures.

As a result, the traffic demand is forecasted to increase and be more than 1.6 times at screen lines (Table9.3.1 and Figure 9.3.1) in 2017.

In order to cope with the future increase of traffic demand as well as to accelerate city development, the trunk roads shall be developed to form a rational road network.

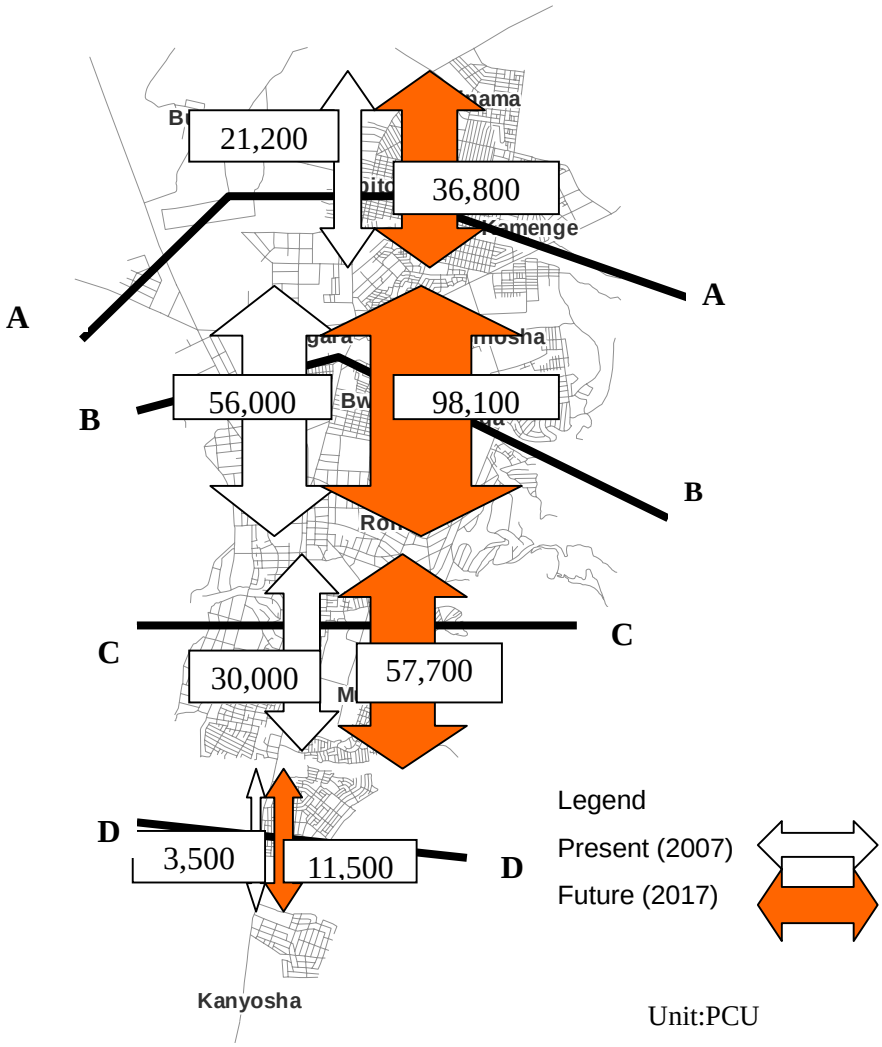


Figure 9.3.1, Traffic Flows at Screen Lines

Table 9.3.1, Traffic Demand at Screen Lines

Screen Line	Location	Traffic Demand		Rate of increase
		2007	2017	(times)
A-A	Nyabagera river	21,200	36,800	1.7
B-B	Ntahangwa river	56,000	98,100	1.8
C-C	Mpimba river	30,000	57,700	1.9
D-D	Kanyosha river	3,500	11,500	3.3

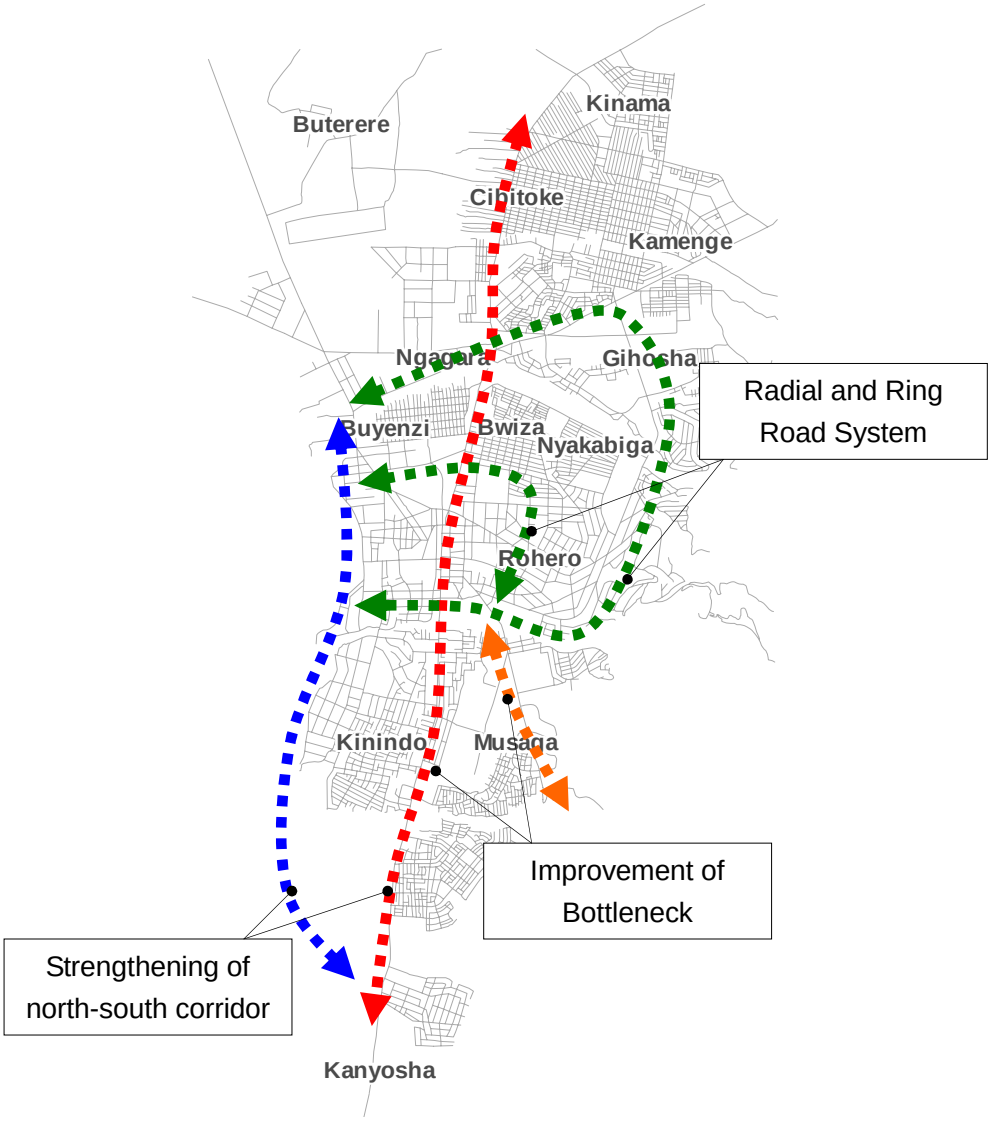


Figure 9.3.2, Future Road Development Policy of Principal Arterial Roads

9-3-1 Coastal alternative route

1) Concept

To cope with the increasing traffic on roads with North-South direction mentioned above, traffic capacity in road network should be expected. Measure to extend the capacity are realised in the following two ways.

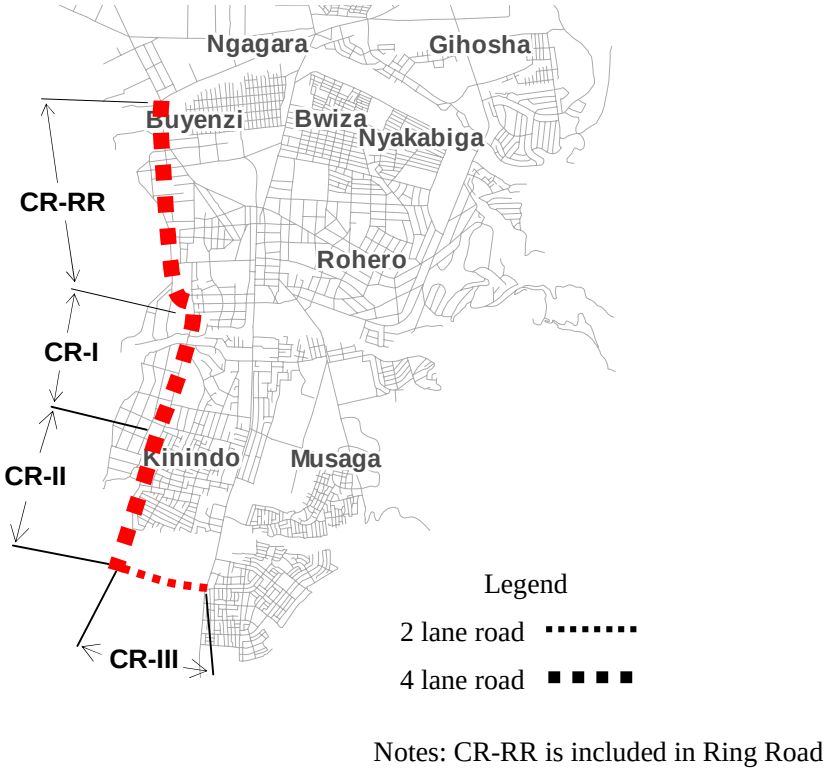
- Strengthen existing road
- Develop an alternative route

Considering urgency of the issue and feasibility in the term until target year, development of

alternative route on the coast side is proposed. This alternative route together with RN-9 and existing north-south axis, creates north-south corridor. Except for the expansion of the road capacity, the corridor has following functions:

- To divide traffic not relating to CBD area
- To form a ladder network pattern that enables dispersion of traffic and increases redundancy.
- To enhance development in southern areas specifically for industrial functions

2) Location of Coastal alternative route



Notes: CR-RR is included in Ring Road

Figure 9.3.3, Location of Coastal alternative route

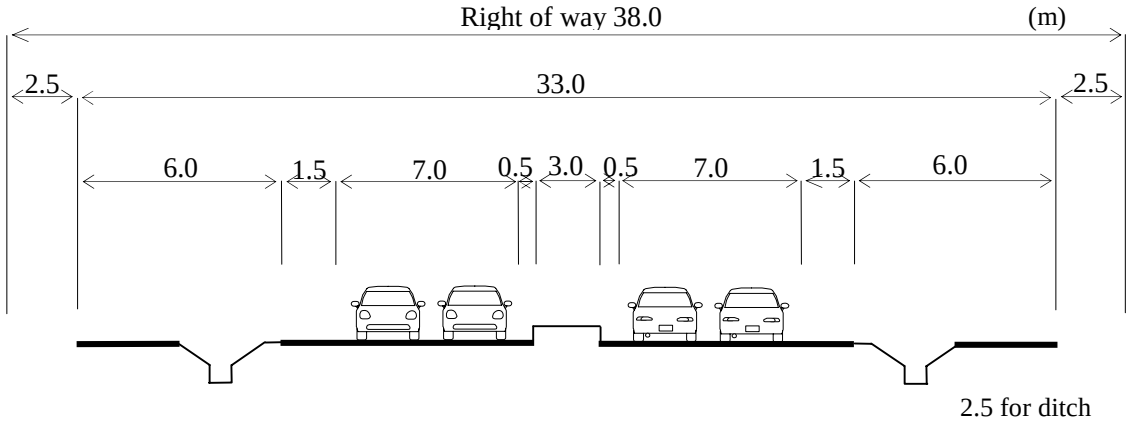
3) Future Traffic Demand

Table 9.3.2 Future Traffic Demand at River Section

Section	Location	Traffic Demand (pcu/day)
CR-RR	Buyenzi, Rohero	8,900 - 9,900
CR-I	Kinindo, Kanyosha	14,400
CO-II	Kanyosha	1,000 - 14,000
CR-III	Kanyosha	300 - 3,000

4) Typical Cross Section

4 Lane Section (CR-RR, CR-I, CR-II)



2 Lane Road (CR-III)

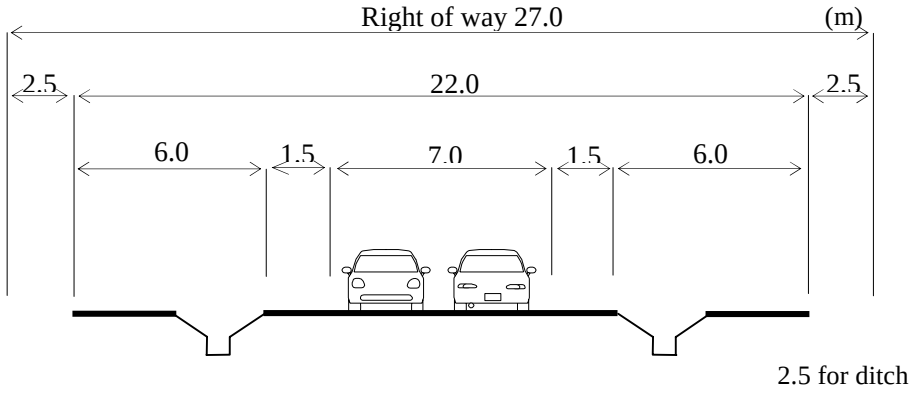


Figure 9.3.4, Coastal Alternative Route 2 Lane Section

5) Projects List

Table 9.3.3 Coastal Alternative Route

Section	Location	Length (km)	Number of lane	
			Present	Propose
CR-RR	Buyenzi, Rohero	2.4	2	4
CR-I	Kinindo, Kanyosha	2.3	2	4
CR-II	Kanyosha	1.8	-	4
CR-III	Kanyosha	0.8	-	2

Source : JICA Study Team

9-3-2 Improvement of North-south Axis around the CBD area

(1) Concept

In spite of the provision of coastal alternative route, capacity in RN-3 on the southern part of North-South axis is estimated to be exceeded around the CBD area due to the concentration of traffic. In long term, RN-3 is expected to be widened into 4 lanes up to the southern border of Bujumbura, but in the period until 2017 the target year of the project, urgent improvement of RN-3 into 4 lanes should be commenced from independence square to the intersection of Av. Nzero and Av. Gasibe.

(2) Location of North-South Axis

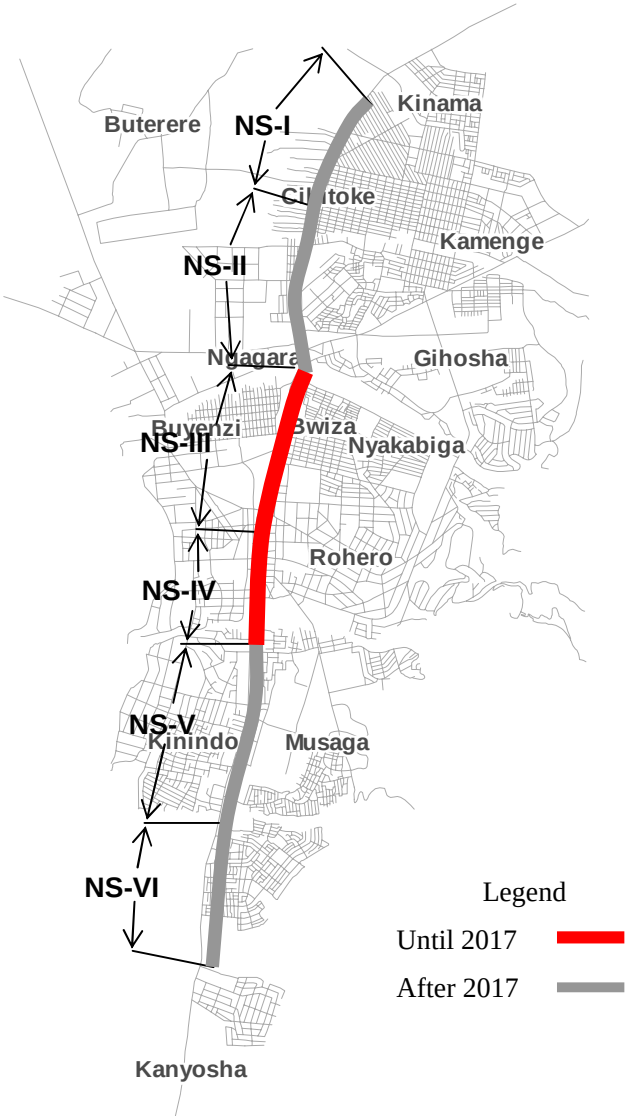


Figure 9.3.5, Location of North-South Axis

(3) Future Traffic Demand

Table 9.3.4, Future Traffic Demand at River Section

Section	Location	Traffic Demand (pcu/day)
NS-I	Kinama	1,400 - 5,300
NS-II	Ngagara	10,100 - 18,800
NS-III	Bwiza	17,700 - 36,700
NS-IV	Rohero	10,800 – 25,200
NS-V	Kinindo	6,100 - 6,500
NS-VI	Kanyosha	3,400 - 3,500

(4) Typical Cross Section

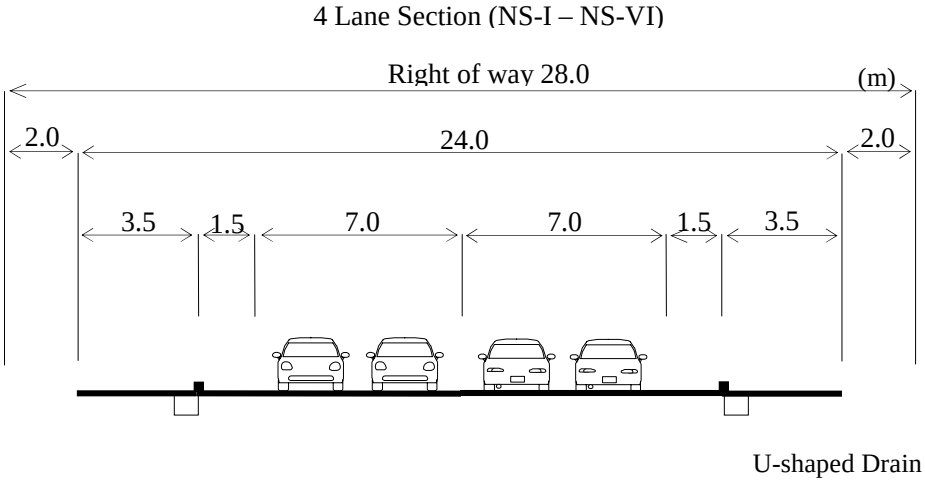


Figure 9.3.6, North-South Road

(5) Projects List

Table 9.3.5 North-South Axis Strengthening Projects

Section	Location	Length (km)	Number of lane	
			Present	Proposed
NS-I	Kinama	2.0	2	4
NS-II	Ngagara	2.5	2	4
NS-III	Bwiza	2.5	4	4
NS-IV	Rohero	1.7	2	4
NS-V	Kinindo	2.9	2	4
NS-VI	Kanyosya	2.4	2	4
Total	-	14.0	-	-

Source : JICA Study Team

9-3-3 Development of the Ring Road in Bujumbura city

(1) Concept

The four-lane urban ring road, at present, is provided at the section between the National Road No.1 in the north and the National Road No. 7 in the south, passing through the east at the foot skirts of the mountains. Furthermore, EU is planning a project to extend the National Road No. 7 up to the Lake Tanganyika side road.

There are some general streets having two lanes along the Lake Tanganyika side but their connectivity is not good. Therefore, traffic tends to use National Roads forming the frame roads for the direct access to the CBD, the situation that causes congestion at peak hours.

In order to cope with the increase in future traffic demand, to mitigate the traffic load to the city centre and to rationalize the traffic operation, improvement of the ring road is necessary. The aim is to disperse the concentrated traffic at the city centre by the ring road, which will be connected with the city centre by streets.

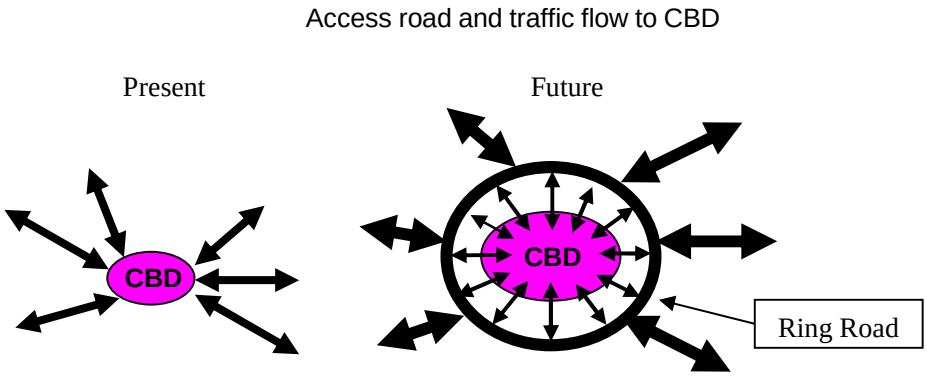


Figure 9.3.7, Development Image of Ring Road

(2) The subject of road improvement projects

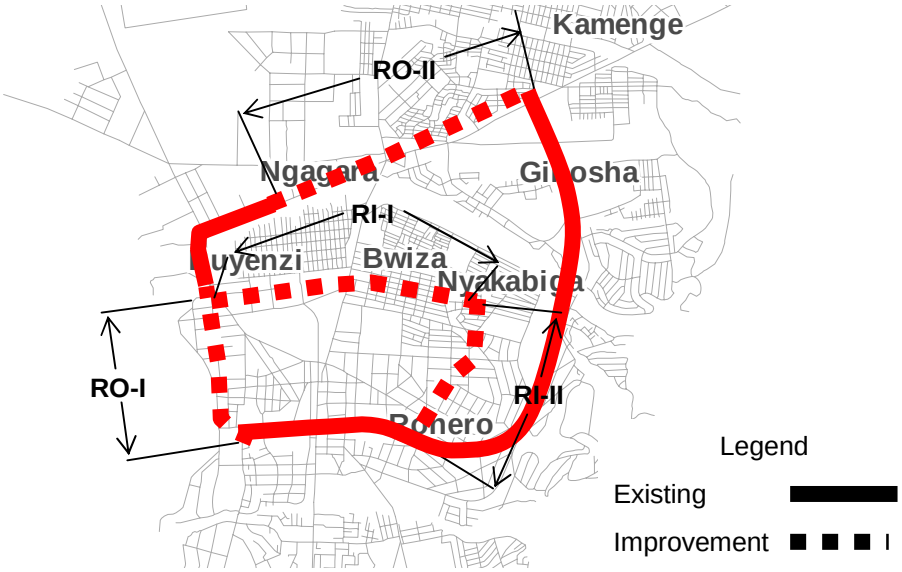


Figure 9.3.8, Location of Ring Road Development Project

(3) Future Traffic Demand (2017)

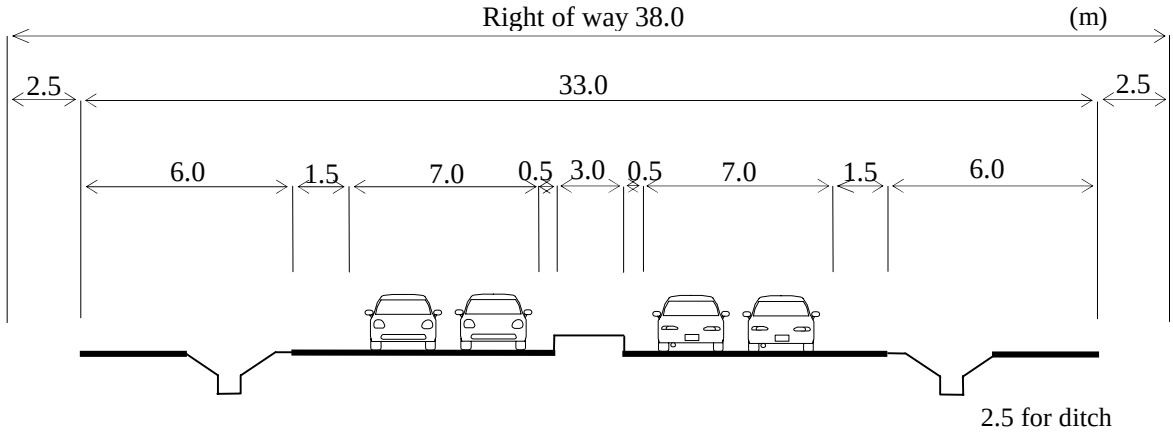
Table 9.3.6 Traffic Demand at Ring Road

Section	Location	Traffic Demand (pcu/day)
RO-I	Ngagara	8,900 - 9,900
RO-II	Rohero	8,600 - 19,500
RI-I	Rohero	2,500 - 12,200
RI-II	Rohero	4,900 - 12,300

Source: JICA study team

(4) Typical Cross Section

<u>4 Lane Section (RO-II)</u>



4 Lane Section (RO-I, RI-I, RI-II)

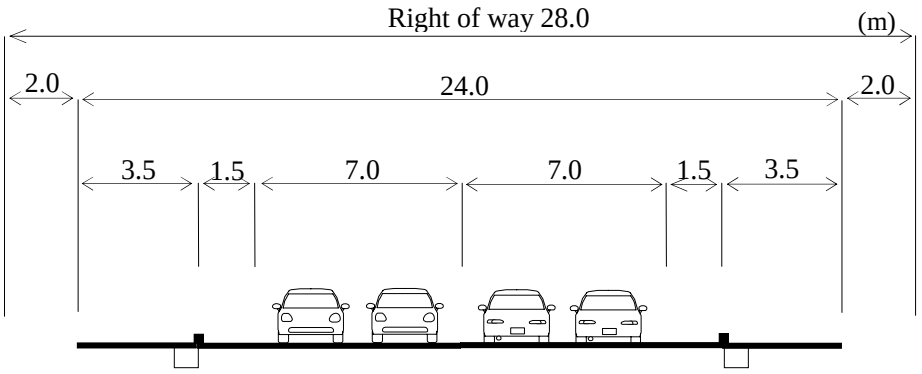


Figure 9.3.9, Ring Road 4 Lane Section

(5) Projects List

Table 9.3.7, Ring Road Development Projects

Section	Location	Length (km)	Number of lane	
			Present	Proposed
RO-I	Ngagara	2.4	2	4
RO-II	Rohero	2.6	2	4
RI-I	Rohero	2.4	2	4
RI-II	Rohero	1.9	2	4

Source : JICA Study Team

9-3-4 Widening of NR-7

(1) Concept

The progress of the development in Kanyosha residential area is expected to deal with the future population growth in Bujumbura City. In order to expand the residential areas in east of Kanyosha community, it is necessary to expand road width, which can be adequate for future traffic demand.

(2) Location of the projects

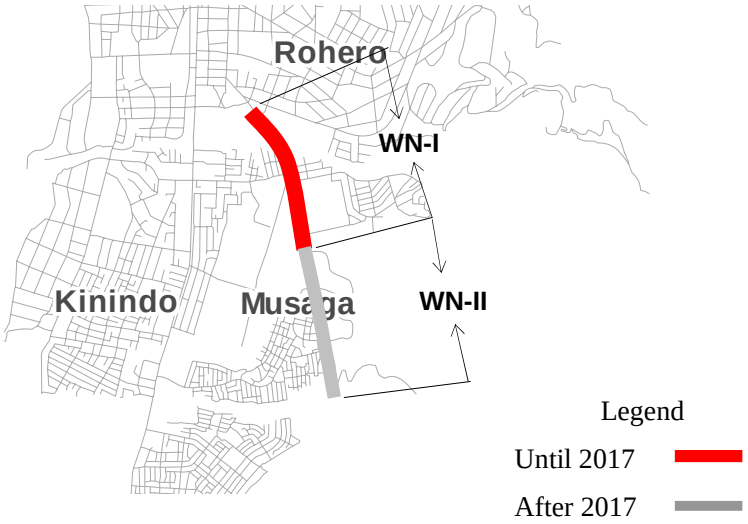


Figure 9.3.10, Location of Widening of NR-7

(3) Future Traffic Demand (2017)

Table 9.3.8, Future Traffic Demand at Widening of NR-7

Section	Location	Traffic Demand (pcu/day)
WN-I	Rohero, Musaga	14,000
WN-II	Musaga	11,300

Source: JICA study team

(4) Typical cross section

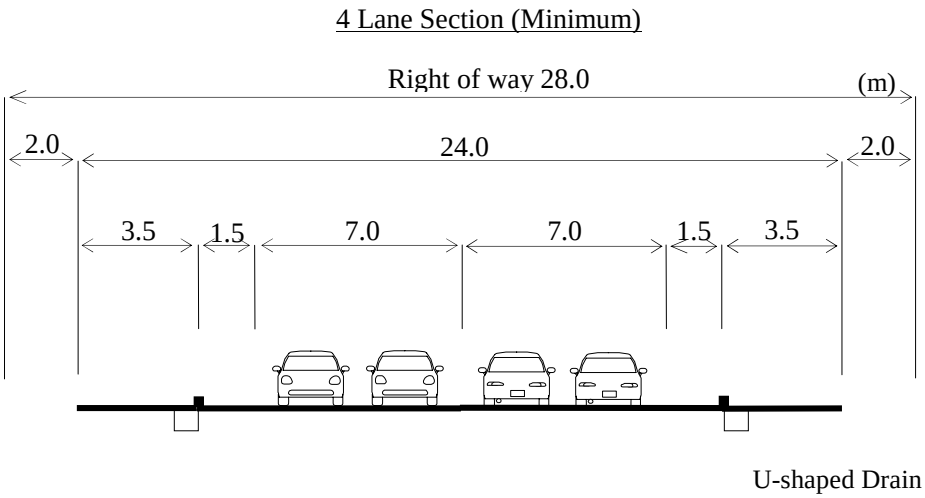


Figure 9.3.11 Widening of NR-7

(5) Projects list

Table 9.3.9 Missing Link Roads

Section	Location	length (km)	Number of lane	
			Present	Proposed
WN-I	Rohero, Musaga	2.0	2	4
WN-II	Musaga	1.6	2	4
Total	-	3.6	-	-

Source: JICA Study Team

9-3-5 Forming the Road Network to Traffic Functions

(1) Concept

City development in Bujumbura is carried out in a form of cluster to principal arterial roads and each cluster is connected to CBD through these principal arterial roads as a frame. Hence, all kinds of traffics are concentrated on the principal arterial roads creating a bottleneck. It is necessary to develop the principal and collector roads so that the traffic can be dispersed and rational operation can be maintained against the increasing future traffic demand.

Construction of river crossing roads to link the regions divided by the rivers, improvement of continuity of collector roads, etc. shall be included in the improvement of the missing links. Improvement of missing links is required not only for the essential benefits of the improvement but also for the mitigation of traffic loads on the principal arterial roads, improvement of utility value of the area along the roads, mitigation of travelling time for regional traffic, etc. so that the total effects become huge.

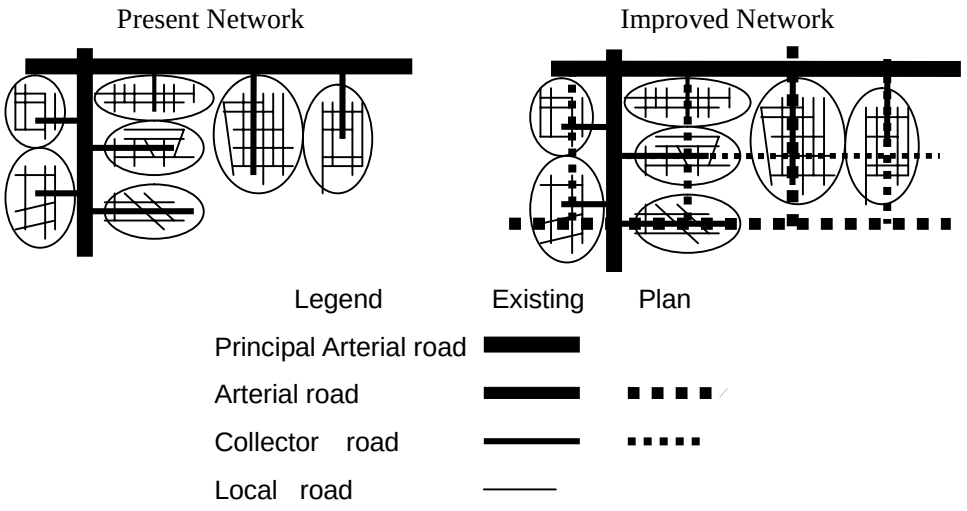


Figure 9.3.12, Image of the Road Network System to Traffic Function

(2) Location of the projects

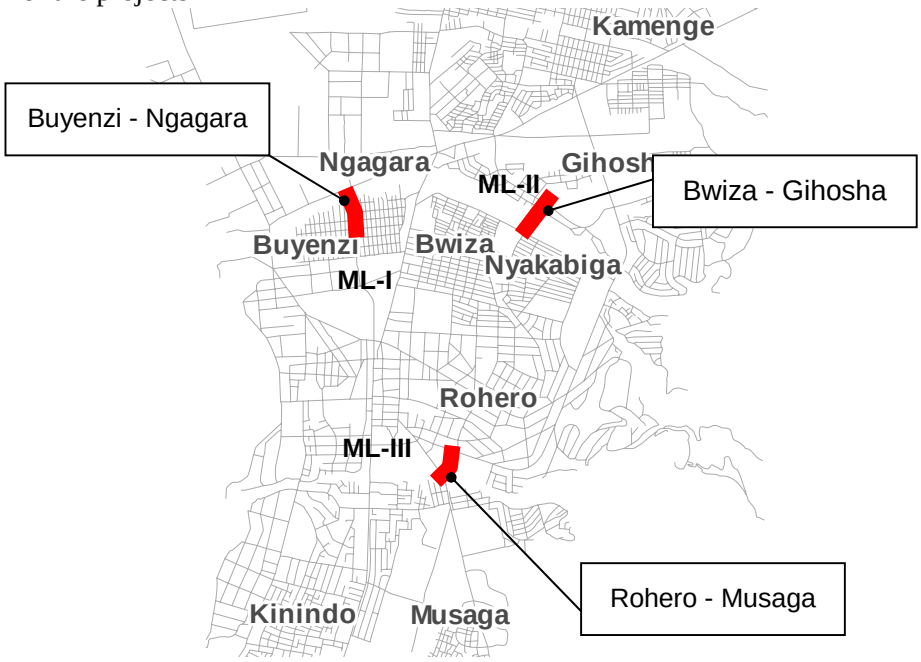


Figure 9.3.13, Location of Missing Link

(3) Future Traffic Demand (2017)

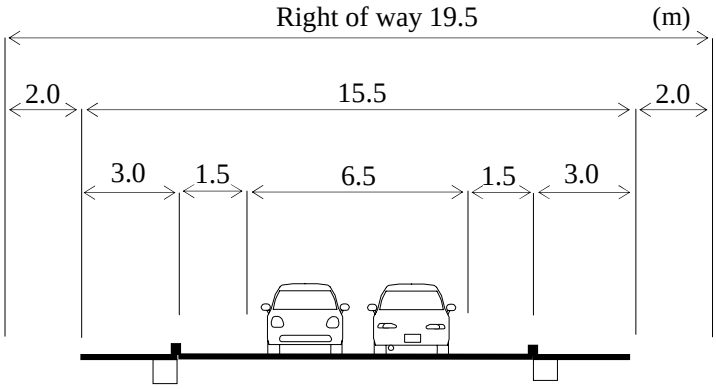
Table 9.3.10, Future Traffic Demand at Missing Link Roads

Section	Location	Traffic Demand (pcu/day)
ML-I	Buyenzi-Ngagara	5,300
ML-II	Bwiza-Gihosha	9,000
ML-III	Rohero-Musaga	5,300

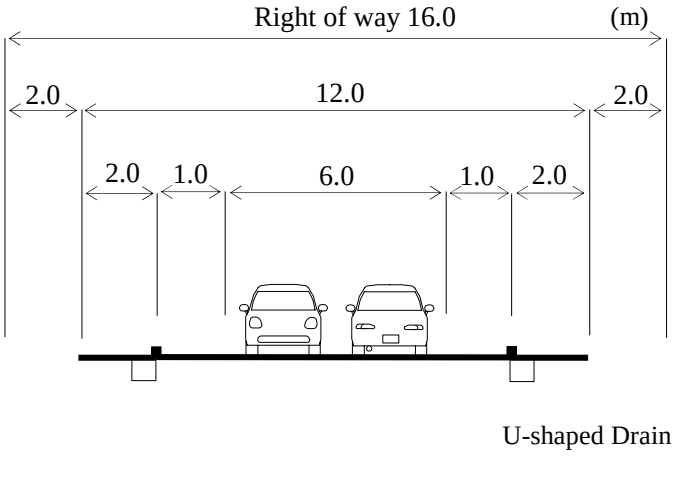
Source: JICA study team

(4) Typical cross section

2 Lane Road (ML-II)



2 Lane Road (ML-I, ML-III)



Bridge Section (ML-I, ML-II, ML-III)

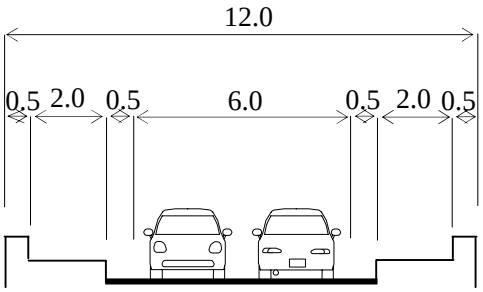


Figure 9.3.14, Missing Link Roads

(5) Projects list

Table 9.3.11 Missing Link Roads

Section	Location	length (km)	Number of lane	
			Present	Proposed
ML-I	Buyenzi-Ngagara	0.5	-	2
ML-II	Bwiza-Gihosha	0.3	-	2
ML-III	Rohero-Musaga	0.6	-	2
Total	-	1.4	-	-

Source : JICA Study Team

9-3-6 Development of the Road Projects Lead to City Plan

(1) Northern Area

1) Concept

The progress of the development in Buterere residential area is expected to deal with the future population growth in Bujumbura City. In order to develop the residential areas systematically, it is necessary to construct new roads, which can attract and accelerate the residential development.

2) Projects location

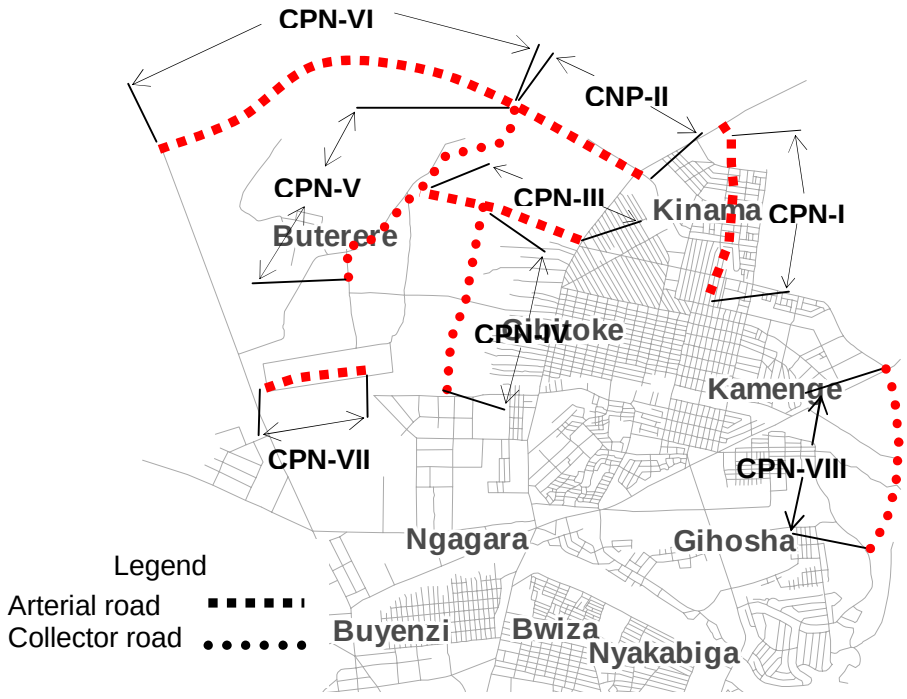


Figure 9.3.15, Location of City Plan Road projects at Northern area

3) Future Traffic Demand (2017)

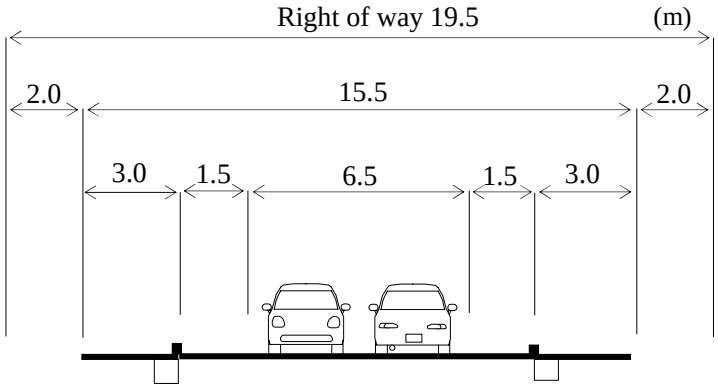
Table 9.3.12 Future Traffic Demand at City Plan Road Northern Area

Section	Location	Traffic Demand (pcu/day)
CPN-I	Kinama	600
CPN-II	Buterere	500
CPN-III	Buterere	4,000 - 4,500
CPN-IV	Buterere	600 - 9,200
CPN-V	Buterere	500 - 3,200
CPN-VI	Buterere	100
CPN-VII	Ngagara	1,100
CPN-VIII	Gihosha	800

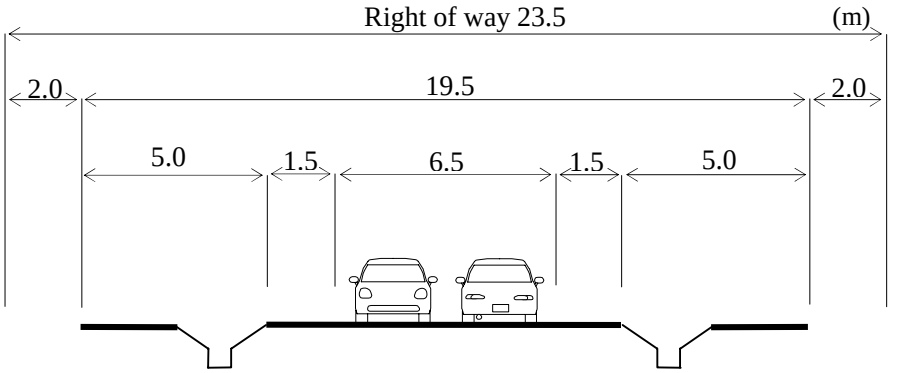
Source: JICA study team

4) Typical cross section

2 Lane Road (CPN-I)



2 Lane Road (CPN-II, III, VI, VII)



2 Lane Road (Minimum)

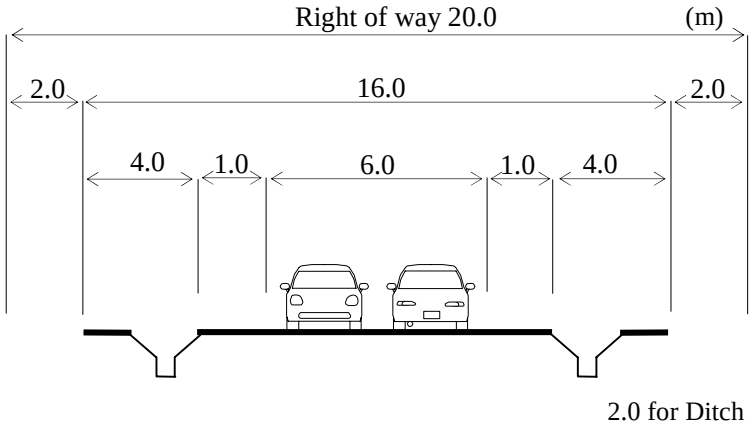


Figure 9.3.16, City Plan Road (Northern Area)

5) Projects list

Table 9.3.13, City Plan Development Projects (Northern Area)

Section	Location	Length (km)	Number of lane	
			Present	Proposed
CPN-I	Kinama	1.7	-	2
CPN-II	Buterere	1.7	-	2
CPN-III	Buterere	2.0	-	2
CPN-IV	Buterere	2.0	-	2
CPN-V	Buterere	3.5	-	2
CPN-VI	Buterere	4.5	-	2
CPN-VII	Bgagara	1.3	-	2
CPN-VIII	Gihosha	3.2	-	2

Source : JICA Study Team

(2) Southern Area

1) Concept

The progress of the development in Kanyosha and Musaga residential areas is expected to deal with the future population growth in Bujumbura City. In order to develop these residential areas systematically, it is necessary to construct new roads to attract and accelerate the residential development.

2) Location of the projects

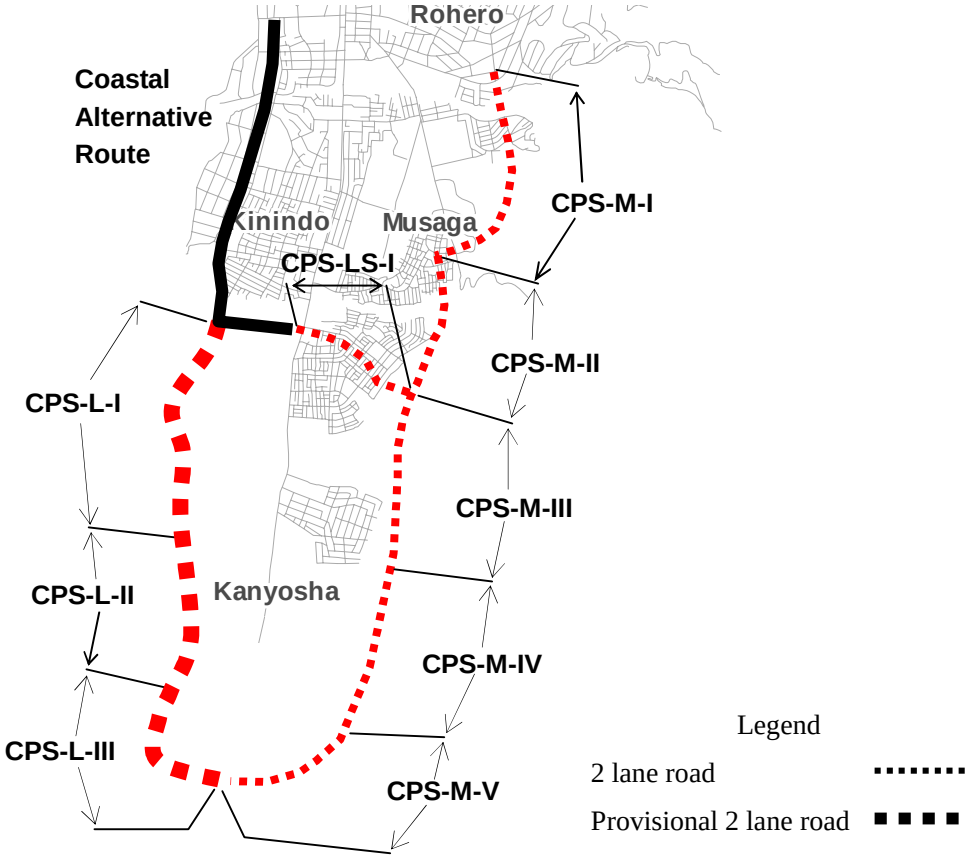


Figure 9.3.17, Location of City Plan Road Projects at Southern Area

3) Future Traffic Demand (2017)

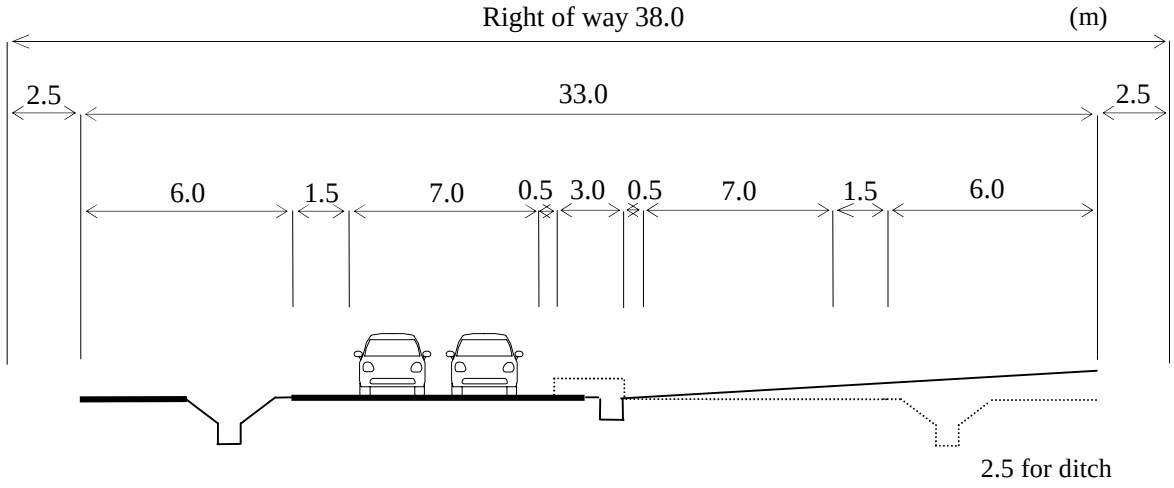
Table 9.3.14, Future Traffic Demand at City Plan Roads Southern

Section	Location	Traffic Demand (pcu/day)
CPS-L-I	Kanyosha	700
CPS-L-II	Kanyosha	300
CPS-L-III	Kanyosha	300
CPS-M-I	Musaga	4,600 - 5,100
CPS-M-II	Musaga, Kanyosha	1,600 - 4,400
CPS-M-III	Kinindo, Kanyosha	1,600
CPS-M-IV	Kanyosha	600
CPS-M-V	Kanyosha	600
CPS-LS-I	Kanyosha	3,000
CPS-LS-II	Kanyosha	400 - 1,000
CPS-LS-III	Kanyosha	100

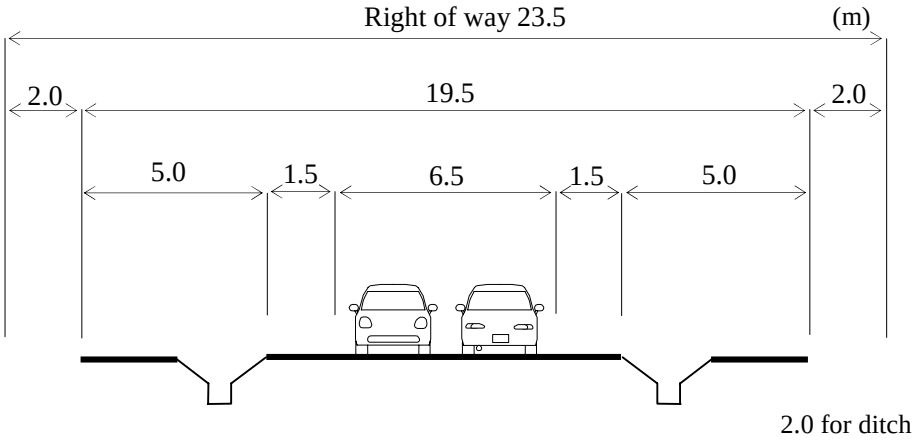
South: JICA study team

4) Typical cross section

4 Lane Section (Provisional 2 lanes) CPL-S-I, II, III



2 Lane Road (CPS-M-II, III, IV, V, CPS-LS-II)



2 Lane Road (CPS-M-I, CPS-LS-I, III)

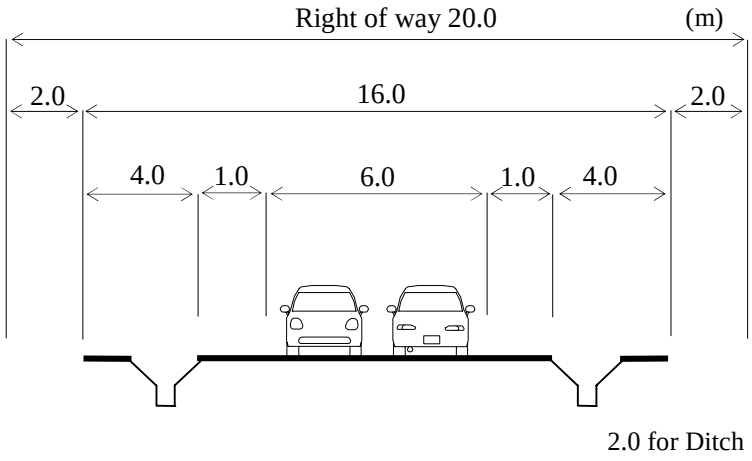


Figure 9.3.18, City Plan Roads (Southern Area)

5) Projects list

Table 9.3.15, City Plan Development Projects (Southern Area)

Section	Location	Length (km)	Number of lane	
			Present	Proposed
CPS-L-I	Kanyosha	2.6	-	2 (4)
CP-L-II	Kanyosha	2.0	-	2 (4)
CPS-L-III	Kanyosha	2.4	-	2 (4)
CPS-M-I	Musaga	2.5	-	2
CPS-M-II	Musaga, Kanyosha	1.8	-	2
CPS-M-III	Kinindo, Kanyosha	2.0	-	2
CPS-M-IV	Kanyosha	1.9	-	2
CPS-M-V	Kanyosha	1.6	-	2
CPS-LS-I	Kanyosha	2.3	-	2
CPS-LS-II	Kanyosha	2.0	-	2
CPS-LS-III	Kanyosha	2.5	-	2
Total	-	23.6	-	-

Notes: (4) after 2017: 4lane, Source: JICA Study Team

9-3-7 Road Project to Improve the Living Environment

1) Concept

Many of the regional roads in the developed area of Bujumbura City are unpaved without adequate drainage facilities causing serious problems to public health. Therefore, there are places where vehicles cannot access and are easily inundated even with little precipitation causing plagues and epidemics. In that regard, improvement of pavements (example interlocking pavement/stone block pavement) and drainage of the local streets in administrative unit Cartier shall be included in the Master Plan.

2) Typical cross section

Typical cross section was set according to existing stone pavement road carried out by World Bank.

2 Lane Road

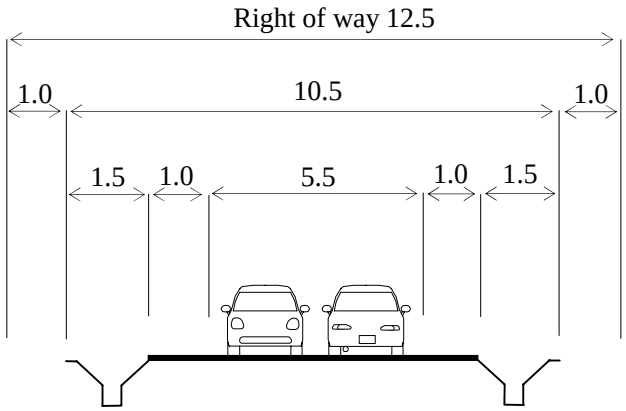


Figure 9.3.19, Stone Pavement Roads

3) Projects list

Table 9.3.16 Stone Pavement Projects

Name of Comune	Length	Pavemnet Ratio	Required Ratio	Reqired Length	Cost
Buterere	24.4	21.5	50.0	7.0	
Kinama	64.4	10.0	30.0	12.9	
Cibitoke	45.4	6.9	30.0	10.5	
Kamenge	45.5	9.7	30.0	9.2	
Ngagara	65.6	39.7	50.0	6.8	
Gihosha	62.0	28.6	50.0	13.3	
Buyenzi	32.9	28.6	50.0	7.0	
Bwiza	28.3	12.7	30.0	4.9	
Nyakabiga	17.4	9.0	30.0	3.7	
Rohero	120.4	62.0	70.0	9.7	
Kinindo	70.0	18.7	30.0	7.9	
Musaga	41.8	32.6	50.0	7.3	
Kanyosha	59.5	12.6	30.0	10.3	
Total	677.5	27.5	43.8	110.4	

Group-A: Pavement ratio = more than 40% Required ratio = 70%
Group-B: Pavement ratio = 20% - 40% Required ratio = 50%
Group-C: Pavement ratio = less than 20% Required ratio = 30%

9-3-8 Summary of road network development

The following figures shows summary of proposed road network development.

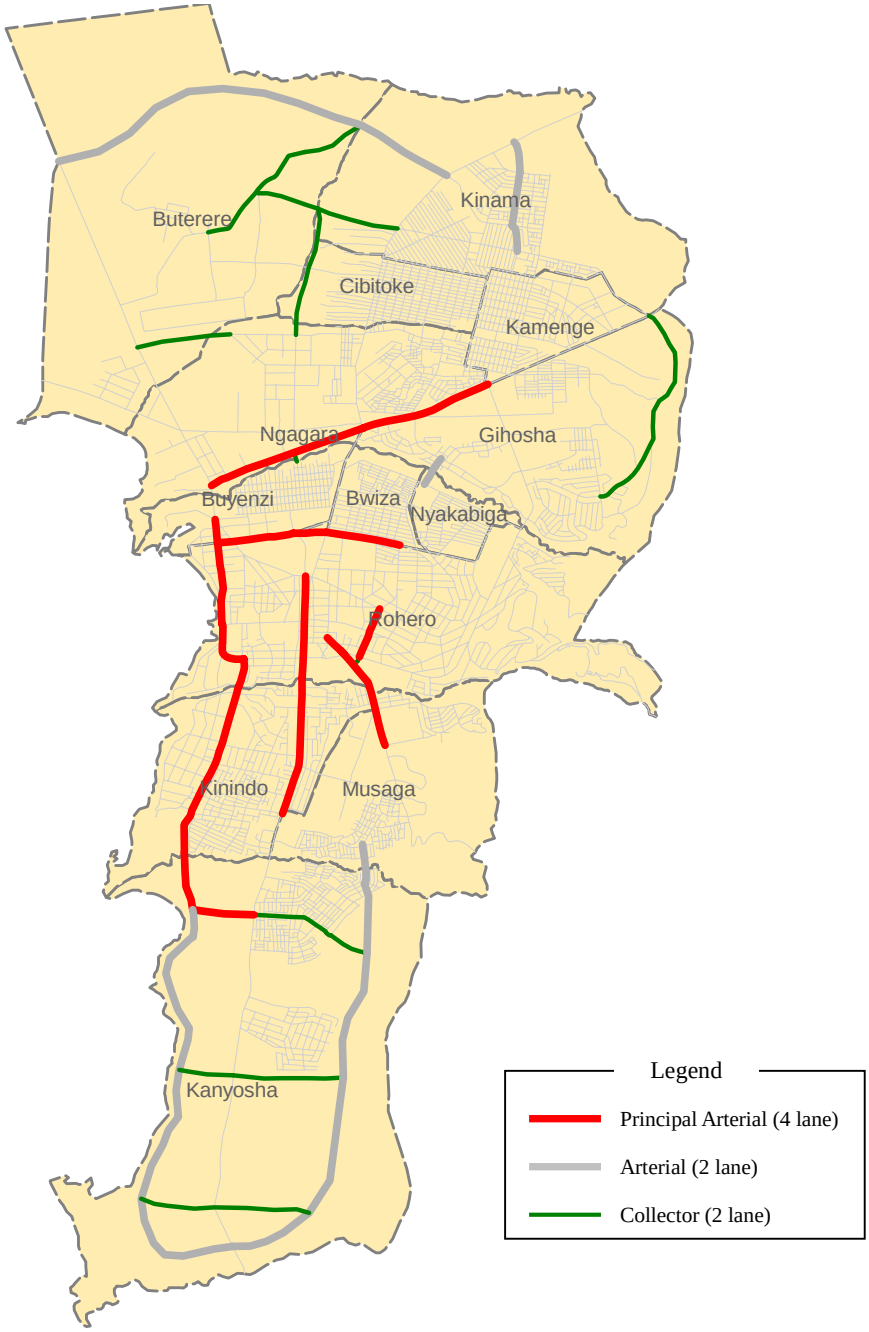


Figure 9.3.20, Road development in 2007

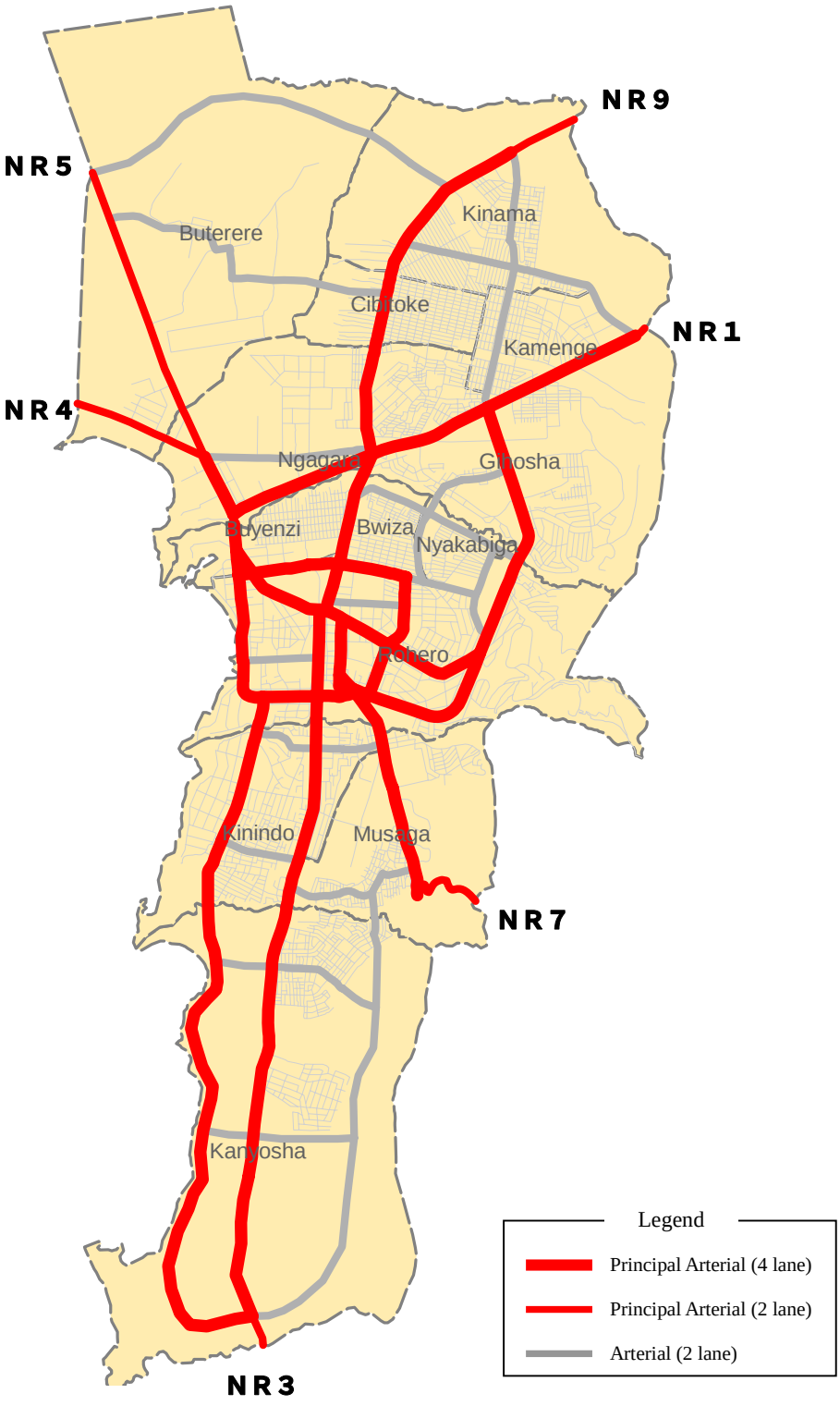


Figure 9.3.21, Future Road network system after 2017

9-4 INTERSECTION IMPROVEMENT PLAN

1) Concept

The levels of safety and traffic capacity of an intersection have profound effects of the configuration elements. These elements are number of intersection legs, angle of intersection and spacing between intersections.

Off-set intersections or deformed intersections are basically not desirable. Off-set intersections are the composition of 2 T-intersections located very close to each other. Under such circumstances, the intersections are excessively enlarged. The directional flow of traffic streams becomes complicated and come into conflict with pedestrian flow in most cases. Installation of traffic signals will require extra careful consideration. Without such considerations traffic signals do not permit safe operation at high capacity.

Improvement for an off-set intersection is illustrated in Figure 9.4.1.

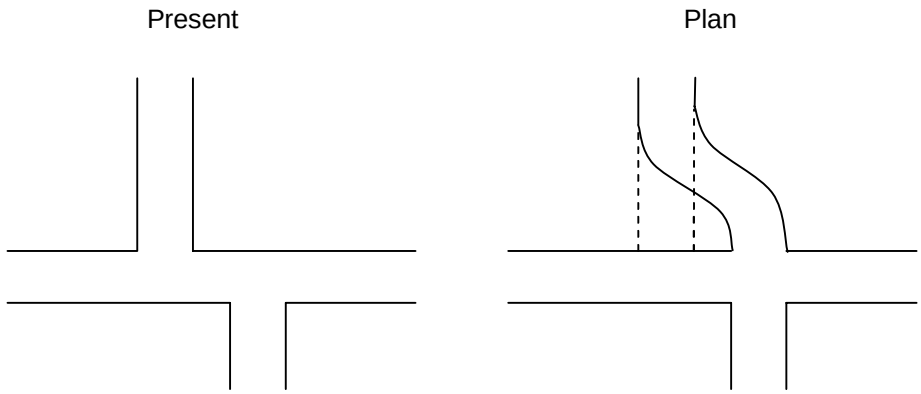


Figure 9.4.1, Improvements for an Off-set Intersection

2) Location of an off-set intersections

Figure 9.4.2 shows the off-set intersections on principal arterial roads in Bujumbura. Those intersections have to be improved to mitigate the traffic congestion and maintain the level of safety for increased future traffic, along with other countermeasures of traffic control such as signalization of the intersections and road traffic flow restriction.

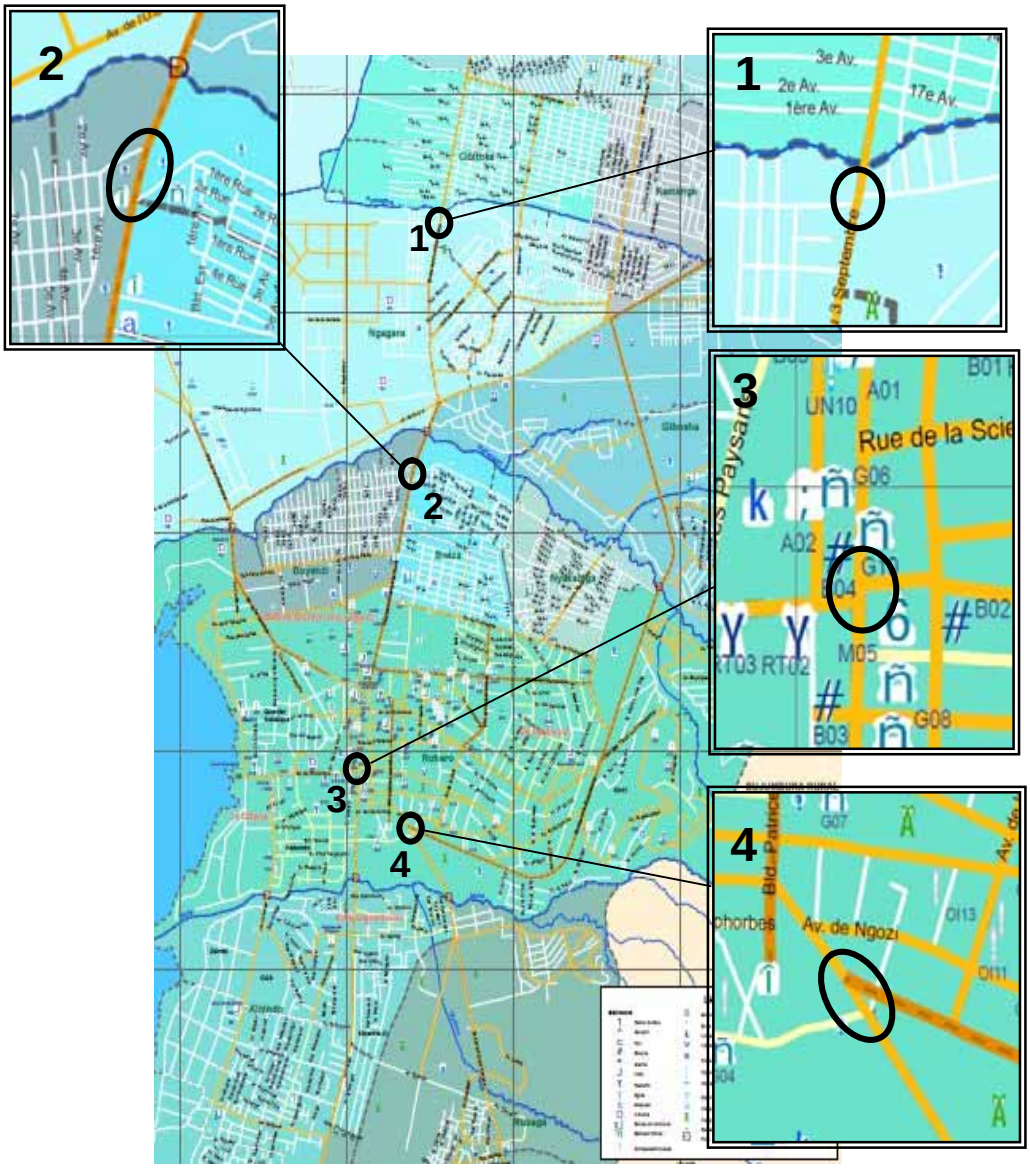


Figure 9.4.2, Location of Off-set Intersections

3) Intersection improvement plan

Figure 9.4.3 shows the signal phasing plan and traffic flow restriction at the roundabout of Place de l' Independance.

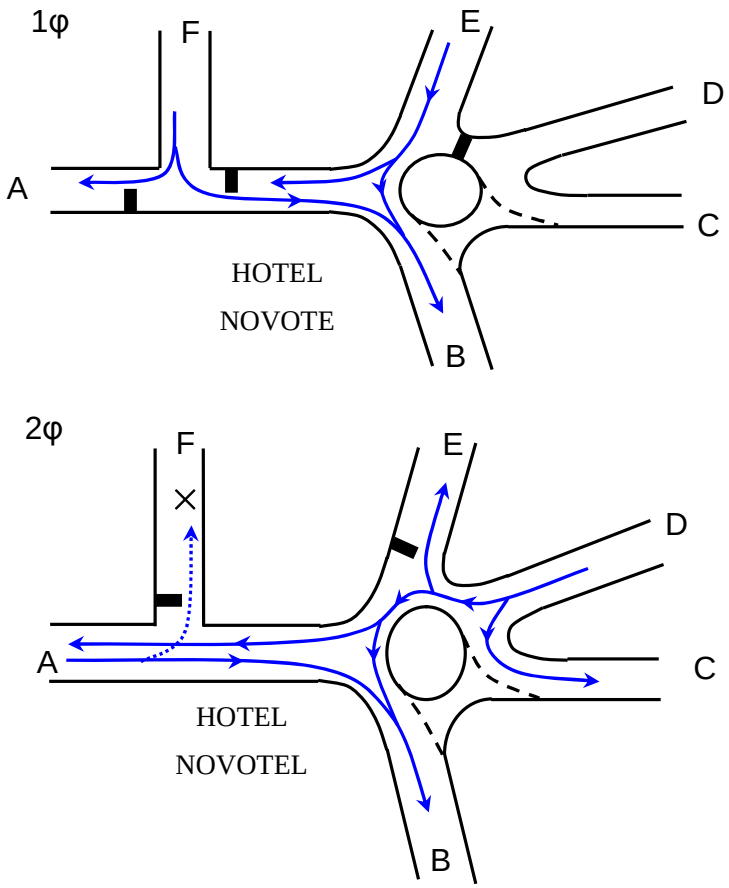


Figure 9.4.3, Signal Phasing and Traffic Flow

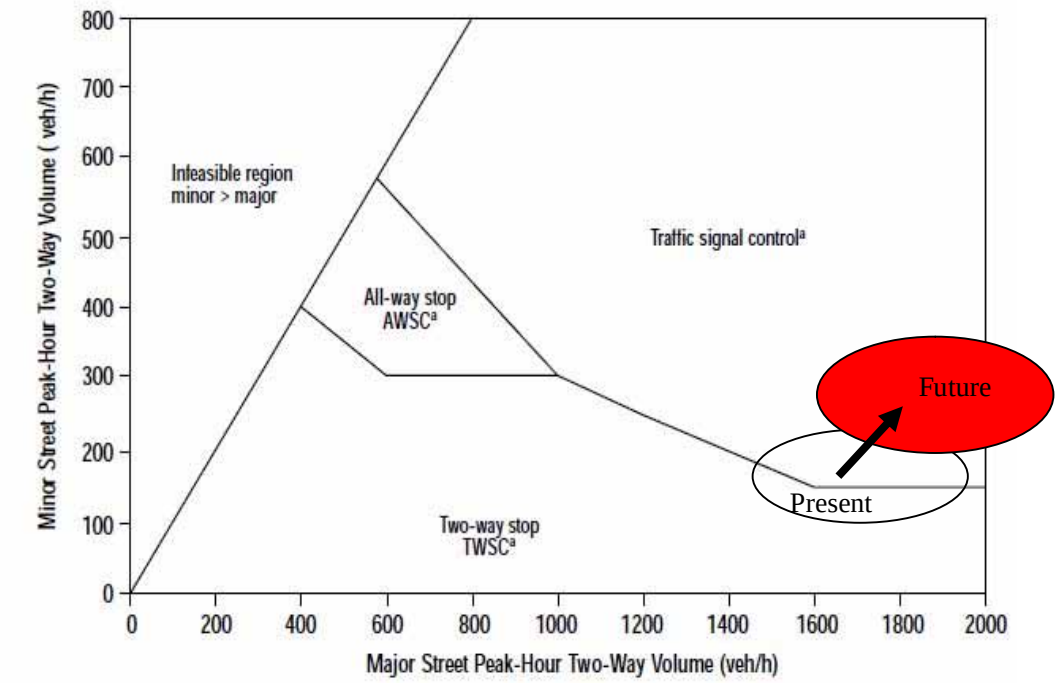
9-5 TRAFFIC FLOW CONTROL

9-5-1 Signalization Project

1) Concept

At present, there is no any road-intersection in Bujumbura city where traffic signal is in operation; and that is a cause of traffic congestion and increasing traffic accidents. Particular phenomenon is found at the intersections on the four-lane principal arterial roads, where the traffic volume is large; the traffic management without signals normally is reaching the margin and is becoming the cause of traffic congestion and accidents.

Figure 9.5.1 shows intersection control type and peak hour traffic volumes defined by HCM, and situation of changing from present to future traffic volumes on principal arterial road intersection.



Source: Highway Capacity Manual 2000

Figure 9.5.1 Intersection Control type and Peak Hour Volumes

2) Location of proposed signalize intersections

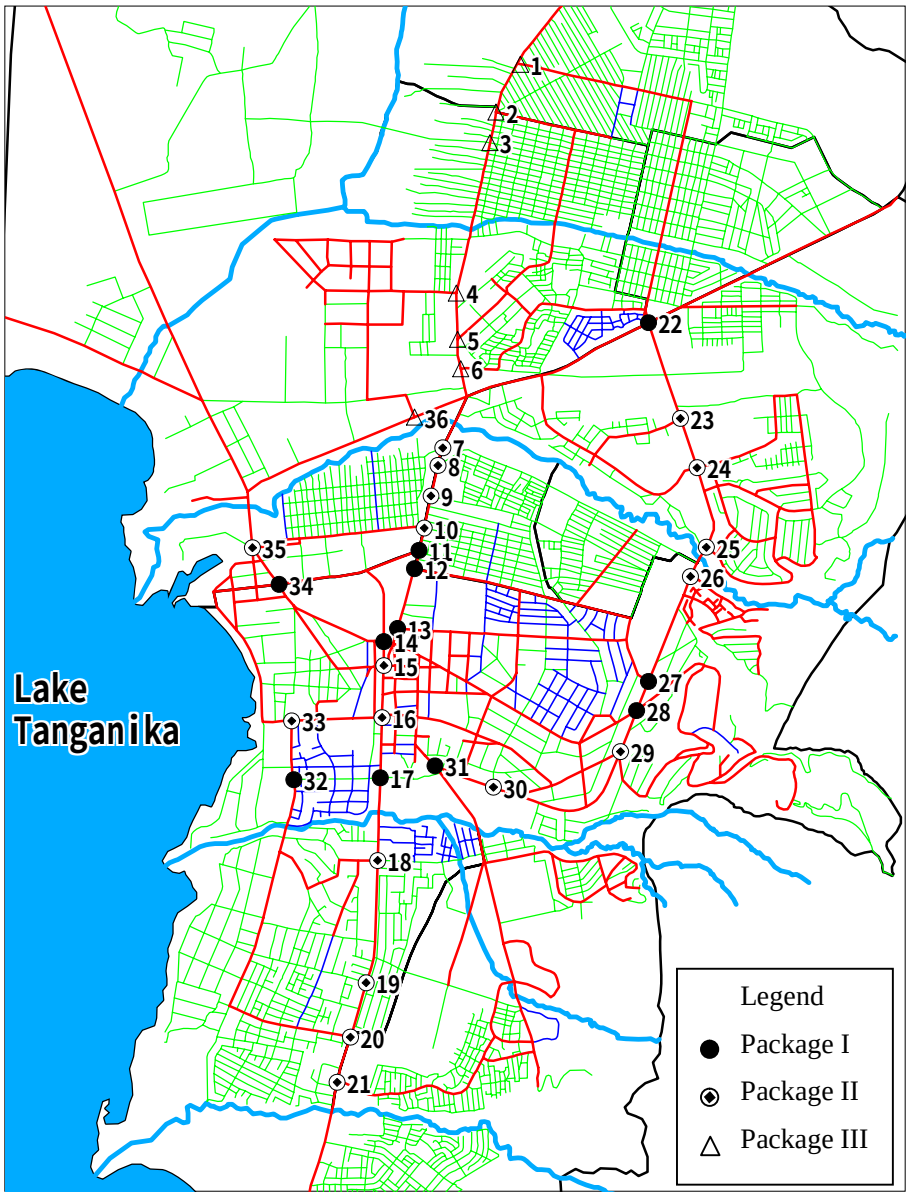


Figure 9.5.2 Location of intersection signalizing Plan

3) Present condition of intersections

The planning elements to signalize intersection stipulate fundamental conditions such as number of intersecting legs, number of lanes, intersecting road hierarchy and intersecting traffic volumes. Table 9.5.1 shows the elements of present intersections on the principal arterial roads.

Table 9.5.1 Element of Intersections

Intersection		Number of Lanes			Interscting Road Hierarcy		Peak Hour Volumes (pcu/h)			
No	Type	Major S.	Minor S.	Inlet	Major S.	Minor S.	Major S.	Minor S	Inlet Toal	LOS
1	3 leg	2	2	3	1	3	400	200	500	D
2	3 leg	2	2	3	1	3	400	200	500	D
3	3 leg	2	2	3	1	3	500	200	600	D
4	3 leg	2	2	3	1	3	600	200	700	D
5	3 leg	2	2	3	1	3	1000	300	1150	D
6	3 leg	2	2	3	1	3	1500	300	1650	E
7	3 leg	4	2	5	1	3	2100	100	2150	F
8	3 leg	4	2	5	1	3	2200	300	2350	F
9	3 leg	4	2	5	1	3	2300	300	2450	F
10	3 leg	4	2	5	1	3	2300	200	2400	F
11	3 leg	4	2	5	1	1	2300	300	2450	F
12	3 leg	4	2	5	1	1	2300	300	2450	F
13	3 leg	4	4	6	1	1	2300	2000	3300	F
14	4 leg	2	2	4	1	2	1200	1200	2400	F
15	3 leg	2	2	3	1	2	1200	1200	1800	E
16	3 leg	2	2	3	1	2	1100	1200	1700	E
17	4 leg	2	4	6	1	1	1500	800	2300	F
18	4 leg	2	2	4	1	2	1500	300	1800	E
19	3 leg	2	2	3	1	3	1500	500	1750	E
20	3 leg	2	2	3	1	2	1200	600	1500	E
21	3 leg	2	2	3	1	2	1200	300	1350	E
22	4 leg	2	2	4	1	1	1000	600	1600	E
23	3 leg	4	2	5	1	3	1500	1000	2000	E
24	3 leg	4	2	5	1	3	2000	1000	2500	F
25	3 leg	4	2	5	1	3	2300	500	2550	F
26	3 leg	4	2	5	1	3	2300	1000	2800	F
27	3 leg	4	2	5	1	2	2300	1000	2800	F
28	3 leg	4	2	5	1	2	2000	1000	2500	F
29	3 leg	4	2	5	1	3	1000	500	1250	D
30	3 leg	4	2	5	1	3	800	300	950	D
31	3 leg	4	2	5	1	1	1100	800	1500	E
32	4 leg	4	2	6	1	2	800	1100	1900	E
33	3 leg	2	2	3	2	2	1100	1100	1650	E
34	4 leg	4	2	6	1	1	1500	1000	2500	F
35	3 leg	4	2	5	1	3	1500	150	1575	E
36	3 leg	2	2	3	1	3	700	300	850	D

Source: JICA study team

Hierarchy: 1: Principal Arterial Road, 2: Arterial Road, 3: Collector Road

Levels of Service (LOS): Peak hour intersection by Highway Capacity Manual 2000

4) Score of appraisal items

Table 9.5.2 shows the score of appraisal items to establish the implementation schedule of signalising the intersections.

Table 9.5.2 Score of Appraisal Items

Type (Configration of Inter Section)	Score
3-leg	1
4-leg	2
5-leg	4

Lane (Total Inlet Lanes)	Score
3	0
4	1
5	2
6	3
8	4

Hierarchy (Intersecting Road)	Score
Arterial to Collector	1
Arterial to Arterial	2
Principal Arterial to Collector	1
Principal Arterial to Arterial	2
Principal Arterial to Principal Arterial	3

LOS (Levels of Service by HCM 2000	Score
Level D	1
Level E	2
Level F	3

Source: JICA study team

5) Order of priority

Table 9.5.3 shows the result of appraisal score of each intersection using the fundamental elements for signalising system.

Table 9.5.3 Score of Appraisal by each Intersection

No	Type	Lane	Hierarchy	LOS	Total
1	1	0	1	1	3
2	1	0	1	1	3
3	1	0	1	1	3
4	1	0	1	1	3
5	1	0	1	1	3
6	1	0	1	2	4
7	1	2	1	3	7
8	1	2	1	3	7
9	1	2	1	3	7
10	1	2	1	3	7
11	1	2	3	3	9
12	1	2	3	3	9
13	1	3	3	3	10
14	2	1	2	3	8
15	1	0	2	2	5
16	1	0	2	2	5
17	2	3	3	3	11
18	2	1	2	2	7
19	1	0	2	2	5
20	1	0	2	2	5
21	1	0	2	2	5
22	2	1	3	2	8
23	1	2	1	3	7
24	1	2	1	3	7
25	1	2	1	3	7
26	1	2	1	3	7
27	1	2	2	3	8
28	1	2	2	3	8
29	1	2	1	1	5
30	1	2	1	1	5
31	1	2	3	2	8
32	2	3	2	3	10
33	1	0	2	2	5
34	2	3	3	3	11
35	1	2	1	2	6
36	1	0	1	1	3

Source: JICA study team

6) Projects list

Based on the result of appraisal score, the intersections are classified into three categories namely package I, II and III according to the order of priority.

Table 9.5.4 Number and Cost of Traffic Signal Construction

Package	Places	Notes
Package I	11	
Package II	18	
Package III	7	North of Bujumbura

9-5-2 Traffic Restriction

1) Concept

By improvement of infrastructures, there are limitations to deal with the traffic congestions in the urban area due to the increase of future traffic demand. As a part of adopting rational traffic operation, regulation of one-way traffic in the CBD shall be introduced so that traffic congestion can be mitigated in the urban area.

2) Intersection legs

The member of intersection legs at an at-grade intersection should not exceed four in principle. The number of conflicting, merging and diverging point increases very rapidly with an increasing number of intersection legs as shown in Table 9.5.5.

Table 9.5.5 Number of Conflicting, Merging and Diverging Points

Type of Intersection	Conflicting	Merging	Diverging	Total
3-leg	3	3	3	9
4-leg	16	8	8	32
5-leg	49	15	15	79
6-leg	124	24	24	172

Source: Japan Society of Traffic Engineer

3) Bottleneck intersections

Figure 9.5.3 shows 10 places of present bottleneck intersections and present traffic flow direction of road in the CBD.

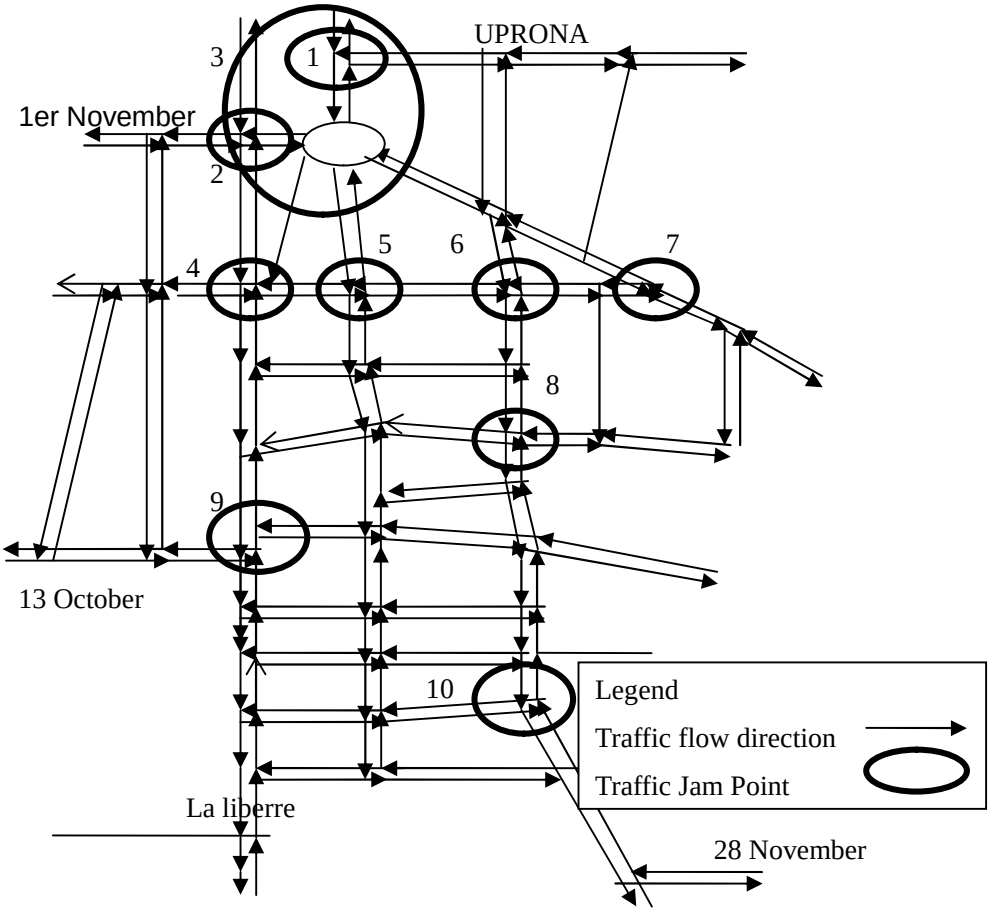


Figure 9.5.3 Present Traffic Flow Direction and Traffic Jam Points at CBD

4) Countermeasure of bottleneck intersections

Table 9.5.6 shows the methods for countermeasures at the bottleneck intersections in CBD.

Table 9.5.6 Countermeasure of Bottleneck Intersection

Number	Countermeasures	Remarks
1	Restriction of left Turn	Figure 9.4.3
2	One-way Control	Figure 9.5.4
3	Improvement of Configuration	Figure 9.4.3
4	One-way Control	Figure 9.5.4
5	One-way Control	Figure 9.5.4
6	One-way Control	Figure 9.5.4
7	One-way Control	Figure 9.5.4
8	One-way Control	Figure 9.5.4
9	Improvement of Off-set Intersection	Figure 9.4.1
10	One-way Control	Figure 9.5.4

5) Plan of traffic flow restriction in CBD road

Figure 9.5.4 shows the road traffic restriction plan in CBD.

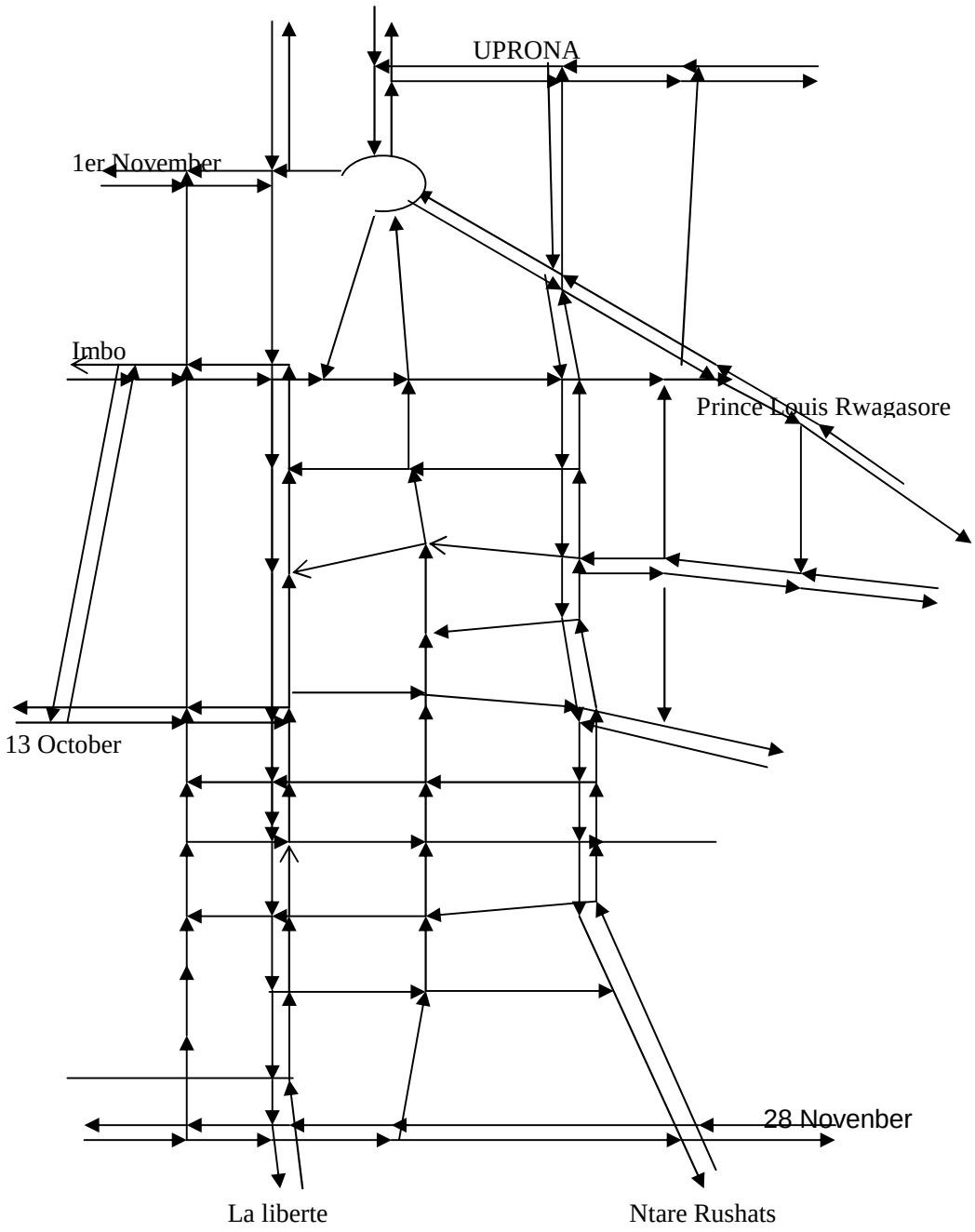


Figure 9.5.4 One-way Traffic Restriction Plan in CBD

9-6 ROAD MAINTENANCE PROJECT

1) Concept

The thickness of the asphalt surface course for the most of the roads in Bujumbura City is 30mm or less, which is apt to be damaged easily even with less heavy traffic vehicles. The causes such as; the pavement has been used for more than it's durable years, formation of pot holes and loss of bearing capacity in sub-base due to inadequate drainage against precipitation, uneven construction quality, mechanical failure in vehicles, etc. may damage the pavement. The damages shall have to be repaired within appropriate time so that the work can be effective and economical. Otherwise, the damage will be enlarged in accelerative speed and the repairing cost will also increase extensively. Adequate maintenance planning considering durability of the pavement is essential.

2) Definition

Maintenance work is classified as routine maintenance work and periodic maintenance work. Routine maintenance work is required irrespective of traffic volume or road surface condition and includes works such as grass cutting and cleaning of road side ditches and culverts. Periodic maintenance work is required depending on the traffic volume and road surface condition; and such works includes overlay, patching, sealing, and other road surface repairing as well as the repairing of road structures.

For this master plan, the followings are not included in road maintenance projects

- Road patrol and inspection personal's wages and over head.
- Minor existing road improvement such as the addition of shoulder and side ditches which are treated as a part of other projects.
- Electric power charges for road lighting and signalling, which shall be estimated and paid by another local government.
- Maintenance of community roads, which shall be done by themselves.

3) Maintenance works and costs

The maintenance costs of the projects are estimated excluding the cost of minor improvement work and assuming a higher maintenance level than presently being executed. As defined above, the cost is estimated in terms of direct construction cost of each work item; the cost for the routine maintenance, which is not affected by road standard and traffic volume, is given as fixed amount; and cost for periodic maintenance, which inherently varies depending on traffic volume and lane width, is proportional to the number of lanes. Work items, frequency and

estimated cost are given in Table 9.6.1.

Table 9.6.1 Maintenance work Frequency

Principal Arterial Road	Frequency	Cost
Routine Maintenance		
Grass Cutting and Cleaning	2time/year	14,280,000
Ditch and Drain Cleaning	2time/year	30,240,000
Lamp Change	1time/1000gays	51,149
Traffic Sign Repair	1time/5years	24,192
Periodic Maintenance		
Resurface	1time/10years	23,100,000
Pavement Marking	1time/5years	260,000
Patching and Sealing	1time/5years	100,000
Total		68,055,341
Arterial and Collector Road	Frequency	Cost
Routine Maintenance		
Grass Cutting and Cleaning	2time/year	9,520,000
Ditch and Drain Cleaning	2time/year	22,680,000
Lamp Change	1time/1000gays	25,574
Traffic Sign Repair	1time/10years	7,560
Periodic Maintenance		
Resurface	1time/10years	11,550,000
Patching and Sealing	1time/5years	50,000
		43,833,134

Source : JICA Study Team

Table 9.6.2, Road Administration Length by year (km)

Year	Principal Arterial	Arterial	Collector	Total
2007	49.3	16.1	54.3	119.7
2008	50.7	26.1	56.5	133.3
2009	50.7	34.1	60.6	145.4
2010	50.7	34.4	60.6	145.7
2011	51.4	34.9	60.2	146.0
2012	52.3	38.7	63.6	154.6
2013	53.0	42.4	67.5	162.9
2014	54.8	45.7	70.2	170.7
2015	56.6	49.0	72.8	177.8
2016	58.4	52.4	75.5	186.3
2017	60.3	55.6	78.4	194.3

Source : JICA Study Team

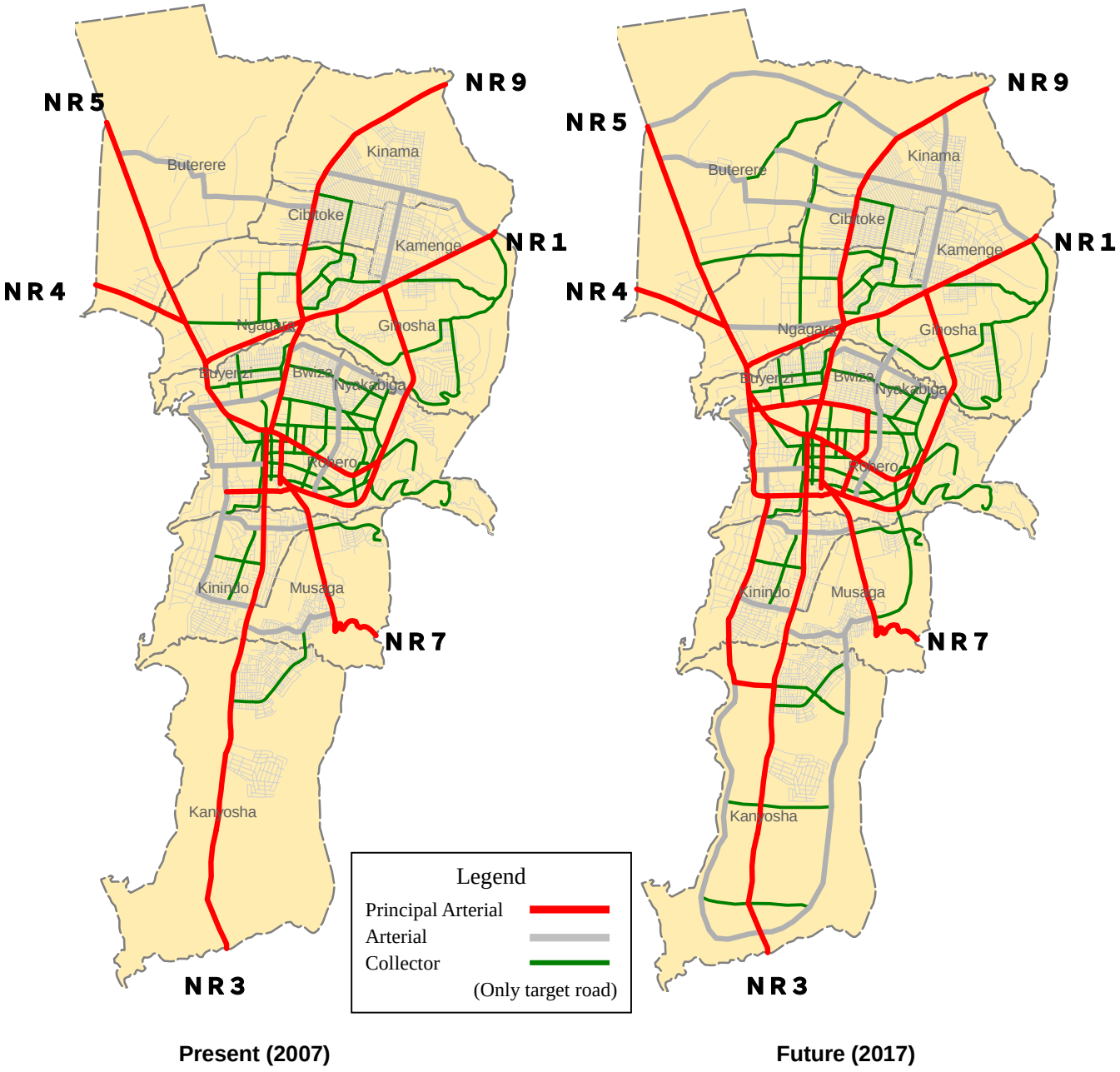


Figure 9.6.1 Maintenance Program Target Roads

9-7 PRELIMINARY COST ESTIMATE

9-7-1 Cost Estimate

(1) Method

Figure 9.7.1 shows the cost estimation procedure. The direct construction costs of each work item are estimated by accumulated method, which combines the cost of labor, equipment and materials as in the normal estimation method. In the case of projects using heavy construction equipment, the equipment expenses occupied the majority cost in the work items. Though it can be seen to change more greatly by using time of the equipment, the cost of equipment is calculated by combination and capacity of the equipment. Equipment working items are estimated by considering combination of typical construction equipment and equipment capacities.

The indirect construction cost can be calculated by the accumulation of each work item cost. Indirect cost which include temporary facilities, field management expenses and general management expenses are a percentage of the direct construction cost.

The project costs also include contingencies, land acquisition and compensation cost which are calculated and added separately.

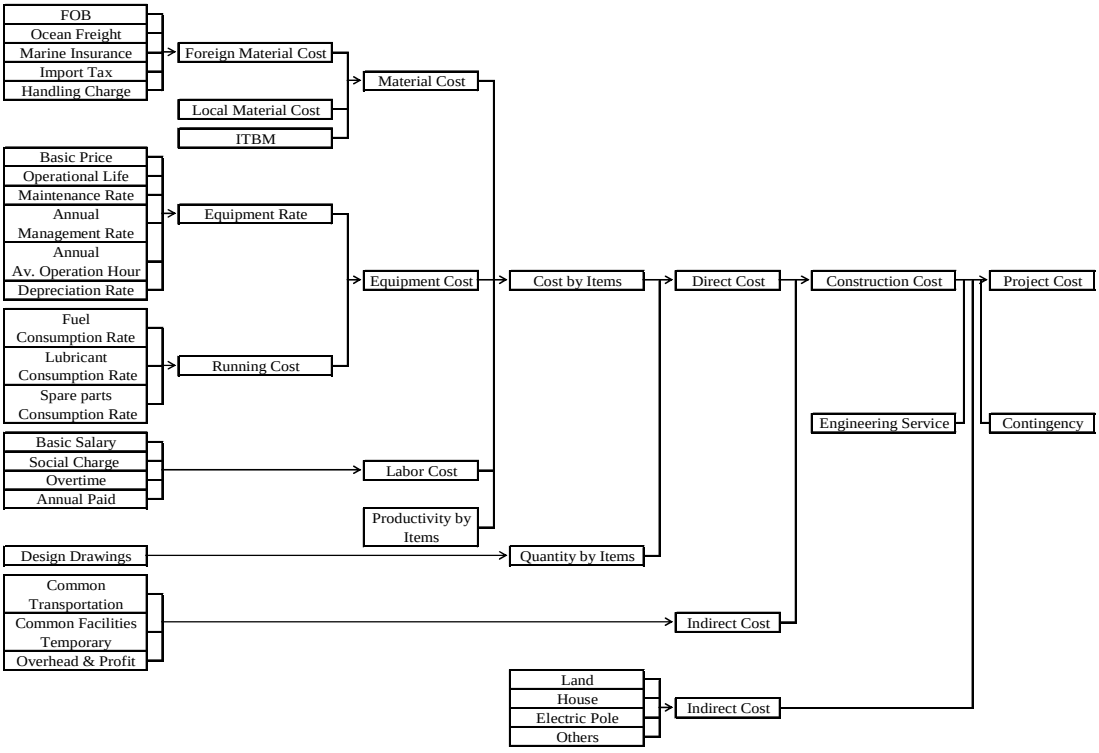


Figure 9.7.1 Cost Estimate Process

(2) Labour Cost

Basic salaries have been calculated over a whole year including holidays. Labour unit costs include 200 hours of overtime worked per month. Basic salary includes social charges, which account to 26% of the average unit wage. Social charges such as worker's accident compensation, Insurance and pension are born by the company and individual person.

Labour unit cost is calculated assuming that overtime expenses of 200 hours per month are included in the basic salary. Labour unit price are classified into 5 specialized tasks namely foreman, skilled labour, unskilled labour, operator, and driver as shown in Table 9.7.1.

Table 9.7.1 Labour Cost

Classification	Unit	Foreign (US$)	Local (BFu)
Forman	Day	0	11,000
Skilled Labor	Day	0	8,800
Unskilled Labor	Day	0	4,400
Operator	Day	0	11,000
Driver	Day	0	8,800

(3) Material Cost

Material costs are divided into national products and imported materials. The CIP (freight/carriage & insurance paid to named point of destination) price of imported materials which are not available in Bujumbura are estimated from foreign price. Material costs are estimated by including also the consideration of import tax, handling charge and transaction tax in the country.

Where the selling price of imported materials are known, 25% of the selling price is regarded as handling charge, of which 10% of the selling price are transportation expense. 50% of the transportation expenses are estimated as the foreign portion. Transaction tax of 17% is added to the material costs.

In case of the national product the majority of the cost component of raw materials are regarded to be the expenses of the production plants, equipment, transportation, and fuel, which would have been imported. The unit costs and assumed foreign and local currency portion for the major materials are as shown in Table 9.7.2.

Table 9.7.2 Foreign Currency Portion in Raw Material

Unit : Percent

Description	Unit Cost (FBu)	Unit	Foreign Currency Portion	Local Currency Portion
Asphalt	1,056,000	ton	60.0	40.0
Base Course Material	53,900	m^3	60.0	40.0
Steel	1,210,000	ton	60.0	40.0
Reinforcing bar	1,100,000	ton	60.0	40.0
Cement	407,000	ton	60.0	40.0
Fine aggregate	48,400	m^3	60.0	40.0
Coarse aggregate	49,500	m^3	60.0	40.0
Crushed stone	41,250	m^3	60.0	40.0
Gravel	13,200	m^3	60.0	40.0
sand	19,800	m^3	60.0	40.0
Gasoline	1,540	litter	60.0	40.0
Diesel oil	1,540	litter	60.0	40.0

(4) Equipment Cost

The construction equipment costs are estimated assuming that the equipment will be assigned to other projects when is not being used. Equipment costs include import tax, consumption tax and all other expenses except operator and driver costs calculated in labor costs.

Equipment cost could be divided into rental cost and operation cost.

Rental cost per hour = ((Basic Price (1.0 - residual value ratio)) × depreciation rate + annual maintenance rate per hour + management rate per hour

Depreciation rate = 1/(annual operation hour × operation life)

Operation cost also include fuel, lubricant, spare part, wage of management and maintenance costs per hour. Table 9.7.3 shows result of calculation of equipment cost per hour.

Table 9.7.3 Equipment Cost

Equipment Name	Unit Cost (FBu/Day)	Equipment Name	Unit Cost (FBu/Day)
Bulldozer, 15ton	528,000	Dump truck, 2ton	73,300
Backhoe, 0.13m^3	180,400	Dump truck, 4ton	134,600
Backhoe, 0.28m^3	233,200	Dump truck, 10ton	196,200
Backhoe, 0.45m^3	422,400	Truck, 2ton	73,300
Backhoe, 0.80m^3	519,200	Truck, 4ton	121,400
Wheel loader, 1.20m^3	418,900	Truck, 6 ton	169,000
Wheel loader, 2.1m^3	708,400	Semi trailer, 15ton	422,400
Crawler crane, 35ton	968,000	Semi trailer, 20ton	633,600
Motor grader, 3.7m	440,000	Semi trailer, 30ton	728,600
Motor grader, 3.1m	431,200	Asphalt distributor, 6,000 L	440,000
Road roller, Macadam 10~12t	320,300	Vibration roller, H. G. 0.8~1.1 t	117,000
Tire roller, 8~20 ton	440,000	Tamper, 60~100kg	52,800
Vibration roller, Combined 3~4 t	135,500	Vibration compactor, 50~60kg	52,800

(5) Indirect Cost

Temporary work cost includes transportation of equipment and plant, mobilization and demobilization, installation and removal of such temporary facilities as power supply, environmental protection, safety facilities, quality and progress control, utilities, and field office maintenance. Field management cost includes wages, office supplies, whereby other expenses includes at field offices, while general administration includes the overhead at contractors head office.

These indirect costs can vary substantially from one contractor to another and depending on the scale of project; number of assumptions must be made for their estimation. Therefore, for simplicity of the estimation, indirect costs have been estimated to be 32% of direct cost from the previously implemented projects estimation. The foreign currency portion and the local currency portion of indirect costs are show in Table 9.7.4.

Table 9.7.4 Indirect Cost Components

Unit : Percent

Description	Foreign Portion	Local Portion	Total
1. Common Temporary Facilities			
1-1 Transportation	3.5	2.0	5.5
1-2 Mobilization	0.8	2.0	2.8
1-3 Demobilization	0.5	2.0	2.5
1-4 Environment Control	0.2	0.5	0.7
1-5 Safety Facilities	0.5	2.0	2.5
1-6 Public Services Charge	0.0	1.0	1.0
1-7 Quality Control	1.0	1.0	2.0
1-8 Field Office Maintenance	0.5	2.5	3.0
Sub-total	7.0	13.0	20.0
2. Field Management	0.0	7.0	7.0
3. General Management	5.0	0.0	5.0
Total	12.0	20.0	32.0

(6) Engineering Service Cost

Engineering service costs vary and depend on the scales of project, tender processing and contract method. Based on previous experiences the engineering service costs are estimated to be 14% of the total of direct and indirect costs. The currency portion of foreign and local is allocated by the same ratio of total cost.

(7) Contingency

A contingency allowance has been included in the total cost to allow for unexpected cost not identified in the detail design and construction stage. In view of the point that the subject projects are to be implemented in urban areas where unexpected difficulties such as traffic congestion, resettlement of inhabitants and scope of construction of related road are highly possible, 10% of total construction and engineering service cost is assumed as physical contingency. Price contingency for cost escalation is considered separately in financial analysis.

(8) Estimated Project Cost

The summaries of total construction costs for each proposed road are show in Table 9.7.5.

Table 9.7.5 Summaries of Total Construction Costs

Name of Project (Section)	Location	Road Length (km)	Construction Cost			Remarks
			Foreign Portion (US$)	Local Portion (FBu)	Total ×1,000FBu	
1. Coastal Alternative Route Projects						
CR-RR	Rohero	2.4	2,071,453	3,792,948,064	6,071,546	
CR-I	Kinindo	2.3	2,224,816	3,972,611,347	6,419,909	
CR-II	Kanyosha	1.8	1,553,589	2,844,711,048	4,553,659	
CR-III	Kanyosha	0.9	626,485	1,330,630,600	2,019,764	
Sub-total		7.4	6,476,343	11,940,901,059	19,064,878	
2. Widening of NR-3 Projects						
NS-IV	Rohero	1.7	1,721,647	2,239,217,590	4,133,029	
NS-V	Kinindo	2.9	2,383,226	3,818,933,739	6,440,482	
Sub-total		4.6	4,104,873	6,058,151,329	10,573,511	
3. Ring Road Development Projects						
RR-II	Rohero	2.6	2,683,477	4,728,148,844	7,679,974	
RI-I	Rohero	2.4	1,972,323	3,160,496,426	5,330,052	
RI-II	Rohero	1.9	1,561,423	2,502,059,817	4,219,625	
Sub-total		6.9	6,217,223	10,390,705,087	17,229,651	
4. Widening of NR-7 Projects						
WN-I	Rohero, Musaga	2.0	2,083,006	3,252,868,912	5,544,176	
Sub-total		2.0	2,083,006	3,252,868,912	5,544,176	
5. Missing Link Development Projects						
ML-I	Buenzi - Ngagara	0.5	576,336	981,736,850	1,615,706	
ML-II	Kikobe - Nyakabia	0.3	637,975	1,023,575,278	1,725,348	
ML-III	Rohero - Musaga	0.6	547,808	975,475,721	1,578,065	
Sub-total		1.4	1,762,119	2,980,787,849	4,919,119	
6. City Plan Development Projects (Northern Areas)						
CPN-I	Kinama	1.7	1,410,351	2,693,627,801	4,245,014	
CPN-II	Buterere	1.7	1,183,359	2,513,412,810	3,815,108	
CPN-III	Buterere	2.0	1,392,187	2,956,956,578	4,488,362	
CPN-IV	Buterere	2.0	895,727	2,105,017,190	3,090,317	
CPN-V	Buterere	3.5	1,567,521	3,683,779,553	5,408,053	
CPN-VI	Buterere	4.5	3,132,422	6,653,152,301	10,098,817	
CPN-VII	Ngagara	1.3	904,923	1,922,022,058	2,917,437	
CPN-VIII	Gihosha	3.2	1,433,163	3,368,027,504	4,944,507	
Sub-total		19.9	11,919,653	25,895,995,795	39,007,615	

Name of Project (Section)	Location	Road Length (km)	Construction Cost			Remarks
			Foreign Portion (US$)	Local Portion (FBu)	Total ×1,000FBu	
7. City Plan Development Projects (Southern Areas)						
CPS-L-I	Kanyosha	2.6	2,049,517	4,181,746,196	6,436,215	
CPS-L-II	Kanyosha	2.0	1,392,187	2,956,956,578	4,488,362	
CPS-L-III	Kanyosha	2.4	1,670,625	3,548,348,035	5,386,036	
CPS-M-I	Musanga	2.5	1,119,659	2,631,271,311	3,862,896	
CPS-M-II	Musanga - Kanyosha	1.8	1,492,644	2,998,963,987	4,640,872	
CPS-M-III	Kinindo - Kanyosha	2.0	1,631,862	3,294,659,364	5,089,708	
CPS-M-IV	Kanyosha	1.9	1,322,578	2,809,108,890	4,263,945	
CPS-M-V	Kanyosha	1.6	1,113,749	2,365,565,122	3,590,689	
CPS-LS-I	Kanyosha	1.4	627,008	1,473,511,680	2,163,220	
CPS-LS-II	Kanyosha	2.0	1,392,187	2,956,956,578	4,488,362	
CPS-LS-III	Kanyosha	2.5	1,119,659	2,631,271,311	3,862,896	
Sub-total		22.7	14,931,675	31,848,359,052	48,273,201	
8. Stone Pavement Projects						
Buterere		7.0	1,616,887	4,215,482,483	5,994,058	
Kinama		12.9	2,979,690	7,768,532,245	11,046,191	
Cibitoke		10.5	2,425,329	6,323,223,724	8,991,086	
Kamenge		9.2	2,125,051	5,540,348,627	7,877,905	
Ngagara		6.8	1,570,689	4,095,040,106	5,822,798	
Gihousha		13.3	3,072,084	8,009,417,000	11,388,709	
Buyenzi		7.0	1,616,887	4,215,482,483	5,994,058	
Bwiza		4.9	1,131,821	2,950,837,880	4,195,841	
Nyakabia		3.7	854,640	2,228,183,618	3,168,288	
Rohero		9.7	2,240,544	5,841,454,921	8,306,053	
Kinindo		7.9	1,824,772	4,757,473,530	6,764,723	
Musanga		7.3	1,686,182	4,396,146,401	6,250,947	
Kanyosha		10.3	2,379,133	6,202,781,348	8,819,828	
Sub-total		110.5	25,523,709	66,544,404,366	94,620,485	
Total		**175.4**	**73,018,601**	**158,912,173,449**	**239,232,636**	