7.4 Ongoing Transport Development Projects

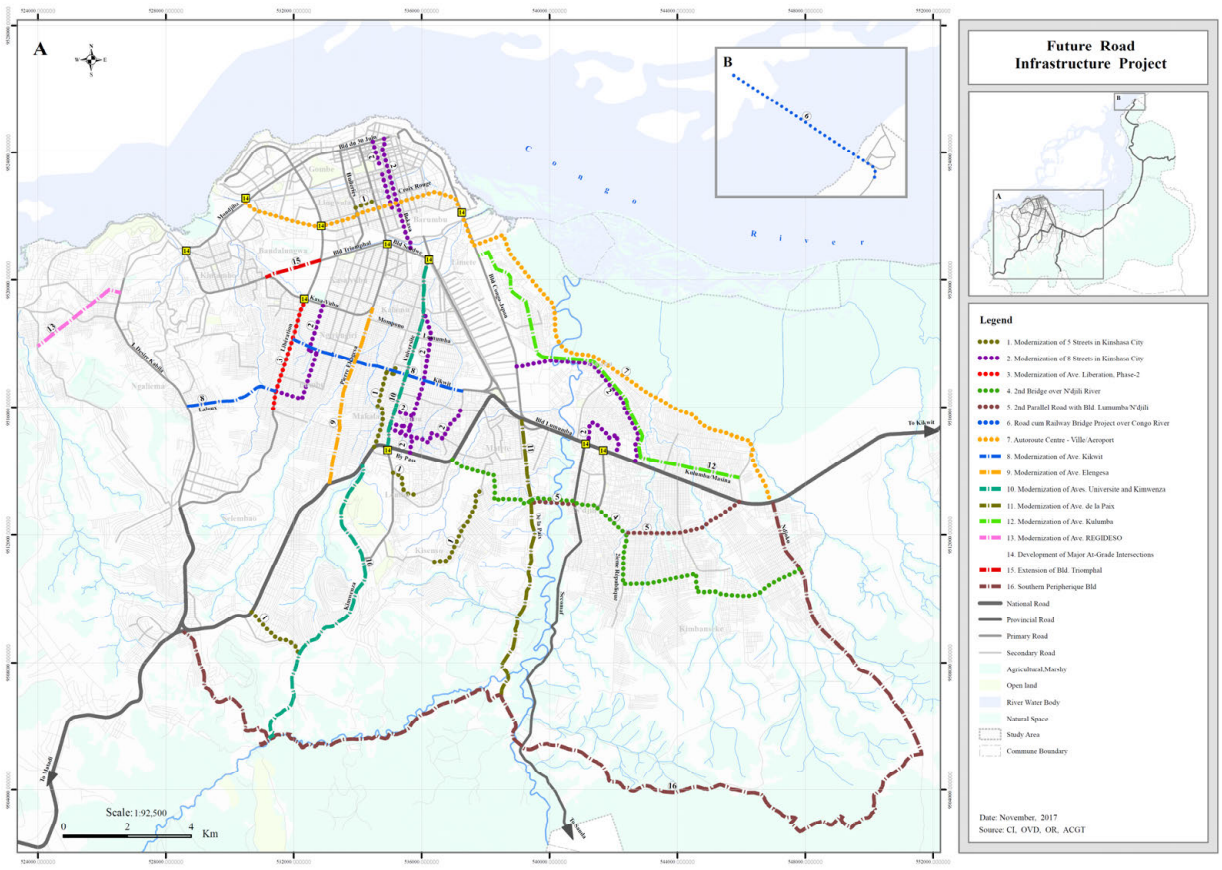
7.4.1 Road Development Plan

Based on interviews from CI, OR, OVD, ACGT and Kinshasa Province, the road infrastructure projects in future and on-going and past 10 years are listed in Table 7.4.1, Table 7.4.2 and Table 7.4.3 respectively. Also, the road infrastructure projects in future and past 5 years and on-going are illustrated in Figure 7.4.1 and Figure 7.4.2.

Table 7.4.1 Future Road Infrastructure Projects

No.	Year	name of the project	Project component	Costs	Implementation Agency	Fund	Remarks
< Future >							
1	2020 [Bidding Processing]	Modernization of 5 Streets in Kinshasa City	[Improvement] 5 streets (Ave. Croix Rouge, Kimwenza, Ave. Ngaba - Biangala, Transversale Bianda, Route de Kisenso), Pavement 2-lane, L = 12.7 km	18 Mil. USD	CI	BADEA + OFID	2 Mil. USD by DRC
2	Waiting for Fund Allocation [Design Completed]	Modernization of 8 Streets in Kinshasa City	[Improvement] 8 streets (Saio, Camp GD – Mateba, Plateau, Bokassa, Sep Congo, Matankumu, Mombele – Kahemba, Prolongment Frigo), Pavement 2-lane, L = 25.9 km	50 Mil. USD	CI	BADEA + OFID + Kuwait Fund	5 Mil. USD by DRC
3	Waiting for Fund Allocation [Land Acquisition]	Ave. Liberation, Phase-2	[Improvement] Widening from 2-lane to 4-lane, L = 3.0 km (HGR Makala – Molart)	14 Mil. USD	CI	Kuwait Fund	Difficult to fix schedule due to President election issue.
4	Undecided [Planning Stage]	2nd N'djili Bridge (Tentative)	[New Construction] L = 15 - 20 km	N/A	Kinshasa Prvo.	WB	*These projects are seemed to be partially overlapped. Need coordination between 2 agencies.*
5	Undecided [Planning Stage]	2nd Parallel Road with Bld. Lumumba/N'djili (Ave. Kabila)	[New Construction] 2 sections with 2-lane and drainage, L = 5.23 km including new bridge over N'djili River	15.506 Mil. USD	OVD	N/A	
6	Undecided [Planning Stage]	Road cum Railway Bridge Project over Congo River between Kinshasa and Brazzaville	[New Construction] No. of Lane = 2	600 Mil. EURO (Appx. 700 mil. USD)	CI	BAD (AfDB) + Private/other funds + DRC	PPP scheme. AfDB is ready to finance 100-150 million USD.
7	Undecided [Planning Stage]	Autoroute Centre – Ville/Aeroport	[New Construction] No. of Lane = 4, L = 22 km which is the most optimum among 3 alternatives.	797 Mil. USD	ACGT	Private + DRC	PPP scheme
8	Undecided [Planning Stage]	Ave. Kikwit	[New Construction] 2 sections with 2-lane and drainage, L = 8.74 km including some small bridges	42.000 Mil. USD	OVD	N/A	
9	Undecided [Planning Stage]	Ave. Elengesa	[Improvement] Widening to 2-lane with drainage, L = 4.39 km including some small bridges	14.555 Mil. USD	OVD	N/A	Surveyed by French company
10	Undecided [Planning Stage]	Widening Ave. Universite including Kimwenza	[Improvement] Widening from 2-lane to 4-lane with drainage in 2 sections (Bld. Sendwe – Ngaba Intersection and Triangle – Route de Kindele – Kimwenza Gare), L = 16.52 km	38.344 Mil. USD	OVD	N/A	
11	Undecided [Planning Stage]	Ave. de la Paix	[Improvement] Pavement 2-lane with drainage, L = 11.0 km	28.200 Mil. USD	OVD	N/A	
12	Undecided [Planning Stage]	Ave. Kulumba	[Improvement] Pavement 2-lane with drainage including new bridge over N'djili River, L = 12.69 km	37.918 Mil. USD	OVD	N/A	*This project is seemed to be partially overlapped with No.2.*
13	Undecided [Planning Stage]	Ave. REGIDESO	[Improvement] Pavement 2-lane with drainage, L = 3.23 km	11.106 Mil. USD	OVD	N/A	
14	Undecided [Planning Stage]	Development of Major At-Grade Intersections of The City	[IS Improvement] Installation of traffic lights at 10 Intersections	50.000 Mil. USD	OVD	N/A	Selected from 19 locations
15	Undecided [Planning Stage]	Extension of Bld. Triomphal	[New Construction] Construction 8-lane with drainage, L = 1.3 km	N/A	OVD	N/A	
16	Undecided [Planning Stage]	Southern Peripherique Bld.	[New Construction] Section (Ave. By Pass Cite Mpumbu - Kimwenza Gare – Ave. Ndjoku – Bld. Lumumba) follows the existing road, but it essentially newly constructed. No. of Lanes = 4, L = approx. 60 km.	N/A	OVD	N/A	

Source: The Study Team



Source: The Study Team

Figure 7.4.1 Future Road Infrastructure Projects

Table 7.4.2 On-going Road Infrastructure Projects

No.	Year	name of the project	Project component	Costs	Implementation Agency	Fund	Remarks
< On-going in 2017 >							
17	2018 [Under Construction]	By-Pass	[Improvement] Widening from 2-lane to 4-lane, L = 13.43 km (Cite Verte – Salong Gare), DBST	66.3 Mil. USD	ACGT	BOT	Delay due to lack of fund
18	2018 [Under Construction]	Rehabilitation Works of Ave. Universite	[Rehabilitation] Re-pavement of 2-lane with drainage from Bld. Sendwe to UNIKIN entrance (Intendance), L = 9.4 km	9.106 Mil. USD	OVD	MITPR	Delay due to rainy season
19	2018 [Under Construction]	Rehabilitation Works of Ave. Bukasa	[Rehabilitation] Partially re-pavement of 2-lane by PCC and installation of drainage, L= 3.323 km	5.023 Mil. USD	OVD	Kinshasa Prov.	
20	2018 [Under Construction]	Rehabilitation Works of Ave. Mokali	[Rehabilitation] Partially re-pavement of 2-lane by Asphalt and installation of drainage, L= 3.742 km	6.578 Mil. USD	OVD	Kinshasa Prov.	
21	2018 [Under Construction]	Rehabilitation Works of Ave. Laloux	[Rehabilitation] Partially re-pavement of 2-lane by Asphalt and installation of drainage, L= 1.020 km	1.974 Mil. USD	OVD	Kinshasa Prov.	
22	2018 [Under Construction]	Rehabilitation Works of Ave. Colonel Ebeya	[Rehabilitation] Partially re-pavement of 2-lane by Asphalt and installation of drainage, L= 2.064 km	2.316 Mil. USD	OVD	Kinshasa Prov.	
23	2018 [Under Construction]	Rehabilitation Works of Ave. Shaba	[Improvement] Partially re-pavement of 2-lane by asphalt and installation of drainage, L= 1.956 km	2.143 Mil. USD	OVD	Kinshasa Prov.	
24	2018 [Under Construction]	Rehabilitation Works of Ave. Komoriko	[Improvement] Pavement of 2-lane by asphalt and installation of drainage, L= 1.050 km	1.243 Mil. USD	OVD	Kinshasa Prov.	
25	2018 [Under Construction]	Rehabilitation Works of Ave. Chretien	[Improvement] Pavement of 2-lane by asphalt and installation of drainage, L= 1.500 km	1.692 Mil. USD	OVD	Kinshasa Prov.	
26	Undecided [Under Construction]	Rehabilitation Works of Ave. Kulumba in Masina Commune	[Improvement] Pavement of 2-lane by asphalt, installation of drainage and construction small bridge, L= 1.990 km	9.101 Mil. USD	OVD	Kinshasa Prov.	Suspended due to lack of fund

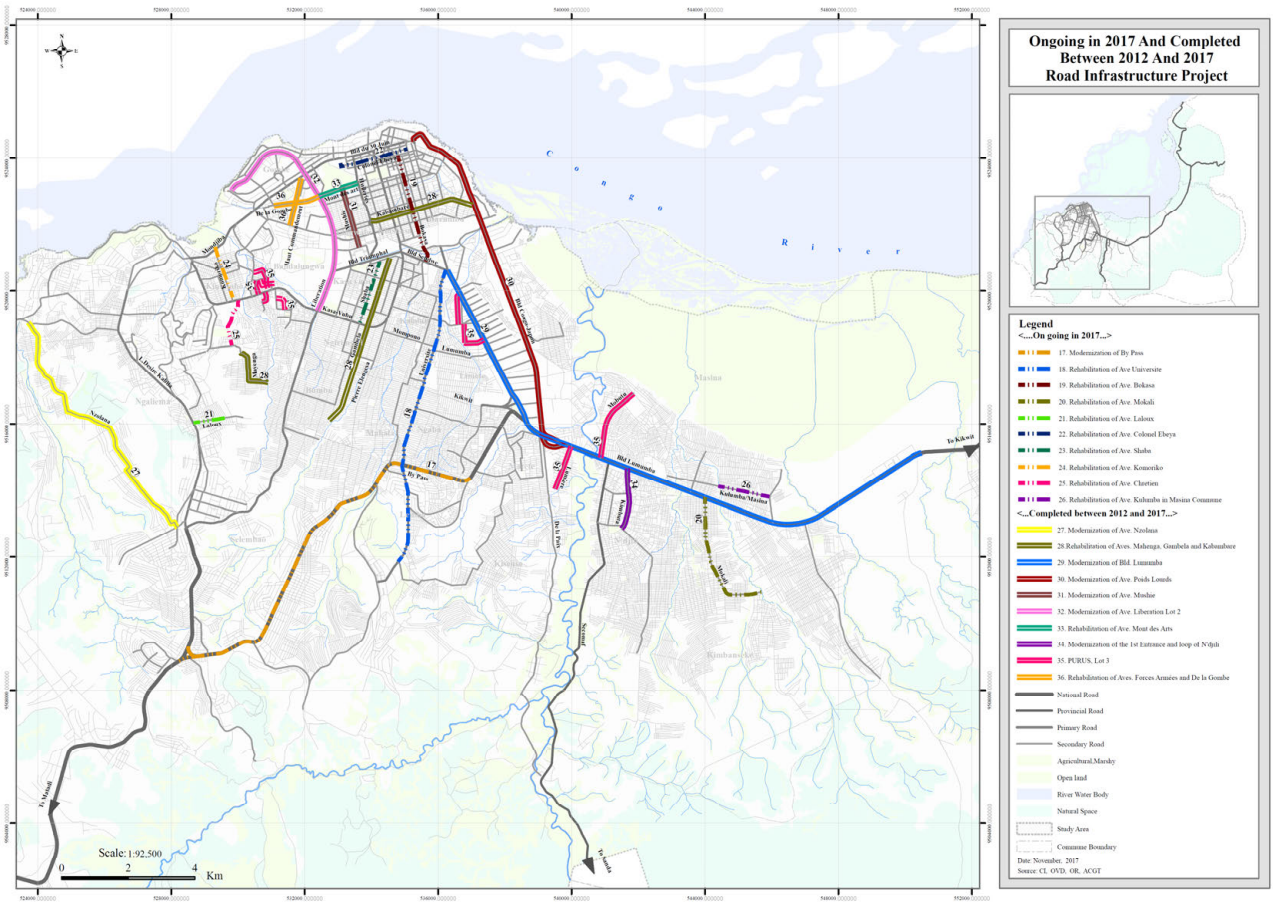
Source: The Study Team

Table 7.4.3 Road Infrastructure Projects in the Past 5 Years

No.	Year	name of the project	Project component	Costs	Implementation Agency	Fund	Remarks
<Completed between 2012 and 2017>							
27	2017	Ave. Nzolana	[Improvement] L = 10.976 km, 2-lane	38.987 Mil. USD	ACGT	Sino-Congolais	Partially fixing until March, 2018 due to erosion.
28	2015	Road Rehabilitation and Sanitation Works of Aves. Mahenga, Gambela and Kabambare	[Rehabilitation] Partially re-pavement of 2-lane and cleaning of drainage. L = 2.27 km	8.740 Mil. USD	OVD	Kinshasa Prov.	
29	2014-2015	Rehabilitation Works and Modernization of Bld. Lumumba	[Improvement] Widening from 4-lane to 8-lane, L = 20.0 km	94 Mil. USD + 149 Mil. USD	OVD (Lot 1)/ ACGT (Lots 2&3)	Government DRC	
30	2014	Ave. Poids Lourds	[Improvement] Widening from 2-lane to 4-lane, L = 12.0 km	5.1 Bil. JPY (45.2 Mil. USD) + 14.5 Mil. USD	CI	Japan + DRC	Japan's Grant Aid, 14.5 Mil. USD by DRC for additional Widening
31	2014	Rehabilitation Works and Modernization of Ave. Mushie	[New Construction] Construction 2-lane with draiange, L = 1.87 km	4.780 Mil. USD	OVD	MITPR	
32	2013	Rehabilitation Works and Modernization of Ave. Liberation Lot 2	[Improvement] Widening from 2-lane to 4/6-lane, L = 10.00 km	39.560 Mil. USD	OVD	MITPR	
33	2013	Rehabilitation Works of Ave. Mont des Arts	[Improvement] Pavement of 2-lane by asphalt and installation of drainage, L = 1.500 km	3.550 Mil. USD	OVD	Kinshasa Prov.	
34	2013	Rehabilitation Works and Modernization of the 1st Entrance and loop of N'djili	[Improvement] Widening to 2-lane and 4-lane, L = 3.500 km	13.415 Mil. USD	OVD	Kinshasa Prov.	
35	2012-2013	Emergency Project of Urban and Social Rehabilitation (PURUS), Lot 3	[Rehabilitation] Partially re-pavement of 2-lane and installation of drainage, L= 22.06 km (Aves. Ango Ango, Bula, Assolongo, Maduda, 8 Decembre, Mobutu, Revolution, Tropique, Zinnias and Lumiere)	23.500 Mil. USD	OVD	WB	
36	2012	Rehabilitation Works of Aves. Forces Armees and De la Gombe	[Improvement] Pavement of 2-lane and installation of drainage (Ave. Forces Armees: L= 1.500 km, Ave. De la Gombe: L = 1.000 km)	2.830 Mil. USD	OVD	MITPR	
< Completed between 2007 and 2011>							
37	2011	Route de Lutendele	[Improvement] L = 4.5 km	19.9 Mil. USD	ACGT	Sino-Congolais	
38	2011	Ave. du Tourisme	[Improvement] L = 6.8 km	29.8 Mil. USD	ACGT	Sino-Congolais	
39	2011	Bld. Sendwe	[Improvement] Widening from 2-lane to 6-lane, L = 1.520 km	36.2 Mil. USD	ACGT	Sino-Congolais	
40	2010	Bld. Triomphal	[New Construction] No. of Lane = 8, L = 2.140 km		ACGT	Sino-Congolais	
41	2010	Bld. 30 Juin	[Improvement] Widening from 4-lane to 8-lane , L = 5.0 km	43.5 Mil. USD	ACGT	Sino-Congolais	
42	2010	Ave. Liberation, Phase-1	[Improvement] Pavement, L = 5.5 km (UPN – HGR Makala)	14.77 Mil. USD + 1.02 Mil. EURO	CI	Kuwait Fund	3 Mil. USD by DRC
43	2010	Rehabilitation Works of Kulumba, Mino Congo and Lumumba. / Kingabwa loop	[Rehabilitation] Re-pavement of 2-lane and installation of drainage. L = 3.00 km	4.740 Mil. USD	OVD	MITPR	
44	2009-2010	Emergency Project of Urban and Social Rehabilitation (PURUS), Lot 2	[Rehabilitation] Partially re-pavement of 2-lane and installation of drainage, L= 11.89 km (Aves. Ecole, Ngiri Ngiri, Assossa, Shaba – Landu and Mompono)	13.400 Mil. USD	OVD	WB	
45	2009	Rehabilitation works and Modernization of Ave. Des Huilleries	[Improvement] Widening from 2-lane to 4-lane, L = 3.8 km	7.152 Mil. USD	OVD	Kinshasa Prov.	
46	2008	Emergency Project of Urban and Social Rehabilitation (PURUS), Lot 1	[Rehabilitation] Partially re-pavement of 2-lane and installation of drainage, L= 1.30 km (Aves. Lukengo, Komoriko and Militant)	1.200 Mil. USD	OVD	WB	
47	2008	Rehabilitation Works of Ave. OUA 2	[Rehabilitation] Re-pavement of 2-lane and installation of drainage, L = 1.460 km	3.870 Mil. USD	OVD	MITPR	
48	2008	Rehabilitation Works of Ave. Bangala	[Rehabilitation] Re-pavement of 2-lane and installation of drainage, L = 0.750 km	1.270 Mil. USD	OVD	MITPR	
49	2007	Emergency Program	[Rehabilitation] Re-pavement of 2-lane, L = 15.400 km (Roadway loop of N'djili, Aves. Yolo, Universite, Gambela, Bangala, Bongolo, Ecuries, Benseke, Nguma, Access road to Sino-Congolais Hospital and official residence of the prime Minister, President)	34.550 Mil. USD	OVD	MITPR	

Note: 1USD=113JPY

Source: The Study Team



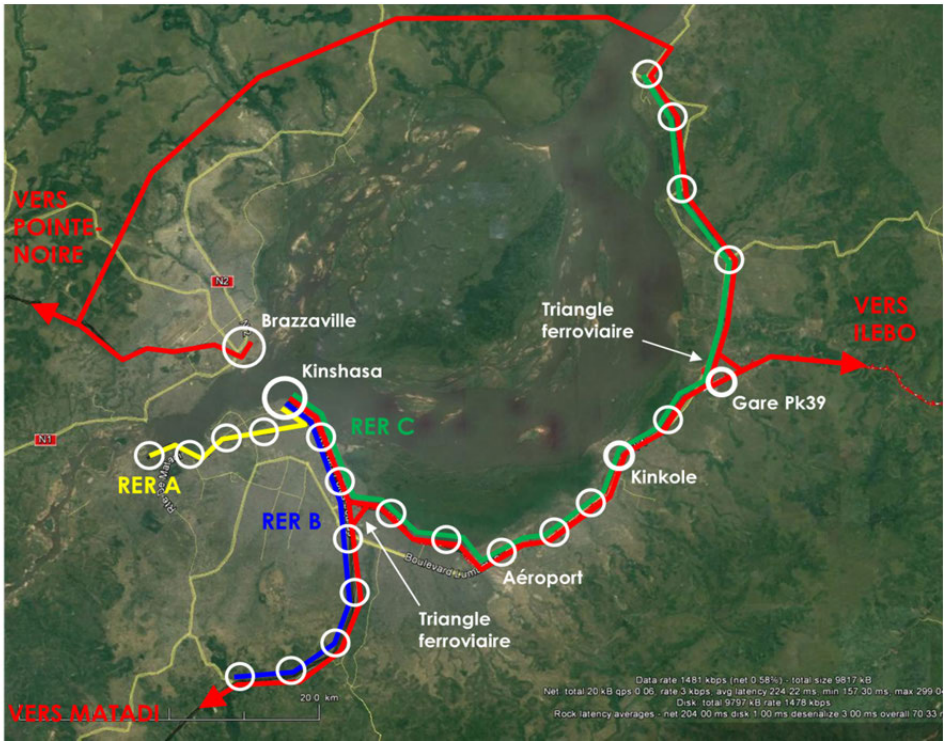
Source: The Study Team

Figure 7.4.2 Road Infrastructure Projects On-going and Past 5 Years

7.4.2 Public Transport Development Plans

As a part of large scale international strategic project, the Kinshasa-Ilebo Railway Project, railways of approximately 800 km from Kinshasa City to Ilebo town in Kasai province, is planned. The project is the priority infrastructure project of NEPAD (the New Partnership for Africa's Development) prepared by the African Union, and the project is being coordinated by ECCAS (the Economic Community of Central African State). In this context, the DRC and the Republic of the Congo exchanged memorandums for the construction in 2009, and the feasibility study was completed in 2016.

The project is planned to be completed by 2022 and it includes the Kinshasa-Brazzaville Bridge Project and railway extension to Kinshasa (Gombe commune) as well. The project is assumed PPP (Public–Private Partnership) scheme and currently it is achieved that 70% of the total cost for constructing the bridge and access to the bridge has been committed.



Source: Etude de faisabilité du prolongement du Chemin de fer Kinshasa-Ilebo, 2016

Figure 7.4.1 Railway Projects in the Future

7.4.3 Traffic Management Plans

Present efforts in traffic safety, control and management in Kinshasa City are as follows:

(1) Traffic Signal

According to the ACGT, there is a plan to replace the inactive traffic signals along 30 Juin Boulevard using the DRC government funding. And some new traffic signals at major intersections along Lumumba Boulevard and Kasa-vubu Avenue were replaced or newly installed recently in 2017 and 2018.

Broken traffic signals on 30 Juin Bld.

Robot traffic signal (new type) on 30 Juin Bld.

New traffic signal on Kasa-vubu Ave.

Source: The Study Team

Figure 7.4.3 Traffic Signals in Kinshasa City

(2) Pedestrian Bridge

Three pedestrian bridges along Lumumba Boulevard have already been built and four more pedestrian bridges will be constructed according to the plan. Seven bridges, with a total cost estimated at US $13.6 million, are planned to be constructed and the locations are described in Table 7.4.4.

Table 7.4.4 Locations of Pedestrian Bridge Construction on Lumumba Boulevard

Location	Phase	Status
Saint Raphael	1st phase	Completed
7eme rues Limite	1st phase	Completed
13 eme rues Limite	1st phase	Completed
Debonhomme	2nd phase	
Marche de la Liberte	2nd phase	
Kingasani Pascal	2nd phase	
Kingasani ya Suka	2nd phase	

Source: ACGT Webpage (http://www.acgt.cd/fr/detail.php?id=65&menu=actualite, media Congo.net: http://www.mediacongo.net/article-actualite-3256.html)

Source: The Study Team

Figure 7.4.4 Pedestrian Bridges on Lumumba Boulevard

(3) Other Traffic Management

In most cases, traffic management measures have been implemented as a part of road construction or rehabilitation projects other than the pedestrian bridge project. Currently, no other projects only for traffic management have been authorized in Kinshasa City.

7.4.4 Kinshasa Urban Development and Resilience Project

There is a plan of a project on urban development and resilience which will be funded by the World Bank. The expected implementing agency is Kinshasa Provincial Ministry of Plan and Infrastructure. The objectives of the project are to improve the living conditions and socio economic opportunities for the residents of targeted poor and vulnerable neighborhoods through selected investments and to strengthen the urban planning and management capacity of the City-Province of Kinshasa. The estimated fund of the project is approximately USD 150 million according to the project pipeline of the World Bank. The components of the project are summarized in Table 7.4.5. The PDTK Study Team and the officers of the World Bank in charge

of the project frequently exchanged information of each project. Thus, the planned components of the project is in line with the Urban Transport Master Plan such as parallel road to Lumumba Boulevard.

Table 7.4.5 Project Components of Kinshasa Urban Development and Resilience Project

Component	Description
Component 1. Resilient infrastructure and urban services	This component would (i) include physical investments to improve living conditions in selected under-equipped neighbourhoods along the N'djili River watershed which are directly exposed to flooding and erosion (ii) detailed studies and selected investments to improve inner-city connectivity and integration of poor neighbourhoods into the urban fabric (for the rehabilitation and construction of an urban roads system).
Component 2. Social and economic inclusion	This component aims to provide a variety of services such as productive safety nets providing access to temporary employment, and poverty graduation programmes.
Component 3. Urban Management Strengthening	This component will provide technical assistance to relevant government institutions at the local, provincial and national levels to strengthen their capacity to improve service delivery and urban management.

Source: The World Bank

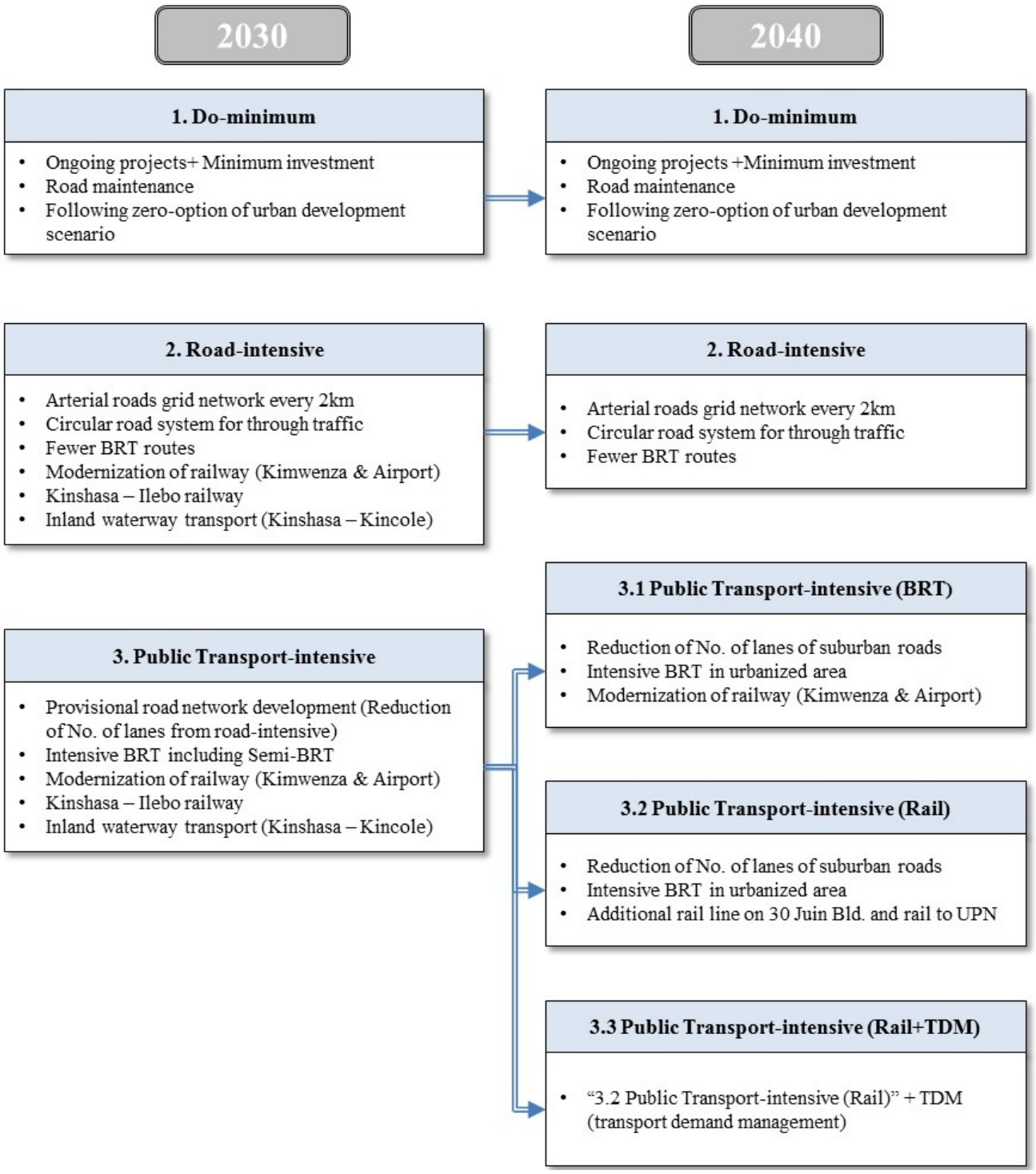
7.5 Alternative Transport Network Scenarios

For the purpose of identifying the suitable transport network option as well as public transport mode, alternative transport network scenarios are prepared. The overall frame of transport network is discussed in Chapter 6 in line with the land use plan. In Section 7.3.3, the road hierarchy system and public transport routes planned to connect major roads to outside of the Study Area, the ports, the airport and the major commercial and business centres are based on the frame network in Chapter 6. Besides, existing plans and projects are taken into account as described in Section 7.4.

Considering the limited financial resources, priority should be given. It also be noted that the future transport modes also should be identified. In addition to the abovementioned consideration, discussions were held in the series of meetings with the TWG and individual meetings with the JCC members and relevant government agencies. In the third JCC meeting, the following alternative transport network scenarios were proposed and discussed.

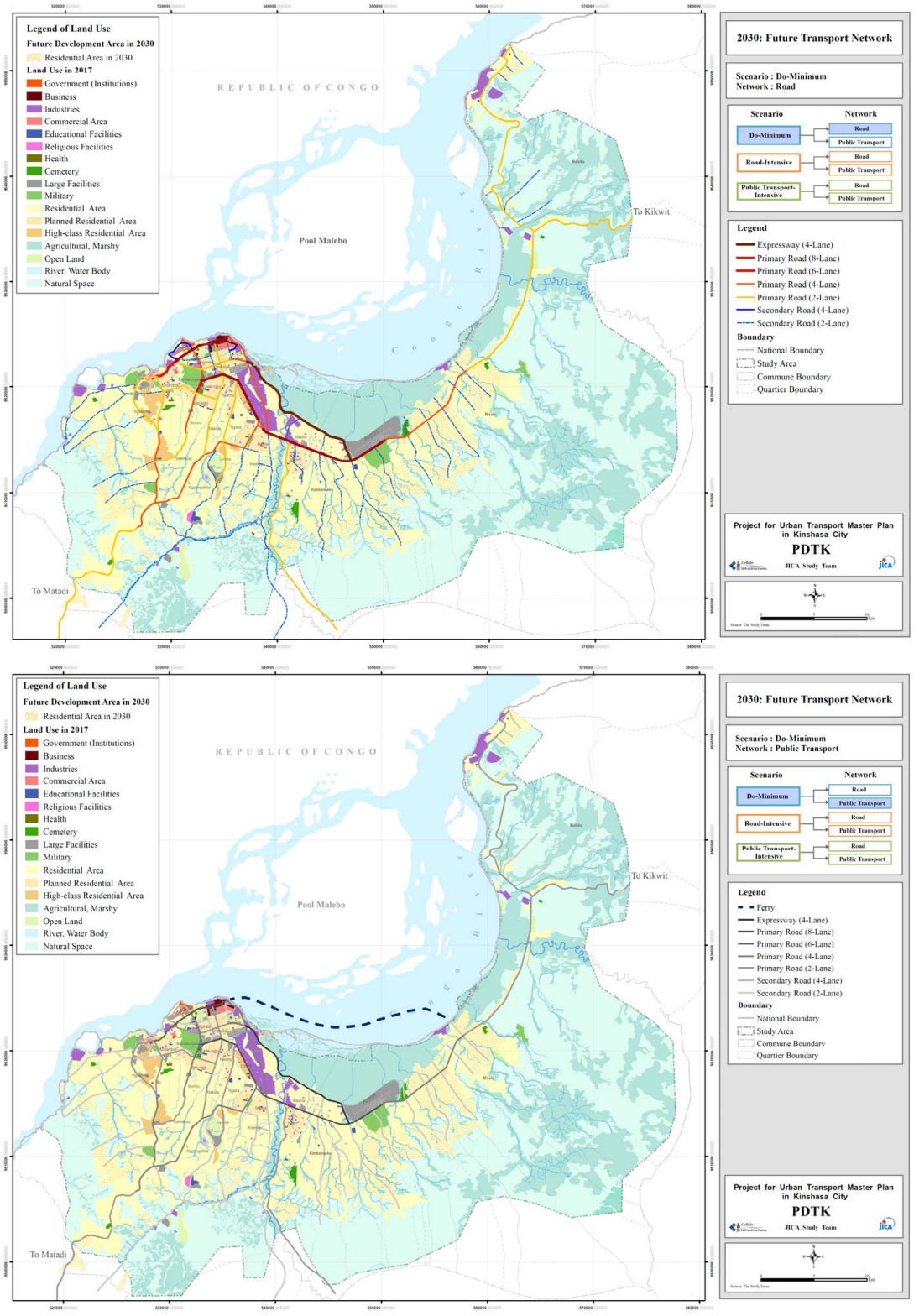
In principle, 3 scenarios; 1) Do Minimum, 2) Road-intensive and 3) Public transport intensive scenarios are prepared as shown in Figure 7.5.1. For the 3) Public transport intensive scenario, the scenario is divided into three derivative scenarios by mode and application of TDM policy in 2040.

The network options of road and public transport are illustrated in Figure 7.5.2 to Figure 7.5.8.



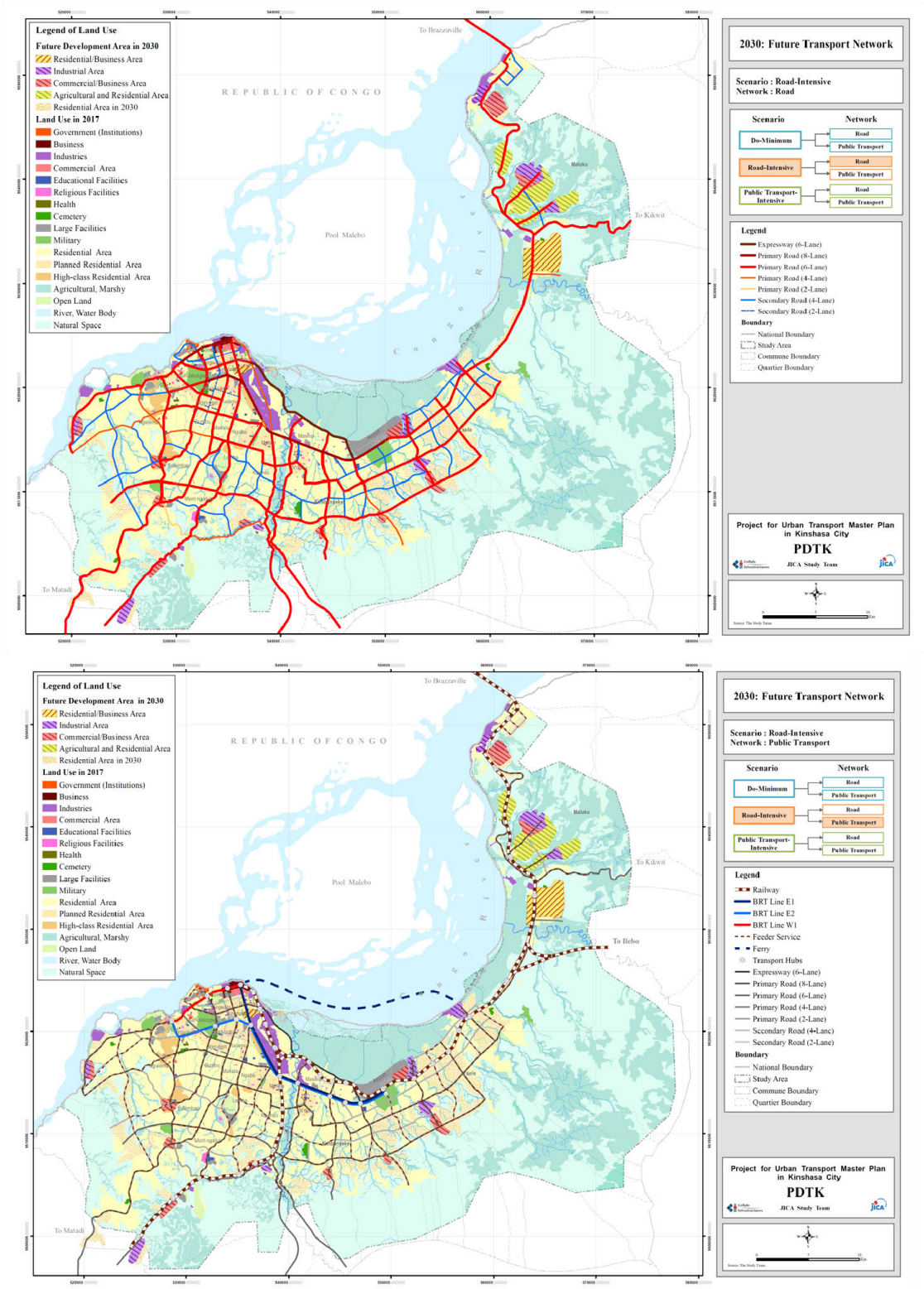
Source: The Study Team

Figure 7.5.1 Alternative Transport Network Scenarios in 2030 and 2040



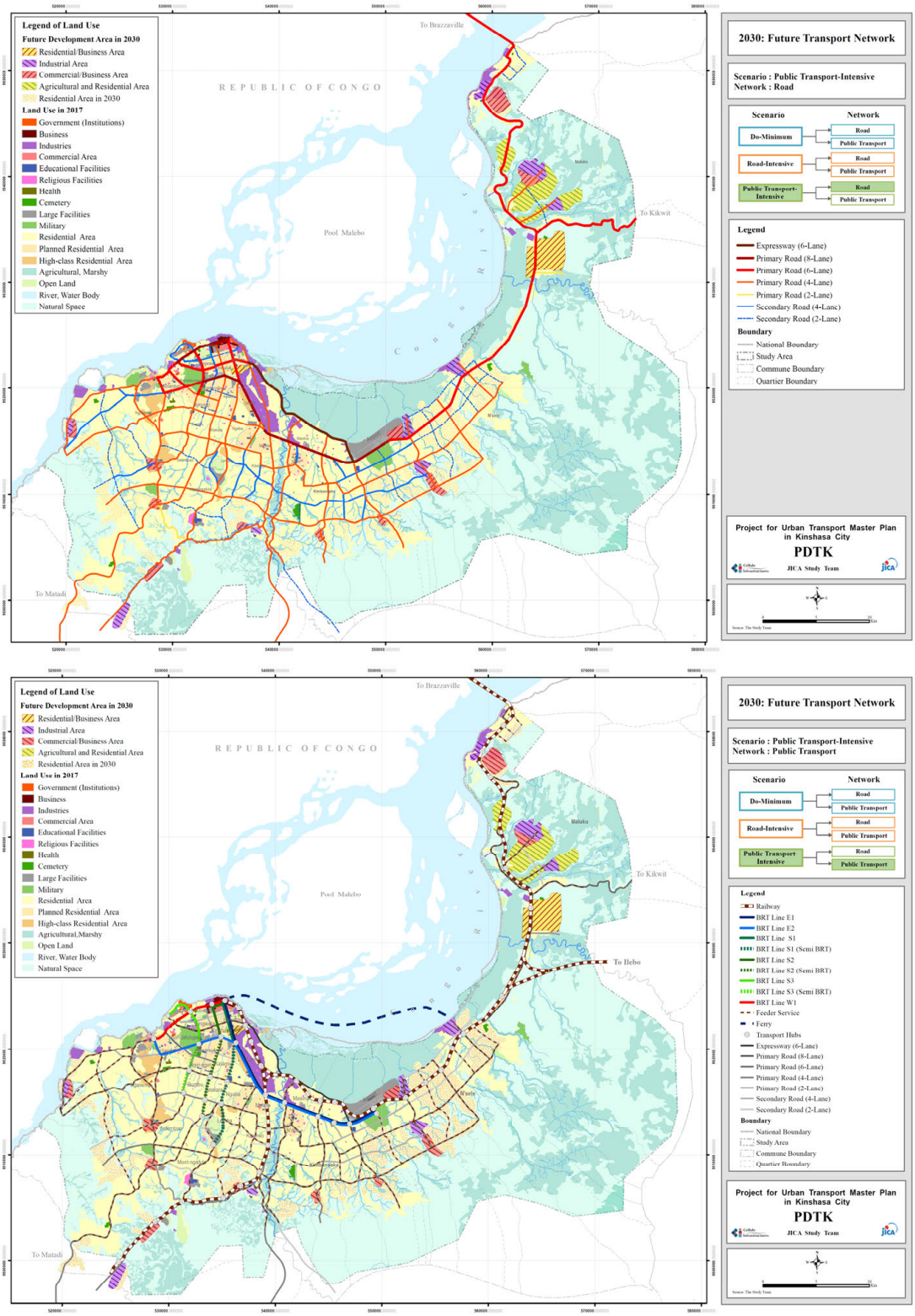
Source: The Study Team

Figure 7.5.2 Road and Public Transport Network on Do-minimum Scenario in 2030



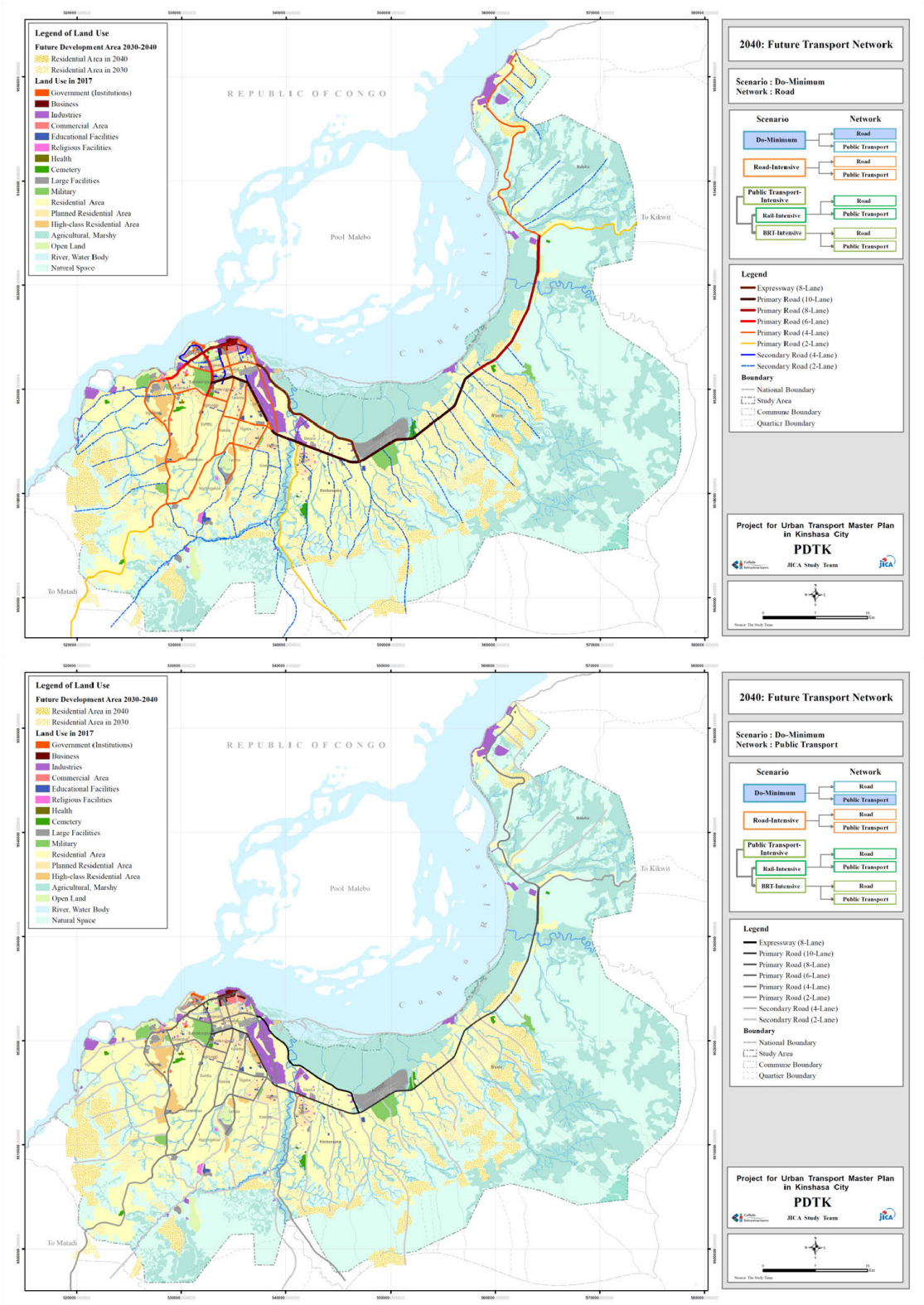
Source: The Study Team

Figure 7.5.3 Road and Public Transport Network on Road-intensive Scenario in 2030



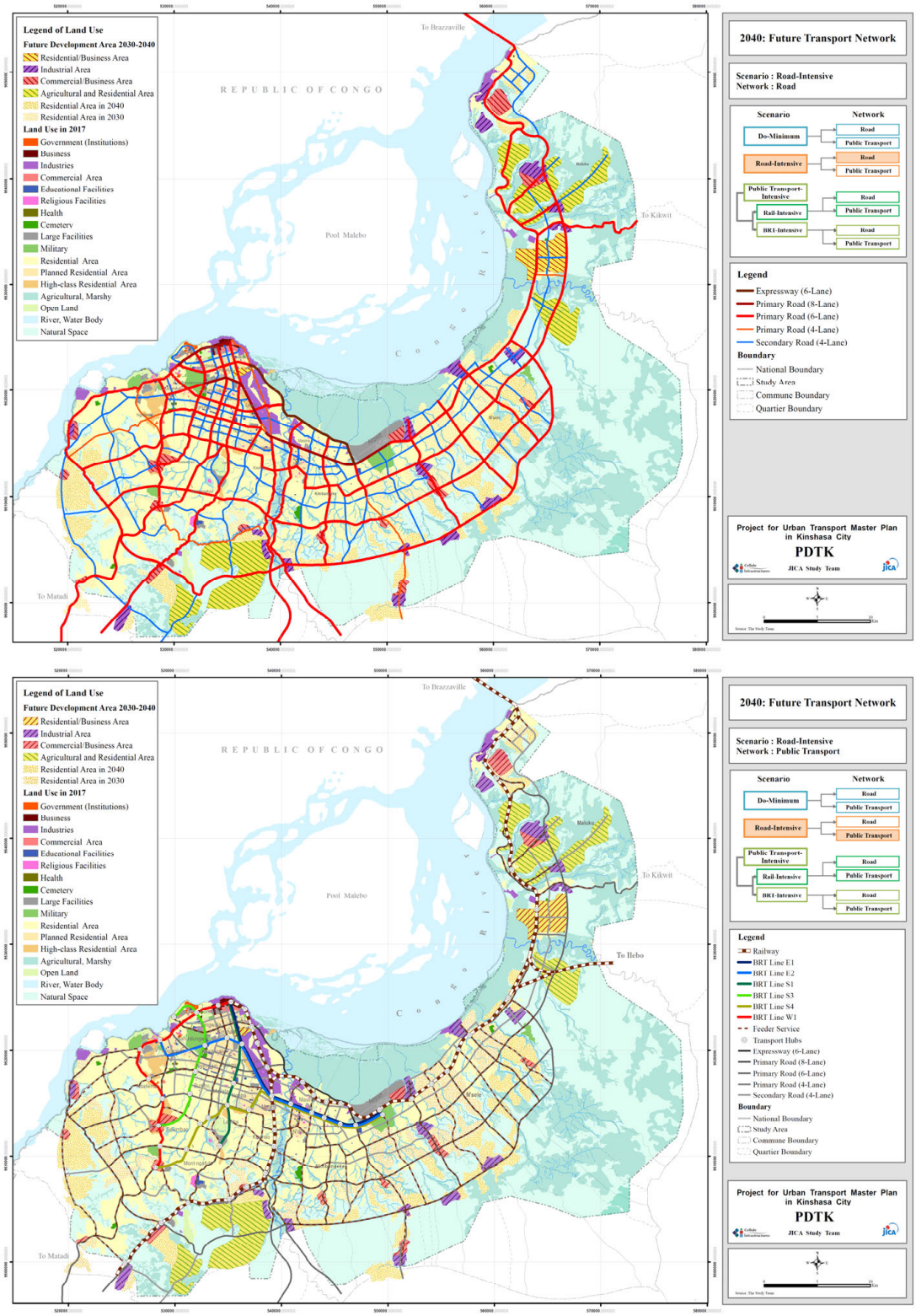
Source: The Study Team

Figure 7.5.4 Road and Public Transport Network on Public Transport-intensive Scenario in 2030



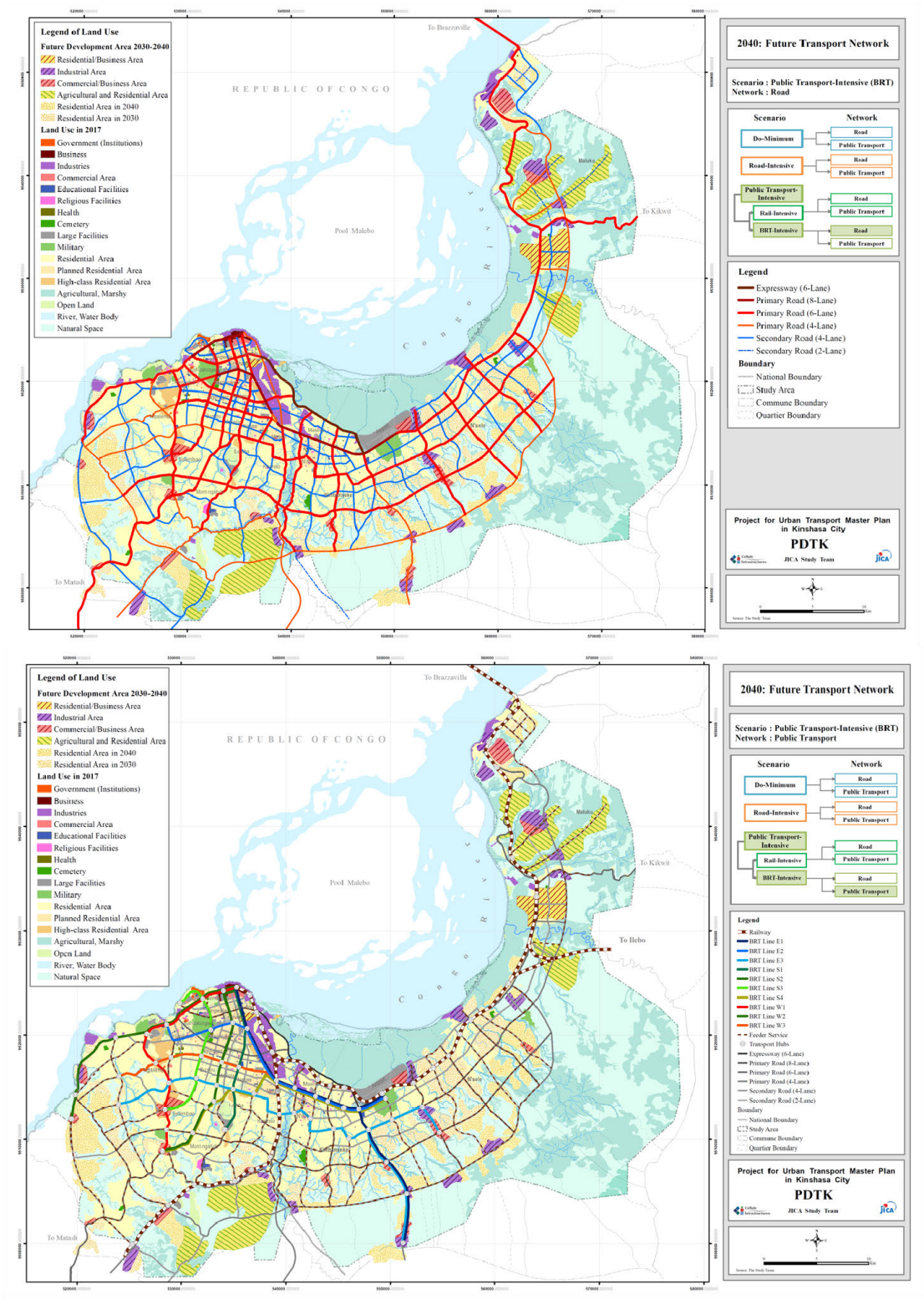
Source: The Study Team

Figure 7.5.5 Road and Public Transport Network on Do-minimum Scenario in 2040



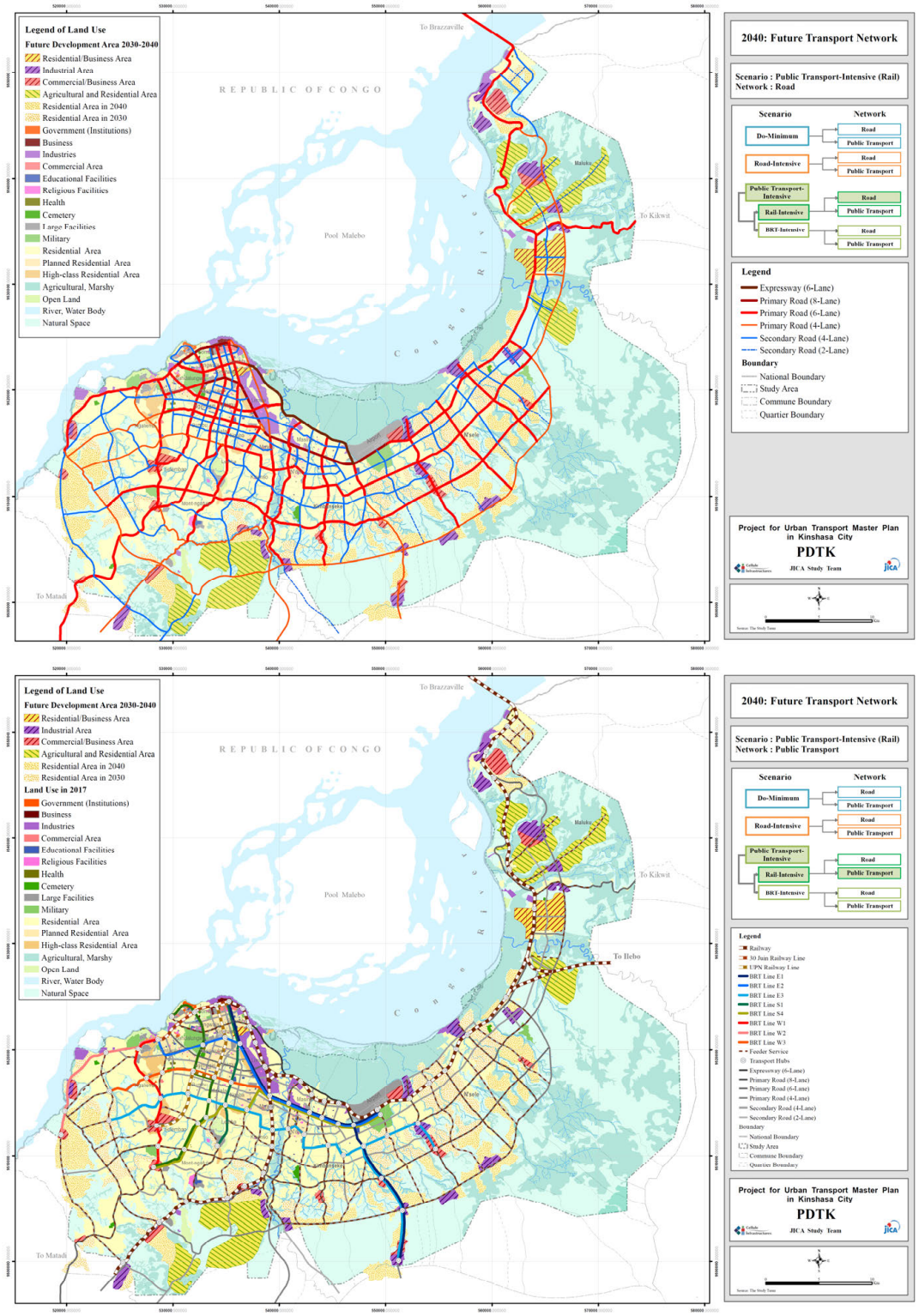
Source: The Study Team

Figure 7.5.6 Road and Public Transport Network on Road-intensive Scenario in 2040



Source: The Study Team

Figure 7.5.7 Road and Public Transport Network on Public Transport-intensive (BRT) Scenario in 2040



Source: The Study Team

Figure 7.5.8 Road and Public Transport Network on Public Transport-intensive (Rail and Rail + TDM) Scenario in 2040

7.6 Transport Demand Analysis and Future Projection

7.6.1 Assumptions

(1) Network Conditions

The network conditions for future transport projections are described in aforementioned Section 7.5. The networks were prepared to satisfy the urban transport policies.

As for the condition of those networks, all road surfaces were improved to smooth traffic flow and the road capacity was reduced to two lanes when BRT or railways were introduced.

(2) Fare System

As of 2017, there is a flat fare system with the price set by the government at CDF 500 per ride, regardless of travel distance. However, from the view of the operators, the result of BRS (Bus Route Survey) indicates that the government-designated fare system tends to disturb the flexibility of their operation and sustainability of their service. Additionally, from the passengers' point of view, this fare system disadvantages those making short-distance trips, which are fairly common as of 2017 in the Study Area.

Thus, a distance-based fare system is recommended in the Study for public transport, which is assumed to include government modernized railways, BRT, feeder services, Transco and New Transkin. The suggested fare system for public transport is an initial fare of CDF 300 plus an additional CDF 40 for each kilometre travelled. This fare system was designed to bring in roughly the same amount of total revenue, while incentivizing short-distance trips and improving user-friendliness for riders. The private transport fare systems were assumed to be unchanged from current conditions.

(3) Trips from External and Special Generator Zones

The trips from external and special generator zones in 2030 and 2040 were estimated using 5 methods: 1) person trips on the roads, 2) freight trips on the roads, 3) trips to/from N'djili Airport, 4) Kinshasa-Brazzaville Bridge, and 5) person and freight trips at the port.

Person and freight trips on roads were estimated using a growth rate method based on the current number of trips. The number of person and freight trips in 2017 was obtained by cordon line surveys, and the growth rate for person trips was calculated using the results of the trip frequency model. There is significant amount of research on the relationship between GDP growth and freight trips which shows that their growth rates are generally parallel. Therefore, the projected GDP growth rate was used to calculate the growth in freight trips.

Air passenger growth rates tend to be related to, but are generally higher than, population growth rates. Using this relationship, future air passenger trips to and from N'djili Airport were estimated using elasticity values between the historical change of air passengers and population growth.

As shown in Table 7.6.2 and Table 7.6.1, the Ministry of Planning is conducting a study on the Kinshasa-Brazzaville Bridge which estimated freight demand in 2015 and 2025, and person trips in 2019 and 2025. These numbers were used by the Study to estimate trips in 2030 and 2040 using the linear interpolation method. It is noted that the majority of freight is expected to travel to the

continental interiors by railway. Thus, the Study Team assumed that ton-wise freight demand will be distributed based on the share of population, and 90% of total freight will be delivered by railway service. There are two cases for person trips to and from the river. Under the first case, the bridge is completed and there is no ferry operating. Under the second case there are both a bridge and ferry. The Study Team assumed the latter case and trips on the ferry were considered to be person trips at ports. The freight trips at ports were estimated using GDP growth rates just as for those on the roads.

Table 7.6.1 Freight Demand on Kinshasa-Brazzaville ('000 tons/year)

2015	2025
2,229	5,200

Source: Ministry of Planning

Table 7.6.2 Passenger Trips on Kinshasa-Brazzaville ('000 trips/year)

Case		2019	2025
Passenger Vehicle	Bridge	3,135	4,344
	Ferry	1,971	2,732
	Total	5,106	7,076
Railway	Bridge	261	346
	Ferry	167	221
	Total	428	567

Source: Ministry of Planning

(4) Parameters

VOT (Values of Time) was estimated using the income approach based on CS and ADS in 2017, and the results of population synthesis model in 2030 and 2040. The estimated VOTs are shown in Table 7.6.3.

Table 7.6.3 Values of Time for Assignment Model

Trip Type		VOT (CDF/Hour)		
		2017	2030	2040
Person Trip	Low Income	218	218	220
	Middle Income	660	791	812
	High Income	2,825	2,891	3,786
Freight Trip	LGT	1,315	1,511	1,543
	HGT	1,981	2,177	2,209
	ACT	2,980	3,176	3,207

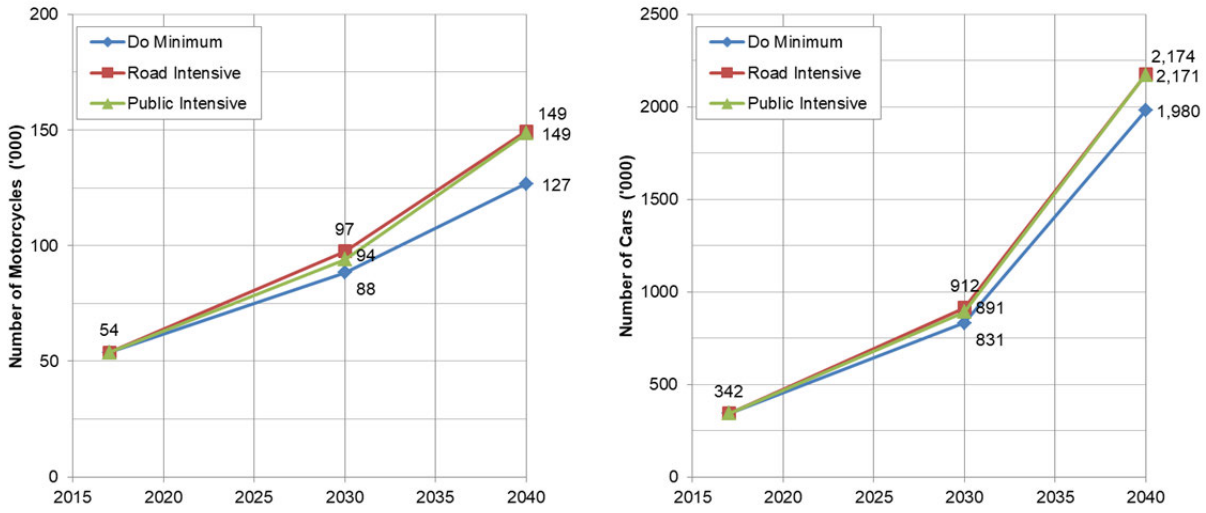
Source: The Study Team

7.6.2 Projected Future Transport Demand

(1) Vehicle Ownership

The number of cars and motorcycles in the Study Area is projected to increase drastically from 2017 to 2040 and this reflects accelerated economic growth and transport network improvements.

In the case of the Road Intensive scenario, the number of cars will increase from 342,000 cars in 2017 to 2,174,000 cars in 2040. This growth rate is the highest among the different scenarios and would result in nearly 6.4 times as many cars on the road in 2040 as in 2017. The share of car-owning households would also increase from 12.5% in 2017 to 36.1% in 2040. The number of motorcycles would also increase from 54,000 in 2017 to 149,000 in 2040.



Source: The Study Team

Figure 7.6.1 Number of Vehicles by Scenario (Left: Motorcycles, Right: Cars)

(2) Number of Trips

As shown in Table 7.6.4, the total number of daily trips in the Study Area in 2017, 2030 and 2040 was estimated based on the trip frequency model. The total number of daily trips in 2017 was 13 million and this number is expected to increase to approximately 21.7 million by 2030 and 30.2 million by 2040 due to population and economic growth.

Table 7.6.4 Number of Daily Trips by Trip Purposes by Scenarios (Unit: '000 trips)

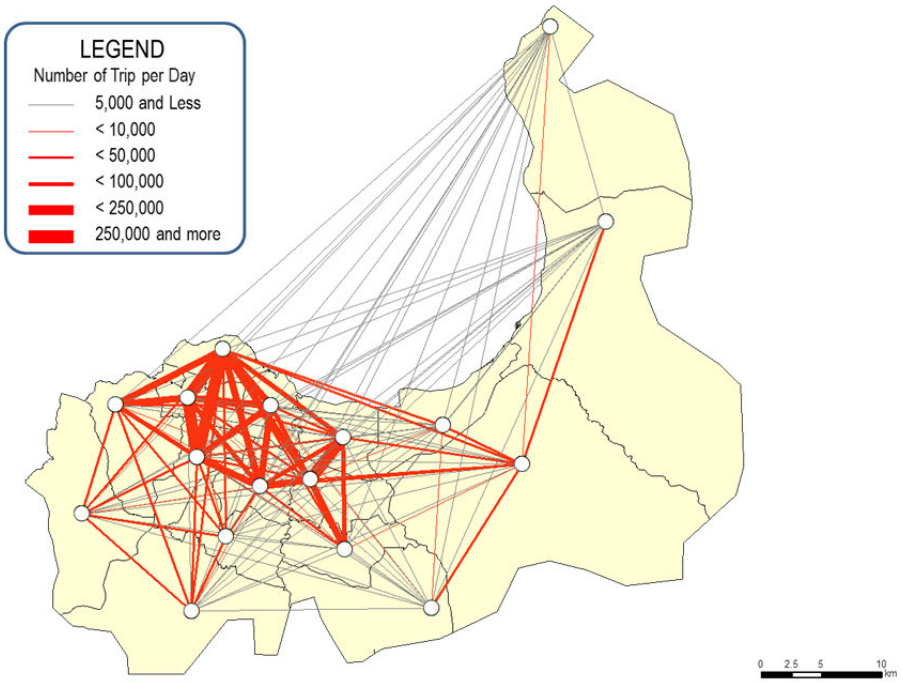
Scenario		HTW	WTH	HTSc	ScTH	HTSh	ShTH	HTO	OTH	NHB	Total
Y2017		1,290	1,206	1,674	1,675	886	957	2,715	2,333	624	13,361
Y2030	Do Minimum	2,203	2,061	2,859	2,861	1,298	1,408	4,261	3,662	1,034	21,648
	Road Intensive	2,216	2,074	2,840	2,842	1,314	1,425	4,266	3,666	1,049	21,694
	Public Intensive	2,217	2,074	2,838	2,840	1,308	1,418	4,263	3,666	1,047	21,670
Y2040	Do Minimum	3,192	2,987	4,183	4,186	1,632	1,779	5,732	4,926	1,502	30,119
	Road Intensive	3,284	3,074	4,107	4,109	1,643	1,786	5,726	4,920	1,539	30,188
	Public Intensive (BRT/Rail)	3,287	3,075	4,107	4,110	1,642	1,786	5,722	4,924	1,543	30,196

Source: The Study Team

Figure 7.6.2, Figure 7.6.3 and Figure 7.6.4 show the trip distribution of all person trips in 2017, 2030, and 2040 respectively based on socio-economic framework of current and Public Intensive scenarios. The distribution of trips under the Road Intensive scenario is almost the same as with the Public Intensive scenario, with slight differences reflecting accessibility of transport system and vehicle ownership. The 395 internal TAZs were simplified to 17 zones to help visualize the

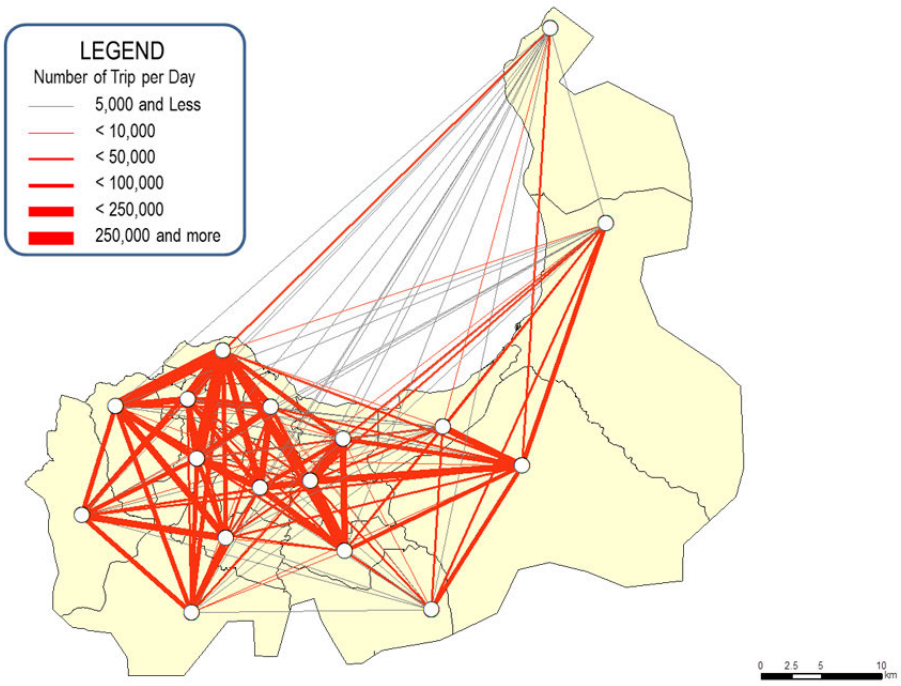
trip distribution.

As shown in these figures, in 2017 the majority of trips were concentrated to and from the CBD (Central Business District) in Gombe, with little demand between sub-districts (e.g. between Maluku and Kimpoko). In 2030 and 2040, it is expected that the distribution of trips will still be concentrated to and from the CBD, but with transport demand between sub-districts rapidly increasing as shown in Figure 7.6.3 and Figure 7.6.4.



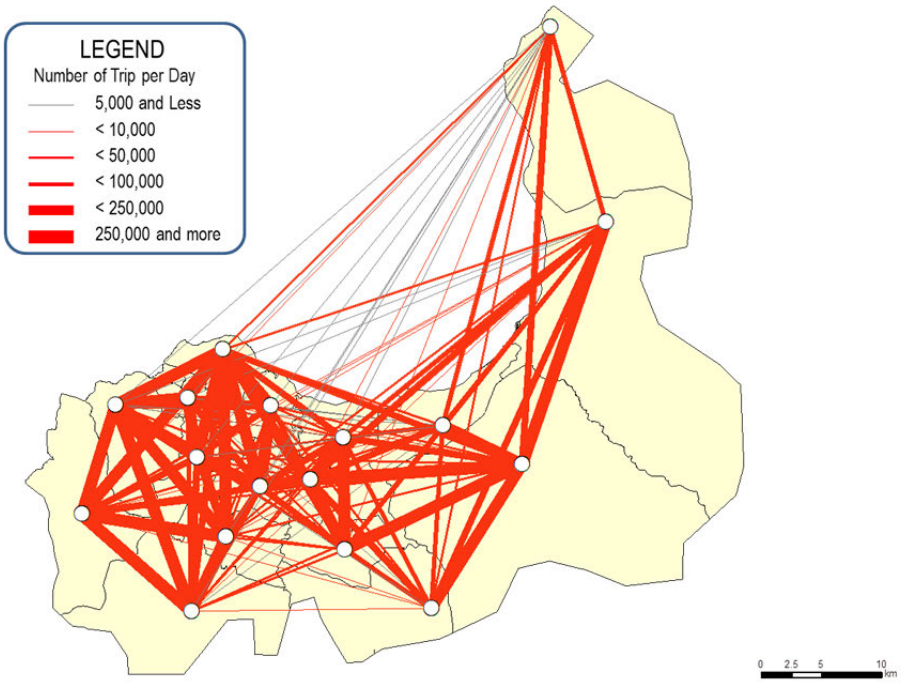
Source: The Study Team

Figure 7.6.2 Desire Lines in 2017



Source: The Study Team

Figure 7.6.3 Desire Lines in 2030 (Public Intensive)

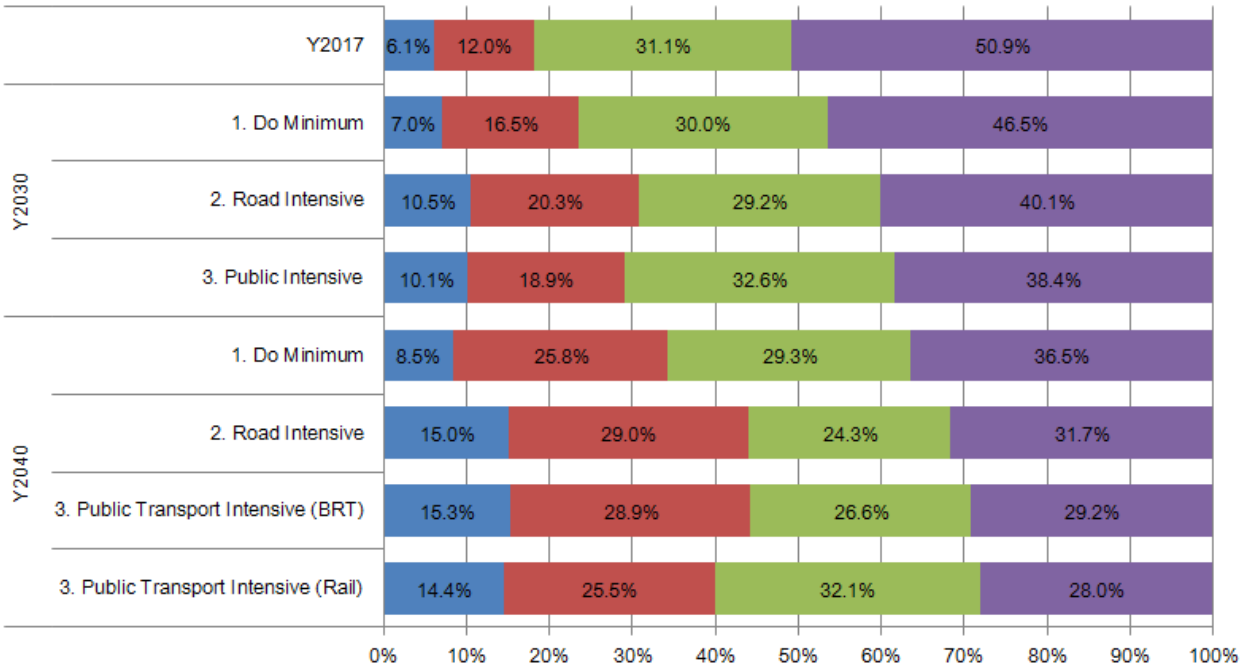


Source: The Study Team

Figure 7.6.4 Desire Lines in 2040 (Public Intensive)

(3) Modal Share

Figure 7.6.5 shows the modal share by each scenario in 2017, 2030, and 2040. The share of motorcycle and car trips under the Road and Public Intensive scenarios will significantly increase from 6.1% to 14.3-15.3% (motorcycles) and from 12.0% to 25.3-29.0% (cars) due to economic growth, increasing vehicle ownership, and transport system improvements. Meanwhile the NMT share (walk and bicycle) will significantly decrease from 50.9% to 27.9-31.7% due to the increasing share of motorcycle and car trips.



Source: The Study Team

Figure 7.6.5 Projected Modal Share of the Study Area

(4) Impact of Transport Demand

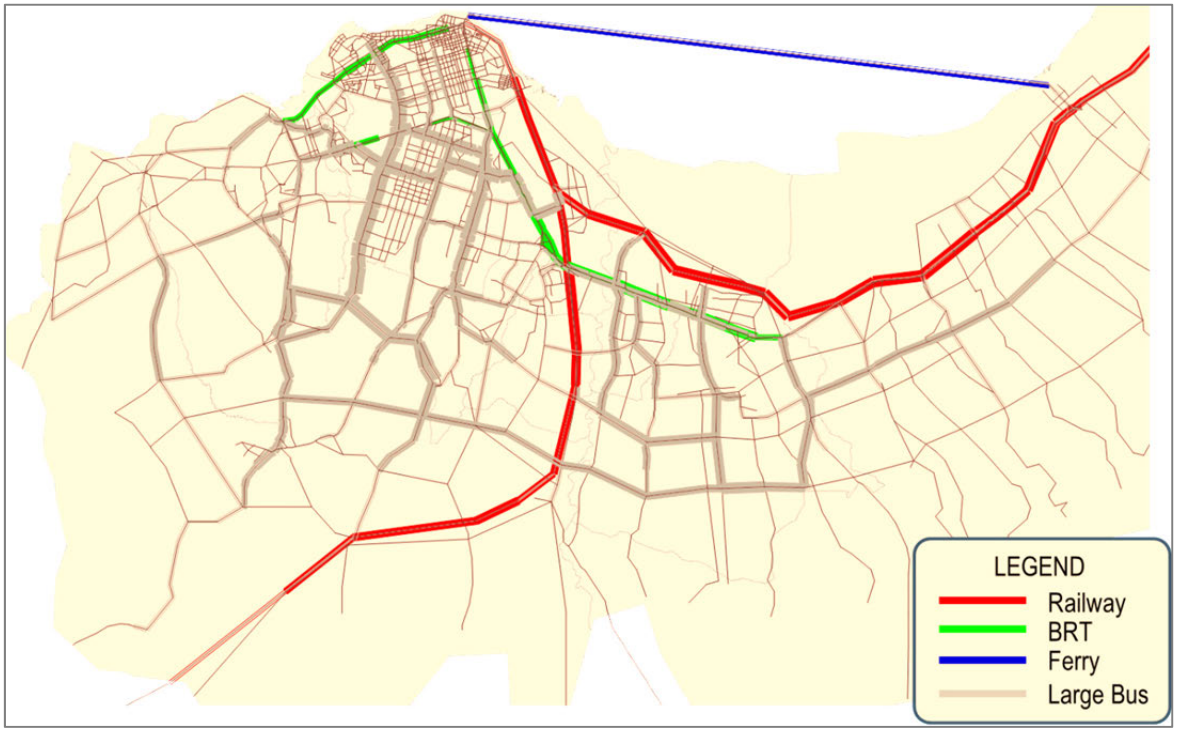
The results of future highway and transit assignment for the Road and Public Intensive scenarios are shown in Figure 7.6.6 to Figure 7.6.9 for 2030 and Figure 7.6.10 to Figure 7.6.17 for 2040. The highway assignment results of the Do Minimum scenario are shown in Section 7.1.2.

In 2030, if either the Road or Public Intensive scenarios are implemented, road congestion will be significantly worse than under the Do Minimum scenario. Road congestion under the Public Intensive scenario is slightly worse than the Road Intensive scenario due to the reduction of the number of lanes dedicated for BRT. However, the difference between the two scenarios is not significant.

In 2040, road congestion under the Public Intensive scenario (Rail) is lowest. However, even with that scenario, the results indicate that both the road and public transport networks will be insufficient to fully absorb future demand, and additional projects and/or policies will be required to alleviate road congestion. Therefore, this study suggests introducing TDM schemes alongside the Public Intensive scenario (Rail) considering necessary budget for project implementation. The impacts of TDM with the Public Intensive scenario (Rail) are shown in the following section.

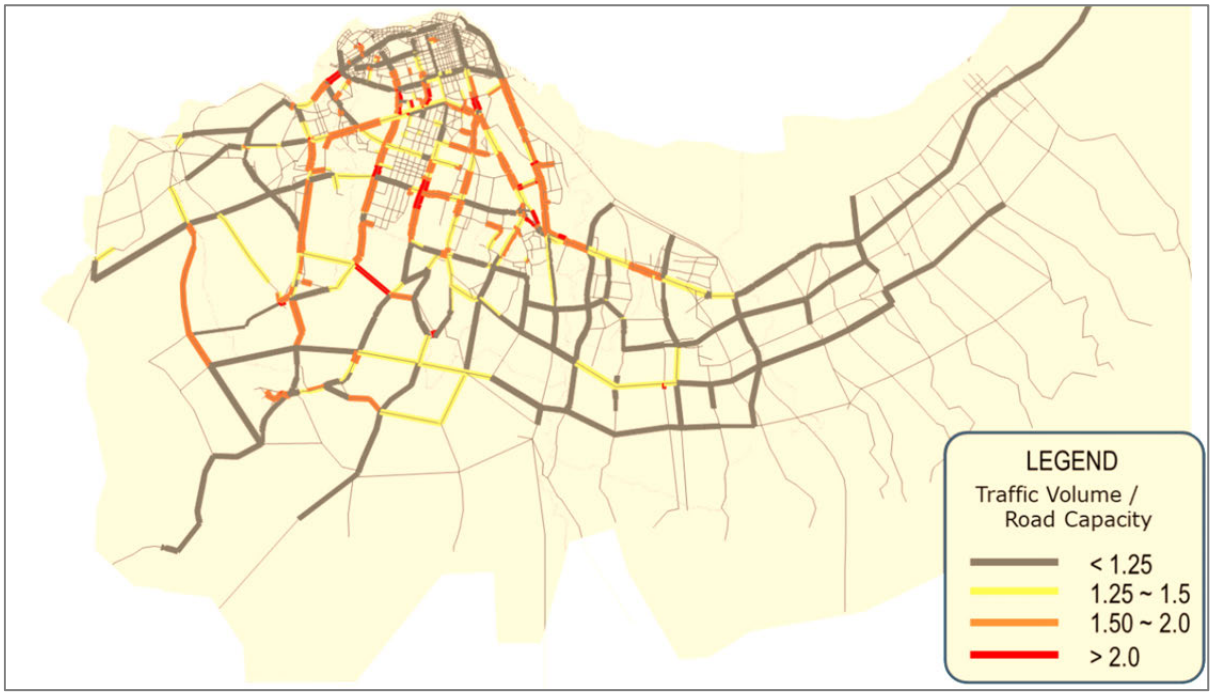
Source: The Study Team

Figure 7.6.6 Highway Assignment Results of Road Intensive Scenario in 2030



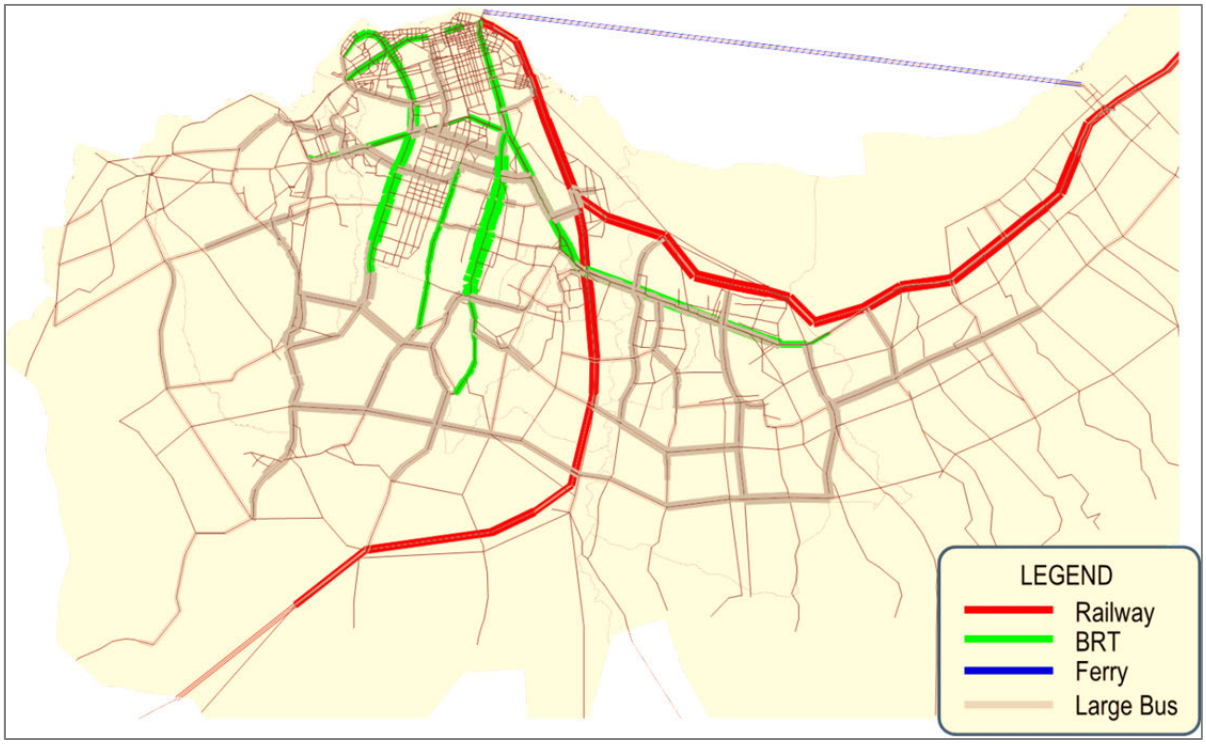
Source: The Study Team

Figure 7.6.7 Transit Assignment Results of Road Intensive Scenario in 2030



Source: The Study Team

Figure 7.6.8 Highway Assignment Results of Public Intensive Scenario in 2030

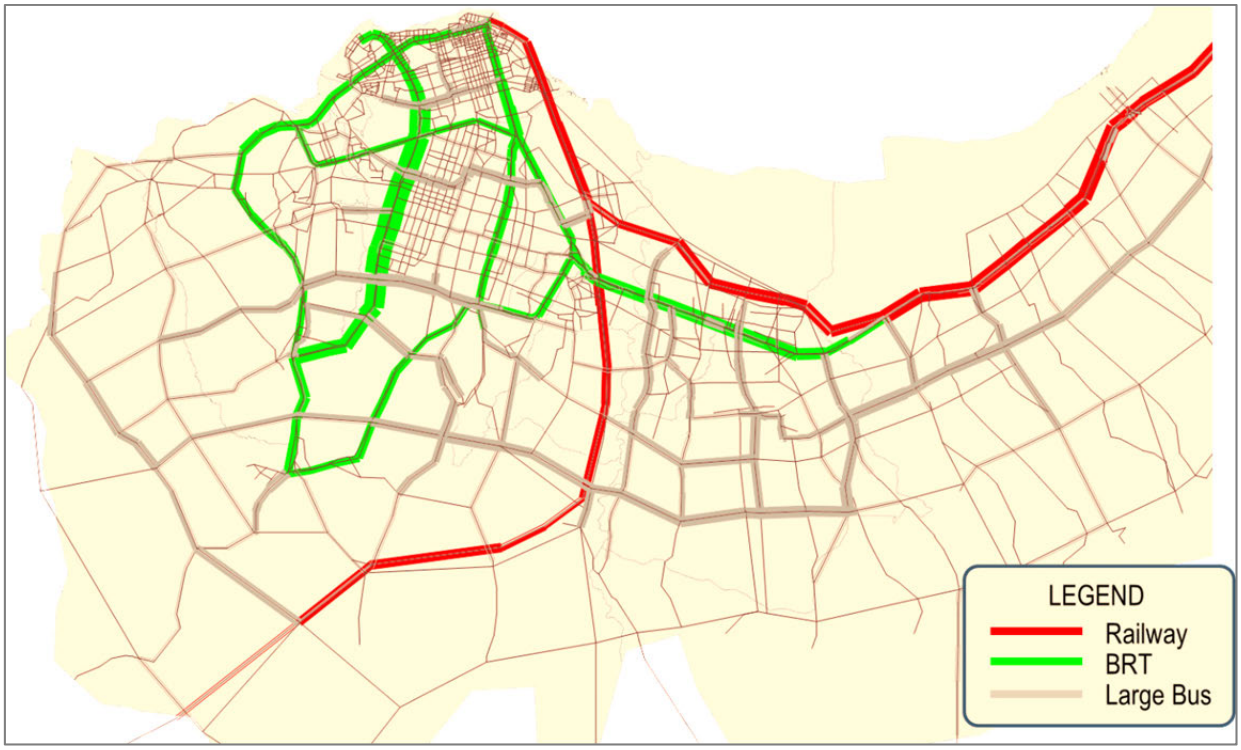


Source: The Study Team

Figure 7.6.9 Transit Assignment Results of Public Intensive Scenario in 2030

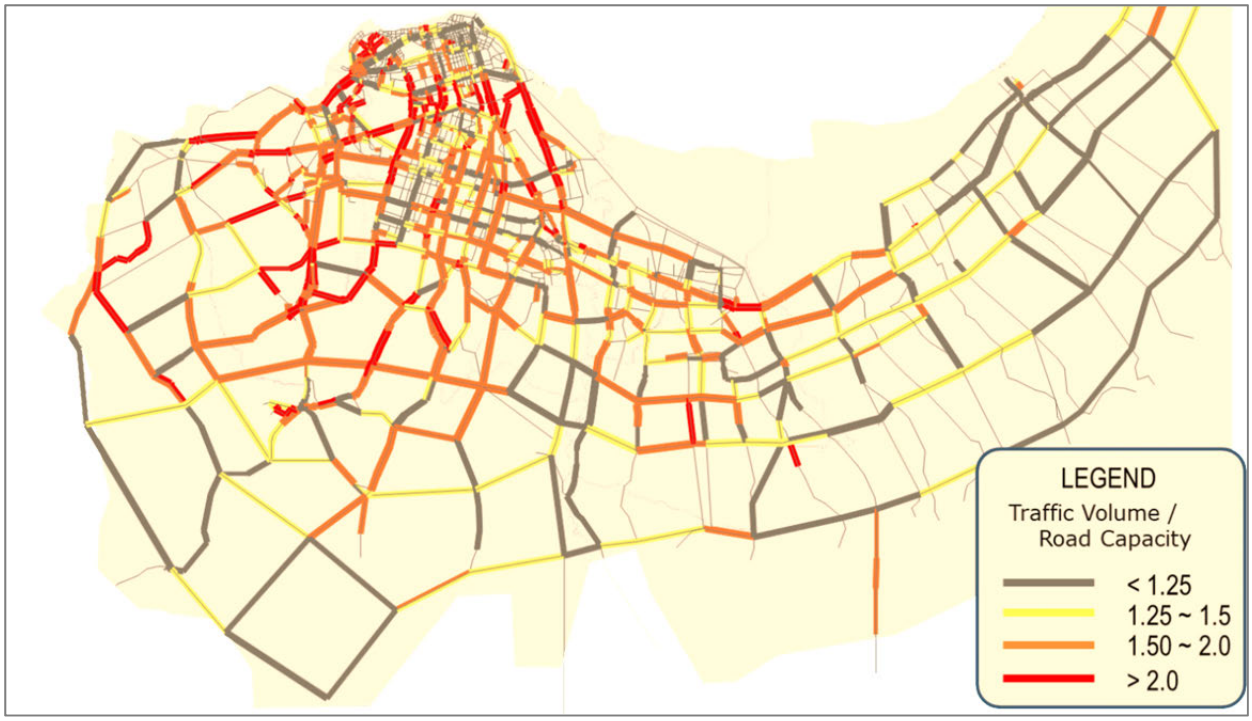
Source: The Study Team

Figure 7.6.10 Highway Assignment Results of Road Intensive Scenario in 2040



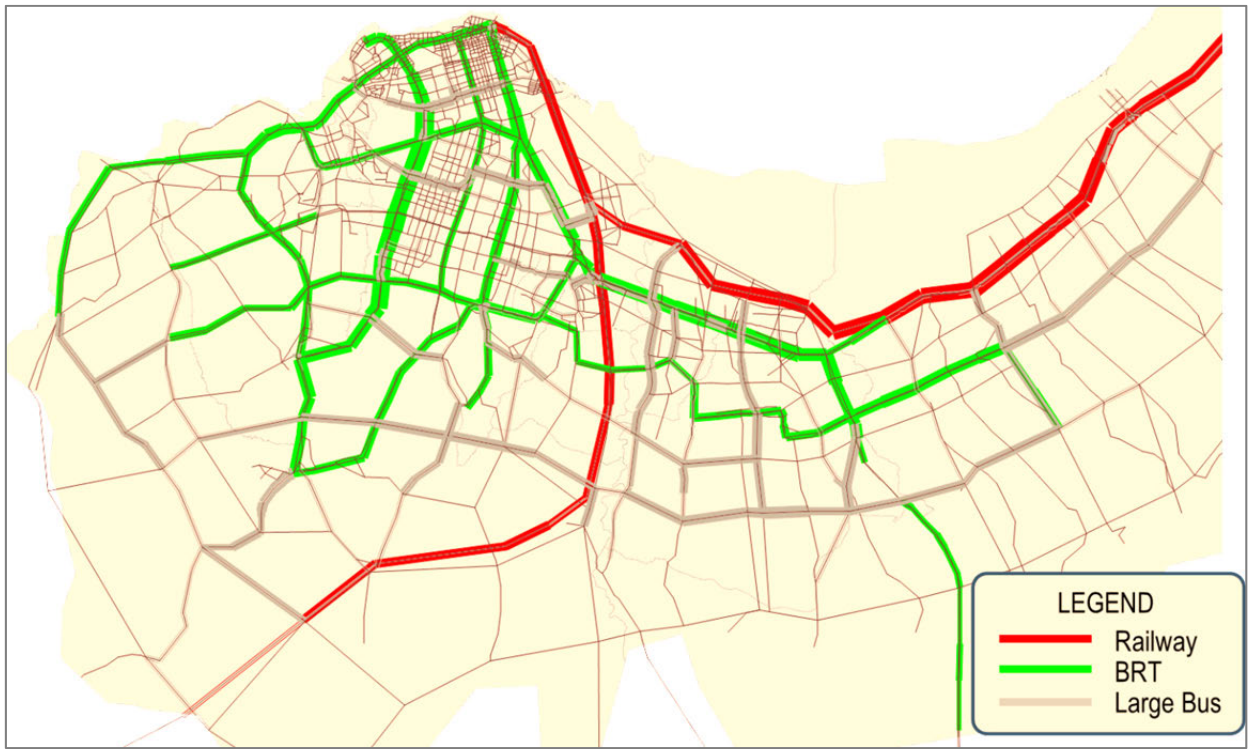
Source: The Study Team

Figure 7.6.11 Transit Assignment Results of Road Intensive Scenario in 2040



Source: The Study Team

Figure 7.6.12 Highway Assignment Results of Public Intensive (BRT) Scenario in 2040

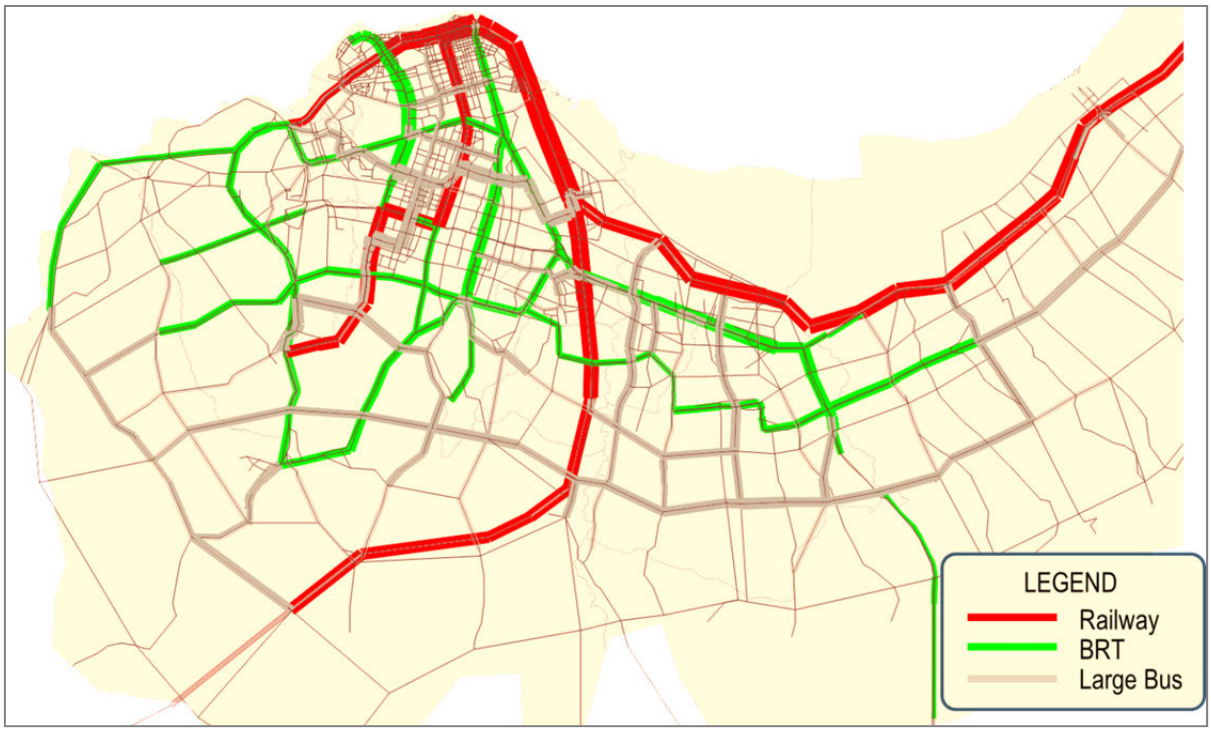


Source: The Study Team

Figure 7.6.13 Transit Assignment Results of Public Intensive (BRT) Scenario in 2040

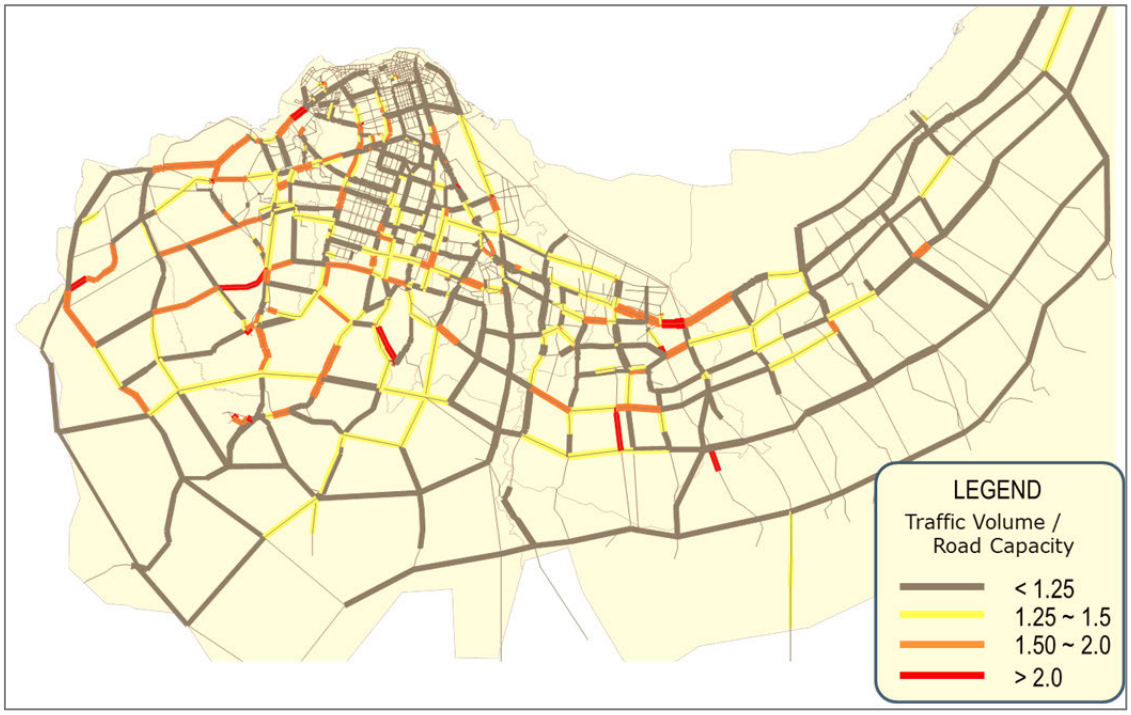
Source: The Study Team

Figure 7.6.14 Highway Assignment Results of Public Intensive (Rail) Scenario in 2040



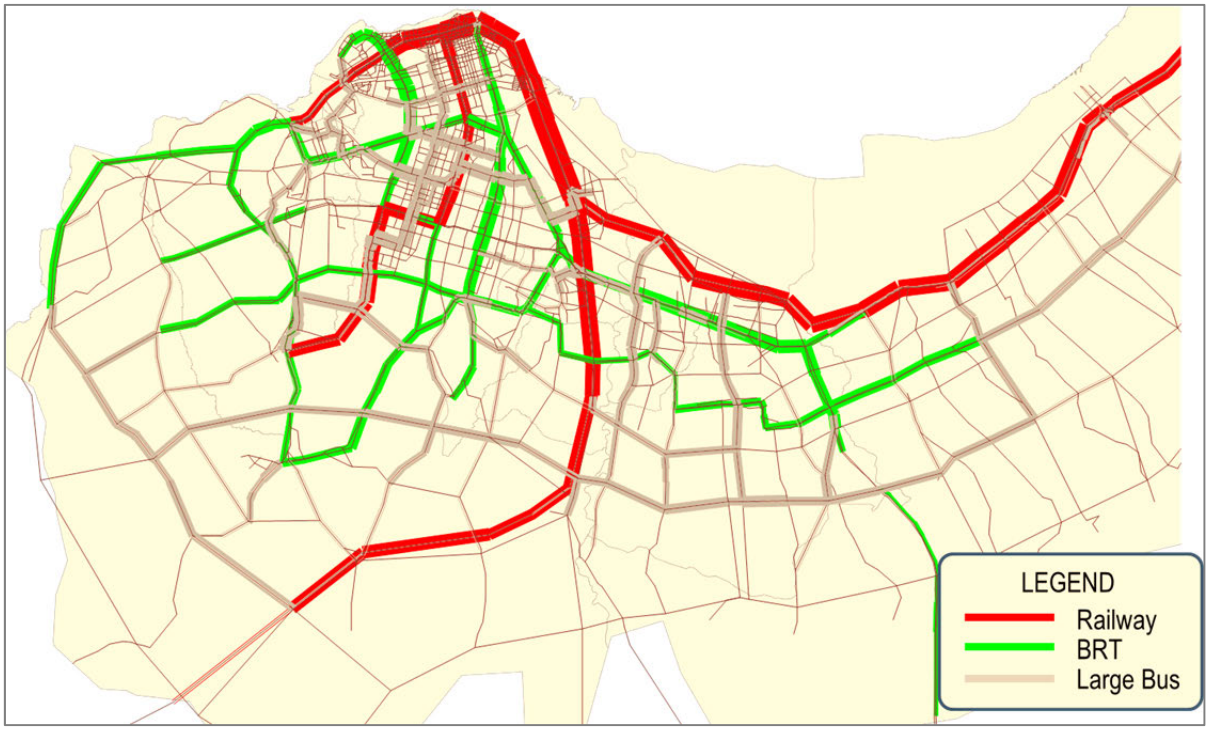
Source: The Study Team

Figure 7.6.15 Transit Assignment Results of Public Intensive (Rail) Scenario in 2040



Source: The Study Team

Figure 7.6.16 Highway Assignment Results of Public Intensive (Rail+TDM) Scenario in 2040



Source: The Study Team

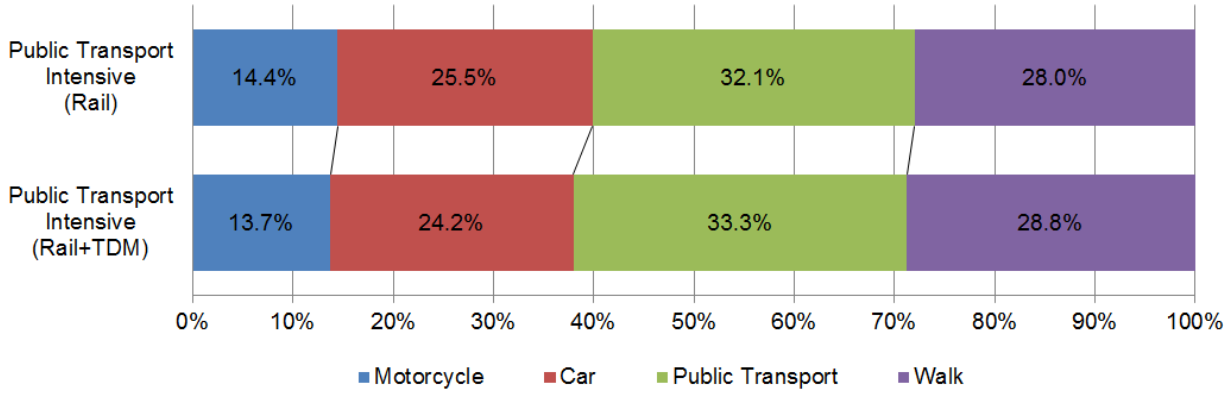
Figure 7.6.17 Transit Assignment Results of Public Intensive (Rail+TDM) Scenario in 2040

(5) Impact of Transport Demand Management

The Study proposes a number of TDM applications as summarized in Section 7.3. Peak Hour Shift Approach, and Parking Charge Policies in the CBD and surrounding communes (Kinshasa, Barumbu and Lingwala) are examined considering implementation costs and the difficulty of new road construction and road widening due to the lack of available of land in these areas.

The impacts of applied TDM approaches are capacity increase by peak hour shift approach and modal shift from private mode to public transport by parking charge policy. The examined parking charge policy is CDF 5,000 for each time a motorcycle or car parks in the CBD and surrounding three communes.

As shown in Figure 7.6.18, motorcycle and car trips are shifted approximately 0.7% and 1.2% respectively, which would directly help to alleviate road congestion. This is an example of the use of TDM methods, and further study is required after implementation; however, the Study results indicate that TDM methods have significant impacts, helping to alleviate road congestion. Additionally, this parking revenue could be used to help fund additional solutions to transport issues, such as new road construction and road widening.



Source: The Study Team

Figure 7.6.18 Impact of TDM

7.7 Strategic Environmental Assessment (SEA) on Alternative Scenarios

Full report of Strategic Environmental Assessment of the Master Plan is attached as Appendix 2 of Volume 1. In Appendix 2, Chapter 4 explains the potential impacts expected in the implementation phase of the Master Plan that must be considered during the development of the Master Plan. These potential are studied for each alternative scenario in the following 7.7.1 as well as in Chapter 5 of Appendix 2. Impacts from the preferred scenario are further studied in the following 7.7.2, as well as in Chapter 7 of Appendix 2. Measures to avoid and minimize these impacts are stated in the following 7.7.5, as well as in Chapter 8 of Appendix 2 of this Report.

7.7.1 Comparative Evaluation of Alternative Scenarios

Among the nineteen environmental items that are expected to be affected when the plan is to be implemented shown in Table 3.6.5 and Table 3.6.6, seven (7) items were not included in the following evaluations because suitable data that can be used as indices proposed in Table 3.6.6 was not available during the Study. The seven items omitted from further evaluation are as follows: water quality, sanitation, waste, ecosystem, land use, flood and inundation, and geology.

Remaining twelve (12) items were grouped into four, and the alternative scenarios were evaluated against each of the four environmental and social aspects in following (2), (3) and (4).

(1) Preconditions

a) Do Minimum Scenario as Baseline

Since the population of Kinshasa is estimated to double by 2040, the existing 2017 condition is far different from the baseline condition in 2040 in every aspect of environment and society. Therefore, the 'Do Minimum Scenario' is used as the baseline, and the other alternative scenarios are then compared with the conditions expected from the 'Do Minimum Scenario.' Expected baseline conditions with implementation of the 'Do Minimum Scenario' in 2040 when compared to 2017 conditions are summarised in Table 7.7.1.

Table 7.7.1 Expected Baseline Conditions with 'Do Minimum Scenario' in 2040 Compared to 2017 Conditions

No.	Items	Expected (↑ positive / ↓ negative / = neutral) changes in 2040 compared to 2017 conditions
1	Air quality	1. ↓ Areas affected by vehicle-generated air pollution will be expanded with double the number of vehicles. 2. ↓ Traffic speeds will be slower with minimal improvement of road network. Consumption of gasoline and emissions from vehicles will increase by more than double.
2	Climate change, transboundary impacts	3. ↓ With minimal improvement to public transport, the consumption of transport fuel per capita will increase, as well as greenhouse gas emissions by the Transport Sector.
3	Involuntary Resettlement and/or Loss of Properties	4. =↓ The minimum Road Plan will be implemented with a small number of resettlements in the short term. In the long-term, land that should be road ROW for an improved city network will be occupied by businesses and houses with minimum space left for traffic. 5. =↓ The minimum improvement works and disturbance for re-designing the road space around the markets in the short term, the land that should be road ROW for better market access will be occupied by businesses with minimum space left for traffic. Traffic congestion around markets will become more serious with doubled population.
4	Physical separation of communities	6. =↓ With minimum control of land use, residential areas will be spread over a large area. A small number of resettlements is expected by 2040. In the long term, the road ROW for a better city network will need to run through already established communities.
5	Social institutions such as social infrastructure and local decision-making institutions	7. =↓ With minimum implementation of road improvements, decision-making procedures, including public involvement and grievance redress mechanism, will not be practiced in various places, and the government and the public will be left with few lessons learned from experiments.
6	Historical and cultural resources	8. = Construction of minimum new roads or expansion of existing roads will impact a small number of cultural and historical resources on or near ROW.
7	Landscape	9. = Minimum road expansion will impact a small number of existing street trees.
8	Poverty	10. ↓ With double the population and minimum improvement of roads and public transport, the general public will suffer from much difficulty in accessing workplaces, markets, schools, hospitals, etc. 11. ↓ Businesses will also suffer difficulties accessing goods and consumers. 12. ↓ Majority of population will be living without access to all-season roads within 2 km from their homes. 13. ↓ Congestion in front of markets will continue and will worsen, which will negatively impact both businesses and customers.
9	Local economy such as employment and livelihood	
10	Traffic/public facilities, infrastructures, social services	
11	Gender	
12	Accidents, crime	14. ↓ Majority of the doubled population will be forced to walk on a small number of roads in good condition. Road and traffic safety will not improve and the number of traffic accidents per capita will increase.

Note: ↑: Positive changes, ↓: Negative changes, =: Neutral

Source: The Study Team

b) Quantitative Evaluation

Quantitative evaluation was calculated as differences of economic benefits between "Without" and "With" scenarios, based on the Highway Development and Management (HDM-4) Road Use Costs Model.

c) Qualitative Evaluation

In the qualitative evaluation, the baseline condition, 'Do Minimum,' is given a 0 (zero), with an improved condition given a +1 (plus one). When a much improved condition can be achieved than +1, a +2 (plus two) was given to the scenario. A worse condition was evaluated in the same manner; A -1 (minus one) was given to an expected condition worse than the 'Do Minimum' condition.

Table 7.7.2 Scenarios for Comparative Evaluation

Evaluation	Expected Condition
-2	Worse than -1 condition
-1	Worse than the 'Do Minimum' Scenario condition
0	'Do Minimum' Scenario condition
+1	Better than the 'Do Minimum' Scenario condition
+2	Better than +1 condition

Source: The Study Team

d) Scenarios Evaluated in SEA

The 'Public Transport Intensive' scenario is divided into three detailed scenarios in the 2040 Master Plan. Although the mode of transport is different, the coverage areas of public transit are generally the same between the BRT-Intensive scenario, the Rail-Intensive scenario and the Rail-Intensive + TDM scenario. Therefore, in this report, the 2040 Public Transportation Intensive Scenario was evaluated as one scenario.

Table 7.7.3 Scenarios for Comparative Evaluation

2040 Scenario	Scenarios compared in SEA
Do Minimum	Do Minimum (Baseline (Table 7.7.1))
Road Intensive	Road Intensive
BRT Intensive	Public Transport Intensive
Rail Intensive	
Rail Intensive + TDM	

Source: The Study Team

(2) Air quality and GHG emissions

The GHG emission and costs are estimated by the average CO2 price of 6.63 USD/tCO2e.9 The GHG emission costs, in USD per vehicle-km for each vehicle type, calculated by HDM-4, are shown in Table 7.7.4.

Table 7.7.4 GHG Emission Costs by Vehicle Type (Economic Price)

Motor cycle	Car	LGT	HGT	ACT	Passenger Van	Mini Bus	Large Bus
0.0003	0.0017	0.0034	0.0078	0.0103	0.0019	0.0030	0.0060

Unit: USD/vehicle-km, Source: The Study Team
LGT: Light goods truck, HGT: Heavy goods truck, ACT: Articulated truck

In addition, reduction of CO2 emissions was calculated as an evaluation criteria based on price based GHG emission cost and unit cost.

Table 7.7.5 Evaluation of Impacts of Scenarios on Air Quality and GHG Emissions

No.	Items	Indicators for Master Plan Evaluation	Do Minimum S.	Road Intensive S.	Public Transport Intensive S.
1 2	Air quality Climate change, transboundary impacts	Reduction of CO2 emission (mil ton/year in 2040)	Baseline	- 4.3	- 4.1 (BRT) - 10.2 (Rail) -13.8 (Rail + TDM)
		Evaluation	**0**	**+1**	**+1 to +2**
		Compared to the 'Do Minimum Scenario,' the Road Intensive Scenario will allow faster traffic speed which leads less consumption of fuel and reduction of CO2 emission. Among the Public Transport Intensive Scenario, the BRT Scenario will achieve nearly the same reduction with Road Intensive Scenario. The Rail and the Rail + TDM Scenarios will, however, achieve more than double of the Road Intensive Scenario.			

Source: The Study Team

[9] European Emission Allowance (EUA) Price
https://www.eex.com/en/market-data/environmental-markets/spot-market/european-emission-allowances#!/

(3) Necessity of land and community

a) Qualitative evaluation

Although the 'Do Minimum Scenario' avoids disturbances of existing residences and businesses, with minimum control of land use, residential areas will spread over a large area by 2040. In the further long term, the road ROW for an improved city network will need land that is occupied with residences and businesses, and the road may need to physically separate already established communities. The other two scenarios will cause disturbances of the existing condition during their implementation, but the result will be a stronger infrastructure for better living and business environment.

At the same time, implementation of road improvements and new road construction with scenarios other than the 'Do Minimum Scenario' will require many decision-making procedures, including public involvement and a grievance redress mechanism. Both the government and the general public will experience trials and errors, and both sides will accumulate lessons learned from these experiments. Such lessons will strengthen the democratic public involvement and grievance redress mechanisms in the governance of all sectors.

b) Quantitative evaluation

The number of involuntary relocation was estimated using the numbers of population distribution in 2017, road coverage area in 2040 for new road construction and road widening, and average number of buildings per area.

The area was classified as urbanized area and non-urbanized area, and number of building per area was set as 21.71 building/ha and 1 building/ha respectively, based on result of Building Use Survey.

Table 7.7.6 Comparative Evaluation of Impacts of Scenarios on Necessity of Land and Community

No.	Items	Indicators for Master Plan Evaluation	Do Minimum	Road Intensive	Public Transport Intensive
Qualitative Evaluation					
3	Involuntary Resettlement and/or Loss of Properties	a. Expected number (or length in km) of existing built up areas to be crossed by proposed new roads	0	-1 (Short term) +1 (Long term)	-1 (Short term) +1 (Long term)
4	Physical separation of communities	Compared to the 'Do Minimum Scenario,' the Road Intensive and Public Transport Intensive scenarios will need about the same land area to construct the network by 2040. However, after 2040, the 'Do Minimum Scenario' will require much larger relocation of residents and businesses for road construction to achieve the same sufficient volume of traffic capacity as the other two scenarios.			
5	Social institutions such as social infrastructure and local decision - making institutions				
6	Historical and cultural resources	b. Number of market areas affected and improved by road space coordination	0	-1 (Short term) +1 (Long term)	-1 (Short term) +1 (Long term)
7	Natural Landscape	Compared to the 'Do Minimum Scenario,' the Road Intensive and Public Transport Intensive scenarios will impact about the same number of markets and businesses by 2040. However, after 2040, the 'Do Minimum Scenario' will require much larger relocation of businesses for improvement of access to the markets than the other two scenarios.			
		c. Existence of public involvement and grievance redress mechanisms in the implementation process of the Study, or its proposal	0	+1	+1
		Compared to the 'Do Minimum Scenario,' the Road Intensive and Public Transport Intensive scenarios will require more communication with property owners, commune members, transport businesses and various other stakeholders during the implementation plan. The process may not be easy, but the opportunity and various lessons learned will strengthen the democratic public involvement and grievance redress mechanisms.			
Quantitative Evaluation		Number of buildings to be removed for road construction	25,100	68,500	67,600
			0	-1	-1
		By 2040, the 'Do Minimum Scenario' will cause least number of building removal. The Road Intensive and Public Transport Intensive scenarios will impact about the same number of markets and businesses .			

Source: The Study Team

(4) Access to employment and social services

a) Qualitative evaluation

With both the 'Road Intensive' and 'Public Transport Intensive' scenarios, the 2 km road grid will be constructed to serve not only as access to Gombe and other existing city centre areas, but also to new District centre areas where people can find employment closer to their residences.

The mass transit system developed by the 'Public Transport Intensive Scenario' will achieve the shortest commuting time for the population. Also with this same scenario, the short distance transportation to the District centres and transportation hubs will be separated from the long-distance cargo trucks and passenger buses, with the majority of car traffic used for short-distance trips.

b) Quantitative evaluation

The number of population in the service area of railway and BRT was estimated by GIS and quartier wise population distribution.

The service area was defined as the population in the area within 1.0 km radius from railway stations and BRT shelters.

Table 7.7.7 Comparative Evaluation of impacts of Scenarios on Access to Employment and Social Services

No.	Items	Indicators for Master Plan evaluation	Do Minimum	Road Intensive	Public Transport Intensive
8	Poverty	The number of population in the service area of railway and BRT (1 km radius from the station) (thousand persons)	0	8,089	12,050 (BRT) 12,024 (Rail) 12,024 (Rail + TDM)
9	Local economy such as employment and livelihood	Evaluation	0	+1	+2
10	Traffic/public facilities, infrastructures, social services	Compared to the 'Do Minimum Scenario,' the Road Intensive Scenario will provide better access to railway stations. Public Transport Intensive Scenario will provide railway/BRT transport hubs near houses and work places. Being near to traffic hubs will benefit the residents and businesses by shorter, better access to works and customers. The benefit will be felt more among those who can not afford a private car.			
11	Gender	Also, compared to the 'Do Minimum Scenario,' the Road Intensive and Public Transport Intensive scenarios will both provide 100% access to all-season roads for every resident in Kinshasa. Securing access to all-season road will benefit those who do not have strong mobility, such as children and elderly.			

Source: The Study Team

(5) Road accidents

The accidental costs, composed by fatality cost and injury cost, was estimated by the value of income one person could earn in 20 years, assuming a person had an accident at the age of 40 and he/she was expected to work for another 20 years. The fatality cost is estimated at USD 8,090 and the injury cost at USD 809, as the injury cost is 10% of fatality cost, according to the interview with a local insurance company.

The total accident costs, in USD per vehicle-km for each vehicle type, calculated by HDM-4, are shown in Table 7.7.8.

Table 7.7.8 Accident Costs by Vehicle Type (Economic Price)

Motor cycle	Car	LGT	HGT	ACT	Passenger Van	Mini Bus	Large Bus
0.000792	0.000462	0.000594	0.000462	0.000462	0.000330	0.000330	0.000330

Unit: USD/vehicle-km,

LGT: Light goods truck, HGT: Heavy goods truck, ACT: Articulated truck

Source: The Study Team

Table 7.7.9 Comparative Evaluation of Impacts of Scenarios on Road Accidents

No.	Items	Indicators for Master Plan evaluation	Do Minimum	Road Intensive	Public Transport Intensive
12	Accidents, crime	Reduction of accident loss (mil USD/year in 2040)	Baseline	-7.9	-7.7 (BRT) -8.7 (Rail) -9.5 (Rail + TDM)
		Evaluation	0	+1	+1
		Compared to the 'Do Minimum Scenario,' the Road Intensive Scenario will provide better safety measures on more roads that will reduce road accidents. With the Public Transport Intensive Scenario, especially by improvement of rail transportation, the number of deaths and injury will be further reduced.			

Source: The Study Team

(6) Overall Evaluation

Table 7.7.10 summarizes the overall comparison of the three Scenarios. Compared to the 'Do Minimum Scenario', the 'Road Intensive Scenario' will give more positive impacts mainly in the social aspects. The 'Public Transport Intensive Scenario' will achieve further positive social impacts, and will also achieve positive impacts in air pollution aspects as well.

Table 7.7.10 Overall Comparative Evaluation of Scenarios

No.	Items	Do Minimum	Road Intensive	Public Transport Intensive
1 2	Air quality Climate change, transboundary impacts	0	+1	+1 to +2
3 4 5 6 7	Involuntary Resettlement and/or Loss of Properties Physical separation of communities Social institutions such as social infrastructure and local decision - making institutions Historical and cultural resources (Omitted from evaluation due to lack of data) Landscape (Omitted from evaluation due to lack of data)	0	-1 (Short term) +1 (Long term)	-1 (Short term) +1 (Long term)
8 9 10 11	Poverty Local economy such as employment and livelihood Traffic/public facilities, infrastructures, social services Gender	0	+1	+2
12	Accidents, crime	0	+1	+1
Overall Evaluation of Transportation Master Plan Alternatives		0	+1	+2

Source: The Study Team

7.7.2 Identification and Evaluation of Impacts of the Masterplan Implementation

(1) Plans and Projects Proposed in the PDTK

The Urban Transport Master Plan is consisted of components shown in Table 7.7.11. Among 17 groups of the Projects proposed, those that require major construction works are shaded in the table.

Most of the construction works will use space of existing road or rail area as work area. Land acquisition and land use change will be necessary for development of roads in the newly expanded urban areas.

Soft component projects, i.e. those shown in lines without shading in the table, will not cause major negative impacts to environment.

Table 7.7.11 Plans and Projects Proposed in the PDTK

Plans	Projects	Major construction works involved	Number of projects
1 Public Transport Plan	1.1 Modernization of Railways	Y	10
	1.2 Development of BRT System	Y	
	1.3 Bus and Paratransit	Y	
2 Road Development Plan	2.1 Strategic Road Projects	Y	76
	2.2 Primary Roads	Y	
	2.3 Secondary Roads	Y	
	2.4 Urban Expressways	Y	
	2.5 Road Maintenance Scheme	N	
3 Traffic Safety, Control and Management Plan	3.1 Road Safety Management Projects	N	24
	3.2 Safer Roads and Mobility Projects	N	
	3.3 Safer Vehicles Projects	N	
	3.4 Safer Road Users Projects	N	
	3.5 Post-crash Care Projects	N	
	3.6 Bottleneck Point Improvement Projects	Y	
	3.7 Parking Management Program Projects	N	
	3.8 Transport Demand Management Projects	N	
	3.9 Smooth Operation of Public Transport Projects	N	

Source: The Study Team

(2) Impacts Expected When the Transport Master Plan is Implemented

a) Positive Impacts

Positive impacts expected when the Transport Master Plan (Public Transport Intensive) is implemented are summarised in Table 7.7.12

Table 7.7.12 Positive impacts expected when the Transport Master Plan is implemented

1	Air quality	1. Increased traffic speed and improvement of public transport service will reduce vehicle emissions.
2	Climate change, transboundary impacts	2. By implementing the Public Transport Plan, the per capita consumption of transportation fuel will be reduced, as well as greenhouse gas emissions in the Transport Sector.
3	Social institutions such as social infrastructure and local decision-making institutions	3. The Implementation plan for the Master Plan may clarify decision-making procedures for the implementation of the Master Plan, including public involvement and grievance redress mechanisms.
4	Poverty	4. By implementing the Urban Transport Plan and Public Transport Plan, the general public will enjoy better access to work places, markets, schools, hospitals, etc. 5. Due to the implementation of the Road Plan, businesses will enjoy better access to goods, consumers, and workers. 6. The implementation of the Road plan will expand and improve the network of all-season roads. 7. By re-designing the road space around markets, congestion in front of the markets will be reduced.
5	Local economy	
6	Traffic/public facilities, infrastructure, social services	
7	Gender	
8	Accidents, crime	8. The implementation of the Urban Transport Plan will improve the road and traffic safety and the number of traffic accidents per capita will decrease.

Source: The Study Team

b) Negative Impacts

No negative impacts are expected by the implementation of the Transport Master Plan. Impacts from specific sub-project of the Master Plan are further studied in Table 7.7.3.

7.7.3 Impacts from Specific Project

(1) Typical Activities Included in Road-Related Construction Works

Typical activities included in road-related construction works are listed in Table 7.7.13.

Among all the impacts, most significant impacts felt by neighbouring communities and road users will be land acquisition, air and noise pollution, and traffic control and restriction around the work areas.

Table 7.7.13 Typical Activities Included in Road-Related Construction Works

Phase	Project Components and Activities	
Planning Phase	Demarcation of work area	● Notification of the Project and restriction of land use ● Land acquisition ● Staking and construction of border fence ● Decision of trees to be felled ● Lease contract of land parcel(s) for stockyard, site office, etc.
Construction Phase	Preparation	
	Set up of stockyard	● Set up of concrete yard ● Set up of asphalt plant ● Storage of oils and chemicals ● Machine repair, re-fuelling
		● Storage of other materials and tools
	Set up of office	● Existence of engineers and office staff
	Set up of workers camp	● Existence of work crew
	Set up of work area	● Existence of work crew
	Traffic control and restriction around work areas	● Road stoppage, detour road, or partial closure of traffic lane
	Removal works (existing road, bridge, etc.)	● Removal of existing structures and vegetation ● Removal and relocation of groundwater pumps and irrigation canals in ROW
	Set up and removal of temporal structures (Detour road, etc.)	● Slow speed at the detour road ● Removal of existing structures and vegetation
	Earthworks Bank/berm construction Excavation for bridge structure	● Alteration of land form (fill, excavation) ● Alteration of land form near water storage lakes (tanks) ● Procurement of fill material
		● Generation of transportation vehicle (mainly to transport fill material)
	Construction general	● Operation of construction machinery and vehicles ● Use of generators
		● Disposal of construction wastes
		● Generation of employment ● Procurement of materials, etc.
Maintenance Phase	Opening of new road sections Existence of upgraded road and bridges	● Generation of exhaust gas and noise felt along new roads ● Occurrence of road accidents ● Difficulty of road crossing (potential community divide) ● Regional scale benefit of all-year roads that provide better access to school, job, and other social and health facilities with ● Regional and national scale benefit of stimulation of economic activities by better, safer, and faster transportation of goods

Source: The Study Team

(2) Planning Phase

a) Negative Impacts

Land acquisition and marking of the project area will require relocation of businesses and residents along existing road space or on the land planned for new road. In case compensation and livelihood assistance are not adequate, affected persons or businesses may not be able to keep the same income or living standard they had before the project.

(3) Construction Phase

a) Positive Impacts

Positive impacts from implementation of the construction works of specific project proposed in the PDTK will include following economic impact.

- Generation of employment
- Development of services for workers
- Procurement of construction materials, lease of vehicles and machineries

b) Negative Impacts

Negative impacts from implementation of the construction works of specific project proposed in the PDTK will include items listed in Table 7.7.14.

Expansion of existing road or construction of new road may lead to resettlement of residents, physical division of existing community, and loss of natural, historical, and cultural resources.

Table 7.7.14 Negative Impacts Expected in the Construction Phase of Specific Project in PDTK

1	Air quality, noise and vibration	● Exhaust gas and noise will be generated by construction works and transportation vehicles.
2	Water quality	● Construction works in or near river and ditch may generate muddy effluent.
3	Waste	● Construction wastes such as used containers and removed pavement materials will be generated.
4	Ecosystem	● Construction works may cause loss of farming land, street trees and urban green belt.
5	Flood and inundation	● Areas susceptible to inundation and flood damage may be more vulnerable during construction works.
6	Geology and erosion	● Areas susceptible to erosion may be more vulnerable during construction works.
7	Involuntary Resettlement and/or Loss of Property	● The Road plan will require relocation of businesses and residents along existing road space or on the land planned for new road ● In case compensation and livelihood assistance are not adequate, project-affected persons or businesses may not be able to keep the same income or living standard they had before the project ● Due to roadway construction work, there will be businesses susceptible to temporary or permanent relocation.
8	Poor	● The poor group may be more severely affected by relocation and insufficient compensations nor assistances.
9	Local economy such as employment and livelihood	● Temporal road closure or restriction of traffic during construction works, especially near markets, may negatively affect local level employment and livelihood.
10	Land use	● Construction works may lead changes in local land use from rural, agricultural to urban.
11	Traffic facilities, public facilities and infrastructures	● Construction works may cause temporal congestion of traffic and inconvenient access to public facilities.
12	Divided communities	● Due to the construction of new arterial roads, existing communities may be physically divided.
13	Historical and cultural resources	● The construction of new or expanded roads may temporarily or permanently affect cultural and historical resources on or near ROWs.
14	Natural Landscape	● Road expansion may require loss of existing street trees.
15	Work safety	● Workers may be injured during the construction works
16	Accidents	● General public may be injured because of the project related vehicles and machineries. ● Traffic restriction around the work area may require detour of passing traffic. ● Traffic control around the work area may cause traffic jam and road accidents.

Source: The Study Team

(4) Operation and Maintenance Phase

a) Positive Impacts

Positive impacts in the operation and maintenance phase of specific project proposed in the PDTK will include following social and economic impacts.

- Faster, smoother road traffic will reduce total fuel consumption, and the total emission of greenhouse gases will also be reduced.

- Regional scale benefit of all-year roads that provide better access to school, job, and other social and health facilities with

- Regional and national scale benefit of stimulation of economic activities by better, safer, and faster transportation of goods

b) Negative Impacts

Negative impacts in the operation and maintenance phase of specific project proposed in the PDTK will include followings.

- Generation of exhaust gas and noise felt along new roads

- Occurrence of road accidents

- Difficulty of road crossing (potential community divide)

- In case compensation and livelihood assistance are not adequate, project-affected persons or businesses may not be able to keep the same income or living standard they had before the project

7.7.4 Measures to Maximize the Positive Impacts

The two most basic necessary measures to maximize the positive impacts are to secure the necessary fund, and to organize strong implementation body.

Besides the above two measures, it is the key for the success of the Master Plan to synchronize transport development and urban development.

To maximize the positive impacts of the Master Plan, urban functions must be encouraged to concentrate along the transit corridor especially in the vicinity of transit stations. In the vicinity of a transit station, mixed-use land use must be enhanced. Thus, urban activities such as business and commercial activities are also observed to cluster along the transit corridor. Transit-oriented cities show higher density, more frequent transit trips and fewer vehicle-kilometres compared with car-oriented cities.

By introducing high density and mixed-use land uses near the transit nodes (stations) and along high capacity transit corridors, urban lifestyle based on non-motorized transport (walking and bicycling) and public transport can be achieved along the transit corridor. This significantly reduces use of a car, trip lengths and emission of air pollutants and greenhouse gases. In addition, public transport can capture higher ridership due to the transit-oriented lifestyle of people along the transit.

Already existing law and decree listed below must be actively implemented to achieve above goals.

- Zoning regulations

Residential area, Commercial/ Business area, Industrial area and Rural area are defined as major zone in the "Decree of the 20 June 1957 on Urban Planning".

- Prevision of Natural Hazard area

Defined in the Article 4 and 5 of the "Decree of the 20 June 1957 on Urban Planning".

- Reserved land for public interest

Areas defined according to the development plan such as schools, health centre, green space, parks etc., defined in the Article 55 of the Land Law.

7.7.5 Measures to Avoid or Minimize the Negative Impacts

To minimize the negative impacts from implementation of the Master Plan, at least the measures listed in Table 7.7.15 must be implemented.

Table 7.7.15 Measures to Avoid or Minimize the Negative Impacts

No.	Negative Impacts	Measures to Avoid or Minimize the Negative Impacts
1	Air quality, noise and vibration	● During the construction phase, the work schedule and locations must be announced to general public so that residents along the road will be prepared and will understand the duration of the impact. ● Construction machineries and vehicles must be maintained well.
2	Water quality	● Construction works in or near river and ditch must use measures to prevent generation and runoff of muddy effluent to outside of work area.
3	Waste	● Wastes must be segregated on the spot of generation. ● Reuse of the waste must be encouraged either by the construction works, by recycle workers and companies, or by local residents. ● Toxic wastes such as oil and paints must be disposed according to the methods and locations directed by the local regulations.
4	Ecosystem	● In the Planning Phase, loss of resources such as farming land, street trees and urban green belt must be avoided and minimized. ● New street trees, green belt and other ecological features must be designed as much as feasible and reasonable.
5	Flood and inundation	● In the Planning Phase, areas susceptible to inundation must be identified and sufficient measures must be designed to prevent flood and inundation during the Construction Phase. ● The preventive measures must be implemented accordingly. ● In case unexpected flood and inundation occurs because of the Project, the construction works must be stopped until adequate countermeasures are implemented to prevent further damages.
6	Geology and erosion	● In the Planning Phase, areas susceptible to erosion must be identified and sufficient measures must be designed to prevent erosion during the Construction Phase. ● The preventive measures must be implemented accordingly. ● In case unexpected erosion occurs because of the Project, the construction works must be stopped until adequate countermeasures are implemented to prevent further damages.

7	Involuntary Resettlement and/or Loss of Property	● Space for road and other traffic facilities must be clearly marked in land use plan and must be kept open until the project is implemented. ● The Project Owner must give best effort to comply with international standards, such as those of WB and JICA, in preparation of resettlement action plan, in provision of compensations and assistances to affected parties.
8	Poor	● The Project Owner must identify vulnerable groups among the PAPs. ● If negative impacts on them can not be avoidable, suitable, sufficient compensations and assistances must be provided to recover their living standards prior to the Project.
9	Local economy such as employment and livelihood	● Road closure must be avoided as much as possible. ● Information on the work duration and traffic restriction must be published to general public as well as facilities and communities to be affected.
10	Land use	● Project information must be published widely so that those who rely on land resources understand the timing of the Project and range of impact correctly. ● In case such group of people who solely rely on land resource, i.e. farmers and stock raisers, are to lose their livelihood significantly, the Project Owner must give best effort to provide sufficient compensation, including alternatives such as provision of alternative land or measure for livelihood.
11	Traffic facilities, public facilities and infrastructures	● Road closure must be avoided as much as possible. ● Information on the work duration and traffic restriction must be published to general public as well as facilities and communities to be affected. ● Use of detour route must be encouraged through information network such as TV, radio, newspaper and SNS.
12	Divided communities	● Road crossing facilities must be provided at suitable intervals to allow easy crossing.
13	Historical and cultural resources	● Road plan must give best effort to avoid the destruction. ● If not avoidable, relocation of such resources in nearby location with the project budget must be considered.
14	Natural Landscape	● Road design must give best effort to save existing street trees within the right of way. ● If not avoidable of felling, re-planting of alternative trees in similar kind must be considered. ● In the suburb hill area, vegetation in river valleys must be conserved as much as possible. ● Suitable drainage must be provided to avoid soil erosion near the roads.
15	Work safety	● The project owner must enforce work safety plan. ● The contractor must follow the work safety plan.
16	Accidents	● In the design phase, sufficient safety measures such as footpath, road crossing, traffic signals, street lights must be allocated. ● During the construction phase, the contractor must provide sufficient and suitable number of signs and staff to control traffic. ● During the construction phase, the work schedule and locations must be announced to general public and encourage to avoid the road section under construction. ● During the construction phase, the contractor must give best effort to avoid or minimize total closure of the road. ● During the construction phase, the contractor and the project owner must publish the contact number and address to accept complaints and suggestions. ● In the operation phase, road safety education, especially for children, will be necessary in the area near to the Primary Road that will receive high speed, large volume traffic.

Source: The Study Team

In addition, According to the Title III of the Decree on laying down the rules for the functioning of the procedural mechanisms for the protection of the environment (*Décret no. 14/019 du 02 août 2014 fixant les règles de fonctionnement des mécanismes procéduraux de la protection de l'environnement*), an environmental and social impact assessment, together with its management plan, must be submitted to any development, infrastructure or exploitation project of any industrial, commercial, agricultural, forestry, mining, hydrocarbons, cement, telecommunication or other materials likely to have an impact on the environment, including all road construction and development projects.

The Congolese Environment Agency (ACE, *Agence Congolaise de l'Environnement*) is responsible for screening development projects and ordering the project proponents in order to conduct environmental and social impact study, and to develop environmental management plans for implementation.

As described in Volume 2 and Volume 3 of this Report, when the University Avenue improvement project is to be implemented as the JICA grant project, an environmental impact assessment will be done according to the DRC laws and the JICA Guidelines so that the negative impacts from the project to be avoided and minimized.

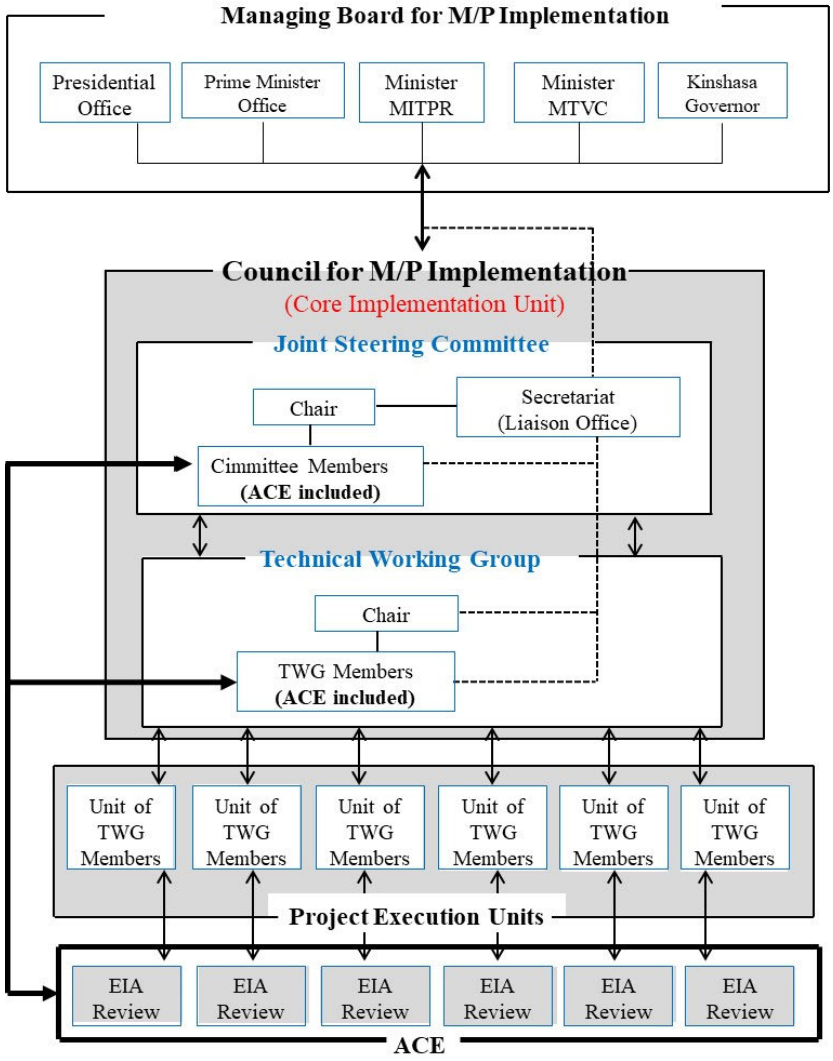
7.7.6 Institutional Arrangement

(1) Proposed Implementation Framework Up to 2030

For implementation of the Master Plan, it is recommended to fully utilize the existing JCC and TWG, which were organized to execute the PDTK in co-ordination and cooperation with JICA. JCC will be converted as Joint Steering Committee. ACE will be represented both in Joint Steering Committee and in TWG to be updated about the progress of Master Plan implementation (Figure 7.7.1).

The Master Plan projects of various transport sub-sectors, such as roads, railways, buses, traffic safety, control and management will be implemented by various driving force organization. Before the implementation of the each projects proposed in the Master Plan, the project will be reviewed by ACE to determine whether an ESIA study is necessary or not (Figure 7.7.1).

The project owner, with assistance of environmental consultant, shall propose environmental management plan to avoid and minimize negative impacts. ACE shall advise and supervise the implementation of the management plan. The responsibility of implementation of the environmental management plan for specific projects will be beard by the project owner.



Source: The Study Team

Figure 7.7.1 Organization Structure of Institutional Framework

7.7.7 Future Plan Toward the Year 2040

In the long term, it is desirable that each office implementing infrastructure development be equipped in-house environmental expert who will lead the ESIA review process in cooperation with ACE.

Constant air quality monitoring and noise level monitoring must accompany with the transport development in Kinshasa. By 2030, it will be necessary to set up monitoring stations and implement constant observation of the air quality and noise level along primary road and other transit. In case the condition surpasses the environmental standards, mitigation measures must be developed and implemented as well.

In the early stage of developing the monitoring system, laboratories in public sector and private sector will need to cooperate to generate the data. The results will be published by Ministry of Environment, Conservation of Nature and Tourism. In the long term, each province office of the Ministry must be equipped with suitable number of monitoring stations to cover all the major cities and roads.

7.8 Selection of Optimum Network Scenario

7.8.1 Overview

This section explains the evaluation and selection of the proposed five transport network scenarios in the Study Area. Each transport network scenario was evaluated by the criteria of economic, financial, and environmental aspects such as economic benefits, transport development cost, and CO_2 emissions. Then, the optimal network scenario was selected based on a multi-criteria analysis.

For the comparison of criteria, "1. Do Minimum" scenario is set as the "Base Case (Without Scenario)", and other scenarios are set as "With Scenario". The two With Scenarios of "2. Road-intensive" and "3. Public transport-intensive" are proposed for 2030, and the four With Scenarios of "2. Road-intensive", "3-1. Public transport-intensive (BRT)", "3-2. Public transport-intensive (Rail)" and "3-3. Public transport-intensive (Rail+TDM)" are proposed for 2040.

7.8.2 Assumption of Evaluation Criteria

(1) Economic Benefit

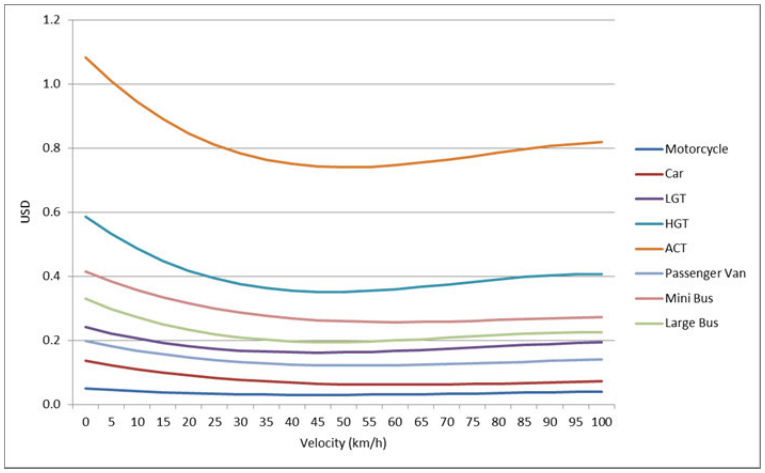
Economic benefit is one of the important criteria for the selection of an optimal transport network scenario. In this Study, the four major economic benefits were calculated as differences between "Without" and "With" scenarios, based on the Highway Development and Management (HDM-4) Road Use Costs Model. The following are the assumptions and results of the economic benefits

a) VOC (Vehicle Operating Cost) Savings

The HDM-4 Road Use Costs Model was applied in calculating the VOC, USD/vehicle-km in 2017 prices. The vehicle fleet data, representing the economic costs excluding the market distortions such as taxes, is the inputs of estimating the VOC. The vehicle fleet data of the nine vehicle types includes the following components:

- Vehicle price (USD/vehicle)
- New tyre (USD/tyre)
- Fuel (USD/litre)
- Lubricating oil (USD/litre)
- Annual interest rate (%)
- Annual kilometres driven (km)
- Service life (years)

The unit vehicle operating cost by vehicle type is shown in the following figure.



Source: The Study Team

Figure 7.8.1 VOC by Vehicle Type (Economic Price)

b) Value of Time Savings

When infrastructure is developed, travel time savings typically arise for personal travel (business and non-business) and freight movement. The VOT was calculated for three income groups based on the results of the Activity Diary Survey conducted by the Study Team in 2017. Table 7.8.1 represents the time value of workers per average trip for the three income categories, in 2017 prices.

Table 7.8.1 Value of Time in Business/Non-Business Trip

Trip Type		2017	2030	2040
Business Trip	Low Income	0.179	0.180	0.181
	Middle Income	0.543	0.651	0.668
	High Income	2.324	2.379	3.115
Non-Business Trip	Low Income	0.041	0.041	0.042
	Middle Income	0.125	0.150	0.154
	High Income	0.536	0.549	0.719

Unit: USD/hour, Source: The Study Team

The time value of freight vehicles is estimated from freight value, interest rate and income of a driver assuming middle income class. The estimated time value is shown in Table 7.8.2.

Table 7.8.2 Value of Time of Freight Vehicle

Vehicle Type	2017	2030	2040
LGT	0.749	0.856	0.874
HGT	1.170	1.278	1.295
ACT	1.802	1.910	1.927

Unit: USD/hour, Source: The Study Team

c) Savings of Accident Costs

The accidental costs, composed by fatality cost and injury cost, was estimated by the value of income one person could earn in 20 years, assuming a person had an accident at the age of 40 and he/she was expected to work for another 20 years. The fatality cost is estimated at USD 8,090 and the injury cost at USD 809, as the injury cost is 10% of fatality cost, according to the interview with a local insurance company.

The total accident costs, in USD per vehicle-km for each vehicle type, calculated by HDM-4, are shown in Table 7.8.3.

Table 7.8.3 Accident Costs by Vehicle Type (Economic Price)

Motor cycle	Car	LGT	HGT	ACT	Passenger Van	Mini Bus	Large Bus
0.000792	0.000462	0.000594	0.000462	0.000462	0.000330	0.000330	0.000330

Unit: USD/vehicle-km, Source: The Study Team

d) GHG (Green House Gas) Emission Savings

The GHG emission and costs are estimated by the average CO_2 price of 6.63 USD/tCO_2e.[10] The GHG emission costs, in USD per vehicle-km for each vehicle type, calculated by HDM-4, are shown in Table 7.8.4.

Table 7.8.4 GHG Emission Costs by Vehicle Type (Economic Price)

Motor cycle	Car	LGT	HGT	ACT	Passenger Van	Mini Bus	Large Bus
0.0003	0.0017	0.0034	0.0078	0.0103	0.0019	0.0030	0.0060

Unit: USD/vehicle-km, Source: The Study Team

In addition, reduction of CO_2 emissions was calculated as an evaluation criteria based on price based GHG emission cost and unit cost.

(2) Transport Development Cost

The transport development cost of economic evaluation in the Study consists of infrastructure cost, O & M (operation and management) cost, and other costs such as traffic management project and traffic safety project.

a) Road Infrastructures

Project costs for urban road development are reviewed and analysed using observed road construction costs in Kinshasa City and neighbouring countries, and Congo-Japon Boulevard in particular.

[10] European Emission Allowance (EUA) Price
https://www.eex.com/en/market-data/environmental-markets/spot-market/european-emission-allowances#!/

Cong-Japon Boulevard had been designed as a two-lane road in the preparatory survey stage. However, it was upgraded to a four-lane road with street lights during construction. During the preparatory survey stage, the construction cost for the road was estimated at 4.0 billion JPY with a total project cost of 5.1 billion JPY, including detailed design, construction supervision and a contingency of 5%. Upgrading the road from two to four lanes added 640 million JPY to the final price tag.

The project summary for Congo-Japon Boulevard is listed in Table 7.8.5.

Table 7.8.5 Project Summary of Congo-Japon Bld.

Items	Preparatory Survey Stage	Construction Stage
Basic Information		
Length	12 km	
No. of Lanes	2	4
Pavement Type	Asphalt Concrete	
Cross Sections		
Carriageway Width	3.50 m	3.25 m
Shoulder Width	2.00 m	0.50 m
Sidewalk Width	1.0 to 2.0 m	2.00 m
Other Width	1.0 m + Ditches in both sides	Ditches in both sides
Total Width	14.0 to 16.0 m + Ditches in both sides	18.0 m + Ditches in both sides
Cross Sections		
Time of Cost Estimation	April 2009	2010
Construction Cost	4.0 Billion JPY	-
Project Cost	5.1 Billion JPY	Add. 640 Million JPY

Source: The Study Team based on the both project information

Based on typical cross sections, which were established in Section 7.3.4 and the information regarding project costs, the project unit costs of roads for the Master Plan Stage are estimated as shown in Table 7.8.6; hilly/mountainous area is set at a 25% increase because these roads will require more earthworks and structures such as slope protection and retaining walls. The O&M cost in this stage is set at 2% of project cost per year.

Table 7.8.6 Project Unit Costs of Roads for Master Plan Stage

Road Classification	No. of Lanes	Project Costs (USD/km)
Primary Network	8	19,000,000
	6	15,400,000
	4	12,600,000
Secondary Network	4	11,600,000
	2	9,000,000

Note: The price escalation was considered based on the consumer price index of DRC released by IMF

Source: The Study Team

Those per-unit project costs are part of a preliminary estimate that needs to be updated. However,

those cost estimates allow for an evaluation of project prioritization and scheduling.

b) Public Transport (Rail and BRT)

Based on past study in other countries, project unit costs and O&M costs for railway and BRT were estimated as shown in Table 7.8.7. The unit costs of railway consists civil works, E&M (Electrical & Mechanical) and rolling stocks (EMU).

Table 7.8.7 Project Unit Costs of Railway and BRT for Master Plan Stage

Category	Unit Costs
Railway (Elevated)	63.2 Million USD/km
Railway (Ground)	31.6 Million USD/km
Railway Depot	108.4 Million USD/Nom
BRT	4.0 Million USD/km

Source: The Study Team

Table 7.8.8 O & M Costs of Railway and BRT for Master Plan Stage

Category	Unit Costs
Railway	5.0 USD/car-km
BRT	0.8 USD/car-km

Source: The Study Team

c) Other Project Costs

The following project costs were also included to all transport network scenarios. The project details were summarized in Chapter 9.

- Bus and Paratransit Projects
- Traffic Management Projects
- Road Safety Projects
- Waterborne Transport Project
- Projects of Institutional and Financial Arrangement

(3) Economic Evaluation

The economic cost benefit analysis was conducted, and EIRR and the economic net present value (NPV) were calculated as parameters to measure the economic return on investment.

The following basic assumptions are set up for the economic analysis.

- Base Year

  The base year of the Project is 2017. The inflation factor is not considered during the evaluation period.

- Evaluation Period

  The evaluation period of 30 years of the project implementation is applied.

- Exchange Rate

  The exchange rate is set as follows.

  - 1 USD = 1,580 CDF
  - 1 CDF = 0.07008 JPY

- Discount Rate

  The discount rate is the rate of return used in a discounted cost benefit analysis to determine the present value of future cost benefit. The discount rate of 12%, used in other economic feasibility reports of DRC, is applied.

- SCF (Standard Conversion Factor)

  The SCF, converting from financial prices to economic prices, has been calculated from the recent trade statistics of DRC. The average SCF for the past five years is 0.94 and this figure is applied to the analysis.

(4) Population in the Service Area of Railway and BRT

The population in the service area of the railway and BRT was estimated by GIS and quartier wise population distribution. The service area was defined as the population in the area within 1.0 km radius from railway stations and BRT shelters.

(5) Involuntary Relocation

The involuntary relocation was estimated by population distribution in 2017, road coverage area in 2040 for new road construction and road widening, and average number of buildings per area. The area was classified as urbanized area and non-urbanized area zed, and number of building per area was set as 21.71 building/ha and 1 building/ha respectively, based on result of Building Use Survey.

7.8.3 Evaluation of Alternative Transport Scenario

To select the optimum transport network scenario, on whether the Road-intensive scenario is appropriate for the Study Area or Public-intensive (BRT, Rail or Rail+TDM) scenario is a more suitable scenario to meet future conditions, alternative transport network scenarios were prepared and analysed based on following viewpoints:

- Supporting Urban Economic Activities;
- Assuring Equity in Transport;
- Improving Safety and Security; and,
- Achieving Environmentally Sustainable Transport.

In conclusion, as shown in Table 7.8.9, the Public-intensive (Rail+TDM) scenario achieved the highest evaluation score, followed by Public-intensive (Rail) and Public-intensive (BRT). Therefore, the Study Team would recommend implementing the Public-intensive (Rail+TDM) scenario in Kinshasa City.

Table 7.8.9 Evaluation of Alternative Transport Network Scenarios

Evaluation Criteria		Do-minimum	Road-intensive	Public Intensive		
				BRT	Rail	Rail+TDM
Supporting Urban Economic Activities	EIRR (%)	**C**	**B-**	**B+**	**B**	**A**
		(Base Case)	24.48%	25.60%	25.52%	25.68%
	NPV (mil USD)	**C**	**B+**	**B-**	**B**	**A**
		(Base Case)	11,555	11,232	11,424	11,716
	Investment Cost (mil USD)	**A**	**C+**	**C+**	**C**	**C**
		4,122	19,847	19,622	21,077	21,077
Assuring Equity in Transport	Population in the Service Area of Railway and BRT (thousand people)	**C**	**B-**	**A**	**A**	**A**
		0	8,089	12,050	12,024	12,024
Improving Safety and Security	Reduction of Accident Loss (mil USD/year in 2040)	**C**	**B-**	**B**	**B+**	**A**
		(Base Case)	7.9	7.7	8.7	9.5
Achieving Environmentally Sustainable Transport	Reduction of CO2 Emission (mil ton/year in 2040)	**C**	**B**	**B**	**B+**	**A**
		(Base Case)	4.3	4.1	10.2	13.8
	Involuntary Relocation (thousand buildings)	**A**	**C**	**B-**	**B-**	**B-**
		25.1	68.5	67.6	67.6	67.6
Total Evaluation		**C**	**B-**	**B**	**B**	**A-**

Evaluation criteria: A: Significantly positive performance is expected. (Recommended)

B: Positive performance is expected to some extent. (Fair)

C: Positive performance can not be expected. (Poor)

Source: The Study Team