CHAPTER 18

PUBLIC TRANSPORT

CHAPTER 18 PUBLIC TRANSPORT

18.1 PLANNING CONCEPT

18.1.1 Improvement of Mobility and Accessibility for All Citizens

The present public transport in Vientiane is insufficient to meet the demands and requirements of the present and potential users. Not all citizens can use public transport. In particular the commuters for schools and offices have no choice and select motorcycles; but the traffic vulnerable[1] such as the aged and the disable, cannot use a car or a motorcycle. Their mobility is limited. In addition, the present bus services operate in the limited routes and areas; non- service areas have hence low accessibility. Paratransit complements bus services and improves the mobility and accessibility but not fully. It is required to promote public transport systems that secure the mobility of all citizens including the less poor and the poor and maintain the accessibility for all locations with improved road infrastructures. Table 18.1-1 shows share of mode in 2007.

Figure 18.1-1 Motorcycle: Inconvenient and Danger in Rainy season

Table 18.1-1 Share of Mode in 2007 (unit: Trip (%))

Mode/ Purposes	Home		Work		School		Others		Total	
Walk	117,838	25	27,085	16	58,627	35	37,718	26	241,268	25
Motor Cycle	283,177	60	110,680	65	101,853	61	77,029	53	572,739	60
Public Transport	18,786	4	6,501	6	1,845	1	10,295	7	37,427	4
Car	51,670	11	25,998	15	8,429	3	20,092	14	106,189	11
Total	471,471	100	170,264	100	170,754	100	145,134	100	957,623	100

18.1.2 Implementation of Environmentally Sustainable Transport Policy

The Government of Lao PDR agreed to promote for Environmentally Sustainable Transport (EST) in the Aichi Statement[2] with ASEAN countries in 2005. The public transport and Transportation Demand Management (TDM) have been the key polices for EST in the Aichi Statesman. The summary is shown below.

[1] Bunta, O. "Identifying Transport Mobility Equity in Developing Country, A Case Study in Vientiane City, Lao PDR", September 2004

[2] Aichi Statement, "Toward establishment of the Regional Forum for the promotion of environmentally sustainable transport (EST) Asia, 1-2 August 2005.

- Maintaining or increasing the share of public transport by improving the quality of such services
- Controlling the demand for private motorized travel through a combination of policies, such as regulatory measures (management of demand for road space), fiscal policies (such as parking fees, vehicle taxes, road users congestion charging, and fuel taxes, etc.), and infrastructure design measures.
- Recognizing Bus Rapid Transit (BRT) as a low-cost mass transit option which can be implemented quickly to meet the growing demand for mobility.
- Recognizing Mass Rapid Transit (MRT) as a mass transit option which can be implemented to meet the growing demand for mobility, where appropriate.

In May 2008, Joint Announcement on Enhanced Cooperation in Environment and Climate Change Issues between Japan and Lao PDR was announced in Tokyo[3]. Adapting and mitigation measures are to enhance cooperation on Clean Development Mechanism (CDM), promotion of clean energy utilization and energy efficiency and conservation, prevention of air pollution.

18.1.3 Specific Considerations of Fuel Price Increase and Planning Concepts and Policies

At the last stage of the Study, a world oil price hike has been occurred. The increase rate is unexpectedly too rapid to absorb by the operators' management efforts and to mitigate by the government policies. The government announced to promote the development and use of renewable energies, bio-fuel or electricity generated by hydropower. On the same day, the government announced also to limitation of keeping the fuel price with subsidies.[4] These issues are substantially considered in the Study, especially in promoting EST. But implementation of Public Transportation with renewable energies must be accelerated by staging-up with sound policy decisions of the government.

Overall and Special Objectives

- Improvement of mobility for all citizen and accessibility of all areas.
- **Rapid Implementation of Environmentally Sustainable Transport (EST) by Public Transport with Renewable Energy**

Planning Concepts and Policies

EST Implementation

- **Introduction of Public Transport System with Renewable Energies**

Mobility

- To save travel time and cost in public transport
- To provide alternative public transport means

Accessibility

- To increase coverage area by a new public transport network

Environment

- To mitigate traffic congestion
- To reduce transport pollution and improve urban transport related environment
- To reduce traffic accidents

[3] The Ministry of Foreign Affairs of Japan, www.mofa.go.jp/region/asia-paci/laos/joint0805.html
[4] Vientiane Times July 14, 2008

18.1.4 Improvement of Level of Service

Targets of improving the Level of Service (LOS) to attract passengers to take bus and the service and performance measure are shown in Table 18.1-2.

Table 18.1-2 Level of Service Improvement

Availability			
Measures	Present LOS	Target LOS	Actions
Frequency:	C: four bus routes including university route: waiting 15 minutes and maximum desirable time to wait if bus missed D~F: others: waiting more than 30 minutes and service unattractive to choice riders	A~B: Express route during peak Hour C: Local routes during midday C: Feeder routes at night time with paratransit for demand responsive transport	•Increase in the number of bus to meet demand on route •New bus network formulation with hierarchical bus routing •New bus modal change terminals at interchange and railway stations
Hour of Services	D: mostly 6:00am to 17:30pm service hours and daytime service provided	B: Express routes 16~18 hours and late evening services provided C: Others: 13~16 hours and early evening services provided	
Service Coverage	124km of length of service routes x0.4km =49.6km2 out of total area of 381.9 km2. Service coverage is 13%	315km length of service routesx0.4km =126km2. Service coverage will be 33%	
Comfort and Convenience			
Measures	Present LOS	Target LOS	
Reliability	D~F: buses waiting full passenger at origin and no bus time table at bus stops	B~C: Two late buses per month or one late bus per week • Securing reliability by on- time performance and proper headway adherence • Increase of travel time	
Amenities	D~E: Mini buses with maximum scheduled loading and Standard buses with comfortable loading for standees at peak hour	C~D: all passengers can sit during daytime and with comfortable loading for standee during peak hours • Improvement of riding quality by new user-friendly bus vehicle • Provision of amenities at transit stops	

Source: Highway Capacity Manual 2000

18.1.5 Planning Flow

(1) Planning Flow

A planning flow for public transport is illustrated in Figure 18.1-2.

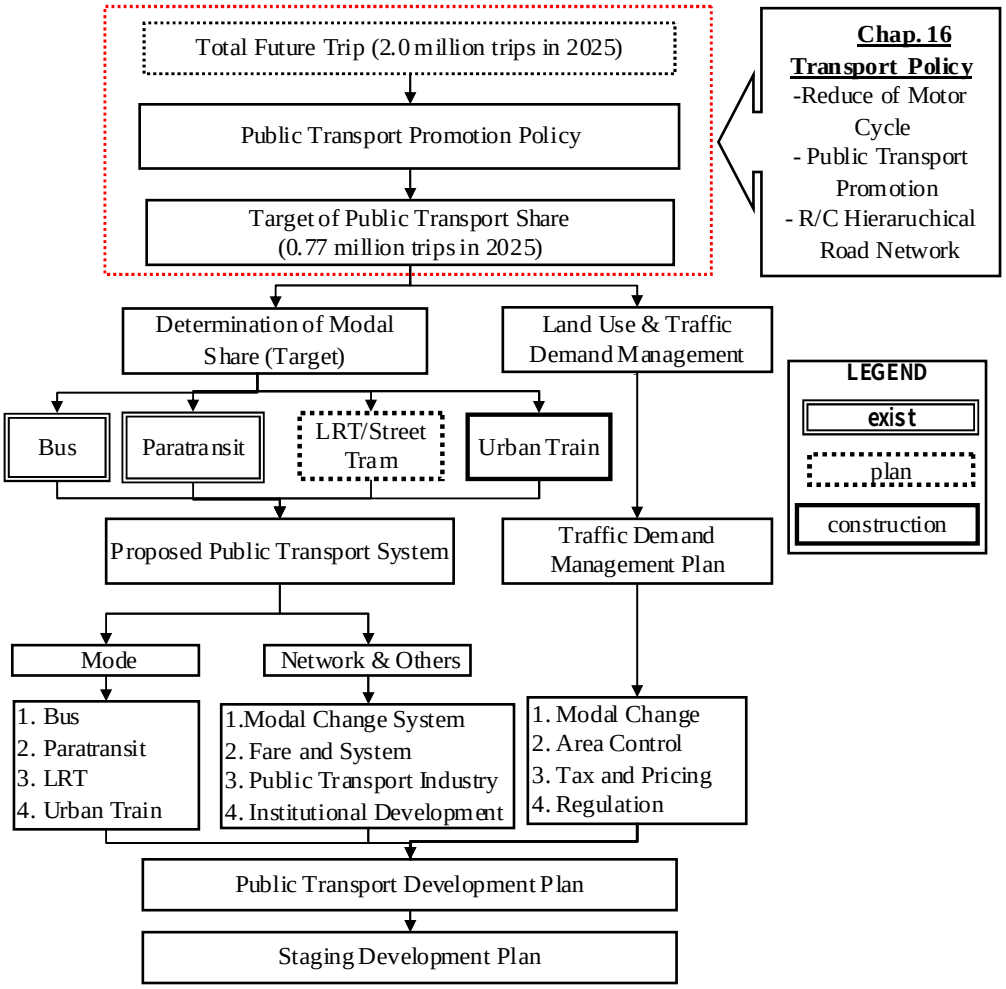


Figure 18.1-2 Planning Flow of Public Transport

(2) Planning Issues

The planning issues are summarized below.

- Improvement for full public transport network; not only for individual mode network.
- Quality of service upgrade for attracting bus use
- Introduction of BRT and School Shuttle Bus Services to meet demands.
- Flexible strategy and incremental implementation of busway improvement taking future BRT/LRT into consideration
- Due consideration of fare level and variation of fare system; unit fare and zone fare for all modal change and periodical and educational fare
- Private participation in equity of semi-public enterprise
- Establishment for public transport management agency

(3) Target of Share of Public Transport

A targeted share of Public Transport in 2025 will be 40% according to the overall transport policy. To achieve this target, direction of the modal change by mode and purpose is presented as follows and Table 18.1-3 shows the target shares.

1. Targeted Modal Share of Public Transport (PT) in 2025: 40%
2. Modal Shift and Staging Target

2013: Reducing of Motor Cycle (M/C) by 15% & Car by 5% for Work
M/C for School by 40% Increase in Public Transport share ⇒15%

2018: Reducing of M/C by 35% & Car by 10% for Work
M/C for School by 70% Increase in Public Transport share ⇒25%

2025: Reducing of M/C(75%) & Car (30%) for Work
M/C for School (90%) Increase in Public Transport share⇒40%

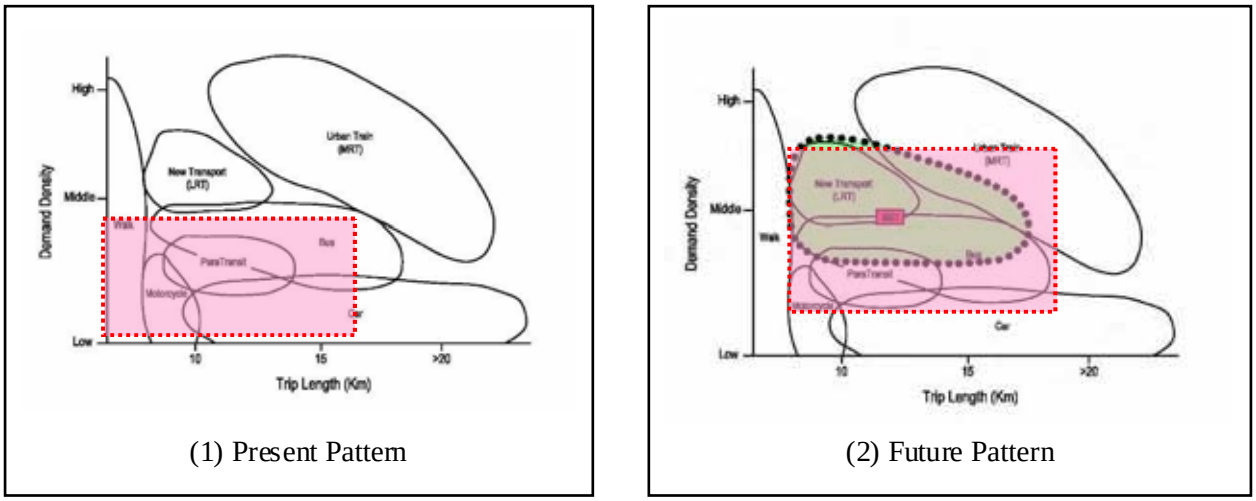
Table 18.1-3 Public Transport Share Target (unit: trip)

Mode	2007		2013		2018		2025	
Walk (NMT)	241,268	25%	276,109	22%	308,991	20%	349,556	18%
M/C	572,739	60%	625,728	51%	589,646	39%	460,894	24%
Car	106,199	11%	149,474	12%	227,772	15%	351,794	18%
Public Transport	37,427	4%	187,655	15%	382,615	25%	766,675	40%
Total	957,633	100%	1,238,966	100%	1,509,024	100%	1,928,919	100%

18.1.6 Proposed Public Transport System and New Mode

(1) Proposed Public Transport System and New Mode

Figure 18.1-3 shows the present trip length and demand pattern having short trip distances and low-demand density (Left figure). The future will be upgraded to medium trip distance and medium demand density with new modes (Right figure). The present transport system composed by walk, paratransit, motorcycle, and bus provides services to the present trip pattern as shown in the left figure and meets the lower traffic demand in Vientiane; the future the system is to be upgraded the present system to use BRT and LRT due to higher traffic demand density and longer trip length as shown in the right figure.



(1) Present Pattern

(2) Future Pattern

Figure 18.1-3 Public Transport System Development with New Modes

(2) Mode Development in Pubic Transport

The mode development from the present services to new public transport modes is summarized below.

Present Modes	New Modes	Future System Components
Mass Transit	**New Mass Transit**	**Network**
• Bus	• BRT • University Shuttle • LRT	• Integrated Public Transport Network with Bus & Railway • Express /Local/ Feeder Bus Service Routes • New Terminal and Bus Station at Strategic Points
Paratransit	**New Paratransit**	**Infrastructures**
• Tuk-tuk • Sonteo • Tax/Bike Tax	• Community Bus • Demand responsive Vehicle	• Hierarchical Road Network • Railway Line
Railway	**Urban Railway**	**Operation and Management**
• Cargo	• Commuter Train	• Fare and Collection • Public Transport Industry
Other Modes	**Other Modes**	**Oriented & Promotion Policy**
• Airport • Ferry	• Heliport • Tourism • Water Taxi	• Public Transport Oriented Land Use and Traffic Demand Management • Expansion of Private Transport Control Management in CBD

(3) New Public Transport Mode

Table 18.1-4 summarized various types of public transport in other cities.

Table 18.1-4 New Urban Public Transport Modes

Type of Public Transport			Development Plan
Improved Bus System	Route Bus  Seoul Bus System	Bus Network in Tokyo (part)  Mix traffic and Flexible routing	• Possible use and improvement of existing facilities and system • Flexible route restructure • Wide range of vehicle capacity: Small (30) Medium (50 pass.) and Big (80 pass.) • Max efficiency with priority lanes, signals and intersections, operation system and fare structure
BRT	New Bus(BRT): Priority lane  BRT Curitiba (Source: ITDP)	Exclusive lane (Bus Way)  Jakarta BRT (Source: ITDP)	• Highly improving of capacity, reliability and travel speed with bus running space on road. • Exclusive lanes in CBD and mix lane in suburb for flexible routing • Maximum use of the improved bus system with minor new facilities • Capacity of 150 passengers with two-wagon
LRT	LRT (3-Wagons): Mix/Fix Rail  Urban Train (LRT NEWS)	Exclusive Way, Kumamoto, Japan 	• Maximum use of BRT system with minor system modification • Capacity of 240 passengers with three-wagon

Besides the above new public transport modes, community and zone buses and paratransit for feeder and specific needs will be considered. The existing and planned urban train also will be utilized for commuter.

18.1.7 Proposed Public Transport System

Figure 18.1-4 conceptualizes a proposed public transport system. The system consist of a public transport network, new mode subsystems together, on which operation, management and environmental issues will be undertaken. Land use and traffic demand management and control are external policies to promote public transport use.

These issues are summarized below.

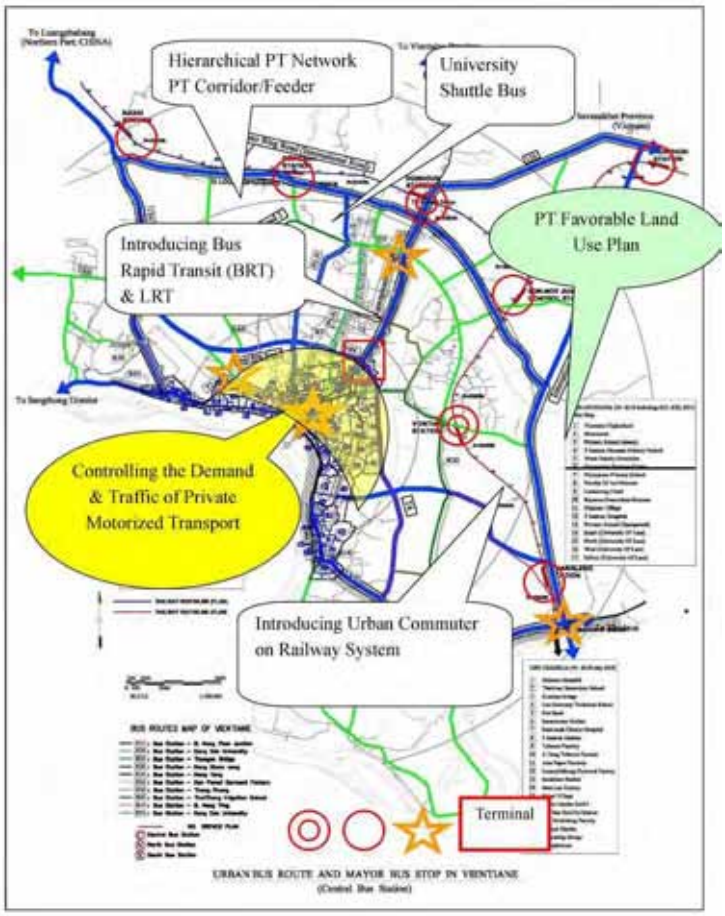


Figure 18.1-4 Proposed Public Transport System

1. Public Transport (PT) Network
- Establishment of hierarchical public transport network and public transport corridor

2. New Mode System
- Introducing Bus Rapid Transit (BRT) and LRT in the Public Transport Corridor
- Introducing Urban Commuter on the present railway system

3. Operation/Management and Environment Issues
- New role of paratransit for community and the disable transport
- Fare system with subsidy and financial and tax policy for Public Transport promotion
- New Public Transport Management Committee for participation of the stakeholders
- Incremental introduction of new public transport mode (BRT/LRT/Urban Railway) in an implementation program
- Efficient and environment friendly new mode like Hybrid bus and LRT for EST

4. Land Use
- Promotion of public transport usage with public transport favorable and oriented land use

5. Traffic Demand Management and Control
- Controlling demand & traffic of private motorized transport in CBD
- Transit mole and pedestrian corridors in CBD

18.2 BUS TANSPORT DEVELOPMENT PLAN

18.2.1 Planning Procedure

Figure 18.2-1 shows flow of bus transport planning.

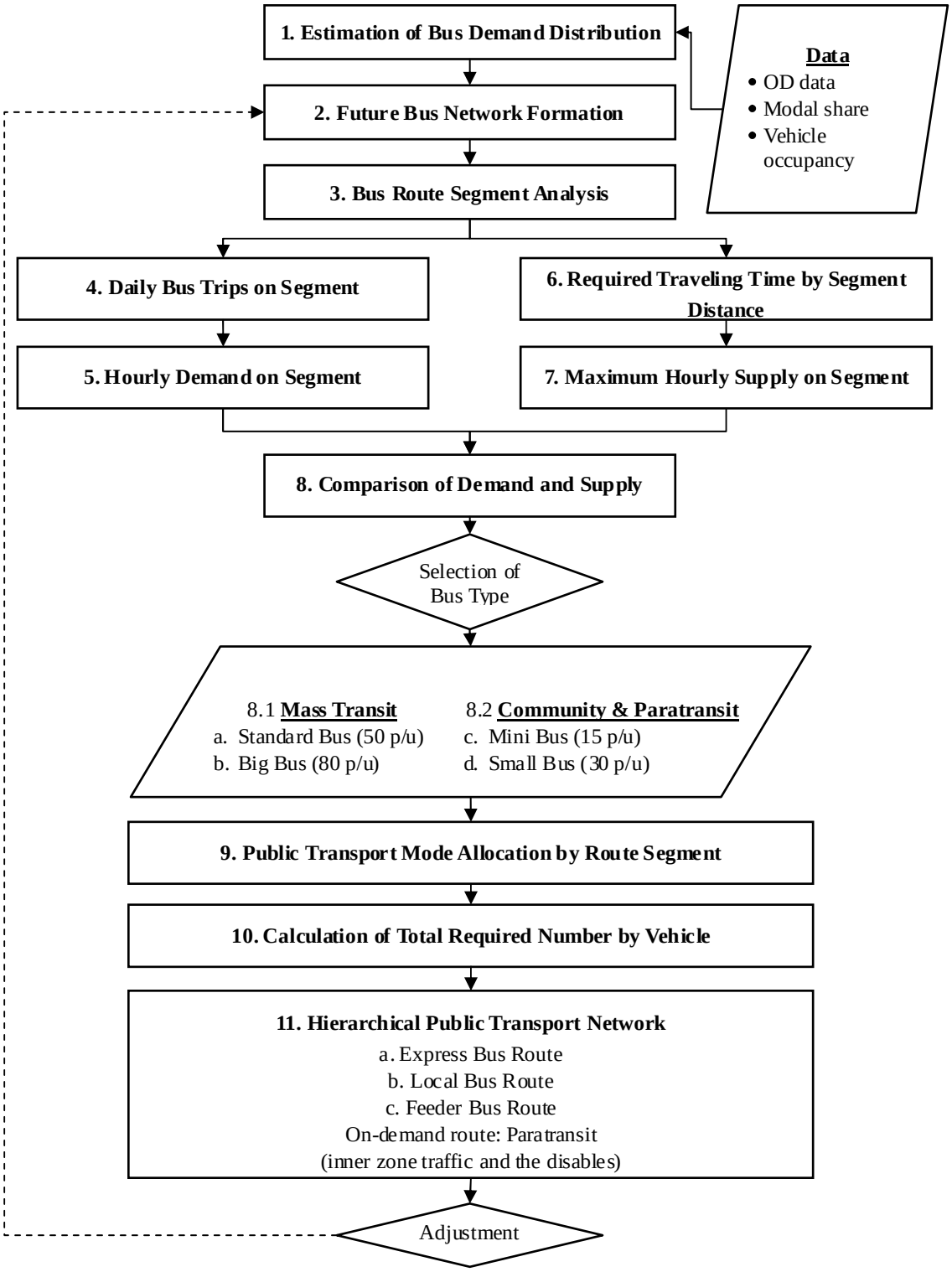


Figure 18.2-1 Flow of Planning of Bus and New Public Transport

18.2.2 Factors of Bus Services Planning

The existing problems in bus services in Vientiane have been identified as listed in Chapter 11. These problems and their possible measures are summarized as follows. The following subsections discuss these problems and measures.

Existing Problems		Measures
＜Bus Services＞ • Insufficient numbers of bus. • Operation with less reliable arrival time. • Poor riding quality buses.	⇒	• Increase of bus units and bus services routes • Securing reliability on bus time schedules • Riding quality improvement
＜Busway and Facility＞ • Insufficient road widths • The Central Bus Station required for renovation and extension, extension of road stops near the CBS area • Requirement of bus stops with lay-by, shelters, benches, etc. • No priority for bus at intersection and traffic signal control	⇒	• Widening of roads used for bus routes • Provision of busway with priority and exclusive lane • Intersection improvement and introduction of bus priority control of traffic signal system • Rehabilitation of CBS with bus stop location and route review • Establishment of bus stop standards and improvement
＜Bus Industries＞ • Decrease of profit of bus operators • Weak financial capacity of Bus Company to improve services.	⇒	• Investment by the government • Promotion of private investment • Capacity development in bus business operation
＜Administration＞ • Fare regulation which reduces freedom of bus business • Little competition among public transport operators • No clear official institution to receive the stakeholders' requests	⇒	• Optimal fare level based on proper financial analysis • Introduction of competition in the market • Preparation of public transport management with all stakeholders at central and local level

18.2.3 Estimation of Bus Demand Distribution

The bus traffic volume (standard bus with capacity of 50 persons) can be estimated by JICA STRADA by assuming the change of modal share as explained Chapter 16. The traffic volume of buses 2025 thus obtained is shown in Figure 18.2-2. Figure 18.2-3 graphically shows future increase of public transport demand represented by bus flow in 2013, 2018 and 2025, respectively. It is seen that the bus flows concentrate on the specific roads; CBD to University of Laos, CBD to the Friendship Bridge, CBD to Viengkam Residential Area, new Inner Ring Road, and Road No.1 of CBD. These routes of high bus demand coincide with the present bus routes.

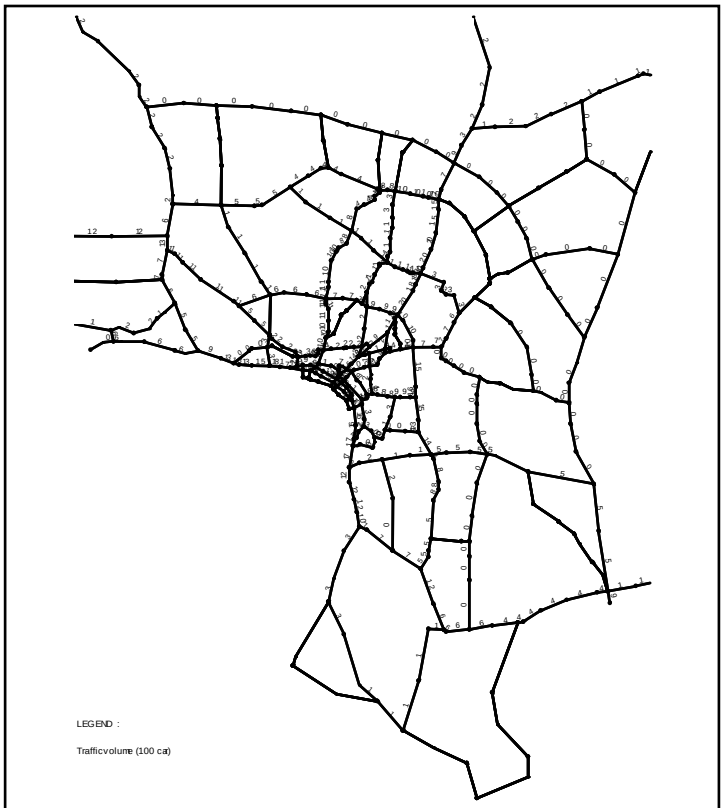


Figure 18.2-2 Bus Traffic Volume in 2025

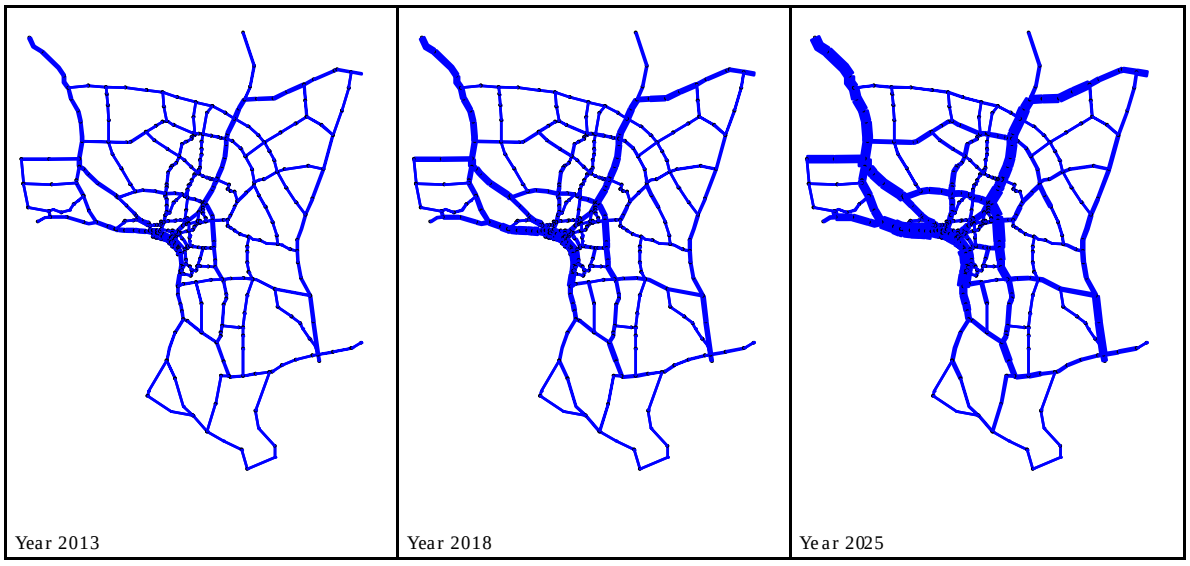
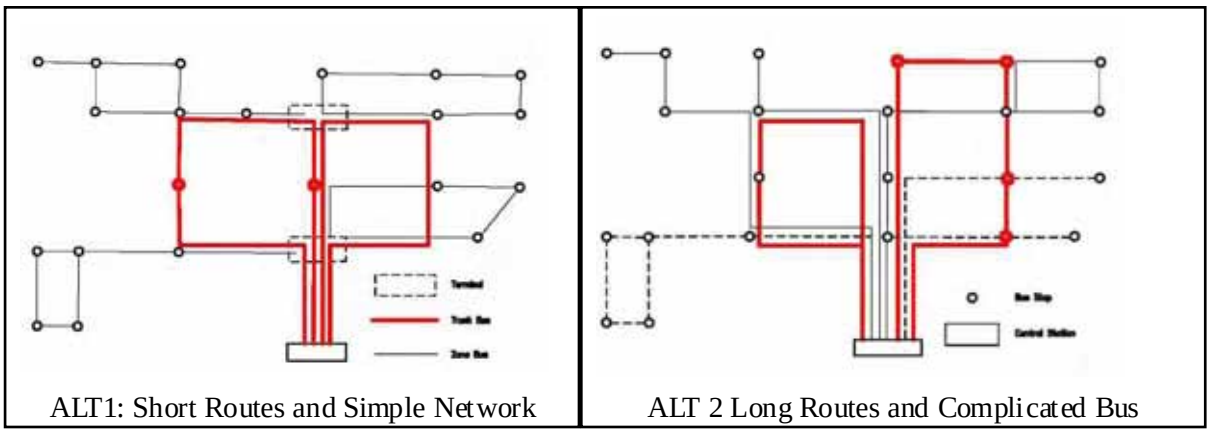


Figure 18.2-3 Bus Assignment on Full Network

18.2.4 Proposed Bus Network Formulation

(1) Alternative Bus Network Concepts

There are two alternative bus network concepts as shown in Figure 18.2-4 and Table 18.2-1 respectively. Alternative 1 (ALT 1) is composed by short bus routes and many bus operations and thus a fewer trunk routes to CBD and zone bus routes connecting bus interchange terminals. This will reduce travel distances and hence travel time and increases bus frequency on route and easily keep on-time performance due to a short travel distance. Alternative 2 (ALT 2) is composed by long bus routes having a few bus operations and all bus routes are concentrated in CBD. This may result in a few bus frequencies on route due to a long travel distance. ALT 2 is the present bus network concept in Vientiane and causes traffic congestions in the CBD. Hence a proposed bus network is formulated based on the ALT 1.



ALT1: Short Routes and Simple Network | ALT 2 Long Routes and Complicated Bus

Source: Edited by K. Amano, "Urban Public Transport (Toshi no Kokyokotu)"

Figure 18.2-4 Alternative Bus Network Concept

Table 18.2-1 Advantages (A) and Disadvantages (D) of Alternative Networks

Criteria	Alternative 1	A/D	Alternative 2	A/D
Reliability on schedule	shorter route distance and only trunk bus entering CBD	A	longer route distance and all concentrated in CBD	D
Waiting Time	fewer waiting time due to many buses due to short route	A	a few buses per hour on route longer waiting time	D
Bus Route Change	route change between trunk and feeder routes	D	a few route changes due to direct connection to CBD	A
Easy Routing	fewer and simple routes	A	many and complicated routes	D
Fare Structure	easy unit fare application	A	travel distance ratio fare and difficult collection	D
Transport Efficiency	efficient operation due to a fewer routes	A	lower ridership in sparse suburbs as the bus is required for fixed schedule operation on all routes	D
Accessibility /Equity	more flexible to introduce zone bus for new routes	A	lower flexible to extend new routes	D
Total Evaluation	Favorable		Not favorable	

(2) Bus Zone Formation

Applying the above ALT 1, six bus zones are proposed as shown in Figure 18.2-5 and Table 18.2-2. New transit stations will be located at connecting points with each zone.

In the bus zone 1 that is the most population density area, circular bus routes will be proposed by combination with transit mole and commuting of tourism spots. The other bus zones are still low density areas and paddy fields except the towns and residential areas located along the main roads and the bus routes will be developed in accordance with the future land use.

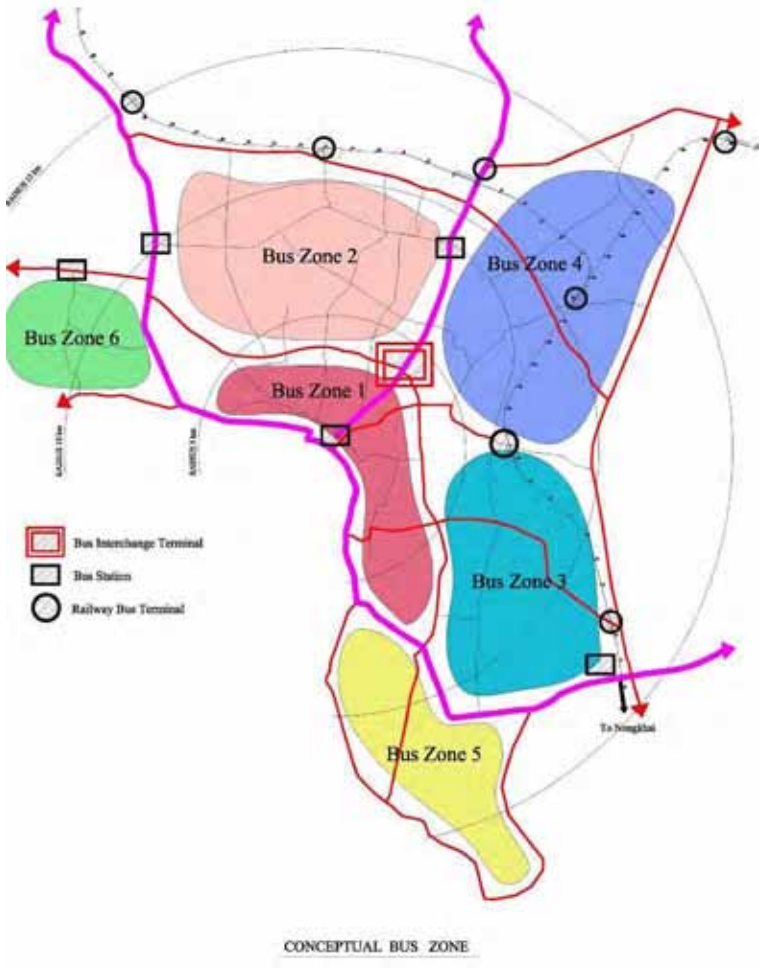


Figure 18.2-5 Proposed Bus Zone

Table 18.2-2 Proposed Bus Zone Formation

Bus Zone	Zone Characteristic	Bus Routes
1	Town and CBD Bordering inner ring with high demand	Mostly express routes Circulation bus routes
2	Laos University Zone Bordering Outer ring and NR 13 south and north with fairly high demand	University Shuttle bus routes Local routes with feeder routes
3	Vientiane Railway Station and Friendship Bridge Bordering No13 South and access to Vientiane Railway Station and Friendship Bridge with fairly high demand	Express routes Local routes
4	East areas with low demand Paratransit favorable	Local and feeder routes
5	South suburbs with low demand Paratransit favorable	Local and feeder routes
6	Viengkam Residential area with high demand and Western suburbs with low demand where paratransit is favorable	Express route Local and feeder

(3) Bus and Route Categories

Table 18.2-3 proposes four bus and route categories in accordance with demand volume and its traffic characters.

Table 18.2-3 Bus and Route Categories

Bus and Route Categories	Demand (two directions)	Bus Services
1. Express Bus Route	More than 1,000 units/day	Express Bus with BRT
2. University Shuttle Bus Route	-	Special service for University
3. Local Bus Route	500 to 1,000 units/day	Standard Bus Service
4. Feeder Bus Route	1 to 500 units/day	Small and Mini Bus service

The Express Bus Routes have high traffic demand of more than 1,000 bus units per day, equivalent to 50,000 passengers per day. Express buses with Bus Rapid Transit system will be proposed on these routes. In 2025, some routes will need to prepare Light Rail Transit. The University Shuttle Bus Route provides bus services exclusively to the National University of Laos, Dongdok Campus. At the present approximately 16,000 students are studying. The University is the biggest commuting demand zone in Vientiane. Local Bus Routes have traffic demand between 500 and 1,000 bus units per day, equivalent to 25,000 and 50,000 passengers. Standard buses (50 passengers) will be operated with using big typed bus (80 passengers) for the critical routes. The Feeder Bus Routes have low traffic less than 500 bus units per day, equivalent to 25,000 passengers. Small sized buses (30 passengers) and mini typed buses (15 passengers) will be operated .Paratransit operation will serve specific and community traffics by demand responsible basis mostly in these zones.

(4) Proposed Bus Route and Segment

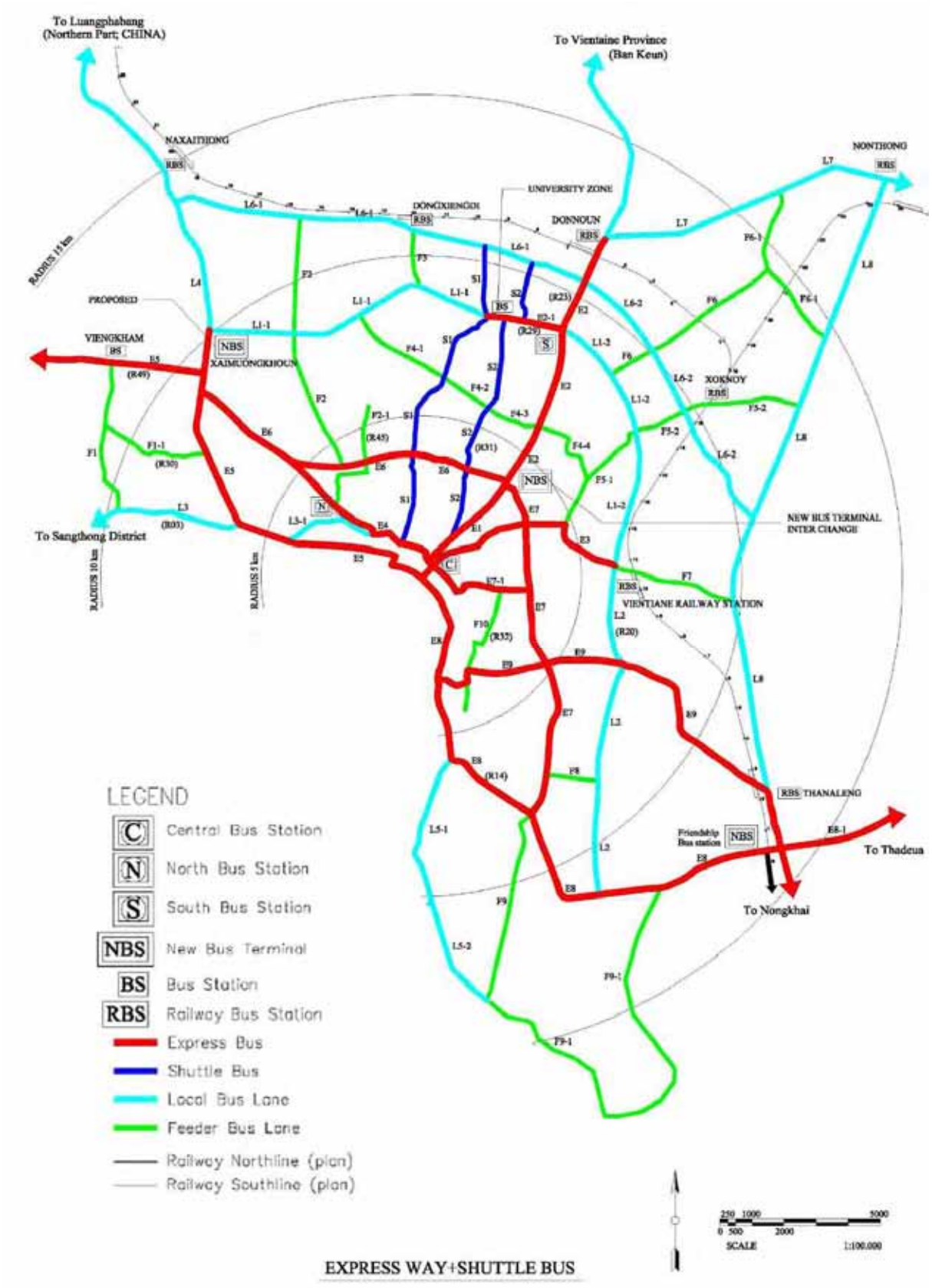


Figure 18.2-6 Proposed Bus Routes and Segments

(5) Proposed Bus Routes and Segment

A proposed bus route segments are shown above in Figure 18.2-6 and Table 18.2-4, respectively.

Table 18.2-4 Bus Route and Segment

SEGMENT	ORIGIN	DESTINATION	LENGH	PRESENT ROUTE	BUS
E1	CBS	NEW BUS TERMINAL	11.70	+E2	EXPRESS
E2	NEW BT	DONNOUN RBS	(7.79)	(R29)	EXPRESS
E2-1	SBS	UNIVERSITY ZONE	2.39	R23	(EXPRESS)
E3	CBS	VIENTIANE RBS	7.46	R20	EXPRESS
E4	CBS	NORTHERN BS	3.56		EXPRESS
E5	CBS	VIENGKHAM BS	14.84	R49	EXPRESS
E6	NEW BT	NEW NORTH BS	12.07		EXPRESS
E7	NEW BT	SOMSANOUK JCT.	10.90		EXPRESS
E7-1	CBS	PHONETHAN JCT.	3.76		EXPRESS
E8	CBS	FRIENDSHIP BRIDGE BS	19.36	R14	EXPRESS
E8-1	FRIENDSHIP BS	THADUEA STATION	4.71	R14	(EXPRESS)
E9	N13+KM3	THANALENG RBS	13.17		EXPRESS
S1	CBS	UNIVERSITY ZONE	9.86	Private	SHUTTLE
S2	CBS	UNIVERSITY ZONE	8.74	R31	SHUTTLE
L1-1	NEW NORTH BS	UNIVERSITY ZONE	9.28		LOCAL
L1-2	UNIVERSITY ZONE	VIENTIANE RBS	8.78		LOCAL
L2	VIENTIANE RBS	SALAKHAM JCT.	10.05	R20	LOCAL
L3	SIKHAY JCT.	BAN KAOLIU JCT.	4.43	R03	LOCAL
L3-1	ASIAN ROAD JCT.	WAT TAI YAI JCT.	2.98	R03	LOCAL
L4	NAXAITHONG RBS	PROPOSED NBS	5.67		LOCAL
L5	JINAIMO JUNCTION	PHOSI JUNCTION	8.51		LOCAL
L6-1	NAXAITHONG RBS	UNIVERSITY ZONE	12.91		LOCAL
L6-2	UNIVERSITY ZONE	DONGKANG JCT.	10.97		LOCAL
L7	DONNOUN RBS	NONTHONG RBS	9.60		LOCAL
L8	NONTHONG RBS	THANALENG RBS	20.14		LOCAL
F1	VIENGKHAM BS	DANKHAM JCT.	4.88		FEEDER
F1-1	THONGPONG JCT.	PHONSOMBOUN JCT.	3.44	R30	FEEDER
F2	DONGKALAO JCT.	CHOMTAI JCT.	8.09	(R45)	FEEDER
F2-1	NBS	NONGPING VILLAGE	4.00	(R45)	FEEDER
F3	NONGPHANGA JCT.	DONGXIENGDI RBS	1.78		FEEDER
F4-1	XAMKET JCT.	BAN DONE DENG JCT.	3.32		FEEDER
F4-2	BAN DONE DENG JCT.	BAN PHONTONG JCT.	1.68		FEEDER
F4-3	BAN PHONTONG JCT.	BAN PHONPHANO JCT.	1.71		FEEDER
F4-4	BAN PHONPHANO JCT.	TAT LUANG MARKET	2.68		FEEDER
F5-1	HOUAKHOUA JCT.	XAMKHE JCT.	3.75		FEEDER
F5-2	XAMKHE JCT.	KHOKSAAT JCT.	5.36		FEEDER
F6	PHONKHAM JCT.	KHOKNOI JCT.	5.89		FEEDER
F6-1	XOKNGAI JUNCTION	XAISOMBOUNE JCT.	5.34		FEEDER
F7	VIENTIANE RBS	NAKHOUAY JCT.	4.87		FEEDER
F8	NONGNAI JCT.	DONGKHAMXANG JCT.	1.60		FEEDER
F9	SOMSANOUK JCT	PHOSI JCT	6.11		FEEDER
F9-1	PHOSI JCT	NAHAI JCT	14.80		FEEDER
F10	PHONTHAN RB	DONPAMAI VILLAGE	4.42	R32	FEEDER
		Total Length	309.56		

18.2.5 Required Bus Number

(1) Bus Passenger and Vehicle Capacity

For public transport modes applied in the plan, three categories of public transport are reviewed; bus mass transit, rail transit and paratransit. In the bus mass transit and paratransit, there are five types of vehicle including a mini bus, a small bus, a standard bus, a big sized bus, bus rapid transit (BRT). In the rail transit, Light Rail Transit (LRT) within the present road right of way and new commuter train system to be developed the present and planned urban railway are considered. Table 18.2-5 presents the maximum capacity of passengers.

Table 18.2-5 Public Transport Mode Capacity

Type	Paratransit		Mass Transit	
Vehicle	Mini Bus	Small Bus	Standard Bus (SB)	Big Bus
Passenger/Unit	15	30	50	80
Travel Speed	20Km/h	20Km/h	20Km/h	20Km/h
Maximum Vehicle Capacity: Head: Time 5mits=12 vehicles/ hour, 12 hours/day=144 vehicles/ day				
Passenger Capacity(p/h)	12x15= >180	12x30= >360	12x50= >600	12x80= >960
Daily Pass. Cap. (p/d)	>2,160	>4.320	>7,200	>11,520
Route	Feeder	Feeder	Local Route	Local Route
Convert to SB	0.3	0.6	1.0	1.6

Type	Mass Transit		Railway
Vehicle	BRT	LRT	MRT
Passenger/unit	150	240	<240
Travel Speed	40km/h	40km/h	60km/h
Maximum Vehicle Capacity: Head Time 5mits=12 vehicles/ hour, 12 hours/day=144 vehicles/ day			
Passenger Capacity	12x150x2.0 =>3,600 p/h (Speed Up 20 to 40km/h)	12x240x2.0 =>5,760 p/h (Speed Up 20 to 40km/h)	<5,760 p/h
Daily Pass. Cap. (p/d)	3,600x12= >43,200	5,760x12= >69,120	< 69,120
Route	Express Route	Express Route	Present Railway
Convert(Bu)	6.0	9.6	< 9.6

(2) Calculation Bus Numbers Required by Route Segments

In order to estimate the bus unit numbers required for the whole proposed bus routes, a method of calculation by segments is applied following Figure 18.2-1 and the results are attached in Appendix 18-2. These results are used for the master plan. For the practical bus operation for each bus route, the detailed estimation of bus numbers will be required based on the further physical routes and traffic demand survey on each route.

(3) Required Bus Numbers

Table 18.2-6 shows the required bus numbers in 2013.

Table 18.2-6 Bus Network and Required Number of Bus (2013)

NO.	ORIGIN	DESTINATION	TYPE	Σ	MB	SM	SB	BB	BRT	LRT
E1	CBS	NEW BUS TERMINAL	BB	14	-	-	12	2	-	-
(+E2)	NEW BT	DONNOUN RBS	(+E1)	-	-	-	-	-	-	-
E2-1	SBS	UNIVERSITY ZONE	SB	3	-	-	3	-	-	-
E3	CBS	VIENTIANE RBS	MB	8	8			-	-	-
E4	CBS	NORTHERN BS	SB/SM	4	-	1	3	-	-	-
E5	CBS	VIENGKHAM BS	SB/SM	18	-	12	6	-	-	-
E6	NEW BT	NEW NORTH BS	SB/SM	14	-	11	3	-	-	-
E7	NEW BT	SOMSANOUK JCT.	SB/SM	13	-	8	5	-	-	-
E7-1	CBS	PHONETHAN JCT.	SB	5	-	-	5	-	-	-
E8	CBS	FRIENDSHIP BR. BS	BB/SB	23	-	-	22	1	-	-
E8-1	FRIENDSHIP BR. BS	THADUEA BS	MB	6	6	-	-	-	-	-
E9	N13+KM3	THANALENG RBS	SB	16	-	-	16	-	-	-
S1	CBS	UNIVERSITY ZONE	SB/SM	12	-	10	2	-	-	-
S2	CBS	UNIVERSITY ZONE	MB	9	9	-	-	-	-	-
L1-1	NEW NORTH BS	UNIVERSITY ZONE	SB/MB	11	9	2	-	-	-	-
L1-2	UNIVERSITY ZN	VIENTIANE RBS	-	0	-	-	-	-	-	-
L2	VIENTIANE RBS	SALAKHAM JCT.	MB	7	7	-	-	-	-	-
L3	SIKHAY JCT.	BAN KAOLIU JCT.	SM/MM	5	2	3	-	-	-	-
L3-1	ASIAN ROAD JCT.	WAT TAI YAI JCT.	MB	2	2	-	-	-	-	-
L4	NAXAITHONG RBS	PROPOSED NBS	SM	7	-	7	-	-	-	-
L5	JINAIMO JUNCTION	PHOSI JUNCTION	MB	9	9	-	-	-	-	-
L6-1	NAXAITHONG RBS	UNIVERSITY ZONE	MB	9	9	-	-	-	-	-
L6-2	UNIVERSITY ZONE	DONGKANG JCT.	MB	8	8	-	-	-	-	-
L7	DONNOUN RBS	NONTHONG RBS	MB	10	10	-	-	-	-	-
L8	NONTHONG RBS	THANALENG RBS	MB	14	14	-	-	-	-	-
F1	VIENGKHAM BS	DANKHAM JCT.	-	-	-	-	-	-	-	-
F1-1	THONGPONG JCT.	PHONSOMBOUN JCT.	MB	3	3	-	-	-	-	-
F2	DONGKALAO JCT.	CHOMTAI JCT.	-	-	-	-	-	-	-	-
F2-1	NBS	NONGPING VILLAGE	MB	3	3	-	-	-	-	-
F3	NONGPHANGA JCT.	DONGXIENGDI RBS	-			-	-	-	-	-
F4-1	XAMKET JCT.	BAN DONE DENG JCT.	MB	3	3	-	-	-	-	-
F4-2	BAN DONE DENG	BAN PHONTONG JCT.	MB	2	2	-	-	-	-	-
F4-3	BAN PHONTONG	BAN PHONPHANO	MB	2	2	-	-	-	-	-
F4-4	BAN PHONPHANO	TAT LUANG MARKET	MB/SB	3	2	1	-	-	-	-
F5-1	HOUAKHOUA JCT.	XAMKHE JCT.	MB/SB	5	2	3	-	-	-	-
F5-2	XAMKHE JCT.	KHOKSAAT JCT.	MB	4	4	-	-	-	-	-
F6	PHONKHAM JCT.	KHOKNOI JCT.	-	-	-	-	-	-	-	-
F6-1	XOKNGAI JCT.	XAISOMBOUNE JCT.	MB	4	4	-	-	-	-	-
F7	VIENTIANE RBS	NAKHOUAY JCT.	-	-	-	-	-	-	-	-
F8	NONGNAI JCT.	DONGKHAMXANG	-	-	-	-	-	-	-	-
F9	SOMSANOUK JCT	PHOSI JCT	MB	5	5	-	-	-	-	-
F9-1	PHOSI JCT	NAHAI JCT	-	-	-	-	-	-	-	-
F10	PHONTHAN RB	DONPAMAI VILLAGE	MB	3	3	-	-	-	-	-
		TOTAL	Unit	264	126	58	77	3	0	0
			%	100	48	22	29	1	0	0

NOTE: MB Mini Bus, SM Small Bus, SB Standard Bus, BB Big Bus, BRT Bus rapid Transit, LRT Light Rail Transit

Table 18.2-7 shows required bus numbers of bus in 2018.

Table 18.2-7 Bus Network and Required Number of Bus (2018)

NO.	ORIGIN	DESTINATION	TYPE	Σ	MB	SM	SB	BB	BRT	LRT
E1	CBS	NEW BUS TERMINAL	BB/BRT	14	-	-	-	10	4	-
(+E2)	NEW BT	DONNOUN RBS	(+E1)		-	-	-	-	-	-
E2-1	SBS	UNIVERSITY ZONE	BB/BRT	3	-	-	-	2	1	-
E3	CBS	VIENTIANE RBS	SM	9	-	9				-
E4	CBS	NORTHERN BS	BB	4	-	-	-	4		-
E5	CBS	VIENGKHAM BS	BB/BRT	18	-	-	-	16	2	-
E6	NEW BT	NEW NORTH BS	BB/BRT	14	-	-	-	13	1	-
E7	NEW BT	SOMSANOUK JCT.	BB/BRT	13	-	-	-	12	1	-
E7-1	CBS	PHONETHAN JCT.	SB/BB	5	-	-	1	4		-
E8	CBS	FRIENDSHIP BR. BS	BB/BRT	23	-	-	-	20	3	-
E8-1	FRIENDSHIP BR. BS	THADUEA BS	MB/SM	6	3	3	-	-	-	-
E9	N13+KM3	THANALENG RBS	BB	16	-	-	-	16	-	-
S1	CBS	UNIVERSITY ZONE	BB/SB	12	-	-	4	8	-	-
S2	CBS	UNIVERSITY ZONE	MB/SM	10	8	2	-	-	-	-
L1-1	NEW NORTH BS	UNIVERSITY ZONE	SB/SM	11	-	2	9	-	-	-
L1-2	UNIVERSITY ZN	VIENTIANE RBS	-	0	-	-	-	-	-	-
L2	VIENTIANE RBS	SALAKHAM JCT.	MB	11	11	-	-	-	-	-
L3	SIKHAY JCT.	BAN KAOLIU JCT.	SB/BB	5	-	-	3	2	-	-
L3-1	ASIAN ROAD JCT.	WAT TAI YAI JCT.	MB	3	3	-	-	-	-	-
L4	NAXAITHONG RBS	PROPOSED NBS	SB/SM	7	-	4	3	-	-	-
L5	JINAIMO JUNCTION	PHOSI JUNCTION	SM	10	-	10	-	-	-	-
L6-1	NAXAITHONG RBS	UNIVERSITY ZONE	MB	13	13	-	-	-	-	-
L6-2	UNIVERSITY ZONE	DONGKANG JCT.	MB	11	11	-	-	-	-	-
L7	DONNOUN RBS	NONTHONG RBS	MB/SB	12	11	1	-	-	-	-
L8	NONTHONG RBS	THANALENG RBS	MB	21	21	-	-	-	-	-
F1	VIENGKHAM BS	DANKHAM JCT.	-	-	-	-	-	-	-	-
F1-1	THONGPONG JCT.	PHONSOMBOUN JCT.	MB/SM	4	3	1	-	-	-	-
F2	DONGKALAO JCT.	CHOMTAI JCT.	SM	10	-	10	-	-	-	-
F2-1	NBS	NONGPING VILLAGE	SM/MB	5	3	2	-	-	-	-
F3	NONGPHANGA JCT.	DONGXIENGDI RBS	-	-	-	-	-	-	-	-
F4-1	XAMKET JCT.	BAN DONE DENG JCT.	SM/MB	4	2	2	-	-	-	-
F4-2	BAN DONE DENG	BAN PHONTONG JCT.	MB	2	2	-	-	-	-	-
F4-3	BAN PHONTONG	BAN PHONPHANO	MB	2	2	-	-	-	-	-
F4-4	BAN PHONPHANO	TAT LUANG MARKET	SB/MB	3	1	2	-	-	-	-
F5-1	HOUAKHOUA JCT.	XAMKHE JCT.	SB	5	-	-	5	-	-	-
F5-2	XAMKHE JCT.	KHOKSAAT JCT.	MB	6	6			-	-	-
F6	PHONKHAM JCT.	KHOKNOI JCT.	MB	-	-	-	-	-	-	-
F6-1	XOKNGAI JCT.	XAISOMBOUNE JCT.	MB	6	6	-	-	-	-	-
F7	VIENTIANE RBS	NAKHOUAY JCT.	-	-	-	-	-	-	-	-
F8	NONGNAI JCT.	DONGKHAMXANG	-	-	-	-	-	-	-	-
F9	SOMSANOUK JCT	PHOSI JCT	SM/MB	7	3	4		-	-	-
F9-1	PHOSI JCT	NAHAI JCT	-	-	-	-	-	-	-	-
F10	PHONTHAN RB	DONPAMAI VILLAGE	SM/SB	5		4	1	-	-	-
		TOTAL		310	109	56	26	107	12	0
			%	100	35	18	8	35	4	0

NOTE: MB Mini Bus, SM Small Bus, SB Standard Bus, BB Big Bus, BRT Bus rapid Transit, LRT Light Rail Transit

Table 18.2-8 shows required bus numbers of bus in 2025.

Table 18.2-8 Bus Network And Required Number of Bus (2025)

NO.	ORIGIN	DESTINATION	TYPE	Σ	MB	SM	SB	BB	BRT	LRT
E1	CBS	NEW BUS TERMINAL	BRT/LRT	14	-	-	-	-	14	(14)
(+E2)	NEW BT	DONNOUN RBS	(+E1)	+E1	-	-	-	-	-	-
E2-1	SBS	UNIVERSITY ZONE	SB/SMB	3	-	-	-	-	3	-
E3	CBS	VIENTIANE RBS	SB	9	-	-	9	-	-	-
E4	CBS	NORTHERN BS	BB/BRT	4	-	-	-	3	1	-
E5	CBS	VIENGKHAM BS	BB/BRT	18	-	-	-	5	13	-
E6	NEW BT	NEW NORTH BS	BB/BRT	14	-	-	-	7	7	-
E7	NEW BT	SOMSANOUK JCT.	BB/BRT	13	-	-	-	6	7	-
E7-1	CBS	PHONETHAN JCT.	BB/BRT	5	-	-	-	3	2	-
E8	CBS	FRIENDSHIP BR. BS	BB/BRT	23	-	-	-	11	12	-
E8-1	FRIENDSHIP BR. BS	THADUEA BS	SMB/MB	6	3	3	-	-	-	-
E9	N13+KM3	THANALENG RBS	BB	16	-	-	-	16	-	-
S1	CBS	UNIVERSITY ZONE	BRT	12	-	-	-	6	6	-
S2	CBS	UNIVERSITY ZONE	SB/SMB	10	-	6	4	-	-	-
L1-1	NEW NORTH BS	UNIVERSITY ZONE	BB/BRT	11	-	-	-	10	1	-
L1-2	UNIVERSITY ZN	VIENTIANE RBS	SMB	11	11	-	-	-	-	-
L2	VIENTIANE RBS	SALAKHAM JCT.	SMB	12	12	-	-	-	-	-
L3	SIKHAY JCT.	BAN KAOLIU JCT.	BB/BRT	5	-	-	-	3	2	-
L3-1	ASIAN ROAD JCT.	WAT TAI YAI JCT.	SMB	4	4	-	-	-	-	-
L4	NAXAITHONG RBS	PROPOSED NBS	SB/SMB	7	-	2	5	-	-	-
L5	JINAIMO JUNCTION	PHOSI JUNCTION	BB/SB	10	-	-	6	4	-	-
L6-1	NAXAITHONG RBS	UNIVERSITY ZONE	SMB	15	15	-	-	-	-	-
L6-2	UNIVERSITY ZONE	DONGKANG JCT.	SMB	13	13	-	-	-	-	-
L7	DONNOUN RBS	NONTHONG RBS	SB/SMB	12	-	11	1	-	-	-
L8	NONTHONG RBS	THANALENG RBS	SMB	24	24	-	-	-	-	-
F1	VIENGKHAM BS	DANKHAM JCT.	SMB	6	6	-	-	-	-	-
F1-1	THONGPONG JCT.	PHONSOMBOUN JCT.	SB/SMB	4	-	2	2	-	-	-
F2	DONGKALAO JCT.	CHOMTAI JCT.	SM/MB	10	3	7	-	-	-	-
F2-1	NBS	NONGPING VILLAGE	SM/MB	5	3	2	-	-	-	-
F3	NONGPHANGA JCT.	DONGXIENGDI RBS	SMB	2	2	-	-	-	-	-
F4-1	XAMKET JCT.	BAN DONE DENG JCT.	SM/MB	4	1	3	-	-	-	-
F4-2	BAN DONE DENG	BAN PHONTONG JCT.	SMB	2	-	2	-	-	-	-
F4-3	BAN PHONTONG	BAN PHONPHANO	SMB	2	-	2	-	-	-	-
F4-4	BAN PHONPHANO	TAT LUANG MARKET	BB	3	-	-	-	3	-	-
F5-1	HOUAKHOUA JCT.	XAMKHE JCT.	BB/BRT	5	-	-	-	3	2	-
F5-2	XAMKHE JCT.	KHOKSAAT JCT.	SMB	6	6	-	-	-	-	-
F6	PHONKHAM JCT.	KHOKNOI JCT.	SMB	2	2	-	-	-	-	-
F6-1	XOKNGAI JCT.	XAISOMBOUNE JCT.	SMB	6	6	-	-	-	-	-
F7	VIENTIANE RBS	NAKHOUAY JCT.	SMB	6	6	-	-	-	-	-
F8	NONGNAI JCT.	DONGKHAMXANG	SMB	1	1	-	-	-	-	-
F9	SOMSANOUK JCT	PHOSI JCT	SMB	7		7		-	-	-
F9-1	PHOSI JCT	NAHAI JCT	SMB	5	5	-	-	-	-	-
F10	PHONTHAN RB	DONPAMAI VILLAGE	SB/SMB	5	-	2	3	-	-	-
		TOTAL		352	152	52	30	77	68	0
			%	100	35	14	9	23	20	0

NOTE: MB Mini Bus, SM Small Bus, SB Standard Bus, BB Big Bus, BRT Bus rapid Transit, LRT Light Rail Transit

(4) Summary of Required Number of Bus

Table 18.2-9 shows a summary of staging the required number of buses and its costs from 2013 to 2025.

Table 18.2-9 Summary of Required Number of Bus and Cost (2013~2025)

NO.	ORIGIN	DESTINATION	2013	2018	2025
E1	CBS	NEW BUS TERMINAL	14	14	14
(+E2)	NEW BT	DONNOUN RBS	-	-	-
E2-1	SBS	UNIVERSITY ZONE	3	3	3
E3	CBS	VIENTIANE RBS	8	9	9
E4	CBS	NORTHERN BS	4	4	4
E5	CBS	VIENGKHAM BS	18	18	18
E6	NEW BT	NEW NORTH BS	14	14	14
E7	NEW BT	SOMSANOUK JCT.	13	13	13
E7-1	CBS	PHONETHAN JCT.	5	5	5
E8	CBS	FRIENDSHIP BR. BS	23	23	23
E8-1	FRIENDSHIP BR. BS	THADUEA BS	6	6	6
E9	N13+KM3	THANALENG RBS	16	16	16
S1	CBS	UNIVERSITY ZONE	12	12	12
S2	CBS	UNIVERSITY ZONE	9	10	10
L1-1	NEW NORTH BS	UNIVERSITY ZONE	11	11	11
L1-2	UNIVERSITY ZN	VIENTIANE RBS	0	0	11
L2	VIENTIANE RBS	SALAKHAM JCT.	7	11	12
L3	SIKHAY JCT.	BAN KAOLIU JCT.	5	5	5
L3-1	ASIAN ROAD JCT.	WAT TAI YAI JCT.	2	3	4
L4	NAXAITHONG RBS	PROPOSED NBS	7	7	7
L5	JINAIMO JUNCTION	PHOSI JUNCTION	9	10	10
L6-1	NAXAITHONG RBS	UNIVERSITY ZONE	9	13	15
L6-2	UNIVERSITY ZONE	DONGKANG JCT.	8	11	13
L7	DONNOUN RBS	NONTHONG RBS	10	12	12
L8	NONTHONG RBS	THANALENG RBS	14	21	24
F1	VIENGKHAM BS	DANKHAM JCT.	0	0	6
F1-1	THONGPONG JCT.	PHONSOMBOUN JCT.	3	4	4
F2	DONGKALAO JCT.	CHOMTAI JCT.	0	10	10
F2-1	NBS	NONGPING VILLAGE	3	5	5
F3	NONGPHANGA JCT.	DONGXIENGDI RBS	0	0	2
F4-1	XAMKET JCT.	BAN DONE DENG JCT.	3	4	4
F4-2	BAN DONE DENG	BAN PHONTONG JCT.	2	2	2
F4-3	BAN PHONTONG	BAN PHONPHANO	2	2	2
F4-4	BAN PHONPHANO	TAT LUANG MARKET	3	3	3
F5-1	HOUAKHOUA JCT.	XAMKHE JCT.	5	5	5
F5-2	XAMKHE JCT.	KHOKSAAT JCT.	4	6	6
F6	PHONKHAM JCT.	KHOKNOI JCT.	0	0	2
F6-1	XOKNGAI JCT.	XAISOMBOUNE JCT.	4	6	6
F7	VIENTIANE RBS	NAKHOUAY JCT.	0	0	6
F8	NONGNAI JCT.	DONGKHAMXANG	0	0	1
F9	SOMSANOUK JCT	PHOSI JCT	5	7	7
F9-1	PHOSI JCT	NAHAI JCT	0	0	5
F10	PHONTHAN RB	DONPAMAI VILLAGE	3	5	5
		TOTAL (Bus Units)	264	310	352
		Cost (x1000US$)	8,444	17,378	25,705

18.2.6 Bus System Improvement Project

(1) Bus Capacity Improvement (BCI)

Bus capacity improvement project will include procurement of new bus and improvement of bus operation system. Figure 18.2-7 shows proposed concepts of combination with express buses and local buses on the two corridors; CBD to University of Laos and CBD to Friendship Bridge.

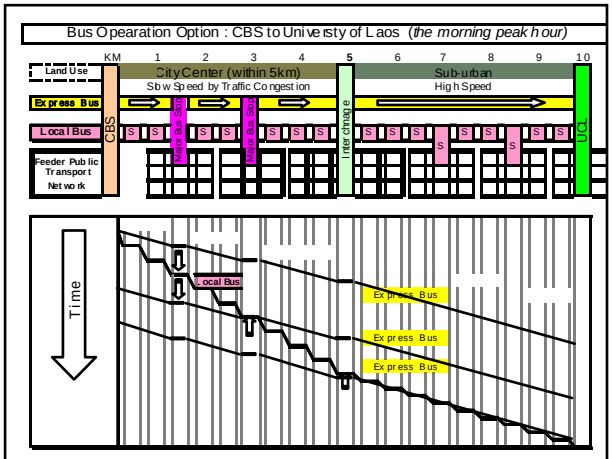


Figure 18.2-7 (1) E1 CBD to University of Laos

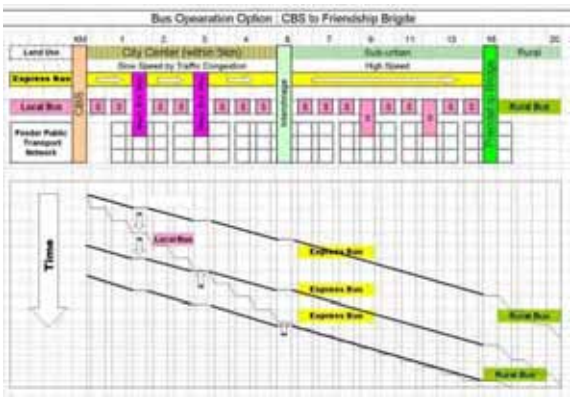


Figure 18.2-7 (2) CBD to Friendship Bridge

(2) Bus Priority Treatment (BPT)

Bus priority treatments are the first stage of introduction of a bus rapid transit plan. The bus priority treatments provide faster, more reliable bus operations, improving passengers' quality of services. This includes bus preferential treatments at intersections; signal priority, queue bypass, queue jump, curb extensions, safety islands, parking restrictions, bus-stops relocation, turn restriction exemption and exclusive bus lanes.

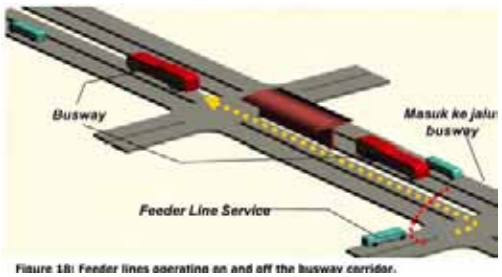


Figure 18: Feeder lines operating on and off the busway corridor.

Express Bus and Local Bus Change

(3) Bus Rapid Transit (BRT)

Bus Rapid Transit will compose six major elements to improve system performance and system benefits. The BRT elements are running way, stations, vehicles, fare collections, intelligence transport systems, and service and operating plans.

Bogota BRT with Guided Bus Lane

Table 18.2-10 shows BRT project and its elements.

Table 18.2-10 BRT Project Elements

BRT Elements	Elements	Implementation Plan
Running Way	1. Running way segregation 2. Running way marking 3. Guidance (lateral):Guided busway	1 & 2 to be done by Bus Priority Treatment (BPT). 3 to be planned also for future LRT
Stations	1. Station type 2. Platform heights 3. Platform layout 4. Passing capacity 5. Station access	All works to be planned in BPT stage including spaces of station for LRT. Station access to be considered by Bus Capacity Improvement (BCI)
Vehicles	1. Vehicle configuration 2. Aesthetic enhancement 3. Passenger circulation enhancement 4. Propulsion	Selection of vehicle and propulsion to be considered for EST. Hybrid or electricity buses preferable.
Fare Collection	1. Fare collection process 2. Fare transaction media 3. Fare structure	Fare collection process & structure to be considered in BCI. Integrated fare to be considered.
Intelligent Transportation Systems	1. Vehicle prioritization 2. Driver assist and automation technology 3. Operation management technology 4. Passenger information 5. Safety and security technology 6. Support technologies	All works to be planned in BPT stage and revised according to the system development
Service and Operating Plans	1. Route length 2. Route structure 3. Service span 4. Frequency of service 5. Station spacing 6. Method of schedule control	All works to be planned in BCI stage. For BRT, minor modification to be done for considering LRT.

Figure 18.2-8 and Figure 18.2-9 show BRT system (central) and guided busway, respectively.

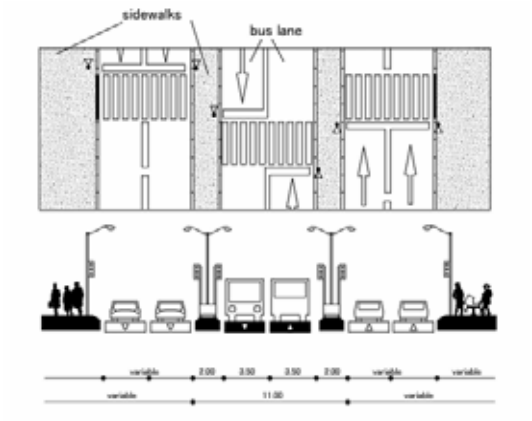


Figure 18.2-8 BRT System (Center)

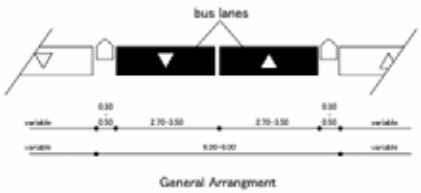


Figure 18.2-9 Guided Busway (Center)

18.3 IMPLEMENTATION PROGRAM

18.3.1 Short and Long Objectives and Priority Criteria

To plan the public transport improvement, a methodology of long and short termed phasing plan will be adopted. These long-term and short-term plans have different objectives, issues and different planning methods.

The short-term plan is to improve the present public transport system based on the present traffic and demand, not considering the future population and land use. The planning issues are improvement of the present service quality and capacity, and reduction of constrains in the present public transport system based on the present road network and the other available public transport modes including paratransit.

The long-term plan is to identify long-term objectives, taking the future national and urban development and its policies into consideration. The important attributes are future population, land use plan and change of urban functions in the future socio-economic frame, and focus of the future traffic demands.

Thus, these plans and proposed projects are summarized as follows.

- Short-term Plan: To improve service quality of the present public transport system with urgent and immediate means and to mitigate transport related-negative impacts to urban environment. To meet these objectives, the present Bus Capacity Improvement and the urgent University Shuttle Bus Service are proposed in the short-term phase.
- Long-tem Plans: To provide preventive and environmentally sustainable public transport system to meet future public transport demand; and to achieve the target modal share. To meet these objectives Bus Priority Treatments/Bus Rapid Transit and Light Rail Transit and Railway Commuter are proposed in the long-term phase.

To decide the priority of the projects, the following criteria were applied.

- Urgent transport problems and issues such as university shuttle bus
- High public transport demand on the present bus routes and segments
- Staging and incremental improvement from Bus Capacity Improvement to Bus Priority Treatment, to Bus Rapid Transit

18.3.2 Implementation Program

Implementation program of public transport development plan is shown in Table 18.3-1.

Table 18.3-1 Implementation Program of Public Transport Development Plan

Project Title	Agency	Q'ty/Cost	Short	Medium	Long
I. Bus Capacity Improvement (BCI)					
1. New Bus Supply	VSBC/Private	Bus Unit	264	310	352
		Cost	*8,444*	*17,378*	*25,705*
2. Bus Network Improvement					
2.1 Bus Runway Improvement	MPW&T	In road	-	-	-
2.2 Bottleneck improvement	MPW&T	In road	-	-	-
2.3 Bus Stop improvement	MPW&T	In road	-	-	-
II. Bus Priority Treatment					
1. Bus Priority Lane/ Intersection Improvement / Traffic Signal Control	MPW&T Vientiane	Length	10km	20km	-
		Cost	*1,000*	*2,000*	-
2. Bus Exclusive Way	MPW&T Vientiane	Length	-	-	30.0km
		Cost	-	-	*9,000*
3. Bus Terminal Improvement	MPW&T Vientiane	Unit	3	1	1
		Cost	3,000	1,000	1,000
(Railway Bus Station)	Railway Authority	Unit	1	3	3
		Cost	-	-	-
4. New Modal Change Terminal	MPW&T Vientiane	Unit	-	1	1
		Cost	-	*3,000*	*3,000*
III. Bus Rapid Transit System					
BRT facility modification	MPW&T Vientiane	Unit		-	84.9km
		Cost		-	*17,000*
IV. LRT (see Note)					
LRT Facility & Rolling	MPW&T Vientiane	km	-	-	(11.5)
		Cost			*(42,120)*
Urban Railway Commuter	Railway Authority	In railway	-	-	-
V. Other Services Improvement					
1. Fare and Collection System	Vientiane	In BCI	-	-	-
2. Paratransit	Vientiane	In BCI	-	-	-
3. Public Transportation Promotion					
(1) Traffic Demand Management	Vientiane	LS	CBD	R=5km	R=10km
		Cost	*1,000*	*5,000*	*10,000*
(2) Traffic Control	Vientiane	LS	CBD	R=5km	R=10km
		Cost	*1,000*	*5,000*	*10,000*
(3) Fare /Collection System Improvement	Vientiane	In BCI	-	-	-
4. Institutional Arrangement					
(1) Public Transport Management Committee		In TDM	-	-	-
Total Cost (x1000US)			***14,445***	***33,378***	***75,705***

Note: Cost is 1000 US$
( ) In case of introduction of LRT in Long-term stage.
R: the area covered with radius from the CBD.

Table 18.3-2 summarizes project cost by staging.

Table 18.3-2 Project Cost by Staging

Stage	Project Components	Cost (thousand US$)
Short Stage (~2013)	Mini Bus and Standard Bus	14,445
Medium Stage (~)2018	A partial BRT with priority way within CBD	33,378
Long Stage (~2025)	Full BRT on expressway and Big Bus	75,705
	Total	123,528

18.3.3 Public Transport System Improvement Benefits

(1) Demand and Supply

Table 18.3-3 shows the target demand trips and supply trips of bus public transport system. All stages of the bus system improvement will be able to meet transit demands by providing sufficient bus service with approximately 80% of efficiency. The 20% of exceeded supply may be considered for adjusting bus operation on peak-hours.

Table 18.3-3 Target Demand and Supply

Stage	Demand (trip)	Supply(trip)	Coverage(D/S)
2013	187,655	222,815	84.2%
2018	382,615	467,711	81.8%
2025	766,675	922,571	83.1%

(2) Improvement of Level of Service by Project

Table 18.3-4 shows impacts of public transport system projects to system performance improvement.

Table 18.3-4 Improvement of Level of Services (LOS)

Project Title	Propose and Works	Freq.	HOS	Coverage	Reliability	Amenities
I. Bus Capacity Improvement						
1.New Bus Supply	Purchase of new bus to meet demand.	H	H	H	H	H
2.Bus Network Improvement						
2.1 Bus Runway Improvement	Improvement of narrow sections and intersections of runway to be made by road projects.	H	-	-	H	-
2.2 Bottleneck improvement	Improvement of critical section of runway to be made by road projects.	H	-	-	H	-
2.3 Bus Stop improvement	Bus bay, shelter and waiting seats to be made by road projects.	-	-	-	-	H

Project Title	Propose and Works	Freq.	HOS	Coverage	Reliability	Amenities
II. Bus Priority Treatments						
3. Bus Priority Treatments	Lane marking and color pavement,	H	-	-	H	H
	Traffic control sign.	H	-	-	H	-
	Intersection improvement	H	-	-	H	-
	Traffic signal control	H	-	-	H	-
4. Bus Exclusive Way	Separation by 15cm-high curb	H	-	-	H	-
	Minor intersection improvement	H	-	-	H	H
	Minor traffic signal control	H	-	-	H	H
5. Bus Terminal Improvement	Existing bus terminal area improvement	-	H	H	-	H
6. New Modal Change Terminal	Public transport mode interchanges	H	H	H	H	H
	Railway bus station	-	H	H	-	H
III. University Shuttle Bus						
7.1 New Bus Procurement	Big sized bus	H	H	H	H	H
7.2 Ticketing System	New system	H	-	-	-	H
7.3 Bus Stops and Bus Runway	Minor improvement	H	-	-	H	H
IV. Bus Rapid Transit System						
8. Bus Rapid Transit System	New bus	H	H	H	H	H
	Fare and collection system (IT)	H	-	-	-	H
	Minor improvement bus stops	-	-	-	H	H
V. LRT						
9.1. New Vehicle	New train	H	H	H	H	H
9.2BRT Facilities	Minor improvement from BRT conversion	H	-	-	H	H
9.3 Platform	Platform modification	H	-	-	H	H
10. Railway Commuter	New commuter train	H	H	H	H	H
VI. Other Services Improvement						
11. Fare and Collection System	New fare system	H	-	-	H	H
	IT Ticketing System	H	-	H	H	H
12. Paratransit	On-demand operation	H	H	H	H	H
13. Public Transportation Promotion						
13.1 Traffic Demand Management	Education and promotion	H	-	H	H	H
13.2 Traffic Control	Traffic signal/control sign	H	-	-	H	H
13.3 Subsidy policy	Policy discussion with stakeholders	-	-	-	-	H
13.4 Public & Private Partnership	PPP policy and plan preparation	-	H	H	-	H
14. Institutional Arrangement						
14.1 Public Transport Authority	Administration	H	H	H	H	H
14.2 Public Management Committee (PMC)	All stakeholders	H	H	H	H	H
14.3 Local PMC	District needs and management	H	H	H	H	H

Note: H means highly impact to system performance. HOS: hours of services

18.4 UNIVERSITY SHUTTLE BUS SERVICE STUDY

18.4.1 Background

The students of University of Laos are the biggest users of bus services. The Dongdok campus of National University of Laos has approximately 16,000 students. The two thirds are commuting students using either bus or motor cycles. The bus users take three bus routes to the University from Central Bus Station; R29, R31 of Vientiane State Bus Company and other minor route by mini bus of a small private bus company. The number of buses is insufficient for students' demands.

In addition, the quality of bus services becomes worsen due to decay of bus vehicles, withdraw of private bus company from the services, and poor road and intersection conditions. The students are forced to use motor cycles and hire Tuk-tuks as shared taxi. This causes traffic congestions and distortions at the entrance gates with thorough traffic on Dongdok Road. Unsafe intersection configuration and broken traffic signals also are the biggest factors for serious traffic accidents. More than ten fatality of the students are reported a year. This concerns relevant authorities including university administration and Ministry of Public Works and Transport to take emergency measures.

In January 2008, Minister of PW&T instructed his Department of Transport and the Administration of University to prepare an urgent shuttle bus service improvement plan with consultation of the JICA Study Team.

To response this request, the Study Team carried out a preliminary survey within a scope of the preparation of master plan in cooperation with the University. The preliminary survey included "a student interview survey" and "bus user survey at CBS" during a week, from 18 to 22 February 2008.

Following the preliminary survey, a feasibility study is proposed with a scope and TOR below.

18.4.2 Project Objectives

(1) Bus demand focus and bus operation plan
(2) Road bottleneck section improvement
(3) Traffic safety plan with intersection improvement and traffic calming measures
(4) Bus user promotion plan including fare system

18.5 PARATRANSIT DEVELOPMENT PLAN

(1) Problems and Issues of Paratransit

The present paratransit consists of Tuk-tuk (including Jambo), Sonteo and Taxi. Only Tuk-tuk is used for the urban population of Vientiane, while Sonteo and Taxi are used for suburban transport and specific transport, respectively. Paratransit operators are private and family owners. They operate a small and shabby vehicle modified from light trucks and motor cycle. All Tuk-tuks are registered by stations near the market, hospital etc. where the demand responsive transport occurs. Mostly averaged travel distance is within 5-km. Table 18.5-1 shows present situations and improvement issues.

Table 18.5-1 Present Situation and Improvement Issues of Paratransit

Paratransit	Present Situations	Improvement Issues
Three associations Sonteo, Tuk-tuk / Jambo, Taxi under DOT of Vientiane	• Membership of association is requirement of operator. • Sonteo operated on urban-rural routes • Tuk-tuk operates in the town • Taxi operates at the station-base.	• Coordination with mass transit modes • Upgrade of services level by new vehicle • Promotion of usage for feeder transport

(2) Review of Role of Paratransit in Public Transport System

The paratransit is defined as either special-purpose in nature, limited to special groups, or offer flexible routing and schedules depending on passenger demands. Thus paratransit service will be more demand-responsive. In less dense areas, demand-responsive transit can be essential part of transportation for the non-driving population; a taxi cab provides this type of services for individual, such as the disables and a mini-bus for community. Route-deviation services are a variant of the paratransit services. In selected areas such as housing areas, buses operate on fixed routes according to a set schedule and passengers may ask drivers for a deviation from the fixed route within acceptance distance. The future paratransit will operate for these roles.

(3) Incremental Approach with Social Roles

The present paratransit system contributes to transport complement to the mass transit services and generation of employment opportunities as informal sectors. Reforms and restructuring the paratransit system, like phasing out the Tuk-tuk services in CBD or urban areas, will need to consider incremental approach with both transport and social roles. Thus the Master Plan proposes that the paratransit will be reviewed in accordance with the bus mass transit development and finally supplemental operation on feeder bus routes where the transport demand is sparse and low.

18.6 RAILWAY TRANSPORT DEVELOPMENT PLAN

(1) Present Railway

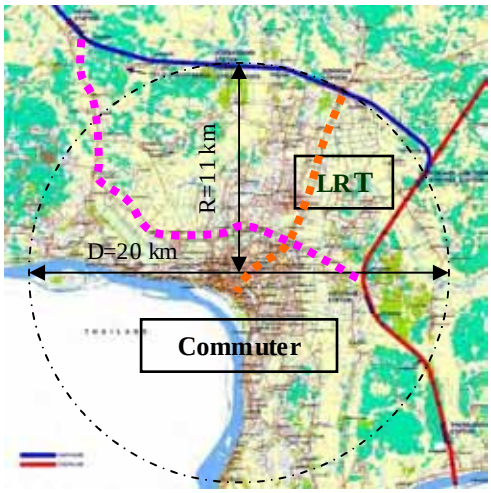
International railway construction of 3.5km was completed in January 2008 between Nongkhai city in Thailand to Thanaleng Station and planed to extend to 20-km long with 5 stations, through city edge around 11-km radius of Vientiane. This scale is nearly the same as Yamanote Line surrounding CBD in Tokyo, Japan.

Yamanote Line in Tokyo

(2) Railway Development Issues

For developing the present new railway infrastructure to the urban commuter, the following issues are to be considered.

- Determination of two different central stations of Vientiane for passengers and freights.
- Formation of urban circular railway
- Combination of LRT and MRT. LRT route for city center and MRT commuter for missing link of circular route, along the Mekong River. Location of LRT stations and land space and the right of way for MRT are required.
- Modal exchange and railway station bus terminal plan, and coordination with future railway extension plan and modal exchange are required.



Railway System in Vientiane

- Establishment of new Urban Commuter and LRT Operator, and Integrated fare system for all public transport modes

(3) The Railway Development Plan

For preparation of the long phase in 2025, the two project studies will be proposed.

1. Light Rail Transit Project (see sector (4))
2. Urban Commuter Development Project

(4) Light Rail Transit Plan

In 2025, a BRT route between CBS and Dongdok will be congested, therefore LRT will be required at this stage. Most of transportation facilities of guided way, bus stops, prioritized signal for BRT should be planned and implemented during the previous stages, which will be used for future LRT system with minor modification.

Milan LRT

18.7 PUBLIC TRANSPORT INDUSTRY DEVELOPMENT PLAN

(1) The present urban bus operator

The Vientiane State Bus Company is sole bus operator for urban public transport in Vientiane. A small private bus operator withdrew bus services after two months of his services due to unprofitable results. The VSBC also has recently decreased the profits and has no financial affordability to increase his capacity by renovating or purchasing new buses. The quality of bus services is getting worse below the Level of Service, unattractive to choice riders. The comprehensive study for improving bus service is required. Table 18.7-1 shows present problems and issued to be improved.

Table 18.7-1 The Present Situation and Improvement Issues of Bus Operator

Bus Operator	Present Situations	Improvement Issues
Vientiane State Bus Company (VSBC)	• Insufficient budget for renewal of aged buses • Bus numbers are so small to meet passenger's' number • Route number is 17 and total bus frequency is 348 • Bus fare is politically low and need permission of government for raising the fare. • Service time is short.	• Profitable fare level • Private sector participation by PPP or direct investment • Subsidy for the public transport users • Policy of public transport promotion • Improve service level and convenience.

(2) Private Involvement and Contract Options

Table 18.7-2 presents an example of the contract options in competition of the markets from the state monopoly to open markets. Bus domain may apply all completion ways.

Table 18.7-2 Urban Public Transport Competition

Contract and Competition	Description	Preferable Mode
Gross cost service contracting	Procurement by a public authority from an operator of specific services at price determined through competitive tendering. The operator passes all on-bus revenue to the authority and does not take any revenue risk. Careful monitoring is required.	Bus/Rail
Net cost service contracting	The operator keeps the revenue and hence incurs both the revenue and supply-cost risks. Difficult modal coordination	Bus/Rail
Management contracting	Operator responsibility for management of a system's operation, possibly including service specification, within agreed-on parameters. The authority owns operational assets. Intermodal coordination relatively easy. Costs will be relatively high.	Bus/Rail
Franchising	A grant of an exclusive right to provide a serve. For a self-contain area or route franchise.	Bus
Concession	A grant of an exclusive right to provide a service without payment by the authority.	Bus/Rail
Quantity Licensing	Total number of vehicles allowed to operate is limited by the authority.	Paratransit
Quality Licensing	Specific minimum conditions for entry	Paratransit
Open Markets	No restriction on transport operators	Paratransit

Source: World Bank, City of the Move, a World Bank Transport Strategy Review.

(3) Recommendation

The Vientiane has experiences in private company entering urban pubic transport services by routes franchise with approved fare. The private operators provided only 30 to 40 minibuses for minor bus routes, because the most of major routes where the demand is higher are operated by the Vientiane State Bus Company. However, the private operators quickly terminated the services due to a lack of users demand on such bus routes. Thus the transport authority and the public users get losing credibility of the private operators.

The private operators will have disadvantages when entering the present markets unless the franchise routes reviews are considered. From state monopolize market to complete markets, full scale of open market is not practical. It is recommended to introduce a well-managed competition or regulated competition at the first stage taking great benefits to the poor into consideration. In this context, subsidies to the poor or the disadvantages will be reviewed. The equity share of the VSBC will be preferable way of public and private partnership at the beginning stage.

18.8 ENVIRONMENTAL SUSTAINABLE TRANSPORT

For the Environmental Sustainable Transport (EST) in Asia, an international meeting of "Asian Mayor's Policy Dialogue for Promotion of Environmentally Sustainable Transport Cities" was held in Kyoto on 23-24 April 2007, following the Aichi Statement. The meeting was organized mainly by United Nations Center for Regional Development (UNCRD), MOE Japan, AWGESC[5], IGES[6], together with MOLIT Japan and ADB. Vice Mayor of Vientiane presented the city EST policy together with the Governor of Luang Prabang. In May 2007, UNCRD started "National Environmentally Sustainable Transport (EST) Strategies and Capacity Building for Socio-economic Concerns" with UN DESA[7] grant. The project finished in January 2008. UNCRD requested the Study Team for coordination and joint-workshops.

In 2006, MTCPC (former MPWT) prepared "Vientiane Sustainable Transport Initiative (Initiative)" for submission to Global Environmental Facility in order to request the financial support. The Initiatives summarized the previous urban transport studies and conclude to promote three project components; (i) Delivery for a high-quality **public transport system** (Bus Rapid Transit: BRT), (ii) Promotion of **non-motorized options**, and (iii) Incentives to **curtail usage of private motorized vehicles**. In May 2007, the MCTPC requested the Study Team to consider the directions of the Initiative. Table 18.8-1 shows Environmental Public Transport Issues in Vientiane

[5] AWGESC: Asean Working Group on Environmentally Sustainable Cities
[6] IGES: Institute for Global Environmental Strategies
[7] DESA: Department for Economic and Social Affairs, UN

Table 18.8-1 Environmental Public Transport Issues in Vientiane

Category	Problems of Urban Public Transport	Solutions
EST Key Element		
Public Transport & TDM	• Increasing share of PT	• Improve level of service and reliability of Bus operation
TDM	• Controlling private car and motorbike numbers from the BRT route	• Bus priority or exclusive lanes
BRT (Bus Rapid Transit)	• No public bus priority policy and regulation	• BRT plan (corridor, operation system)
MST (Mass Rapid Transit)	• No plan for using a planned railway	• Commuter and modal exchange plan at the railway stations
Public Health	• Reducing traffic accident for PT users	• Improvement of bus stops and its pedestrian crossing
	• Air pollution and noise	• Using clean energy (electricity)
Land Use Planning (LUP)	• No LUP policy and strategies for PT	• Focus on the movement of people and goods, not cars
		• LUP with a particular emphasis on PT
	• Unplanned, low density expansion of urban areas	• Encouraging the integration of both land use and transport planning
	• Need urban revitalization	• Mixed-use development, favoring concentrated development around public transport nodes
Urban transport infrastructure	• Need TP favorable transportation infrastructure	• Hierarchical road system
Non-motorized transport (NTM)	• Need to coordinate NMT and PT	• Bicycle parking
Social equity and gender perspectives	• Need for and contribution of safe and affordable PT in urban transport system to the alleviation of poverty and the promotion of social development • Need for condition for women, the most vulnerable users, including children, the elderly, and the physically disabled.	• Policy of special fare charged • Subsidy policy for the fare charged
Road safety and maintenance	• Need to reduce traffic accident by PT	• PT traffic safety plan
Strengthening road side air quality monitoring and assessment	• Need to reduce air pollution from PT vehicles on road side	• Cleaner fuel promotion • Land use plan along the road side
Traffic noise management	• Need for prevention of excessive noise	• Promotion of high-quality PT
Cleaner Fuel	• Need for planning for eventual transition to renewable fuels	• Promotion of electricity use • Promotion of bio fuel

CHAPTER 19

TRAFFIC MANAGEMENT PLAN

CHAPTER 19 TRAFFIC MANAGEMENT PLAN

This chapter presents the recommended basic traffic management plan that must be effectively and promptly applied to improve and prevent the further deterioration of traffic environment and accident level in Vientiane City. This basic traffic management plan is formulated based on the analysis of the various traffic management and operational problems identified in CHAPTER 11.

19.1 PLANNING CONCEPT

The basic planning concept of traffic management is to implement remedial but low-cost measures. These measures must be able to be implemented within the short-term to prevent further deterioration of traffic conditions. Main objectives of such a traffic management plan should therefore focused on effective ways to increase road capacity under the current conditions while implement remedial measures to improve traffic safety level.

19.1.1 Existing Traffic Problems

Vientiane City is currently witnessing an increasing trend in traffic accidents while severe traffic congestions on major roads and intersections are expected to occur frequently in the near future. Under such a scenario, the basic traffic management plan is formulated by examining the various causes of these current traffic problems.

(1) Traffic Engineering and Technical Perspectives

- Disorderly traffic flow due to mixed traffic composition,
- Inadequate pavement markings such as median line and lane markings,
- Inadequate traffic signs,
- Inefficient traffic processing at intersections and along some road sections,
- Undeveloped vehicle channelization facilities at intersections,
- Inadequate geometric structures,
- Lack of pedestrian islands and traffic safety facilities,
- Lack of pedestrian crossing facilities,
- Lack of signal control facilities,
- Inadequate traffic regulations, especially parking regulation,
- Lack of traffic accident database,
- Lack of traffic engineers.

(2) Traffic Safety Perspective

- Insufficient traffic safety education,
- Indifference among drivers in obeying traffic regulations,
- Weak traffic enforcement.

19.1.2 Objective of Traffic Management Plan

The objective of a traffic management plan is to implement comprehensive measures upon investigation of the current traffic operation problems in Vientiane while predicting various traffic problems that are likely to occur in the near future, in order to achieve a safe, efficient and smooth traffic environment for all road users in the city.

19.1.3 Measures for Traffic Management Plan

Traffic problems in Vientiane have been compounded and complicated over the years, which call for immediate implementation of remedial measures to achieve the 3-E policy objective, (Traffic Engineering, Education and Enforcement). The following are traffic remedial measures recommended to achieve the objective of the Traffic Management Plan.

(1) Traffic Engineering Improvements

a. Improvement of road structures and design

Good road structure is essential for promoting good traffic operation which in turn, is necessary for achieving smooth traffic flow and reduces traffic accidents.

b. Improvement of traffic intersections

One of the key factors for smooth traffic flow is adequate traffic capacity at both road sections and intersections. Reduced capacity in handling traffic demand at intersections is one of the critical traffic problems faced by Vientiane.

c. Introduction of signalized traffic intersections

The introduction of more signalized intersections to the city is essential. Signalized traffic intersections are capable of improving traffic handling capacity at intersections, thus reduce congestion while improve travel time and traffic safety level.

d. Setting up of a traffic accident data management system

To reduce traffic accidents effectively, analyses of past traffic accidents are very essential in order that remedial measures can be formulated. To do that, a traffic accident data management plan must be set up.

(2) Promotion of Traffic Safety Education

One of the reasons for the increasing trend in traffic accidents is the lack of traffic safety awareness among road users and their indifferent attitude towards the need for obeying traffic regulations and rules when driving on the roads. The promotion of traffic safety education is therefore much needed in Vientiane.

(3) Strengthening Traffic Enforcement

Current traffic enforcement is inadequate in Vientiane for deterring road users from violating various traffic regulations and rules. A more stringent traffic enforcement system and procedure is needed to ensure that road users obey and respect all the traffic regulations and rules. Only by doing so can they enjoy a better traffic environment in the future.

19.2 TRAFFIC ENGINEERING AND TECHNIQUES

This section presents some of the short term and low-cost remedial measures that can be implemented immediately to prevent the deterioration of the current traffic situations and problems. The most effective ways for achieving such an objective are suggested. At the same time, such remedial measures also have the effects of improving the level of traffic safety in the city.

19.2.1 Road Section Improvements

(1) Necessity of Road Section Improvements

In general, more traffic accidents are found to occur at intersections compared to road sections. However, such a trend is only observed in the urban areas where most intersections also experienced more serious traffic congestion problems.

Nevertheless, many traffic accidents still occur along road sections. Factors contributing to such a phenomenon can be removed to achieve a higher safety level for road users. At the same time such measures may also promote smoother traffic flow and increase the road handling capacity.

Road surface marking along the direction of traffic lanes is one of the important road facilities for promoting smooth traffic flow. There are many types of markings such as median lines, traffic lane lines, curb lines and others. In addition, raised median can be installed to physically prevent the intrusion of vehicles from the opposite traffic stream.

These road surface facilities, when installed continuously on long road sections, have the beneficial effects of providing guidance on the driving manners among road users. For this

reason, they are indispensable road facilities for the promotion of smooth and safe traffic flows.

Besides the problem of a mixed traffic, there is also a severe lack of such road surface marking facilities in Vientiane. As a result of these two factors, traffic flow in the city is very disorderly. The installation of such facilities is thus an indispensable and urgent task.

(2) Median Line

Median line has the important function of demarcating the direction of traffic flow on the roads. It also indicates safe driving spaces for the drivers. Depending on the types of median lines used, a solid line would indicates prohibition for overtaking while a broken line indicates overtaking is allowed along that road section.

Based on the installation standards for median lines, all road sections with road width below 5.5 to 6.0 meters do not require median line markings. Road sections with width above this standard require the installation of median lines.

It is recommended that road median lines be provided for all the road sections in Vientiane.

In Laos, it is a common practice to use white-colored line markings with similar line widths for both the median and lane markings. This practice is in fact dangerous because such different line markings cannot be easily differentiated at a glance. This is particularly true during the night or under raining conditions. It is therefore recommended that the use of yellow-colored lines with wider width be adopted for all median line markings in Vientiane.

(3) Traffic Lane Lines

Similar to the median line markings, traffic lane lines have the important functions of encouraging and guiding traffic flow in an orderly manner on the roads.

The concept of traffic safety using lane markings is the provision of a safe and continuous traveling space within these lanes. In addition, these lane markings also assist the drivers in confirming the safety level visually to the left / right or front / back of the vehicle when changing lanes.

Traffic lane lines are indispensable for all road sections having 4 or more traffic lanes.

In the city of Vientiane, there are numerous two-wheel vehicles among the traffic streams. Even though the provision of two traffic lanes for one direction is sometimes difficult along streets with narrow width, the use of traffic lane lines can ensures that at least one traffic lane

is reserved for all 4-wheel vehicles with the remaining road width to be used by the two-wheelers. Hence the segregation of 4-wheel vehicles from the 2-wheelers is possible.

To guide and ensure that all 2-wheelers use the outer lane along the road sections, it is essential to provide painted symbols of a two-wheeler or writings on the road surface within the outer traffic lane.

(4) Road Shoulder Lines

Shoulder lines marking at both edges of a paved road demarcate the end of the paved roadway surfaces. Traveling beyond these lines is thus not possible. It is therefore imperative that road shoulder lines are provided for all road sections in Vientiane.

In Vientiane, although there are road sections that are paved with proper stone curbs, many other road sections have open soil or sand at the shoulders. Due to such physical limitation, the installation of road shoulder lines hence depends on type of road shoulder treatment.

(5) Maintenance and Management of Pavement markings

After the road sections have been resurfaced or improved or when the markings have faded, fresh new pavement markings must be installed to such road sections. The lifespan of any pavement marking is rather short, even if plastic marking paints are used. Therefore regular remarking within 1 or 2 years is necessary to ensure their visibility.

Regular maintenance of all pavement markings is absolutely necessary to ensure their conditions and hence their intended functions in promoting smooth traffic flow and safety.

(6) Raised medians

Raised medians provide a higher level of traffic safety and improve operations for through traffic vehicles on a multi-lane road. (See examples in Pictures 18.2-1 and 18.2-2).

The benefits of such raised medians are:

- physically segregate the two opposing traffic streams,
- restrict access to / from the arterial with the adjoining side roads,
- provide pedestrian refuge areas.

The raised medians installed along the major arterial roads are very useful in Vientiane. They restrict driving on opposing roadways and left-turning to/from the minor roads or driveways. In future, when driving manners among road users are substantially improved, such raised median installed on roadways having limited road width may be removed to provide additional road space for traffic operations.

Picture 19.2-1 Example 1 of a Raised Median

Picture 19.2-2 Example 2 of a Raised Median

(7) Sidewalk and Pedestrian Crossing

Although sidewalks are mostly installed along roadways in Vientiane, properly maintenance of these sidewalks is hardly carried out. Due to the lack of continuity of these pedestrian sidewalks, pedestrians are sometimes forced to walk on the roadways. Hence, the provision of a continuous, safe and free-of-obstructions sidewalk system in Vientiane is highly recommended. Although it may be impossible to implement such a plan into practice at once, a gradual and step-by-step approach may be adopted.

Zebra-crossing markings are commonly used for pedestrian crossings along road sections in Vientiane. However, for national level road sections in the suburbs, such pavement marking alone for ensuring safe pedestrian crossings is not sufficient. The following additional facilities are sometimes needed at zebra-crossing markings:

- Pedestrian crossing signs posted on poles at road intersections,
- Clear and visible stop lines before the zebra-crossing markings,
- Good illumination at night,
- Illuminated warning signs for higher nigh time visibility of such crossing facilities.

At intersections where pedestrian traffic and pedestrian volumes are high, pedestrian-only signals become necessary.

19.2.2 Intersection Improvements and Traffic Operation

(1) Necessity in Intersection Improvements

Traffic accidents occur more frequently at intersections compared to regular road sections. Similarly, traffic congestions also occur more frequently at intersections compared to road sections. For this reason, appropriate improvement measures and proper traffic operation at intersections are very essential.

In Vientiane, there are many intersections found to have poor geometric design structures or inadequate traffic management facilities. Furthermore, there are also intersections that have been improved previously but are not properly maintained.

For those intersections that have not been improved, they are experiencing numerous incidents of traffic accidents. Since severe traffic accidents might happen at such intersections, their improvements are therefore necessary.

For those intersections that have previously been improved but are poorly maintained or where the traffic management facilities are not functioning well, urgent improvements measures for these intersections are also necessary. Such improvement measures are relatively low cost and can be easily implemented within a short period of time. Effectiveness of such improvements is also usually very high.

There are several roundabouts in Vientiane. Among these roundabouts, if traffic management facilities are installed at medium to small-scale roundabouts, traffic congestions and accidents at these locations can be significantly improved. On the other hand, if traffic volumes and accidents are unusually high at some of these roundabouts, then it is necessary to consider converting these roundabout junctions to crossroad intersections with traffic signal control.

(2) Selection of Intersections to be Improved

Although there are several methods in choosing intersections that need to be improved, technically, traffic volumes and traffic accidents are the two major indicators that must be considered.

By ranking the problematic intersections by their number of traffic accidents or by the number of severe accidents, highly dangerous intersections can be revealed and selected for improvements.

By ranking intersections according to their high traffic volumes or severity in congestions, intersections requiring urgent improvement measures can also be revealed and selected. In addition, if congestion at an intersection is observed to have extended to the next intersection upstream, then such an intersection should be given a higher priority for urgent improvement.

For road sections, analyze the traffic conditions as well as the occurrence of traffic accidents on these sections. Based on such analyses, dangerous road sections that required urgent improvements can be selected. Under this circumstance, all intersections within such a selected road sections should also be regarded as intersections that required urgent improvements.

Finally, effectiveness of the improvement measures as well as budget allocations for improvement works are the other factors that would determine the decision in the selection of intersections or road sections to be improved.

(3) Improvement Measures for Intersections

Important points to consider when improving intersections are the use of curbstones to improve the geometric configuration of the intersection, roadway resurfacing to achieve smooth running surface and installation of traffic management facilities.

The geometric restructuring and installation of traffic management facilities are all aimed at ensuring orderly and smooth traffic flow through the intersection. These must be done with careful considerations to the traffic demand volumes for through, left and right turn traffic in relation to the capacity of the intersection. The frequency and type of traffic accidents that have occurred must also be carefully analyzed. Finally, based on the final improvement plan, a new design is to be prepared and implemented.

Traffic management facilities are facilities that are to be installed within the intersection or near the intersection, all aimed at guiding the vehicle and pedestrian traffic through the intersection in a safe and smooth manner. The major facilities therefore include median line markings, median, lane markings, channelization islands, pedestrian crossings, stop lines and other road surface markings as well as traffic signs.

For intersections facing severe traffic congestion or frequent traffic accidents, the installation of traffic control signals as part of the improvement measures is necessary.

(4) Introducing Left-turn Traffic Lane Markings

Currently the frequent weaving of left-turn traffic with through traffic at many of the intersections in Vientiane is one of the common reasons causing chronic traffic congestion and traffic accidents in the city.

For this reason, it is recommended that left-turn traffic lane marking be introduced. This broken-line marking would help to streamline and channel all the left-turn traffic to travel within the designated space away from the through traffic. This practice has been proven to be effective both in Japan and USA.

(5) Installation of Exclusive Left-turn Lane

Exclusive left-turn lanes may be provided depending on the volume of the left-turn traffic volumes. The exclusive left-turn lane is capable of improving the traffic processing capacity and safety level of the intersection. However, if the left-turn traffic volume is too high and

vehicle queue for the left-turn is too long, it may obstruct the smooth flow of the through traffic.

It is recommended that such exclusive left-turn lane be provided wherever possible to control the left-turn traffic with the aid of left-turn signal control phase at major intersections in the city. If severe congestion still persists even with such improvement measures, then only the prohibition of left-turn traffic may be considered. (See Figure 19.2-1)

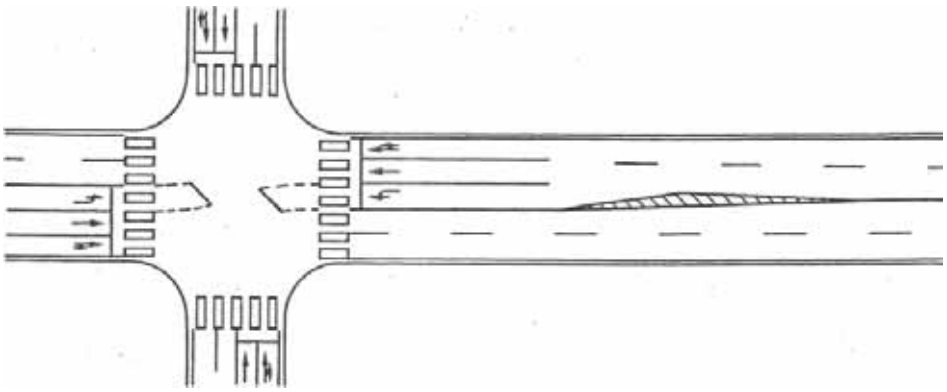


Figure 19.2-1 Basic Design of Exclusive Left-turn Lane at Intersection

(6) Prohibition of Parking within and near an Intersection

Current traffic regulations and laws in Laos prohibit the parking of vehicles within or near to an intersection. Even if there is no warning signs or other designations, drivers are expected not to park their vehicles in these locations. It is recommended that red curbside markings be introduced to clearly designate parking/waiting prohibition area within and near the intersections in the city.

Such color markings is just a temporary measure. Proper traffic safety education is needed to impart such basic knowledge for all road users in Laos in the future so that even without such markings, drivers will abstain voluntarily from do so at an intersection.

19.2.3 Traffic Signal Control

(1) Improving Signal Control

Signal control system currently in operation in Vientiane is an area-wide traffic control system whereby signal timings are all centrally controlled from a traffic management control center using traffic data gathered by vehicle detectors.

1) All-Red Signal Display

It is proposed that an all-red signal display phase after the yellow signal be introduced to all the signalized intersections in the city. This is to achieve total clearance of vehicles and

pedestrians within the intersection so that traffic safety level can be improved further at these locations.

2) Location of Signal Heads and Other Control Devices

It is also recommended that the authority carry out a total review of the present installation standards for all signal heads and control devices at all intersections in the city. This is to achieve consistency and better efficiency for these devices, which include signal heads, location of pedestrian crossing, stop line markings and no-parking curb markings.

19.2.4 Parking Regulations

The present parking prohibition signs and markings in the city are rather confusing to the drivers. As a result, road sections with parking prohibition are not easily comprehensible to the users. Improvement to this traffic management facility is thus necessary.

Furthermore, there are certain road sections that should have parking prohibition but instead parking is allowed. On the other hand, there are also road sections that have parking prohibition at present but are judged to be unnecessary.

It is recommended therefore that the authority carry out a comprehensive parking survey on all roadways in the city so that a more efficient parking control plan can be formulated and implemented.

During such a survey, the impacts of parked vehicles on the traffic flow and their causal effect to traffic safety must be carefully assessed from the traffic engineering perspective. In addition, opinions from the affected or nearby residents or businesses must be taken into account. Finally, it becomes necessary to design a set of standards for parking prohibition for the city.

Although parking prohibition is currently been enforced by the traffic police, rampant parking violations are commonly seen in the city. More stringent enforcement by the police on haphazard parking is thus necessary.

In addition, since it is expected that traffic demand will increase rapidly in the near future, securing parking spaces for vehicles will become a potential complex traffic management issue in the future. Thus it is recommended that the authority coordinates with urban and development control planners to examine the mandatory provision of parking spaces within new buildings proposed for the city.

19.2.5 Uniform Traffic Control Device Deployment Guidelines

A uniform traffic control device installation standards does not exist in Vientiane. Most of the devices are installed on project basis, with differing installation requirements or standards between projects. For this reason, there is no consistency in the installation standards of these devices in the city.

With such inconsistency in installation, road users are easily confused and incorrect judgment may occur within the split-second recognition by drivers. This situation makes driving in Vientiane rather dangerous and inconvenient for those drivers who are not familiar with these conditions in the city.

It is recommended that a uniform installation standard be formulated for the installation of various traffic control devices, including traffic signals, traffic signs, markings, parking prohibition signs and displays, work-in-progress signs, speed limit signs near to schools and public institutions (speed zones) and others.

19.2.6 Lack of Traffic Management Specialists

There is an acute lack of qualified traffic engineers who possess sufficient traffic management knowledge and experience both within the government agencies as well as in the private sector. The government hence has to rely on services provided by foreign experts. Such an over-dependency on foreign aids is not viable in the long term.

This lack of qualified traffic management specialists is one of the major problems faced by the city. It therefore must be viewed with urgency by the government and since the training of such personnel takes time, it is most important that the government begins a program to provide education and training in this area as soon as possible.

19.2.7 Setting up of a Traffic Accident Data Management System

(1) Necessity of a Traffic Accident Database Collection and Analysis System

At present, traffic accident data is collected manually and kept as an annual statistical data. However, this data is insufficient to allow traffic engineers in carrying out comprehensive analyses on traffic accidents. Hence, effective remedial measures cannot be properly formulated to decrease the number of traffic accidents on the roads.

It is therefore necessary to introduce a unified and comprehensive traffic accident data management system whereby traffic accident data is collected in sufficient details to build up a good database, allowing traffic engineers to conduct subjective analyses on traffic accident causes using advance analytical programs and finally examining suitable remedial measures to overcome the problems posed by traffic accidents.

This Study recommends that the city adopt a system that gives priority to identifying appropriate measures to reduce traffic accidents effectively in the short term at all the high accident locations.

This system should also possess the following major 4 components:

a. Setting up of a comprehensive database on traffic accidents,
b. Identifying high accident locations,
c. Analyzing causes of accidents at these high accident locations,
d. Examining possible remedial measures and implementing them.

(2) Configuration for the Proposed Traffic Accident Database Management System

Presently, Vientiane City is in the process of introducing the above-mentioned Traffic Accident Database Management System. As a first step, a traffic accident database shall be established as the first component suggested above.

An outline of the system and its configuration recommended by the Study Team is shown in Figure 19.2-2. It is suggested that the system be installed and operated at the MCTPC or TP.

Computer terminal units to input every traffic accident data are to be located in the central police office and nine (9) other district police offices. Every time any new data is input into the computer at any of the district police offices as a daily routine work, such data will be automatically sent to the central computer at MCTPC or TP online. Such data will be duly processed and the database updated automatically.

The CPU for data processing will therefore receive traffic accident data on a daily basis from each of the nine police offices. It will verify such data and then save it into the computer. Hence data input at the center is not necessary.

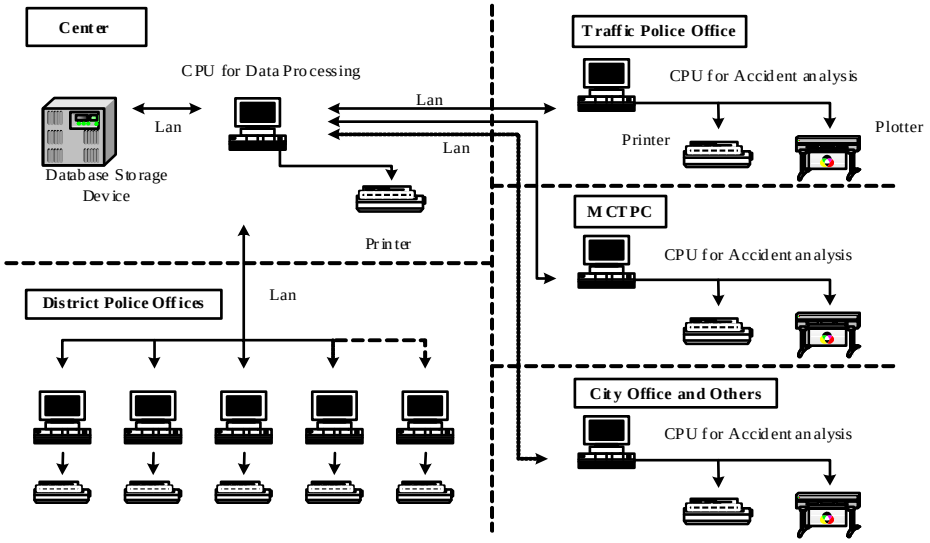


Figure 19.2-2 Configuration of the Traffic Accident Database Management System

(3) Using Global Positioning System (GPS) for Identifying Traffic Accident Locations

It is also suggested by this Study that GPS be employed to identify traffic accident locations. GPS allows accurate identification of accident locations without having to manually measure distances from reference points in order to locate the accidents. GPS also allows easy plotting of such accident locations on maps. Digital cameras with GPS capability are now available in the market.

(4) Future Development

The introduction of this advantageous traffic accident database management system would further enhance the effects of road improvement and traffic control measures. This is because various underlying traffic accident causes and factors, which are mostly ignored at present, can be revealed and made available to engineers who are formulating these improvement measures.

It is also easy to expand such a system from the city level to the national level by additions of a national main center (as a primary first tier level) and local subsystems (as secondary or second tier level). Only minor modifications to the associated equipment are needed.

When this system becomes fully functional, it is also possible to link or combine the installed traffic accident database with other databases, such as those on vehicles and drivers, traffic volumes and road inventory databases. This system has the potential to be developed into a comprehensive system that can contribute towards achieving total traffic planning and traffic safety improvement programs.

19.3 TRAFFIC SAFETY EDUCATION

This section discusses on the enhancement of traffic safety perception and awareness among road users as well as traffic safety education, including the kind of educational activities that are most suitable for implementation according to the type of target groups. These are examined based on the present traffic accident conditions, characteristic of traffic accidents and results of daily traffic observation in Vientiane City.

Remedial measures on traffic safety education recommended for Vientiane are:

(1) Driver Education

Driver education is directly related to the Driver Licensing System being practiced in Vientiane. It is suggested that before a driving license is issued to the driver, his knowledge

on traffic safety and his driving skills must be sufficiently and thoroughly assessed to a high standard.

Currently, motorcycle and Tuk-Tuk drivers are not required to undergo mandatory education at registered driving schools. Without any formal training, they are however allowed to undergo driving tests for obtaining the driving licenses. In examining the motorcycle drivers' behavior in the city, they are found to have very poor driving skills or bad etiquette. It is therefore recommended that the authority makes it a mandatory requirement for all motorcycle and tuk-tuk owners to undergo driving education and training at registered driving schools before undergoing the driving license tests.

This is particularly essential for the Peoples Republic of Laos, since there is no other opportunity for motorcyclists to learn traffic safety, traffic rules, and safe driving skills.

The current system also does not required repeat traffic offenders or drivers involved in accident to undergo driving re-education. It is necessary to carry out regular traffic safety education to all drivers. It is also very important to re-educate all those who repeatedly violate traffic rules and regulations or those who have caused traffic accidents.

(2) Training of Qualified Instructors for Traffic Safety Education

One of the reasons that current traffic safety education has almost no impact on the safety awareness among the public is the absence of adequate and qualified traffic safety instructors. Qualified instructors must be trained to carry out such jobs in order to produce the desired effects.

Three (3) types of instructor groups must be trained to carry out traffic safety education at different level or institutions to different target groups. These are:

- Traffic safety instructors for traffic safety education at schools,
- Traffic police to be trained on Traffic Safety Education,
- Driving instructors at private driving schools to be trained on Traffic Safety Education.

(3) Introducing traffic safety education to school education curriculum

After introducing the traffic safety education workshops for schools teachers, training of professional traffic safety instructors and establishing the required institute, it is proposed that the traffic safety education be introduced as part of the regular school education curriculum as a further step towards achieving traffic safety education consciousness among all citizens of Laos. Traffic safety education for children is a long-term plan but its future impacts are very significant and wide reaching as it will benefit their entire lives.

Thus to offer traffic education in all schools is one of the long-term feasible measures to improve the awareness on traffic safety awareness at the national level.

(4) Implementing Regular Traffic Safety Campaigns

One of the effective methods to overcome the problem of high traffic accidents is to carry out traffic safety campaigns at regular intervals targeting all citizens, namely the general public, school children, parents and drivers.

Based on the outcomes of the actual performances of the traffic safety campaign held by the study team, it is suggested that such traffic safety campaigns be carried out repeatedly as one of the effective means to improve traffic safety in Laos. As a first priority, campaign should be conduct in Vientiane City first and then extended to other cities.

(5) Establishing Traffic Safety Patrol and Instruction Unit

Traffic safety education for pupils and children in schools can be promoted by establishing a special central traffic police patrol and instruction unit.

Under such a unit, a group of instructors would visit all kindergartens, primary schools, secondary schools and high school in the city regularly and provide traffic safety education to them.

These professional instructors are to be organized under the traffic police-patrolling unit. Female police officers are most suitable for such task.

(6) Construction of Traffic Safety Park for Traffic Safety Education

A Traffic Safety Park is a useful facility for children to familiarize themselves with the simulated traffic situations. One of the purposes of such a park is to learn the traffic rules and acquire ways in protecting themselves from traffic accident while playing safely in the facility. There are successful examples of traffic parks in Singapore and Japan.

19.4 TRAFFIC ENFORCEMENT

Measures to strengthen traffic enforcement are suggested in this section, in order to improve the current traffic situation where traffic accidents are likely to increase rapidly in Vientiane City in the near future. Issues focusing on drivers in Vientiane City are extracted based on characteristic of traffic accidents, driving behavior, and the current condition of traffic regulations and enforcement.

Urgent remedial measures based on these analyses are suggested below.

(1) Strengthen Driving Instructions and Enforcement on Illegal Drivers

It is unrealistic to expect immediate results by stepping up traffic enforcement on illegal driving in Vientiane, considering the old entrenched poor drivers' habits. Thus, it is suggested that a grace period of about one year for enforcement will be set up with a focus on providing instructions on proper driving to motorists during this period. The objective is not to punish illegal driving but to provide instructions on proper driving manners.

It is more effective to select certain regulations and enforce them emphatically at a selected time period, day of week etc. rather than trying to enforce all the rules in one single campaign. This will also be done progressively. This method of selective and progressive enforcement provides more impressions to drivers and is also easier for the enforcement officers to conduct their duties.

In selecting the regulations to be enforced, violations or causes of traffic accidents that have occurred most frequently can be listed up based on analyses of traffic accidents and then given their priority accordingly. Those with high priority will then be selected for enforcement.

The selective enforcements are suggested in the following order of priority, based on site observations and the survey data:

- Driving on the opposing roadway
- Ignoring traffic signal
- Drunken driving
- Driving at high speed
- Parking in or near to intersections
- Ignoring pedestrians on crossing walk

(2) Strengthen Enforcement on Ignoring Traffic Signals

At many signalized intersections in Vientiane, when the yellow signal changes to red, many vehicles still try to cross the intersection by speeding up. Motorcycles are also commonly observed to ignore these warning and stopping signals. Such dangerous behaviors are most frequently observed during traffic congestion periods. When these vehicles cannot clear out of the intersection, they obstruct the movement of the on-coming vehicles from the cross traffic direction. This situation would further lengthen the congestion time period as the processing capacity of the intersection is further reduced.

Hence, stringent enforcement on motor vehicles and motorcycles ignoring traffic signals is a high priority and urgently needed.

(3) Maintenance and plenitude of enforcement facilities

To achieve effectiveness in enforcement, provision and maintenance of proper and complete enforcement facilities and equipment is also necessary. Currently there is an acute lack of such enforcement equipment both quantitatively and qualitatively.

It is therefore necessary to consider the provision and maintenance of such enforcement facilities and equipment in a plenitude manner at the Vientiane central traffic police headquarters. The following equipments are recommended to help reduce traffic congestion and accident. Quantity may be estimated as a rough guide based on the number of vehicles passing through Vientiane City.

Types of facilities recommended are as follows:

- Two-way communication phones between police officers on site,
- Microphones installed at major intersections for drivers' and pedestrians' guidance,
- Respiratory alcohol detectors,
- Speed enforcement facility.

19.5 TRANSPORTATION DEMAND MANAGEMENT

19.5.1 Concept of Transportation Demand Management

Transportation demand management is a technique in alleviating the over-concentration of traffic demand spatially and timely by altering the traffic demand frequency, destinations, time periods, travel routes, occupancy efficiency, load ratio efficiency and others.

'Road Pricing' and 'Park & Ride' are two examples of traffic demand management techniques successfully employed by cities in several countries to reduce the over concentration of demand during rush hours.

19.5.2 Possible Measures to be Introduced in Vientiane City

The following are several traffic demand management techniques that are deemed suitable for implementation in Vientiane city.

(1) Improvement of Public Transport Service

As discussed in Chapter 16, the improvement of public transport service is considered to be the most suitable and effective measure for managing traffic demand.

(2) 'Park & Ride' or 'Park and Bus Ride'

For 'Park and Ride' method to be effective and successful, ample and safe parking spaces close to public transport terminals or stations are needed. In many of the successful cases seen around the world, such 'Park & Ride' method is most effective if it is planned as part of the rail transit facilities, whereby the parking fees is incorporated into the rail transit fare making it very convenient to the users.

(3) Staggering of Working Hour or School Hour

The hourly fluctuations of demand by all vehicle types towards the city centre of Vientiane can be seen Figure 19.5-1. During the morning peak hours of 8 – 9 am, a concentrated demand of 1,828 vehicles was recorded. This excessive concentrated traffic demand can be shifted to other hours so as to less the burden on the road capacity. For example, by setting an equal demand for the period of 8 – 9 am and 9 – 10am, 375 vehicles from the 8 – 9 am period may be shifted to the 9 – 10 am period. Hence the demand for the 8 – 9 am time period may be reduced to 1,453 vehicles.

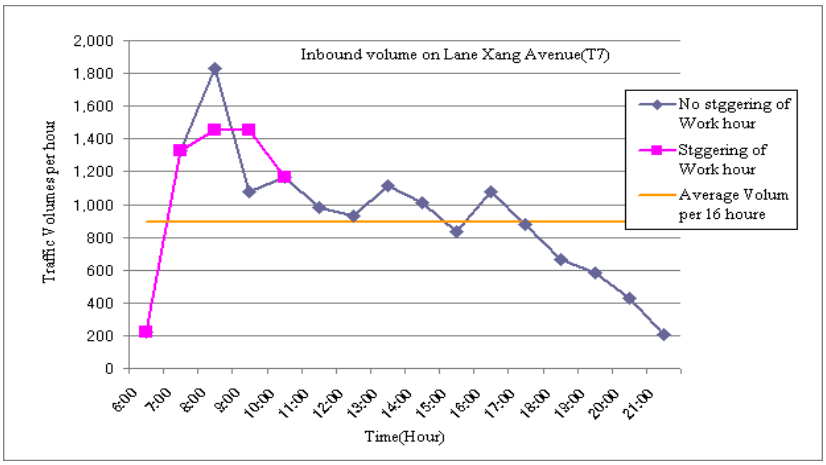


Figure 19.5-1 Example of Effect by Staggering of Working Hour

However, the implementation of this measure faces several obstacles. For instance, whether there are offices or commercial establishments that can implement such staggering work hours for their employees. Or whether travelers are able to plan their work, shopping and school trips in advance. Lastly, all citizens must be willing to cooperate and take steps to alter or change their travel patterns

(4) Parking Policies and Regulations

Vehicles traveling to the city center would require parking at the city center. Hence by regulating the supply of parking facilities or increasing parking charges in the city center, it is

theoretically possible to reduce traffic demand to the city center. This is another traffic demand management technique commonly used in cities.

However, for this measure to work effectively, it is imperative that enforcement of illegal parking be strengthen while an efficient method in parking charges collection is also necessary. As an alternative transport mode to commuters, services of the public transport system must also be improved.

Without these prerequisites, this method may create other problems and bring about adverse economic impacts to the city center.

19.6 PROPOSED TRAFFIC MANAGEMENT PROJECTS

19.6.1 Selection of Target Issues

(1) Urgent Issues Facing Vientiane City

For Vientiane City to improve its traffic safety level and to alleviate traffic congestion, the following are urgent issues that must be promptly addressed:

1) Traffic Engineering Issue

- Installation of traffic management facilities (such as pavement markings, safety islands, road signs and others) at non-signalized traffic intersections,
- Signalization of traffic intersections,
- Installation of traffic markings along undivided road sections,
- Demarcation of allowable roadside parking as well as prohibited areas, together with the installation of relevant parking control signs and curbstone markings,
- Gathering sufficient traffic accident data and the formation of a traffic accident management system.

2) Driver Education Issue

- Improve motorcyclists' driving knowledge by implementing writing tests for these drivers when they applied for their motorcycle driving licenses.
- Provide driving education to motorcycle driving license applicants at driving schools or training centers.

3) Enforcement Issue

- Prepare a comprehensive traffic enforcement manual and provide education/trainings to traffic enforcement officers based on such a manual.

(2) Issues to be Examined by This Study

From among the various traffic management issues identified above, this Study has proposed the following two (2) traffic management measures for urgent implementation:

1) Installation of traffic management facilities (such as pavement markings, safety islands, road signs and others) at non-signalized traffic intersections,
2) Installation of traffic markings along roadway sections.

For the other issues, they have been either included in other projects currently under implementation or being deliberation by the authorities. These are elaborated below.

- Signalization of traffic intersections:
  This issue is currently being addressed by VUDAA in its 'Traffic Control Signal System Extension Plan'.

- Gathering of traffic accident data and the formation of a traffic accident management system:
  The authority in the 'Road Safety Action Plan in Lao PDR' is presently addressing this issue. (in Section-2: Road Accident Data System, Section-5: Improvement of Hazardous Location and Section-13: Road Safety Research of the planning report).

- Improve motorcyclists' driving knowledge by implementing writing tests for these drivers when they applied for their motorcycle driving licenses:
  The Department of Transport in the MPWT is currently deliberating on the various problems in improving the contents of driving skill tests for license applicants.

- Provide driving education to motorcycle driving license applicants at driving schools or training centers:
  This suggestion is presently being implemented under the 'Road Safety Action Plan in Lao PDR' as described in 'Section-10-5: Review motorcycle training and licensing regulation' of its planning report.

- Prepare a comprehensive traffic enforcement manual and provide education/trainings to traffic enforcement officers based on such a manual:
  This issue is also currently being implemented under the 'Road Safety Action Plan in Lao PDR' as described in 'Section-11: Traffic police and law enforcement' of its planning report as well as in the 'Road for Rural Development Project NDF-426 Lao'.

Table 19.6-1 Traffic Management Planning - (Recommendations Examined)

Issues		Objective	Contents	On-going Project
Traffic Engineering	Effective and safe use of road space	Streamlining of traffic flow by vehicle types.(Separation of traffic by vehicle types using pavement markings)	• Specify lanes for cars, motorcycles and tuk-tuk by direction. • Install road surface markings. • Specify and posting of signage at prohibited parking areas.	
	Ensure safe and effective traffic flow through traffic intersections	Streamlining of traffic flow by direction	• traffic lane regulation by direction • installation of safety islands • installation of pavement markings and others • introduce left turning lane. • introduce traffic signal control	Extension plan of signalization by VUDAA
		Traffic flow based on 'right of way'	• installation of traffic signs and pavement markings.	
	Traffic accident analysis	Proposal of an effective traffic accident reduction measure	• collection and management of traffic accident data. (build up of database)	• RSAP-2: Road accident data system
			• formulate countermeasures based on results of traffic accident data analysis.	• RSAP-5: Improvement of hazardous location • RSAP-13: Road safety research
Traffic education	Safe driving and walking	Understanding and obeying traffic rules; and increase traffic safety awareness	• Drivers' education (esp.for motorcyclists when issuing their driving licenses) • Students' education on traffic safety (to include in their study curriculum) • Citizen's education on traffic safety (traffic safety campaign, more stringent traffic enforcement)	• RSAP-10-5: Review motorcycle training and licensing regulation • RSAP-6: Road safety education for children and young adults • RSAP-8: Road safety publicity campaigns
Traffic enforcement	Traffic guidance and enforcement	Improve traffic guidance and enforcement skills among traffic police officers	• training for traffic police officers • standardize on items and methods for an effective enforcement (prepare enforcement manual)	• RSAP-11: Traffic police and law enforcement • RTARV:-1stPhase 3: Improve the traffic police of Vientiane

RSAP: Road Safety Action Plan in Lao PDR

RTARV: Report of Road Traffic Accident Reduction in Vientiane

19.6.2 Proposed Road Section Improvement Project

(1) Background on the necessity of pavement marking installation

One of the reasons that encourage the disorderly and dangerous driving manner among vehicle drivers in Vientiane is the absence of pavement markings. Not only motorcycles but also motor vehicles are found to sometimes travel in the opposing traffic lanes. In addition, 2-wheeled vehicles are not segregated from the 4-wheeled vehicles along multi-lane highways (more than 2 lanes in one direction). These vehicles would travel on any lanes as the drivers pleased. Such behavior does not only pose danger to other road users, but also is the main reason for the lowering of road capacity and traffic congestion.

Based on the analysis of raw traffic accident data in 2006 (this data represents only a sample of about 25% of all total traffic accidents for that year), 81% of all traffic accidents occurred on roadway sections while 19% occurred at road intersections. In most cities, traffic accidents tend to concentrate more at road intersections rather than road sections. But based on available data in Vientiane, traffic accidents happened largely along road sections. (as a comparison or reference, out of the total traffic accidents in Japan, including all those along rural roads, 57% of these accidents occurred at road intersections while 41% along road sections).

With this background and the traffic characteristics or conditions in Vientiane or Laos, improvements for road sections especially that of appropriate design and installation or pavement markings are necessary. This proposal is in fact very economical yet very effective in reducing traffic accidents.

(2) Objective

The objective of this project is to install appropriate pavement markings on roads in almost the entire area of Vientiane City, so as to guide the traffic to flow in an orderly manner.

(3) Types and Functions of Pavement Markings

Pavement marking on single roadway is a very important traffic safety device in separating the two opposing traffic streams. It is also important for segregating 4-wheeled from 2-wheeled vehicle traffic. Furthermore, pavement marking has the special feature of being able to provide certain traffic regulation or information not only at a particular spot, but also continuous information that is applicable over a long distant roadway.

However, pavement marking has its limitations too. Visibility of markings can sometimes be obscured by water or sand and dirt. In addition, its durability is relatively shorter than other facilities and requires regular maintenance.

The following are the major types of pavement markings commonly used on roadway sections:

a. Longitudinal pavement marking
   This includes centerline marking, lane line marking and edge line marking (left and right edges of road).

b. Other type of pavement markings
   These include pedestrian crossing marking, warning marking and dangerous spot warning marking.

(4) Installation standards of pavement markings in Laos

1) Center line marking

According to the current installation standards of pavement markings along single roadway section as practiced in Laos, there are 6 different types of centerline markings. They are all in white and each line is 100 mm in width.

- Single broken line on Rural Roads
- Single broken line on Urban Roads
- Single solid line
- Double solid line
- Broken line with a solid line (for No-Passing Zone)
- Double line with Hatch Crossings

Besides these, central median is installed on other roadways to segregate the traffic lanes.

2) Lane line marking

Similarly, there are 5 types of lane line markings. They are also all in white with the line width at 100 mm.

- Broken line on Rural Road
- Broken line on Urban Road
- Long broken line
- Short broken line
- Solid line

(5) Proposed Installation Standards and Additional Changes

1) Proposed pavement marking on roadway section

a. Yellow Center Line

Comparing the road pavement standards in Laos with those of other countries, basically it does not differ significantly and it is considered suitable. However, it is proposed that yellow paint be used for the centerline instead of white. This is because the current white paint used on the centerline has rendered it to be difficult to differentiate by drivers in a split second. It can pose potential danger to the road users. By using yellow color on the centerline, it also makes it easier for the drivers to recognize a one-way traffic road since it will not have any yellow centerline.

b. Use of double broken line as center line

To further increase the visibility and durability of the centerline, the use of either double broken line or wider centerline was considered. However, the use of double broken line is recommended.

c. The use of symbol marking in combination with word markings

- Use of the word marking 'STOP' (See Figure 19.6-1 (1))
- Use of the word marking 'SLOW DOWN' (See Figure 19.6-1 (2))
- Use of the symbol marking to indicate the designation of 'motorcycle' lane (see Figure 19.6-1 (3))
- Use of the symbol marking to indicate the designation of 'bicycle' lane (see Figure 19.6-1 (4))

Figure 19.6-1 (1) Word marking "STOP"

Figure 19.6-1 (2): Word marking "Slow Down"

Figure 19.6-1 (3): Symbol marking to Indicate 'Motorcycle Lane'

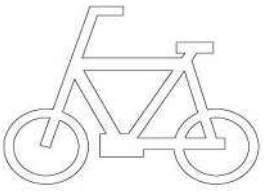


Figure 19.6-1 (4): Symbol marking to indicate 'Bicycle Lane'.

2) Installation Standards of Pavement Marking for this Study

The installation standards of pavement markings recommended by this Study are derived basically from the existing Laos installation standards but in consideration of the current traffic situation and problems faced by the city. The recommended Longitudinal Pavement Marking installation standards are formulated and shown in Figure 19.6-2.

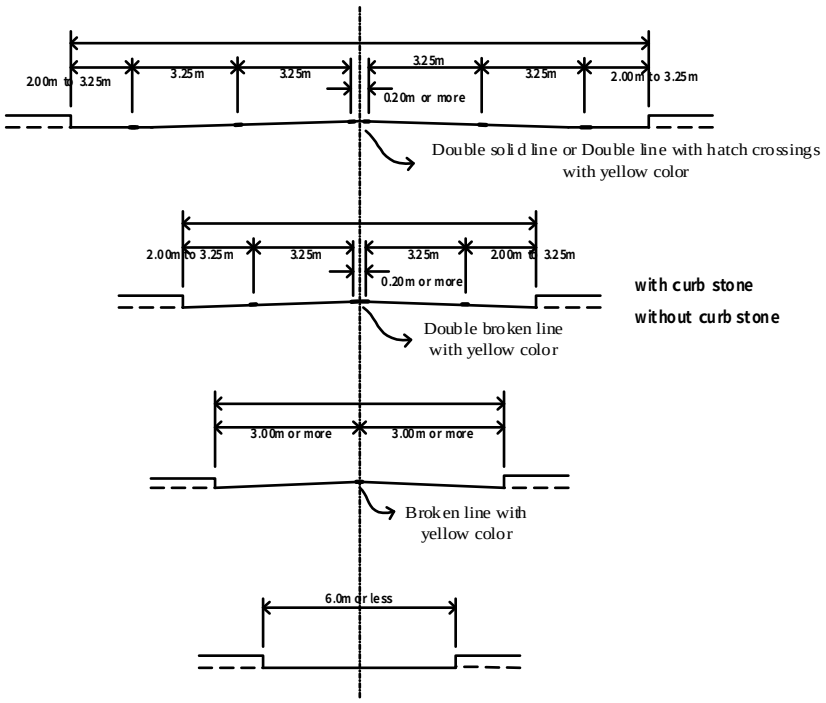


Figure 19.6-2 Design Standard of Longitudinal Pavement Markings

Notes: the red line indicates position of the centerline in the figure above.

- Edge line marking should be installed on all rural arterials having a roadway width of 6.0 meter or more,
- Edge line marking may be installed on urban roads with or without centerline markings,
- Edge line marking should be installed on roads where an engineering study or engineering judgment indicates a need for such edge line markings,
- Installation of edge line marking may be difficult if the road shoulder is not paved.

(6) Target Roads

Basically, all the roads in Vientiane City are considered as the target roads in this Project. Hence they include all the National Roads and Major Roads within the 7 districts (the Study Area) in Vientiane City. The target roads also include all the Minor Roads within the city center. Excluding the road intersections, the target roads for this Project has a total length of 235.4 km.

However, the target roads would only include all the above mentioned roads having good surface pavements, namely those roads with concrete, asphalt or double bituminous surface

treatment (DBST) roads. Figure 19.6-3 (1) and (2) shows the target road sections for this Project.

Figure 19.6-3 (1) Routes where pavement markings will be installed in Vientiane City

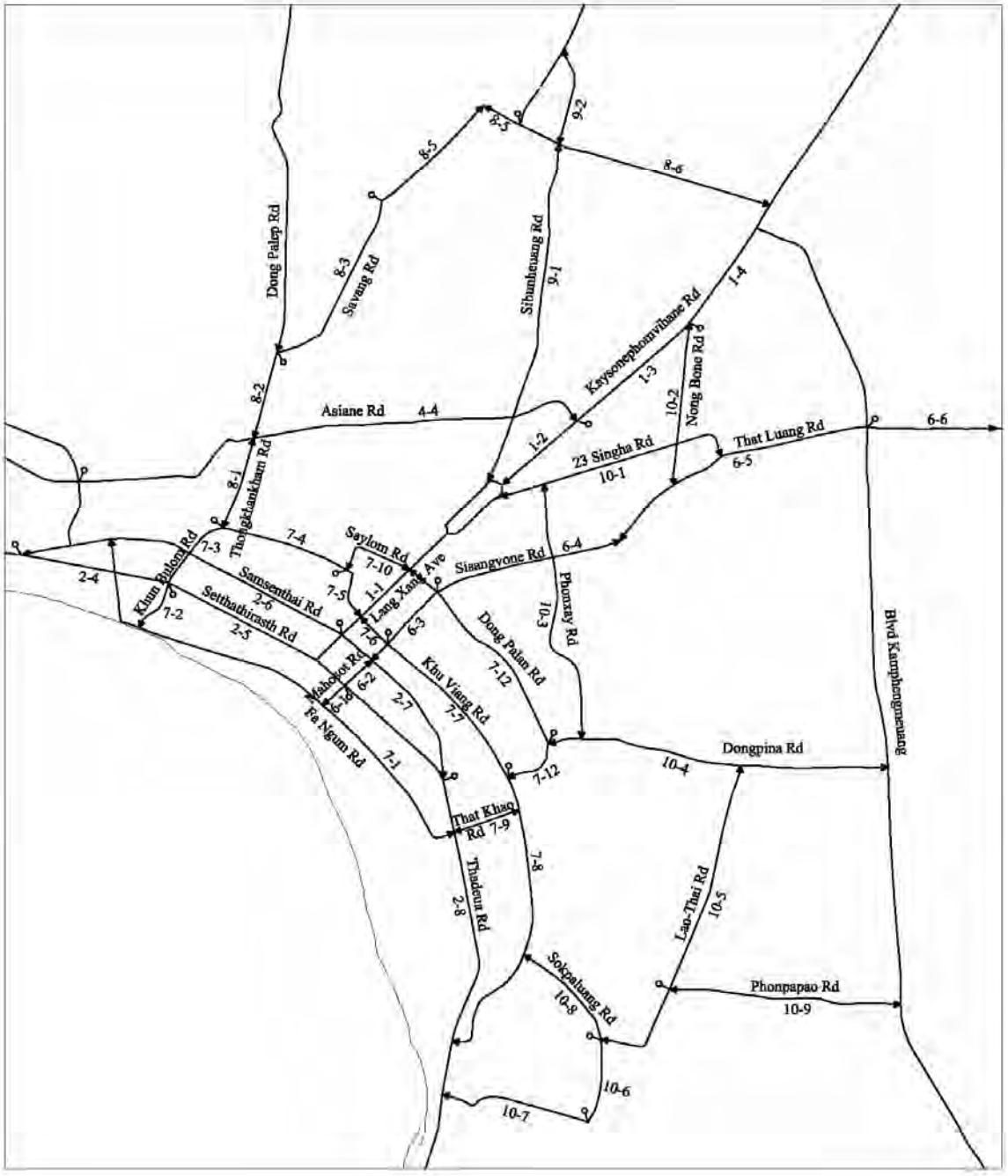


Figure 19.6-3 (2) Routes where pavement markings will be installed in Vientiane City

(7) Pavement Marking Design for Each Target Road Section

Pavement markings for each of the target road sections are designed based on its cross-sectional characteristics, especially its road width and the installation standards as described before for the centerline and lane line. Naturally, if there are sections having different road widths within one road, different pavement marking design will be prepared to suit these different conditions. The detailed drawings of these proposed pavement markings for each of the target road sections are given in the Appendix 19-1~19-2.

As a result of this design exercise, for the total length of 171.3 km of the target road sections, a total length of 230 km of yellow centerlines is proposed. The total length of traffic lane lines proposed is 604 km.

(8) Total Estimated Cost for Pavement Marking Installation

The estimated installation cost for the proposed pavement markings is given below. The unit costs used for this cost estimation include both the material cost as well as labor cost. For yellow markings, the unit cost per m^2 is US$20.00 while it is US$20.00 for white markings.

- Cost of yellow center line marking (10,973 m^2) = US$219,457.00
- Cost of white lane line marking (38,283 m^2) = US$765,650.00

Total cost of proposed pavement markings = US$985,107.00

(9) Benefits Derived from Installation of Pavement Markings

For the purpose of evaluating the installation of pavement markings, the potential reduction in traffic accident is used as the beneficial indicator. Besides the reduction of traffic accident, other benefits such as reduction in delay time caused by traffic congestion may be used. For the evaluation of this Project however, only the reduction of traffic accident is used to compute the benefits.

1) Expected reduction in Traffic Accidents

Based on the traffic accident statistics published by the Department of Traffic Police, there were a total of 2,191 accidents in 2007. Analysis conducted by JICA Study Team indicates that 81% of such accidents occurred on the road sections. Among these accidents, the effects of better pavement marking may not be able to help reduce accidents caused by overtaking from the rear (27%). Better pavement markings however, can be expected to help reduce particularly the head-on collision and sideswipe collusion accidents.

Bearing in mind the above conditions, the reduction in traffic accidents is forecasted as described below:

- Forecasting of total traffic accident by year

  The total reported number of traffic accident in 2007 is 2190 cases. The number of traffic accidents over the past years is on the up trend and this is expected to continue in future if no measures are taken to abate them.

  This total number of traffic accident is computed as a ratio against the total number of vehicle· kms to represent the rate of traffic accident in relation to growth in travel demand. Based on this rate, the total number of traffic accidents in Vientiane City is forecasted as 2,437 cases for 2008, 2,683 cases for 2009, 2,930 cases for 2010 and 3,177 cases for 2011.

(total vehicle· kms in 2007 was 2,122,000 veh.km, and by 2013, this demand is forecasted to reach 3,556,000 veh.km by this Study).

- Assuming this Project is completed by 2009, the total number of traffic accident for that year is forecasted as 2,683 cases.
- Share of traffic accident cases in the Project Area
  Assuming that 90% of the total traffic accidents occurred within the Project Area in Vientiane City, then the target traffic accident cases is 2,415 cases (2,683 x 0.9).
- Share of traffic accidents on roadway sections
  Past statistics showed that 81% of the total traffic accident occurred along roadway sections while 19% at road intersections. Assuming the same ratio, the target accident cases for 2009 on roadway section will be 1,956 cases (2,415 x 0.81).
- Out of the total number of traffic accident on roadway section, 27% are Head-on Collusion and 44% are Sideswipe Collusion accidents. Applying these ratios, the number of accidents targeted to benefit from improved pavement marking is 1,389cases (1,956 cases x (0.27 + 0.44)).
- Assuming that as a result of improved pavement markings, there is a 25% reduction in traffic accidents (of head-on and sideswipe collusion types), then in 2009, there will be a decrease in accident by 347 cases. (1,386 cases x 0.25). In other words, it can be expected that this Project will help to prevent about 13% of the total traffic accidents on the roadway sections within the Project Area.
- By similar presumption, a reduction of 379 traffic accidents in year 2010 and 411 accidents in 2011 can be expected.

2) Average economic loses due to traffic accidents

Based on analytical results of traffic accidents as well as claimant data obtained from automobile insurance companies in Vientiane City, the necessary cost involved for each of the Head-on Collusion and Sideswipe Collusion accident is computed. The average cost is found to be US$1,135 per accident.

However, due to contract option in the automobile insurance policies, payment to accident victims is limited to only part of the medical expenses. Considering that there are other damages such as lost of income during the convalescence period or impacts on families, the economic losses due to an accident is much higher than the amount paid by the insurance company. For this reason, the average economic cost of an accident in Vientiane is estimated to be twice that of the damages paid out by the insurance companies.

Consequently, the average economic cost of a head-on or sideswipe accident on road sections in Vientiane is taken to be US$2,300.00.

3) Expected Monetary Benefits from Reduction in Traffic Accidents

Based on the forecasted number of accidents prevented by virtue of the improvement in pavement marking as described above, the economic benefits are computed as follows:

- Benefits of US$798,100.00 in year 2009
- Benefits of US$872,000.00 in year 2010
- Benefits of US$945,300.00 in year 2011

———————————————————

Total for three years = US$2,615,000.00

(10) Economic Evaluation on the Pavement Marking Improvement Project

From the yearly benefits and total Project Cost estimated above, the yearly B/C ratio for 2009 is 0.8 (798,100/985,107). This means that about 81% of the total cost of installing the proposed pavement markings on the roadway sections can be recouped within the first year. Furthermore, since the pavement marking has an average life span of about 3 years, the B/C ratio for the Project is computed to be 2.65 (2,615,000 / 985,107). In this computation, the life span of the marking is taken to be 3 years. If high quality material is used for such marking, the life span can be much longer and hence the B/C ratio will be even higher.

Moreover, this computation of economic benefit is based on the reported traffic accidents data gathered by the traffic police. On the other hand, the total number of persons that received treatment on injuries inclusive of fatalities caused by traffic accidents as recorded in the major 5 hospitals in Vientiane in 2006 was 18,937. Compared this figure with the total number of fatalities and injuries of 3,572 recorded by the police department, the data from the hospital is about 5.3 times higher.

Taking into consideration this under reported factor, the revised 3 years lifespan B/C ratio of the pavement marking project will be about 14.1. ((2,615,000 x 5.3)/ 985,107) = (13,859,500 / 985,107)

In other words, from just one installation of pavement marking on the roadway sections, an economic loss of US$13,859,500 can be prevented. This clearly illustrates how important the pavement marking is in the reduction of traffic accidents.

(11) Flexibility of Pavement Marking Installations

Pavement marking is an indispensable part of road facilities. However, the installation of pavement marking does not require that all markings work be done at the same time. Its installation can be phased out in stages depending on the available budget. Priority therefore

can be given to roadways that have totally no markings or those which have high number of traffic accidents.

For example, Savang Road that has no center line (1.9 km in length, Section 8-2 and 8-3) requires only US$1,600 to have the center line installed; while North 13 Rd which is an accident prone roadway (7.1 km in length, Section 2-1 and 2-2) requires only US$11,800 to install the center line but if all lane lines are also to be installed, a sum of only US$46,300 is required.

19.6.3 Establishing Traffic Management Facilities at Traffic Accident Prone Areas

(1) Objective

As elaborated in the preceding sections, it is proposed that a project to install longitudinal pavement marking be carried out for road sections along major roads in Vientiane City for the objective of reducing traffic accidents and minimizing economic losses due to such accidents. As the next step, this section focuses on the traffic accident-prone areas or black spots. The objective of this section is to examine the available counter measures that can be done to reduce traffic accidents or their adverse effects at these black spots.

(2) Scope and Procedure of Study

This study follows the following procedure to arrive at the desirable counter-measures for the accident black spot.

1) Selection of target black spots,
2) Gathering the necessary data on these selected black spots,
3) Analysis of traffic accident data,
4) Implement site survey,
5) Deliberate on general counter-measures,
6) Design of draft improvement plans,
7) Estimation of costs,
8) Evaluation of proposed improvement plan.

(3) Selection of Target Black Spots

For this particular study on black spot, it is decided that the 15 spots identified in the Report on 'Project on Road Traffic Accident Reduction in Vientiane Capital' by VUDAA in November 2004 be selected as the target study areas. The selection of these 15 spots was also based on further confirmation obtained from assessment by the traffic police as well as site survey by traffic engineers. (It should be noted that the consideration of all the traffic

accident black spots in Vientiane City is not possible due to the lack of traffic accident data for all the spots.)

Among these selected 15 spots, improvement works at 4 spots have already been completed while design plans of improvement measures for a further 4 spots have also been completed. That leaves 7 spots to be studied further in this Study.

Table 19.6-2 (1) shows the names of these 7 locations yet to be studied and Table 19.6-2 (2) shows the 8 spots that have already been improved or design of their improvement plans completed.

Table 19.6-2 (1) Traffic Black Spot Locations to be Improved

No*	No	Location	Accidents Rate**	Location Feature	Planned by	Remark
1	(1)	ODEON Intersection (T2)	168 A's/yr	5 leg IS		Signalized
2	(2)	Circus Intersection	3-4 A's/wk	3 leg IS		
3	(6)	That Luang Neua Intersection	2-3 A's/wk	4 leg IS		
4	(7)	Phontong Intersection	2 A's/wk	3 leg IS & Curve		
5	(12)	KM9 cemetery location	3 F's/yr	Road Section		
6	(13)	Thonghankham Intersection	28 A's in 7 mths	4 leg IS		Signalized
7	(15)	Intersections at That Luang square (& east Intersection)		Roundabout & 4 leg IS		

Notes

*: This number is renumbered for this study

** A's: Accidents, F's: Fatal accidents, M: month, IS: Intersection

Table 19.6-2 (2) Traffic Black Spot Locations Improved or Design Completed

No	Location	Accidents Rate **	Location Feature	Planned by	Remark
(3)	Phonsay Intersection (RtNo13&T2)	28 A's in 7 mths	3 leg IS	VUDAA	Improved
(4)	Phonkheng Intersection (RtNo13)	3 F's/yr	4 leg IS	SwRoad(1)	Improved
(5)	Phonphanao Intersection (RtNo13&T4N)	3-5 A's/wk	3 leg IS	SwRoad(2)	Improved
(8)	Ophthalmic hospital Intersection	2 F's/yr	3 leg IS	SwRoad(1)	Designed
(9)	KM7 Intersection at fuel station	2-3 F's/yr	3 leg IS	SwRoad(1)	Designed
(10)	Sharp curve at NongNieng market	4 F's/yr	Curved section	SwRoad(1)	Designed
(11)	Nongteng Intersection		3 leg IS	SwRoad(1)	Designed
(14)	Many hazardous locations on Road 13 south	more than 10 F's/yr	Section	SwRoad(2)	Improved

Notes

** A's: Accidents, F's: Fatal accidents, M: month, IS: Intersection

SwRoad(1) : Report" Road Accident Black Spots in Vientiane & Recommended Countermeasures" Road for Rural Development Project NDF-426 Lao; Consultancy Services, Package 3: Road Safety May 2007

SwRoad(2): Kayson Phomvihan Road safety Project by Department of Road, MPWT

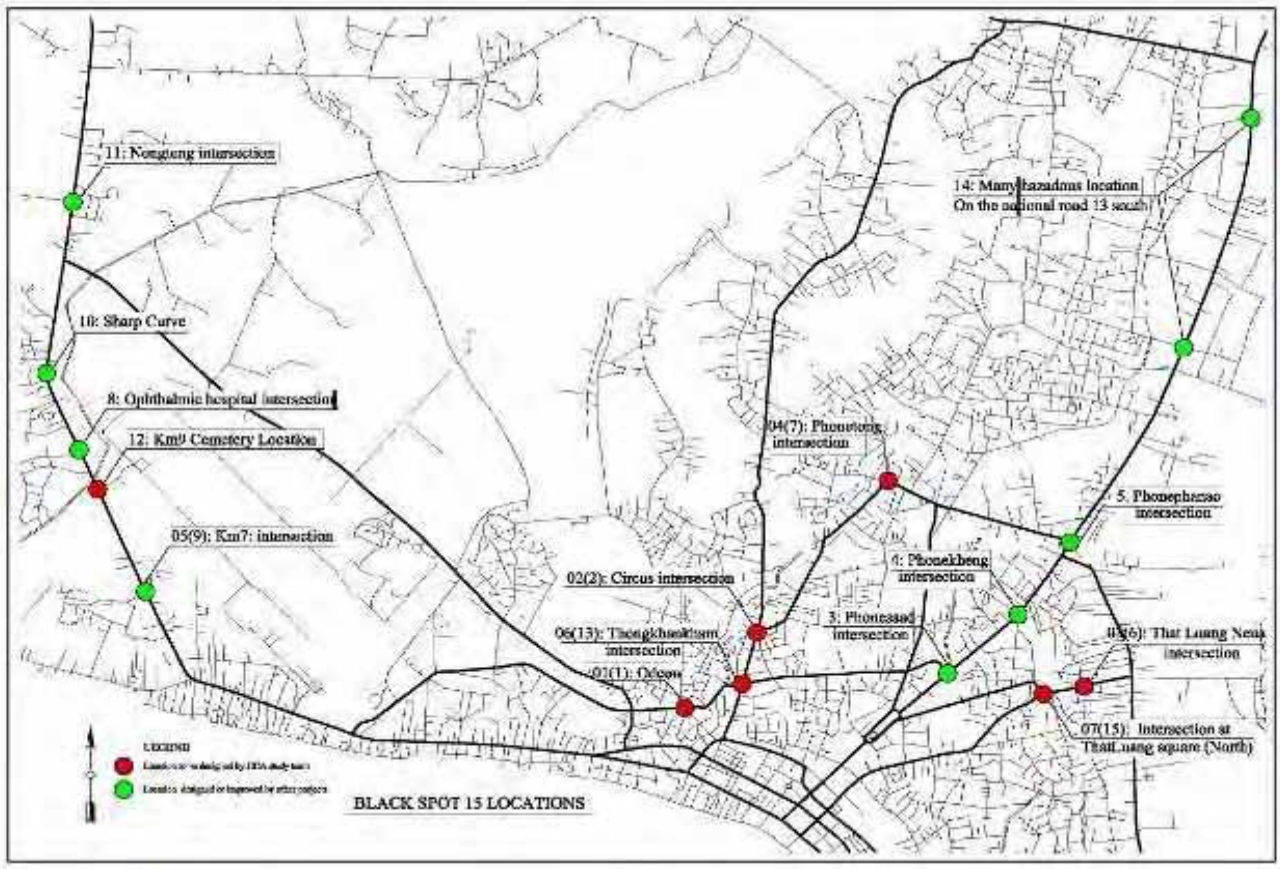


Figure 19.6-4 Traffic Accident Black Spot Locations and Selected Study Location in Vientiane City

(4) Gathering of Necessary Data on the Selected Study Locations

- Traffic accident record data …….. From traffic police department,
- Intersection drawings …….…… From existing drawings or those surveyed by VUDAA,
- Traffic volume data ……..…….. From traffic flow survey conducted in this JICA Study.

(5) Analysis of Special Traffic Features from the Accident Data

According to the 2006 traffic accident data maintained by the Vientiane traffic police department, there were a total of 15 traffic accidents occurred at the selected 7 study black spots. Table 19.6-3 below shows the distribution of these accidents by the target study location and their respective accident features.

Table 19.6-3 Traffic Accident Number in 2006 and their Special Features at the 7 Target Study Locations

No	Target Location	Accidents Record maintained by traffic police	Number of Accidents in 2006	Special Features
1	ODEON Intersection (T2)	168 A's/yr	0	-
2	Circus Intersection	3-4 A's/wk	2	Collusion of left turning vehicle with through traffic vehicle
3	That Luang Neua Intersection	2-3 A's/wk	2	Collusion of left turning vehicle with through traffic vehicle
4	Phontong Intersection	2 A's/wk	0	-
5	KM9 cemetery location	3 F's/yr	5	Head-on collusion of vehicles in opposite directions, Sideswipe collusion of vehicles in same direction
6	Thonghankham Intersection	28 A's/7 M's	1	Ignoring traffic signal
7	Intersections at That Luang square (& east Intersection)		5	Collusion of left turning vehicle with through traffic vehicle

(6) Analysis of Issues and Problems

For each of the 7 study locations, their respective traffic operation problems or issues are identified through analyses of the basic traffic volume data and information gathered from on-site surveys. Consequently, counter-measures are proposed for each of these problems identified. This is done in the following sequence.

a. On-site survey is carried out first to grasp the existing traffic situation at the study location as well as gathering of existing traffic management facilities installed at these locations. From the survey, traffic operation problems are identified,
b. Understanding the special features of accidents that have occurred at the target locations by examining the traffic accident diagrams,
c. Forecast of future traffic conditions based on existing traffic volume and traffic composition data.

From these problems or issues identified for these 7 target locations, the common features or issues are clarified such as:

a. No appropriate pavement markings at these intersections and disorderly traffic flow pattern,
b. Poor visibility of traffic intersection. Early recognition of intersection not possible by drivers,
c. Drivers often do not give way or pay attention to pedestrians.

(7) Design of Intersection Improvement Plans

1) Drafting of Improvement Plans

Bearing the above issues in mind, the appropriate countermeasures for each of the target locations are carefully selected. The major problems faced by each target location and the proposed countermeasures are summarized in Table 19.6-4.

Together with these measures, it is also proposed that the road surface pavement at these target locations be improved/replaced as well. For major road, road pavement up to 50m from the intersection while for minor road, up to 30m should be improved or replaced. Most of these target locations have BTC pavement while those with asphalt pavement are no longer in good conditions and its time to replace them. With such road pavement improvement, damage to the intersection will be minimized and the proposed pavement markings will last longer.

Table 19.6-4 Major Issues and Proposed Countermeasures for the Target Locations

Present conditions and Problems	Countermeasure
1. ODEN Intersection - a 5 legged intersection with traffic signal control	
● Rough road surfaces ● Disorderly traffic flow ● Huge traffic conflict area ● Indiscernible pavement markings ● Illegal parking at intersection	● Surface pavement improvement ● Install road median ● Install new pavement markings ● Install parking prohibition markings (red broken line marking on curb stone)
Alternative: If traffic congestion at this intersection occurs in the near future, a possible countermeasure would be to prohibit left turning movement from the minor road at the western location of this intersection.	
2. Circus Intersection - an irregular cross intersection	
● Congestion occurs during peak hours especially on the east side of Savang Rd	● Install an exclusive right turn lane at the north-eastern corner of the intersection to facilitate traffic coming from the east of Savang Rd but turning to the north of Dong Palep Rd ● Install center divider on the minor road east of Savang Rd. ● Install traffic turning guide lines within the intersection for traffic coming from the east along Savang Rd
● Many disorderly driving behavior within the intersection ● Poor pavement markings	● Install appropriate pavement markings on all minor roads
● Absent of pedestrian crossing facilities	● Install pedestrian crossing facilities.
Note: Signalization of this intersection is necessary and it is currently being considered by VUDAA	

3. That Luang Neua Intersection
- a regular cross intersection

● Drivers traveling on the major roads have difficulty in recognizing the intersection	● Emphasize the presence of this intersection by installing pedestrian crossing facilities as well as stop lines
● Many parked vehicles near the intersection, further obscuring the intersection	● Parking prohibition marking on curb stones (red and white painting)
● No center line or lane markings	● Install appropriate pavement markings ● Install stop signs at the entry legs along minor roads.
● No pedestrian crossing facility	● Install pedestrian crossing markings

Note: Road surface pavement along the minor roads is necessary.

4. Phantong Intersection
- Intersection formed by an minor road adjoining at the near 90^{o} curved section of Phantong road

● The curved section of Phantong road and the intersection are difficult to discern,	● Install warning sign to warn drivers of curved road section ahead. ● Install warning sign to warn drivers the presence of intersection ahead
● There is no clear demarcation on the edge of the curved road section. There is no safe channelization facility for traffic entering the intersection.	● Install curbside stones along the curved road section and install parking prohibition painting (yellow and white) on these curbstones. ● Install guardrail or low poles (including delineators) to guide the traffic in maneuver the curved section,
● Traffic speed along this road section is general high.	● Install markings to slow down traffic: 1) Install Rumble Strip Lines 2) Install word marking "Slow Down"
● Unclear center line marking along this road section	● Install solid yellow center line marking ● Install Cats Eye device along the center line
● Drivers on the major road have difficulty in recognizing the presence of the intersection	● Enhance visibility and recognition of intersection by installing stop lines and pedestrian crossing markings
● Very bad driving behavior at this intersection, many vehicles even travel on the opposing roadway.	● Install appropriate pavement markings on all minor road
● No pedestrian crossing facility	● Install pedestrian crossing markings

5. KM9 Cemetery Location
- a straight road section facing a cemetery

● Center line marking exists but it is not clearly visible	● Install yellow double brocken centerline marking ● Install cats eye device at the terminus of broken line marking
● Unclear road edges	● Improve road shoulder and install the road edge line marking
● No lane marking	● Install lane markings
● No street lighting rendering the area dark at night.	● Erect street lightings.

Alternative: If traffic accident reduction is still insignificant after the above improvement measures, then consider the implementation of prohibiting overtaking along this road section.

6. Thongkhankham Intersection
- a cross intersection of two major roads with signal control

● Road surface pavement is relatively good, but several potholes still exist	● Repair the surface pavement
● Traffic congestion occurs during peak hours	
● All movements as well as left turn traffic are very disorderly	● Install guide line markings within the intersection for left turn vehicles at all entry legs to the intersection
● Poor pavement markings as they are not clearly visible	● Improve the maintenance of pavement markings
● Signal lanterns are installed on arm-poles, rendering them too small to the drivers and thus difficult to see	

Note: Consider replacing the signal lanterns on the arm poles with bigger sizes, such as 30cm diameter lanterns.

7 Intersections at That Luang square (& east Intersection)
- A roundabout intersection together with a junction at 100m from the roundabout

<u>Roundabout</u>	
● Disorderly traffic movements within the roundabout	● Install proper pavement markings within the roundabout to guide the movement of traffic streams
● Traffic with no rights of way but entering the intersection without giving way to those with right-of – way.	
● Many vehicles are observed to travel on top of safety islands (demarcated only by marking)	● Correct the location of safety islands (markings)
● Pavement markings are not clearly visible	● Install appropriate pavement markings on each minor roads entering the roundabout
● Difficulty in crossing the road by pedestrians	● Install pedestrian crossing facilities

In between the Intersections ● Many vehicles are observed to change lane or travel on the opposing roadway ● Parked vehicles near the intersection. At the Intersection ● Difficult to recognize the presence of this intersection ● Difficulty in crossing the street by pedestrians.	● Install double solid yellow center line to prohibit overtaking of vehicles ● Install Cats Eye Device on the solid line ● Install lane markings ● Prohibit parking along this section of the road by erecting parking prohibition signs or painting of curbstone with yellow and white to that effect. ● Install stop lines and pedestrian crossing facility ● Install stop line, center line and stop sign on the minor road

2) Design of improvement plan based on the countermeasures

Design drawings for improvement of these target intersection locations are prepared based on the countermeasures deliberated above. These drawings are contained in the Appendix 19-3~19-10 of this Report. Cost estimation for each location is in the Appendix 19-11.

As a reference or example, the existing conditions (photograph) and recommended improvements (drawing) for the T-intersection formed by a curved road section with a minor road at No.3: Phonetong Intersection is given below in Figure 19.6-5 (1) and (2) respectively.

Figure 19.6-5 (1) Existing Conditions of No.3:Phonetong Intersection

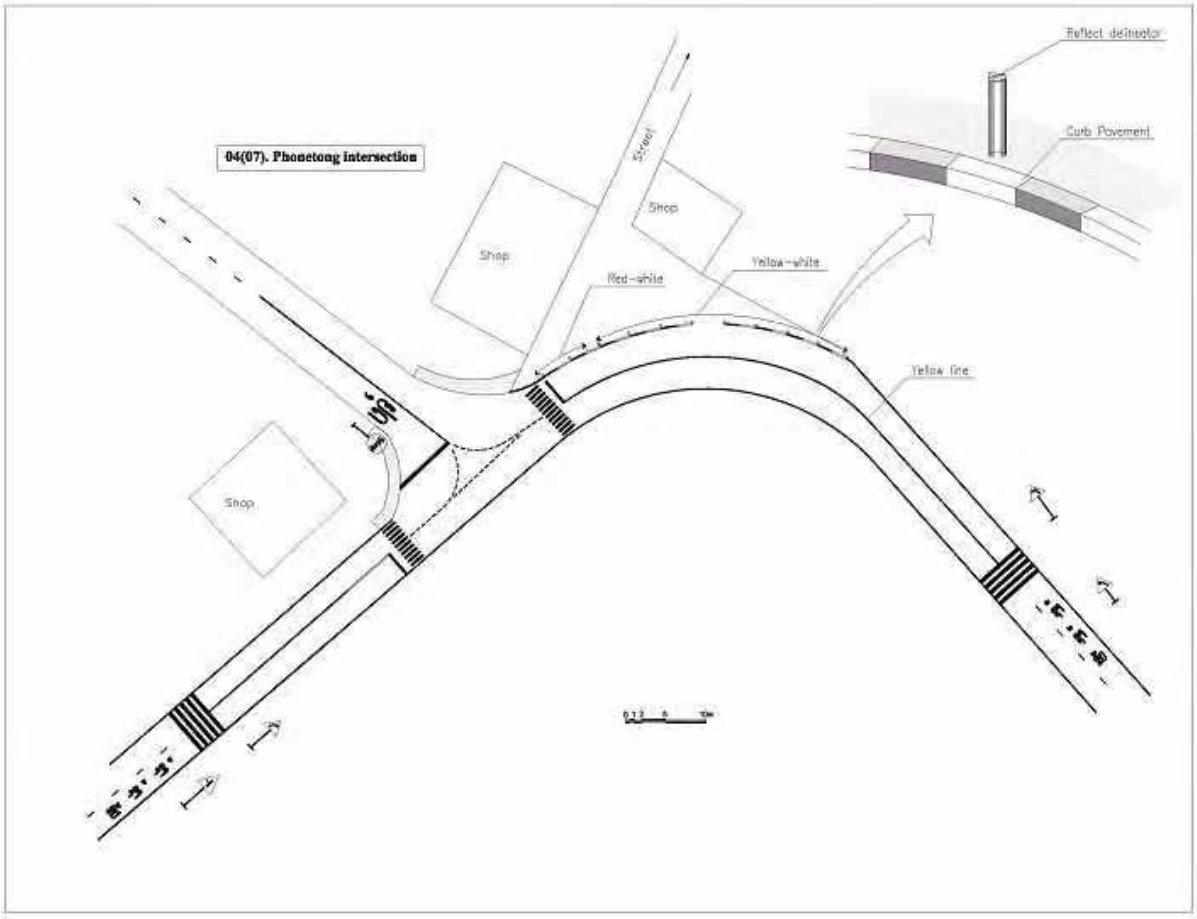


Figure 19.6-5 (2): Recommended Improvement Measures to
No.3 Phonetong Intersection

(8) Estimation of Costs

The costs for the recommended improvement measures to the target 7 accident-prone locations are given in Table 19.6-5 below.

A total cost of US$609,963 is needed for all the recommended improvements. Therefore, the average cost of each location is about US$87,138. However, without the cost for road pavement improvement, the total cost for all the traffic management facilities is only US$71,846(12% of total cost). The average cost per intersection for the traffic management facilities is only US$10,264

The area of the pavement improvement is consisted of inside of intersection, 50 meter on the intersection legs of major road and 30 meter section on the legs of minor road for all the target locations.

Table 19.6-5 Estimated Costs of Improvement Measures for the 7 Target Intersections

(in US$)

No	Location	Cost of management facilities	Cost of road surface improvement	Total cost
1	ODEON Intersection (T2)	7,199	17,859	25,057
2	Circus Intersection	7,895	23,317	31,212
3	That Luang Neua Intersection	3,231	31,693	34,924
4	Phontong Intersection	14,022	11,899	25,920
5	KM9 cemetery location	27,406	117,320	144,726
6	Thonghankham Intersection	3,488	176,364	179,851
7	Intersections around That Luang square	8,606	159,666	168,272
	Total Cost	**71,846**	**538,118**	**609,963**
	Average Cost	**10,264**	**76,874**	**87,138**

(9) Evaluation of Recommended Improvement Plans

1) Expected reduction in Traffic Accidents

Traffic accident records maintained by the traffic police department indicated that there were 15 traffic accidents at the 7 target intersection locations in year 2006. There is an increasing trend in traffic accidents in Vientiane City and this can also be expected at these 7 locations.

Similar to the forecast of future expected traffic accidents at roadway sections, traffic accidents at the 7 intersections are projected in proportion to the increase in traffic demand (vehicle.km) at each of these locations. It is also assumed that with the recommended traffic management measures presented above, 50% of the expected future traffic accidents at these locations may be prevented. Table 19.6-6 shows the projected future traffic accidents with and without the expected 50% reduction achieved through improvement of the traffic management measures.

Table 19.6-6 Forecasted Traffic Accidents and Expected Reduced Accidents

Year	Forecasted future traffic accident	Expected Accident Reduction
2009	19	9.5
2010	21	10.5
2011	23	12.5

A total of 32.5 accidents may be prevented within the 3 years with the recommended improvements.

2) Economic loss per accident

Computation results on the average economic lose caused by traffic accidents is found to be US$1,000 per accident. However, considering the various other inherent damages and loses, the average economic loses per accident is assumed to be twice, that is US$2,000. (Note: Compared to the computed economic loses per accident for roadway section of US$1,135, the figure for intersection is slightly lower at US$1,000. This is probably due to the extent of

damage, which is usually smaller at intersection by virtue of lower travel speeds at intersection compared to roadway section.)

Therefore if the recommended traffic management measures are implemented, an economic benefit of US$65,000 can be expected (US$2,000 x 32.5 accidents).

3) Evaluation

The evaluation is done on two categories of recommended improvement measures:

- Evaluation on improvement of traffic management facilities only,
- Evaluation on improvements of traffic management facilities together with suggested improvements to road surface pavement.

a) Evaluation on improvement of traffic management facilities only

The lifespan of the recommended traffic management facilities (especially, pavement marking) is assumed to be 3 years. An economic benefit of US$65,000 can be expected. Therefore the B/C ratio for the recommended measures will be 0.90 (US$65,000/US$71,846).

Comparing the number of patients treated for injuries due to accidents at the 5 major hospitals in Vientiane to the reported injuries maintained by the traffic police, the total number of injuries recorded by the former is 5.3 times higher. Taking this factor into consideration, it is estimated that the revised B/C ratio would be 4.8 (0. 90 x 5.3). From this evaluation, it is clear that the recommended improvements would bring about a substantial amount of economic benefit due to the reduction of traffic accidents.

b) Evaluation on improvements of traffic management facilities together with suggested improvements to road surface pavement.

In the current pavement condition on unimproved intersections, mostly every year pavement surface has been damaged by rain water and after the rain season, easy and simply improvements are made on only damaged sections or spots the improvement can not solved basically the problem.

The initial cost of the major improvement of road surface for long life usage is higher than that of many minor improvements. However, the total cost of the major improvement in the long term is cheaper.

Furthermore, impacts of the long life improvement are not only to save the cost of the pavement improvement, but also to obtain such various benefits as:

- keeping smooth traffic flow and avoiding decreasing traffic capacity on road
- reducing traffic accident caused by poor pavement

- keeping convenient and comfortable usage for road users
- maintaining traffic control facilities for long time, especially pavement markings

(10) Improvement for Accident-Prone Locations in Future

In this Study only 7 accident-prone locations are examined and their improvement measures proposed. However, there are still many more locations in Vientiane City that are prone to traffic accidents and a certain degree of improvements must be carried out for them in the future.

As a proposal for future plan, many locations in the City that are prone to traffic accidents need to be identified. Adopting similar procedure as illustrated in this Study for the 7 target locations, improvement measures have to be deliberated to counter the accident-prone effect for these locations. These recommended measures can then be implemented and evaluation done to assess their effectiveness in traffic accident reduction.

CHAPTER 20

IMPLEMENTATION PLAN

CHAPTER 20 IMPLEMENTATION PLAN

20.1 IMPLEMENTATION FRAMEWORK

A total of 50 projects of road improvement and 5 projects of bridge improvement are proposed in Chapter 17. Also, improvements of the public transport system are proposed in Chapter 18. Further, various measures for traffic management and traffic safety are proposed in Chapter 19. Since, the total volumes of works of these projects are considerably large and the period for implementing these projects spans over more than 15 years, diligent plan of implementation is indispensable for successful achievement of this Mater Plan.

There are a few basic factors to be considered in formulating an implementation plan of urban transport master plan, including

(i) Time schedule
(ii) Project costs and financing scheme
(iii) Institutional capacity of implementing agency

This Chapter discusses these factors.

In addition to the Road Network Development and Public Transport Development, several projects of traffic safety are proposed in this Study. However, the scale of works and costs required for these traffic safety projects are very small in comparison to those required for the Road Network Development and Public Transport Development. Actually some of the proposed physical improvements of the black spots and installation of median division can be implemented when the roads are improved. Therefore, this Chapter mainly discusses these two major components.

20.2 IMPLEMENTATION SCHEDULE

The target year of this Master Plan is set at year 2025, 17 years from the completion of this Study. This 17-year period is divided into the following three terms:

(i) Short Term: 2008 – 2013 (5 years +)
(ii) Medium Term: 2014 – 2018 (5 years)
(iii) Long Term: 2019 – 2025 (7 years)

Projects of the Road Network Development and Public Transport Development are categorized into these three terms based on the priority of each project. Therefore, the implementation plan of the entire Master Plan is formulated by combining these

implementation plans.

The road projects to be implemented in each Term have been selected based on the prioritization criteria described in Chapter 17. These projects are further distributed within each Term considering such factors as easiness of implementation, urgency and magnitude of required fund.

Table 20.2-1 shows the Implementation Schedule of the projects included in the Road Network Development Plan and Public Transport Development Plan.

Table 20.2-1 Implementation Schedule

Project No.	Length (km)	Cost (US$ mil.)	Type of Work*	Short Term 08	09	10	11	12	13	Medium Term 14	15	16	17	18	Long Term 19	20	21	22	23	24	25
Road Network Development																					
Short Term																					
4	7.9	6.45	**n**																		
5	2.7	3.31	**w, c**																		
6	4.1	3.21	**w, c**																		
11	9.0	15.41	**w, o, s**																		
14	4.2	7.95	**n, s**																		
15	1.8	3.10	**w, o, s**																		
17	0.5	0.23	**o, L**																		
18	7.0	8.45	**w, o, s**																		
19	2.1	0.84	**w, o**																		
23	11.2	5.52	**w, c**																		
34	1.5	1.62	**w, o, s**																		
36	3.0	3.23	**w, o, s**																		
37	2.2	2.37	**w, o, s**																		
39	10.0	6.63	**w, o**																		
40	7.0	3.02	**w, o, c**																		
43	9.5	3.86	**w, o, c**																		
B1, B2, B3, B4	0.2	4.76																			
Subtotal	83.9	79.96																			
Medium Term																					
1	10.6	11.92	w, o, s																		
7	5.1	4.17	n																		
8	6.6	5.39	n																		
9	6.4	5.00	w, c																		
12	5.0	6.20	w, o, c, s																		
16	10.9	7.46	w, s																		
20	4.7	6.61	n, s																		
21	1.8	2.46	w, c, s																		
22	2.0	2.81	n, s																		
24	5.0	6.25	w, o, s																		
33	5.1	4.17	n																		
35	1.9	0.94	w, c																		
47	5.2	2.40	w, c																		
49	22.5	8.42	w, o																		
X5		1.10																			
Sub Total	92.8	75.30																			
Long Term																					
2	1.6	1.02	**o, L**																		
3	16.4	9.55	**w, s, o, L**																		
10	10.0	6.03	**o, L**																		
13	3.8	4.37	**w, o, s**																		
25	3.6	2.94	**n**																		
26	2.0	1.33	**w, o**																		
27	4.2	3.07	**w, o, c**																		
28	3.2	1.19	**o, L**																		
29	11.7	11.27	**o, s**																		
30	3.6	1.90	**n**																		
31	4.6	3.76	**n**																		
32	1.6	0.79	**w, c**																		
38	1.7	0.63	**o, L**																		
41	0.9	0.93	**o, s**																		
42	1.5	0.58	**w, o**																		
44	3.2	1.16	**o**																		
45	3.4	1.79	**n**																		
46	6.0	3.16	**n**																		
48	5.4	2.85	**n**																		
50	4.8	2.53	**n**																		
B5	0.045	1.11																			
Sub Total	93.25	61.96																			
Public Transport Development																					
Procurement of Buses																					
264 Units		8.45																			
310 Units		17.38																			
352 Units		25.70				(1st Batch = 100 Units)															
Bus Terminal Improvement																					
3 Locations		3.00																			
1 Location		1.00																			
1Location		1.00																			
Provision of Bus Priority Lane/Busway																					
Bus Lane	10 km	1.00																			
	20 km	2.00																			

20.3 COST REQUIREMENT

20.3.1 Road Network Development Project

The costs of road projects to be implemented in Short-, Medium- and Long-Term are summarized in Table 20.3-1. Breakdown of the cost for each project is described in Chapter 17. The costs of roads projects shown in Chapter 17 are for the civil works only and do not include the cost for preparation (survey, design etc) and the consultants for construction supervision. These additional costs are assumed to be 7 % of those of civil works. The figures in the right- most column of Table 20.3-1 and Table 20.2-1 include these additional costs.

Table 20.3-1 Cost of Road Network Development

Term	No. of Projects	Cost (US$ mil.)	
		Civil Works Only	With Preparation & Supervision
Short Term	• Improvement of 14 road sections • Replacement of 4 bridges	78.9	84.4
Medium Term	• Improvement of 14 road sections • Replacement of 1 bridge	75.3	80.6
Long Term	• Improvement of 22 road sections • Replacement of 1 bridge	63.3	67.4

Figure 20.3-1 shows the amount of annual disbursement for implementing the proposed projects. The maximum amount of annual disbursement is approximately US$ 20 million.

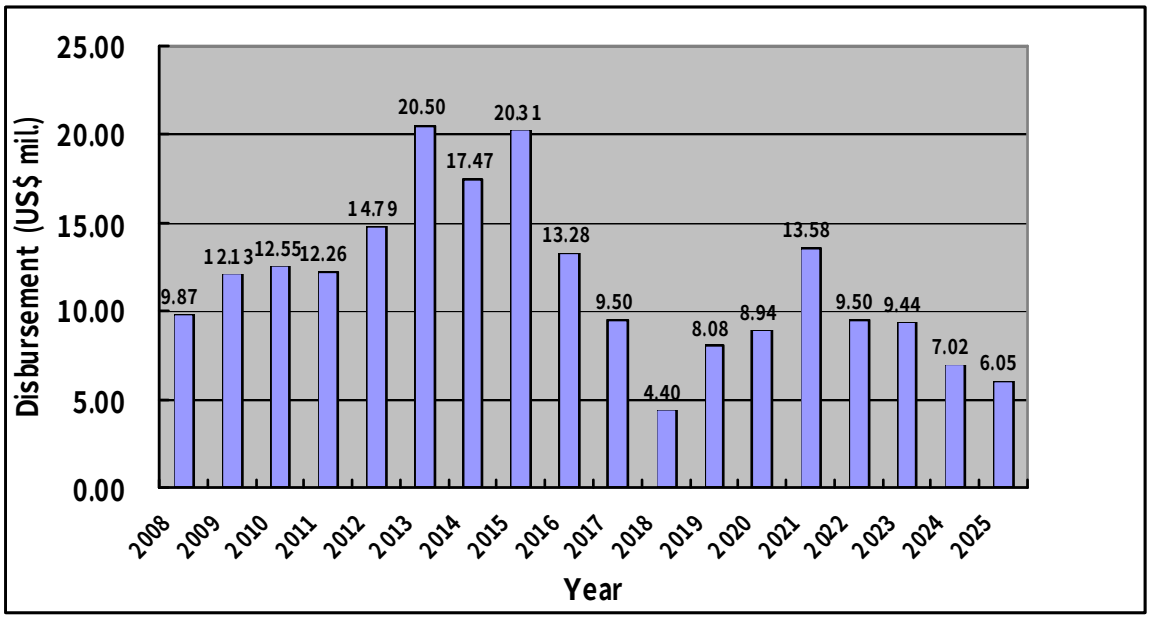


Figure 20.3-1 Annual Disbursement for Road Projects

20.3.2 Public Transport Development

The costs of projects for Public Transport Development are described in Chapter 18. They are summarized in Table 20.3-2.

Table 20.3-2 Cost of Public Transport Development

Term	Project	Total Cost (US$ mil.)
Short Term	• Procurement of 264 units of buses • Improvement of 3 bus terminals • Provision of bus priority lane for 10 km • Intersection Improvement	14.4
Medium Term	• Procurement of 310 units of buses • Improvement of 1 bus terminal • Construction of 1 new modal change station • Provision of bus priority lane for 20 km	33.4
Long Term	• Procurement of 352 units of buses • Improvement of 1 bus terminal • Construction of 1 new modal change terminal	75.7

(1) Procurement of Bus Fleet

Among the projects of the Public Transport Development, most urgent one is procurement of bus fleet. The estimated annual disbursement for procurement of bus fleet is summarized in Figure 20.3-2.

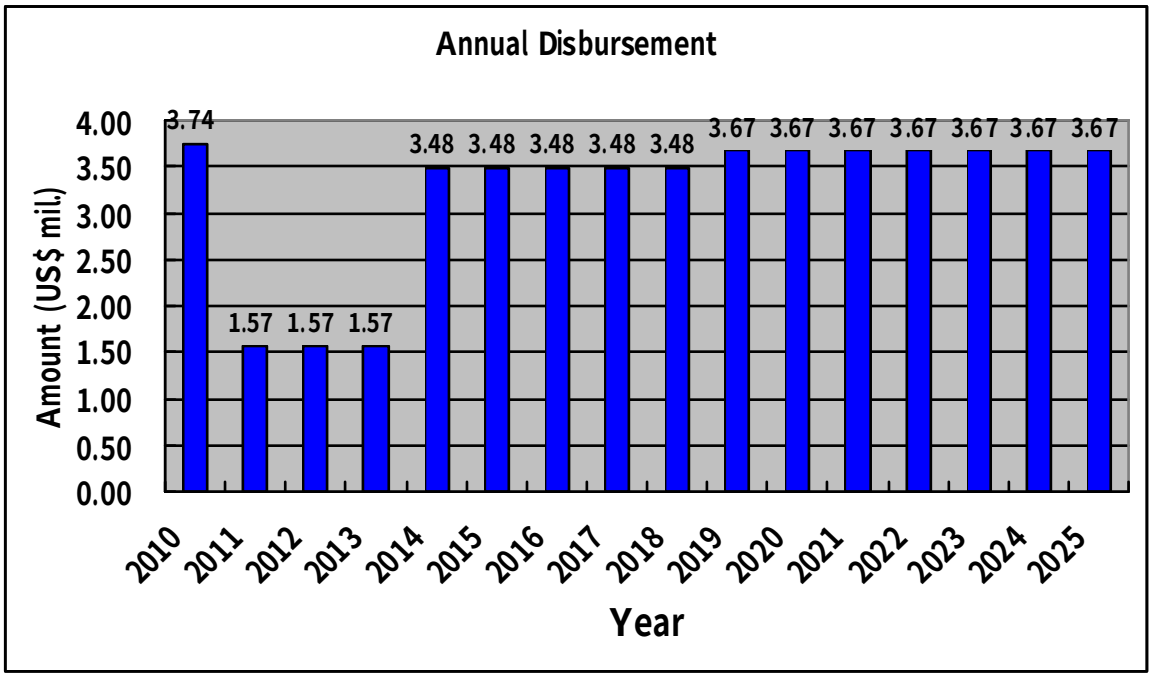


Figure 20.3-2 Annual Disbursement for Procurement of Bus Fleet

This disbursement was prepared based on the following assumptions:

(i) Out of the total of 226 units of buses to be procured in the Short Term, 100 units are procured in year 2010 as the 'Starting Batch'. They will be operated as the 'new bus services'. The cost of this Starting Batch is calculated to be US$ 3.14 million.

(ii) The remaining 126 units are procured evenly in the following 3 years (2011 – 2013) or 42 units every year. The cost for this procurement is calculated to be US$ 1.32 million per year.

(iii) All of 310 units to be procured in the Medium Term are procured evenly over 5 years (2014 – 2018) to catch up with the growing demand, resulting in the procurement of 62 units every year.

(iv) Also for the Long Term, all the 352 units are procured evenly over 7 years (2015 – 2025), resulting in the procurement of about 50 units per year and estimated disbursement of US$ 3.67 million every year.

(v) It is assumed that the buses need to be replaced after being used for 5 - 10 years. Thus, the fleet procured in year 2010 need to be replaced in year 2020, at latest. The above numbers of buses have been calculated considering such replacement. Thus, for example, certain number among 62 units to be procured every year in the Medium Term is for those of replacement. Old buses to be replaced have some salvage value, but this salvage value is not considered in this financing plan because of its uncertainty.

As can be seen in the figure, US$ 3.74 million is needed in year 2010. This is the maximum amount. In other years, annual disbursement is below US$ 3.7 million.

(2) Construction or Improvement of Facilities

Annual disbursement for construction/improvement of the public transport facilities, such as bus lane and bus terminal, is shown in Table 20.3-3.

Table 20.3-3 (1) Annual Disbursement for Construction/Improvement of Public Transport Facilities (1)

	Short Term				Medium Term				
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Amount (US$ mil.)	0.25	1.25	3.25	1.25	2.40	2.40	2.40	2.40	2.40

Table 20.3-3 (2) Annual Disbursement for Construction/Improvement of Public Transport Facilities (2)

	Long Term						
Year	2019	2020	2021	2022	2023	2024	2025
Amount (US$ mil.)	2.86	2.86	3.86	2.86	2.86	11.36	11.36

As can be seen in the table, the amount of annual disbursement is in the order of US$ 3 million or less, except those in years 2024 and 2025 when the bus way is to be constructed.

20.4 FINANCING PLAN

20.4.1 Financing Plan of Road Network Development

While the maximum annual disbursement of the Road Network Development is estimated at approximately US$ 20 million, as shown in Table 20.3-3, the amount of fund required for each term is in the range of US$ 60 to 80 million, as shown in Table 20.3-1.

The total budget of MCTC for road in FY 2004/05 was approximately US$ 78 million, including own resource of the Government and foreign financial assistance. (See Section 10.3) Thus, US$ 20 million corresponds to approximately 25 % of the total road budget of the Ministry.

Currently, the total expenditure of DPWT of Vientiane and VUDAA on road, including those financed by the foreign aid, is considered to exceed US$ 20 million. However, large portion of this US$ 20 million comes from foreign aids. Thus, the Government cannot supply sufficient fund to fully implement the Master Plan Projects with its own fund.

On the other hand, the revenue of the Government, and thus the fund available for road, is expected to increase in the future as the national economy grows in the future. Therefore, it is reasonable to plan foreign aid to fill the financial gap between the amount needed for development of road network and the amount supplied by Government's own fund with foreign aid, including loan from WB, ADB and JBIC, and return the loan in the later years.

Figure 20.4-1 shows the change of the financial gap between the required budget and fund available to the Government estimated based on the following scenario:

(i) The Government fund is assumed to increase in proportion to the growth of GDP: As described in Chapter 12, the GDP of Lao PDR is forecasted to increase to approximately 4 times of that of present one.
(ii) The amount of the Government's own fund is assumed to be US$ 5 million in year 2009 and increase in proportion to the growth in GDP.
(iii) This financial gap is assumed to be filled with the foreign assistance including loans from the World Bank, ADB and various aids of Japanese Government and private participation, if possible.

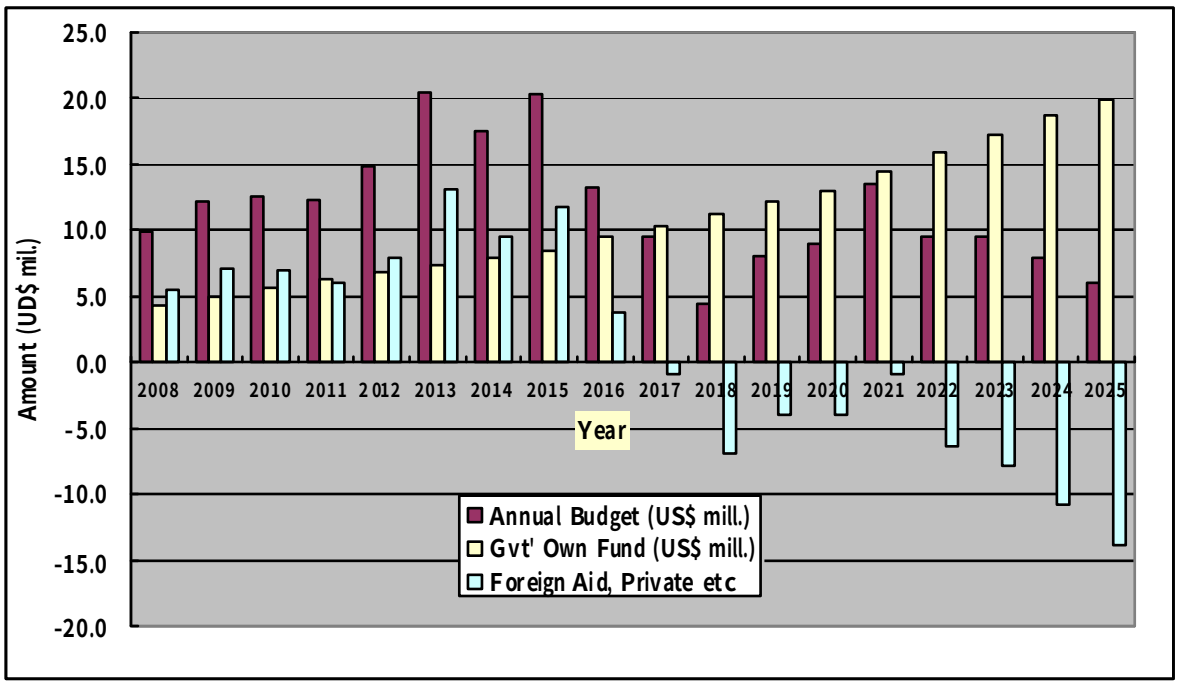


Figure 20.4-1 Change of Financial Gap for Implementation of Road Projects

From Figure 20.4-1, the followings can be observed:

(i) The situation, where the Government needs foreign financial assistance or private participation for implementation of this Master Plan, is anticipated to continue up to year 2016. The total amount to be financed by such foreign aid and/or private participation between year 2008 and year 2016 is estimated at US$ 72 million.

(ii) However, as the revenue of the Government will increase and the budget will be increased, this financial gap will become smaller every year. After year 2017, the amount of the fund that the Government can supply will exceed the required amount.

(iii) Thus, the government will then be able to return the loan.

Generally, amortization period of international financing institutions, such as ADB and JBIC is in the order of 20 years. In addition, 3 to 5 years of grace period is given. Therefore, payment of US$ 10 million of ADB loan borrowed in year 2010, for example, starts from year 2015 and annual payment is about US$ 0.5 million and ends in year 2025. AS such, financial burden of the payment for amortization of such loans is not considered to be heavy, since the major part of such payment will occur the economic level of Laos will have reached the stage where the revenue of the Government will be sufficient to return the loan.

Toll Road System

Toll road system is often adopted in financing road projects. Actually, there is a plan to construct the eastern section of the proposed Outer Ring Road with toll road system.

Toll road system is often used in financing inter-urban type of roads. It is usually not used in urban streets because it is difficult to construct toll collecting facility on urban streets. Therefore, this Master Plan does not consider toll road system as one of the financing method. However, owing to the rapid development of IT (information technology), charging each vehicles for using urban street is now possible. Accordingly, road user charge which is collected as a vehicles use road/street can be adopted as one of the fund source if socially accepted.

20.4.2 Financing Plan of Public Transport Development

(1) Procurement of New Bus Fleet

As for the Public Transport Development, approximately US$ 1.5 – 3.7 million is required every year for the Short Term. Considering that the annual revenue of VSBC in FY 2005/06 was in the order of US$ 3 million and the profit was minus, the amount required for procurement of new bus fleet may be excessively large to be borne by VSBC alone. Accordingly, some kind of financial assistance, either by the Government or foreign aid, needs to be considered.

There are several possible fund sources for the Government/VSBC:

(i) Commercial loan
(ii) Loan from the aid agencies such as the World Bank, ADB and JBIC
(iii) Loan from the fund operated by the Government such as National Pension Fund
(iv) Grant/subsidy from the Government
(v) Participation of private investor(s)

Participation of private investor(s) is the fund source which should be seriously sought for. In the past, there have been a few cases of bus services operated by private firms, including Ton-Li-Pa-Si Bus Company. However, these bus services so far remain relatively small scale and are not expected to bare large share in the public transport in Vientiane.

Commercial loan and loan from the fund operated by the Government do not seem to be commonly adopted by VSBC. Government may consider giving financial support for operation of bus services, but it may be difficult to give large amount of subsidy/grant for procurement of new bus fleet.

Thus, the main fund source for procurement of the new bus fleet is assumed here to be loan from the aide agencies, including WB, ADB and JBIC, for the purpose of discussion of financing plan.

Currently, VSBC is in a difficult financial condition and cannot be expected to shoulder the payment of amortization of loan needed for procurement of new buses. It needs further

detailed study on the business operation of VSBC before any conclusion on the financial capacity of VSBC purchasing the new bus fleet is made. However, increase in the number of units of buses is naturally expected to increase the revenue, resulting in the better financial condition of VSBC than the current one.

For example, if the number of bus unit is doubled, naturally, the revenue is expected to become 2 times of the current one. While operation cost is also anticipated to become double, increase in fixed cost, such as administration cost including the salary of employees, as a whole, is not anticipated to become double. Then, the profitability of VSBC is expected to be improved. Figure 20.4-2 schematically shows this concept. If the profitability of VSBC will improved, there will be possibility that VSBC can borrow loan(s) from aid agencies and return it later.

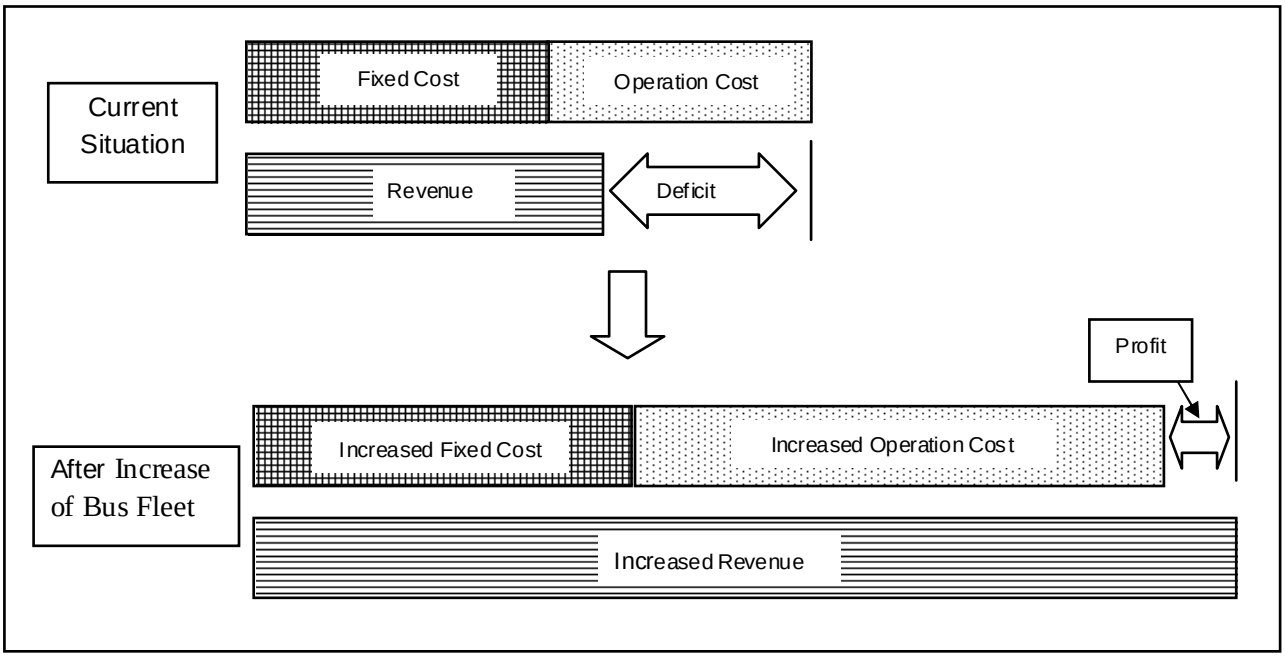


Figure 20.4-2 Concept of improving financial condition due to increase of revenue

(2) Construction/Improvement of Public Transport Facilities

Compared to the cost of procurement of new bus fleet, the cost for construction/improvement is relatively small, at least in the Short Term. They also need to be implemented together or after the proposed road projects are implemented. Thus, it is assumed that these projects are planned and implemented in conjunction with the proposed road projects and financing of majority of public transport facilities, except bus terminal, is assumed to be planned together with those of road projects.

There is one bus terminal operated by a private firm. Thus, there is a possibility that private investor is interested in construction/improvement of bus terminal. The government should encourage such private participation.

CHAPTER 21

EVALUATION OF THE PLAN / PROJECTS

CHAPTER 21 EVALUATION OF THE PLAN / PROJECTS

21.1 ECONOMIC EVALUATION

Economic evaluation generally aims to find the economic feasibility by examining whether the project will bring about sufficient contribution to the national or regional economy based on the comparison of the costs and benefits. Generalized travel cost of the project are quantified to compare them. Travel Time Cost (TTC) and Vehicle Operating Cost (VOC) are the main items to be quantified. Other items such as accidents reduction benefit is not considered here.

In addition to these direct quantifiable benefit, several other direct and indirect benefits can be identified, such as increased comfort in vehicle operation, effect of regional development. These benefits, however, are not counted in this study, since it is very difficult or even impossible to quantify them.

21.1.1 Travel Time Cost (TTC)

(1) Time value

To quantify travel time cost, time has to be evaluated in monetary term. Income approach is usually used to evaluate the time. Using figures shown in Table 21.1-1 hourly product (time value) of 0.522 US$/hour is obtained.

Table 21.1-1 Economic Figures

ITEMS	VALUE
GDP (million Kip)	30,599,882
Number of Labor	2,738,893
GDP per Labor (Kip)	11,172,354
Annual Working Hour	2,000
Ration of Labor Product	90%
Hourly Product (Kip)	5,027
Hourly Product (US$/hour)	0.522
Exchange rate US$ (Oct. 2007) (Kip)	9,627

According to the person trip survey carried out by the Study Team which is introduces in Chapter 5, work related trip rate are:

- To work 17.8%
- Personal business 2.4%
- Firm business 0.4%

Total of work related trips is 20.6%, and the same percentage among “to home” trip can be assumed from work. So, doubled figure of 41.2% of total trip are considered to be time value applicable trips. It means the time value of 0.215 US$/hour is applicable for all trip purposes.

(2) Time cost for vehicle type considered

In order to apply the time values to the vehicle categories considered here, an average occupancy of each vehicle types is considered in obtaining TTC. As for bus passenger a half of the number is considered to be time value applicable. As for truck, TTC would be obtained considering the opportunity cost of the cargo which the truck is carrying. However, since such kind of survey was not undertaken in this study, the same TTC as bus is applied.

Table 21.1-2 Occupancy and TTC for Vehicle Types

	Motor Cycle	P. Car	Sonteo	Bus	Truck
Occupancy	1.3	2.3	4	28.3	1.6
TTC (US$/h)	0.280	0.495	0.861	3.044	3.044

21.1.2 Vehicle Operating Cost (VOC)

VOC is further divided into distance dependent and time dependent.

(1) Distance dependent VOC

Distance dependent VOC consists of cost of fuel, lubricant, tire, maintenance, spare parts and depreciation. Table 21.1-3 shows vehicle price, and Table 21.1-4 shows price of fuel, lubricant and tire available in Vientiane surveyed by the Study Team.

Table 21.1-3 Vehicle Price

unit US$

	STD	Duty & Tax	Total	Margin	Financial cost	Economic cost
M/C	275	275	550	55	605	330
Car	6,840	7,866	14,706	1,471	16,177	8,311
Sonteo	6,696	4,794	11,490	1,149	12,639	7,845
Bus	14,400	8,410	22,810	2,281	25,091	16,681
Truck	12,960	5,858	18,818	1,882	20,700	14,842

Table 21.1-4 Price of fuel, lubricant and tire

	CIF	Duty & tax	Magin	Financial cost	Economic cost
Fuel					
Super Gasoline	0.613	0.393	0.025	1.030	0.638
Gasoline	0.593	0.361	0.025	0.954	0.618
Diesel	0.634	0.216	0.025	0.850	0.659
Lubricant					
Gasoline	8.78	3.51	1.23	13.52	10.01
Diesel	10.12	4.05	1.42	15.58	11.54
Tire					
Motor Cycle	7.60	3.04	1.06	11.70	8.66
P. Car	47.30	18.92	6.62	72.84	53.92
Bus & Truck	119.25	47.70	16.70	183.65	135.95

Table 21.1-5 Unit Rate

	M/C	Car	Sonteo	Bus	Truck	Unit
Fuel	0.088	0.135	0.208	0.28	0.296	liter/km
Lubricant	0.658	1.316	5.001	7.852	7.145	l/1000km
Tire	0.11	0.22	0.285	0.306	0.407	1/10,000km
Maintenance	0.236	0.471	1.166	2.67	1.665	hr/1,000km
Spare Parts	0	0.001	0.001	0.003	0.002	l/1,000km

Source : Surveyed by the Study

By applying the price shown in Table 21.1-4 to the unit rate shown in Table 21.1-5, unit VOC shown in Table 21.1-6 is obtained. As for depreciation, residual value of fixed amount method and distance the vehicle driven over life span are considered.

Table 21.1-6 Distance Dependent VOC

unit: US$/km

	M/C	Car	Sonteo	Bus	Truck
Fuel	0.055	0.084	0.129	0.185	0.195
Lubricant	0.007	0.013	0.050	0.091	0.082
Tire	0.000	0.005	0.006	0.025	0.044
Maintenance	0.000	0.001	0.001	0.003	0.002
Spare Parts	0.000	0.006	0.011	0.049	0.027
Depreciation	0.002	0.009	0.009	0.012	0.007
Total	**0.064**	**0.116**	**0.207**	**0.365**	**0.358**

(2) Time dependent VOC

Time dependent VOC consists of cost of depreciation, interest, insurance, crew cost, and overhead. Annual driven hour is considered to calculate time dependent depreciation. As for interest, opportunity cost for residual value over vehicle life time is considered. As for insurance unit rate as follows are used.

Passenger Car Y = (0.035 x 1,000 x 0.5)/(500 x S)

Bus Y = (0.040 x 1,000 x 0.5)/(2,500 x S)

Truck Y = (0.060 x 1,000 x 0.5)/(1,750 x S)

Where Y= unit insurance cost per 1,000 km

S= Travel speed (km/h) assumed 30

The rates are multiplied with the vehicle costs to get insurance costs. As for crew cost, assumed number of crew is; 0.5 for car, 1.12 for sonteo, 1.24 for bus and truck are used. As for overhead, 10% of total of above costs are considered. Table 21.1-7 shows time dependent VOC thus obtained.

Table 21.1-7 Time Dependent VOC

unit: US$/hour

	M/C	Car	Sonteo	Bus	Truck
Depreciation	0.054	0.655	0.262	0.310	0.241
Interest	0.003	0.083	0.078	0.032	0.043
Insurance	0.000	0.010	0.009	0.004	0.008
Crew	0.000	0.261	0.585	0.648	0.648
Overhead	0.006	0.101	0.093	0.099	0.094
Total	**0.063**	**1.110**	**1.027**	**1.094**	**1.035**

21.1.3 Economic Evaluation of Individual Projects

(1) Road Development Scenarios

1) Economic indices

The projects considered to be evaluated are mentioned in Chapter 16. They are

- Scenario 1 : minimum development plan,
- Scenario 2 : functionally same as maximum plan, but lower scale plan,
- Scenario 3 : maximum development plan.

The project costs are estimated as shown in Table 21.1-8.

Table 21.1-8 Financial and Economic Cost of Scenarios

	Financial cost (1000 $)	Economic cost (1000 $)
Scenario 1	87,000	78,000
Scenario 2	125,000	112,500
Scenario 3	217,000	195,300

The results of the economic analysis in terms of EIRR, B/C ration and NPV are presented in Table 21.1-9.

Table 21.1-9 Results of Economic Analysis

	Veh-km	Veh-hour	Speed (km/h)	VCR	Travel cost (1000$)	EIRR	B/C	NPV (1000$)
Do Nothing	12,890,987	623,921	20.7	1.38	516,172			
Scenario 1	12,619,433	545,330	23.1	1.15	490,877	13.5%	1.11	8,429
Scenario 2	12,293,390	402,821	30.5	1.02	447,068	17.9%	1.57	64,631
Scenario 3	12,372,436	303,547	40.8	0.71	414,736	18.1%	1.54	87,237

2) Sensitivity analysis

To examine that in case project costs and benefits vary how the indices are sensible to the variation is a purpose of the sensitivity analysis. 10 % of increase and decrease of cost and benefit are considered. For the calculation of B/C ratio and NPV, a discount rate of 12% is applied. The results are shown in Table 21.1-10 to Table 21.1-12. The upper figure denotes EIRR, the middle figure denotes B/C ratio and the lower figure denotes NPV.

Table 21.1-10 Results of Sensitivity Analysis for Scenario 1

		Cost		
		-10%	**0%**	**+10%**
Benefit	**+10%**	16.7% 1.35 24,979	15.0% 1.22 17,125	13.5% 1.11 9,272
	0%	15.1% 1.23 16,282	13.5% 1.11 8,429	12.1% 1.01 575
	-10%	13.5% 1.11 7,586	12.0% 1.00 -268	10.6% 0.91 -8,122

Table 21.1-11 Results of Sensitivity Analysis for Scenario 2

		Cost		
		-10%	**0%**	**+10%**
Benefit	**+10%**	21.0% 1.92 93,749	19.3% 1.73 82,422	17.9% 1.57 71,094
	0%	19.5% 1.75 75,959	17.9% 1.57 64,631	16.6% 1.43 53,304
	-10%	17.9% 1.57 58,168	16.4% 1.41 46,841	15.2% 1.29 35,513

Table 21.1-12 Results of Sensitivity Analysis for Scenario 3

		Cost		
		-10%	**0%**	**+10%**
Benefit	**+10%**	21.4%	19.6%	18.1%
		1.88	1.69	1.54
		128,322	112,142	95,961
	0%	19.8%	18.1%	16.7%
		1.71	1.54	1.40
		103,418	87,237	71,057
	-10%	18.1%	16.5%	15.1%
		1.54	1.39	1.26
		78,514	62,333	46,152

In case of Scenario 1 increase of cost or decrease of benefit put the scenario at fringe of feasibility. If at the same time cost increase and benefit decrease, this scenario turns to be not feasible any more.

In case of other scenarios, even the most unfavorable situation, they are all feasible.

(2) Public Transport Alternatives

Public transport alternatives are generated in the previous Chapters. They are

- Alternative 1 : pursuing the present tendency
- Alternative 2 : para-transit oriented
- Alternative 3 : bus transit oriented
- Alternative 4 : Light Rail Transit will be introduced

The project costs of the alternatives are shown in Table 21.1-13.

Table 21.1-13 Financial and Economic Project Cost

	Financial cost (1000 $)	Economic cost (1000 $)
Alternative 1	2,060	1,854
Alternative 2	48,859	43,973
Alternative 3	47,244	42,520
Alternative 4	79,398	71,458

The results of the economic analysis in terms of EIRR, B/C ration and NPV are presented in Table 21.1-14.

Table 21.1-14 Results of Economic Analysis

	Veh-km	Veh-hour	Speed (km/h)	VCR	Travel cost (1000$)	EIRR	B/C	NPV (1000$)
Do Nothing	12,890,987	623,921	20.7	1.38	516,172			
Alternative 1	12,372,436	303,547	40.8	0.71	414,736	18.1%	1.54	87,237
Alternative 2	6,945,785	147,050	47.2	0.51	293,565	34.5%	3.24	398,309
Alternative 3	6,533,983	135,210	48.3	0.47	269,815	39.6%	4.17	551,257
Alternative 4	6,434,114	132,813	48.4	0.47	256,605	40.9%	4.05	565,138

1) Sensitivity analysis

10 % of increase and decrease of cost and benefit are considered. For the calculation of B/C ratio and NPV, a discount rate of 12% is applied. The results are shown in Table 21.1-15 to Table 21.1-17. But, Alternative 1 is omitted because it is same as Scenario 3. The upper figure denotes EIRR, the middle figure denotes B/C ratio and the lower figure denotes NPV.

Table 21.1-15 Results of Sensitivity Analysis for Alternative 2

		Cost		
		-10%	**0%**	**+10%**
Benefit	**+10%**	40.3% 3.96 473,652	37.1% 3.57 455,896	34.5% 3.24 438,139
	0%	37.4% 3.60 416,065	34.5% 3.24 398,309	32.0% 2.95 380,552
	-10%	34.5% 3.24 358,478	31.8% 2.92 340,721	29.5% 2.65 322,965

Table 21.1-16 Results of Sensitivity Analysis for Alternative 3

		Cost		
		-10%	**0%**	**+10%**
Benefit	**+10%**	46.0% 5.09 641,214	42.5% 4.58 623,798	39.6% 4.17 606,382
	0%	42.8% 4.63 568,672	39.6% 4.17 551,257	36.9% 3.79 533,841
	-10%	39.6% 4.17 496,131	36.6% 3.75 478,715	34.1% 3.41 461,300

Table 21.1-17 Results of Sensitivity Analysis for Alternative 4

		Cost		
		-10%	**0%**	**+10%**
Benefit	**+10%**	47.6%	44.0%	40.9%
		4.95	4.46	4.05
		658,697	640,174	621,652
	0%	44.3%	40.9%	38.1%
		4.50	4.05	3.68
		583,660	565,138	546,615
	-10%	40.9%	37.8%	35.1%
		4.05	3.65	3.31
		508,624	490,102	471,579

As all alternatives have high indices, even the most unfavorable situation of sensitivity test, the indices do not fall so much.

CHAPTER 22

INITIAL ENVIRONMENTAL EXAMINATION

(IEE)

CHAPTER 22 INITIAL ENVIRONMENTAL EXAMINATION (IEE)

The purpose of IEE (Initial Environmental Examination) is to document screening of the environmental consequences of the subproject in accordance with regulation on Environmental Assessment in the Lao PDR and JICA guidelines to identify potential adverse and beneficial environmental impacts, and is to document the possible mitigation and monitoring measures that would be incorporated in the project to eliminate or minimize the adverse impacts.

22.1 GENERAL OBECTIVES OF IEE STUDY

The general objectives of IEE study for the study of Master Plan on Comprehensive Urban Transport in Vientiane are to:

- Provide information about the general environmental setting of the project area as baseline data,
- Provide information on potential impacts of the project and the characteristic of the impacts, magnitude, distribution, who will be the affected group, and their duration,
- Provide information on potential mitigation measures to minimize the impacts, and
- Provide basic information for formulating management and monitoring plan.

22.1.1 Scope of Study

The IEE study will focus on an assessment of existing environmental condition (including physical, biological, economic and social conditions) and preparation of an environmental impact mitigation measures and monitoring plan for each stage of the project activities within study area. The study area covers six districts of which 4 defined as urban districts such as Chanthabouly, Sikhottabong, Sisattanak and Xaysetha, and 2 defined as semi-urban districts such as Hadxaifong and Xaythany. The study will be based on available secondary data, reports and relevant ideas from local residents and officials through interviewing and discussion.

22.1.2 Type of Project

Type of the project will be defined in accordance with JICA Guidelines for Environmental and Social Considerations, which generally classifies the project under three categories as below:

- Category A: projects are classified as Category A if they are likely to have significant adverse impact on the environment and society. An EIA (Environmental Impact Assessment) is required to address significant impacts.

- Category B: Projects classified as Category B if they have potential adverse impact on environmental and society but less than those of Category A. An IEE is required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

- Category C: Projects unlikely to have adverse environmental impacts. Either EIA or IEE is not required.

Among the categories described above, the project with construction of missing link roads, road widening and intersection improvement is classified as a project category A under JICA's project classification. As a result, the project is involved with large scale of land acquisition and resettlement activities and would create some significant adverse impacts on natural environments where the project component such as construction of missing link roads takes place within protected forest areas.

22.2 SCOPING FOR INITIAL ENVIRONMENTAL EXAMINATION

The scope of IEE is determined for different types of projects/programs to be included in the master plan for comprehensive urban transport in Vientiane Capital. The summary of the scoping for IEE for each different type of interventions was shown in Table 23.2-1. Some proposed projects/ programs for the master plan are expected to create positive and possible negative impacts and issues as highlighted below:

22.2.1 Improvement of Intersections

- Depending on the location where the intersection need to improve from T-typed intersection to conventional four-road intersection; relocation of the households who identified as affected household due to improvement of the proposed intersections will be a major social issue.

- Where business/trading activities surround the intersection, traffic jam during the construction period is expected.

- A series of consultation meeting with various stakeholders including local business, village and district organizations should be held for appropriated consultation between the government and the public communities.

22.2.2 Widening of the Roads

- Depending on the location where an existing road is occupied by structures such as shops, motorcycle repairing shops, and small restaurants, removal or demolition may become a delicate social issue.
- During construction of road widening, inconvenient traffic flow is expected.
- A series of consultation meeting with various stakeholders including local business, village and district organizations should be held for appropriated consultation between the government and the public communities.

22.2.3 Construction of the Roads

- New road construction would bring some impacts on natural and social environments especially, where some sections of the new roads passes through forest and residential areas where large number of land acquisition and resettlement activities are involved.
- Where the proposed roads pass through conserved forest, significant impact on trees and animals is expected.
- A series of stakeholder consultation meeting should be held with various stakeholders including local residents, village and district organizations and NGO working for conservation of the natural environment.

22.2.4 Replacement of the Bridges

- No significant natural environmental impact would be expected due to replacement or construction of bridges.
- Traffic congestion and temporary utilization of local agricultural land used for by-pass during construction period will affect local society. In addition a few temporary structures of shops near Nong Niang Bridge are subject to remove.

22.2.5 Construction of the Bus Terminals

- Depending on the location where the governmental land not available for constructing new bus stations, land acquisition is required.
- New bus terminals should create some number of job opportunities and employment for local residents leading to local economic development. However, noise and air pollution generated during operational period where bus located nearby residential areas.
- A series of consultation meeting with various stakeholders including local business, village and district organizations should be held for appropriated consultation between the government and the public communities.

Table 22.2-1 (1) Scoping of the Environment and Social Considerations (1/5)

a. Improvement of Intersections

Aspect of environment		With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Involuntary Resettlement	B	Some building structures including shops and houses will be relocated.		No involuntary resettlement is involved.
	2. Local economy such as employment and livelihood, etc.	B	Some shops/stalls need to be relocated and some sellers may lose their jobs.		Not applicable.
	3. Land use and utilization of local resources		No effect is expected.		Not applicable.
	4. Social institutions such as social infrastructure and local decision-making institutions	+	Improved accessibility to social institutions are expected due to reduction of traffic congestion around intersections.	B	Low accessibility to social institutions due to traffic congestion around intersections should prevail.
	5. Existing social infrastructures and services such as transport and life facilities	++	Pedestrian crossing will be improved.	B	Past trend of transport and utility will prevail.
	6. The poor, indigenous and ethnic people	C	Some shops, residents and street vendors may move out of the area.		No change will take place for local people.
	7. Misdistribution of benefit and damage		No effect is expected.		Not applicable.
	8. Cultural heritage		No such resources are known to exist.		Not applicable.
	9. Local conflict of interests		No effect is expected.		Not applicable.
	10. Water Usage or Water Rights and Rights of Common		No such right/common is known to exist.		Not applicable.
	11. Health & Sanitation	+	Reduction of traffic congestion should improve health condition of people living around intersections .	B	Air quality may worsen at intersections.
	12. Hazards (Risk) Infectious diseases such as HIV/AIDS		No effect is expected.		Not applicable.
Natural environment	13. Topography and Geographical features		No significant impact is anticipated.		Not applicable.
	14. Soil Erosion	B	Minor erosion during construction may occur.		Not applicable.
	15. Groundwater		No effect is expected.		Not applicable.
	16. Hydrological Situation		No effect is foreseen.		Not applicable.
	17. Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)		No such areas are involved.		Not applicable.
	18. Flora, Fauna and Biodiversity	B	A few shrubs or common trees may need to be removed.		Not applicable.
	19. Meteorology		No effect is expected.		Not applicable.
	20. Landscape	B	Some roundabout with greenery will be affected.	B	Past trend of transport will be prevail.
	21. Global Warming		No significant impact is expected.		Not applicable.
Pollution	22. Air Pollution	B	Air pollution will temporarily increase by construction vehicles.	A	Air pollution will prevail in the future.
	23. Water Pollution		No significant impact is expected.		Not applicable.
	24. Soil Contamination		No such possibility is foreseen.		Not applicable.
	25. Waste		No significant impact is expected.		Not applicable.
	26. Noise and Vibration	B	Noise may increase due to increased traffic.	B	Present noise should prevail.
	27. Ground Subsidence		No effect is foreseen.		Not applicable.
	28. Offensive Odor	+	Emission-free automobiles will increase.	B	Exhaust gas from vehicles will cause some offensive odor.
	29. Bottom sediment		No effect is expected.		Not applicable.
	30. Accidents	++	Improved intersections will reduce traffic congestion and accidents.	B	Traffic congestion should chronically congest further.

* A: Serious impact is expected; B: Some impact is expected; C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.);
No Mark: No impact is expected. IEE/EIA is not necessary.

Where positive impact is expected,
++: Significantly positive impact is expected; +: Some positive impact is expected.

Table 22.2-1 (2) Scoping of the Environment and Social considerations (2/5)

b. Widening of Existing Roads

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Involuntary Resettlement	B	Although widening of the road will be limited to the ROW, some informal sectors occupying the road reserve need to be relocated.	B	No part of the local community is affected by the project but traffic congestion should prevail.
	2. Local economy such as employment and livelihood, etc.	B	Small shops/ residents need to be relocated in some road sections.	B	Regional economy may suffer from congested roads.
	3. Land use and utilization of local resources		No effect is expected.		Not applicable
	4. Social institutions such as social infrastructure and local decision-making institutions	+	Accessibility to social infrastructures and local institutions will be improved.	B	Traffic congestion should prevail
	5. Existing social infrastructures and services such as transport and life facilities	++	Separated traffic lanes for motorbikes/bicycles and sidewalks should be improved.	B	Past trend of transport will be prevail
	6. The poor, indigenous and ethnic people	C	Construction of the roads may affect the poor such as farmers who will lose their productive land to the project.		Not applicable
	7. Misdistribution of benefit and damage		No effect is expected.		Not applicable
	8. Cultural heritage	C	Some religious assets i.e. part of temple may be affected		Not applicable
	9. Local conflict of interests	B	Conflict among the local people on future land use may occur		Not applicable
	10. Water Usage or Water Rights and Rights of Common		No such right/common is known to exist.		Not applicable
	11. Health & Sanitation	+	Dust generated during construction may temporarily affect local residents and travelers. However, dust will not occur after completion of road widening.	B	Air pollution may worsen along existing roads.
	12. Hazards (Risk) Infectious diseases such as HIV/AIDS	C	Infectious diseases such as HIV/AIDS due to inflow of construction workers.		Not applicable
Natural environment	13. Topography and Geographical features		No change is expected.		Not applicable
	14. Soil Erosion	+	Paved lane should reduce soil erosion.		Not applicable
	15. Groundwater		No effect is expected.		Not applicable
	16. Hydrological Situation		No effect is foreseen.		Not applicable
	17. Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)		No such areas are involved.		Not applicable
	18. Flora, Fauna and Biodiversity	B	A few shrubs or common trees may need to be cut down.		Not applicable
	19. Meteorology		No effect is expected.		Not applicable
	20. Landscape	+	Paved lanes will improve the visual appearances of roads.		No significant change of urban landscape should take place
	21. Global Warming		No significant impact is expected.		Not applicable
Pollution	22. Air Pollution	B	Air pollution will temporarily occur by vehicles and machines used for construction activities.	A	Uncontrolled air pollution should prevail.
	23. Water Pollution		No significant impact is expected.		Not applicable
	24. Soil Contamination		No effect is foreseen.		Not applicable
	25. Waste	B	Construction debris need to be properly disposed.		Not applicable
	26. Noise and Vibration	B	Noise and vibration may increase due to increased traffic.	A	Present noise and vibration should prevail.
	27. Ground Subsidence		No effect is foreseen.		Not applicable
	28. Offensive Odor	+	Emission-free automobiles will increase.	B	Exhaust gas from vehicles will cause some offensive odor.
	29. Bottom sediment		No effect is expected.		Not applicable
	30. Accidents	++	Separated traffic lanes for motorbikes/bicycles may decrease traffic accidents.	B	Traffic congestion should chronically congest further.

* A: Serious impact is expected; B: Some impact is expected; C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.);
No Mark: No impact is expected. IEE/EIA is not necessary.

Where positive impact is expected,
++: Significantly positive impact is expected; +: Some positive impact is expected.

Table 22.2-1 (3) Scoping of the Environment and Social Considerations (3/5)

C. Road Construction

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Involuntary Resettlement	B	Some section of the road construction will involve involuntary resettlement.		No resettlement is involved.
	2. Local economy such as employment and livelihood, etc.	+	Economic development will be induced along the new constructed roads.	B	Regional economy may suffer from congested roads in the surroundings.
	3. Land use and utilization of local resources	C	Detailed survey is necessary.		Not applicable.
	4. Social institutions such as social infrastructure and local decision-making institutions	+	Accessibility to social infrastructure and local institute will improved.	B	Traffic congestion should prevail in the surroundings.
	5. Existing social infrastructures and services such as transport and life facilities	++	New roads will generate new facilities along the roads	B	Traffic congestion should prevail in the surroundings.
	6. The poor, indigenous and ethnic people	B	Construction of the roads may affect the poor such as farmers who will lose their productive land to the project.		Not applicable.
	7. Misdistribution of benefit and damage	C	The project may cause misdistribution of benefit and damage of the local residents, farmers and seller living along the areas.		Not applicable.
	8. Cultural heritage	C	Possible damage of cultural properties may occur in some sections of the new roads.		Not applicable.
	9. Local conflict of interests	B	Conflict among the local people on future land use may occur		Not applicable.
	10. Water Usage or Water Rights and Rights of Common	B	Some possible change of the watercourse of existing channels		Not applicable.
	11. Health & Sanitation	+	New roads with high standard design include drainage system and sidewalks will improve health and sanitation condition of people living along the roads		Not applicable.
	12. Hazards (Risk) Infectious diseases such as HIV/AIDS	C	Infectious diseases such as HIV/AIDS due to inflow of construction workers.		Not applicable.
Natural environment	13. Topography and Geographical features	C	Topography may change in some sections of new roads		Not applicable.
	14. Soil Erosion	B	Soil erosion may occur due to improper designs and construction methods		Not applicable.
	15. Groundwater	C	Negative impact on groundwater may occur due to construction activities such as excavation and leachate.		Not applicable.
	16. Hydrological Situation	C	Some possible impacts on surface water may occur.		Not applicable.
	17. Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)		No such areas are involved.		Not applicable.
	18. Flora, Fauna and Biodiversity	C	The road passing through forest conservation or wetland will affect the fauna & flora. It is anticipated that several common tree will be cut down.		Not applicable.
	19. Meteorology		No effect is expected		Not applicable.
	20. Landscape	+	Paved lanes will improve the visual appearances of roads.		Not applicable.
	21. Global Warming	+	CO2 emission is reduced by improvement of accessibility to a destination.		Not applicable.
Pollution	22. Air Pollution	B	Air pollutants emitted from construction machines and vehicular traffic will affect ambient air quality.		Not applicable.
	23. Water Pollution	B	River water may be contaminated by construction activities.		Not applicable.
	24. Soil Contamination	B	Spillage of lubricants or any petroleum products used for construction will cause soil contamination.		Not applicable.
	25. Waste	B	Construction debris need to be properly disposed.		Not applicable.
	26. Noise and Vibration	B	Noise and vibration may increase due to increased traffic of heavy vehicles.		No applicable.
	27. Ground Subsidence		No effect is foreseen.		Not applicable.
	28. Offensive Odor		No effect is foreseen.		Not applicable.
	29. Bottom sediment		No effect is expected.		Not applicable.
	30. Accidents	B	Accident may occur due to generation of traffic.		Not applicable.

* A: Serious impact is expected; B: Some impact is expected; C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.);
No Mark: No impact is expected. IEE/EIA is not necessary.

Where positive impact is expected,
++: Significantly positive impact is expected; +: Some positive impact is expected.

Table 22.2-1 (4) Scoping of the Environment and Social Considerations (4/5)

d. Replacement of Bridges

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Involuntary Resettlement	B	Relocation of temporary shops and houses for one of the proposed bridges.		Not applicable.
	2. Local economy such as employment and livelihood, etc.	+	Replacement of existing bridges with new high standard bridges will cause positive effects.		Not applicable.
	3. Land use and utilization of local resources		No effect is foreseen.		Not applicable.
	4. Social institutions such as social infrastructure and local decision-making institutions	+	Accessibility to social infrastructures and local institutions will be improved.	B	Traffic congestion should prevail.
	5. Existing social infrastructures and services such as transport and life facilities	++	Positive effects are expected.	B	Risk in accident during the crossing of the bridge should prevail.
	6. The poor, indigenous and ethnic people		No effect is foreseen.		Not applicable.
	7. Misdistribution of benefit and damage		No effect is foreseen.		Not applicable.
	8. Cultural heritage	C	No such resources are known to exist.		Not applicable.
	9. Local conflict of interests		No effect is expected.		Not applicable.
	10. Water Usage or Water Rights and Rights of Common		No such right/common is known to exist.		Not applicable.
	11. Health & Sanitation	+	Improvement of bridges will cause positive effects.	B	Air pollution may worsen at existing bridges.
	12. Hazards (Risk) Infectious diseases such as HIV/AIDS		No effect is foreseen.		Not applicable.
Natual environment	13. Topography and Geographical features		No change is expected.		Not applicable.
	14. Soil Erosion	B	Minor soil erosion during replacement of the bridges may occur.		Not applicable.
	15. Groundwater	C	Bridge piers will not be deep enough to affect groundwater.		Not applicable.
	16. Hydrological Situation	C	Installation of new bridge structures may cause some impact on surface water and its flow.		Not applicable.
	17. Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)		No such areas are involved.		Not applicable.
	18. Flora, Fauna and Biodiversity	B	Some kind fishes and animals will be affected during construction.		Not applicable.
	19. Meteorology		No effect is expected.		Not applicable.
	20. Landscape	+	New replaced bridges will have good visual appearances.	B	Landscape should gradually deteriorate.
	21. Global Warming		No effect is foreseen.		Not applicable.
Pollution	22. Air Pollution		No significant impact is expected.		Not applicable.
	23. Water Pollution		No significant impact is expected.		Not applicable.
	24. Soil Contamination		No effect is foreseen.		Not applicable.
	25. Waste	B	Construction waste and debris need to be properly treaded.		Not applicable.
	26. Noise and Vibration		No effect is foreseen.		Not applicable.
	27. Ground Subsidence		No effect is foreseen.		Not applicable.
	28. Offensive Odor		No effect is foreseen.		Not applicable.
	29. Bottom sediment	C	Contamination of bottom sediments by dumping of waste material during replacement of the bridges may occur.		Not applicable.
	30. Accidents	++	Improvement of bridges will reduce accident during the crossing of the bridges.	B	Frequent accidents during the crossing of a bridge still occur.

* A: Serious impact is expected; B: Some impact is expected; C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.);
No Mark: No impact is expected. IEE/EIA is not necessary.

Where positive impact is expected,
++: Significantly positive impact is expected; +: Some positive impact is expected.

Table 22.2-1 (5) Scoping of the Environment and Social Considerations (5/5)

e. Construction of Bus terminals

	Aspect of environment	With Project		Without Project	
		Rating*	Explanation	Rating*	Explanation
Social environment	1. Involuntary Resettlement	B	Land acquisitions are required.		Not applicable.
	2. Local economy such as employment and livelihood, etc.	+	Job opportunities and service activities will be induced around the new bus terminals.	B	Regional economy may suffer from congested roads.
	3. Land use and utilization of local resources	B	Land speculation will occur due to increased price of the lands around the areas.		Not applicable.
	4. Social institutions such as social infrastructure and local decision-making institutions	+	Accessibility to social infrastructures and local institutions will be improved.	B	Traffic congestion should prevail.
	5. Existing social infrastructures and services such as transport and life facilities	++	More convenience of local residents to access to public transport services.	B	Inconvenience of some residents to access to public transport facilities should prevail.
	6. The poor, indigenous and ethnic people	+	Some jobs/employment will be available for local people especially, for the poor living around the areas.	B	Present living condition of the poor should prevail.
	7. Misdistribution of benefit and damage	C	Possible misdistribution of benefit and damage among residents and shop owners.		Not applicable.
	8. Cultural heritage		No such resources are known to exist.		Not applicable.
	9. Local conflict of interests	B	Some conflict between local residents and people from other places may occur in the future.		Not applicable.
	10. Water Usage or Water Rights and Rights of Common		No such right/common is known to exist.		Not applicable.
	11. Health & Sanitation	B	Wastewater discharge from new bus terminal may affect the residents living around the areas.	B	Traffic congestion should prevail.
	12. Hazards (Risk) Infectious diseases such as HIV/AIDS	B	Infectious diseases such as HIV/AIDS will be introduced due to large number of passengers from different places coming to the areas.		Not applicable.
Natural environment	13. Topography and Geographical features		No significant impact is expected.		Not applicable.
	14. Soil Erosion		No effect is foreseen.		Not applicable.
	15. Groundwater		Right structure of the new stations will not affect the groundwater flow.		Not applicable.
	16. Hydrological Situation		No effect is foreseen.		Not applicable.
	17. Coastal Zone (Mangroves, Coral reefs, Tidal flats, etc.)		No such areas are involved.		Not applicable.
	18. Flora, Fauna and Biodiversity		No significant impact is expected.		Not applicable.
	19. Meteorology		No effect is expected.		Not applicable.
	20. Landscape	+	Proper design with high standard of the new bus terminals will cause positive effects.		No significant effect is foreseen
	21. Global Warming		No effect is foreseen.		Not applicable.
Pollution	22. Air Pollution	B	Some significant impact is expected where a new bus terminal is constructed nearby residential areas.		Not applicable.
	23. Water Pollution	B	Waste discharge from new bus terminals will increase water pollution in surrounding areas.		Not applicable.
	24. Soil Contamination	B	Contamination of soil may occur due to leaking of lubricant from buses.		Not applicable.
	25. Waste	B	Solid waste generated around the station will be increased.		Not applicable.
	26. Noise and Vibration	A	Noise emission from buses during operational phase will affect the people living around the new bus terminals.		No applicable.
	27. Ground Subsidence	B	Large structure of new bus terminal may cause ground subsidence		Not applicable.
	28. Offensive Odor	B	Exhaust emission during load and unload of passengers in a station will cause some offensive odor.		Not applicable.
	29. Bottom sediment		No significant impact is expected.		Not applicable.
	30. Accidents	B	A few traffic accident may occur due to increased travels around new bus stations/ terminals.		Not applicable.

* A: Serious impact is expected; B: Some impact is expected; C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.);
No Mark: No impact is expected. IEE/EIA is not necessary.

Where positive impact is expected,
++: Significantly positive impact is expected; +: Some positive impact is expected.

22.3 EXPECTED ENVIRONMENTAL IMPACTS OF THE MASTER PLAN AND MITIGATION MEASURES

The environmental impact of the master plan was prepared based on field survey and observation by the IEE study team. The field observation was undertaken along the roads, intersections, bridge and new bus terminals proposed to improve and construct by the master plan. The details of result of environment impacts of master plan were shown in Appendix 22.3-1. While the following are overall description of the environmental impacts of the master plan and its mitigation measures;

22.3.1 Improvement of Intersections

It is expected that some positive and negative impacts will occur due to the improvement of intersections. However, there is no significant adverse impact will occur except that, in the intersection of South 13 Road and T4 Road where large land acquisition and resettlement involve. The anticipated impacts on natural and social environments are identified as follows;

Positive Impacts

Traffic congestion will be reduced as a result of smooth flow of traffic around the improved intersections. At the same time the pedestrians crossing will be improved in parallel with improvement of intersections

Negative Impacts During Projection Construction and Operational Periods

- Some building structures including shops and houses will be relocated.
- There is no significant natural environment impact caused by intersection improvement. However, part of gardening of some roundabouts and middle islands of roads will be lost.
- Depending on the location where a business district encompasses the intersection, traffic jam during construction period is expected.
- Some public properties such as traffic signals and traffic lights need to be reinstalled.
- Air and noise pollution will increase due to increased traffic during operational period.

Mitigation Measures

- Appropriate traffic control measure and traffic management plan should be prepared during construction and operational periods respectively.
- Proper signage and information announcement for the above should be prepared by the contractor during execution period.

- Where acquisition of land and relocation of local people are required, the resettlement action plan with appropriate compensation measures will be prepared to minimize significant adverse impact on local residents especially, for the poor and venerable group.

22.3.2 Widening of the Roads

Although the road improvement activities (road widening) will take place only within the Right of Way, some impacts on natural and social environments are still expected to be occurred. The following are the details;

Positive Impacts

The traffic congestion on the existing roads will be reduced which contribute to smooth operation of buses and other public transport travels. In the same time, traveling time of passengers should be reduced and more comfortable. In addition, improved operating condition of existing roads with high standard design (introduction of separate lane for motorbikes and bicycles and sidewalks) will improve road safety and decreases the accident rate on the existing roads.

Negative Impacts During the Construction Period

- Dust from construction activities such as concrete mixing, and construction traffic, and pollutants generated from asphalt plants and heavy diesel equipments will affect air quality during construction phase.
- Noise and vibration from operation of heavy machinery used for road improvement activities will be the major impacts on local residents along the existing roads. However, such impacts will be limited to short period of construction activities.
- Some temporary structure such as shops and houses which occupy the road reserve should be removed from the alignment of the existing roads.
- Temporary traffic disturbances will occur along the existing roads especially, during the rush hours.
- A number of naturally grown trees and tree planting area are expected to be cut down especially, at the narrow section of the roads.

Negative Impacts During the Operational Period

- Noise and air pollution will increase due to increased traffic.
- Separated traffic lanes for motorbikes / bicycles may decrease traffic accidents.

Mitigation Measures

- Where acquisition of local residential land and relocation of local people are required, resettlement action plan with appropriate compensation measures will be prepared to minimize significant adverse impact on local residents especially, on the poor.
- Proper signage and information announcement should be prepared by the contractor during construction period to avoid traffic accident.
- Appropriate traffic control measure and traffic management plans should be prepared during construction periods.
- Water spray for earth road surface during construction period can minimize negative impacts.
- All vehicles, equipments and machineries used for construction activities shall be regularly maintained and correctly operated (including the use of dust filters or hoods) so that air quality would conform to acceptable standard.
- At nearby schools, the contractors will discuss with the school principals regarding agree time for operating these machines and completely avoid noise disturbance near school during examination times and construction at night time will be prohibited.
- Planting trees and bushes to act as natural noise protection barriers on both sides of the road particularly, in front of sensitive areas such as schools, hospitals, libraries and habitation.
- Road safety campaigns should be proposed, and warning signage will be installed along the roads during operational period.

22.3.3 Construction of the Roads

New road construction proposed by the master plan would bring some significant impacts on natural and social environments especially, where some sections of the new roads pass through forest and residential areas in which large number of land acquisition and resettlement activities are involved and further EIA study is required those mentioned sections. The following are details of some negative and positive effects by construction of the new roads:

Positive Impacts

Upon completion, it is expected that traffic congestion in urban areas should be reduced as a result of construction of the missing link roads, outer ring roads and other new alternative transportation routes. In addition, the potential economic development including trade, commerce and other basic service activities will be induced along the both side of the roads leading to increasing of job opportunities and employments of local people especially, the poor.

Negative Impacts During Construction Period

- Land acquisition and involuntary resettlement will be involved where the road construction pass through residential, agricultural areas.
- Where some sections of the roads pass through the protected areas such as Dong Phosy and Dong Banxay, a full EIA study is required.
- Air pollutants emitted from construction machines and vehicular traffic will affect ambient air quality.
- Noise and vibration generated by heavy trucks and machineries used for construction activities will be a major problem during construction period.
- Unforeseen risk of accidents that could affect human health and environment such as risks of traffic accidents, risks from transportation of hazardous materials, risks from accidental fire or explosion may occur if there is no proper prevention measure.

Negative Impacts During Operational Period

- Noise disturbance created by vehicular traffic during operational period may affect to habitats of animal and plants where the new roads passes through the protected areas such as Dong Phosy and Dong Banxay protected areas.
- Increased traffic after construction of the roads has the potential to generate air pollution and noise and to increase the number of accidents.

Mitigation Measures

- Where acquisition of local residential land and relocation of local people are required, resettlement action plans with appropriate compensation measures will be prepared to minimize significant adverse impact on local residents especially, on the poor and vulnerable group of people.
- Proper signage and information dissemination should be prepared by the contractor during construction period to avoid an accident.
- Appropriate traffic control measure and traffic management plan should be prepared during construction periods.
- Water spray for earth road surface during construction period can minimize negative impact.
- All vehicles, equipment and machinery used for construction shall be regularly maintained and correctly operated (including the use of dust filters or hoods) so that air quality conforms to acceptable standard.

- Construction materials (sand, gravel and rock) and spoil materials will be transported by truck covered with tarpaulins, and storage of construction materials must be appropriate, especially inflammable and explosive materials.
- Propose plantation of trees and bushes to act as natural noise protection barriers on both sides of the road particularly, in habitation areas.
- Road safety campaigns should be intensified and warning signage will be installed along the roads during operational period to minimize road accidents.

22.3.4 Replacement of the Bridges

Positive Impacts

- Improved bridge with high design standard could ensure safety and convenience of crossing over the bridge.

Negative Impacts During Construction and Operation Periods

- Temporary shops and houses nearby Nong Niang bridge are relocated.
- Waste from construction activities and debris.
- Temporary utilization of the local agricultural and residential lands for temporary detour around the bridges is expected during construction period.
- Temporary traffic disturbance is also expected during replacement of the bridges.

Mitigation Measures

- Resettlement action plans with appropriate compensation measures will be prepared to minimize significant adverse impact on the owners of temporary shops and houses.
- Proper signage and appropriate traffic control measure and traffic management plan should be prepared to avoid traffic congestion and accidents during crossing over the bridge.
- Waste materials and debris from replacement activities should be disposed properly.

22.3.5 Construction of Bus Terminals

Positive Impacts

- Overall traffic congestion problem in Vientiane Capital will be solved.
- Convenience of accessibility to public transport of the local people will increase.
- Job and employment opportunity for local people especially, the poor will be provided as a result of increased activity of local trades/business and other services around new bus stations.

Negative Impacts During Construction Period

- Land acquisition will be involved where the government's land not available for construction of new bus stations.

Negative Impacts During Operational Period

- Air and noise pollution will be increase due to increased vehicular traffic especially, Tuk-Tuk, Jambo and motorcycles around the new bus stations.
- Risk in traffic accident may increase due to improper management of traffic around new bus stations.
- Solid waste generated by passengers within bus stations will be a major problem in the future.

Mitigation Measures

- Where acquisition of local residential land of local people are required, resettlement action plan with appropriate compensation measures will be prepared to minimize significant adverse impact on local residents especially, on the poor.
- Appropriate traffic control measure and traffic management plan around new bus terminals should be prepared to avoid accidents.
- Where the new terminals located nearby the residential areas, noise protection barrier such as high concrete fences and plantation of trees encompassing the bus terminals should be provided.
- Providing of garbage collection bins in each station and frequency or daily disposal of the domestic waste generated within bus terminals should be introduced.

22.3.6 Alternatives

Do Nothing: Do nothing alternative is the case that almost future road network, traffic pattern and public transport services are assumed to be the same as the present situation. Based on the traffic survey and traffic demand forecast conducted by the study team, the volume of traffic tends to increase due to increased number of private cars and motorcycles. Therefore the do nothing alternative would lead to traffic congestion when existing roads are overloaded and public transport is not sufficiently served, resulting in increased air pollution and noise problem. A comparison of potential impacts of the "with" and "without" alternatives is shown in Table 22.3-1.

Alternative 1: This alternative is generated with the combination of two major scenarios: minimum social impact road improvement and bus oriented public transport for road network scenario and public transport scenario respectively. The main idea of this alternative is try to improve public transport system especially, public bus service in order to reduce the number of private vehicles usage (including motorcycles) which is considered as the major source of traffic congestion, accident and air pollutants emission in Vientiane urban centre. On the other hand, improvement of road network including road widening, construction of missing link roads as well as bridge replacement are also proposed in this alternative to ensure smooth flow of traffic for both public buses and other common vehicles.

In parallel with above positive impacts, this alternative will also create some negative impacts especially, impact on social environment which require an acquisition of local residential or agricultural lands and relocation of various types of buildings and structures.

Alternative 2: The idea of alternative2 is similar to alternative1 which intend to improve both road work and transport system. In addition to current services of public bus transport, the new public transport mode such Light Rail Transit (LRT) was introduced in alternative2 in order to provide more capacity in terms of number of passengers with less emission of air pollutants and noise. At present, LRT seems to be a new story for public transport system in Vientiane as well as other cities in Lao PDR. Therefore, LRT will be the better public transport mode due to large capacity with environmentally sustainable alternative for the long term period compared to other alternatives. However, due to LRT mostly require a large scale of financial factor for investment and other supporting basic infrastructures for operation, applying of LRT should be taken into account by the government and responsible agencies.

Thus, based on preliminary evaluation of among above alternatives, alternative1 seems to be most realistic approach in terms of social and environmental point of view for improvement of the urban transport system in Vientiane Capital.

Table 22.3-1 A Comparative Evaluation of Transport System Alternatives for Environmental Aspect

Alternatives	Environmental Impacts	Social Impacts
Zero-Alternative (Do Noting) Present Pattern (Road and Traffic)	Due to increasing number of vehicular traffic and no-control of traffic volume, noise and air pollution will be gradually increased and more than acceptable level. [X]	Not involved Not involved Not acceptable of poor quality of current service Traffic congestion and accident still remain and tend to increase [X]
Alternative1 Minimum Social Impact Road Improvement Bus-Oriented Public Transport	By improving road network with standard design, greenery along the roads will be improved leading to health improvement. By reducing private car use, traffic nuisance such as noise and air pollution will be reduced. Flora and fauna will be affected where some sections of the roads pass forest areas. [R]	Moderate Moderate Largely acceptable of improved bus service Traffic congestion and accident will be reduced [O]
Alternative2 Minimum Social Impact Road Improvement Bus + LRT Public Transport	By improving road network with standard design, greenery along the roads will be improved leading to health improvement. By reducing private car use, and introducing LRT in the city center, noise and air pollution will be decreased. Flora and fauna will be affected where some sections of the roads pass through forest areas. [O]	Large Large Largely acceptable of improved bus service and LRT Traffic congestion and accident will be reduced/ Large amount of investment is required [R]

Note: Social Impact:1) ROW acquisition, 2) Relocation of PAP, 3) Public Acceptance, 4) Other effects
Evaluation: [O]= Most Realistic Alternative, [R]= Realistic Alternative, [X]= Not recommended

22.4 INSTITUTIONAL REQUIREMENT, MONITORING PROGRAM AND COSTS

This section briefly describes the proposed institutional arrangement and monitoring activities to be carried out, and cost estimates required for this management and monitoring activities. In addition, tentative TOR for EIA for further environmental assessment was also prepared in this section. However, the detailed EMP including (i) a summary of potential impacts, (ii) proposed mitigation measures, (iii) proposed environmental quality monitoring program, (iv) community consultation, (v) responsibilities for mitigation and monitoring requirements, (vi) responsibilities for reporting and review, and (vii) cost estimates will be provided in the IEE/EIA for individual projects during feasibility studies proposed in the master plan.

22.4.1 Institutional Requirement

(1) Legal Framework and Responsibility

STEA: Under the Regulation on Environmental Assessment in the Lao PDR (2000), STEA is a coordinating agency for all environmental programs in Lao PDR which responsible for providing overall environmental guidance and reviewing and approving the environmental assessment reports and issuing the environmental compliance certificate for all development projects.

VSTEO: In the Vientiane Capital, STEA is represented by the VSTEO. The VSTEO is responsible for making both short and long term environmental management strategies, monitoring all implementation of environmental management and environmental policies in Vientiane Capital which has District Environmental Management Units as a supporting or coordinating agencies.

MPWT (initially MCTPC): Since the project is expected to be involved with improvement of urban transport system in Vientiane Capital, MPWT is directly responsible for monitoring and evaluating the implementation of the EMP of this project, and is obliged to report to STEA according to the Regulations on Environmental Assessment in the Lao PDR (2000). Within MPWT, overall environmental assessment and management of road sector projects in Lao PDR is under the responsibility of the Environmental and Social Division (ESD). On the one hand, the agency responsible for environmental assessment and management of transport sectors has yet to be determined.

(2) Institutional Arrangement and Responsibility

The project Management Unit (PMU) is responsible for whole project including implementing the measures for mitigating the negative environmental impacts and overall environmental monitoring during construction phase in the project area. A group in charge of environmental management and monitoring will be established under the guidance of the

PMU and, on behalf of the PMU, will manage all issues relating to the environment during the various stages of the project implementation such as before project implementation, during the project construction and during project operation and maintenance.

22.4.2 Environmental Monitoring and Management Plan

The IEE has identified the generic monitoring and management program, which will help mitigate adverse impacts. The effective implementation of the mitigation measures to mitigate or minimize the environmental impacts would require the program to undertake a comprehensive monitoring. The objective of monitoring is to ensure that the construction and operation activities are carried out in an environmentally sensitive and responsible manner, and in accordance with the recommendations of IEE. The monitoring during project construction will focus on implementation of mitigation measures to minimize pollution (dust and noise disturbance generated during construction phase), road traffic congestion and accident. The monitoring during project implementation will focus on air quality (dust, TSP, PM10, SO2 and NOx), noise generated from vehicular traffic and transportation of passengers and freight, waste management (solid waste and wastewater) and other problems regarding road traffic and accident. The result will be compared to the baseline data gathered during the initial IEE preparation. From the comparison, the environmental situation in the project area can be assessed:

- Actual scope and level of impacts and their critical level from environmental pollutant sources compared with the predicted condition,
- Impact of pollutants,
- Measures to protect environment in the project area and,
- General effectiveness of those measures.

22.4.3 Environmental and Monitoring Cost

The project Management Unit (PMU) is responsible for implementation of the EMP during project implementation. The cost needed for environmental management and monitoring (including costs for mitigation measures and monitoring) will be prepared in the next stage when the project component of master plan is clearly defined.

22.4.4 Terms of Reference for an EIA

Since the Master Plan on Comprehensive Urban Transport in Vientiane Capital has not finalized yet, the tentative terms of reference for the EIA for the study of the Master Plan on Comprehensive Urban transport in Vientiane Capital is established and will be finalized later. The tentative Terms of Reference for conducting the EIA for this study are as follows:

(1) Introduction - Identification of the project to be assessed and explanation of the executing arrangements for conducting the EIA.

(2) Background Information – A description of the major component of the proposed projects, the implementing agencies, and a brief history of the projection and its current status.

(3) Study Area – Specification of the boundary of the study area for assessment as well as any adjacent or remote areas, which should be considered with respect to the project.

(4) Scope of work – Standard environmental impact assessment techniques will be used including site reconnaissance, literature review, Internet search, field work, data analysis and interview with appropriate personnel, in order to satisfy the TOR. The following tasks will be performed by the employee:

Task1: Description of the proposed projects: A full description of the projects and their existing setting, using maps as appropriate. This is to include general layout, size, location, physical characteristics, biological environment and socio-cultural setting

Task2: Description of the environment. Assemble evaluation and present data on the relevant characteristics of the study area. Information will include the following:

- Physical environment: Geology, topography, soils
- Natural environment: Surface drainage, flood risk
- Biological environment: Forest/vegetation cover, existing wildlife (flora and fauna), rare or endangered species, sensitive habitats, species of commercial importance, migratory birds, nuisance species, pests and insects.
- Socio-cultural environment: land use, traffic patterns, proposed developments, public health issues, demographics, employment and waste management.

Task3: Determination of potential impact of the proposed projects. Impacts will be determined as significant positive or negative, direct or indirect, short-term or long-term, unavoidable or irreversible. To identify significant adverse impact on natural and social environments caused by project activities, the details of preliminary baseline surveys of affected lands, houses, shops and other structures; air quality (including dust and pollutants); noise and vibration; flora and fauna; and others are required. In addition, cumulative effects of the proposed development will also be highlighted.

Task4: Mitigation and management of negative impacts. Recommendation will be made for feasible and cost effective measures to prevent or reduce significant impacts to acceptable levels.

Taks5: Recommendations for the development of an environmental management plan. Recommendation will be made for the development of an environmental plan to ensure that procedures are in place to handle any significant impacts of the project.

Task6: Recommendations for the development of a monitoring plan. Recommendations will be made for the development of a monitoring plan to implement the mitigation measures and long-term minimization of negative environmental impacts.

Task7: Public participation and consultation with local residents, community leaders, local government organizations, NGOs and relevant governmental agencies through consultation meeting and interview will be undertaken in order to involve all local people, stakeholders and concerned agencies into EIA process as well as project implementation.

(5) Report – the EIA report will be concise and limited to the significant environmental issues. The main text will focus on findings, conclusions and recommended action, support by summaries of data collected and citations for any references used in interpreting those data. The report will be organized according to general contents and format of an EIA report for development projects in the Lao PDR as shown in Appendix 22.4-1.

(6) The report shall be prepared in close collaboration with the specialist assigned by the employer.

(7) The report shall be written in English by using the Microsoft Word format.

(8) An interim report and the completion of full EIA report in three copies together with a soft copy shall be submitted to the employer in accordance with the designed schedule.

Table 22.4-1 shows type of survey and their baseline data required during further EIA study.

Table 22.4-1 Type of Survey and Their Baseline Data Required During Further EIA Study.

Type of survey	Information Requirement	Location	Method
Air Quality	SPM, PM10, NO2, CO2, SO2, wind and weather condition data	Along the road and Junction/intersection points proposed to improve and construct*	Installation of air quality measurement equipments
Noise	dB[A] (Leq8, Leq24 and Lmax)	Along the road and Junction/intersection points proposed to improve and construct*	Installation of noise level measurement equipments
Water Quality	pH, BOD, TSS, DO and etc	That Luang Marsh	Sampling collection test
Flora & Fauna	Diversity of wildlife and their habitat at protected areas and wetland area. Number of ancient or mature trees would be cleared.	That Luang Marsh, Dong Phosy and Dong Banxay forest conservation areas	Field survey and Data collection from relating agencies
Social and Culture Heritage	Income and employment condition Quality of life (water, sanitation and education) Accessibility to infrastructure, public/ governmental institution. Local ancient cultural/heritage sites would be damaged by the project.	Along the roads proposed to improve and construct	Field survey and Data collection from relating agencies
Resettlement	Number of APs. Area of lands (including residential, agricultural, industrial lands) and government/ public lands acquired by the project. Number, type and size of affected structures/building (House, shop, factory, company and other business building). Other government/public assets such as electricity pole, traffic sign, etc would be affected by the project. Land price (government set up and market prices)	Along the roads and Junction/intersection points proposed to improve and construct	Field survey

* Selection of sites to install air and noise monitoring equipments should be considered based on density of population, ease of access, and availability of night time security to guarantee safety of monitoring equipments.

Note: TSP= Total Suspended Particulates; PM10= Particle Less Than 10 Microns in Diameter; SO2= Sulfur Dioxide; NOx= Nitrogen Dioxide; CO2=Carbon Dioxide

22.5 PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

22.5.1 Objective and Methodology

The main objective of public participation during the study period of IEE under the study of master plan on comprehensive urban transport in Vientiane Capital is to establish the clarification, understanding and participation among local people and government officers (both local and central levels), NGOs and private business sectors. On the other hand, the public participation is an effective tool for public hearing and listening to opinions and suggestions from the public for consideration in the project development. For this study, the public consultation and discussion with various target groups of people were carried out through three manners as following:

(1) Stakeholder meeting

During this IEE preparation, two stakeholder meetings took place with various stakeholders from line ministries, departments, NGO and other related organizations, freight and public transport operators (including public and private sectors) in order to involve them to the earliest stage of the study. The 1st stakeholder meeting was held on August15, 2007 at Don Chan Palace Hotel in Vientiane Capital. On the one hand, the 2nd stakeholder meeting was held under the joint auspices of the 3rd steering committee meeting on January15, 2008 at Vientiane Governor Office. However, it is expected that some additional stakeholder meetings will be held within 2008.

During the 1st and 2nd stakeholder meeting, various opinions and comments regarding current condition of transport system in Vientiane Capital and improving approaches were pointed out from participants. The details of agenda, list of registered participants and minutes of meeting of both 1st and 2nd stakeholder meetings are shown in Appendix 22.5-1a, Appendix 22.5-1b and Appendix 22.5-1c.

(2) Consultation and discussion with concerned government officers

In addition to above stakeholder meetings, the public consultations with a wide range of relevant government officials at different levels of district within Vientiane Capital as well as at the central levels were carried out (see Appendix 22.5-2 for list of local officials with whom urban transport and environmental issues were discussed during IEE study). During that time, several concerns, opinions and suggestions from those government officials were pointed out. These concerns and suggestions were considered in preparing proposed mitigation measures and the Environmental Management Plan (EMP).

(3) Interview and discussion with local residents within project districts

Interview and discussion with local residents and community leaders in project districts were

carried out during October to November 2007. The interview was conducted with 3,234 households within 144 villages of 6 districts (see Appendix 22.5-3 for list of number of households by village and district). The issues of current transport system, road safety, environmental condition, and benefit and impacts of the improvement of transport system were the main subjects needed to discuss during the interview.

22.5.2 Summary of the Result of Public Consultation and Discussion with Concerned Local Government and Villagers

(1) Summary of Discussion of Local Officials

The discussion on urban transport and environmental issues were made with various local officers of six districts within the study area and many useful opinions and comments were gained from those people. The following are some opinions and comments raised by different group of local officers:

A. District's CTPC offices.

Most of local officers from each district's CTPC office expressed their appreciation to the study of master plan which would contribute to more improvement of urban transport system in Vientiane Capital, especially improvement of road network and public transportation. During discussion, some district's CTPC officers stated that the traffic accident and congestion as well as dust were considered as a major problems of urban transport in Vientiane, they also pointed out that the main sources of such problems were due to the increased number of private vehicles including motorcycles, illegal parking along the roads especially, in front of business and commercial areas. Moreover, lack of effective enforcement of law or regulation was also one source of that problem.

The major concerned of the district's CTPC officers relating to individual project implementation proposed in master plan were land acquisition and resettlement activities because of the improvement of road and public transport facilities such as bus terminals and intersections requiring large scale of relocation/demolition of building or structures, compensation and long process of consultation with local people and community organizations along the project areas. In addition, illegal transportation of sand, soil and gravel during night or sleeping times was also source of dust and noise disturbance. For public transport, they thought that public transport, particularly public bus service was a better choice for people especially, for the low and medium income group of people for daily traveling. However, the public transport did not attract the people to use because it could not secure reliability of service in terms of waiting time.

B. District Forestry and Agriculture Offices.

The local officers from district Forestry and Agriculture Office said that they concerned about agricultural and cultivation lands of local farmers that would be lost by the clearing of the ROW, especially for the new alignment of proposed missing link roads passing through the large area of agricultural areas and irrigation canals. In addition, they also concerned about impacts on fauna and flora within protected areas such as Dong Phosy, Dong Banxay conservation areas and That Luang marsh. The local officers said that although they assumed that there was no significant impact on wild animals along the existing road alignment since the core habitat of animals was far from the roads, however in long term period, some potential negative impacts on wild animals may occur due to increased traffic and heavy transportation along the road in the next future. Therefore, the local officers suggested that further specific study on natural environment should be included into the project components of the master plan.

C. Vientiane Science, Technology and Environmental Office (VSTEO)

The representative of VSTEO stated that it was a great time to improve urban transport system in Vientiane Capital since the number of vehicles and traffic volume were increasing rapidly, resulting in traffic accident and congestion. In addition to increased traffic volume and number of vehicles, the poor condition of road network and low standard vehicle, especially motorcycles were also the sources of above problems. Moreover, they also pointed out that no respect on driving rule and regulation and lack of awareness of road safety of the drivers were the other source of traffic accident and congestion.

In terms of public transport, they said that the number of buses serving by the operator was not sufficient and most of them were in poor condition and this was the reason why the public transport could not attract the people at present. They highlighted that introduction of private operator was a good way to increase more competition in order to benefit the users and promote more using of public transport of the people. Regarding LRT system, event if it would require large financial scale for investment, they thought it was a good system for long term period due to its large capacity of service with less emission of air pollutant during operation. However, LRT system was still new for Laos so that the introduction of this system should be taken into account to avoid unexpected impacts.

(2) Summary of Discussion with Local Villagers within Study Area

During IEE study, the questionnaire relating to current environmental problem and urban transport issue were raised to different groups of people in terms of age, level of education and occupation. A summary of the responses of local people is shown in Table 22.5-1. According to the figure of responses of the local resident on problem relating to urban

transport such as air and noise pollution presented in Table 22.5-1, nearly half of the interviewed people weighed a noise and dust problems at moderate and big level. While, air pollution was also weighed by the local residents but the level of air pollution ranged from moderate to small levels. Based on the result obtained during interview, the people thought that the major sources of noise and air problems (including dust and air pollutant) were from bad condition of existing roads and vehicles. Moreover, lack of specific regulation or measure for noise and air pollutant emission control was also one reason that such problem still retained.

Regarding current services of public transport modes in Vientiane, more than half of the interviewed people said that the service of public transport service especially, bus, Tuk -Tuk and Song Theo was still sufficient while, only Taxi services that the people though it was enough with current demand. During interview, more than half of local people usually complained about quality of vehicles serving with poor and overload condition.

The major concern of the local people/communities was about their properties that would be lost or damaged by the project implementation. Reflecting this, the land acquisition and relocation issue was the common issue questioned by the local people during the interview. However, most of them said that they were willing to move with full compensation if the project required acquisition of land and resettlement.

In general, most of local residents (about 3,179 respondents or 98% of the total) expressed their supporting ideas to the implementation of project. This was because the people understood that the project would contribute to potential economic development and tourism promotion, and their quality of life would be improved by improvement of their accessibility to the public transport with cheaper, comfortable and better environmental condition.

Table 22.5-1 Details of Responses of Local Residents on Urban Transport Improvement in Vientiane Capital.

No	Issues	Response (individual)					
1	What are the causes of road accident?	Bad condition of vehicle	Road condition	Increasing of vehicle	ineffective law enforcement	Attitude of driver	People not respect to regulation
		695	1,508	2,255	847	2,505	1,894
2	What are the causes of traffic congestion?	Bad condition of vehicle	Road condition	Increasing of vehicle	ineffective law enforcement	Attitude of driver	People not respect to regulation
		794	1,363	2,674	1,428	1,866	1,569
3	What are the causes of Noise disturbance?	Bad condition of vehicle	Lack of noise emission control	ineffective law enforcement	Attitude of driver		Other
		2,438	2,408	1,868	2,918		71
4	What are the causes of Air pollutant?	Bad condition of vehicle	Lack of effective emission control	Increasing of vehicle	ineffective law enforcement		Other
		2,797	3,002	1,344	2,541		18
5	What are the causes of dust?	Road condition	Soil and rock transportation	ineffective law enforcement	Lack of frequent cleaning of the road		Other
		2,750	2,689	1,590	2,671		3
6	Weight of problems related to urban transport	Very big	Big	Moderate	Little		No
	Noise disturbance	218	1,248	1,442	308		18
	Dust	351	1,189	1,147	525		22
	Air pollutant	66	423	1,314	1,264		169
7	What do you think about road condition in VT	Good	Narrow	Fair		Poor	
		636	1,233	1,282		84	
8	General view on improvement of urban transport system	Support		Against		Don't know	
		3,179		46		9	

9	What do you thing about public transport services?	Enough with demand	Not Enough	Not on time	Old vehicle	Bad attitude of driver	Overload	Expensive
	Bus	2,085	1,007	1,023	2,415	417	1,714	117
	Tuk Tuk	2,196	792	576	1,950	908	471	2,242
	Taxi	954	2,001	435	1,557	493	226	2,246
	Song Theo	1,243	1,641	534	1,182	874	1,536	1,343
	Bike Taxi	25	185	13	18	19	6	21

10	What will the improvement of urban transport contribute to economic development?	Promoting potential tourism development	Reduce expenditure for transportation	Encourage people to use public transport and preserve environment	other
		1,079	2,625	1,813	8

11	If the improvement of the urban transport requires acquisition of your properties, what is your view on resettlement?	Willingness to distribution with out compensation	Willingness to the distribution with full compensation	Other
		480	2,725	29

Source: Field survey, November, 2007.

22.6 FINDINGS

It is expected all project components proposed in the Master Plan will create some positive impacts on social environment as a result of improvement of traffic flow in the urban areas of Vientiane Capital, public transport system (reduced travel time and price) and road safety (in particular in each black spot and intersection)

The IEE study reveals that the implementation of the development activities such as intersection improvement, bridge replacement and construction of new bus stations proposed in the master plan would create minor significant negative impact on both natural and social environments, however the proposed mitigation measures could minimize those negative impacts during project implementation.

For the other components of development activities (such as road widening and construction of missing roads) proposed in the Master Plan will create some major significant impacts on both social and natural environments. A number of land acquisition and relocation of houses, shops and other structures from the areas will be major negative impacts on social environment, while the loss of natural grown trees and planting trees and animals due to project implementation activities will be negative impacts on natural environment, especially where the roads pass through forest or protected areas such as Dong Phosy and Dong Banxay forested protected areas.

22.7 CONCLUSION

Upon completion of proposed project components of master plan on comprehensive urban transport in Vientiane Capital will be caused some environmental impacts, which will be both positive and negative. The positive impacts are improvement of public transport system, traffic flow, health quality of local residents and environmental conditions including noise and air pollution in the urban centre will be decreased.

In parallel with positive impacts, some minor significant adverse impacts on social and natural environment will be caused by implementation of the major components of the master plan. However, those minor adverse impacts will be minimized through proper mitigation measures during construction and operational periods. However, the environmental monitoring included in the environmental management plan should be properly carried out during construction regularly and through the operation by environmental concerned agencies to ensure mitigation measures are properly implemented as required.

In addition to above minor adverse impacts, it is anticipated that some activities of major components of the master plan such as road widening and construction projects will cause some significant adverse impacts on both social and natural environments such as large scale of land acquisition and resettlement in densely-populated areas, and encroachment on flora

and fauna where some sections of the roads pass through forest or protected areas. Therefore, further specific studies or a full EIA study with clarification of Terms of Reference (TOR) need to be carried out for such proposed project components. The details of TOR for an EIA study and its general outline for the EIA report were prepared in section 6.4 of chapter VI.

References

1. Environmental Protection Law (EPL) No. 02/NA/99 (1999), STEA

2. Regulation on Environmental Assessment in the Lao PDR (2002), STEA

3. JICA Guidelines for Environmental and Social Considerations (2004)

4. Environmental Guidelines (1999), MCTPC

5. Road Law (1999), MCTPC

6. National Forestry Law (1996), MAF

7. National Law on Land (2003), Department of Land, Ministry of Finance

8. Decree on the Compensation and Resettlement of the Development Project (2005), Prime Minister's Office

9. Preservation and Management of National Cultural Heritage, Notice No. 943 (1995), Ministry of Information and Culture

10. Regulation of the Management of National Biodiversity Conservation Areas (NBCAs), Aquatic and Wild Life (2003), MAF

11. Environmental Studies, final report (June 2004), Road for Rural Development Project, ADB TA 3756-LAO

12. Ambient Air and Noise Monitoring in Vientiane Municipality (Sep2002-Feb2003), MIH and STEA

13. Air Quality and Noise Level Monitoring Programme for Vientiane and Selected Province, Technical Advisory Note (September, 2006), Sida and STEA.

14. 2005 Statistical Report on Tourism in Lao PDR, LNTA

CHAPTER 23

CONSIDERATIONS ON IMPLEMENTATION

SYSTEM AND ORGANIZATION

CHAPTER 23 CONSIDERATIONS ON IMPLEMENTATION SYSTEM AND ORGANIZATION

23.1 PROBLEMS IN IMPLEMENTATION SYSTEM AND THEIR MEASURES

This Master Plan mainly proposes the measures in three major areas of transport/traffic, *ie*. improvement of road network, improvement of public transport system and traffic management. Through discussions with the officials of the relevant organizations of the following problems for implementation of the projects proposed in the Master Plan have been identified.

(i) Necessity of strengthening legislation system, as well as its enforcement, for securing future right of way, in line with adequate urban planning
(ii) Ambiguity in responsibility/function for policy making and planning of public transport/bus services

These problems are vital to the successful implementation of the Master Plan, and thus, indispensable for achieving the targets of the Master Plan.

23.1.1 Necessity of Strengthening Legislation System for Securing Future Right of Way

One of the salient features of the proposals made in this Study is to secure the right of way (ROW) in advance to enable future widening of the road when it becomes necessary. If the additional ROW needed for widening is to be acquired in a short period, such as one year, it will cause harsh negative impact for those to be relocated. One of the practical methods for securing the future ROW with minimum negative social impact is to prepare and authorize an urban development plan where the plan of future ROW is clearly designated and construction of new buildings within the designated ROW is regulated.

In the process of socio-economic development, many houses and building become less useful and need to be rebuilt. If there is a rule to prohibit constructing new houses within the designated future ROW, the houses to be rebuilt are necessarily constructed out of future ROW. The owner of the house to be rebuilt can freely plan the timing of relocation by evaluating the remaining life period the existing house. This will greatly reduce the negative impact or inconvenience caused by rebuilding, and thus, greatly reduce social impact. Figure 23.1-1 shows the concept of securing future ROW with this method.

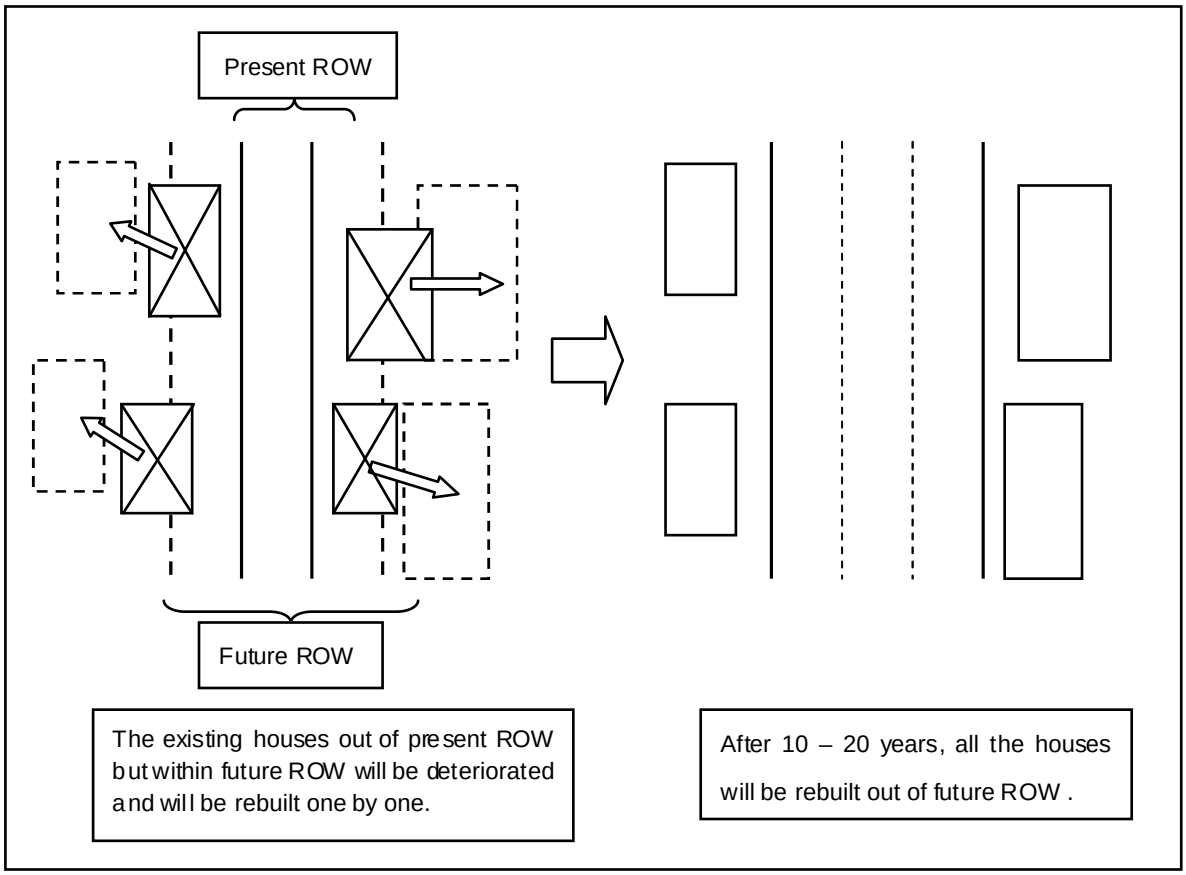
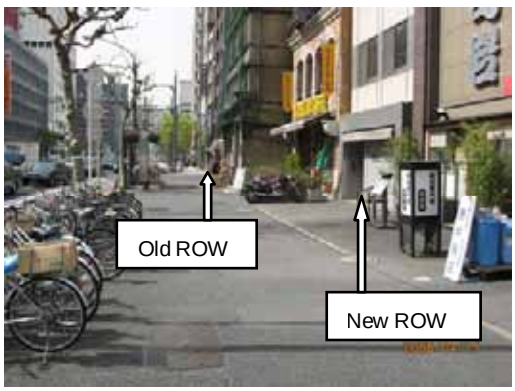
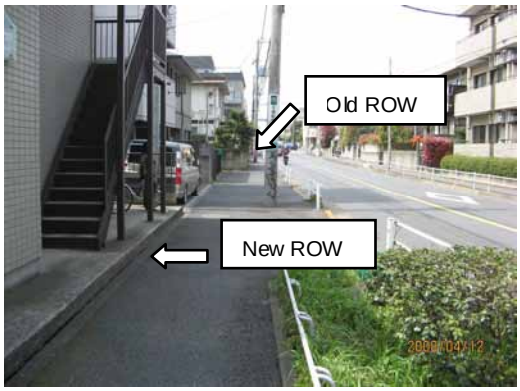


Figure 23.1-1 Securing Future ROW by Prohibiting Building New House in Designate ROW

This method has been effectively used in Japan to mitigate the negative impact of resettlement. Figure 23.1-2 show examples of street where newly built houses/building is constructed out of future ROW and old building is still remaining along old ROW.



Commercial/Business District



Residential District

Figure 23.1-2 Building/Houses Along New and Old RROW

23.1.2 Ambiguity in Responsibility for Policy Making and Planning of Public Transport

Diligently prepared business plan is indispensable for sound development of public transport, just like any other business. To prepare business plan, establishment of policy on public transport is necessary.

The policy on public transport should clearly show the following aspects:

(i) Is the public transport regarded as 'pure civil service' or 'pure business', or mixture of these?
(ii) If the public transport is operated by a governmental or semi-governmental institution, to what extent is the right of decision making given to the said institution?
(iii) What is the basic policy for financing?
(iv) What is the basic policy for participation of private enterprises?

Once the policy for public transport is established, a business plan of public transport (bus cervices) should be prepared illustrating the following items:

(i) Analysis of present demand and estimation of future demand
(ii) Calculation of frequency of operation by route and number of bus units needed
(iii) Estimation of the fund required for purchasing and maintaining the bus fleet and periodical replacement of bus units
(iv) Financing plan

It is recommended that the Ministry of Public Works and Transport establish the policy for public transport and VSBC prepare its business plan based on the public transport policy.

23.1.3 Coordination Committee on Urban Transport

As can be seen in the above, solution of problems of urban transport often needs close coordination/cooperation of relevant institutions. For this reason, coordination committees on urban transport have been established in many countries, participated by such institutions as ministry responsible for road and transport, representative of the concerned city or province, traffic police division etc. This mechanism is worth being considered to be adopted in the case of Vientiane.

Therefore, it is recommended that a coordination committee for urban transport be established. The committee shall consist of the members including the following:

- Vice Minister in charge of transport, MPWT (Chair person)
- Director of Transport, MPWT

- Director of Roads, MPWT
- Vice Governor of Vientiane in charge of transport
- Mayors of Districts
- Representative of VUDAA
- Representative of Traffic Police
- Representative of Bus Operators
- Representative of Para-Transit Associations
- Representatives of Users of Public Transport/Roads, such as University, Chamber of Commerce

23.2 PROBLEMS IN IMPLEMENTING ORGANIZATIONS AND THEIR MEASURES

23.2.1 Road Network Development

The principal responsibility of implementing the road projects in the Study Area is supposed to rest with VUDAA. VUDAA is currently functioning as the implementing agency for various large scale projects financed by the foreign donors. Accordingly, it is supposed that VUDAA has sufficient capacity to implement the road projects proposed in this Master Plan.

On the other hand, as for securing future ROW, the current practice of monitoring construction of new building does not seem to be sufficient. In the 1st Stakeholder Meeting for this Study, held in July 2007, an opinion pointing out that construction of illegal building sometimes cannot be checked. Therefore, the function of VUDAA or other relevant agency for checking illegal building may need to be strengthened. This capacity will be effective also to check construction of illegal houses within the designated ROW, as proposed in Subsection 23.1.1.

23.2.2 Public Transport Development

VSBC is the largest provider of bus services for urban transport in the Study Area. It has been operating buses services in Vientiane and currently owns more than 100 units of buses. Therefore, VSBC is considered to have sufficient experience/capacity for actual operation of bus services.

However the current VSBC does not seem to have clear and well-recognized future business plan. Through discussion with a senior management of VSBC, the Study Team has learned that there is no clearly established mechanism for preparing or approving future business plan of urban bus services in the Ministry of Public Works and Transport which is responsible for administration of VSBC.

According to VSBC, the number of bus units actually operated is around 60 against more than

100 units owned. This situation needs to be urgently improved because decrease in workable buses result in decrease in the revenue as well as decrease in frequency and number of routes of bus operation.

Evidently, buses are automobiles and need replacement after their life period, such as 10 years, is over. Therefore, it is necessary for the operator of buses to plan replacement of bus fleet periodically and prepare the fund for this replacement in order to make the business sustainable.

To cope with the growing demand for bus transport, the number of buses needs to be increased in the future. Clear future business plan, including financing plan, is vital for the development of public transport in Vientiane. It is recommended that the Government and VSBC start preparation of future business plan of VSBC based on the results of this Study.