Socialist Republic of Vietnam
Ho Chi Minh City and Binh Duong Province

Preparatory Survey on Transit Oriented Development in Binh Duong Province and BRT Development Project (PPP Infrastructure Project)

Final Report

Appendix-A: Traffic simulation for comparison of traffic control alternatives at Suoi Tien Terminal

Appendix-C: Draft Environmental Impact Assessment of Binh Duong Bus Rapid Transit Development Projet

February 2016

Japan International Cooperation Agency (JICA)

Tokyu Corporation
Nippon Koei Co,. Ltd.
NIKKEN SEKKEI Research Institute
Koei Research Institute International

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Appendix-A
Traffic simulation for comparison of traffic control alternatives at Suoi Tien Terminal (STT)

1 Background

According to current plan of HCMC, in order to access to STT, BRT needs to use a long detour route which may increase travel time, delay time and decrease travel speed. To mitigate these negative impacts, Survey Team recommended five alternatives for organizing traffic in front of STT in addition to the original plan provided by HCMC. These six alternatives are summarized as follows:

a) Original plan by HCMC: no additional infrastructure would be constructed in front of STT (Case-0)
b) Construct flyover on QL1A for through-put vehicles
c) Construct underpass on QL1A for through-put vehicles
d) Construct a U-turn bridge dedicated for BRT
e) Construct a U-turn tunnel dedicated for BRT
f) Install signalized intersections in front of STT

Due to the complexity of traffic situations in the area, it is challenging to clearly explain merits and demerits of each alternatives. In order to support stakeholders, e.g. HCMC, Binh Duong Province etc., in decision-making process, it is necessary to provide a comprehensive and understandable comparison of these alternatives. Hence, Survey Team conducted a traffic simulation to perform the comparison.

2 Objective

This traffic simulation is aimed to make a detailed quantitative and visible comparison of traffic control alternatives at STT. Particularly, it covers a network of approximately 2 km around STT with conventional vehicle types (truck, standard bus, car, and motorcycle) and BRT. Performances of alternatives would be predicted and compared by following indicators:

- Queueing time and queueing length
- Average travel speed and travel time
- Average time loss and economic loss

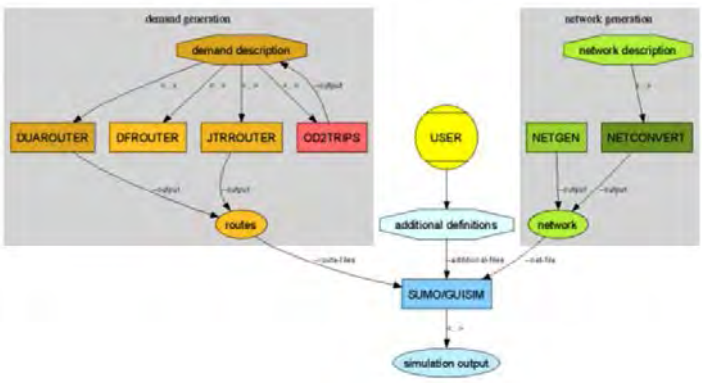
3 Methodology

3.1 Analysis Software

This study used SUMO (Simulation of Urban MObility), a microscopic simulation software which has been developed and freely distributed by Institute of Transport System, Germany since 2001.
(http://www.dlr.de/ts/en/desktopdefault.aspx/tabid-9883/16931_read-41000/)

3.2 Simulation Preocess

Process of simulation is described in Figure 1.



Source: Sourceforge.net: SUMO User Documentation - sumo

Figure 1 Process of simulation by SUMO

Required input data are network configuration (nodes, edges, signals etc.) and traffic demand (flows, routes, etc.).

Network can be either built by 1) generating an abstract network using NETGEN, or 2) setting up manually by user's description and importing it with NETCONVERT.

Traffic demand can be either determinatively assigned by user or dynamically assigned by a built-in module (DUAROUTER, DFROUTER, JTRROUTER, OD2TRIPS).

Additional conditions, such as traffic light, bus stop, etc., can be separately defined by user.

Finally, network, routes and additional conditions are imported to the main calculation module SUMO/GUISM to perform simulation.

4 Traffic Simulation at STT in 2025

4.1 Input Data

(1) Networks

Based on the similarity in traffic situations, the six alternatives could be further combined into three simulation scenarios as follows:

- Scenario 1 (hereinafter referred by "case0"): represents original plan of HCMC, i.e. no additional infrastructure would be constructed in front of STT. BRT and vehicles from Binh Duong would travel on service road to a U-turn bridge and turn left to access to STT.
- Scenario 2 (hereinafter referred by "case flyover"): represents alternative-b) and alternative-c), i.e. a flyover or an underpass would be constructed in front of STT. Through-put vehicles would travel on the flyover/underpass while those accessing to STT would utilize opened spaces on the ground.
- Scenario 3 (hereinafter referred by "case signal"): represents alternative-f), i.e. the area in front of STT would be opened for at-grade intersections. Through-put vehicles would be stopped by signals to give way for those accessing to STT.

Simulations of alternative-d) and alternative-e) are omissible due to the fact that traffic volume of BRT is less than 1% of total traffic volume in the area and thus, solely improving access of BRT would not give much impacts on the entire network. In other words, traffic performance under these 2 alternatives would not be much different from that under original plan (case0).

Details of 3 scenarios are showed in Figure 2.

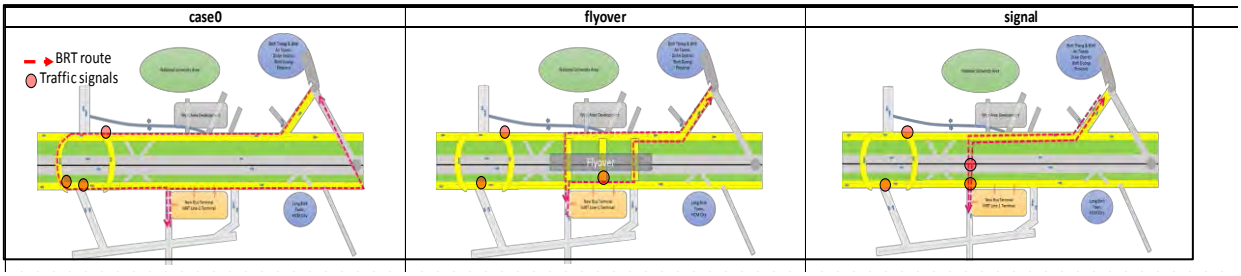


Figure 2 Three scenarios for traffic control at STT

(2) Traffic demand

Table 1 shows traffic demand used in the simulation. They are peak-hour (7:00 am – 8:00 am) volume estimated for 2025. Main through-put vehicles are trucks, buses (coaches) and cars; vehicles from/to STT are BRT, short distance buses, cars and motorcycles.

Table 1 Traffic demand used in simulation

Direction	Main roads (veh/peak hour)			Service roads (veh/peak hour)				Total
	Truck	Bus	Car	BRT	Bus	Car	Motorcycle	
SG-BD	694	631	1037	--	--	--	5428	7790
BD-SG	450	312	528	--	--	--	5550	6840
SG-STT	--	--	--	--	653***	68	477	1198
BD-STT	--	--	--	20	547	68	477	1112
STT-SG	--	--	--	--	653	68	477	1198
STT-BD	--	--	--	20	547	68	477	1112

*Data sources:
SAPI Traffic Survey (2014)
SAMCO NEBR Report
Survey team's result

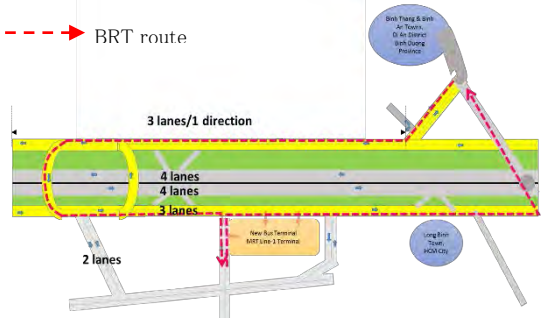
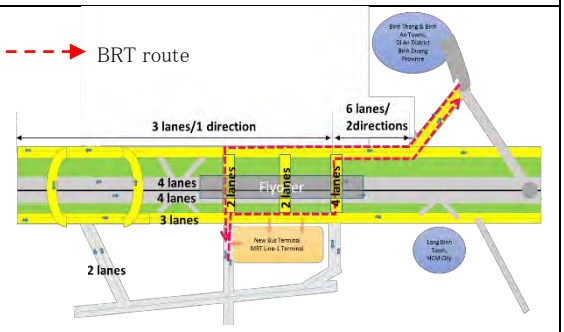
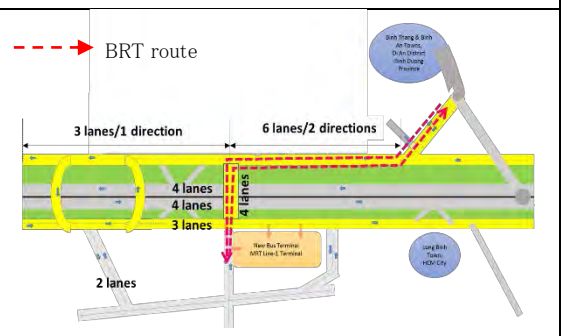
**Notes:
SG-BD: from Tram 2 to Tan Van;
BD-SG: from Tan Van to Tram 2
SG-STT: from Tram 2 turning right to STT
BD-STT: from Tan Van or Binh Duong turning left to STT
STT-SG: from STT to Tram 2
STT-BD: from STT to Tan Van

***In case signal, about 200 buses would be assigned on Main roads.

(3) Road allocation

QL1A in the target area is divided into main stream and service roads. Basically, main stream (8 lanes/2 directions) is used by through-put vehicles while service roads (3 lanes/1 direction) are for vehicles from/to STT. On service roads, the right most lane is dedicated for motorcycle, the middle one is mixed and the left most lane is car lane. Besides, in each scenarios, there are different numbers of connecting roads for traffic from/to STT. Table 2 shows detailed specifications in 3 scenarios.

Table 2 Road allocation in each scenarios

	Description	Figure
Case0	- Service road 1 (From BD): 3 lanes/ 1 direction - Main stream: 4 lanes + 4 lanes - Service road 2 (From SG): 3 lanes/ 1 direction - Connecting road: + For bus from STT to Tram 2: 2 lanes/ 2 directions	
Flyover	- Service road 1 (From BD): 3 lanes/ 1 direction - Main stream: 4 lanes + 4 lanes - Service road 2 (From SG): 3 lanes/ 1 direction – 6 lanes/ 2 directions - Connecting roads: + For bus from STT to Tram 2: 2 lanes/ 2 directions + For arriving BRT: 2 lanes/1 direction + For car, motorcycle: 2 lanes/ 1 direction + For departing BRT: 4 lanes/ 2 directions	
Signal	- Service road 1 (From BD): 3 lanes/ 1 direction - Main stream: 4 lanes + 4 lanes - Service road 2 (From SG): 3 lanes/ 1 direction – 6 lanes/ 2 directions - Connecting roads: + For bus from STT to Tram 2: 2 lanes/ 2 directions + For vehicles crossing main road: 4 lanes/ 2 directions	

4.2 Output

(1) Queue

In this simulation, queueing vehicles are defined as those traveling at less than 5 km/h. Accumulative queueing time and queueing length are shown in Figure 3 and Figure 4.

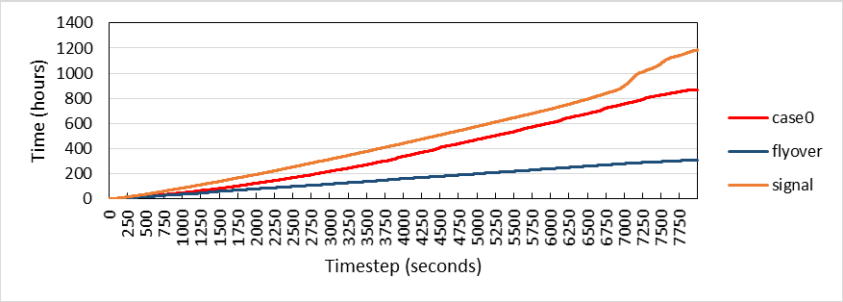


Figure 3 Accumulative queueing time

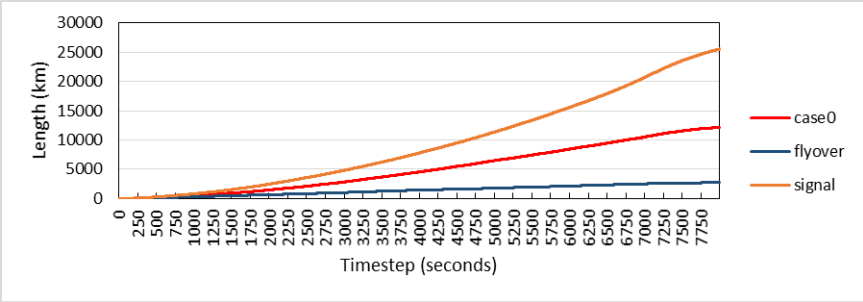


Figure 4 Accumulative queueing length

Table 3 Summary of queueing data

	case0	flyover	signal
Total queueing time (hrs)	869	307	1186
Average queueuing time (s/veh)	358	126	273
Total queueing length (km)	12,122	2,704	25,556

Summary of queueing data is shown in Table 3. In case signal, because traffic on main stream are being stopped at signalized intersections, queueing time and queueing length increase dramatically. However, regarding average queueing time, case0 shows the longest time of 358 s/veh, case signal decreases it to 273 s/veh, while case flyover further decreases it to 126 s/veh.

(2) Speed

Average speeds for each types of vehicle and for all vehicles in the area are shown in Table 4.

Table 4 Average speeds

Average speed (km/h)	case0	flyover	signal
Bus	23.9	30.4	26.0
BRT	33.5	29.9	27.2
Car	23.8	28.9	29.7
Motorcycle	31.1	33.2	33.2
Truck	--	--	32.4
All	**26.9**	**31.4**	**29.4**

To compare the stability of traffic control in the 3 scenarios, degradation of speed over time,

particularly of public transport, e.g. bus and BRT, should be further investigated. Figure 5 and Figure 6 show degradation of speed for buses from Tram 2 and Tan Van to STT. Since BRTs follow nearly the same route with buses from Tan Van, it can be estimated that their speed profiles are similar.

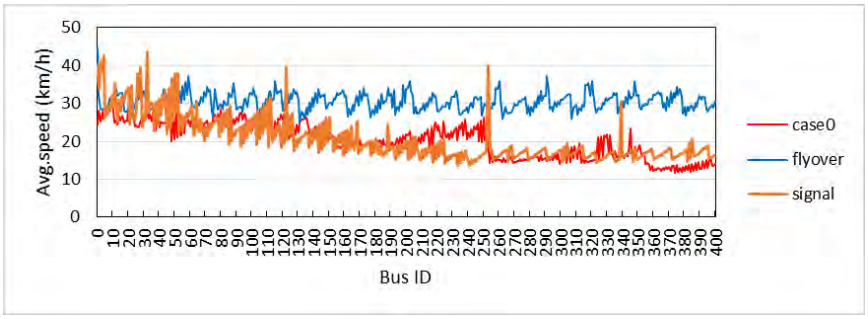


Figure 5 Degradation of speed over time (Bus SG-STT)

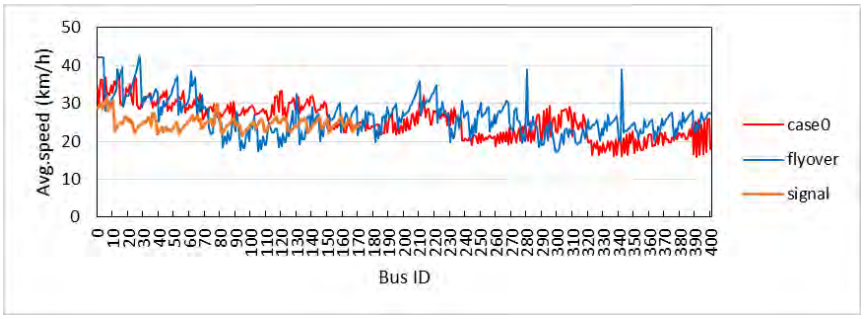


Figure 6 Degradation of speed over time (Bus BD-STT)

For speed of buses from Tram 2 to STT, case flyover shows best performance as the speed are stable at high level over time. Case0 and case signal give similar impacts to speed. In both scenarios, increasing queueing length at entrance blocks vehicles from entering or moving on, thus, their speed gradually decrease over time. However, compared to case0, signal can provide more stable speed for buses which are higher than 15 km/h.

For speed of buses from Tan Van to STT, three scenarios give out similar results. As buses from Tan Van are either interfered by U-turn bridge or traffic signals, their speeds are fluctuating in a range from 15 km/h – 40 km/h.

(3) Travel time of public transport

Travel time of public transport accessing to STT is one of the most significant factors for evaluating the effectiveness of traffic control in front of the terminal. Table 5 shows average travel of buses from Tram 2 (SG-STT), buses from Tan Van (BD-STT) and BRT from Binh Duong (BD-STT) in 3 scenarios.

Table 5 Average travel time of public transport accessing to STT

Average travel time (minutes)	case0	flyover	signal
Bus SG-STT	5.5	3.4	5.2
Bus BD-STT	8.3	2.3	3.3
BRT BD-STT	7.7	2.5	2.5

In case-0, with no extra infrastructure provided, vehicles accessing to STT from Binh Duong

must follow a detour route of about 3 km and merge with buses from Tram 2 on service road 2. This scenario increases travel time not only by the lengthened route but also by congestion on the service road. Consequently, it resulted in the longest travel time for accessing traffic.

In case flyover, vehicles from Tan Van can directly access to STT from service road 1 by connecting roads, thus, route's length can be shortened and congestion on service road 2 can be resolved. This scenario shows the shortest travel time.

In case signal, accessing vehicles from Tan Van can reduce route's length as in case flyover but need to wait for multiple signals before entering STT, thus, travel times in this scenario are longer but not very different from those of case flyover. However, for buses from Tram 2, intersecting with a large volume of buses from Tan Van causes long waiting time at the signal and thus, increase their travel time.

(4) Time loss

Time loss is defined as the difference between ideal travel time, i.e. if vehicle travel with desired speed, and actual travel time calculated in the simulation. It is usually used for measuring economic loss of traffic control scheme.
Table 6 shows average time loss of all vehicle types in the target area.

Table 6 Average time loss of vehicles in the target area

Average time loss (s/veh)	case0	flyover	signal
Bus	78.57	63.43	61.73
BRT	138.69	54.77	102.39
Car	124.18	48.46	105.95
Motorcycle	115.62	54.38	61.81
Truck	--	--	88.24
All	**113.57**	**57.91**	**91.71**

As time loss is estimated based on travel time, it is obvious that case0 shows the highest time loss, case signal shows an improvement of about 22 s/veh and case flyover shows the lowest time loss which is about half of case0.

5 Economic analysis

Based on time loss calculated in the previous section, we estimated economic loss of each scenarios. Results are described in Table 7, 8 and 9.

Table 7 Economic loss in case0

Type	pax/veh[1)]	Avg. loss (s/veh)	no. of veh	Total time loss (s)	Time loss in 1 peak hour (hr.pax)	Time loss in 1 day[2)] (hrs/day)	Economic loss in 1 day[3)] (USD/day)
Bike	1.2	78.57	1507	118,419.56	39.47	466	1,076
Bus	18.5	138.69	2045	283,594.79	1,457.36	17,197	39,725
Car	1.6	124.18	125	15,497.90	6.89	81	188
BRT	23.6	115.62	38	4,439.82	29.11	343	793
TRUCK	--	--	--	--	--	--	--
Total	**--**	**113.57**	**3,715**	**421,952.08**	**1,532.83**	**18,087**	**41,782**

Table 8 Economic loss in case flyover

Type	pax/veh[1)]	Avg. loss (s/veh)	no. of veh	Total time loss (s)	Time loss in 1 peak hour (hr.pax)	Time loss in 1 day[2)] (hrs/day)	Economic loss in 1 day[3)] (USD/day)
Bike	1.2	63.43	1519	96,370.19	32.12	379	876
Bus	18.5	54.77	2227	121,987.96	626.88	7,397	17,088
Car	1.6	48.46	134	6,512.74	2.89	34	79
BRT	23.6	54.38	41	2,218.80	14.55	172	396
TRUCK	--	--	--	--	--	--	--
Total	**--**	**57.91**	**3,921**	**227,089.68**	**676.45**	**7,982**	**18,439**

Table 9 Economic loss in case signal

Type	pax/veh[1)]	Avg. loss (s/veh)	no. of veh	Total time loss (s)	Time loss in 1 peak hour (hr.pax)	Time loss in 1 day[2)] (hrs/day)	Economic loss in 1 day[3)] (USD/day)
Bike	1.2	61.73	1517	93,633.98	31.21	368	851
Bus	18.5	102.39	2825	289,239.65	1,486.37	17,539	40,515
Car	1.6	105.95	1411	149,519.70	66.45	784	1,811
BRT	23.6	61.81	40	2,447.71	16.05	189	437
TRUCK	--	88.24	1037	91,492.14	25.41	300	2,099 [4)]
Total	**--**	**91.71**	**6829**	**626,333.18**	**1,625.50**	**19,181**	**44,308**

*Notes:
1) Occupancy ratio for BRT is the average value in one day, and estimated by the Survey Team; occupancy ratio for other types of vehicles are from SAPI Survey
2) Assume that time loss in off-peak hour = 70% of that in peak-hour; there are 2 peak-hours and 14 off-peak-hours in one day; traffic in night time (about 8 hours) are negligible.
3) Unit value of time of **2.31 USD/hr** is used (From SAPI Survey)
4) Unit value of time of **7 USD/hr/veh** is used for truck (From The Preparatory Survey on Trung Luong – My Thuan Expressway Project in Viet Nam, Final Report, Feb 2013, JICA)

Table 10 shows the comparison of economic loss in 3 scenarios.

Table 10 Comparison of economic loss

	Economic loss in 1 day (USD/day)	Benefits compared to case0 (USD/day)
Case0	41,782	--
Flyover	18,439	23,343
Signal	45,001	-2,526

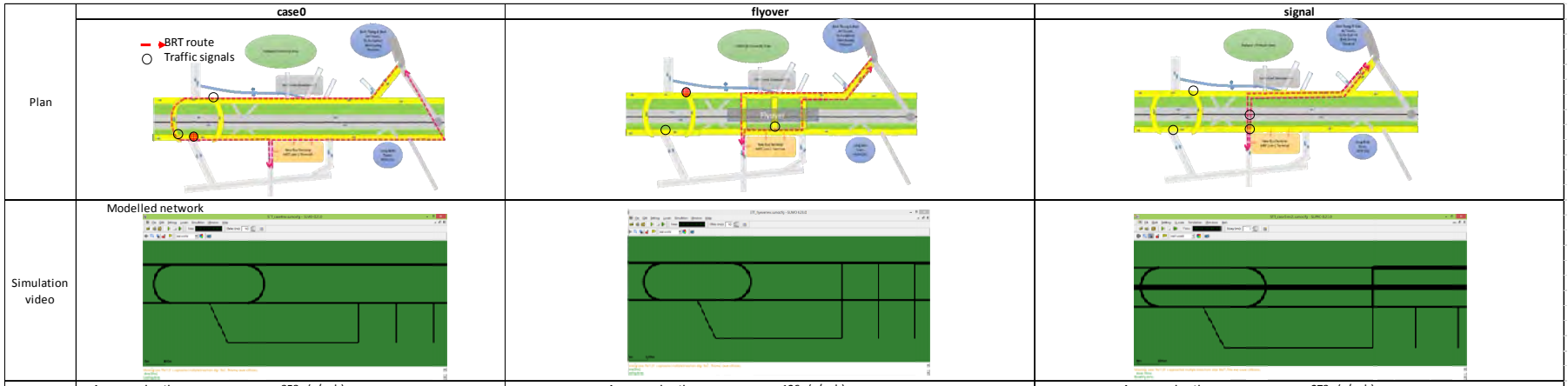
The results indicate that construction of a flyover would bring a benefits of approximately 24,343 USD/day for all travelers in the area while installation of signalized intersections would cause a deficit of approximately 2,526 USD/day.

6 Conclusions and recommendations

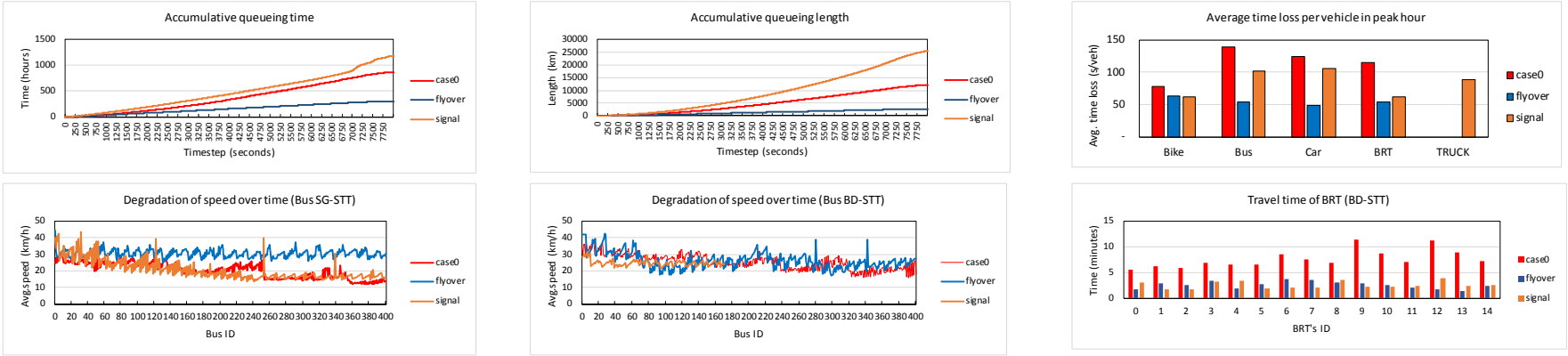
A microscopic traffic simulation was conducted to predict traffic situations in front of STT under different control schemes. Three scenarios representing 6 alternatives proposed by HCMC and Survey Team were analyzed using average queueing time and length, travel time and speed, time loss and economic loss as indicators.

Summary of results is shown in Figure 7.

The results indicated that compared to the original plan of HCMC, construction of flyover or underpass would improve the overall traffic performance in the area including travel time, speed and economic loss. On the other hand, installation of signalized intersections could solely reduce travel time and time loss of buses and BRT while its interference in traffic on main stream increases time loss of through-put vehicles and thus, generates higher economic loss. Consequently, it is highly recommended that construction of flyover/underpass should be prioritized as a permanent solution for the area.



Detailed results



Economic benefit analysis

		case0				flyover				signal			
Type	pax/veh	veh/peak hour	Time loss in 1 peak hour (pax.hour)	Time loss in 1 day (pax.hour)	Economic loss in 1 day (USD/day)	veh/peak hour	Time loss in 1 peak hour (pax.hour)	Time loss in 1 day (pax.hour)	Economic loss in 1 day (USD/day)	veh/peak hour	Time loss in 1 peak hour (pax.hour)	Time loss in 1 day (pax.hour)	Economic loss in 1 day (USD/day)
Bike	1.2	1507	39	466	1,076	1519	32	379	876	1517	31	368	851
Bus	18.5	2045	1457	17,197	39,725	2227	627	7,397	17,088	2825	1,486	17,539	40,515
Car	1.6	125	7	81	188	134	3	34	79	1411	66	784	1,811
BRT	23.6	38.4	29	343	793	41	15	172	396	40	16	189	437
Truck	--	--	--	--	--	--	--	--	--	1037	25	300	2,099
Total	--	3715	1533	18,087	41,782	3922	676	7,982	18,439	6829	1,625	19,181	44,308
						Economic benefit of flyover construction			**▲23,343 USD/day ▲490,208,914 VND/day**	**Economic deficit of signal installation**			**▼2,526 USD/day ▼53,044,144 VND/day**

Figure 7 Summary of simulation results

JAPAN INTERNATIONAL COOPERATION AGENCY

BUS RAPID TRANSIT DEVELOPMENT PROJECT OF BINH DUONG

ENVIRONMENTAL IMPACT ASSESSMENT (DRAFT)

HOCHIMINH CITY, February 2016

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1. Introduction

1.1. Background

The main objective of the Binh Duong Bus Rapid Transit (BRT) Development Project is to develop a BRT system operating between Binh Duong New City and Suoi Tien Terminal Station of HCMC MRT Line-1. The study area is shown in Figure 1-1.

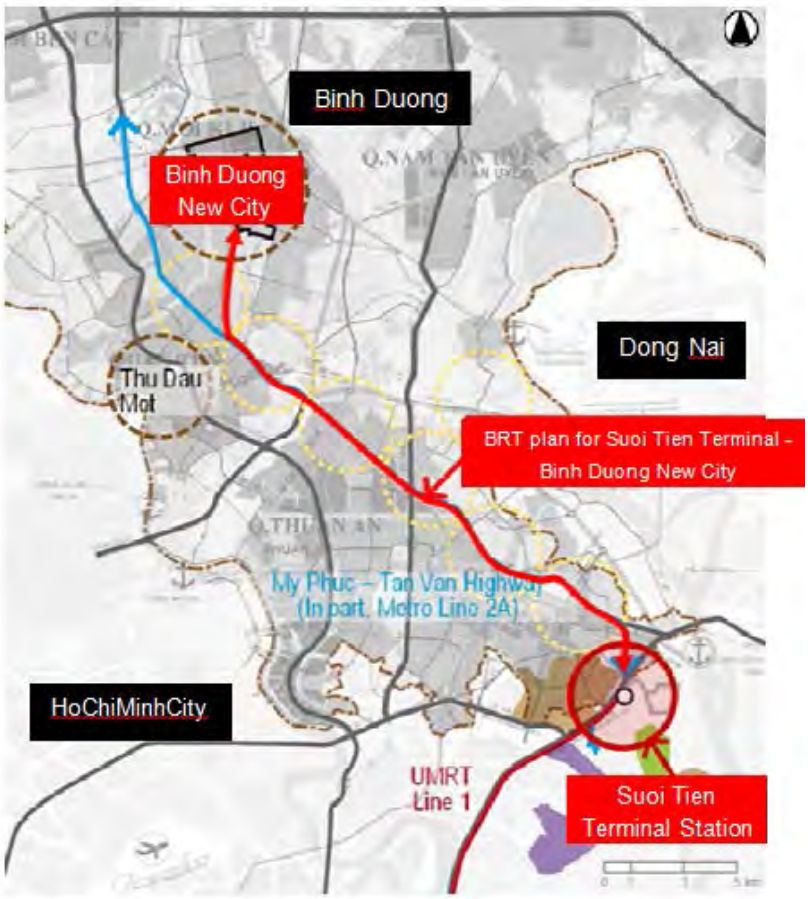


Figure 1-1.Study area

The planned BRT route will start from the BRT Depot located in the north of Binh Duong New City, via Hung Vuong Street, to the intersection in Vo Van Kiet Street, and enter Pham Ngoc Thach Street. Pham Ngoc Thach Street is an arterial road with 4 lanes on each side and 4.3 km of extension, connecting Binh Duong New City and Thu Dau Mot City. At the intersection of Pham Ngoc Thach Street and My Phuoc- Tan Van (Mp-Tv) Road, the BRT route will enter Mp-Tv Road toward HCMC. Mp-Tv Road is the main road of the BRT route. The total length of BRT route on Mp-Tv Road is 21.2 km. At the end of Mp-Tv road, the BRT route will be connected with QL-1 through a planned short-cut road, and finally approach to Suoi Tien Terminal Station of HCMC MRT Line 1 and the New Eastern Bus Terminal that is planned in the east of Suoi Tien Terminal Station.

The construction and operation of the BRT depot, the flyovers and bus stops along the BRT route may cause some impacts to the natural environment and the communities along the route. Therefore, it needs to conduct an Environmental Impact Assessment (EIA) Study in accordance with Japan International Cooperation Agency Guidelines for Environmental and Social Considerations (2010) (hereinafter referred to as "JICA Environmental Guidelines") and Vietnam regulations on EIA, with aim to assess impacts of the project, and propose measures to avoid/mitigate these impacts.

1.2. Content of the study

The EIA Study has aim to identify potential environmental impacts which may be caused by the planned BRT Project, and to propose measures to avoid or mitigate the significant negative impacts. The main tasks of the Study are as followings.

- Confirmation of current natural conditions and site specific
- Confirmation of current socio-economic conditions
- Preparation of environmental scoping
- Baseline environmental survey
- Socio-economic survey
- Preparation of EIA report (draft)

(1) Confirmation of current natural conditions and site specific

Current natural conditions of the areas along the BRT route including the followings were confirmed based on existing data/information and field reconnaissance survey.

- Topographic characteristics, land elevation, etc.
- Meteorological data (rainfall, sunshine, evaporation, etc.)
- Drainage system / sewage system / river system
- Road network, road area ratio
- Green space/area, landscape
- Land use situation, residential condition, outline of ecosystem
- Landmarks, outstanding structures (market, school, hospital, government office, temple, church, relics, high voltage electric power cable, high voltage electric power pole, etc.)
- Environmentally sensitive structures / areas
- Flooding, drainage condition

- Others.

(2) Confirmation of current socio-economic conditions

Current socio-economic conditions of the communes in the project area were confirmed, based on existing data/information and field reconnaissance survey. Main factors confirmed by this survey include the followings:

- Communes, districts
- Population density
- Commune demography (population, number of households, household size, HH income, etc.)
- HH living condition (electric, piped water, toilet, sewage, internet, etc.)
- Major economic activities, occupations, means of livelihood.

(3) Preparation of environmental scoping

After examining current environmental and social conditions of the project area, identifying the environmentally sensitive structures / areas around the project sites, and discussing with relevant Vietnamese authorities, an environmental scoping was prepared to describe range of significant and potentially-significant impacts, and proposed environmental study methods.

(4) Baseline environmental survey

Baseline environmental survey was carried out at 8 sites located near the planned flyovers along Mp-Tv Road. The baseline data on air quality, noise and vibration were collected, and used to assess the current quality of environment, and for the environmental monitoring during the project implementation in the future.

(5) Socio-economic survey

An interview to about 200 households was conducted to collect baseline data on socio-economic conditions of the project-affected persons (PAPs) and to prepare profiles of PAPs, which are necessary for assessing effectiveness of the project in the operation phase.

(6) Preparation of EIA report (draft)

An EIA report (draft) was prepared which the contents conformable with JICA Environmental Guidelines.

2. Outlines of the project

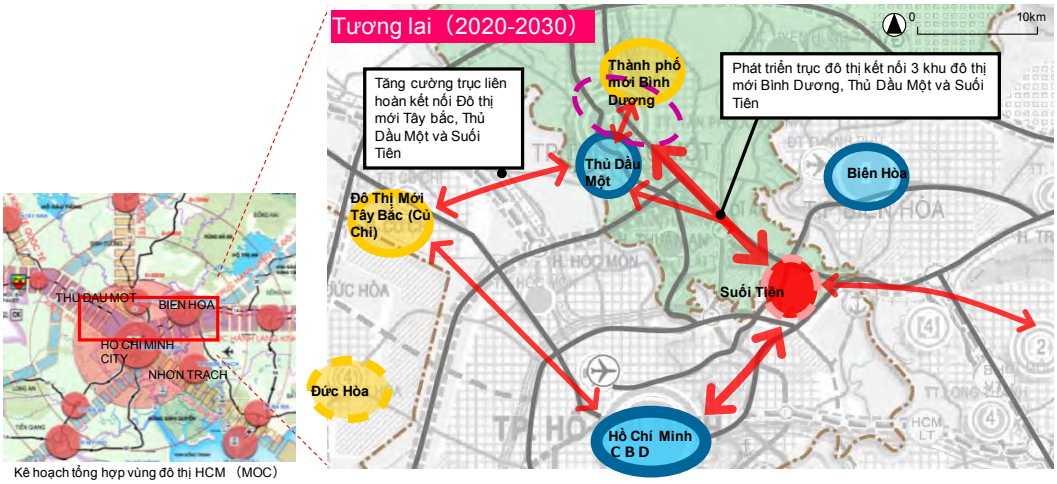
2.1. Objective of the project

In Vietnam, the development of transportation infrastructure does not scope with the traffic demand which is rapidly increasing together with the economic growth. Especially, in Ho Chi Minh City, there are critical issues of transportation such as traffic jam, accidents, air pollution, noise, vibration, etc.

To improve the current situation, the Government of Vietnam has prepared the Socio-Economic Development Strategy (SEDS) 2010 - 2020 that includes policies to develop transportation system in the major cities. The development of transportation infrastructure is also considered as one of the most critical issues in the 5-year implementation strategy.

Based on the above-mentioned SEDS, HCMC is implementing the MRT Line-1 Project with Japanese ODA and technical cooperation. The planned MRT Line-1 has 19.8 km of extension, and will connect Ben Thanh Station in the central business district (CBD) of HCMC and Suoi Tien Terminal Station in District 9 in the east of the City. Its operation is scheduled to be started in 2019. It is expected that the MRT Line-1 will contribute to the modal shift from private cars and motorbikes to public transportation means, and further socio-economic development of HCMC and its surrounding regions.

On the other hand, there are several newly-developed urban cities around HCMC whose population is rapidly increasing, such as Binh Duong New City and Cu Chi, in addition to the existing urban cities such as Thu Dau Mot City, Bien Hoa City, etc. (See Figure 2-1) Public transportation is considered indispensable to efficiently link these cities together.



Source: JICA Study Team

Figure 2-1. Assumed future urban axis at HCMC Metropolitan

The planned BRT route which links Binh Duong New City and Suoi Tien Terminal Station would contribute a lot to solve negative aspects of urban development such as urban malfunctions and environmental unfriendliness.

Major objectives of the Project are:

a) Strength inter-city nodes on the urban axis linking Binh Duong Province, HCMC, and Dong Nai Province: Suoi Tien Terminal Station is located in the center of the developing areas of Binh Duong Province, HCMC, and Dong Nai Province, which has development potential as an inter-city node.

b) Contribute to the efficient use of HCMC MRT Line-1: The project would contribute to MRT ridership and sustainable operation by promoting modal shift from private means of transportation to public transportation means.

c) Establish a beachhead on future extension of HCMC MRT Line-1: The BRT Project will create a basement for future extension of HCMC MRT Line-1.

2.2. Necessity, validity of the project

Consistency with the Vietnam government of development policy

Vietnam Government has set a vision towards the industrialization of the country by 2020 that is stated in "the 10-year Socio Economic Development Strategy" (2011-2020). In order to promote the strengthening of industrialization and modernization of economic competitiveness, sustainable economic growth has become an important task. Impact of economic loss due to chronic traffic congestion in metropolitan areas such as Hanoi and Ho Chi Minh City is large. Therefore, urban infrastructure development is considered as a priority basis to address the traffic problem.

Also, as the work may be a financial burden for the government, private funds are considered as the leverage that can be raised from different sources. PPP infrastructure-related legislation has been issued in November 2010, practical enforcement has been started.

Consistency with regional transportation comprehensive development plan

As described above, HCM City's northwest region (Binh Duong Province, Bien Hoa, Ba Ria - Vung Tau, etc.) has been significantly progressing in industrial development. Recently, there is an expansion trend in trade between southern Vietnam and Cambodia. Traffic demand connecting the northwest provinces and Cambodia to HCM city center has been increasing year by year while NH 13 which is mainly used for this connection is already over-capacity.

To alleviate traffic congestion in HCM city center and at the main roads of Binh Duong Province, development of HCM City Ring Road network is necessary in one hand; on the other

hand, it is also necessary to develop a mass public transportation system to connect satellite regions and centers.

Future route of the BRT project is an important route to link the two large development areas and to form city axis (Binh Duong Province and Ho Chi Minh City Metropolitan area). In addition, the route is expected to stimulate demand towards the MRT Line 1. It is strived to improve convenience while promote the use of public transportation since it is possible to expand the TOD as an urban development.

Binh Duong Province transportation integrity comprehensive development plan

The "Binh Duong Province transportation master development plan" indicated that urban transportation development is the major goal, in which development of seven MRT route is a long-term goal. Of these, MRT Line 1 which will be built at the median strip of Mp-Tv road is prior to operate in 2020. However, according to the forecast results of traffic demand in the region which were carried out in the PPP survey, it is too early to establish the BRT Line 1 in 2020. For this reason, instead of developing MRT, it is better to construct a BRT route on Mp-Tv road since the route is more desirable at this stage.

Validity of Japan cooperation

Japan and Vietnam have signed a Country Assistance Policy in which Japan will support Vietnam to achieve medium goal including: (1) Promotion of Economic Growth and Strengthening International Competitiveness; (2) Responding to vulnerability and (3) Strengthening governance.

For the first priority area, (1) strengthening growth and competitiveness, it is said that: "Towards sustainable development through strengthening the international competitiveness, Japan supports Viet Nam to improve the market economy system, reform finance and develop the industry and human resources; to develop arterial traffic and urban transport network, supply energy stably and promote saving energy in order to meet the demands for economic infrastructure which is increasing along with the economic growth".

In addition, under the Viet Nam Assistance Plan (July 2009) along with the promotion of the PPP scheme, the country is encourage to work with Japanese companies and using Japan's advanced technology in infrastructure development. The scheme also encourages the development of transportation network including urban railway and other roads which could promote the economic growth and strengthen international competitiveness.

Coordination with other projects being implemented by Japan cooperative

A major transportation infrastructure in Ho Chi Minh City area that have been developed by Japan's cooperation is as follows:

1. Ho Chi Minh City Urban Railway (HCM City MRT 1 Line, Ben Thanh – Suoi Tien)

2. Cai Mep-Thi Vai International Port
3. North-South Highway (Ho Chi Minh City –Long Thanh - Dau Giay)
4. North-South Highway (Ben Luc - Long Thanh)
5. Saigon East-West Highway

Since this BRT project is being planned to start from Suoi Tien terminal station of HCM City MRT Line 1, further increasing in the user of the HCM City MRT Line 1 is possible to contribute to the improvement of the MRT economic effect. In addition, the route is expected to be able to contribute in promoting the use of the port by strengthening connectivity with Cai Mep – Thi Vai international port.

Local assistance to Japanese companies

My Phuoc Industrial Park which is located in the vicinity of this BRT has a number of Japanese companies. Additionally, many other Japanese companies are working in other industrial parks such as VSIP-1, VSIP-2. Need of travelling between these industrial and HCMC central district is high while NH 13 is over-capacity. As the result, this BRT is expected to create more change for transportation of passengers between the two areas.

Validity of the route selected to set up the BRT

To set up the BRT route, it is necessary that the road has at least four or more lanes since it is expected that 1 lane is use for time-zoning lane, other lane is for low speed vehicle such as motorbike/walk.

It is estimated that motorbike and walk occupies 80% of traffic volume in Vietnam, at the four-lane road, the BRT need to have an exclusive lane. Otherwise, it will cause a heavy traffic and traffic congestion and accident will occur frequently. In addition, the fact that the existing four-lane roads are formed for a long time with houses along both sides. A widening of these roads will require large-scale resettlement which may cause environmental impact on the community.

As the result, Binh Duong Province decided to use the Mp-Tv road with about 90% of road construction has been completed to establish the BRT and this route is considered to have the highest possibility since it connect directly to the MRT Line 1's Suoi Tien Terminal station.

National Highway 13 is the main road that connects HCM City and Thu Dau Mot City. This NH is currently over-capacity and faced serious congestion around morning and evening rush hours. On the other hand, NH 13 is along with crowded population including houses and shops, etc. therefore to develop a BRT on this road is not feasible since it takes more time and costs for land acquisition.

2.3. Project outline

BRT corridor between Suoi Tien Terminal Station and Binh Duong New City will be developed on the existing and constructing highways (Figure 2-2).

In order to achieve the targeted on-time and fast performance, it shall consider not only hard infrastructures such as dedicated line, flyover at major intersections and block of crossing traffic on BRT corridor by closing median strip but also soft infrastructure and operational measures such as installation of a Public Transportation Priority System (PTPS) and introduction of dedicated/priority lane during a specified time. For the planning of BRT infrastructure, traffic safety shall be ensured taking into accounts a consistency with the related road facilities and minimized the negative impacts on general traffic.

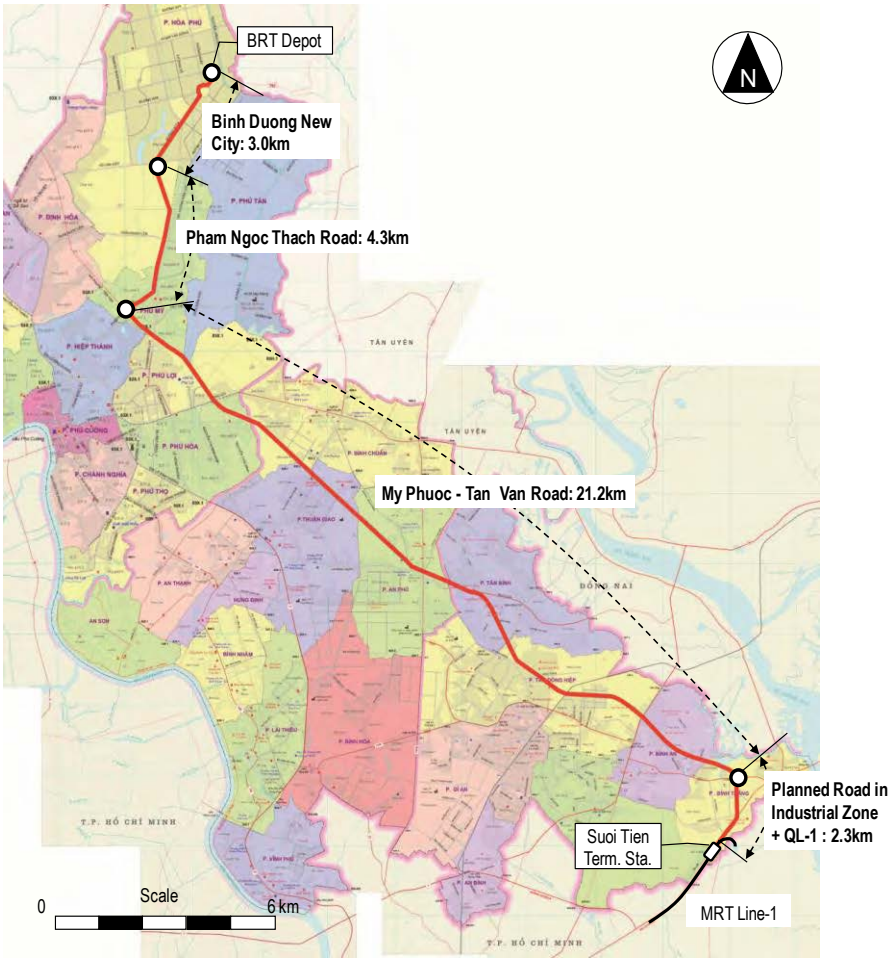


Figure 2-2. Planned BRT route

1) Design Standard applied to the existing Highways for building BRT Corridor

BRT corridor will be built on the Binh Duong new city road, Pham Ngoc Thach road, My Phuoc – Tan Van road, internal road of industrial park and QL-1 and design standard applied to these highways is Urban Road Design Requirements (TCXDVN104-2007). Its major geometric design criteria and cross-sectional elements are shown in Table 2-1 and Table 2-2, respectively.

Table 2-1. Major Geometric Design Criteria

Item			Criteria
1	Road Classification		Urban Road
	Urban Category		Special Urban, Class-I
2	Terrain		Flat
3	Design Speed (km/h)		80
4	Horizontal Alignment	Horizontal Curve	
		Desirable Minimum Radii of Horizontal Curve (m)	400
		Absolute Minimum Radii of Horizontal Curve (m)	250
5	Vertical Alignment	Maximum Grade-Up (%)	5.0
		Critical Maximum Length of Grades	
		For 6.0 % (m)	-
		For 5.0 % (m)	700
		Vertical Curve	
		Minimum Radius of Crest Curve (m)	
		Desirable Minimum Radius (m)	3000
		Desirable Radius (m)	4500
		Minimum Radius of Sag Curve (m)	
		Desirable Minimum Radius (m)	2000
		Desirable Radius (m)	3000
6	Lateral Clearance (m)		Travelled width
	Vertical Clearance (m)		4.75

Source :TCXDVN104-2007

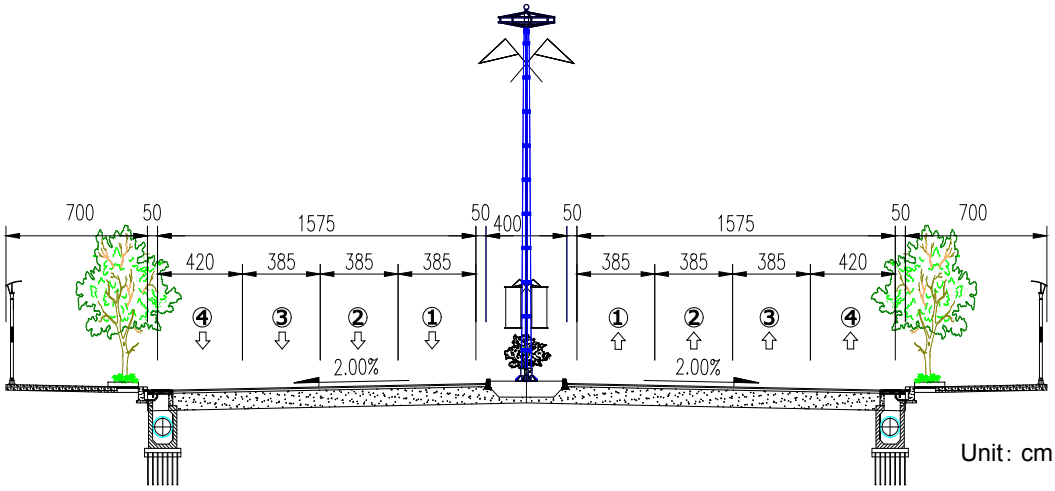
Table 2-2. Cross-Sectional Elements

Element	Criteria
Design Speed, Road Class	80km/h, Main urban Primary
Number of Travelled Way (minimum)	6
Formation Width (m)	
Travelled Way Width (m)	3.75m
Outer Shoulder Paved Width (m)	2.0 – 3.0m Takes width enough for emergency parking
Median Width (m)	3.0m for construction condition I 2.5m for construction condition II 2.0m for construction condition III
	Safety lane 0.75m for construction condition I 0.50m for construction condition II, III
Non-motorized vehicle lane	Separate from carriageway and shoulder by different elevation, barrier etc.

Element	Criteria
Side walk	Minimum width of sidewalk and lighting 7.5m for construction condition I 5.0m for construction condition II 4.0m for construction condition III * In case used for bus stop etc., this width must be wider than 2.0m.
Cross fall of Roadway (%)	2.0
Slope of Earthworks Fill	 V : H = 1:1.5
Auxiliary lane Right-turn lane Left-turn lane near central reservation Left-turn lane not near central reservation	 Not 0.25m smaller than next lane and >3m >3.0m Not 0.25m smaller than next lane and >3m

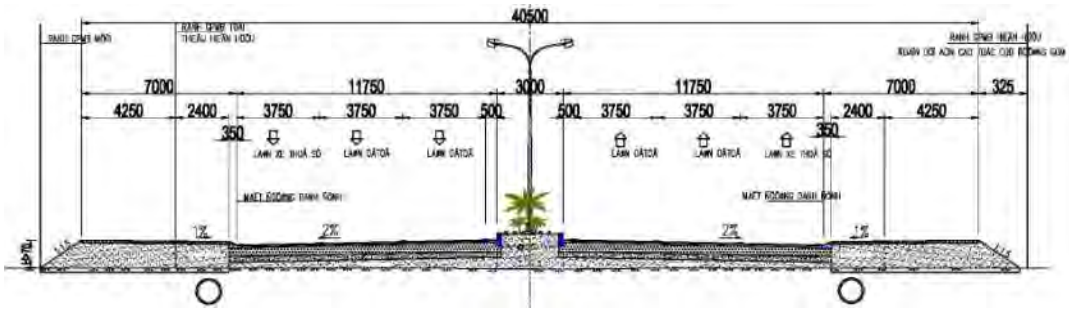
Source :TCXDVN104-2007

As shown in Figure 2-3. Typical Cross Section of the Existing Roads, actual cross section of the existing roads does not strictly follow the standard and it is flexibly decided (for example: to utilize the outer shoulders for motorbikes and non-motorized vehicles).



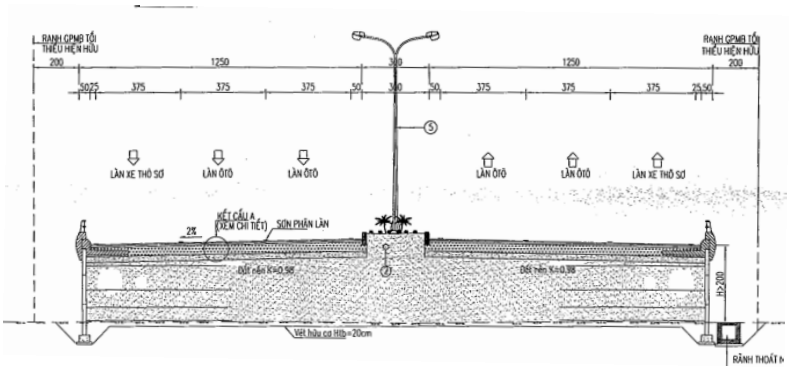
Unit: cm

i) Pham Ngoc Thach Road



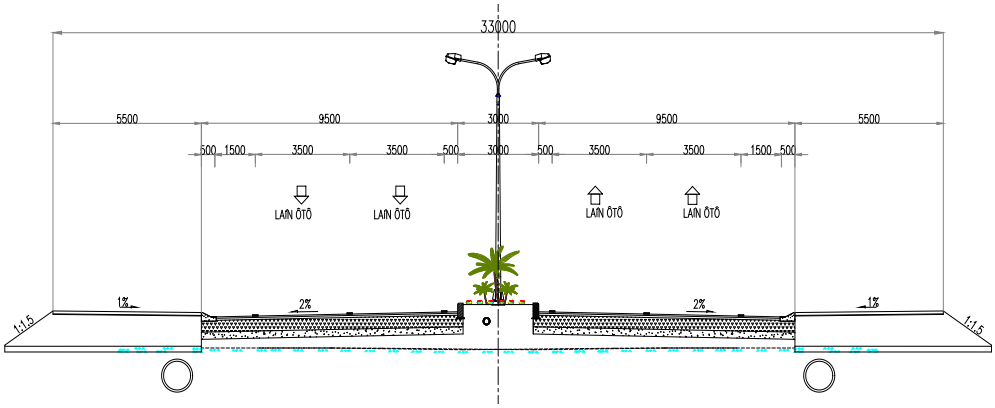
Unit: m

ii-1) My Phuoc – Tan Van Road (with sidewalk)



Unit: m

ii-2) My Phuoc – Tan Van Road KM4+975 – KM5+625 (without sidewalk)



Unit: m

iii) Internal Road of Industrial Park

iv) QL-1 between Tram 2 IC and Tan Van IC

Unit: m

Source : Design Drawings of each Project, but i) and iii) are prepared by JICA Study Team

Figure 2-3. Typical Cross Section of the Existing Roads

2) Design Standard applied to BRT Corridor

BRT corridor is proposed to basically apply same design standard (TCXDVN104-2007) as the existing road. However, in case not be able to conform to the standard due to a limited land area etc., other Vietnamese standard such as Specifications for Highway Design TCVN4054:2005 will be considered referring to other BRT projects.

Table 2-3. Basic Policy on Application of Design Standard for BRT Corridor

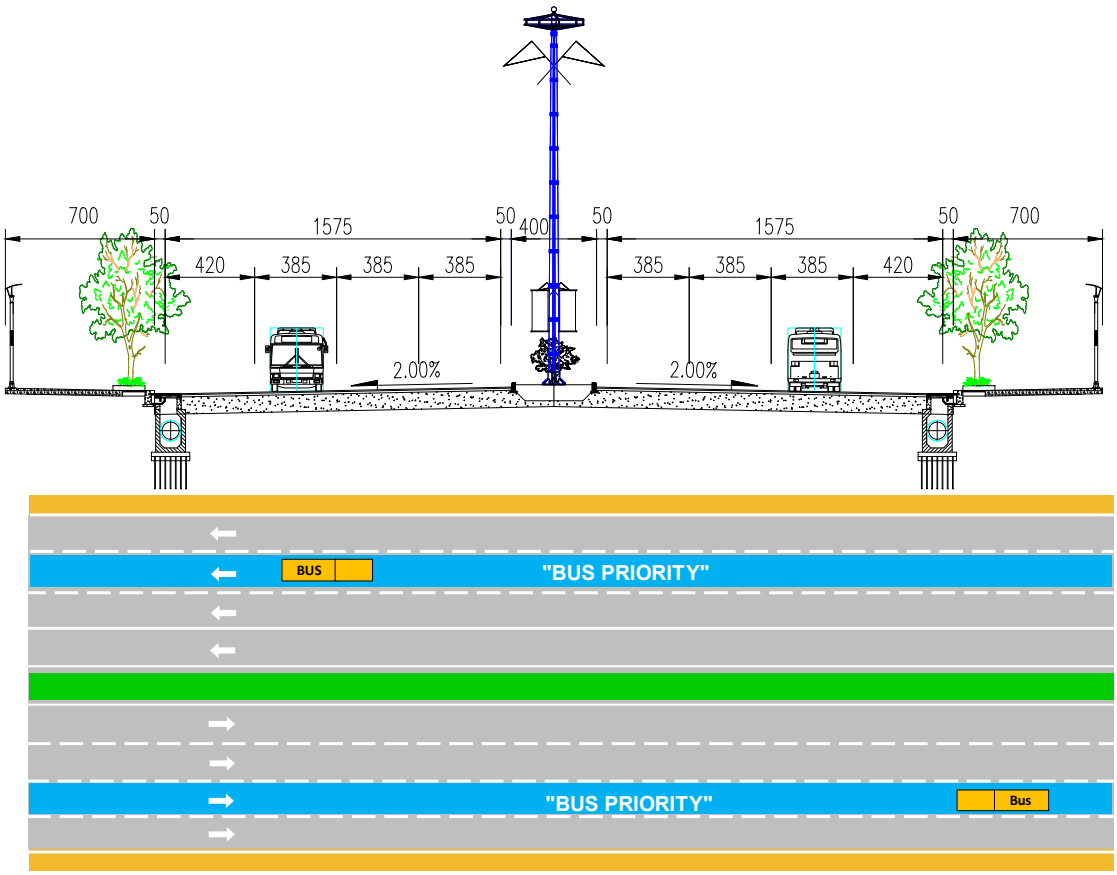
Section	Standard
BRT Priority Lane/ Dedicated Lane by hours	Urban Road Design Requirements TCXDVN104-2007 etc.
BRT Dedicated Lane	Specifications for Highway Design TCVN4054:2005 etc.
Flyover/ Viaduct	Specifications for Highway Design TCVN4054:2005 etc.

Source :JICA Study Team

3) BRT Route and Cross Section

Binh Duong New City Road and Pham Ngoc Thach Road Sections

In the section from bus terminal/depot and Pham Ngoc Thach road, priority lane or mixed lane with other traffic will be applied. In the Pham Ngoc Thach road, as shown in Figure 2-4. BRT Route and Cross Section on Pham Ngoc Thach Road, the 2nd traffic lane is used as BRT priority lane since the 1st traffic lane is occupied by motorbikes. This is same route as a shuttle bus operated by BECAMEX Tokyu Bus between Binh Duong New City and Thu Dau Mot.



Source :JICA Study Team

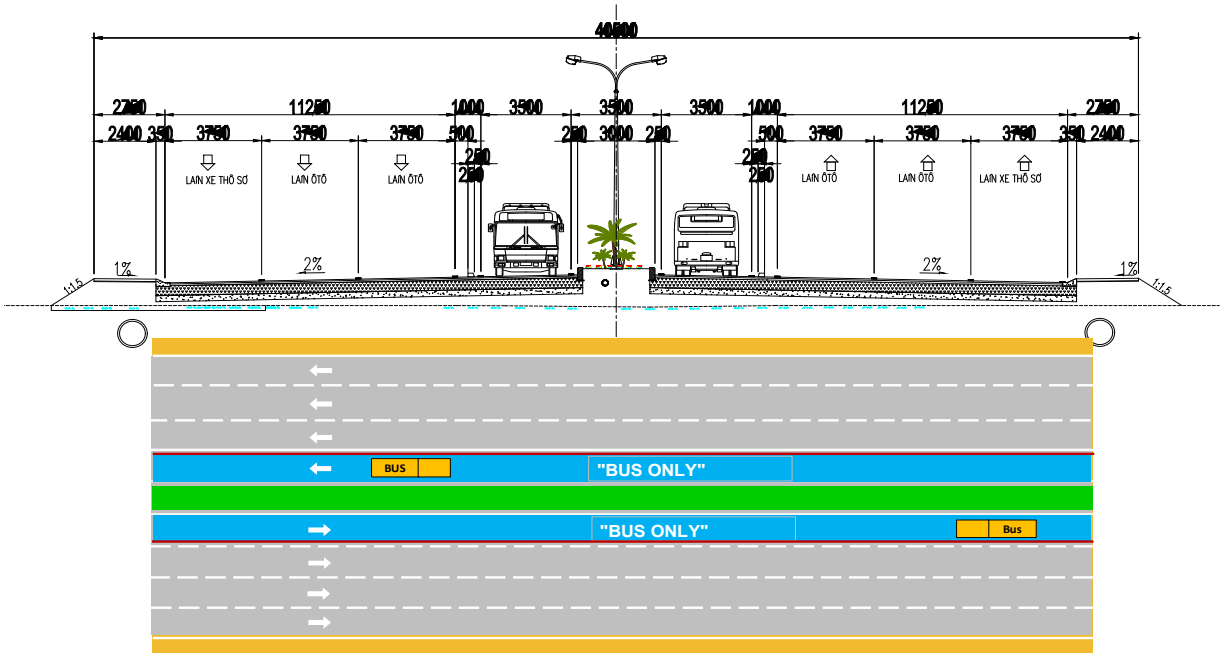
Figure 2-4. BRT Route and Cross Section on Pham Ngoc Thach Road

My Phuoc – Tan Van Road Section

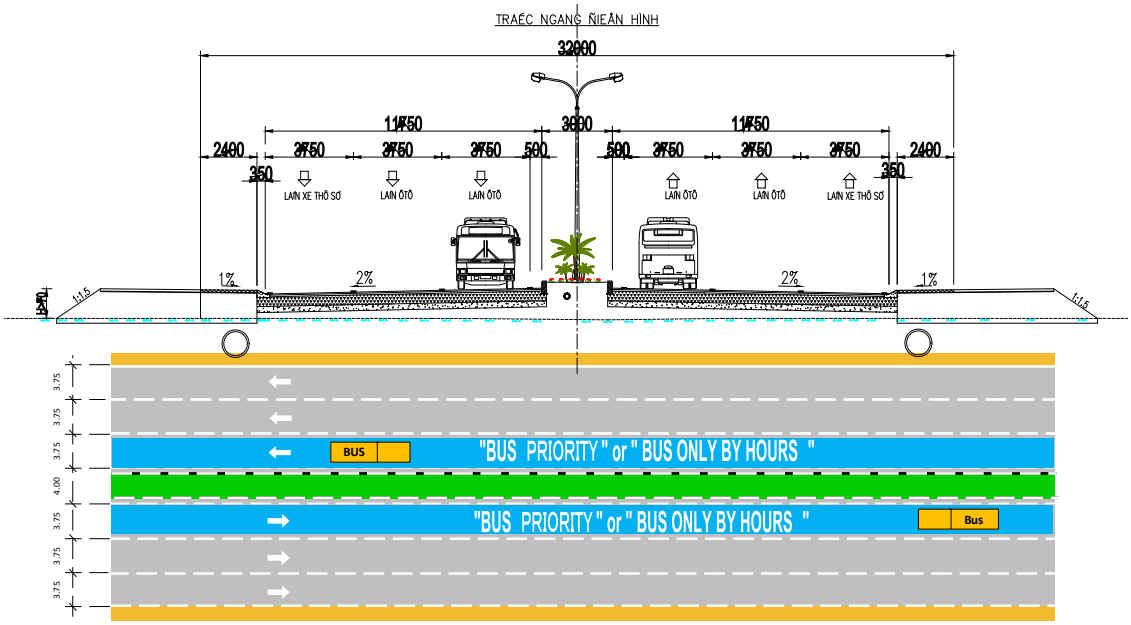
High traffic volume with higher ratio of heavy traffic is assumed to be happened at the section between Tan Van IC and An Phu Intersection with DT 743A in My Phuoc – Tan Van Road. In order to ensure a general traffic flow and also to achieve the on-time and fast performance of BRT, widening to 4-lane from current 3-lane per direction and arrangement of one dedicated lane can be considerable. As for feasibility of widening, it will be studied based on the traffic demand forecast, availability of land, cost and its responsibility and discussed with relevant authorities after interim report.

For other section after An Phu Intersection, 3-lane per direction is maintained and BRT lane will arrange on priority lane or dedicated lane by hours.

BRT lane and cross-section of My Phuoc – Tan Van Road is shown in Figure 2-5.



i) BRT Dedicated Lane after widening to 4-lane each direction



ii) BRT Priority/ Dedicated Lane by hours in existing plan of 3-lane each direction

Source: JICA Study Team

Figure 2-5. BRT Lane and Cross Section on My Phuoc – Tan Van Road

Internal Road of Industrial Park Section

The length of BRT route can be shortened about 1.3km in case passing through the internal road of industrial park comparing to the detour route around Tan Van Interchange. In this section, it is proposed to build a viaduct which has piers arranged inside the median strip of the internal road of the industrial park.

The viaduct will be divided into two directions and reached to the green belt of QL-1 after overpassing service road and main track of QL-1.

Since green belt at this location belongs to Binh Duong Province but QL-1 widening project is being implemented by HCM PC, it is required to obtain approval from both province and city for using a part of the inside green belt of QL-1 for the approach bridge and connection to QL-1.

Location of the flyovers

The construction of 8 flyovers along My Phuoc – Tan Van Road is recommended in order to improve the running speed of BRT buses operating between Binh Duong New City and Suoi Tien Station / New Eastern Bus Terminal. Locations of these flyovers are shown in Table 2-4 and Figure 2-6.

Table 2-4. Location of the planned flyovers

No.	ID	STA	Crossing Road	1/2 of road width (m)
1	IS-1	0+000	DT743A	20.25
2	IS-5	3+078	National Highway 1K	20.25
3	IS-12, IS-13	7+272, 7+471	Nguyen Thi Minh Khai	20.25
4	IS-21, IS-22	10+559, 10+611	An Phu Intersection	20.25
5	IS-25	11+950	An Phu 16	20.25
6	IS-29	14+647	Thu Khoa Huan	20.25
7	IS-32, IS-33	17+700, 17+874	Nguyen Thai Binh, Phu Loi (DT743)	33.25
8	IS-37	20+225	Huynh Van Luy	33.25

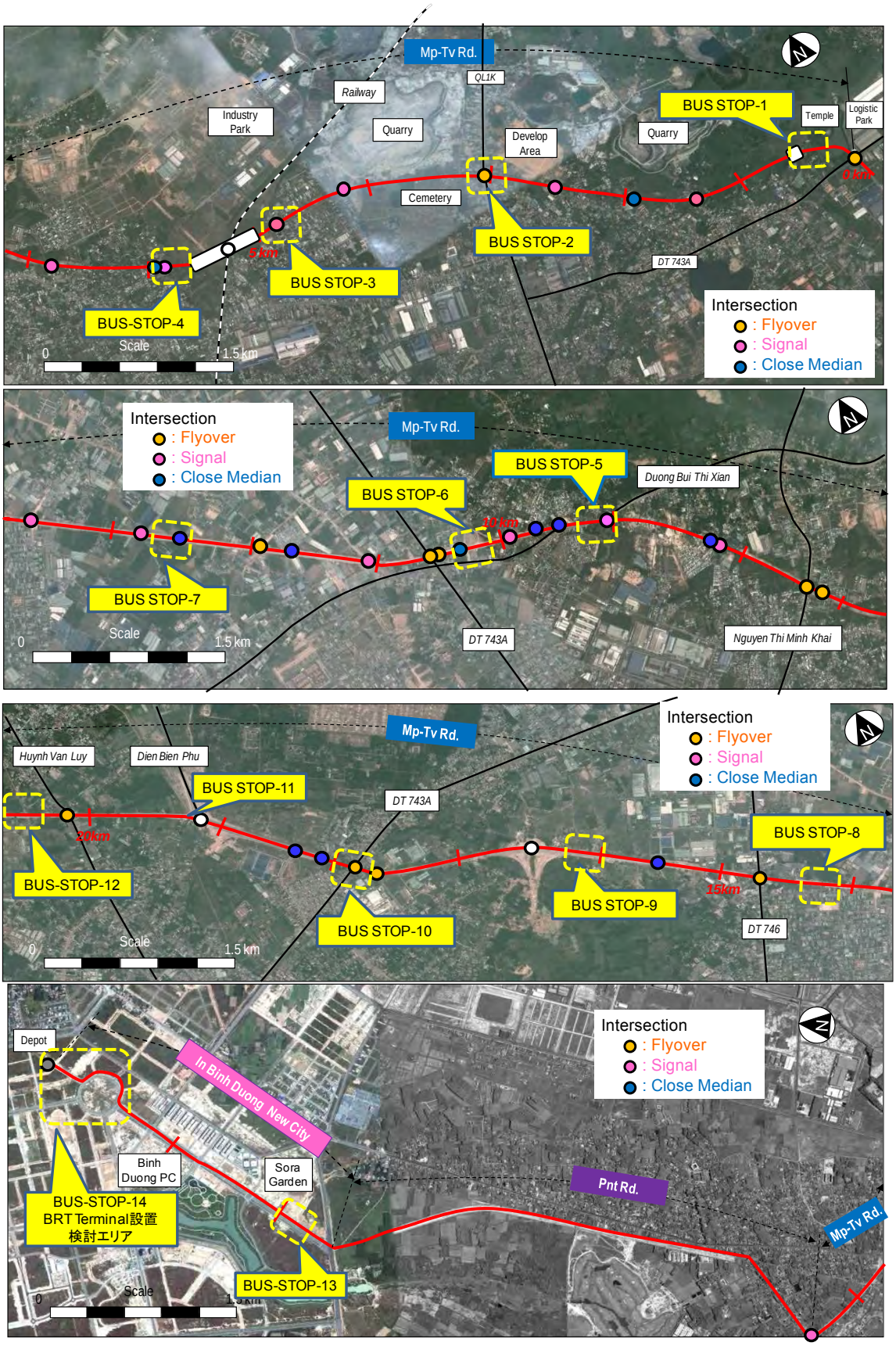
Location and structure of the bus stops

Focusing on speed of BRT, 3 types of bus stop structure are considered as described below by construction cost, road width and development space near BRT stop.

a) BRT Stop at roadside
b) BRT Stop in median
c) BRT Stop on flyover

Road shoulder is used at narrow segment, median is also wide segment, flyover is connecting point of major roads.

As the result of consideration of distance between BRT stop and structure, location of BRT stop is described follow. However, location of figure below is a draft phase of consideration. Detailed location is been considering by discussion with Binh Duong Province.



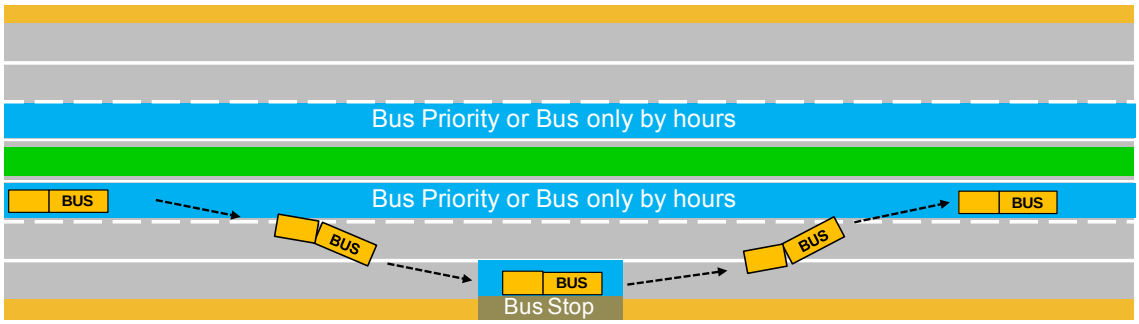
Source : JICA Study Team

Figure 2-6. BRT Stops

BRT Bus Stop

Bus Stop at road side

In this type, BRT vehicle must across two lanes to access to Bus stop. As for facilities of bus stop, roof and chairs will be equipped as same as a bus on regular route. Pedestrian bridge should be considered in case no across measure is available near bus stop.



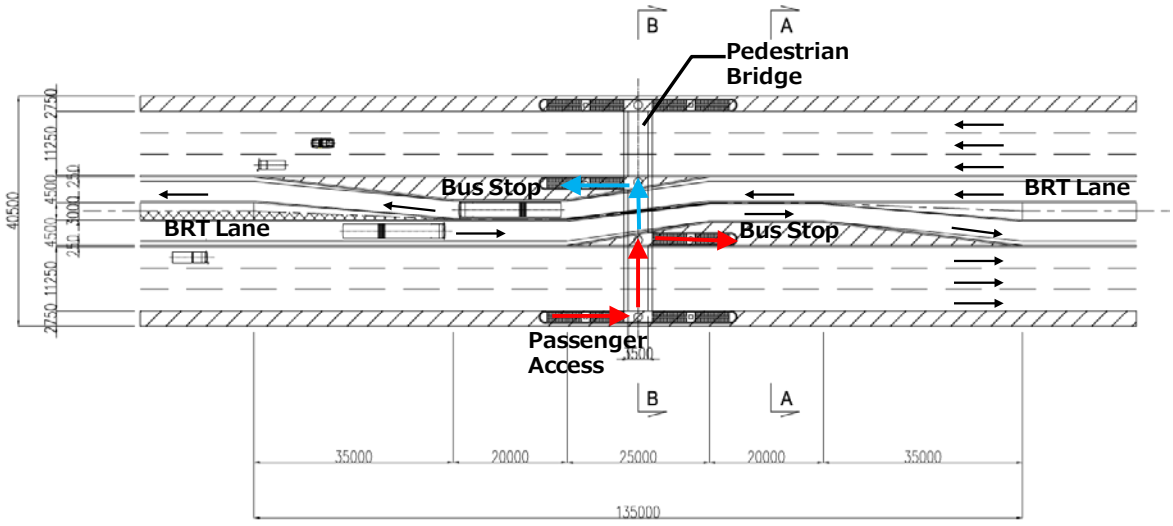
Source : JICA Study Team

Figure 2-7. Bus Stop at road side

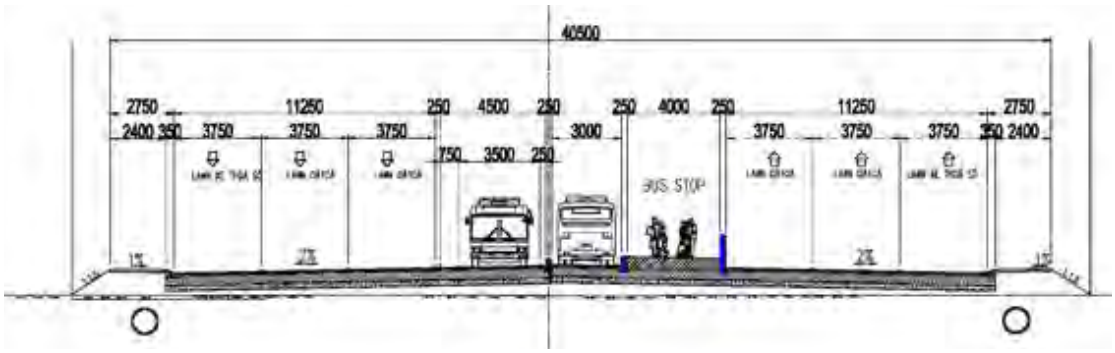
Bus stop at median strip

This type of bus stop will be planned at the section between Tan Van IC and An Phu Intersection in case widening to four lanes in each direction. Outline of facilities is described as follows, and plan and typical cross section are shown in Figure 2-8.

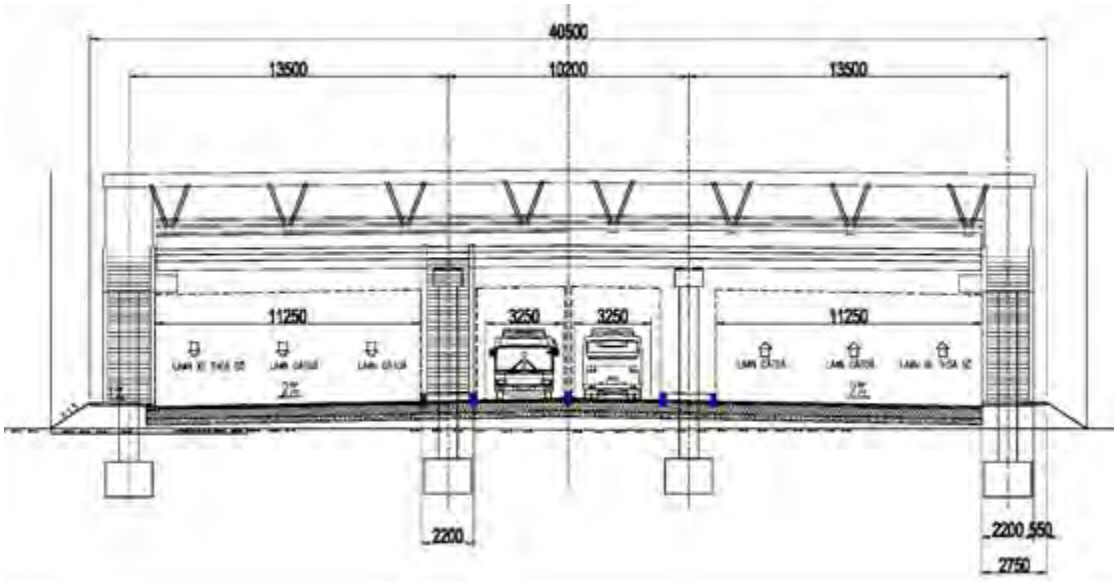
- The length of acceleration and deceleration lane is in accordance with standards for main urban road in TCXDVN104-2007.
- Loading and alighting length is set at 18m so that one articulated bus can stop. The length shall be updated based on the traffic demand forecast and operation plan.
- At the bus stops, the busway lane can be narrowed to 3.0 meters because the BRT vehicle is operating at a slower speed.
- Center median is arranged at 0.25 meter with inner safety lane 0.25 meter (no inner safety lane at the side of stopping lane), in total 0.5 meter.
- The width of station platform is 4.25 meters including 0.25 meter of curve. This is the maximum width the within 42.5 meter right of way.
- To ensure the safety for BRT users when across the main track and also improve connectivity both side communities for neighboring residents, pedestrian bridge is considerable.



i) Plan



ii) Typical cross section （A-A）



iii) Typical cross section （B-B）

Source : JICA Study team

Figure 2-8. Plan and Cross Section of Bus Stop at center median

It is one concern that width of sidewalk is reduced to 2.75 meters from 7.00 meters, and pedestrian bridge is arranged in this small sidewalk space. To avoid this situation, additional land acquisition for the part of pedestrian bridge or reduction of widths of pedestrian bridge and platform are considerable. This issue shall be discussed with the relevant agents and local authorities.

Bus Stop on the Flyover

This type of bus stop is planned at two intersections with National Highway No.1K (KM03+078) and DT743A (KM17+874). At the bus stop area on flyover, bus stop will be outside of passing lane to avoid disturbing flow of general vehicles.

As for the access way to the bus stop, two options are compared and studied. Option-1 has advantages to reduce the bridge height and shorten the bridge length, consequently construction cost can be saved. As disadvantage, accessibility is not so convenient because the user shall go across the main track by pedestrian crossing and then use stair or elevator for boarding the bus of opposite side.

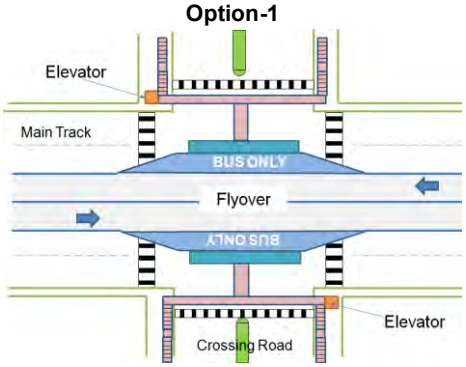
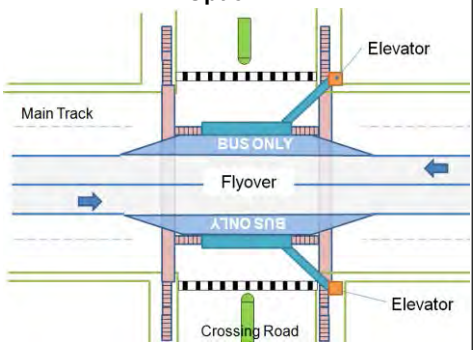
On the other hand, Option-2 has a good access to the bus stop by using pedestrian bridge from any sides. However, a high height of bridge and a longer bridge length due to arrangement of pedestrian bridge under flyover cause increasing construction cost.

Following issues are considered for two options.

- Barrier free so that the person with a wheel chair and a baby carriage can access to the bus stop.
- To install elevators instead of slope because climbing a longer distance (100 to 200 meters) is not convenient for person with disable and a large area for the slope is difficult to be reserved.
- Stairs and elevators will be built in the sidewalk of crossing road which has a plan to expand in future. Therefore, the implementation of the widening project is precondition for the bus stop on flyover.

Comparison between the options is summarized in Table 2-5.

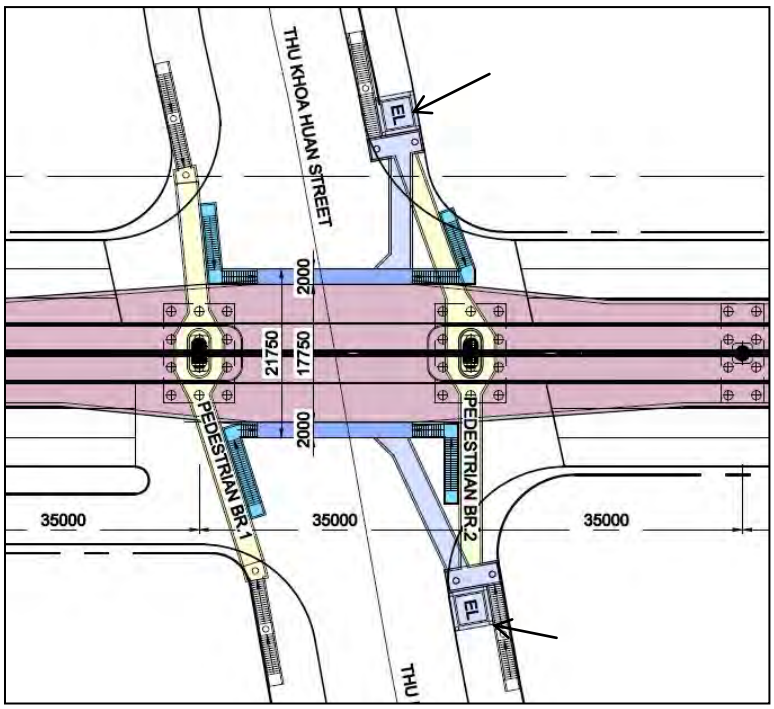
Table 2-5. Comparison of Accessibility to Bus Stop on the Floyver

Evaluation Item	Option-1	Option-2
		
Accessibility for Bus Users	Shorter distance in case access to bus stop from the same side. In case from the opposite side, users shall cross the main track by pedestrian crossing. △ (worse)	Shorter distance to bus stop from any locations ○ (better)
Accessibility for Bus Users of PWD*1/	To access to the elevator, going across by pedestrian crossing is required at maximum two times. X (bad)	To access to the elevator, crossing main track by pedestrian crossing is not required. ○ (better)
The Community connectivity	When going across main track, only pedestrian crossing is available. △ (worse)	When going across main track, pedestrian bridge with elevator is available. ○(better)
Effect on Main Track Traffic	Pedestrian crossing with traffic signal is required. △ (worse)	Not required pedestrian crossing ○(better)
Cost	1.0 time ○ (better)	1.5 times X (bad)
Evaluation Result	△ (Worse)	○ (Better)

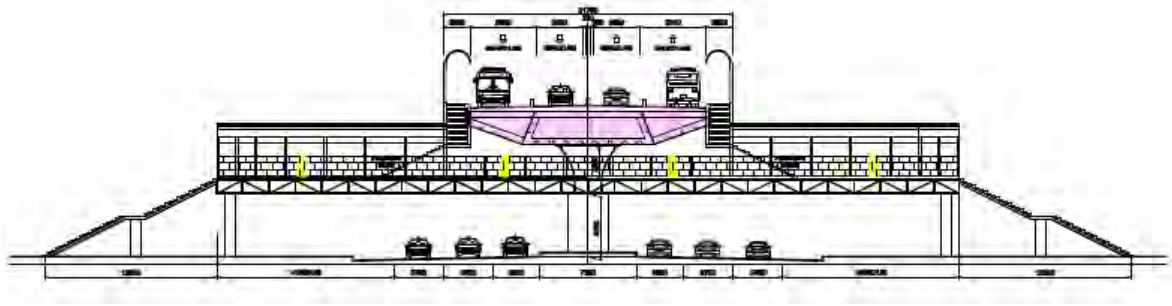
*1/ PWD: Person with Disable

Source : JICA Study Team

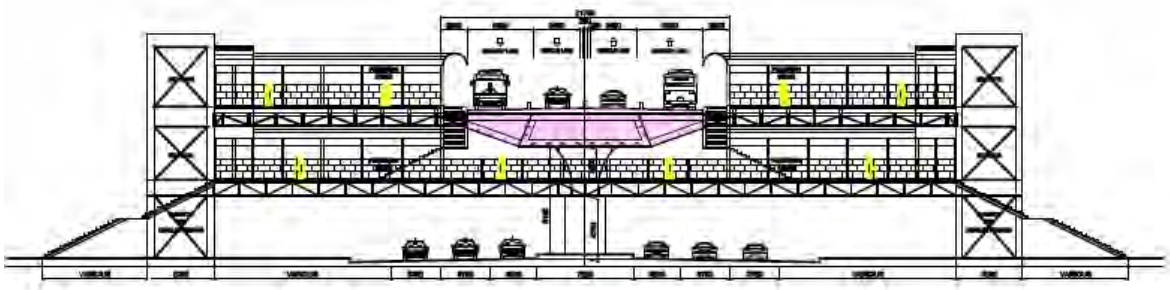
Although cost of Option-2 is 1.5 times higher than Option-1, Option-2 is recommended in terms of much higher convenience for BRT users. Plan and typical cross section of Option-2 case is shown in Figure 2-9.



i) Plan



ii) Cross Section where arranged only stairs



iii) Cross Section where arranged both elevators and stairs

Source : JICA Study Team

Figure 2-9. Plan and Cross Section of Bus Stop on Flyover

BRT Depot

A management center with the area of about 24,000 m^2 will be constructed at Binh Duong New City by BECAMEX TOKYUBUS CO., LTD., who expects to operate BRT route. This Depot also will be used for the existing bus shuttle route operated by this company from Thu Dau Mot City to Binh Duong New City. Table 2-6 show the planned capacity of the depot in terms of number of buses and persons.

Table 2-6. Planned capacity of the depot

Year	2020	2030	2040
Shuttle bus (unit)	9	9	9
Feeder bus (unit)	6	6	6
BRT bus (unit)	29	73	123
Total number of bus (unit)	44	88	138
General Manager (pers)	2	2	2
Staff (pers)	7	13	20
General Affairs Manager (pers)	1	1	1
Advisor (pers)	1	1	1
Accountant Chief (pers)	1	1	1
Accountant staff (pers)	1	1	1
Other managers (pers)	2	2	2
Engineers (pers)	7	14	22
Total staff working at depot (pers)	22	35	50
Bus drivers (pers)	107	213	333
Total personnel number (pers)	129	248	383

Source: JICA Study Team

3. Characteristics of the study area

3.1 Current natural conditions

Based on the review of existing documents, reports, etc., and on the field reconnaissance survey, the following items of current natural environment of the area are surveyed:

- Topographic characteristics, land elevation, etc.
- Meteorological data (rainfall, sunshine, evaporation, etc.)
- Drainage system / sewage system / river system
- Road network, road area ratio
- Green space/area, landscape
- Land use situation, residential condition, outline of ecosystem
- Landmarks, outstanding structures (market, school, hospital, government office, temple, church, relics, high voltage electric power cable, high voltage electric power pole, etc.)
- Housing development areas, industrial zones, and other larger-scaled development areas
- Environmentally sensitive structures / areas
- Data on air quality, noise, etc.
- Flooding, drainage condition
- Others

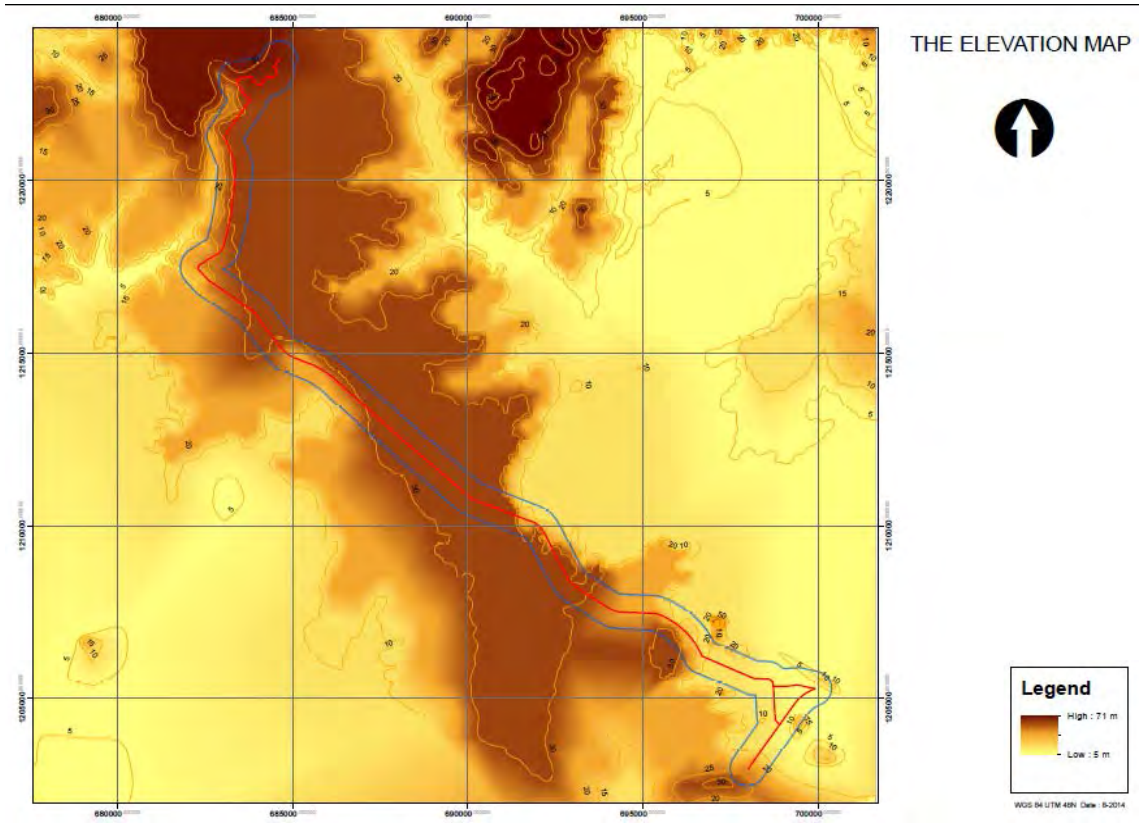
The survey covers an area along the BRT route (started from Binh Duong New City and ended at Suoi Tien Terminal Station of HCMC MRT Line 1, with about 31km of extension, and within 500m from the road sides. Result of the survey is summarized as following.

1) Topographic characteristics: The survey area can be divided into 3 sections depending on their topographic characteristics as followings.

- In the first section, from Suoi Tien Terminal Station to the starting point of My Phuoc – Tan Van Road, the elevation varies significantly. There are several sites on National Highway No.1 where the land is very low (elevation is +1m), but in the other sites, elevation changes from +2m to +37m. The average elevation in this section is +15.4m.

- In the second section, from the starting point of My Phuoc – Tan Van Road to the intersection with Pham Ngoc Thach Street (at the entrance to Binh Duong New City), the land is relatively high with elevation changes slowly from +13m (in the south-eastern site) to +36m (in the north-western site). The average elevation in this section is +30.1m.

- In the third section, from My Phuoc – Tan Van Road to the planned BRT depot, the land is quite high, with elevation varies from +20m to +39m. The average elevation in this section is +31.3m.



Source: JICA Study Team

Figure 3-1. Elevation map of the survey area

2) Meteorological data:

Binh Duong's climate is characterized by the hot and rainy weather, with high humidity. It is a tropical monsoon climate, divided into two distinct dry and wet seasons. The rainy season usually starts in May until late October.

In early months of the rainy season, there are regular short but heavy showers, while the months of July, August, and September usually have continuous rain, sometimes lasting for 1-2 days and nights continuously. Binh Duong seldom experiences hurricanes, but sometimes is affected by local storms.

The average annual temperature in Binh Duong is 26^{o}C-27^{o}C, with the highest temperature recorded is 39.3^{o}C, but in the night it fall to 16^{o}C-17^{o}C. In the dry season, the average annual humidity is in the range of 76%-80%, with the highest at 86% in September and the lowest at 66% in February. The average annual rainfall each year is 1.800-2.000 mm.

Detail of rainfall, humidity, sunshine and air temperature during the latest 4 years from 2010~2013 are shown in Table 3-1~Table 3-4.

Table 3-1. Rainfall from 2010~2013

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2010	31.1	-	31.3	118.8	36.4	172.5	226.2	221.5	303.2	248.2	303.6	87.6	1780.4
2011	3.3	4.7	64.5	174.8	212.5	282.7	263.2	139.4	214.2	197.5	272.5	52.1	1881.4
2012	55.1	70.5	101.9	219.5	202.2	191.5	317.0	116.7	449.8	115.5	114.7	7.3	1961.7
2013	**16.8**	-	**14.6**	**124.0**	**242.4**	**409.8**	**215.0**	**255.2**	**277.0**	**391.6**	**116.2**	**59.2**	**2,121.8**

Table 3-2. Monthly mean humidity from 2010~2013

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2010	77	75	72	74	76	83	87	89	87	89	87	81	**81**
2011	77	74	74	77	83	87	87	87	88	87	84	77	**82**
2012	78	79	75	81	83	85	85	84	89	84	84	78	**82**
2013	**78**	**70**	**74**	**78**	**85**	**89**	**91**	**91**	**92**	**92**	**87**	**84**	**84**

Source: Statistical Year Book - Binh Duong 2013

Table 3-3. Monthly sunshine duration from 2010~2013

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2010	184.2	230.7	223.6	219.2	225.3	215.8	171.8	154.2	193.3	105.6	162.0	174.4	2260.1
2011	171.4	200.5	153.1	199.3	215.0	156.0	165.0	175.0	170.0	195.0	180.0	195.0	2175.3
2012	154.1	184.7	209.5	234.5	210.7	176.6	186.3	220.7	126.8	179.2	186.7	224.9	2294.7
2013	**190.5**	**212.1**	**231.0**	**188.1**	**215.3**	**158.2**	**155.9**	**180.4**	**119.5**	**193.2**	**184.5**	**145.5**	**2,174.2**

Source: Statistical YearBook - Binh Duong 2013

Table 3-4. Monthly air temperature from 2010~2013

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2010	25.9	27.1	28.5	29.6	30.5	28.7	27.5	27.0	27.2	26.6	26.2	25.7	27.5
2011	25.3	26.5	27.3	28.1	28.2	27.3	27.5	27.4	26.7	26.7	26.7	25.2	26.9
2012	25.9	26.4	27.7	28.0	28.0	27.6	27.1	27.8	26.4	27.1	27.1	26.9	27.2
2013	**26.5**	**28.4**	**27.8**	**30.3**	**29.5**	**28.3**	**27.1**	**27.2**	**26.7**	**26.8**	**27.0**	**25.3**	**27.6**

Source: Statistical YearBook - Binh Duong 2013

3) Drainage system: In general, drainage systems are found in the newly-constructed residential areas. Besides, almost all industrial zones are equipped with wastewater treatment system. Rainwater flows into the small ditches and then into Sai Gon River or Dong Nai River.

4) Road network, road area ratio:

This refers to the percentage of area of paved road to the total area of the land (excluding water surface). In the survey area the road area ratio is nearly 8 %, with the main roads are:

- Hung Vuong Boulevard (~3 km), Pham Ngoc Thach Street (including the new road

under construction 4.3 km), Huynh Van Luy Street, in Hoa Phu Ward;

- MP-TV Road (21.2 km) crosses Hiep Thanh, Phu My, Phu Hoa of Thu Dau Mot City, and others wards of Thuan An and Di An Town. Large scale intersections in this section are: Intersection with Phu Loi Street at Phu Loi Ward; with Road No. 746 at Thuan Giao Ward; with Road No. 743 at An Phu Ward.

At the end section of MPTV Highway in Di An Town, MP-TV Road intersects National Highway 1 K at Binh An Ward and connect to National Highway No. 1A at Binh Thang Ward.

5) Green lands, wetlands, etc.: Green lands in the survey area are found mainly in Binh Duong New City Park, Thu Dau Mot Golf Course, Cultural and Historic Park, and Martyrs Cemetery.

6) Land use:

Current land use situation in the survey area is summarized in Table 3-5. Residential land occupies 30.5% of total surface area. Besides, industrial land occupies 12.9%, and land for reforestation and agriculture occupies 11.1% of the total surface area.

Table 3-5. Current land use situation in the survey area

No.	Land use type	Area (ha)	Portion (%)
1	Residential Areas	1,028.65	30.50
2	Industrial Land	435.44	12.91
3	Forestation/Vegetation	375.47	11.13
4	Bare land	354.94	10.52
5	Agriculture Land	317.37	9.41
6	Road	268.05	7.95
7	Planned Residential Land	157.53	4.67
8	Park Land	119.60	3.55
9	Quarry	56.34	1.67
10	Cemetery	47.38	1.40
11	Freight Yard	42.64	1.26
12	Education Land	29.37	0.87
13	Constructing Area	22.01	0.65
14	Lake	20.18	0.60
15	Martyrs 's Cemetery	18.29	0.54
16	Wetland	16.25	0.48
17	Sport Facilities	14.48	0.43
18	Aquaculture Land	12.64	0.37
19	Religious Land	9.96	0.30
20	Waterway	7.94	0.24
21	Constructing Road	6.20	0.18
22	Cultural Land	4.16	0.12
23	Wild Vegetation	2.97	0.09
24	Railway	2.11	0.06
25	Water Pipeline	1.32	0.04
26	Land for Health	0.99	0.03
27	Electricity Facilities	0.34	0.01
	Total	3,372.61	100.0

Source: JICA Study Team

7) Ecosystem: The study area is almost urbanized and the natural environment became unsuitable for valuable animals/plants to inhabit.

8) Acoustic environment: The noise levels measured in 2009 at all 12 sites along My Phuoc – Tan Van Road had already exceeded the maximum permitted noise level stated by the Vietnamese noise standard (Table 3-6).

9) Ambient air: At several sites along My Phuoc – Tan Van Road, the measured concentrations of TSP and SO_2 had already exceeded the maximum permitted levels stated by the Vietnamese ambient air standard, (see Table 3-6).

Table 3-6. Noise levels and concentrations of pollutants in ambient air measured at the sites along My Phuoc – Tan Van Road

No.	Item	Noise level (dBA)			Concentration of pollutants in ambient air (µg/m3)			
		L_{min}	L_{max}	L_{eqa}	TSP	CO	NO_2	SO_2
1	GS/348	65.1	84.5	74.3	230.73	3406	51.65	144.26
2	GS/349	51.0	80.2	72.2	247.87	4073	159.89	254.86
3	GS/350	60.1	93.9	80.2	616.28	187	33.03	224.4
4	GS/351	63.2	97.6	84.0	219.22	331	60.20	170.38
5	GS/352	72.2	96.4	83.1	250.69	296	39.34	165.38
6	GS/353	61.0	80.5	68.2	458.76	1670	166.9	334.58
7	GS/354	60.3	90.7	88.8	452.02	3001	125.23	365.37
8	GS/355	71.4	99.0	82.9	707.81	2193	66.95	207.23
9	GS/356	62.6	90.8	78.4	379.51	3948	37.08	248.83
10	GS/357	57.9	74.8	67.2	340.45	5820	65.64	458.65
11	GS/358	72.9	91.3	82.4	782.98	3931	68.69	452.7
12	GS/359	74.1	94.5	81.2	851.42	5000	54.87	417.42
	Permitted levels	55 - 70 (1)			300(2)	30,000(2)	200(2)	350(2)

Source: EIA Report 2009, Center for Environment and Resource Monitoring (CERM)

Note:

(1) QCVN 26:2010: Maximum permitted noise level - National Technical Regulation on Noise

(2) QCVN 05:2013/BTNMT: National Technical Regulation on ambient air quality

(3) Codes of surveyed sites :

GS/348: Intersection of MPTV Highway and Pham Ngoc Thach Street

GS/349: HiepThanh Residential area No. 3

GS/350: Intersection of MPTV Highway and Huynh Van Luy Street

GS/351: Intersection of MPTV Highway and Thu Khoa Huan Street

GS/352: Intersection of MPTV Highway and Road No. 743

GS/353: Intersection of MPTV Highway and Tao Luc Road No. 1

GS/354: Intersection at Thuan Giao Residential area

GS/355: An Phu Intersection

GS/356: Flyover at Tan Dong Hiep Ward

GS/357: Flyover at Dong An Residential area

GS/358: National Highway No. 1A

GS/359: End point of MPTV Highway

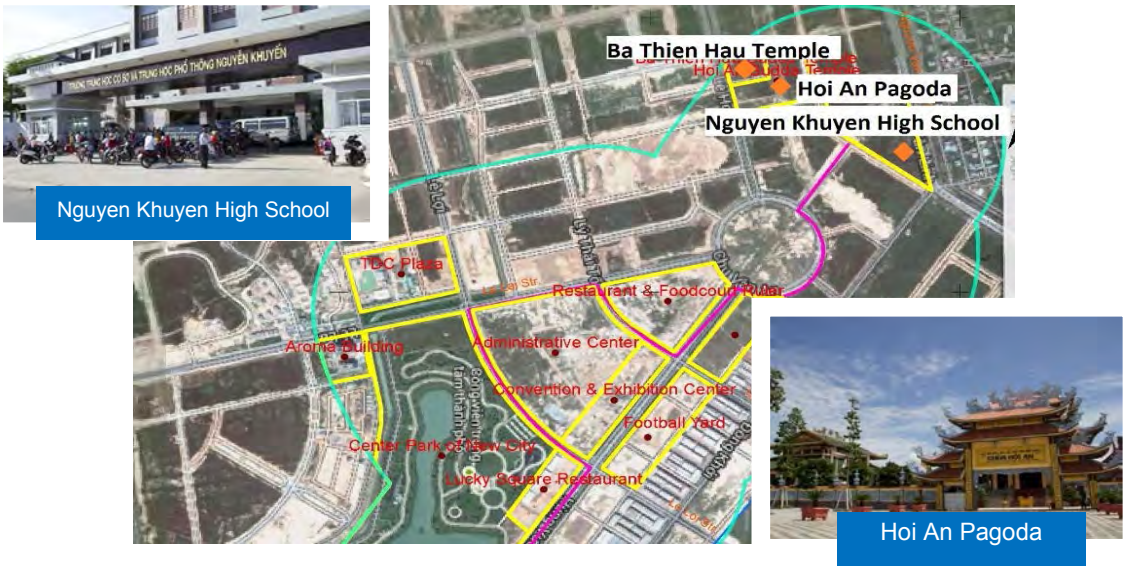
10) Flooding: There is no report on flood caused by high tide or heavy rain in the survey area.

11) Outstanding facilities, environmentally sensitive spots: Identified outstanding facilities and environmentally sensitive spots are shown in Table 3-7. In particular, the sensitive spots found in the area within 100m from the road sides are shown in Figure 3-2 ~ Figure 3-5.

Table 3-7. Outstanding facilities, environmentally sensitive spots

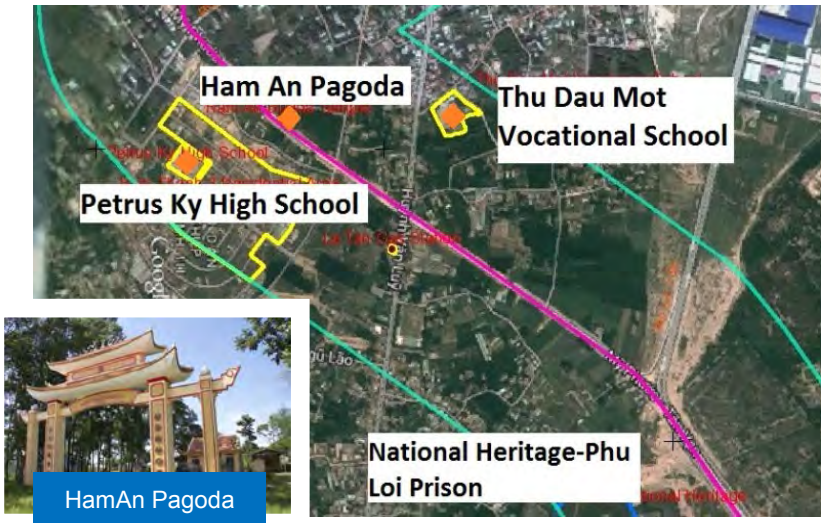
Name	Distance from BRT road	Name	Distance from BRT road
Nguyen Khuyen High School;	200 m	Nam Binh Pagoda	Road edge
Hoi An Pagoda;	270 m	Tan Ninh Pagoda	50 m
Ba ThienHau Temple;	400 m	Tan Dong Hiep High School	440 m
Petrus Ky High School	330 m	Tan Dong Hiep primary School	430 m
Thu Dau Mot Vocational School	300 m	Tan An Temple	80 m
National Heritage-PhuLoi Prison	400 m	Doan Thi Diem Primary School	Road edge
Ham An Pagoda	Road edge	Binh An Secondary School	320 m
PhuHoa 2 Primary School	500 m	Ngai Thang Pagoda	200 m
Hoang Dieu Preschool	400 m	Nghia Son Church	360 m
An Phu Primary School	150 m	Xaloi Pagoda	220 m
Tan Binh High School	370 m	Dormitory of VNU-HCM	450 m
Phuoc Dong Tu Pagoda	140 m	Hung Kings Temple	300 m
An Nhon Temple	80 m	Cao Thai Church	410 m

Source: JICA Study Team



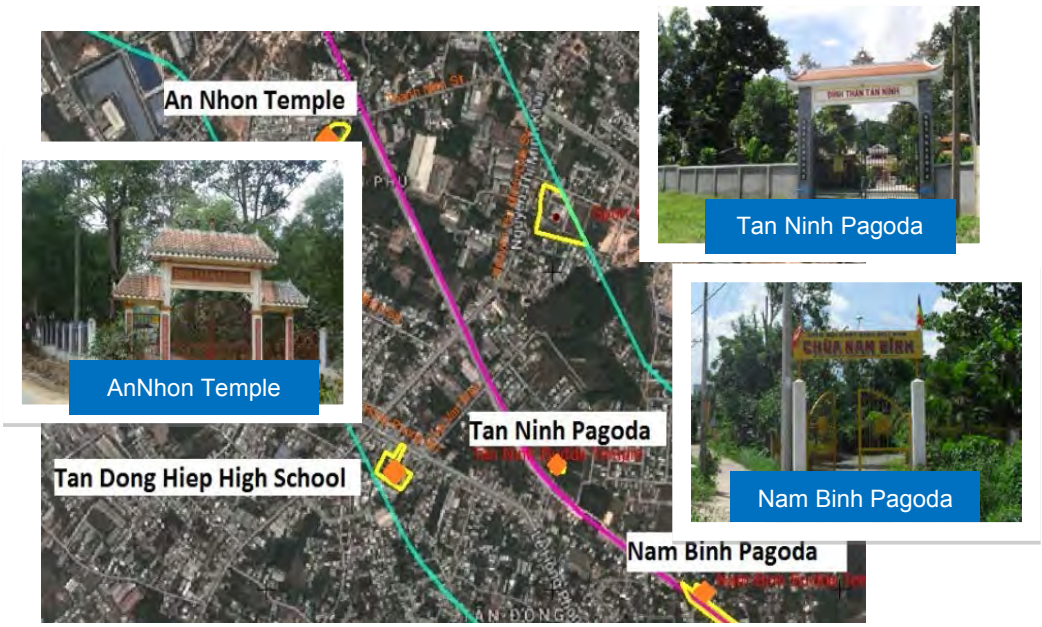
Source: JICA Study Team

Figure 3-2 Outstanding facilities, environmentally sensitive spots (1)



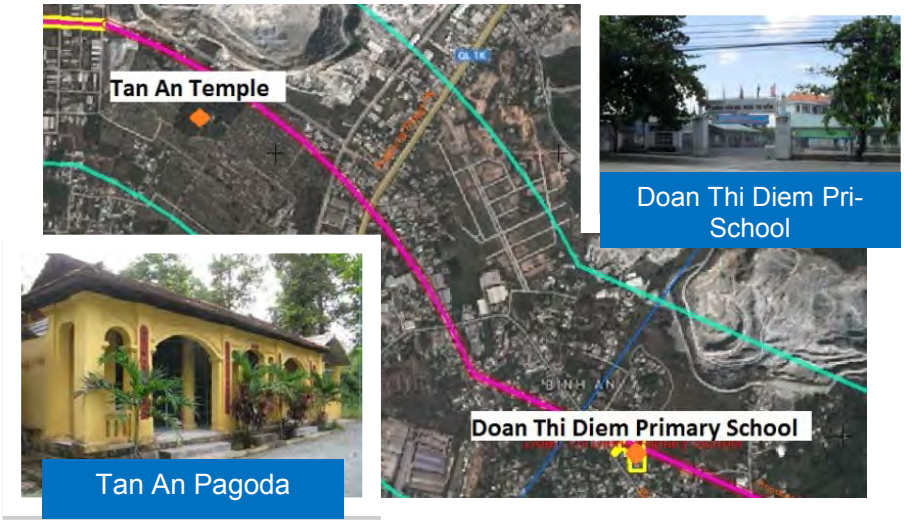
Source: JICA Study Team

Figure 3-3. Outstanding facilities, environmentally sensitive spots (2)



Source: JICA Study Team

Figure 3-4. Outstanding facilities, environmentally sensitive spots (3)



Source: JICA Study Team

Figure 3-5. Outstanding facilities, environmentally sensitive spots (4)

3.2 Current socio-economic conditions

3.2.1. General socio-economic characteristics of the wards/communes

Based on data and information collected from local authorities at district/town and ward level, the socio-economic characteristics of the wards/ communes located along the BRT route can be described as following.

The planned BRT route will go through 14 wards/communes of 4 districts belonging to Ho Chi Minh City (HCMC) and Binh Duong Province. The route passes through several commercial centers and industrial zones of Binh Duong Province (16 industrial zones and 02 industrial clusters) where many domestic and foreign workers, staffs and experts are living and working. The ending point of the route is planned at Suoi Tien Terminal Station (the station with intermodal facilities) where there is a concentration of many factories, universities and a large number of local and migrant residents.

Areas along the BRT route in Binh Duong Province have highly concentrated population and high industrial development. In 2013, average income of these areas is fairly high, ranging from VND 44.4 million/capita/year (equivalent to USD 2,100/capita/year) to 60 million/capita/year (equivalent to USD 2,850/capita/year).

In HCMC, the Binh Duong BRT passes through Long Binh Ward of District 9. The district is the largest urban district of HCMC, with 114.0 km^2. However, District 9 has the lowest population density, with 2,425 persons/km^2 (Source: Statistic Bureau of HCMC, 2013).

Socio-economic figures of cities/towns/districts where the BRT route passes through is summarized in the following table.

Table 3-8. Socio-economic data of the districts

Province	City/Town/ District	Area (km^2)	Populati-on (person)	Population density (person/ km^2)	Average income/ capita (VND million /year)	Economic structure (%)		
						Industry-construction	Trade-service	Agri-Forestry - Aquaculture
Binh Duong	Thu Dau Mot	118.67	269,620	2,272	55.4	39.0	60.8	0.2
	Thuan An	83.69	441,149	5,271	44.4	72.6	27.1	0.3
	Di An	59.95	373,876	6,236	60.0	73.0	26.7	0.2
HCMC	District 9	114.0	18,231	859	-	-	-	-

Source: Statistical Year Book of Binh Duong 2013, Socio-Economic Report of Thu Dau Mot City, Thuan An Town and Di An Town 2013; Statistical Year Book of HCMC 2013.

Socio-economic characteristics of the wards/communes where the BRT project passes through are summarized in Table 3-9 below.

Table 3-9. Socio-economic data of the BRT affected wards

District	Ward/ Commune	Permanent resident (Person)	Number of HH (HH)	Population density (person/ km^2)	Poverty/ Close to poverty[1] (HH)	Economic structure		
						Industry - construction (%)	Trade-service (%)	Agriculture-Forestry (%)
Thu Dau Mot	Hoa Phu	4,473	1,114	17	06/15	55.0	45.0	0.0
	Phu My	12,744	3,441		68/53	32.0	63.0	5.0
	Hiep Thanh	18,813	5,137		54/134	12.5	87.4	0.1
	Phu Loi	36,928	7,466	259	199/144	27.0	72.0	1.0
	Phu Hoa	19,201	4,860	2914	34/64	23.0	76.0	1.0
Thuan An	Thuan Giao	10,592	2,571	923	12/69	50.3	29.7	20.0
	Binh Chuan	16,156	3,818	1416	60/43	70.6	29.4	0.0
	An Phu	65,098[2]	3,468[2]	5967[2]	31/19	60.0	30.0	10.0
Di An	Tan Binh	45,000	5,540	4344	51/126	60.0	30.0	10.0
	Tan Dong Hiep	48,257	13,636	3417	33/66	89.9	9.7	0.4

[1]Poverty line of Binh Duong Province (2013-2015): 1,000,000 VND/person/month in rural areas and 1,100,000 VND/person/month in urban areas; HCMC (applied for 2009-2015) is 12.000.000 VND/capita/year ($2US/capita/day), close to poverty 16,000,000 VND/capita/year

[2]Population: including permanent and temporary residents; Number of households: counted for permanent households.

	Binh An	26,214	4,075	435	52/35	40.0	50.0	10.0
	Binh Thang	13,616	1,979	2490	11/20	35.0	65.0	0.0
	Dong Hoa	55,484	7,903	5407	31/22	20.0	40.0	40.0
District 9	Long Binh	18,231	4,884	859	84/377	-	-	-

Source: PC of wards, 2014.

Ethnic composition in the project area includes mainly Kinh people, occupying 93.9% of population in An Phu Ward (Thuan An Town) to 100% in Tan Binh Ward (Di An Town). There are few ethnic minority groups in the survey area including Ba To, Stieng, Hoa, Tay, Thai, Muong, and Khmer people. Temporary residents occupy a considerable part in some wards (more than 70%) such as Hoa Phu Ward, Thuan Giao Ward, Binh Chuan Ward and An Phu Ward. They are workers from other provinces or foreign experts working at industrial zones or companies.

Economic structure of wards in Binh Duong Province is oriented to industry-construction and trade-services. Of these 13 wards, the two sectors occupy equal or more than 90% the economic growth in 11 wards. Two wards have high ratio of agriculture - forestry sector are Thuan Giao Ward and Dong Hoa Ward (20% and 40%, respectively).

Table 3-10. Summarized socio-economic characteristics of the target communes

Wards	Summarized socio-economic characteristics
1) HoaPhu	Binh Duong New City is a part of this ward. The road network is well developed with many wide roads. Population density is low. Residential areas are widely dispersed. Large scale industrial zones include VSIP (119 factories), Dong An II (22 factories). Besides, the province administrative office building, the TDC Plaza, the Sora Tower are well known in the locality.
2) Phu My	A large part of the ward territory is located along Huynh Ngoc Luy Street and Pham Ngoc Thach Street (under construction). Outstanding facilities include: the Vietnam-Korean Vocational College, Phu My Sport Center, Dai Dang Industrial Zone, Song Than Industrial Zone.
3) HiepThanh	The north-western area of the ward is adjacent to BRT route. Outstanding facilities include Hiep Thanh III Residential Area, Hiep Thanh III Apartment (10-storeys high).
4) PhuLoi	The national historical relic namely “Phu Loi Prison”, Dai Dang Industrial Zone (275 ha, 39 factories). It is said that among households affected by the My Phuoc-Tan Van Road Development Project, 18 households are now still refusing to relocate.
5) PhuHoa	Shija Vietnam Company, Thu Dau Mot University are outstanding in the commune. Phu Hoa Residential Area are well known in the locality.
6) ThuanGiao	Outstanding spots include: Viet Huong Industrial Zone (50 factories), Vietnam-Singapore Industrial Zone (140 factories), Thuan Giao Residential Area (4 ha), and several large-scaled super markets.
7) BinhChuan	The ward is well known with Binh Chuan Residential Zone (in the North of My Phuoc-Tan Van Road), Binh Thanh Company, Hai My Market, etc.
8) An Phu	The ward lays in the North-South direction along Provincial Road No. 743.

Wards	Summarized socio-economic characteristics
	Population density is quite high (5,967pers/km^2). Outstanding spots include: Tan Binh Industrial Zone, Viet-Sing Industrial Zone, Viet-Sing Residential Area, An Phu Residential Area, An Phu Bus Terminal, Binh Duong Water Supply Company, etc.
9) Tan Binh	Population is fairly high (4000 pers/km^2). The ward is well known with Tan Binh Industrial Zone, and Biconsi Residential Area (70 ha), etc.
10) Tan Hiep Dong	A part of the ward territory is crossed by the national railway. Tan Dong Hiep A Industrial Zone (53ha) and Tan Dong Hiep B Industrial Zone (163ha) are working places of about 30,000 persons. There is a large quarry in the western part of the ward.
11) Binh An	There is a large quarry in the northern part of the ward. Population density is quite low (435pers/km^2). The outstanding National Agriculture College is located in the South of the ward.
12) Binh Thang 13) Dong Hoa	National Highway No.1, Tan Van Bus Terminal, Binh An Garment Factory, and the Cultural and Historical Park are located in the South-West of the wards.
14) Long Binh	The ward is bordered with National Highway No.1 and the Martyrs Cemetery in the North-West, and Dong Nai River in the East.

Source: JICA Study Team

4. Legal framework for environmental and social considerations

4.1. Vietnam legal framework on environmental impact assessment

4.1.1. Laws and regulations on environmental protection

Table 4-1 lists up main laws and regulations on environmental protection in Vietnam.

Table 4-1. Main laws and regulations on environmental protection

Issuance date	Code/Number	Title
2002/06/26	Decision No. 82/2002/QD-TTg	Establishment, Mandate and Operations of the Vietnam Environment Protection Fund
2002/07/16	Decision No. 53/2002/QD-BKHCNMT	Promulgating the Organization and Operation Charter of Vietnam Environmental Protection Fund (expired)
2002/08/09	Decision No. 62/2002/QD-BKHCNMT	Promulgating the Regulation on the Protection of the Environment in Industrial Parks
2002/11/11	Decree No. 91/2002/ND-CP	Prescribing the Functions, Tasks, Powers and Organizational Structure of the Ministry of Natural Resources and Environment
2003/04/02	Decision No. 45/QD-TTg	Establishment of provincial Department of Natural Resources and Environment.
2003/05/08	Decision No. 600/2003/QD-BTNMT	Specifying mandates, responsibilities; powers and organizational structure of the Department of Water Resources Management
2003/06/23	Decision No. 782/2003/QD-BTNMT	Promulgating the Charter on organization and operation of Vietnam Environment Protection Fund
2005/12/12	Decision No. 328/2005/QD-TTg	Approving the state plan on environmental pollution control till 2010
2006/06/23	Decree No. 65/2006/ND-CP	Organization and Operation of the Natural Resources and Environment Inspectorate
2006/08/09	Decree No. 81/2006/ND-CP	Sanctioning of Administrative Violation in the Domain of Environmental Protection
2006/11/22	Decree No. 140/2006/ND-CP	Providing for the Environmental Protection at Stages of Elaboration, Evaluation, Approval and Implementation of Development Strategies, Planning, Plans, Programs and Projects
2007/04/23	Decree No. 59/2007/NĐ-CP	on solid waste management
2007/08/27	Circular No. 06/TT-BKH	On environmental protection in appraising and approving programs and projects
2008/04/03	Decision No. 48/2008/QD-TTg	Guidelines on preparation of F/S report for the ODA projects financed by international bank (ADB、AFD、JICA、KfW、WB)
2008/07/15	Circular No. 03/2008/TTLT-BTNMT- BNV	Guiding the functions, tasks, powers and organizations of the natural resources and environment related specialized units under the people's committees at all levels
2008/09/15	Decree No. 102/2008/ND-CP	Stipulation on the collection, management, exploitation and use of natural resources and environmental data
2008/09/18	Circular No. 04/2008/TT-BTNMT	Guiding the formulation and approval or certification of environmental protection schemes and the examination and inspection of implementation

Issuance date	Code/Number	Title
		of environmental protection schemes
2008/09/30	Decision No. 132/2008/QD-TTg	Stipulation on function, tasks, responsibilities, and organizational structure of Vietnam Environmental Protection Administration under MONRE
2008/12/28	Decision No.68/2008/QĐ-BLĐTBXH	Stipulation on List of equipment, personal protective equipment for workers, who are working in or related to risk and/or hazardous aspects
2010/03/18	Circular No. 08/2010/TT-BTNMT	Stipulation on the preparation of national environmental report, sectorial environmental situation report, and provincial environmental status report
2010/04/06	Circular No. 09/2010/TT-BGTVT	Stipulation on environmental protection for transportation infrastructure development projects
2012/04/24	Circular No. 13/2012/TT-BGTVT	Amending some articles of the Circular No. 09/2010/TT-BGTVT on environmental protection for transportation infrastructure development projects
2012/03/16	Circular No. 01/2012/TT-BTNMT Replaces Circular No. 04/2008/TT-BTNMT	Regulation on setting-up, assessment, approval, inspection and certification of the implementation of detailed environmental protection project; setting-up and registration of simple environmental protection project
2013/11/14	Decree No. 179/2013/ND-CP	Decree on the sanction of administrative violations in the domain of environmental protection
2014/06/23	Law No. 55/2014/QH13	Law on Environmental Protection (Note *) Amended from the Law No. 52/2005/QH11
2014/08/28	Circular No.50/2014/TTLT-BTNMT-BNV	On function, responsibility, right, and organization structure of agency in charge of natural resources and environment in provinces, cities, districts.
2015/01/06	Decree No.03/2015/ND-CP	Stipulations on confirmation of damages to environment
2015/02/14	Decree No. 18/2015/ND-CP	Stipulation on environmental protection masterplan, strategic environmental assessment (SEA), environmental impact assessment (EIA), and environmental protection plans (Note *) Replacing Decree No. 29/2011/ND-CP and Decree No. 35/2014/ND-CP (will come into effect on 15 June 2014)
2015/02/14	Decree No. 19/2015/ND-CP	Providing detailed guidelines for Implementation of a Number of Articles of the Law on Environmental Protection (Note *) Replacing Decree No. 80/2006/ND-CP and Decree No. 21/2008/ND-CP
2015/05/29	Circular 27/2015/TT-BTNMT	Provide guidance on the implementation of strategic environmental assessment, environmental impact assessment, and environmental protection plan. (Note *) Replacing Circular No. 26/2011/TT-BTNMT

Note: Important law or regulation relating to the preparation of environmental impact assessment (EIA) of this Project*

Besides, the Government of Vietnam has joined 32 international environmental conventions/ agreements/ treaties, and is reviewing the plan to join other 6 ones (refer to the document "Register of International Treaties and Other Agreements in the Field of the Environment", published by UNEP in 2005, and website of Vietnam Environmental Protection Agency). Table 4-2 lists main international conventions/ agreements/ treaties relating to environmental protection which Vietnam has engaged.

Table 4-2. List of international environmental conventions/agreements/treaties which Vietnam engaged to

No.	Name	Effective Date in Vietnam	Management Body
1.	Cartagena Protocol on Bio-safety	2004 Ac	VEPA, MONRE
2.	Kyoto Protocol on Climate Change	2002 R	GDMH, MONRE
3.	Stockholm Convention on Persistent Organic Pollutants (POPs)	05/2001 R	VEPA, MONRE
4.	UN's International Declaration on Cleaner Production	22/9/1999	MPI
5.	UN Convention to Combat Desertification	23/11/1998 Ac	MARD
6.	Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal	13/03/1995 Ac	VEPA, MONRE
7.	Agreement on Cooperation for the Sustainable Development of the Mekong River Basin	1995 S	MFA
8.	United Nations Convention on the Law of the Sea (UNCLOS)	25/07/1994 R	MFA
9.	Vienna convention for the protection of the ozone layer including the Montreal Protocol on Substances that Deplete the Ozone Layer	26/01/94 Ac	GDMH
10.	United Nations framework Convention on Climate Change	16/11/1994 R	MONRE
11.	Convention on Biological Diversity (CBD)	16/11/1994 R	VEPA, MONRE
12.	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	20/01/1994 R	MARD
13.	MARPOL International Convention for the Prevention of Pollution from Ships	29/08/1991 S	VNMB, MOT
14.	Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar)	20/9/1988	MONRE, MARD
15.	Convention Concerning the Protection of the World Cultural and Natural Heritage	10/10/1987 At	MOCI
16.	Convention on the Conservation of Migratory Species of Wild Animals (CMS)	Under discussion	
17.	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction	1998 R	NP
18.	Agreement on the Network of Aquaculture Centres in Asia and the Pacific	1989	MONRE
19.	Agreement for the Establishment of the Asia-Pacific Fishery Commission	1995 At	MOF
20.	Agreement on the Conservation of Nature and Natural Resources	Under discussion	

Legend: GDMH:General Department of Meteorology and Hydrology, MOF: Ministry of Fishery, VNMB: Vietnam Marine Bureau, MFA: Ministry of Foreign Affairs, MOT: Ministry of Trade, MONRE: Ministry of Natural Resources and Environment, MARD: Ministry of Agriculture and Rural Development, MPI: Ministry of Planning and Investment, MOH: Ministry of Health, MOST: Ministry of Sciences and Technologies, MOT: Ministry of Transportation, MOCI: Ministry of Culture and Information, now is the Ministry of Culture, Sport and Tourism. NP: National President
S: Signed, R: Ratification, At: Accepted, Ap: Approval, Ac: Accession

(1) Law on Environmental Protection

In Vietnam, the Law on Environmental Protection (LEP) is the umbrella law and the most

comprehensive legal base relating to environmental protection. Its first version was approved in 1993, and amended first time in 2005 and second time in 2014. The Law on Environmental Protection amended in 2014 (hereinafter referred to as "the 2014-amended-LEP") was passed on June 23, 2014 by the XIIIth National Assembly (with the Law Code 55/2014/QH13), and became effective since January 1st, 2015. Table 4-3 shows the content of the 2014-emended-LEP.

Table 4-3. Content of the 2014-amended-LEP (ratified on June 23, 2014 at the 8th National Assembly, 7th session)

Chapter I: GENERAL PROVISIONS	
Article 1.	Governing scope
Article 2.	Applicable entities
Article 3.	Interpretation of terms
Article 4.	Principles of environmental protection
Article 5.	Regulatory policies on the environmental protection
Article 6.	Course of actions that are advised to take to protect the environment
Article 7.	Prohibited acts
Chapter II: PLANNING FOR ENVIRONMENTAL PROTECTION, STRATEGIC ENVIRONMENT ASSESSMENT, ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL PROTECTION PLAN	
Section 1. PLANNING FOR ENVIRONMENTAL PROTECTION	
Article 8.	Principle, level and term of the planning for environmental protection
Article 9.	Basic contents of the planning for environmental protection
Article 10.	Responsibility for preparing the planning for environmental protection
Article 11.	Consultation on, inspection and approval of the planning for environmental protection
Article 12.	Review and modification of the planning for environmental protection
Section 2. STRATEGIC ENVIRONMENT ASSESSMENT	
Article 13.	Strategic environment assessment objects
Article 14.	Carrying out the strategic environment assessment
Article 15.	Main subject-matters of the report on strategic environment assessment
Article 16.	Verification of the report on strategic environment assessment
Article 17.	Receiving the verification comments and reporting the conclusive result of verification of the report on the strategic environment assessment
Section 3. ENVIRONMENTAL IMPACT ASSESSMENT	
Article 18.	Environmental impact assessment objects
Article 19.	Carrying out the environment impact assessment
Article 20.	Remaking the report on the environment impact assessment
Article 21.	Consultation to be required in the process of the strategic environment assessment
Article 22.	Main subject-matters of the report on environmental impact assessment
Article 23.	Authority to appraise the report on environmental impact assessment
Article 24.	Appraisal of the report on environmental impact assessment
Article 25.	Approval of the report on the environmental impact assessment
Article 26.	Responsibility assumed by the project owner after being granted the approval of their report on the environmental impact assessment

Article 90.	Document compilation, registration and licensing of hazardous waste treatment
Article 91.	Classification, collection, and storage of hazardous wastes prior to processing
Article 92.	Transport of hazardous wastes
Article 93.	Conditions of facilities that process hazardous wastes
Article 94.	Waste management contents in environmental protection planning
Section 3. MANAGEMENT CONVENTIONAL SOLID WASTES	
Article 95.	Responsibility to classify conventional solid wastes
Article 96.	Collection and transport of conventional solid wastes
Article 97.	Recycling and treating conventional solid wastes
Article 98.	Conventional solid waste management contents in environmental protection planning
Section 4. WASTEWATER MANAGEMENT	
Article 99.	General regulations on wastewater management
Article 100.	Collection and treatment of wastewater
Article 101.	Sewage treatment system
Section 5. MANAGEMENT AND CONTROL OF DUST, EXHAUST GASES, NOISE, VIBRATION, LIGHT, AND RADIATION	
Article 102.	Management and control of dust and exhaust gases
Article 103.	Management and control of noise, vibration, light, and radiation
Chapter X: POLLUTION CONTROL, ENVIRONMENTAL REMEDIATION AND IMPROVEMENT	
Section 1. ACTIONS AGAINST ESTABLISHMENTS CAUSING SERIOUS ENVIRONMENTAL POLLUTION	
Article 104.	Actions against establishments causing serious environmental pollution
Section 2. ENVIRONMENTAL REMEDIATION	
Article 105.	General regulations on environmental pollution reduction and classification of polluted areas
Article 106.	Pollution reduction and environmental remediation
Article 107.	Pollution reduction and environmental remediation
Section 3. PREVENTING AND RESPONDING TO ENVIRONMENTAL EMERGENCIES	
Section 108.	Preventing environmental emergencies
Article 109.	Environmental emergency response
Article 110.	Developing environmental emergency response forces
Article 111.	Determination of damage caused by environmental emergencies
Article 112.	Responsibility for environmental remediation
Chapter XI: ENVIRONMENTAL TECHNICAL REGULATIONS, ENVIRONMENTAL STANDARDS	
Article 113.	Environmental technical regulation system
Article 114.	Principles of constructing environmental technical regulations
Article 115.	Symbols of environmental technical regulations
Article 116.	Requirements for technical regulations on surrounding environment quality
Article 117.	Requirements for technical regulations on waste
Article 118.	Construction and promulgation of environmental technical regulations
Article 119.	Environmental standards
Article 120.	Construction, appraisal and promulgation of environmental standards
Chapter XII: ENVIRONMENTAL MONITORING	
Article 121.	Environmental monitoring

Article 122.	Environmental components and emissions to be monitored
Article 123.	Environmental monitoring program
Article 124.	Environmental monitoring system
Article 125.	Environmental monitoring responsibilities
Article 126.	Conditions of environmental monitoring
Article 127.	Environmental monitoring data management
Chapter XIII: ENVIRONMENTAL INFORMATION, DIRECTIVE, STATISTICS AND REPORTING	
Section 1. ENVIRONMENTAL INFORMATION	
Article 128.	Environmental information
Article 129.	Collection and management of environmental information
Article 130.	Announcement and supply of environmental information
Article 131.	Publishing of environmental information
Article 132.	Environmental indicators
Article 133.	Environmental statistics
Section 3. ENVIRONMENTAL REPORTING	
Article 134.	Annual environmental protection reporting responsibilities
Article 135.	Report of environmental protection tasks
Article 136.	Annual socio-economic report on environmental protection
Article 137.	Environmental quo status reporting responsibilities
Article 138.	Environmental quo status report
Chapter XIV: RESPONSIBILITIES OF REGULATORY AGENCIES FOR ENVIRONMENTAL PROTECTION	
Article 139.	State management on environmental protection
Article 140.	State management responsibilities of the Government for environmental protection
Article 141.	State management responsibilities of the Minister of Natural Resources and Environment to environmental protection
Article 142.	State management responsibilities of Ministers, heads of ministerial level bodies on environmental protection
Article 143.	State management responsibilities of the people' committees of all levels on environmental protection
Chapter XV: RESPONSIBILITIES OF VIETNAM FATHERLAND FRONT, SOCIO-POLITICAL ORGANIZATIONS, SOCIO–OCCUPATIONAL ORGANIZATIONS AND RESIDENTIAL COMMUNITY FOR ENVIRONMENTAL PROTECTION	
Article 144.	Responsibilities and rights of Vietnam Fatherland Front
Article 145.	Responsibilities and rights of socio-political organizations, socio-occupational organizations
Article 146.	Rights and obligations of local communities
Chapter XVI: RESOURCES FOR ENVIRONMENTAL PROTECTION	
Article 147.	Expenditure of state budget on environmental protection
Article 148.	Cost of environmental protection
Article 149.	Environmental protection fund
Article 150.	Environmental service development
Article 151.	Incentives and support for environmental protection tasks
Article 152.	Development and application of science and technology to environmental protection
Article 153.	Environmental industry development
Article 154.	Communicating and popularizing the law on environmental protection

Article 155.	Provision of environmental education and provision of training for environmental protection forces
Chapter XVII: INTERNATIONAL COOPERATION ON ENVIRONMENTAL PROTECTION	
Article 156.	Signing and becoming a member in the international treaty of environmental protection
Article 157.	Environmental protection during international economic integration
Article 158.	Expanding international cooperation on environmental protection
Chapter XVIII: INVESTIGATING, INSPECTING AND HANDLING VIOLATIONS, SETTLING ENVIRONMENTAL DISPUTES, CLAIMS AND ACCUSATIONS	
Article 159.	Responsibilities for organizing and directing the investigation and inspection of environmental protection tasks
Article 160.	Actions against violations
Article 161.	Environmental disputes
Article 162.	Complaints, accusations and lawsuits
Chapter XIX: COMPENSATIONS FOR ENVIRONMENTAL DAMAGES	
Article 163.	Damages caused by environmental pollution and degradation
Article 164.	Principles of handling responsibilities of organizations, individuals causing environmental pollution
Article 165.	Determination of damages caused by environmental pollution, degradation
Article 166.	Determination of damages caused by deterioration in environmental function and productivity
Article 167.	Liability insurance for environmental damages
Chapter XX: EXECUTION PROVISIONS	
Article 168.	Transitional clause
Article 169.	Effect
Article 170.	Detailed regulations

Among articles of the 2014-amended-LEP, the following ones are considered applicable in the process to implement the Project.

- **Article 18: Environmental impact assessment objects.**

  Clause 1 - Environmental impact assessment objects consist of: (a) Projects subject to the decision on investment intentions made by the National Assembly, Government and the Prime Minister; (b) Projects that use land parcels situated in wildlife sanctuaries, national parks, historical – cultural monuments, world heritage sites, biosphere reserves, scenic beauty areas that have been ranked; (c) Projects that can cause bad effects on the environment. Clause 2: List of projects mentioned at Points b and c Clause 1 of this Article shall be regulated by the Government.
- **Article 19: Carrying out the environment impact assessment.**

  Clause 1: Owners of projects regulated in Clause 1 Article 18 of this Law shall carry out, on his own, or hire an advisory organization to carry out the environmental impact assessment

and take statutory responsibility for the conclusive result after carrying out such assessment. Clause 2: The environment impact assessment must be performed in the preparatory stage of the project. Clause 3: The conclusive result yielded after carrying out the environment impact assessment shall be expressed in the form of the report on environmental impact assessment. Clause 4: Expenses incurred from the formulation and inspection of the report on environmental impact assessment, and included in total investment budget shall be covered by the project owner.

- **Article 21: Consultation to be required in the process of the strategic environment assessment.**

  Clause 1: The consultation to be required in the process of environmental impact assessment is aimed at completing the report on environmental impact assessment, helps minimize the bad impacts on the environment and human beings and ensure the sustainable development of the project. Clause 2: Project owners are obliged to consult with regulatory agencies, organizations and communities that are directly affected by the project. Clause 3: Projects that do not require the consultation include: (a) Those in conformity with the planning for concentrated manufacturing, trading and service provision areas under the approval of the report on environmental impact assessment at the infrastructural construction stage for the project; (b) Those specified in the list of state secret projects.

- **Article 22: Main subject-matters of the report on environmental impact assessment.**

  1. Origin of the project, project owners, and the competent authority's approval of the project; method of the environmental impact assessment.

  2. Evaluation of technological choice, work items and any activity relating to the project which can cause bad effects on the environment.

  3. Assessment of current status of natural and socio-economic environment carried out at areas where the project is located, adjacent areas and demonstration of the suitability of the selected project site.

  4. Assessment and forecast of waste sources, and the impact of the project on the environment and community health.

  5. Assessment, forecast and determination of measures for managing the risks of the project posed to the environment and community health.

  6. Waste disposal measures.

  7. Measures for minimizing the impact of the project on the environment and community health.

  8. Consultation result.

  9. Environmental management and monitoring programs.

  10. Budget estimate for the construction of environmental protection facilities and measures to be taken to minimize the environmental impact.

11. Alternatives to the application of measures for the environment protection.

- **Article 23: Authority to appraise the report on environmental impact assessment**

  Clause 1: The Ministry of Natural Resources and Environment shall arrange to appraise the report on environmental impact assessment in respect of the following projects: (a) Projects subject to the decision on investment intentions made by the National Assembly, Government and the Prime Minister; (b) Interdisciplinary or inter-provincial projects stipulated at Points b and c Clause 1 Article 18 in this Law, exclusive of those classified as the secret projects in the field of national defense and security; (c) Projects verified by the Government's authorized entities. Clause 2: Ministries and quasi-ministerial agencies shall appraise the report on environmental impact assessment in respect of projects that shall be permitted under their decision and approval, but are not specified in regulations mentioned at Points b and c Clause 1 of this Article. Clause 3: The Ministry of National Defense and the Ministry of Public Security shall arrange to appraise the report on environmental impact assessment in respect of projects that shall be permitted under their decision and approval, and those classified as the secret projects in the field of national defense and security. Clause 4: Provincial People's Committees shall arrange to appraise the report on environmental impact assessment in respect of investment projects within their territories that are not regulated at Clause 1, 2 and 3 of this Article.

- **Article 24: Appraisal of the report on environmental impact assessment**

  Clause 1: The Head or the person who takes over as a leader of the agency in charge of the approval task shall arrange to carry out the appraisal of the report on environmental impact assessment by means of seeking the permission from the appraisal council or obtaining advisory opinions from relevant agencies and organizations, and concurrently bear legal responsibility for their appraisal result. Clause 2: Members of the appraisal council and entities that are requested to contribute their advisory opinions shall be legally responsible for such of their opinions. Clause 3: When necessary, the agency in charge of appraisal shall arrange to conduct a poll to obtain the critical opinions from other institutions, organizations and experts in relation to the appraisal of the report on environmental impact assessment. Clause 4: Within an appraisal period, where any adjustment or supplementation is required, the appraisal agency is responsible to send a written notification thereof to the project owner.

- **Article 25: Approval of the report on the environmental impact assessment**

  Clause 1: Within a period of 20 days which begins with the date when the report on environmental impact assessment is received after being adjusted at the request of the verification agency, the head or the person who takes over as the leader of the approval agency shall be responsible to approve the report on environmental impact assessment; if the report is rejected, the project owner must be notified in writing in which the reasons for such rejection must be clearly explained. Clause 2: Decision on approving the report on

environmental impact assessment shall serve as the ground for the competent authority's following tasks: (a) Decision on the intention to invest in the projects specified in Article 18 of this Law must be granted if the project is required to obtain such decision in accordance with laws. (b) Issuing and revising the prospecting permit, mineral extraction permit in respect of the mineral exploration and extraction projects; (c) Approving the plan for prospecting or exploration, and the plan for mine development in respect of petroleum exploration and extraction; (d) Issuing and revising the construction permit in respect of the projects on the development of works or structures that are required to obtain the construction permit before commencement; (e) Issuing the investment certificate with reference to projects that are not regulated at Points a, b, c and d in this Clause.

- **Article 26: Responsibility assumed by the project owner after being granted the approval of their report on the environmental impact assessment**

  Clause 1: Comply with the requests specified in the approval of their report on environmental impact assessment. Clause 2: Where any change in the project size, capacity and technology applied in the project execution is blamed for the bad impact on the environment in comparison with the alternatives given in the approved report on environmental impact assessment, but is not too serious to make another report as stipulated at Point c Clause 1 Article 20 of this Law, the project owner must send their explanation to the agency who grants the approval of the report on environmental impact assessment, and the project shall be commenced only after obtaining the permission from such agency.

- **Article 27: Responsibility assumed by the project owner before bringing the project into operation.**

  Clause 1: Apply measures for the environmental protection under the decision on the approval of their report on environmental impact assessment. Clause 2: Notify the agency who grants the approval of the report on environmental impact assessment on the progress of developing environmental protection works functioning as an ancillary part of major projects that can cause bad impacts on the environment in accordance with the Governmental regulations. These projects will be commenced only after the agency in charge of the approval of the report on environmental impact assessment has inspected and certified the completion of environmental protection works.

In addition, the Government of Vietnam has issued Decree 18/2015/ND-CP, and then Decree 19/2015/ND-CP as the instructive guidance for implementation of LEP.

Decree 18/2015/ND-CP is particularly important since it states relatively in detail the process necessary for implementing EIA for the Project. Table 4-4 shows the content of this Decree.

Table 4-4. Content of Decree 18/2015/ND-CP

Chapter 1. GENERAL PROVISIONS		
	Article 1	**Scope** : This Decree promulgates environmental protection planning (EPP), strategic environmental assessment (SEA), environmental impact assessment (EIA) and/or environmental protection plans of the Law on Environment protection.
	Article 2	**Regulated entities:** This Decree shall apply to agencies, organizations, or individuals involved in EPP, SEA, EIA, and/or environmental protection plans in the territories of the Socialist Republic of Vietnam.
Chapter 2. ENVIRONMENTAL PROTECTION PLANNING (EPP)		
	Article 3	Formulation of EPP (national EPP, provincial EPP)
	Article 4	Assessment of EPP
	Article 5	Approval for national EPP
	Article 6	Approval for provincial EPP
	Article 7	Disclosure of EPP
Chapter 3.		
	Article 8	Implementation of strategic environmental assessment (i.e. responsibility of owners of projects listed in Appendix I)
	Article 9	Preconditions of organization in charge of implementing strategic environmental assessment
	Article 10	Appraisal of report on strategic environmental assessment
	Article 11	Obligatory reporting on result of appraisal of report on strategic environmental assessment
Chapter 4.		
	Article 12	Implementation of environmental impact assessment (i.e. responsibility of owners of projects listed in Appendix II)
	Article 13	Preconditions of organization in charge of implementing environmental impact assessment
	Article 14	Appraisal and approval of report on environmental impact assessment
	Article 15	Remaking and re-submission of report on environmental impact assessment
	Article 16	Responsibility of the project owner after the report on environmental impact assessment is approved
	Article 17	Inspection and verification of environmental protection facility in the operation phase of the project
Chapter 5.		
	Article 18	Registration of environmental protection plan (responsibility of owners of projects not listed in Appendix II)
	Article 19	Confirmation of environmental protection plan
Chapter 6.		
	Article 20	Financial sources for environmental protection planning, strategic environmental assessment, environmental impact assessment, environmental protection plan, and for implementation of environmental protection proposal
	Article 21	Reporting system
Chapter 7.		
	Article 22	Management of environmental protection, environmental assessment carried out before the effective date of this Decree
	Article 23	Effective date of the Decree (April 1st, 2015)
	Article 24	Agencies responsible for implementation of the Decree

Appendix II of Decree No.18/2015/ND-CP lists 113 projects where the project owner should carry out the environmental impact assessment.

According to the Article no. 12 and Appendix II of the Decree 18/2015/ND-CP, for transportation sector that construction projects for road bridges or rail bridges with the length at least 500 m (excluding feeder roads) shall implement EIA. The main component of the BRT project is to build new 08 flyovers at intersections with the total length of more than 500m therefore it is obligatory to carry out EIA.

In addition, the Government of Vietnam (GoV) has issued Decree 19/2015/ND-CP as the instructive guidance for implementation of LEP. Furthermore, many regulations on environmental protection have been issued, such as Circular 27/2015/TT-BTNMT by MONRE which stipulate regulations on Environmental Protection Planning, Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), and Environmental Protection Plans, etc.

4.1.2. Technical framework for EIA

The projects which are obligated to make EIA report are defined in detail and listed up in Appendix II of Decree 18/2015/ND-CP (issued on February 14, 2015). Accordingly, before implementation of an individual project, the concerned development policy/plan/program should be approved, and the concerned environmental impacts should be anticipated and assessed. Preparation of EIA for the project shall follow the Circular 27/2015/TT-BTNMT dated May 29, 2015 by MONRE which stipulated detailed guidance on implementation of articles of Decree No. 18/2015/ND-CP.

4.1.3. Gaps between JICA Environmental Guidelines and Vietnam's legal framework on environmental assessment

The current EIA system in Vietnam is basically consistent with international practice. However, it lacks concrete procedures and requirements for information disclosure, public consultation. In addition, it lacks consideration on impacts to local socio-economy such as the followings.

(1) Local economy such as employment, livelihood, etc.

(2) Utilization of land, local resources, etc.

(3) Social institutions, local decision-making institutions

(4) Vulnerable social groups (the poor, indigenous peoples, etc.)

(5) Equality of benefits and losses, equality in the development process

(6) Gender, children's rights

(7) Local conflicts of interest

Table 4-5 lists up major deviations between Vietnam's impact assessment legal framework and JICA Environmental Guidelines for Environmental and Social Considerations (April 2012).

Table 4-5. Deviations between Vietnam's EIA legal framework and JICA Environmental Guidelines

JICA Environmental Guidelines	Vietnam's EIA legal framework
1. Principle: Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.	At the project level, environmental impacts are assessed and examined only from the stage of F/S. IEE or Environmental Scoping is not compulsory in the environmental assessment procedure. In an EIA report, alternatives should be examined, and all anticipated impacts caused by the project should be assessed without the scoping process.
2. Ensuring accountability and transparency	There is no provision on accountability and transparency in Vietnam regulations on environmental assessment.
3. Ensuring meaningful participation of stakeholders - In principle, project proponents etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent, in order to take into consideration the environmental and social factors in a way that is most suitable to local situations, and in order to reach an appropriate consensus. - (In the case of Category A projects,) JICA encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed. - The outcome of such consultations must be incorporated into the contents of project plans.	According to Decree 18/2015/ND-CP, in the process of making the EIA report, the project owner should carry out consultation by the following method: - Send a written request for consultation and a document outlining the main project items, environmental issues, and measures to mitigate environmental impacts to people's committees (PCs) of communes, wards or townships where the project is to be implemented and representatives of communities and organizations directly affected by the project; - Request the above-mentioned PCs and representatives of communities and organizations to give comments on the document sent. - In case of necessity, the commune-level PCs shall organize a dialogue with the project owner and representatives of organizations and communities directly affected by the project. - After receiving the written request for consultation, the commune-level PCs shall reply the project owner in writing and publicize such reply. Past this time limit, if a consulted PC fails to send a written reply to the project owner, it is regarded as agreeing with the project owner's investment plan. The consultation with the community under the direct impact of the project shall be carried out in the form of community meeting co-chaired by project owner and the People's Committee of the commune where the project is carried out together with the participation of representatives of Vietnamese Fatherland Front of communes, socio-political organizations, socio-professional organizations, neighborhoods, villages convened by the People's Committee of the commune. All opinions of delegates attending the meeting must be sufficiently and honestly stated in the meeting minutes. This is the new regulation for the EIA process in Vietnam which enable public participation in in

JICA Environmental Guidelines	Vietnam's EIA legal framework
	preparation of EIAs.
4. Information disclosure - JICA discusses frameworks with project proponents etc. in order to ensure information disclosure, and comes to an agreement in an early stage of cooperation projects. - (In the case of Preparatory Survey,) Project proponents etc. disclose scoping drafts, which consist of project name, countries, locations, project outlines, categorizations and the reasons behind them, alternatives, impacts, and contents. - EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	According to Circular 27/2015/TT-BTNMT (Article 09), after receiving the decision on the EIA report approval sent by Ministries or ministerial-level agencies, the People's Committee of the province shall copy the decision and send them to the Service of Natural Resources and Environment, the People's Committee of district, and the People's Committee of the commune where the project is carried out and the management board of industrial park if the project is carried in the industrial park According to Circular 27/2015/TT-BTNMT (Article 10), the project owner shall send the environment management plan to the People's Committee of the commune where the consultation was held during the implementation of EIA in order that the plan shall be posted public before the construction commencement. However, it seems that the process and method to disclose such information are not properly undertaken in actuality. Therefore, in general, the project-affected people are not easy to access to information such as the EIA report or the EMP of the project, and present their opinions on the project.
5. Project categorization: JICA classifies projects into four categories (A ~ C, and FI) according to the extent of environmental and social impacts, taking into account an outline of project, scale, site condition, etc.	The system of environmental assessment in Vietnam is consisted of: (1) Strategic Environmental Assessment (SEA), (2) Environmental Impact Assessment (EIA), and (3) Environmental Protection Plans (EPP). Objects subject to elaboration of SEA are socio-economic development strategies, plannings and plans at national level, regional level, provincial level, key economic regions, and inter-provincial river watersheds. At the project level, projects are categorized into two groups: group has to elaborate an EIA report, and group has not to elaborate an EIA report but only has to submit an EPP. Decree 18/2015/ND-CP lists up 113 groups of projects which have to elaborate and submit an EIA report for approval.
6. Impacts to be assessed: The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups	According to Circular 27/2015/TT-BTNMT (stipulating in detail a number of articles of Decree 18/2015/ ND-CP), impacts in pre-construction phase, construction phase, and operation phase should be anticipated and assessed. In pre-construction phase, alternatives on project location, and without- the-project option should be examined, and impacts caused by land acquisition, relocation, and resettlement should be assessed. In construction phase and operation phase, all project activities should be identified and impacts caused by these activities should be anticipated and assessed while taking into considerations the source of impact, subject of impact, extent of impact, occurrence frequency of impact, recovering possibility, etc. However, it seems that the following impacts are not properly considered: impacts to local economy (employment, livelihood, utilization of land, etc.), local resources, social institutions, local decision-making

JICA Environmental Guidelines	Vietnam's EIA legal framework
such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety. Items to be addressed in the specific project are narrowed down to the needed ones through the scoping process.	institutions, vulnerable social groups (the poors, indigenous peoples, etc.), equality of benefits and losses, equality in the development process, gender, children's rights, and local conflicts of interest.
7. Concern about Social Environment and Human Rights: JICA respects the principles of internationally established human rights standards such as the International Convention on Human Rights, and gives special attention to the human rights of vulnerable social groups including women, indigenous peoples, persons with disabilities, and minorities when implementing cooperation projects.	There is no provision on concern about human rights in the legal framework on project impact assessment in Vietnam.
8. Involuntary Resettlement People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites. ... In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	In Vietnam, issues on land acquisition, compensation, resettlement, etc. are regulated by the law and regulations on land administration (such as the New Land Law 2003, Decree 69/2009/ND-CP, Circular 14/2009/TT-BTNMT, etc.). If a development project needs to acquire some lots of land, then these above-mentioned law and regulations will be applied, an inventory-of-loss (IOL) will be carried out, and people who loses lands, properties, means of livelihood, etc. will be compensated and/or supported in relocation and resettlement. Measures to help project-affected people in restoring livelihood, improving living standard, etc. after resettlement have not been properly considered for a long time in the past. Only in the recently-issued Decree 69/2009/ ND-CP, the livelihood restoration plan has been stated for the first time as a measure to help affected people in obtaining sustainable livelihood. However, it needs further efforts to improve legal framework on involuntary resettlement and strengthen capacity of local agencies responsible for planning and implementing the livelihood restoration plan.
9. Indigenous Peoples Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives.	There is no particular provision on indigenous peoples in Vietnam's legal framework on project impact assessment.
10. Monitoring Project proponents etc. should make	According to Decree 18/2015/ND-CP (Article 16), after the EIA report is approved, the project owner

JICA Environmental Guidelines	Vietnam's EIA legal framework
efforts to make the results of the monitoring process available to local project stakeholders. When third parties point out, in concrete terms that environmental and social consideration are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.	shall formulate, approve and publicize the Environmental Management Plan at the offices of the commune-level PCs where consultation had been conducted. However, in the legal framework on impact assessment in Vietnam, there is no provision on the project owner's obligation to publicize results of monitoring process, and the procedure to settle complaints rose by the public on environmental issues relating to the project.

4.2. Outlines of relevant agencies

There are provincial and local agencies playing different roles in the appraisal and approval of the EIA report as follows

- The People's Committee of the province shall evaluate and approve EIA reports of projects in the province and under its competence as described in Article 11 of the Decree 18/2015/ND-CP
- Department of Natural Resources and Environment (DONRE) of Binh Duong Province which is an agency assisting PPC in management of environmental issues. The DONRE have delegated powers to make decisions on numerous issues (including EIA under authorization of PPC) related to the use and management of local resources and environment; cooperate with the People's Committee of local districts in the project areas to monitor the environment of the project in the construction stage and operation stage. The environmental protection division under DONRE is to assist Director of DONRE to appraise and approve EIA report (if PPC authorized DONRE), environmental protection plans; assist the director to guide, inspect and confirm the implementation of EIA after approval.
- EIA appraisal and approval council: The assessment of EIA report shall be conducted by the EIA report assessment council established by the Heads of the EIA report assessment authority with at least 07 members. Members of EIA report assessment council shall consist of 01 President, 01 Vice President where necessary, 01 Secretary member, 02 opponent members and other members, which at least 30 percent of the Assessment council members having at least 06 years' experience in the EIA field.
- People committee and Fatherland Front Committees act as responsible authorities and communities. They act as a go-between for the local community and the proponents and

may initiate public involvement.

4.3. Required procedure of environmental assessment, etc. for the project

Procedures of Environmental Impact Assessment (EIA) for the proposed project Vietnamese Law on Environmental Protection (No. 55/2014/QH13, took effect in 2015) requires owners of the projects with a potential risk of causing an adverse impact on the environment to carry out an environmental impact assessment (EIA) concurrently with the project feasibility study (Article 18 and 19). The detailed procedures concerning the preparation, appraisal and approval of the EIA are prescribed in Decree No.18/2015/ND-CP and Circular 27/2015/TT-BTNMT, as presented in **Figure 4-1**.

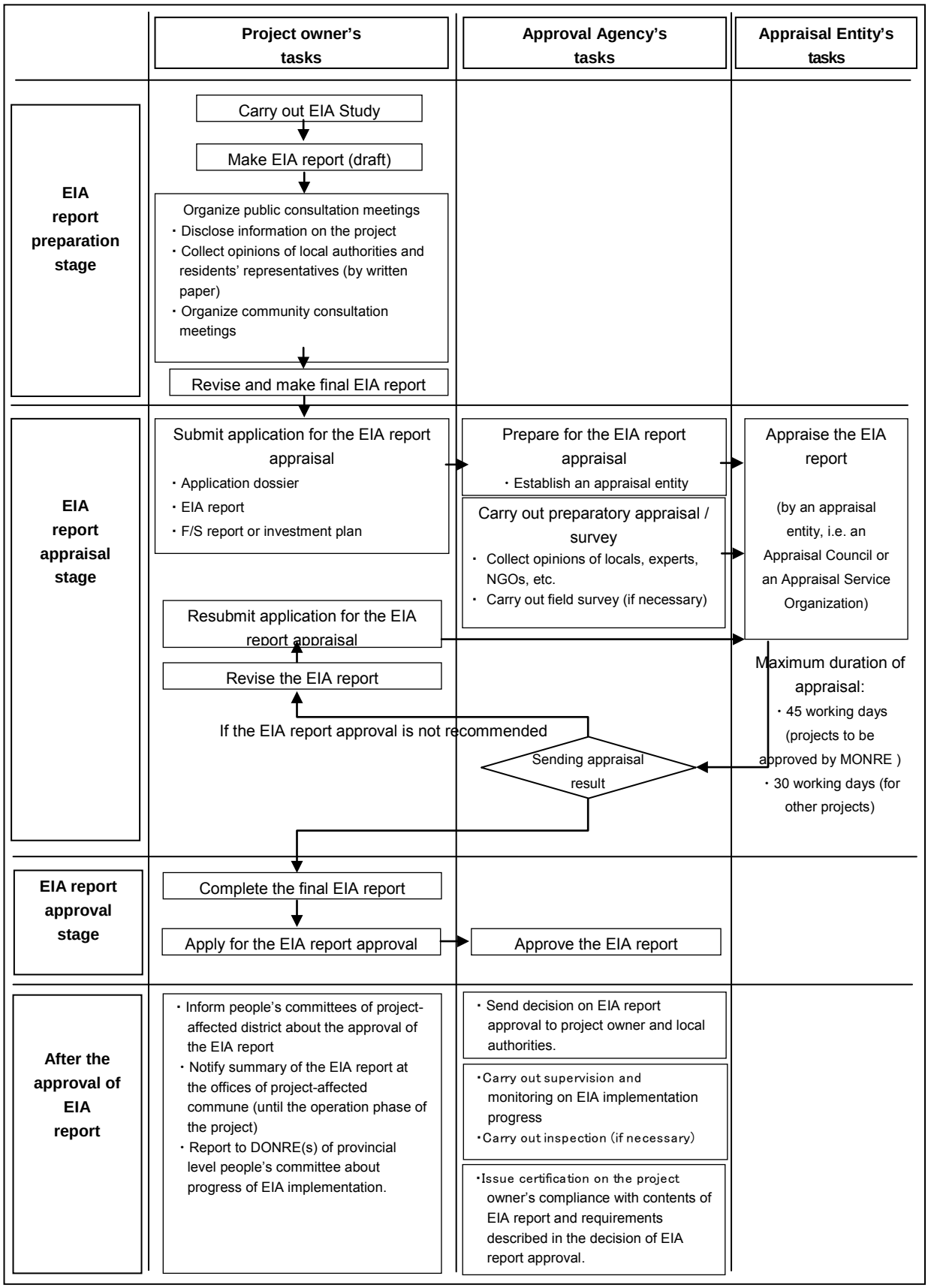


Figure 4-1 . Process for EIA Prepration of this project

To prepare EIA report for this Project, in order to satisfy requirements of JICA for a development project, the following issues should be taken into consideration.

Scoping

Although this step is not required in Vietnamese legal regulations, it shall be conducted early in the project cycle at the same time as pre-feasibility study of a development project. Problems are be pinpointed early allowing mitigating design changes to be made before expensive detailed work is carried out and to ensure that detailed prediction work is only carried out for important issues. Assessment of alternatives shall be analyzed and term of reference is prepared for the full EIA at this stage.

To evaluate all the problems that may arise when any project is implemented, the potential impacts are assessed in the form of matrix of impacts. The matrix of impacts gives an overview of the activities of the project, the environmental components which will be affected by each activity and the impact magnitude on the environment.

Examination of alternatives

The findings of the examination of environmental and social considerations of a funded project must include alternative proposals, mitigation measures (JICA Environmental Guidelines). Issues proposed at the scoping stage are further assessed with separate prediction studies. Realistic and affordable mitigating measures are proposed with estimating the scope of the impacts. The "without project" scenario and alternatives are also comprehensively tested in this stage.

This phase of an EIA requires good management of a wide range of technical specialists with particular emphasis on:

- Prediction methods;
- Interpretation of predictions, with and without mitigating measures;
- Assessment of comparisons.

Numerical values, or weightings are applied to different environmental impacts including reversible or irreversible, mitigable, non-mitigable, etc. When comparing a range of proposals or a variety of mitigation or enhancement activities, a number of characteristics of different impacts are highlighted.

Management and monitoring

Appropriate follow-up plans and systems, such as monitoring plans and environmental management plans are prepared; and costs of implementing such plans and systems, and financial methods to fund such costs, must be determined. Plans for projects with particularly

large potential adverse impact must be accompanied by detailed environmental management plans JICA Environmental Guidelines). The Management and Monitoring sets out the mitigation measures needed for environmental management and the institutional requirements for implementation. The institutional framework encompasses relationships among stakeholders including roles and responsibilities in terms of management, finance, and implementation of EMP. The Environmental Management Plan includes clear recommendations for action and the procedures, program and costs for their implementation.

The monitoring is to compare predicted and actual impacts, particularly if the impacts are either very important or the scale of the impact cannot be very accurately predicted. The results of monitoring will be used to manage the environment, particularly to highlight problems early so that action can be taken.

During construction and operation phases, construction or operation activities might cause unexpected negative effects to the environment and local people health. That might not be solved with mitigation measures proposed in this EMP, adjustment of EMP or even construction work therefore shall be considered.

Public participation

Consultations with relevant stakeholders, such as local residents, should take place throughout the preparation and implementation stages of a project (JICA Environmental Guidelines). Public participation is to ensure that the affected people have been adequately consulted and their views taken into account in project preparation and implementation. Public consultation will reveal new information, improve understanding and enable better choices to be made. During construction and operation of the project, public participation is necessary to grasp local residents' opinions on unexpected impacts and to promptly carry out corrective actions.

According to Decree No. 18/2015/ND-CP and Circular 27/2015/TT-BTNMT in the process of making the EIA report, the project owner should carry out consultation with PCs at wards/communes level and representatives of communities (normally ward/commune fatherland fronts) and organizations.

Decree No. 18/2015/ND-CP also stipulated requirement of the consultation with the community (in the form of community meeting) directly affected by the project during preparation of EIA report.

5. Examination of alternatives

5.1. Zero-option

The Zero-option (existing bus route) is operated between Binh Duong New City and Ben Thanh along NH 13. Total travel time of this existing route is 113 minutes. The BRT route proposed by JICA Study Team is planning to connect Binh Duong New City and Suoi Tien Terminal station through Pham Ngoc Thach Road – My Phuoc-Tan Van Road - Planned road in Industrial Park – NH 1A. Terminal of BRT is located at Suoi Tien Terminal Station and passengers therefore can go to Ben Thanh via MRT Line-1. Total travel time of BRT and MRT is shorter compared to 113 minutes as existing travel time of bus on NH 13.

5.2. Other alternatives

There is a risk that related projects will not be developed, which has a negative impact on BRT operation speed by congestion and impassible sections. For such cases, two alternative routes have been studied as follows

Alt-1: U-turn at Tram 2 IC on QL-1

Mp-Tv Rd.
> TL-743C
> Tan Van IC
> NH-1A (to HCMC)
> Tram 2 IC
> NH-1A (to Dong Nai)
> Suoi Tien Terminal Station.

Alt-2: Pass through in National University

Mp-Tv Rd.
> NH-1K
> (Narrow Road)
> Roads in National University, HCMC
> U turn Lane at HCMC Marty's Cemetery.
> Suoi Tien Terminal Station.

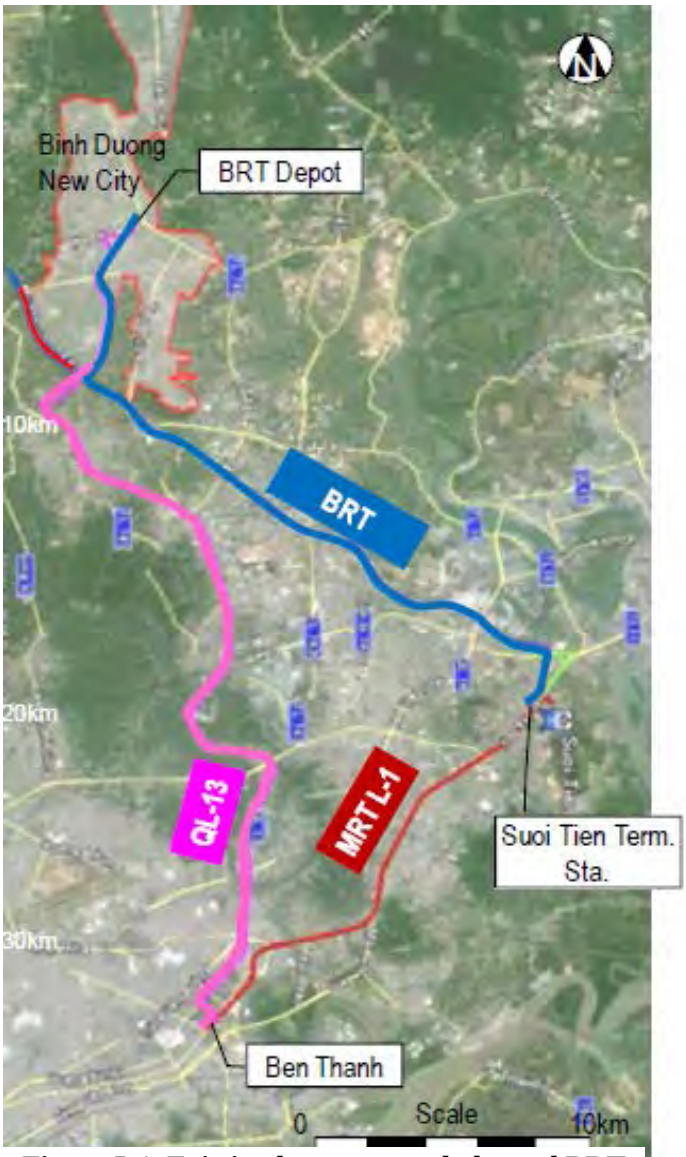


Figure 5-1. Existing bus route and planned BRT route

Figure 5-2. Alternative BRT (draft)

The above figure shows alternative routes in case that two related projects are undeveloped, planned road in industry zone and NH-1A Flyover in front of STT St. They were proposed to Binh Duong Province and HCMC at 6th Monthly Meeting, but both routes are judged to be unrealistic. Alt-3 takes long way and waste time by detouring NH-1A for access to STT St. Alt-4 has narrow section, where BRT hardly pass through, and need to coordinate for going through roads in VNU-HCM.

5.3. Consideration of alternatives

The consideration of a range of alternatives helps to produce a solution that satisfies the purpose and need for the project while protecting environmental, cultural, and community resources. The following table describes the examination of environmental impacts for alternatives of without-the-project (zero-option), with-the-project (Mp-Tv – NH 1A – Industrial park – Suoi Tien Terminal Station) and two other alternative routes.

Table 5-1. Examination of alternatives of Binh Duong MRT

Alternatives	Alternative 1 Zero option (without-the-project)	Alternative 2 (Mp-Tv – QL1 – Industrial park – Suoi Tien Terminal Station)	Alternative 3 (U-turn at Tram 2 IC on QL-1)	Alternative 4 (Pass through in National University)
Description of alternatives	Existing bus route is operated between Binh Duong New city and Ben Thanh along QL-13	Binh Duong New City – Pham Ngoc Thach Road – My Phuoc –Tan Van Road – Planned road in Industrial Park – NH 1A – Suoi Tien Terminal Station. From Suoi Tien Terminal Station to Ben Thanh via MRT Line-1	Mp-Tv Rd – TL-743C – Tan Van IC – NH 1A (to HCMC) – Tram 2 IC – NH 1A (to Dong Nai) – Suoi Tien Terminal Station.	Mp-Tv Rd. – NH 1K – (Narrow Road) - Roads in National Univ, HCMC – U turn Lane at Cemetery – Suoi Tien Terminal Station.
Social impacts	Operation of bus on NH-13 contributes to heavy traffic congestion of the highway especially in peak time of morning and evening. Total travel time is 113 minutes.	Travel time from Binh Duong New City to Ben Thanh is shorter, it is schedule 10 minutes shorter compared to existing bus route.	It has longer distance and travel time due to detouring NH-1A for access to Suoi Tien St.	It has a narrow Section (W=6 m, L=860m), where BRT hardly pass through
	No land acquisition will be required	Land acquisition will be required for the section in the South of Industrial Park to NH 1A	No land acquisition will be required	Land acquisition will be required for the section through VNU-HCM
		Employment creation and population growth along the BRT Route especially area near bus stations, resulting in increase in tax revenue	Employment creation and population growth along the BRT Route especially area near bus stations, resulting in increase in tax revenue	Employment creation and population growth along the BRT Route especially area near bus stations, resulting in increase in tax revenue
Environmental impacts	More emission loading of air pollution due to longer bus travel distance and time. Moreover traffic congestion enhances the emission. No pollution due to construction of additional structures.	Alleviate air pollution by bus on NH 13 Temporary environmental impacts such as air pollution, noise from building structures (flyover on Mp-Tv road and in the Industrial Park, Mp-Tv road expansion) during construction phase	Same as Alternative 1	Same as Alternative 1 Moreover noise impacts to residents along the narrow section would be significant in operation phase as due short distance from the noise source (buses) to the receptors (houses)

Source: JICA Study Team

6. Stakeholder consultation meetings

6.1. Requirements of public consultation

According to Decree No. 18/2015/ND-CP and Circular 27/2015/TT-BTNMT, in the process of making the EIA report, the project owner should carry out consultation with PCs of affected wards/communes and representatives of the affected communities. The consultation with the community (in the form of community meeting) is required for EIA preparation (Decree No. 18/2015/ND-CP). In this project, to meet both GoV and JICA's requirement, a socio-economic survey had been carried out during February and March, 2015, using a Detailed Household Questionnaire. The survey team had carried out interview to 200 households who are residing near the planned flyovers along My Phuoc-Tan Van Highway.

Objectives of the survey are to collect baseline information on socio-economic conditions of the project-affected persons (PAPs) and to prepare profile of PAPs, which are necessary for assessing effectiveness of the project implementation. In addition, the survey had aim to collect PAPs' opinions on the project necessity, predicted impacts, suggested impact-mitigation measures, etc., for reflecting in the process of project planning and implementation.

Following preparation and filed works were implemented:

- Review collected data (from previous surveys) and getting deeply understand of the surveyed areas,
- Prepare Detailed Household Questionnaire and explanatory documents, maps
- Organize survey teams,
- Getting permission for the Survey,
- Explain to and discuss with people's committees of project-affected districts and wards on the survey;
- Identify households to be interviewed;
- Distribute explanatory document (or leaflet) to the households to be interviewed, in order to let them know beforehand about the project and the survey;
- Conduct interviews to keys persons of project affected households

Detail of the survey results are presented in the "Report on Socio-economic Survey for BRT Project", in Appendix 2. The following section summarizes main points related to the EIA.

6.2. Result of public consultation

6.2.1. Expected benefits of the project

About one-fifth of the respondents agreed that the project will generate significant benefits to the community, because they know about the current traffic problems in the project areas, and recognize that the project will help to reduce traffic jams in the project area. However, another large number of them (64%) found that the project will bring both benefits and impacts to the locality. Nevertheless, 9% of the households said that they cannot find any benefit of construction of the BRT project whereas other 8% answered carefully that at the moment, they do not recognize any benefit from the project. Among those who found no benefit, about one fifth is living in Thu Dau Mot City (Table 6-1).

Table 6-1: Perception on Benefit of the Project (%)

Do you think the project brings you with benefit?	Thu Dau Mot (N=51)	Thuan An (N=97)	Di An (N=50)	Total (N=198)
Yes	23.6	12.4	30.0	19.7
No	19.6	6.2	2.0	8.6
Both benefit and impact	52.9	71.1	60.0	63.6
Can not answer now	3.9	10.3	8.0	8.1
Total	100	100	100	100

Once the respondents said *"yes"* for the question *"Do you think the project brings you with benefit?"*, they were asked to rank about project's benefits that they are expected. A large number of respondents recognizes that the project will firstly help to *"smooth the transportation"* (79.5%); secondly to *"ensure the safety for moving within the city/province"* (66%); thirthly to "*reduce trafic jam"* (62%) and finally to *"reduce transportation costs"* (61%). It is calculated more than a quarter of respondents (27%) think that the project will not *"improve environmental quality nor reduce exhaust gas and dust from current vehicles"* (Table 6-2).

Table 6-2: Specific Benefits of the Project (%)

Benefits	None	Not significant	High
1- Increase income by providing services/business for bus stops (N=196)	36.7	34.7	28.6
2- Smooth the transportation (N=200)	11.5	9.0	**79.5**
3- Ensure the safety for the family while moving within the city/province (N=198)	16.7	17.2	**66.1**
4- Reduce trafic jam (N=200)	21.0	17.0	**62.0**
5- Reduce transportation costs (N=196)	18.4	20.4	**61.2**
6- Improve environmental quality, reduce exhaust gas and dust from motorbikes and private cars (N=198)	26.8	31.3	41.9

6.2.2. Tentative impacts of the project.

Nearly a half of interviewees said that the project will generate minor environmental impacts such as air pollution, noise and vibration during construction and operation of the BRT system. Another quarter of interviewees said that the project may cause potential impacts including air pollution and noise pollution (26% and 29% of respondents respectively) to the community.

Regarding social impacts of the project, a majority of interviewees believed that there will be not significant impact on their society. However, some interviewees worried that the project may cause social disturbance in the area (20% of interviewees) or create more social evils (18% of interviewees) due to the migration and/or movement of a large number of people. Furthermore, other 22% of interviewees expressed concern about the impacts on local travelling, especially during the construction phase of the project. Table 6-3 presents interviewees' perception on the project's impacts.

Table 6-3. Interviewed residents' perception on impacts of the project (%)

Benefits	None	Not significant	High
Environmental Impacts			
1- Air pollution	30.7	42.2	26.1
2- Noise during construction of the BRT	30.0	41.5	28.5
3- Vibration during construction of the BRT	41.0	46.0	13.0
4- Reduce landscape beauty and values	51.0	37.4	11.6
Social Impacts			
5- Appearance of immigrants and/or movement of a huge number of people may cause the disorder in the area	51.8	28.1	20.1
6- Social evils will be increased	53.8	28.1	18.1

Benefits	None	Not significant	High
7- Construction of the BRT will affect HH's current business/service	55.5	24.0	20.5
8- Impacts on travelling of the HH	53.5	24.7	21.8

7. Environmental Scoping

Impacts that may be caused by the planned BRT project in pre-construction phase, construction phase and operation phase are summarized in Table 7-1.

Table 7-1. Result of Environmental Scoping

Item	No.	Environmental factor	Assessment		Reason of assessment
			Pre-construction& Construction	Operation	
Pollution	1	Air pollution	B-	C±	[Construction stage] • Dust and polluted gas will be generated from the operation of construction machine around the construction sites of flyovers, depot, bus stops. [Operation stage] • Operation of buses may cause more air pollution by exhaust gas. • However, it is expected that total volume of exhausted CO2 and other polluted substances in the project area will be decreased due to the decrease in private vehicle and the mitigation of traffic congestion.
	2	Water pollution	C-	C-	[Construction stage] • Polluted water generated by construction works of flyovers and depot may cause negative impact to surface water environment. [Operation stage] • Polluted water and waste oil generated from the depot may cause negative impact to the surrounding water bodies.
	3	Wastes	C-	C-	[Construction stage] • Construction wastes and general wastes from construction sites of flyovers and depot may cause negative impact to the surrounding environment. [Operation stage] • Improperly-disposed wastes from the depot and the bus stops may cause negative impact to environment.
	4	Soil pollution	D	C-	[Construction stage] • Materials which may cause soil pollution will not be used for construction works.

Item	No.	Environmental factor	Assessment		Reason of assessment
			Pre-construction& Con struction	Operation	
					[Operation stage] • Waste oil and polluted water from the depot may cause soil pollution to the surrounding area.
	5	Noise, vibration	B-	B±	[Construction stage] • Levels of noise and vibration may increase due to construction works. [Operation stage] • Level of noise and vibration may increase due to the bus operation. • However, noise level in total may decrease due to the decrease in private vehicles.
	6	Ground subsidence	D	D	[Construction stage / Operation stage] • Construction of flyovers and depot with light structures on the solid land in the project area is expected not cause ground subsidence.
	7	Offensive odor	D	D	[Construction stage / Operation stage] • Construction works and its maintenance do not generate offensive odor.
	8	Bottom sediment	D	D	[Construction stage / Operation stage] • Large-scale soil reclamation or civil work is not required for construction of flyovers, depot, and bus stops. Therefore, the Project is expected not caused bottom sediment to the surrounding water bodies.
Natural environment	9	Protected areas	D	D	[Construction stage / Operation stage] • There is not any protected areas such as national park observed in the project area.
	10	Eco-system	D	D	[Construction stage / Operation stage] • The areas around the project site are already urbanized and occupied by many industrial zones and residential areas.
	11	Hydrological situation	D	D	[Construction stage / Operation stage] • The construction and operation of the BRT system is expected not cause affect to the flow of rivers those are located far from the BRT route.
	12	Topography and geo-graphical features	D	D	[Construction stage / Operation stage] • The project areas is occupied mainly by fairly flat low hills. Impact to topography and geographical features around the depot and flyovers is not predicted.

Item	No.	Environmental factor	Assessment		Reason of assessment
			Pre-construction& Con struction	Operation	
Social environment	13	Involuntary resettlement	C-	D	[Pre-construction stage] • The BRT Project requires land for the depot and the bus route. However, land for the depot had been acquired by Binh Duong PC during the 2003-2010 period, under the Binh Duong Industrial – Service and Residential Complex Development Project. Due diligence survey is required to ensure that the process of land acquisition for this land is conform with JICA Environmental Guidelines. • Land required for the BRT route had been almost acquired under the Mp-Tv Road Construction Project, Pham Ngoc Thach Road Construction Project, etc. • Construction of 8 flyovers and 13 bus stops along Mp-Tv Road is planned in Phase 1 (by 2018). However, there is no need to acquire additional land for these flyovers and bus stops, because they are planned within the ROW of Mp-Tv Road. [Operation stage] • Requirement of additional land acquisition and resettlement is not expected during operation stage of the BRT bus.
	14	The poor	D	C+	[Construction stage / Operation stage] • The Project is expected not cause impact to the poor. • The Project may help to improve accessibility of the poor, the elderly people, the handicapped persons, etc.
	15	Indigenous and ethnic people	D	D	[Construction stage / Operation stage] • Indigenous and ethnic people are not observed residing around the project area.
	16	Local economy such as employment and livelihood	C±	B+	[Construction stage] • Residents and business activities near the construction sites may be affected by dust, noise, traffic jam, etc. temporarily during construction stage. • Local residents may have opportunity to work as construction worker for the project. [Operation stage] • Local economy and industry may be promptly developed due to the improved acessibility to Suoi Tien Terminal Station, New Eastern Bus Terminal, Cai Mep-Thi Vai International Port, Hi-Tech Park, HCMC University, Ben Thanh Business Center, etc. • The Project may contribute to economic development of the areas around the bus stops

Item	No.	Environmental factor	Assessment		Reason of assessment
			Pre-construction& Con struction	Operation	
	17	Land use and utilization of local resources	B+	A+	[Construction stage / Operation Stage] • There may be significant change in land use in the areas along Mp-Tv Road, especially in the areas around the bus stops, where agricultural land may change into residential land, urban land, commercial land, etc. • The flyovers and the pedestrian bridge built at the bus stops may help local residents to across Mp-Tv Road in more easier and safer manner. • Improvement of traffic condition may distribute to the efficient use of local resources.
	18	Water usage or water rights and rights of common	D	D	[Construction stage / Operation Stage] • There is not any river or lakes in the project area. The project is expected not cause impact to the water usage of local residents.
	19	Existing social infrastructures and service	B-	B+	[Construction stage] • Traffic jam may occur on the roads around the construction sites during construction. [Operation stage] • The BRT buses may help improve local residents' accessibility to public facilities in large area.
	20	Social capitals, local organizations, such as authorities to make decisions	D	D	[Construction stage / Operation stage] • Mp-Tv is a newly constructed road, and therfore the BRT project will not cause significant impact to the existing public transportation system of the locality.
	21	Misdistribu-tion of benefit and damage	C-	C-	[Construction stage] • Residents who riside near the construction sites may suffer more direct impact of dust, noise, traffic jam, etc. than residents who reside far from the construction sites. [Operation stage] • Residents who reside right near the bus stops may earn more direct benefits (such as increased land price, reduction of travel time, etc.) from the project than residents who reside far from the bus stops.
	22	Local conflict of interests	D	D	[Construction stage / Operation stage] • Conflict of interests between local residents/communes is not predicted by the Project.

Item	No.	Environmental factor	Assessment		Reason of assessment
			Pre-construction& Con struction	Operation	
	23	Cultural, historical heritage	B-	B-	[Construction stage / Operation stage] • One national heritage relic (Phu Loi Prison) is found in the project area, but it is located 400 m far from the planned BRT route. • Some sensitive spots (churches, pagodas, schools, etc.) are found within 500m from the planned BRT route. Among these spots, Ham An Pagoda (Hiep Thanh Ward) and Doan Thi Diem Primary School (Binh An Ward) are located right near the BRT route and may be affected directly by noise, air pollution, trafic jam, etc..
	24	Landscape	C-	D	[Construction stage] • The appearance of temprorary structures, construction machines, etc. may cause damage to the local landscape during the construction stage. [Operation stage] • Negative impact to landscape is not predicted, due to no any scenic landscape is observed in the area along the BRT route.
	25	Gender	D	D	[Construction stage / Operation stage] • Impact to gender that requires particular consideration is not expected.
	26	Children's right	D	C+	[Construction stage] • Impact to children's right that requires particular consideration is not expected. [Operation stage] • The bus operation and the pedestrian bridge at the bus stop may help improve children's accessibility to other areas.
	27	Hazard (risk), infectious diseases such as HIV/AIDS	C-	C-	[Construction stage] • Risk of HIV/AIDS infection may increase among construction workers, amusement places around construction sites. [Operation stage] • Rural communes along the BRT route may be quickly developed in term of economy, and will be easily communicated with other areas, and therefore, may face increased risk of infection.
	28	Working environment (including working safety)	C-	D	[Construction stage] • Dust and exhaust gas generated by construction works may cause negative affect to workers' health. • Wastes from worker camps and construction office may worsen sanitary condition of the surrounding areas.

Item	No.	Environmental factor	Assessment		Reason of assessment
			Pre-construction& Con struction	Operation	
					[Operation stage] • Impact to working environment that requires particular consideration is not expected.
Others	29	Accident	B-	B-	[Construction stage] • There is risk of traffic accident on the roads around the construction sites. [Operation stage] • Traffic accident may occur around the bus stops due to the inattention of both drivers and pedestrians.
	30	Trans-boundary impacts, global warming	C-	B+	[Construction stage] • Greenhouse gas (CO_2) will be generated by construction works. [Operation stage] • It is expected that total volume of greenhouse gas will be decreased, due to the decrease in motorbikes and other means of private transportation. • The BRT buses using compressed natural gas (CNG) as fuel will be introduced to the Project with aim to reduce green house gas.

Note *A+/-: serious positive/negative impact is expected;*
B+/-: positive/negative impact is expected to some extent;
C+/-: extent of impact is unknown, further study is needed;
D : limited impact/negligible impact, further study is not needed.

8. Environmental and social surveys

8.1. TOR for surveys on environmental and social considerations

The impacts which were assessed as "A-", "B-" or "C-" through the scoping mentioned above are subjects to the further detailed surveys. The following Table 8.1 shows TOR for these surveys.

Table 8-1. TOR for the detailed surveys on impacts assessed as "A-", "B-" or "C-"

Item	No.	Environmental factor	Assessment: Pre-construction / Construction	Assessment: Operation	Survey items	Survey methods
Pollution	1	Air pollution	B-	C±	1.Ambient air quality 2.Environmental standards 3.Construction activities 4.Estimated traffic volume	・Review of existing documents ・Measurement of concentrations of air pollutants along the bus route ・Confirmation of method and content of construction ・Estimation of total volume of air pollutants generated in the future based on estimated traffic volume ・Estimation of concentrations of air pollutants at specified sites along the bus route
	2	Water pollution	C-	C-	1.Quality of surface water and groundwater 2.Water quality standards 3.Water usage situation	・Review of existing documents ・Analysis of quality of surface water and groundwater ・Hearing to relevant persons ・Confirmation of method and content of construction
	3	Wastes	C-	C-	1.Wastes disposal methods at construction sites and the surroundings	・Hearing to relevant persons ・Study on similar cases
	4	Soil pollution	D	C-	1.Construction plan and operation plan for the bus depot	・Hearing to relevant persons ・Study on similar cases
	5	Noise, vibration	B-	B±	1.Current noise and vibration levels 2.Environmental standards 3.Location of sensitive spots (hospitals, schools, etc.) 4.Impacts from construction works	・Hearing to relevant persons ・Study on similar cases ・Review of existing documents ・Measurement of noise levels and vibration levels along the bus route ・Estimation of noise levels in the future based on estimated traffic volume ・Confirmation of construction methods/contents
Social environ	13	Involuntary resettlement	C-	D	1.Scope of resettlement (surface area of acquired land, number	・Survey on legal framework, institution

Item	No.	Environmental factor	Assessment: Pre-construction / Construction	Assessment: Operation	Survey items	Survey methods
					of affected households, other affected properties, etc.) 2.Resettlement plan	・Confirmation of resettlement plan (compensation, resettlement, etc.) ・Study on similar cases
	16	Local economy such as employment and livelihood	C±	B+	1.Living situation of affected households 2.Local current economic activities 3.Situation of vehicles and pedestrians crossing the road	・Socio-economic survey ・Review of existing documents ・Field reconnaisance ・Study on similar cases
	19	Existing social infrastructures and service	B-	B+	1.Condition of utilities allocatedalong the bus route 2.Situation of vehicles and pedestrians crossing the road	・Field reconnaisance ・Review of existing documents ・Hearing to relevant persons ・Study on similar cases
	21	Misdistribution of benefit and damage	C-	C-	1.Living situation of affected households 2.Resettlement plan	・Socio-economic survey ・Review of existing documents ・Study on similar cases
	23	Cultural, historical heritage	D	B-	1.Religious structures along thebus route	・Field reconnaisance ・Hearing to relevant persons
	24	Landscape	C-	D	1.Street trees along the bus route	・Field reconnaisance ・Review of existing documents ・Hearing to relevant persons
	27	Hazard (risk), infectious diseases such as HIV/AIDS	C-	C-	1.Health situation of workers	・Hearing to relevant persons ・Study on similar cases
	28	Working environment (including working safety)	C-	D	1.Working environment	・Hearing to relevant persons ・Study on similar cases
Others	29	Accident	B-	B-	1.Working accidents 2.Number of occurred traffic accidents	・Hearing to relevant persons ・Study on similar cases ・Review of existing documents
	30	Transboundary impacts, global warming	C-	B+	1.Impacts of construction works 2.Forecasted traffic volume	・Confirmation of construction method/content ・Estimation of total to-be- exhausted greenhouse gas (CO2) in the future, based on the forecasted traffic volume

Source: JICA Study Team

Note A+/-: serious positive/negative impact is expected;

B+/-: positive/negative impact is expected to some extent;
C+/-: extent of impact is unknown, further study is needed;
D : limited impact/negligible impact, further study is not needed.

8.2. Results of natural environmental baseline survey

Center of Environmental Technology in Ho Chi Minh City - Institute of Environmental Technology had carried out a survey on air quality, noise and vibration at eight (8) sampling location in the project area in February 2015. Measurement result is summarized in the following table (Detailed result of the measurement is presented in Appendix 1)

Table 8-2. Environmental monitoring result

No	Parameters	Result								Allowable limits
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	
1.	Temperature (^{0}C)	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	
2.	Humidity (%)	61.0	61.0	52.4	47.8	39.0	37.4	38.6	33.9	
3.	Wind speed (m/s)	0.9	1.3	0	0.1	0	0.8	1.0	1.5	
4.	Air quality									
4.1	PM10 (mg/m^3)	0.013	0.069	0.081	0.092	0.045	0.046	0.032	0.031	0.15 mg/m^3 (QCVN/BTNMT 05:2013)
4.2	TSP (mg/m^3)	0.017	0.087	0.055	0.055	0.055	0.053	0.045	0.040	0.30 mg/m^3 (QCVN/BTNMT 05:2013)
4.3	NO_2 (mg/m^3)	0.007	0.083	0.012	0.019	0.043	0.003	0.059	0.012	0.20 mg/m^3 (QCVN/BTNMT 05:2013)
4.4	SO_2 (mg/m^3)	ND (LOD = 0.02)	ND (LOD = 0.02)	ND (LOD = 0.02)	ND (LOD = 0.02)	ND (LOD = 0.02)	0.023	0.038	ND (LOD = 0.02)	0.35 mg/m^3 (QCVN/BTNMT 05:2013)
4.5	CO (mg/m^3)	3.60	4.01	4.23	3.61	3.03	4.09	3.76	1.49	30 mg/m^3 (QCVN/BTNMT 05:2013)
4.6	THC (mg/m^3)	ND (LOD = 0.01)	ND (LOD = 0.01)	ND (LOD = 0.01)	ND (LOD = 0.01)	ND (LOD = 0.01)	ND (LOD = 0.01)	ND (LOD = 0.01)	ND (LOD = 0.01)	5 mg/m^3 (QCVN 06:2013/BTNMT)
5	Noise	-	-	-	-	-	-	-	-	
5.1	Leq - 30 min (dBA)	**80.0**	55.3	62.7	**77.5**	**71.9**	**75.3**	**71.6**	45.1	70 dBA (QCVN/BTNMT 26:2010)
5.2	Leq - 60 min (dBA)	**73.8**	52.3	59.1	**76.5**	69.3	**73.5**	69.4	43.0	70 dBA (QCVN/BTNMT 26:2010)
5.3	Leq - 240 min (dBA)	**71.4**	49.3	58.0	69.2	67.0	**71.2**	**70.9**	43.3	70 dBA (QCVN/BTNMT 26:2010)
6.	Vibration	-	-	-	-	-	-	-	-	
6.1	High frequency (dB)	50.7	42.6	39.8	51.3	38.3	51.1	39.8	41.6	70 dB (QCVN/BTNMT 27:2010)

No	Parameters	Result								Allowable limits
		Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	
6.2	Low frequency (dB)	61.6	59.1	52.2	63.5	51.6	66.8	49.8	53.1	70 dB (QCVN/BTNMT 27:2010)

Note:

Sampling sites:

- *Site 1: km00+000 MP-TV (starting point of My Phuoc –Tan Van Road)*
- *Site 2: km02+000 – Near Doan Thi Diem Elementary School*
- *Site 3: km07+000 – Near Tan Ninh Pagoda*
- *Site 4: km10+600 – Near An Phu Intersection*
- *Site 5: km14+650 – Near DT746 Intersection*
- *Site 6: km17+870 – Near DT743 Intersection*
- *Site 7: km20+630 – Near Hoa An Pagoda*
- *Site 8: Near BRT Depot in Binh Duong New City*

Air quality:

- *Results of monitoring and analysis show that all of air quality parameters are lower than Vietnamese standards on ambient air – QCVN 05:2013/BTNMT and QCVN 06:2013/BTNMT.*

Noise:

- *Noise measurement levels at Site 2, Site 3, and Site 8 are lower than permitted noise level QCVN 26: 2010/BTNMT at all the measuring times. These locations are located far from the existing intersections and populated areas.*
- *Noise measurement levels at Site 1, Site 4, Site 6 and Site 7 were higher than permitted noise level QCVN 26: 2010/BTNMT. At the time of measurement, there were many heavy vehicles (e.g trucks, containers) operating near these sites , and it may be the reason of noise levels exceeding allowable limit of 70dBA for period from 6:00h to 21:00h in normal areas (The National Technical Regulation on Noise - QCVN 26:2010/BTNMT)*
- *The noise level at Site 5 with Leq-30min (dBA) was higher than the allowable limit. Leq60min (dBA) and Leq-90min (dBA) were close to the permitted levels of QCVN 26:2010/BTNMT*

Vibration:

- *Vibration levels of all sites are lower than the permitted level (QCVN 27:2010/BTNMT)*

8.3. Results of socio-economic baseline survey

The household survey was conducted around eight flyovers from Km 0+000 to Km 20+225 along My Phuoc - Tan Van Highway of Binh Duong Province. There are 200 households represented for 802 people were face-to-face interviewed. Main findings of the household interview of 200 HHs living around eight proposed flyover sites will be built at major intersections along My Phuoc – Tan Van Road are described as below.

Occupation of local people

Occupation of the interviewed people and their spouse is varied. However, the majority of them work in business/service sector (56% of HH's heads and 34% of the spouses). Retailed shop and house leasing are main business activities in the survey area. There are 18% of householders and 16% of the spouses are factory workers while 11% and 7% of them are unemployed,

respectively. The data also reveals that approximately one third of the spouse (mostly wives) is doing housework. The following figure provides details type of occupation of the respondents.

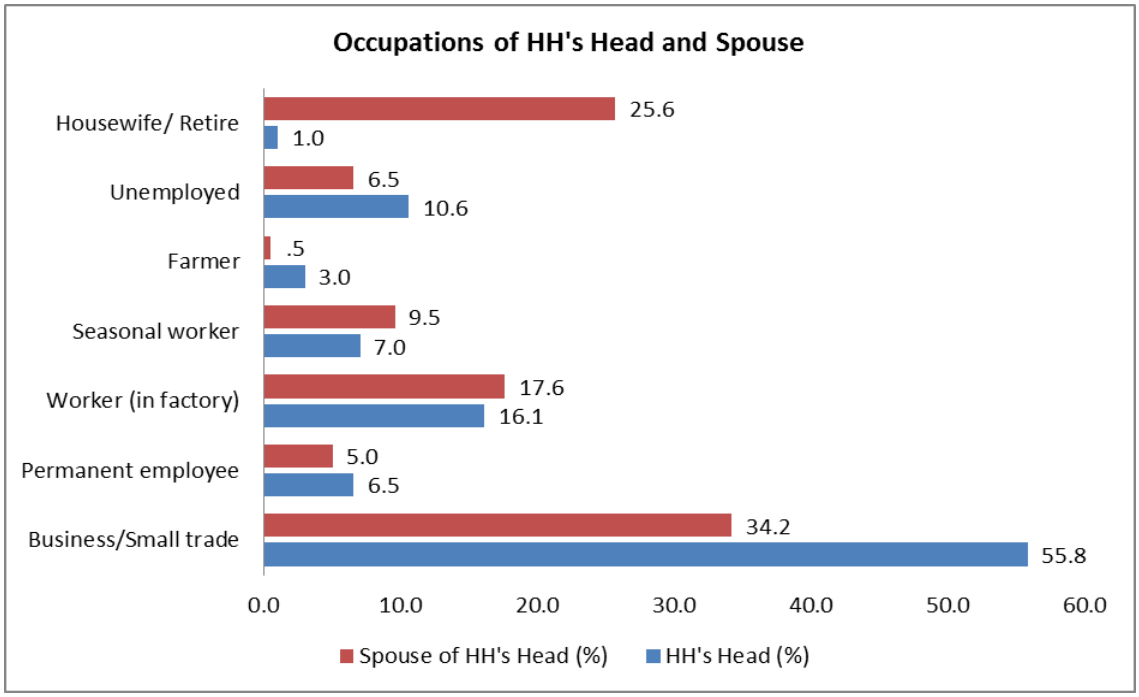


Figure 8-1. Occupations of the Head of Households

Social-economic Status

Results from the survey indicated that the majority of sampled households in the survey areas are living above the poverty line (89%) following the standard[3] of Binh Duong Province. However, about 5% of the interviewees are living close to the poverty line (Figure 8-2).

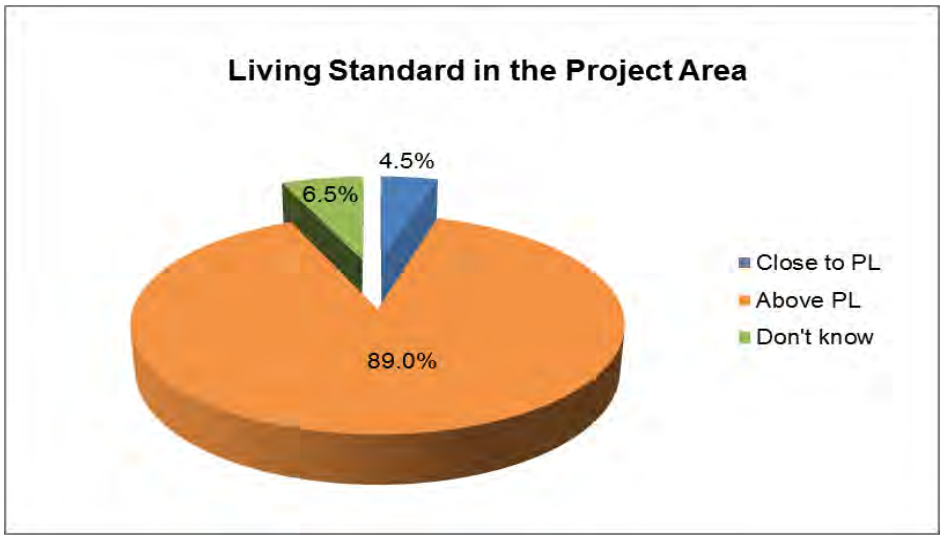


Figure 8-2. Living Standard of the Surveyed Households

[3]Decision No. 51/2013/QĐ-UBNDof Binh Duong PC on Poverty Standard. PL:12 million VND/person/year (rural); 13.2 million VND/person/year (urban). Close to the PL: 15.6 million VND/person/year (rural); 17.2 million VND/person/year (urban).

Sources of Income

Source of primary income of the surveyed households is mainly from business/service, occupies 62% of HHs. Working in industrial sectors created primary income for about one fourth of the respondents whereas agriculture generated income for only 2% of the households.

There are 51% of surveyed households have no secondary income meanwhile other 17% and 10% of them have secondary income generated from industrial sectors and business/service activity, respectively. House rental is also the main income source of about 6% of the sampled households.

Table 8-3. Sources of Household's Income

Income Sources	Primary Income		Secondary Income	
	No	Percentage (%)	N	Percentage (%)
Nil income	0	0.0	102	51.0
Business/Service	123	61.5	19	9.5
Industrial Sectors	49	24.5	34	17.0
Agriculture	3	1.5	2	1.0
Seasonal works	5	2.5	12	6.0
Welfare/Retire	6	3.0	8	4.0
Asset rental	12	6.0	8	4.0
Others	2	1.0	15	7.5
Total	**200**	**100.0**	**200**	**100.0**

The data reveals that in most of the cases, household's head and his/her spouse were responsible for household's primary income (52% of total samples). Besides, the head alone generated main income of 25% households whereas other 8% has main income that generated by the head and children.

The household average monthly income in the survey area is around 18.1 million dong/month. People in Thu Dau Mot City seem to have higher monthly income than those in other areas (25 mil.dong/HH/month compared with averagely 16 mil.dong/HH/month). Household monthly income varies from about 1.5 mil.dong/HH/month to 400.0 mil.dong/HH/month.

Living Facilities

The surveyed households are basically facilitated with necessary devices for living such as TVs, air-conditioners, refrigerators, washing machines, etc. Each household owns averagely one TV, one fridge, one washing machine and two motorcycles in their family. The data also reveals that 7% of the samples have car and other 8% own trucks. Trucks are usually used for carrying

goods/commodity in private enterprises. Compared with other areas in the south-east region of Vietnam, people in the project areas have better living conditions

Source of water

The percentage of the households using tap-water for drinking is not high in the surveyed area. Nearly a half of the sampled HHs connected to tap-water whereas other 45% of them use well-water for cooking and drinking. Number of HH in Di An District using tap-water is high (68% of sampled households) meanwhile in Thuan An District, more people use well-water than other areas.

Well-water is usually used for washing and other daily purposes. About 60% of respondents said they mainly use this source of water for daily activities except cooking and drinking. The portion of people using well-water is especially high in Thuan An with 68% of sampled households.

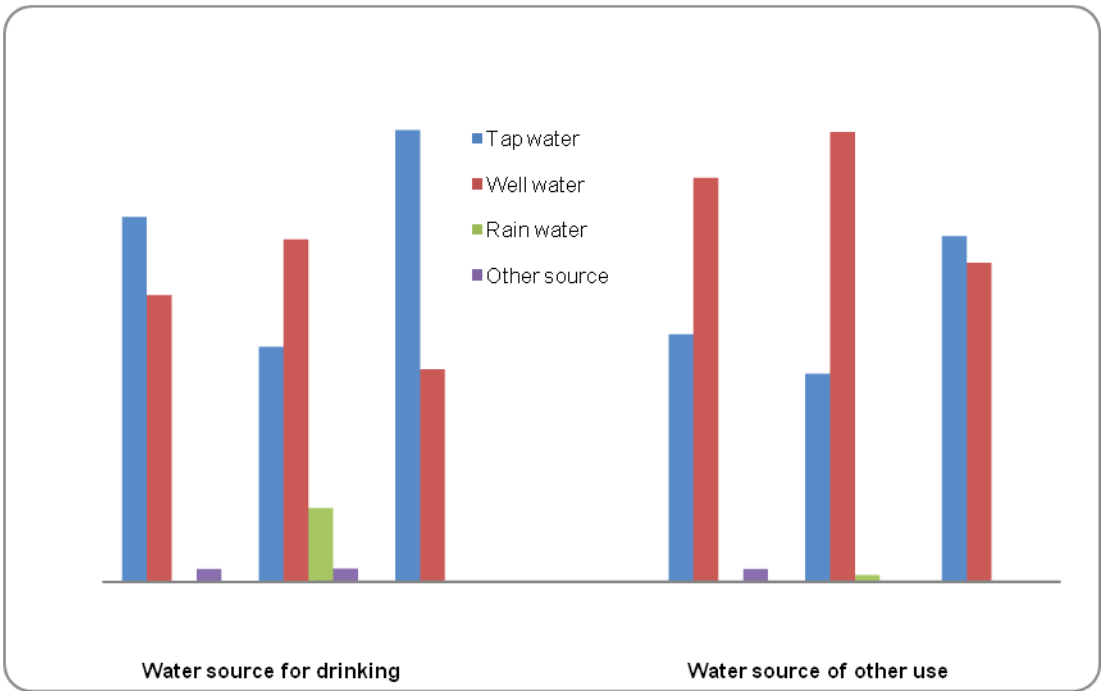


Figure 8-3. Main sources of water

Electricity

It is reported that 97% of surveyed households are connected to the national electricity grid. Of 7 households (or 3%) who use other source of electricity, 4 use motor generators and other 3 share electricity grid with their neighbors. These households have just moved into the area and building their house. As said by local authority, these households can register to use grid electricity and tap-water.

Regarding the question on the shortage of electricity during dry season, 99% of respondents who use grid electricity agreed that recently grid electricity is supplied regularly and stably.

Sanitation conditions

Types of Toilet: 99% of sampled households use septic-tank toilets, however only 46% of them have connected septic-tank[4]. This portion is homogeneously in all survey areas. There is only 1 household use public toilet in the areas.

Solid Waste Collection: 98% of domestic garbage is collected by the Sanitation Companies. It is reported by the respondents that since monthly fee for garbage collection is reasonable, most of the inhabitants use this service instead of throwing garbage rashly. However 2% of surveyed households said to throw their rubbish while other 1% daily burned their waste.

Means of Transportation

Motorcycle is the main transport vehicle in the survey area. Indeed, there are 96% of respondents said that they mainly use motorbikes for moving within the province. There are 3% of the samples use public transport (mainly bus) whereas other 5% of them use private car for transportation. Number of respondents owing cars is especially high in Binh Duong New City in comparison with in other survey areas (12% of sampled households in Binh Duong New City own private car compared with 3% in Thuan An and 0% in Di An District) (Figure 8-4).

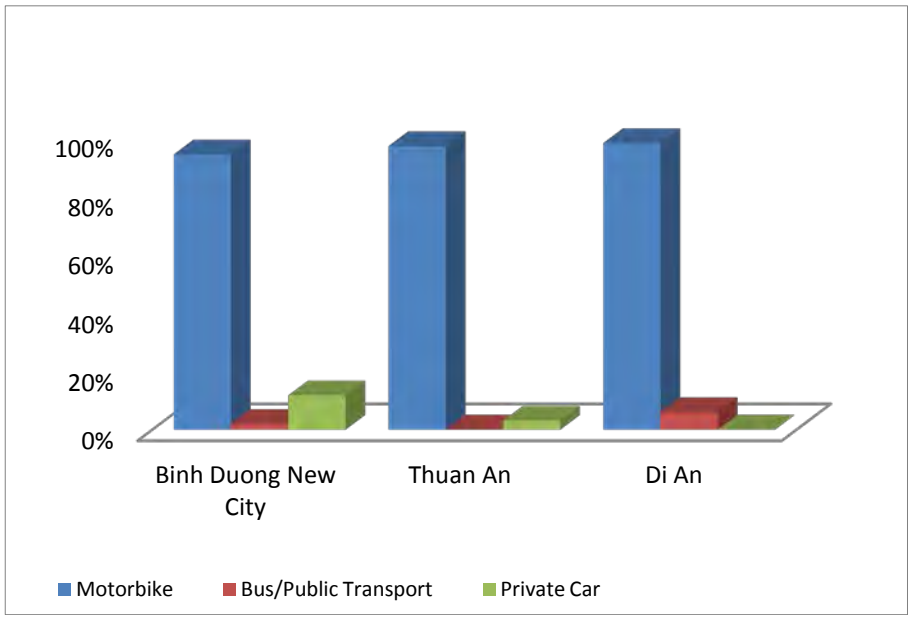


Figure 8-4. Means of Household's Transportation

[4]The toilet that has filter tanks and connected to public drainage system.

9. Environmental impact assessment

Positive impacts

Overall, this project will improve public transportation of the region of Binh Duong province and Ho Chi Minh City; controlling the increase of private vehicles; improving urban environment. The positive impacts of project are summarized as follows.

- Improve convenience and to promote using public transportation, with implementation of urban development based on TOD.
- Encourage public transport demand toward introducing urban railway: With the reduced travel time, reliability of public services the BRT system could be more preferred than motorcycle for people living along the route.
- The project will reduce air pollution for the region because for the same numbers of passengers the new buses used in the project will emit lesser pollution compared to that from vehicles in case of non-project situation. National strategy of climate change adaptation and mitigation focused on application of low carbon fuel, toward using CNG, LPG for public buses and taxi with targets of 20% by 2020 and 80% by 2050 (Detailed calculation air quality is presented in the section of impact on air quality).
- Contribute to reduced traffic conflict and accident in the corridor.

Negative impacts

- Temporary generation of pollutants such as solid wastes, hazardous wastes, wastewater and air pollution during construction phase
- Potential increase of air and noise due to buses in operation phase
- Potential increase of environmental issues such as waste generation at BRT bus stations, flyovers, depot (terminal and parking areas).

Based on results of surveys, the environmental factors which are preliminarily assessed as "A^-" or "B^-" (A^-: serious negative impact is expected; B: negative impact is expected to some extent) (Table 7-1, environmental scoping) are assessed again as following.

9.1. Assessment of impacts during the pre-construction phase

Environmental impacts during pre-construction are negligible. As said, the BRT Project requires land for the depot and the bus route. However, land for the depot had been acquired by Binh Duong PC during the 2003-2010 period, under the Binh Duong Industrial – Service and Residential Complex Development Project. The process to acquire land for the BD Complex Development Project had been started in 2003 and ended in 2010. The project required acquisition of 4,196 ha of land. About 7,000 households (30,000 persons) were affected, of which 6,200 households had been forced to relocate to other places. The due diligence review of involuntary resettlement for the BRT depot was carried out in this PPP F/S in line of JICA

Environmental Guidelines. The review has aim to confirm if the process of compensation payment, provision of supports, resettlement of people affected by land acquisition for the planned BRT depot meets JICA's policies on involuntary resettlement and social considerations. Result of the review is attached in this EIA as Appendix 3.

Land required for the BRT route had been almost acquired under the Mp-Tv Road Construction Project, Pham Ngoc Thach Road Construction Project, etc. except for the road section in the most south side which passes through the Binh An Industrial Park and links Mp-Tv Road with Suoi Tien Terminal Station and New Eastern Bus Terminal. Land acquisition for this road section is being implemented by Binh Duong PC. The BRT buses will use this road after its construction is completed.

Construction of 8 flyovers and 13 bus stops along Mp-Tv Road is planned in Phase 1 (by 2018). However, there is no need to acquire additional land for these flyovers and bus stops, because they are planned within the ROW of Mp-Tv Road

No environmentally-sensitive areas or archaeology or ecology and biodiversity sites are found in or near the project site.

9.2. Assessment of impacts during the construction phase

Environmental impacts during construction phase are impacts of solid wastes, hazardous wastes, wastewater and air pollution from construction of flyovers, depot, bus stops.

These impacts are temporarily occurring in the construction period. Construction of other structure such as closing median trips, BRT stops, pedestrian bridges will have minor and short-time impacts.

9.2.1. Impact of air pollution

Monitoring in February 2015 at 8 sampling sites along the proposed route showed that all of air quality parameters are lower than Vietnamese standards on ambient air – QCVN 05:2013/BTNMT and QCVN 06:2009/BTNMT.

The route will pass through or parallel with some residential areas. Therefore, construction of the project will affect air environment and people living near the construction sites due to the following causes.

- Activity digging and leveling for will cause dust.
- Operation of vehicles transporting construction materials; the process of loading and unloading construction materials and equipment from cranes, trucks dump down to storage areas of materials will generate dust and gas emissions (e.g., NOx, CO, SO_2, VOC).

- Dust and gas emissions increasing, especially on dry days.

Total amount of dust, noxious gases arising from combustion of the fuel of construction equipment is based on the amount of diesel consumption from construction activities. If a truck (with size from 3.5 to 16 tons) consumes 1 ton of diesel, it will emit into the air about 4.3 kg of TSP; 20S kg of SO_2 (S as a function of sulfur in diesel, according QCVN01: 2007/BKHCN, S = 0.05%); 55kg of NOx; 28kg of CO, and 12kg of VOC.

Table 9-1. Emission from transport vehicles

Vehicles	Unit (u)	TSP kg/u	SO_2 kg/u	NO_x kg/u	CO kg/u	VOC kg/u	Pb kg/u
Truck use petrol							
Urban road	1.000km	0.4	4.5 S	4.5	70	7	0.31
	Ton of fuel	3.5	20 S	20	300	30	1.35
Highway	1.000km	0.6	3.3 S	7.5	50	3.5	0.22
	Ton of fuel	3.6	20 S	4.5	300	20	1.35
Truck 3,5 – 16tons use diesel							
Urban road	1.000km	0.9	4.29 S*	11.8	60	2.6	-
	Ton of fuel	4.3	20 S	55	28	12	-

Source: Rapid inventory techniques in environmental pollution (WHO, 1993)

*: According QCVN01: 2007/BKHCN S=0.05%

Operation of machines and trucks however are intermittent therefore the pollution is minor. The experience and data from other road/highway construction projects (such as Hochiminh - Long Thanh - Dau Giay expressway) showed except TSP concentration of other air parameters measured near construction sites near construction sites were lower than the allowable level of standards (QCVN/BTNMT 05:2013).

The pollution magnitude due to dust will be small or large depending on road quality, method of load and unload construction materials and excavated soils, etc. Emission of dust (sand dust) caused by earthworks, handling material and transportation of material are 1-100 g/m^3, 0.1-1 g/m^3, and 0.1-1 g/m^3 respectively (WHO, 1993). Dust will be dispersed into air and pollute surrounding environment and content of dust will increase on dry and sunny days. If there is no proper mitigation measures the dust concentration will certainly exceed the standard and obviously affect people living nearby construction sites.

The receptor of air pollution sources are areas near construction sites (BRT depot, flyovers, bus stops), especially areas of concentrated pollulation including:

- Km 3 + 078 (Bus stop-2, IS-5, intersection with National Highway 1K)
- Km 7 + 272 (IS-12)
- Km 7 + 471 (IS-13, intersection with Nguyen Thi Minh Khai road)
- Km 10 + 559 (IS-21, An Phu intersection)

- Km 10 + 611 (IS-22, An Phu intersection (DT743A)

Sensitive spots including Ham An pagoda and Doan Thi Diem school located far from the construction sites will be not affected by the impacts of location.

The impact of air pollution is unavoidable during the construction period. However, this impact can be mitigated to acceptable condition by applying appropriate technical and management measures.

9.2.2. Impacts of Noise and vibration

Impacts of noise

Results of the environmental baseline survey indicated that noise measurement values at site 2, site 3, and site 8 were lower than permitted noise level QCVN 26: 2010/BTNMT at all the measuring times. These locations are located far from intersection and lesser populated areas. Noise level at other sampling sites exceeded the standard.

During construction phase, noise may be arised from following equipments:

- Building equipment.
- Construction of bored piles for flyovers
- Convey soil, stone, materials.

The main sources of noise will be construction machines with the noise levels as high as 76 – 89 dBA, which however significantly decrease over distances. Result of noise level at different distances is presented in the Table 9-2.

Table 9-2. Noise levels at different distances

Equipment	Distance (m)					
	1.5*	10	20	30	40	50
Backhoe	78	68.9	65.6	63.7	62.3	61.2
Compactor	83	73.9	70.6	68.7	67.3	66.2
Truck	76	66.9	63.6	61.7	60.3	59.2
Excavator	81	71.9	68.6	66.7	65.3	64.2
Jackhammer	89	79.9	76.6	74.7	73.3	72.2
Gradder	85	75.9	72.6	70.7	69.3	68.2
Bulldozer	82	72.9	69.6	67.7	66.3	65.2
Concrete mix machine	79	69.9	66.6	64.7	63.3	62.2
Crane	81	71.9	68.6	66.7	65.3	64.2
Chain saw	84	74.9	71.6	69.7	68.3	67.2

Source: Construction noise handbook (US Department of Transportation, 2006)

In this project, light construction machinery such as backhoe, truck, excavator, bored pile drilling machine will be used to construct flyovers. The noise at distance of 30m is predicted

lower than the permissible standard of 70dB from 6h00 to 21h00 (QCVN 26:2010/BTNMT). Accordingly the noise impact to local residential areas can be rated as moderate and temporary.

Impacts of Vibration

Construction of the flyovers will not apply equipment generating high level of vibration. For construction of BRT depot, soft-soil treatment machine such as pile driving, soil compacting would be used but the vibration caused by these machine is minor. Moreover, the construction site at BRT depot, located within the Binh Duong New City, is surrounded by mostly vacant land. There is only a school, Nguyen Khuyen High School, located about 100m from the proposed BRT depot. The impact of vibration therefore is predicted insignificant.

9.2.3. Impacts of solid and hazardous waste

Currently, some residential areas and industrial zones locates along the planned BRT route. Almost domestic wastes generated by local people are collected and treated by local environmental companies while industrial zones have the waste treatment systems.

Wastes generated during construction phase include solid waste from domestic activities, construction waste and waste hazardous (oil and grease waste).

Domestic-generated solid waste: Domestic solid waste generated from workers' facilities contains organic wastes such as paper, plastics, cartons, food waste. Average generation of domestic solid waste is about 0.4 – 1.0 kg/person/day (Vietnam National Environment Report 2011 – Solid waste). It is estimated 30 – 50 workers/camp (for each construction site of flyovers and BRT depot), the daily solid waste generation caused by this project during construction phase is 12 - 50 kg/day/camp. This waste consists of organic substances (food waste) and other non-biodegradable wastes such as cans, plastic, paper, etc. Beside the impact on the aesthetics, biodegradable wastes would cause bad odor and source of pathogens if proper treatment is not applied.

Construction waste: debris from digging to create ground (background construction) and unsuitable materials, mortar residue and excess concrete, used fuel containers, and oily cloths. This waste mainly causes impact on aesthetics of the area. Hazardous waste sources are oily contaminated waste from regular maintenance such as used fuel containers and oily cloths. The amount of this waste is little and not a regular waste.

Bentonite slurry mixed with excavated soil in construction of bored holes for flyovers, etc. The excavated soil is around 50 – 70 m^3/a bored hole and could be reused for other purposes such ground leveling on site or at other places. Other solid waste is daily generated in small amount and it could be effectively collected, sorted and disposed at suitable landfills.

9.2.4. Impacts on accidents, traffic congestion

As the construction site of flyovers are at intersections the possible impacts to traffic would be encroachment of traffic for arrangement of work items such as scaffold, material yard, machines, etc.

During construction phase, accidents accompanied with excavation works, construction machinery, etc. may occur. The social survey revealed that along MP-TV road is usually faced of serious traffic jams and accidents caused by heavy lorries and trucks. Currently, traffic jams offen occur at intersection of MP-TV Road with DT 743A Road, An Phu roundabout, and Phu Loi Road (DT 743).

The increase of vehicles for construction work of flyovers, especially mentioned above, may increase the risk of accidents and make traffic congestion for local routes to the construction site. A part of roads around the project sites may be temporarily blocked and cause traffic congestion at some sections. Traffic would be encroached due to arrangement of work items such as scaffold, material yard, machines. The vehicles carrying the materials, wastes to and from the construction area may drop spoil or soil on the road surface which creates slippery condition and increases the risk of unsafe traffic. These impacts could be prevented with implementation of traffic safety management for these vehicles.

9.2.5. Impacts of risks and incidents

Health Risks

During the construction phase, risk of HIV/AIDS infection may increase among construction workers, amusement places around construction sites.

Beside, dust and exhaust gas generated by construction works may cause negative affect to workers' health. Dust (particulate matters) pollution are generated by earth work activities and truck movement. Airborne high dust concentrations may cause respiratory difficulty. Chemical hazards generated by exhaust emissions containing high concentration of SO_2, CO, VOC, PAHs from construction equipment, trucks and painting, which may cause lung diseases.

These impacts depends on organization of construction activities and distance from the construction sites/impact generators and the receptor, but they are expected as minor and would be avoided by preventive measures such as personal protective equipment for workers.

Fire incidents

The petroleum which is composed of mainly hydrocarbon compounds is able to evaporate quickly and pose the risk of fire incident. Electricity system for construction work may cause ignition, resulting in fire or explosion in an explosive atmosphere such as near fuel tanks, near flammable materials.

Occupational accidents in construction work

Accident risks may occur at any other activity in the construction process by improper implementation of safety regulations. There are several risks of accidents which need proper implementation of safety measures as follows:

- Traffic accidents could occur if the traffic management such as signs and guide management for construction equipment and transportation of raw materials is poorly implemented
- Carelessness in labor, lack of personal protection equipment, or lack of strict safety practices could also cause unfortunate accident;
- Working hours and long-term continuity can significantly affect the health of workers, causing fatigue, dizziness or fainting spells for workers at construction sites;
- Besides, there are other risks of incidents including working on high elevation, electricity shock, working in slippery condition during rainy days, etc.

9.3. Assessment of impacts during the operation phase

9.3.1. Impacts of air pollution

The construction of 8 flyovers along My Phuoc – Tan Van Road is recommended with aim to improve the running speed of BRT buses operating between Binh Duong New City and Suoi Tien Station / New Eastern Bus Terminal.

According to result of surveys on current environmental and social conditions of the areas along My Phuoc – Tan Van Road, the areas around these flyovers are almost urbanized, populated and may be affected by the project during the operation phase, especially in terms of air pollutions, noise, traffic accidents, etc.

This prediction is carried out to confirm the extents of impacts of air pollution which may be caused by the moving vehicles, including BRT buses, to the areas adjacent to the planned flyovers. Report on results of the prediction is attached in this report as Appendix 4.

a) Wind velocity and wind direction

Table 9-3 shows data on wind velocities and wind directions collected at So Sao Meteorological Station in Binh Duong Province, during 2010~2014 (5 years) period.

Table 9-3. Wind velocities and wind directions in the study area

Items			Month											
			I (Jan)	II (Feb)	III (Mar)	IV (Apr)	V (May)	VI (Jun)	VII (Jul)	VIII (Aug)	IX (Sep)	X (Oct)	XI (Nov)	XII (Dec)
2010	*Monthly average wind speed*		1	1	1	1	1	1	0.4	1	0.4	1	1	1
	Maximum wind	*Speed*	12	10	12	12	10	12	12	12	12	12	10	12
		Direction	N	SE	E	SE	SE	SW	SW	S	SW	SW	NE	N
		Occurred date	19	10	25	18	01	08	02	28	11	04	07	22
2011	*Monthly average wind speed*		0.3	1	1	1	1	1	1	1	1	1	1	1
	Maximum wind	*Speed*	10	10	12	12	12	12	14	9	10	8	10	8
		Direction	NE	SE	SW	N	E	NW	SW	WSW	SW	NW	NE	NE
		Occurred date	06	20	09	19	20	22	30	01	12	02	02	19
2012	*Monthly average wind speed*		1	0.3	0.4	0.4	1	1	1	1	1	0.4	1	1
	Maximum wind	*Speed*	8	10	8	14	12	14	14	12	12	10	10	8
		Direction	NE	E	SE	SW	W	SW	SE	SW	SW	W	S	SE
		Occurred date	11	22	5	2	14	17	17	1	6	7	5	13
2013	*Monthly average wind speed*		1	1	1	1	1	1	1	1	1	1	1	1
	Maximum wind	*Speed*	8	8	16	12	12	12	11	11	12	12	10	7
		Direction	NW	SE	S	SW	NE	SW	W	W	WSW	SSE	SE	ESE
		Occurred date	6	3	5	27	5	4	28	17	15	6	7	15
2014	*Monthly average wind speed*		1	1	1	1	1	1	1	1	1	1	1	1
	Maximum wind	*Speed*	8	7	9	11	10	12	13	8	13	9	9	10
		Direction	NE	SSE	E	ESE	SSE	W	W	W	WNW	S	W	ENE
		Occurred date	18	7	11	5	3	23	7	1	12	4	30	12

b) Current conditions of ambient air quality, vibration, and noise

Table 8-1 in the previous Chapter 8 shows result of the survey on ambient air quality, vibration, and noise carried out on February 11, 2015, at the sites adjacent to the planned flyovers.

c) Forecasted traffic volume

Based on result of traffic demand forecast, the traffic volume by vehicle types in 2020 and 2040 at the sites nearby the planned flyovers are summarized as followings (Table 9-4).

Table 9-4. Forecasted traffic volume at the sites adjacent to the planned flyovers on My Phuoc – Tan Van Road

(Unit: vehicle/peak hour)

No.		1	2	3	4	5	6	7	8
Flyover ID		IS-1	IS-5	IS-12, 13	IS-21, 22	IS-25	IS-29	IS-32, 33	IS-37
2020 without BRT	Small cars	2,293	3,682	1,950	2,227	2,319	2,124	1,929	1,929
	Big cars	0	0	78	34	33	33	88	88
2040 without BRT	Small cars	3,001	6,439	2,168	2,464	3,632	3,188	2,228	2,228
	Big cars	0	0	104	7	7	7	37	37
2020 with BRT	Small cars	2,396	3,773	2,030	2,260	2,354	2,116	1,968	1,968
	Big cars	11	11	90	43	43	43	96	96
2040 with BRT	Small cars	3,995	7,116	2,314	2,494	3,654	2,963	2,428	2,428
	Big cars	50	50	155	56	56	56	74	74

Source: JICA Study Team.
Note: For big cars in "With BRT" cases, numbers of BRT bus predicted by the operation plan are applied.

d) Prediction of air pollutant emission

Sources of air pollution during operation phase are mainly from emission of vehicle engines, emission of friction between vehicle tires and road pavement.

The following formula is used to calculate gaseous pollutant (SO2, NOx, CO, and TSP) discharge source intensity of the planned road.

$$Q_t = V_w \times \frac{1}{3600} \times \frac{1}{1000} \times \sum_{i=1}^{2} (N_{it} \times E_i)$$

In which, Q_t : discharge intensity of gaseous pollutant (ml/m·s (or mg/m·s))
E_i : air emission coefficient of i type vehicle (g/km·vehicle)
N_{it} : hour traffic volume by i type vehicle (vehicle/h)
V_w : conversion coefficient (ml/g (or mg/g))

Regarding the air emission coefficient E_i, the following formulation is used [5].

$E_i = a/x + bx + cx^2 + d$

5 Referred to "Technical Handbook for Environmental Impact Assessment of Roads", 2007 Revision, Japan Highway Environment Research Institute (HERI).

In which, x is vehicle speed (km/h), and a, b, c, d are regression parameters.

To predict air pollutants emitted by moving vehicles during operation phase (with wind velocity > 1.0m/s), the following Plume Model is used (Source: Technical Handbook for Environmental Impact Assessment of Roads, 2007 Revision, HERI).

$$C(x,y,z) = \frac{Q}{2\pi \cdot u \cdot \sigma_y \cdot \sigma_z} \exp\left(-\frac{y^2}{2\sigma y^2}\right)\left[\exp\left\{-\frac{(Z-H)^2}{2\sigma_z^2}\right\}+\exp\left\{-\frac{(Z+H)^2}{2\sigma_z^2}\right\}\right]$$

In which,

C(x,y,z)	: air pollutant concentration at survey site (x,y,z) (ppm or mg/m^3)
Q	: air pollutant emission rate (ml/s or mg/s)
u	: vehicle average speed (m/s)
H	: height of source of emission (m)
σ_y, σ_z	: diffusion coefficient toward y dimension and z dimension (m)
x	: distance from emission point source to survey site along the wind direction (m)
y	: horizontal distance from survey point to x axis (m)
z	: vertical distance from survey point to x axis (m)

σ_y, σ_z are calculated by the following formulations:

$\sigma_y = W/2 + 0.46\ L^{0.81}$ (in case of $x<W/2$: $\sigma_y = W/2$) (m)

$\sigma_z = \sigma_{z0} + 0.31\ L^{0.83}$ (in case of $x<W/2$: $\sigma_z = \sigma_{z0}$) (m)

In which,

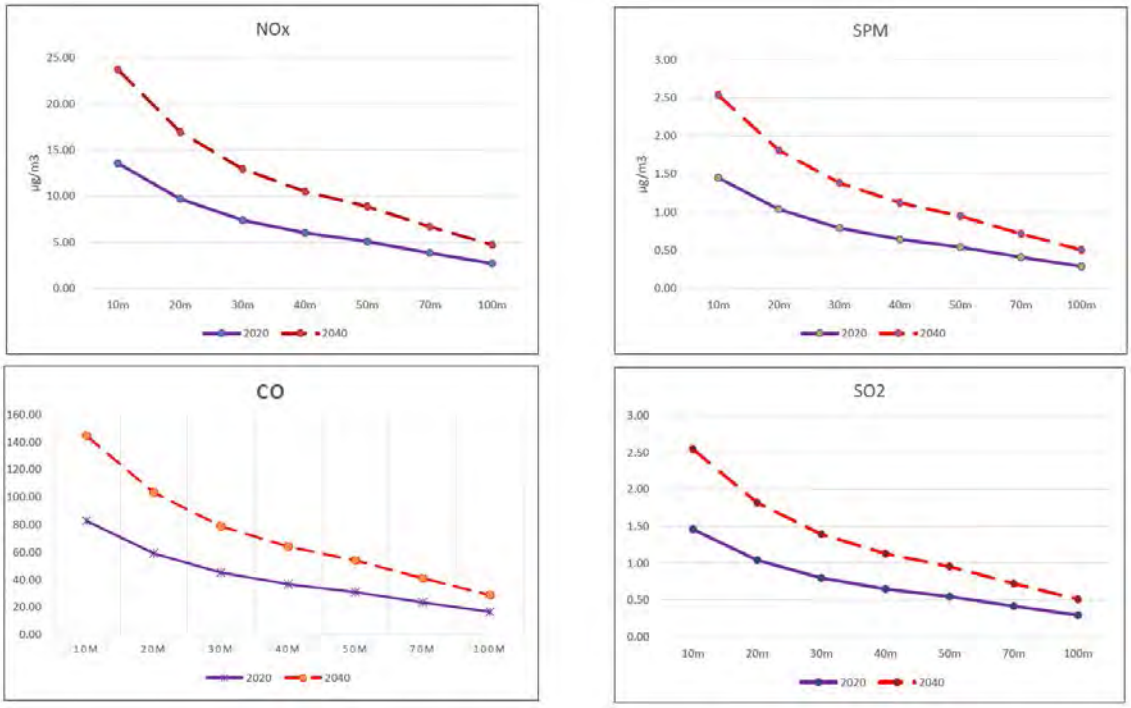
L :	distance from the survey point to the road side = x-W/2 (m)
x :	distance from emission point source to survey site along the wind direction (m)
W :	road width (m)
σ_{z0} :	initial vertical diffusion coefficient (m) in case of no existing of noise barrier : $\sigma_{z0} = 1.5$ in case of existing of noise barrier : $\sigma_{z0} = 4.0$

e) Result of prediction of diffused air pollutant concentrations

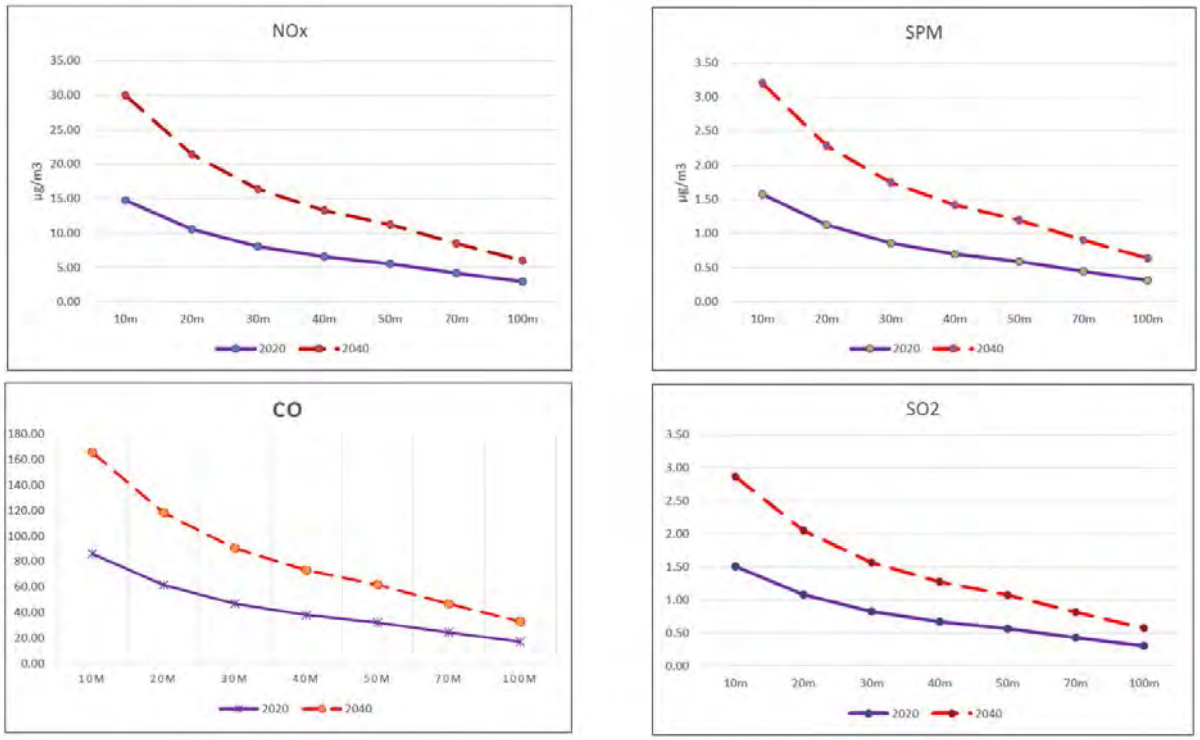
Since the meteorological conditions of the study area are almost similar with insignificant differences in wind velocity, wind direction; and the road cross sections are almost the same (road width, height of road embankment, etc.), it is reasonable to carry out prediction calculation only for the road sections with heavy traffic volume and where there is residential area located nearby.

Consequently, the road sections nearby the flyover IS5, IS21, and IS29 are selected for the prediction calculation.

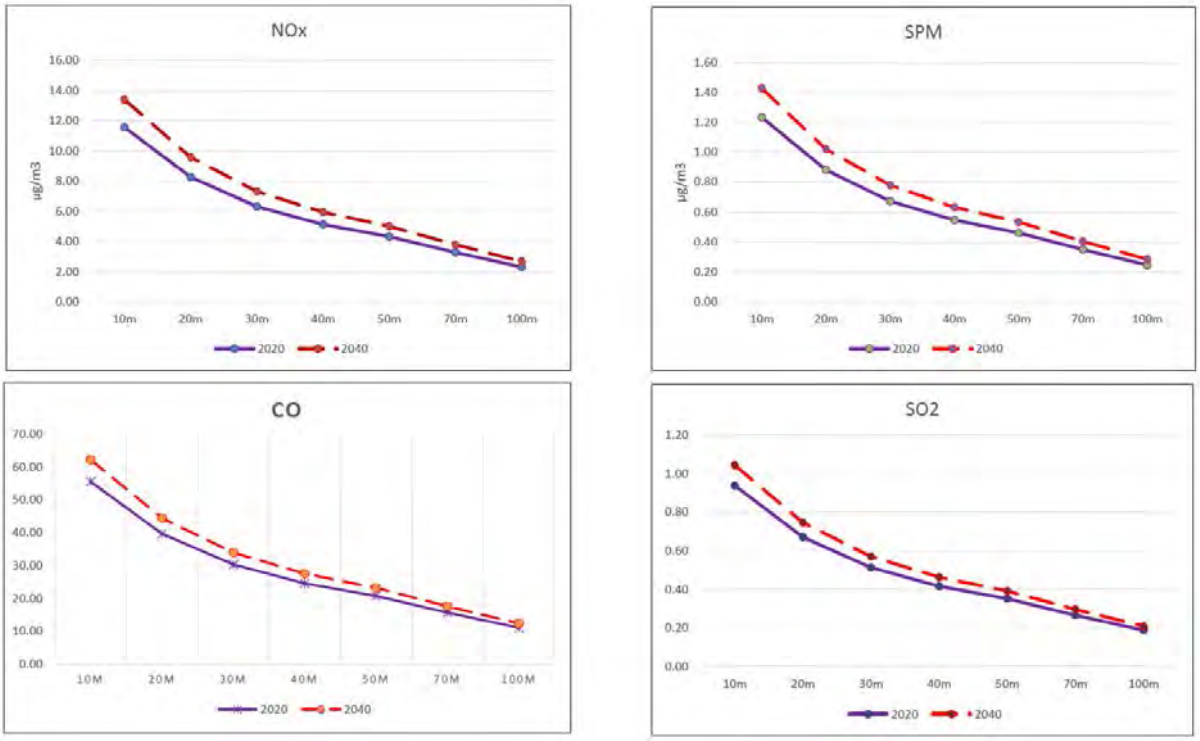
Result of prediction calculation is summarized in Figure 9-1 as following



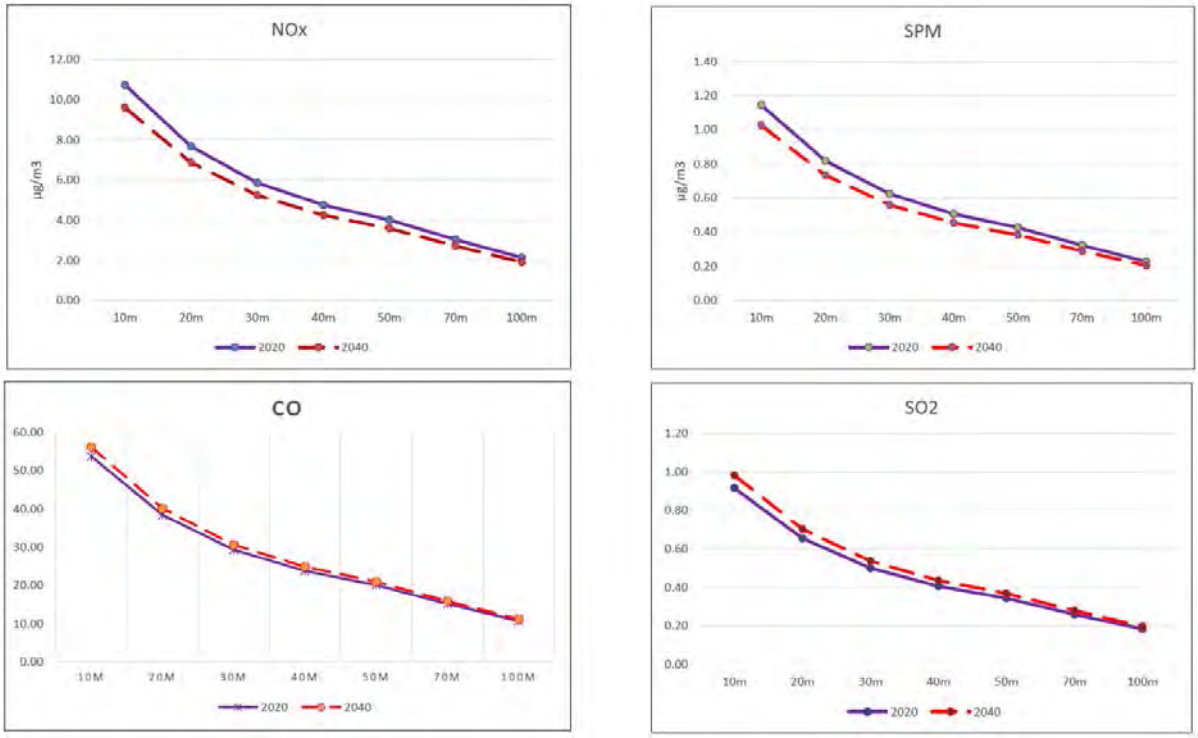
(1a) Prediction of diffused air pollutant concentrations at road section nearby Flyover IS5 – without BRT



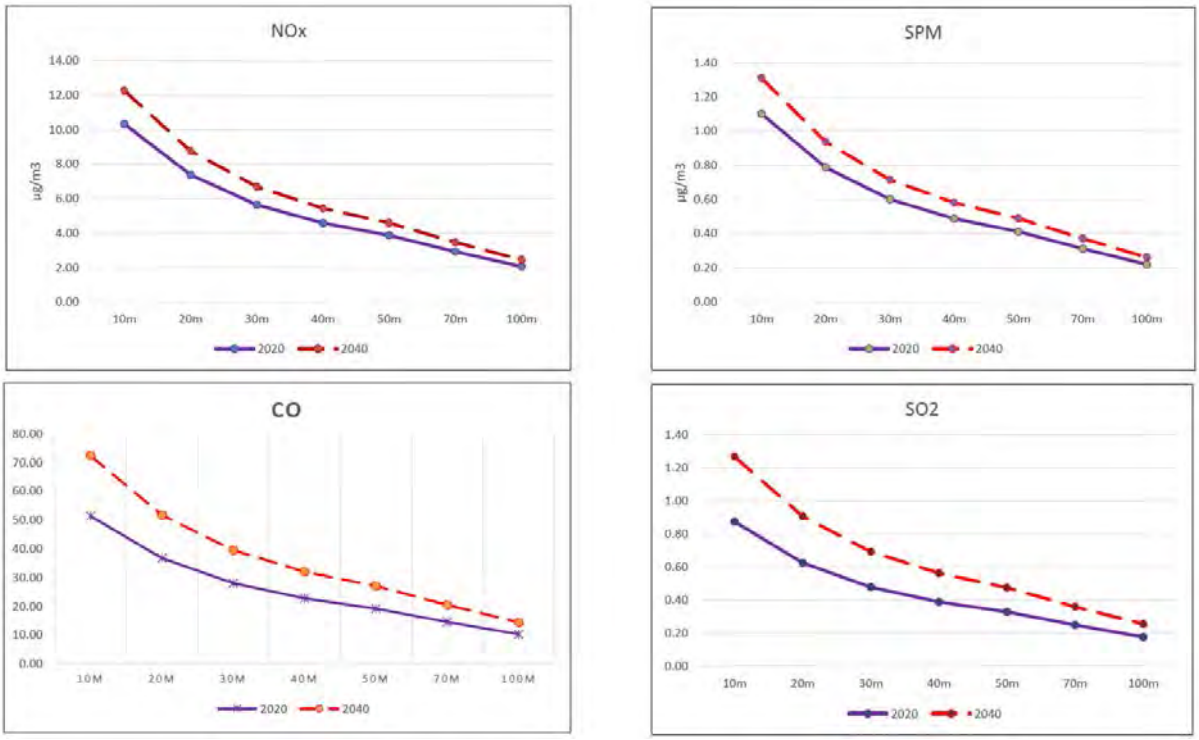
(1b) Prediction of diffused air pollutant concentrations at road section nearby Flyover IS5 – with BRT



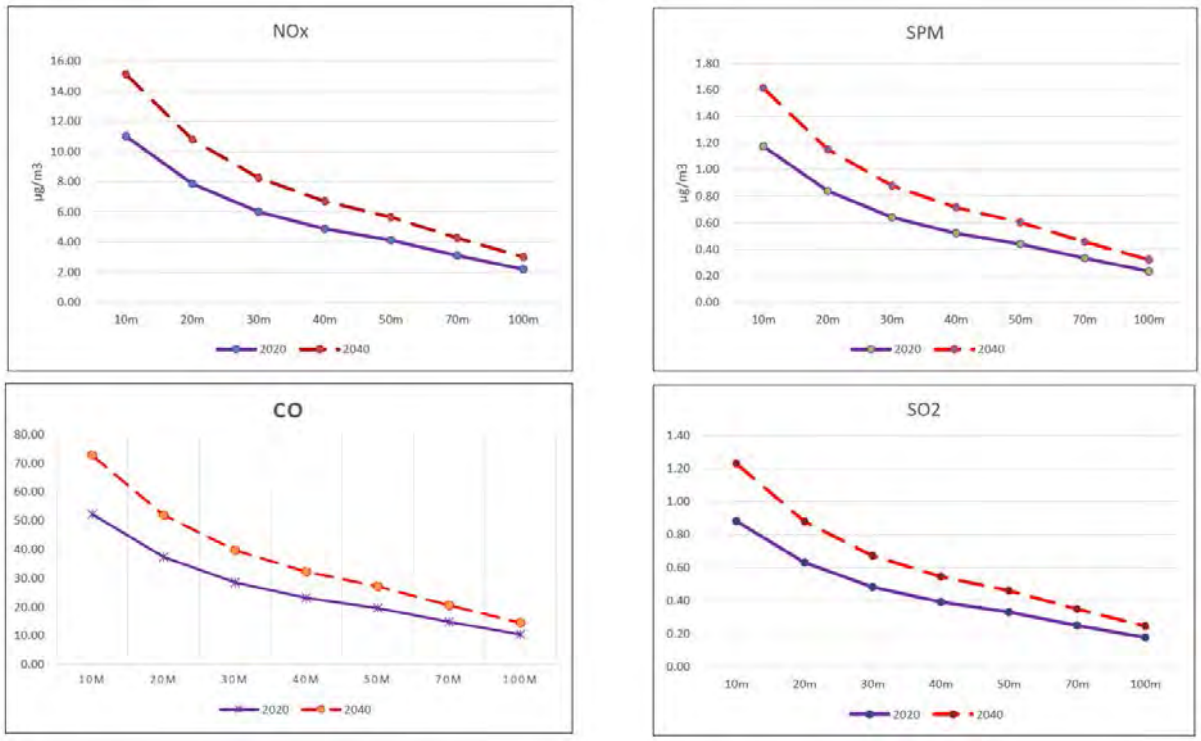
(2a) Prediction of diffused air pollutant concentrations at road section nearby Flyover IS21 – without BRT



(2b) Prediction of diffused air pollutant concentrations at road section nearby Flyover IS21 – with BRT



(3a) Prediction of diffused air pollutant concentrations at road section nearby Flyover IS29 – without BRT



(3b) Prediction of diffused air pollutant concentrations at road section nearby Flyover IS29 – with BRT

Figure 9-1. Result of prediction of diffused air pollutant concentrations

f) Assessment

In comparison between predicted air pollutant concentrations and allowable maximum of air pollutant concentrations stated in QCVN 05:2010/BTNMT, it can conclude that:

- Even in case of occurrence of traffic jam (hour vehicle velocity = 10km) in peak hour, concentrations of TSP, CO, NO_2, SO_2 predicted in 2020 and 2040 at all road sections nearby the planned flyovers IS5, IS21, and IS29 are smaller than the allowable maximum concentrations stated in QCVN 05:2010/BTNMT.

- There are no remarkable differences between the air pollutant concentrations predicted in case of "with BRT" and "without BRT". Consequently, it can conclude that impact of air pollutants generated by the Project in operation phase is insignificant.

- The predicted traffic volumes in peak hour in all road sections in 2020 and 2040 are relatively low. The heaviest traffic volumes predicted in 2040 in peak hour are 7,116 small-car-units at IS5, and 155 big-car-units at IS12 and IS13. These small traffic volumes are considered as main factors contributing to the low levels of air pollutant concentration.

9.3.2. Impacts of noise

In operation phase, noise level of vehicle flow is linear which is normally unstable and depends much on many factors such as traffic volume, types of vehicles, features of roads, etc. Therefore, relevant integral average noise numeric value in a course of time is used to evaluate noise level caused by vehicle flow in rush hours.

Model ASJ 2003 is used to predict average equivalent noise level Leq per hour (dBA) at sensitive positions along the route. This model is developed by "Acoustic Society of Japan" (ASJ) and is being widely used in Japan. Calculating method of ASJ Model 2003 is presented below.

The A-weighted sound pressure level LAi [dB] for noise propagation from the ith source position to the prediction point is calculated considering attenuation due to various factors in the sound propagation from an omnidirectional point source in a hemi-free field as

$$L_{A,i} = L_{WA,i} - 8 - 20 \lg r_i + \Delta L_{cor,i}$$

where LWA,i is the A-weighted sound power level of a single running vehicle at the ith source position [dB] and ri is the direct distance from the ith source position to the prediction point [m]. ΔLcor,i denotes the correction related to various attenuation factors in the sound propagation from the ith source position to the prediction point [dB], and is given by

$$\Delta L_{cor,i} = \Delta L_{dif,i} + \Delta L_{grnd,i} + \Delta L_{air,i}$$

where ΔLdif,i is the correction for diffraction [dB], ΔLgrnd,i is the correction for the ground effect [dB], and ΔLair,i is the correction for atmospheric absorption [dB].

Since there is not plan to install any kind of barrier along Mp-Tv Road, then the correction of diffraction ΔLdif,i is ignored in this calculation.

Noise level caused by a transport means is calculated by the following formula:

$$L_{AE} = 10\lg\{1/T \times \Sigma(10^{0.1L_{A,i}} \times \Delta t_i)\}$$

In which:

- L_{AE}: *noise exposure level over one time unit (one vehicle)*
- Δt_i: *a certain period of time set to calculate* L_{AE}
- $L_{A,i}$: *source noise level in a period of time* Δt_i

Power level is calculated by the following formula, applied for continuous vehicle flow:

$L_{WA} = 46.7 + 30\log_{10}V$ *(for small vehicles as passenger car, motorcycle, small truck, car);*

$L_{WA} = 53.2 + 30\log_{10}V$ *(for big vehicles as bus, heavy truck).*

In which V = vehicle's speed.

The forecast results on noise level during operation phase are presented in following figures.

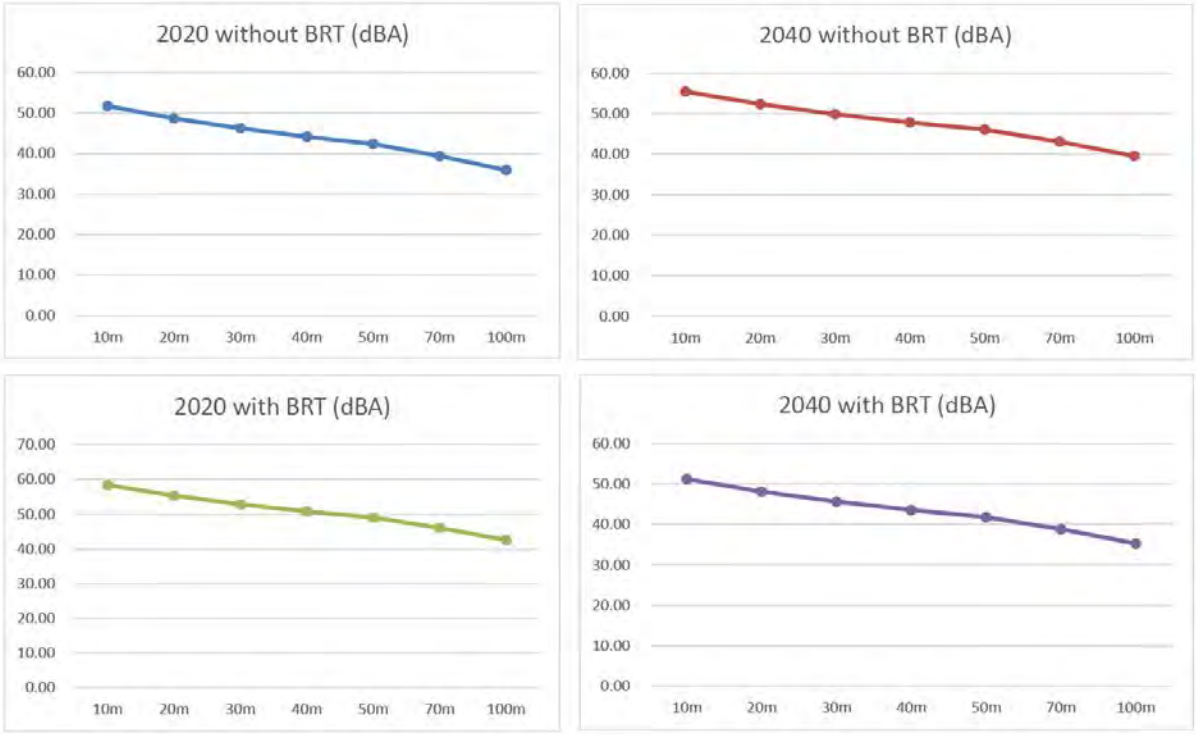


Figure 9-2. Prediction of noise level at road sections nearby the planned flyover IS5

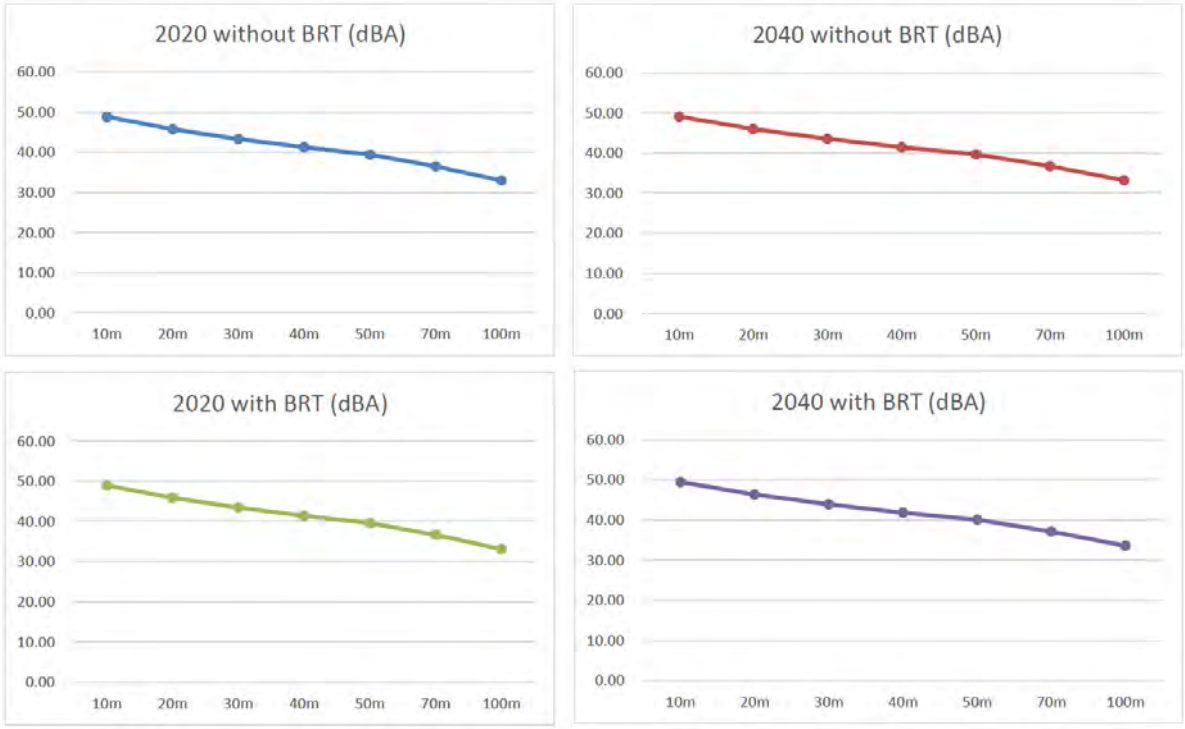


Figure 9-3. Prediction of noise level at road sections nearby the planned flyover IS21

Figure 9-4. Prediction of noise level at road sections nearby the planned flyover IS29

Assessment

- The highest noise level (58.4 dBA) is predicted in case of with BRT at the road section nearby the planned flyover IS5 in 2020. Besides, the noise level predicted in case of without BRT at the same road section in the same year of 2020 is 51.8 dBA. Difference between these noise levels is 6.6 dBA. This small difference leads to the conclusion that impact of the BRT Project to ambient air quality is insignificant.

- This noise impact assessment does not take into consideration the background noise level, due to the lack of baseline data. However, the noise level monitored on February 11, 2015 (Main Volume, Table 8-1) at the site nearby the planned flyover IS21 (near An Phu Intersection) is 76.5 dBA and exceeds allowable maximum noise level (70 dBA) stated in QCVN 26:2010/BTNMT "Technical regulation on noise". At some other sites along My Phuoc – Tan Van Road, especially at the sites near the major intersections, the monitored noise levels are also high and exceed the allowable maximum noise level. Therefore, it is recommended to continue monitoring the noise level along My Phuoc – Tan Van Road, and take proper measures to mitigate impact of noise at the sites nearby the sensitive receptors, such as hospital, school, religious facility, etc. Attention should be paid to the two sensitive spots are located right near the BRT route and may be affected directly by the project, Ham An Pagoda (Hiep Thanh Ward) and Doan Thi Diem Primary School (Binh An Ward).

9.3.3. Impacts of solid waste

The amount of waste generated at bus stations is from passengers. Although this is non-hazardous waste and mainly contains organic substances, it needs to be managed to mitigate environmental issues and disease.

At the BRT Depot, waste generated from activities of operational center, fuel recharge station, parking and washing areas. Assume that one person working in the depot will discharge 0.5 kg of solid waste per day, then 65 kg, 125 kg, and 190 kg of solid waste generated from the depot should be collected and treated in 2020, 2030, and 2040, respectively. In addition, hazardous wastes such as waste batteries, tires, oily waste will be generated from the operational and maintaining activities of BRT buses. These hazardous wastes need to be separated, collected, transferred and treated properly to avoid negative impacts on environment as well as public health.

Based on the prediction of BRT demand, estimation of average waste generation at each bus stop station, with about 0.015 kg of waste generated by a passenger per trip, will be 130 kg/day in 2020 and 530 kg/day in 2030.

Hazardous waste from the operational phase of this project is generated mainly in BRT depot from operational and maintaining activities of BRT buses, including waste batteries, oily waste. These hazardous wastes need to be separated, collected, transferred and treated properly to avoid negative impacts on environment as well as public health. The estimated amount of hazardous waste generated at the depot is 100 – 200 kg/day.

9.3.4. Impacts of wastewater

The wastewater in operation phase is only generated at the depot, including both domestic wastewater and wastewater from car washing and maintenance activities.

Assume that a person working in the depot will use 65 litters of clean water per day[6], then the estimated volume of wastewater generated from the depot is about 8,5 m3/per day. In 2020, 16m3/day in 2030, and 24 m3/day in 2040. This waste water should be treated before discharging to drainage system.

Domestic wastewater from the depot shall be treated by septic tank. Based on the estimated volume of wastewater at the depot in 2040, the tank capacity shall be as follow:

Volume of domestic wastewater = 24 m^3/day * 2 day of storage = 48 m^3;

In addition, wastewater also generated from washing buses. This wastewater contains organic substances, oil and suspended solids that require treatment before discharging to drainage system. Assume that it needs 3 m^3 of water to wash a bus per day, then the estimated total wastewater generated from bus washing is 133 m^3/per day in 2020, 264m^3/day in 2030, and 414 m^3/day in 2040

Wastewater from washing buses shall be collected and screened to extract out solid wastes, before moving to a stabilization tank. Then wastewater shall be stabilized before being discharged into a flotation tank, where oil and suspended solids are removed. Then it shall be discharged into a coagulation and sedimentation tank with supporting of coagulating chemicals. The wastewater needs to be disinfected before discharged to drainage system.

Rain water from the ground of the depot shall be directly discharged to local drainage system. Solid waste on the ground shall be regularly cleaned to prevent pollutants from running into the drainage system and potentially cause water pollution.

9.3.5. Impacts of accidents and traffic congestion

There will be an increase of traffic volumes during the operation phase. Traffic accident may occur around the bus stops due to the inattention of both drivers and pedestrians. There would

[6] Volume of water used in a common office, as result of a survey in Tokyo, http://www.mhlw.go.jp/topics/bukyoku/kenkou/suido/ryuiki/dl/06.pdf

be an increase of the risk of traffic congestion especially at peak hours (3-5 minutes interval of buses) in urban sections which are crowded of many transportation means.

9.3.6. Impacts of risks and incidents

During the operation phase the main risk of fire incidents are electrical accidents or fire risk of fuel in vehicles at the BRT depot. Firefighting and fire prevention measures shall be strictly applied for the depot.

9.4. Summarized results of environmental and social surveys

Table 9.5 shows the summarized results of surveys for the impacts factors described in Table 8.1.

Table 9-5. Summarized results of surveys on environmental and social considerations

Impact factor	Survey / prediction results
Air pollution B- / C±	**[In the construction phase]** In the construction phase, ambient air environment and people living near the construction sites (bus depot, flyovers) would be affected due to the following causes: - Soil works such as digging and leveling which cause dust. - Operation of vehicles transporting construction materials; - Loading and unloading construction materials and equipment from cranes, - Increased dust and gas emissions on dry days. Total amount of dust, exhaust gases arising from combustion of the fuel of construction equipment is based on the amount of diesel consumption from construction activities. If a truck (with size from 3.5 to 16 tons) consumes 1 ton of diesel, it will emit into the air about 4.3 kg of TSP; 20S kg of SO_2 (S as a function of sulfur in diesel, according QCVN01: 2007/BKHCN, S = 0.05%); 55kg of NOx; 28kg of CO, and 12kg of VOC. The experience and data from other road/highway construction projects (such as Hochiminh - Long Thanh - Dau Giay expressway) showed that, except for TSP, concentration of other air parameters measured near construction sites were lower than the allowable level of standards (QCVN/BTNMT 05:2013). Near the construction sites (BRT depot, flyovers, bus stops), there are several residential areas which may directly affected by air pollution such as the following: - Km 3 + 078 (Bus stop-2, IS-5, intersection with National Highway 1K) - Km 7 + 272 (IS-12) - Km 7 + 471 (IS-13, intersection with Nguyen Thi Minh Khai road) - Km 10 + 559 (IS-21, An Phu intersection) - Km 10 + 611 (IS-22, An Phu intersection (DT743A) However, Ham An Pagoda and Doan Thi Diem School and other sensitive spots are located far from the construction sites and will be not affected by air pollution. The impact of air pollution is unavoidable during the construction period. However, this impact can be mitigated to acceptable condition by applying appropriate technical and management measures. **[In the operation phase]** The construction of 7 flyovers along My Phuoc – Tan Van Road is recommended with aim to improve the running speed of BRT buses operating between Binh Duong New City and Suoi Tien Station / New Eastern Bus Terminal. According to result of surveys on current environmental and social conditions of the areas along My Phuoc – Tan Van Road, the areas around these flyovers are almost urbanized, populated and

Impact factor	Survey / prediction results
	may be affected by the project during the operation phase, especially in terms of air pollutions, noise, traffic accidents, etc. A prediction is carried out to confirm the extents of impacts of air pollution which may be caused by the moving vehicles, including BRT buses, to the areas adjacent to the planned flyovers in 2020 and 2040. Since the meteorological conditions of the study area are almost similar with insignificant differences in wind velocity, wind direction; and the road cross sections are almost the same (road width, height of road embankment, etc.), it is reasonable to carry out prediction calculation only for the road sections with heavy traffic volume and where there is residential area located nearby. Consequently, the road sections nearby the flyover IS5, IS21, and IS29 are selected for the prediction. In comparison between estimated air pollutant concentrations and allowable maximum of air pollutant concentrations stated in QCVN 05:2010/BTNMT, it can conclude that: - Even in case of occurrence of traffic jam (hour vehicle velocity = 10km) in peak hour, concentrations of TSP, CO, NO_2, SO_2 predicted in 2020 and 2040 at all road sections nearby the planned flyovers IS5, IS21, and IS29 are smaller than the allowable maximum concentrations stated in QCVN 05:2010/BTNMT. - There are no remarkable differences between the air pollutant concentrations predicted in case of "with BRT" and "without BRT". Consequently, it can conclude that impact of air pollutants generated by the Project in operation phase is insignificant. - The predicted traffic volumes in peak hour in all road sections in 2020 and 2040 are relatively low. The heaviest traffic volumes predicted in 2040 in peak hour are 7,116 small-car-units at IS5, and 155 big-car-units at IS12 and IS13. These small traffic volumes are considered as main factors contributing to the low levels of air pollutant concentration.
Water pollution C- / C-	**[In the construction phase]** Polluted water generated from the construction works, especially for the depot may cause negative impact to surface water environment. However, impact of water pollution is predicted insignificant and limited, since the depot is a small-scaled structure, and the use of heavy construction machine is not expected. **[In the operation phase]** The wastewater in operation phase is only generated at the depot, including both domestic wastewater and wastewater from car washing and maintenance activities. Assume that a person working in the depot will use 65 litters of clean water per day [Note 1)7], then the estimated volume of wastewater generated from the depot is about 8,5 m3/per day. In 2020, 16m3/day in 2030, and 24 m3/day in 2040. This waste water should be treated before discharging to drainage system. Domestic wastewater from the depot shall be treated by septic tank. Based on the estimated volume of wastewater at the depot in 2040, the tank capacity shall be as follow: Volume of domestic wastewater = 24 m^3/day * 2 day of storage = 48 m^3; In addition, wastewater also generated from washing buses. This wastewater contains organic substances, oil and suspended solids that require treatment before discharging to drainage system. Assume that it needs 3 m^3 of water to wash a bus per day, then the estimated total wastewater generated from bus washing is 133 m^3/per day in 2020, 264m^3/day in 2030, and 414 m^3/day in 2040 Wastewater from washing buses shall be collected and screened to extract out solid wastes, before moving to a stabilization tank. Then wastewater shall be stabilized before being discharged into a flotation tank, where oil and suspended solids are removed. Then it shall be discharged into a coagulation and sedimentation tank with supporting of coagulating chemicals. The wastewater needs to be disinfected before discharged to drainage system.

[7] *Note 1) Volume of water used in a common office, as result of a survey in Tokyo, http://www.mhlw.go.jp/topics/bukyoku/kenkou/suido/ryuiki/dl/06.pdf*

Impact factor	Survey / prediction results
Wastes C- / C-	**[In the construction phase]** Wastes generated during construction phase include solid waste from domestic activities, construction waste and waste hazardous (oil and grease waste). Domestic-generated solid waste: Domestic solid waste generated from workers' facilities contains organic wastes such as paper, plastics, cartons, food waste. Average generation of domestic solid waste is about 0.4 – 1.0 kg/person/day (Vietnam National Environment Report 2011 – Solid waste). It is estimated 30 – 50 workers/camp (for each construction site of flyovers and BRT depot), the daily solid waste generation caused by this project during construction phase is 12 - 50 kg/day/camp. This waste consists of organic substances (food waste) and other non-biodegradable wastes such as cans, plastic, paper, etc. Beside the impact on the aesthetics, biodegradable wastes would cause bad odor and source of pathogens if proper treatment is not applied. Construction waste: debris from digging to create ground (background construction) and unsuitable materials, mortar residue and excess concrete, used fuel containers, and oily cloths. This waste mainly causes impact on aesthetics of the area. Hazardous waste sources are oily contaminated waste from regular maintenance such as used fuel containers and oily cloths. The amount of this waste is little and not a regular waste. **[In the operation phase]** At the BRT Depot, waste generated from activities of operational center, fuel recharge station, parking and washing areas. Assume that one person working in the depot will discharge 0.5 kg of solid waste per day, then 65 kg, 125 kg, and 190 kg of solid waste generated from the depot should be collected and treated in 2020, 2030, and 2040, respectively. In addition, hazardous wastes such as waste batteries, tires, oily waste will be generated from the operational and maintaining activities of BRT buses. These hazardous wastes need to be separated, collected, transferred and treated properly to avoid negative impacts on environment as well as public health. Based on the prediction of BRT demand, estimation of average waste generation at each bus stop station, with about 0.015 kg of waste generated by a passenger per trip, will be 130 kg/day in 2020 and 530 kg/day in 2030.
Soil pollution D / C-	**[In the operation phase]** Soil pollution in the operation phase is expected mainly from the operation of the BRT depot. Waste oil, oily solid wastes from the bus maintenance work, polluted water from the bus washing, etc., may cause soil pollution to the areas around the depot.
Noise, vibration B- / B±	**[In the construction phase]** During construction phase, noise may be arised from the following equipments: - Building equipment. - Construction of bored piles for flyovers - Convey soil, stone, materials. The main sources of noise will be construction machines with the noise levels as high as 76 – 89 dBA, which however significantly decrease over distances. In this project, light construction machinery such as backhoe, truck, excavator, bored pile drilling machine will be used to construct flyovers. The noise at distance of 30m is predicted lower than the permissible standard of 70dB from 6h00 to 21h00 (QCVN 26:2010/BTNMT). Accordingly, the noise impact to local residential areas can be rated as moderate and temporary. Regarding impact of vibration, construction of the flyovers will not apply equipment generating high level of vibration. For construction of BRT depot, soft-soil treatment machine such as pile driving, soil compacting would be used but the vibration caused by these machine is minor. Moreover, the BRT depot is located in an area surrounded mostly by vacant land. There is only a school, Nguyen Khuyen High School, located about 100m from the proposed BRT depot. The impact of vibration therefore is predicted insignificant. [**In the operation phase]** The Model ASJ 2003 (developed by the Acoustic Society of Japan) was used to predict noise levels in the operation phase at several sites along the BRT route. Based on the result of estimation, the impact noise in the operation phase can be assessed as below.

Impact factor	Survey / prediction results
	- The highest noise level (58.4 dBA) is predicted in case of with BRT at the road section nearby the planned flyover IS5 in 2020. Besides, the noise level predicted in case of without BRT at the same road section in the same year of 2020 is 51.8 dBA. Difference between these noise levels is 6.6 dBA. This small difference leads to the conclusion that impact of the BRT Project to acoustic environment is insignificant. - This noise impact assessment does not take into consideration the background noise level, due to the lack of baseline data. However, the noise level monitored on February 11, 2015 at the site nearby the planned flyover IS21 (near An Phu Intersection) is 76.5 dBA and exceeds allowable maximum noise level (70 dBA) stated in QCVN 26:2010/BTNMT "Technical regulation on noise". At some other sites along My Phuoc – Tan Van Road, especially at the sites near the major intersections, the monitored noise levels are also high and exceed the allowable maximum noise level. Therefore, it is recommended to continue monitoring the noise level along My Phuoc – Tan Van Road, and take proper measures to mitigate impact of noise at the sites nearby the sensitive receptors, such as hospital, school, religious facility, etc. Attention should be paid to the two sensitive spots are located right near the BRT route and may be affected directly by the project, Ham An Pagoda (Hiep Thanh Ward) and Doan Thi Diem Primary School (Binh An Ward).
Involuntary resettlement C- / D	**[In the construction phase]** Main infrastructure planned in this project includes: (1) a BRT bus depot planned in Binh Duong New City, (2) a number of flyovers planned in major road intersections, (3) a number of bus stops planned along the bus route, (4) a short-cut road connecting Mp-Tv Road with NH No,1 and STT Station. Land for these facilities and road had been acquired (or is being acquired) by the Binh Duong New City Development Project, or the Mp-Tv Road Construction Project, or the NH No.1 Widenning Project. It also does not need to acquire additional land for the planned flyovers and bus stops, because these facilites are planned within the ROW of Mp-Tv Road. Results of the due diligence review of involuntary resettlement for the BRT depot carried out in this PPP F/S can be summarized as following: 1) It is difficult to verify the implementing process of compensation, supports, and resettlement that had been done more than 10 year ago. However, based on the result of interview to affected HHs, it can conclude that agencies in charge of resettlement had paid great effort to carry out the due compensation and help affected HHs in resettlement. 2) The New Law on Land 2003 and its relevant regulations were not applied. However, Binh Duong Province PC's policies on compensation and resettlement were generally relevant. 3) In general, inventory of loss, definition of entitlement for compensation, calculation of compensation amount, etc. were properly implemented. There is not significant discrepancy in comparison with Vietnamese regulations and JICA Guidelines. 4) Large-scaled resettlement sites were developed, and affected people were compensated with relatively large land lots in these resettlement sites. A part of affected people could use these land lots for restoring their livelihood. Besides, there are many industrial zones around the Binh Duong New City those can provide working place for affected people. 5) There was no complaint raised by the 3 households who had lived in the land lot proposed for the BRT depot. It is said that all complaints raised by other affected people had been completely redressed at the time of due diligence review. 6) There is no recorded problem on the considerations to socially vulnerable groups. 7) It is unable to verify the process of consultation with affected people. 8) Monitoring system has not been established.
Local economy such as employment and livelihood C± / B+	**[In the construction phase]** Residents and business activities near the construction sites of the flyovers may be temporarily affected by dust, noise, traffic jam, etc. during construction stage. However, local residents may have opportunity to work as construction worker for the project.

Impact factor	Survey / prediction results
Existing social infrastructures and service B- / B+	**[In the construction phase]** During construction phase, accidents accompanied with excavation works, construction machinery, etc. may occur. The social survey revealed that serious traffic jams and accidents caused by heavy lorries and trucks are occurred frequently on MP-TV Road. Currently, traffic jams offen occur at intersection of MP-TV Road with DT 743A Road, An Phu roundabout, and Phu Loi Road (DT 743). Vehicles for construction work of flyovers may cause increased risk of accidents and traffic jam on the roads around the construction sites. Traffic would be encroached due to arrangement of work items such as scaffold, material yard, machines. Vehicles carrying materials, wastes to and from the construction area may drop spoil or soil on the road surface which creates slippery condition and increases the risk of unsafe traffic. These impacts could be mitigated with implementation of traffic safety management for these vehicles.
Misdistribution of benefit and damage C- / C-	[**In the construction phase]** Residents who reside near the construction sites may suffer more direct impact of dust, noise, traffic jam, etc. than residents who reside far from the construction sites. **[In the operation phase]** Residents who reside right near the bus stops may earn more direct benefits (such as increased land price, reduction of travel time, etc.) from the project than residents who reside far from the bus stops.
Cultural, historical heritage D / B-	**[In the operation phase]** One national heritage relic (Phu Loi Prison) is found in the project area, but it is located 400 m far from the planned BRT route. Among sensitive receptors located along My-Tv Road, Ham An Pagoda (Hiep Thanh Ward) and Doan Thi Diem Primary School (Binh An Ward) may be affected directly by air pollution, noise, traffic accident, etc. caused by the operation of BRT buses. Particular attention should be paid to these two facilities.
Landscape C- / D	[**In the construction phase]** The appearance of temporary structures, construction machines, etc. may cause damage to the local landscape during the construction stage. However there is no outstanding scenic landscape along the BRT route that needs particular consideration.
Infectious diseases such as HIV/AIDS C- / C-	**[In the construction phase]** During the construction phase, risk of HIV/AIDS infection may increase among construction workers, amusement places around construction sites. **[In the operation phase]** Rural communes along the BRT route may be quickly developed in term of economy, and will be easily communicated with other areas, and therefore, may face increased risk of infection.
Working environment (including working safety) C- / D	[**In the construction phase]** Dust and exhaust gas generated from the construction works may cause negative affect to workers' health. Dust (particulate matters) pollution are generated by earth work activities and truck movement. Airborne high dust concentrations may cause respiratory difficulty. Chemical hazards generated by exhaust emissions containing high concentration of SO2, CO, VOC, etc., from construction equipment, trucks and painting, which may cause lung diseases. These impacts depends on organization of construction activities and distance from the construction sites/impact generators and the receptor, but they are expected as minor and would be avoided by preventive measures such as personal protective equipment for workers. Besides, accident risks such as the followings may occur at the work place due to improper implementation of safety regulations: - Traffic accidents could occur if the traffic management such as signs and guide management for construction equipment and transportation of raw materials is poorly implemented - Carelessness in labor, lack of personal protection equipment, or lack of strict safety practices could also cause unfortunate accident; - Working hours and long-term continuity can significantly affect the health of workers, causing fatigue, dizziness or fainting spells for workers at construction sites; - Besides, there are other risks of incidents including working on high elevation, electricity shock, working in slippery condition during rainy days, etc.

Impact factor	Survey / prediction results
Accident B- / B-	**[In the construction phase]** During construction phase, the increase of vehicles for the flyover construction works may cause more traffic congestions on the local road network, and increase the risk of traffic accidents around the construction sites. A part of roads around the project sites may be temporarily blocked and cause traffic congestion at some sections. Traffic would be encroached due to arrangement of work items such as scaffold, material yard, machines. The vehicles carrying the materials, wastes to and from the construction area may drop spoil or soil on the road surface which creates slippery condition and increases the risk of unsafe traffic. **[In the operation phase]** There will be an increase of traffic volumes during the operation phase. Traffic accident may occur around the bus stops due to the inattention of both drivers and pedestrians. There would be an increase of the risk of traffic congestion especially at peak hours (3-5 minutes interval of buses) in urban sections which are crowded of many transportation means.
Transboundary impacts, global warming C- / B+	**[In the construction phase]** Greenhouse gas (CO_2) will be generated from the construction works.

Source: JICA Study Team

Table 9.6 shows impact assessment in the stage of scoping and the ones based on results of surveys

Table 9-6. Impact assessment in scoping stage and after surveys

Items	No.	Environ-mental factors	Assessment				Reason of assessment
			Scoping		After survey		
			Pre-construction/ construction	Operation	Pre-construction/ construction	Operation	
Pollution	1	Air pollution	B-	C±	B-	D	[Construction stage] • Dust and polluted gas will be generated from the operation of construction machine around the construction sites of flyovers, depot, bus stops. [Operation stage] • Impact caused by the operation of buses on ambietn air is expected insignificant • It is expected that total volume of exhausted CO2 and other polluted substances in the project area will be decreased due to the decrease in private vehicle and the mitigation of traffic congestion.
	2	Water pollution	C-	C-	D	B-	[Construction stage] • Polluted water generated from the construction works, especially for the depot may cause negative impact to surface water environment. However, impact of water pollution is predicted insignificant and limited, since the depot is a small-scaled structure, and the use of heavy construction machine is not expected. [Operation stage]

							• Polluted water and waste oil generated from the depot may cause negative impact to the surrounding water bodies.
	3	Wastes	C-	C-	B-	B-	[Construction stage] • Construction wastes and general wastes from construction sites of flyovers and depot may cause negative impact to the surrounding environment. [Operation stage] • Improperly-disposed wastes from the depot and the bus stops may cause negative impact to environment.
	4	Soil pollution	D	C-	D	B-	[Construction stage] • Materials which may cause soil pollution will not be used for construction works. [Operation stage] • Waste oil and polluted water from the depot may cause soil pollution to the surrounding area.
	5	Noise, vibration	B-	B±	B-	B±	[Construction stage] • Levels of noise and vibration may increase due to construction works. [Operation stage] • Level of noise and vibration may increase due to the bus operation. • However, noise level in total may decrease due to the decrease in private vehicles.
	6	Ground subsidence	D	D	D	D	[Construction stage / Operation stage] • Construction of flyovers and depot with light structures on the solid land in the project area is expected not cause ground subsidence.
	7	Offensive odor	D	D	D	D	[Construction stage / Operation stage] • Construction works and its maintenance do not generate offensive odor.
	8	Bottom sediment	D	D	D	D	[Construction stage / Operation stage] • Large-scale soil reclamation or civil work is not required for construction of flyovers, depot, and bus stops. Therefore, the Project is expected not caused bottom sediment to the surrounding water bodies.
Natural environment	9	Protected areas	D	D	D	D	[Construction stage / Operation stage] • There is not any protected areas such as national park observed in the project area.
	10	Eco-system	D	D	D	D	[Construction stage / Operation stage] • The areas around the project site are already urbanized and occupied by many industrial zones and residential areas.
	11	Hydrological situation	D	D	D	D	[Construction stage / Operation stage] • The construction and operation of the BRT system is expected not cause affect to the flow of rivers those are located far from the BRT route.
	12	Topography and geographical features	D	D	D	D	[Construction stage / Operation stage] • The project areas is occupied mainly by fairly flat low hills. Impact to topography and geographical features around the depot and flyovers is not predicted.
Social environ	13	Involuntary resettlement	C-	D	D	D	[Pre-construction stage] • The BRT Project requires land for the depot and the

							bus route. However, land for the depot had been acquired by Binh Duong PC during the 2003-2010 period, under the Binh Duong Industrial – Service and Residential Complex Development Project. Due diligence survey is required to ensure that the process of land acquisition for this land is conform with JICA Environmental Guidelines. ・Land required for the BRT route had been almost acquired under the Mp-Tv Road Construction Project, Pham Ngoc Thach Road Construction Project, etc. ・Construction of 8 flyovers and 13 bus stops along Mp-Tv Road is planned in Phase 1 (by 2018). However, there is no need to acquire additional land for these flyovers and bus stops, because they are planned within the ROW of Mp-Tv Road. [Operation stage] ・Requirement of additional land acquisition and resettlement is not expected during operation stage of the BRT bus.
	14	The poor	D	C+	D	C+	[Construction stage / Operation stage] ・The Project is expected not cause impact to the poor. ・The Project may help to improve accessibility of the poor, the elderly people, the handicapped persons, etc.
	15	Indigenous and ethnic people	D	D	D	D	[Construction stage / Operation stage] ・Indigenous and ethnic people are not observed residing around the project area.
	16	Local economy such as employment and livelihood	C±	B+	B±	B+	[Construction stage] ・Residents and business activities near the construction sites may be affected by dust, noise, traffic jam, etc. temporarily during construction stage. ・Local residents may have opportunity to work as construction worker for the project. [Operation stage] ・Local economy and industry may be promptly developed due to the improved acessibility to Suoi Tien Terminal Station, New Eastern Bus Terminal, Cai Mep-Thi Vai International Port, Hi-Tech Park, HCMC University, Ben Thanh Business Center, etc. ・The Project may contribute to economic development of the areas around the bus stops
	17	Land use and utilization of local resources	B+	A+	B+	A+	[Construction stage / Operation Stage] ・There may be significant change in land use in the areas along Mp-Tv Road, especially in the areas around the bus stops, where agricultural land may change into residential land, urban land, commercial land, etc. ・The flyovers and the pedestrian bridge built at the bus stops may help local residents to across Mp-Tv Road in more easier and safer manner. ・Improvement of traffic condition may distribute to the efficient use of local resources.
	18	Water usage or water rights and rights of common	D	D	D	D	[Construction stage / Operation Stage] ・There is not any river or lakes in the project area. The project is expected not cause impact to the water usage of local residents.

	19	Existing social infrastructures and service	B-	B+	B-	B+	[Construction stage] • Traffic jam may occur on the roads around the construction sites during construction. [Operation stage] • The BRT buses may help improve local residents' accessibility to public facilities in large area.
	20	Social capitals, local organizations, such as authorities to make decisions	D	D	D	D	[Construction stage / Operation stage] • Mp-Tv is a newly constructed road, and therfore the BRT project will not cause significant impact to the existing public trnasportation system of the locality.
	21	Misdistribution of benefit and damage	C-	C-	B-	B+	[Construction stage] • Residents who riside near the construction sites may suffer more direct impact of land acquisition, dust, noise, traffic jam, etc. than residents who reside far from the construction sites. [Operation stage] • Residents who reside right near the bus stops may earn more direct benefits (such as increased land price, reduction of travel time, etc.) from the project than residents who reside far from the bus stops.
	22	Local conflict of interests	D	D	D	D	[Construction stage / Operation stage] • Conflict of interests between local residents/ communes is not predicted by the Project.
	23	Cultural, historical heritage	C-	C-	B-	B-	[Construction stage / Operation stage] • One national heritage relic (Phu Loi Prison) is found in the project area, but it is located 400 m far from the planned BRT route. • Some sensitive spots (churches, pagodas, schools, etc.) are found within 500m from the planned BRT route. However, among these spots, Ham An Pagoda (Hiep Thanh Ward) and Doan Thi Diem Primary School (Binh An Ward) are located right near the BRT route and may be affected directly by the Project.
	24	Landscape	C-	D	D	D	[Construction stage/Operation stage] • Negative impact to landscape is not predicted, due to no any scenic landscape is observed in the area along the BRT route.
	25	Gender	D	D	D	D	[Construction stage / Operation stage] • Impact to gender that requires particular consideration is not expected.
	26	Children's right	D	C+	D	B+	[Construction stage] • Impact to children's right that requires particular consideration is not expected. [Operation stage] • The bus operation and the pedestrian bridge at the bus stop may help improve children's accessibility to other areas.
	27	Infectious diseases such as	C-	C-	D	D	[Construction stage] • Risk of HIV/AIDS infection may increase among

		HIV/AIDS					construction workers, amusement places around construction sites. [Operation stage] ・Rural communes along the BRT route may be quickly developed in term of economy, and will be easily communicated with other areas, and therefore, may face increased risk of infection.
	28	Working environment (including working safety)	C-	D	B-	D	[Construction stage] ・Dust and exhaust gas generated by construction works may cause negative affect to workers' health. ・Wastes from worker camps and construction office may worsen sanitary condition of the surrounding areas. [Operation stage] ・Impact to working environment that requires particular consideration is not expected.
Others	29	Accident	B-	B-	B-	B-	[Construction stage] ・There is risk of traffic accident on the roads around the construction sites. [Operation stage] ・Traffic accident may occur around the bus stops due to the inattention of both drivers and pedestrians.
	30	Transboundary impacts, global warming	C-	B+	C-	B+	[Construction stage] ・Greenhouse gas (CO_2) will be generated by construction works. [Operation stage] ・It is expected that total volume of greenhouse gas will be decreased, due to the decrease in motorbikes and other means of private transportation. ・The BRT buses using compressed natural gas (CNG) as fuel will be introduced to the Project with aim to reduce greenhouse gas.

Note *A+/-: serious positive/negative impact is expected;*
B+/-: positive/negative impact is expected to some extent;
C+/-: extent of impact is unknown, further study is needed;
D: limited impact/negligible impact, further study is not needed.

Source: JICA Study Team

10. Impact mitigation measures and implementation cost

10.1. Impact mitigation measures during construction phase

10.1.1. Measures to prevent and mitigate impacts of air pollution

To prevent dust from construction activities:

- Stockpiles of sand and aggregate shall be sufficiently enclosed to avoid blowing dust.
- Storing the excavated soil storage areas must be placed in the designed areas far from any residential area.
- Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate such as mixing concrete and all stored materials shall be dampened during dry and windy weather.
- Debris from construction work on high elevation shall be transported to the ground in containers with plastic or tarpaulin cover to prevent dust dispersion.
- Build temporary walls around the construction sites the height of fence must be at least 2 m.

To prevent impacts of dust from vehicles, the following requirements shall be applied:

- Dust suppression measures shall be used, including covering materials with tarpaulin, limiting the speed for vehicles transporting construction materials (e.g. 5km/h in construction site).
- Areas within the site where there is a regular movement of vehicles shall have an acceptable hard surface and be kept clear of loose surface material.
- Watering and cleaning debris and spoil on local roads shall be regularly carried out to avoid dust impact and unsafe traffic condition.

All equipment and machinery on the site shall be operated at designed capacity. They shall be sufficiently maintained to ensure compliance with safety and air pollution requirements. In addition, the contractors shall use construction equipment and vehicles which comply with the latest regulations on exhaust gas control (for example Decision No. 249/2005/QĐ-TTg of the Prime Minister, Regulation on Emission Roadmap dated 10 October 2005 for road transportation vehicles)

10.1.2. Measures to prevent and mitigate impacts of noise and vibration

To reduce noise and vibration from the construction sites, the following measures shall be implemented

- Installing the temporary walls around the construction sites to reduce noise to receptors
- Using construction machinery and vehicles which reduces noise and vibration. Construction machinery and vehicles should be periodically inspected and maintained to be able to use in best condition.
- Operation of vehicles should be properly managed to avoid concentration of vehicles at a same time and in the same place. Operators of construction machinery and drivers of vehicles transporting equipment and materials should be instructed and trained appropriately. Use of machines causing loud noise (bulldozer, excavator etc.) is limited between 18h00 and 6h00 to avoid annoyance in resting time of local people. If night-time construction is necessary, the contractor will apply for a permit from local authorities and inform residents about coming works in advance.
- Usage of machines generate noise level over >55 dBA at night (from 22:00 to 6:00) is strictly prohibited at the location nearby residential area, especially at high density population sites such as Bus stop 3, 6, 9 and 12.
- Transporting and unloading materials shall be limited in peak hours to minimize impacts on traffic and health of workers and local residents.

10.1.3. Measures to prevent and mitigate impacts of solid wastes

During construction phase, solid wastes and sewage from the construction sites may cause adverse impacts to the adjacent water bodies. Mitigation for impacts of construction wastes shall include the following measures.

For domestic waste:

- Domestic waste generated on the site shall be managed as the following steps: i) provide dustbins at work site; ii) waste category for reuse; iii) domestic waste and garbage from worker camps need to be collected by hygienic manner through service provision of local companies.
- Garbage bins: need to meet the requirement of Ministry of Construction QCVN 07:2010/BXD as detail: i) vollume of garbage bin will be 100 litters and no exceed 1m3; ii) garbage bin with coverage; iii) location of garbage bins will be every 100 meters; iv) waste standing on garbage bin will not allow to over 24h; v) daily clean the bins is required.

- Disposal of solid wastes into surrounding environment such as watercourses agricultural field and public areas is prohibited.

For construction solid waste

- Contractors should bear efforts to reduce construction debris, and solid wastes, and to separately collect, re-use these wastes such as levelling on site.
- Unusable construction wastes, garbage generated from worker camps, and waste soils should be properly collected, treated, and disposed by authorized company in accordance with regulations of Binh Duong Province and HCM City
- Precaution measures such as tarpaulin cover shall be used to cover spoils when transporting the spoils to disposal sites to avoid dropping on roads.
- Handling of hazardous materials and wastes shall implement the following measures
- Fuel storage sites shall be located away from water bodies and on a cement pavement with embankment capture and fuel leaking.
- Vehicles and machinery shall be operated properly to avoid accidental spills.

For hazardous wastes:

- Hazardous wastes such as used fuel containers, oily cloths, oil and grease wastes shall be collected and stored in sturdy bins to avoid leaking into the environment.
- The contractor shall employ a competent company to transport and treat hazardous wastes in accordance with MONRE's Circular No. 12/2011/TT-BTNMT dated 14 April 2011.

10.1.4. Measures to prevent and mitigate impacts of wastewater

Impacts of construction wastewaters can be mitigated by the following mitigation measures.

- In construction phase, wastewater generated from construction sites should not be discharged directly to drainage system or surrounding surface water bodies. Wastewater should be settled and preliminarily treated before discharge.
- Adequate precautions will be taken to prevent chemical and fuel leaking that consequently would be flushed into the pond or the drainage system.
- In rainy seasons, temporary drainage shall be established to avoid local inundation. Sediments trapped in the drainage shall be removed and treated as a solid waste source.
- Provide the facilities in the site including latrines, holding areas, garbage bins. Waste from latrines will be collected and treated properly through an economic contract with local environmental companies;

- Washing instruments/vehicles next to the water bodies (for example construction site of flyover at Km0+000 of Mp-Tv Road) is forbidden to avoid leaching of waste, sludge, soil, oil contaminated water.
- Contractors should make sanitation management plan for construction sites, and duly implement this plan. Particularly, sanitary facilities (trash bins, toilets, etc.) should be appropriately placed at construction sites, and staff in charge of sanitary management should be deployed appropriately at every construction site, etc.

10.1.5. Measures to prevent and mitigate impacts on accidents, traffic congestion

The following measures shall be implemented to mitigate traffic congestion and ensure traffic safety.

- Construction vehicle operation plan should be appropriately made, and routes for construction vehicles should be properly planned to avoid concentration of machinery and vehicles in limited roads.
- For proper control of traffic or when/ where necessary, flagmen shall be assigned to direct the movement of traffic on access roads to the construction site.
- Within or in the vicinity of the project area warning and guide signs shall be furnished when necessary and provide lighting at construction site at night;
- In order to minimize disruption to traffic flows the construction site shall be enclosed with temporary fence to provide a visual barrier between the construction site and adjacent traffic.
- In case of blocking traffic for transport of heavy equipment the contractor shall inform and co-operate with local authorities and people in advance to minimize impacts to local traffic and local people. Coordinate with traffic polices on moderate the traffic flow during rush hours, especially at major intersections such as DT 743 A (Km0+000), An Phu, and Phu Loi.
- Drivers of vehicles bringing equipment and materials should be properly trained to ensure that they observe the driving rules, driving routes, etc.

10.1.6. Measures to prevent and mitigate impacts of risks and incidents

Before commencement of the construction, compulsory management measures to prevent and respond to risks and incidents shall include the followings:

- Regulations on health and safety shall be prepared and its contents covers issues on health and safety on construction site including regulation on hygiene practices, traffic safety,

safety in using equipment such as heavy machines and electrical devices, hazards associated with hazards associated with various construction activities.

- All workers and staff shall attend induction course on occupational health and safety within their first week on site. Periodic courses shall be conducted not less than once every six months.
- An occupational health and safety board shall be developed, comprising representatives of construction teams. The board will look after implementation of required measures, and to ensure that health and safety precautions are strictly implemented for the protection of workers and the general public in the vicinity of construction areas.
- Safety inspections shall be regularly conducted by the occupational health and safety board and other relevant staffs. The inspection shall cover health and safety condition on site and status of all safety equipment including scaffolds, guardrails, working platforms, hoists, ladders and other means of access, lifting, lighting, signing and guarding equipment, etc.
- An emergency response plan shall be prepared, addressing preventive, mitigation responding measures for emergency events due to project activities such as accidents, spills of hazardous substances, fire, and other incidents.
- Contractor shall readily provide and maintain lights, protection fences, signboards and wardens where necessary to prevent local people access the sites.

To prevent and mitigate health risks to workers and local residents the following measures shall be implemented

- It is anticipated that a number of temporary construction workers will come to the project site. Therefore, it needs to carry out sanitary health education to workers, and measures to prevent spread of infectious diseases. Periodic health care check for worker (every 6 months as regulated) is suggested
- Adequate drainage in construction sites shall be provided to prevent water logging and formation of breeding sites for mosquitoes.
- Hygienic sanitation facilities/toilets with sufficient water shall be supplied.
- All solid wastes, wastewaters, and hazardous wastes shall be properly treated as described in the above sections to prevent impacts to workers' health.
- Workers shall sufficiently wear personal protective equipment such as sound ear plugs, protective masks when working with noise or dust generating machines, vehicles, etc.

To prevent occupational accidents in construction work the following measures shall be implemented.

- First aid facilities are equipped on site and readily accessible by workers.
- Safety equipment and protective clothing such as protective masks, safety belts for working at high elevation are sufficiently provided to workers.
- Precautions to ensure that objects (e.g., equipment, tool, debris, precast sections, etc.) do not fall onto or hit construction workers shall be implemented. Based on a case specific basis, fall prevention/protection measures may include installation of guardrails with mid-rails and toe boards at the edge of any fall hazard area, etc.
- Sufficient lighting during night working as appropriate shall be provided to enable safe equipment operation.
- Precaution measures to ensure public safety shall be implemented including fencing of construction sites and excavation sites and guarding such areas to restrict public access, fencing on all areas of excavation greater than 2 m deep, warning signs at the periphery of the construction site.
- Speed limits of vehicles on construction site shall be strictly imposed.
- Equipment on the construction site shall have required safety certificates and be regularly maintained.

Fire prevention and firefighting measures shall cover the followings:

- Workers shall be trained on fire prevention and firefighting.
- Smoking and practices generating ignition sources shall be prohibited in construction area.
- Fire-fighting equipment shall be equipped at fuel storage, the work areas, where appropriate, and at construction camps.
- Petroleum used for the construction equipment and other flammable materials shall be kept in separate isolated stores, away from potential sources of ignition.

10.2. Impact mitigation measures during operation phase

10.2.1. Measures to prevent and mitigate impacts of air pollution

Managing the emission from vehicle operation and controlling the emission from vehicles including buses need to comply with active regulations and standards such as:

- Decision No. 49/2011/QD-TTg date 01/09/2011 of Prime Minister on providing the roadmap for application of exhaust emission standards to manufactured, assembled and imported brand-new cars and motorbikes, detail road map as i) apply UERO 4 standard from 01/01/2017 and ii) apply EURO 5 standard from 01/01/2022;

- Circular No. 31/2011/TT-BGTVT dated 15/4/2011 of Ministry of Transport on Regulating on providing technical safety and environmental protection verification for imported automobile;
- Checking the vehicle quality according to Circular No. 56/2012/TT-BGTVT dated 27/12/2012 of Ministry of Transport on providing technical safety and environmental protection verification of road motor vehicles; and Circular No, 10/2014/TT-BGTVT of Ministry of Transport on revising the Circular No, 56/2012/TT-BGTVT on providing technical safety and environmental protection verification of road motor vehicles
- Circular No, 10/2009/TT-BGTVT dated 24/06/2009 of Ministry of Transport on technical safety and environmental protection inspection of road motor vehicles;

Controlling the secondary dust release from surface: The following measures shall be applied for the area of BRT depot, bus station

- Periodically carrying out surface cleaning the depot's ground to control secondary dust release.
- Tree should be planted at the depot, along the route and bus station when applicable to both prevent dust dispersion and create landscape at bus stop stations.

10.2.2. Measures to prevent and mitigate impacts of noise

To mitigate impacts of noise from buses the proper and regular maintenance of buses shall be implemented and the above regulation shall be followed in order to keep buses at good condition and reduce noise level at the sources (buses).

For sensitive spots located right near the planned BRT route such as Ham An Pagoda (Hiep Thanh Ward) and Doan Thi Diem Primary School (Binh An Ward), monitoring of noise level shall be conducted to evaluate the impact of noise. Planting trees or building noise reducing walls shall be considered if the impact is serious. Selection of of mitigation measures method shall be conducted in consultation with the affected people and local authorities.

Use of horn shall be limited or prohibited at sensitive areas along the roads such as schools, pagodas.

10.2.3. Measures to prevent and mitigate impacts of solid waste

The following measures should be implemented to avoid/mitigate impacts of domestic wastes.

- Solid wastes and dusts in the bus stations and depot shall be properly collected and treated. Garbage bins shall be provided in various locations at the depots including exit gates and toilets to collect all the domestic wastes. Waste segregation at source would be

implemented with different colors for the bins to separate organic and inorganic wastes, enhancing waste reuse and recycle. For bus stations, one garbage bin for organic and another one for inorganic solid wastes shall be sufficient. Similarly, two bins shall be equipped for each location at the depot.

- Make contract with company who is entrusted to collect, treat, and dispose solid wastes generated from the stations and depot to ensure that it is properly carried out in accordance with related regulations.

As calculated hazardous waste is generated at the depot during operation phase, thus the mitigation measures only focus on this area. The main mitigation measures are proposed as bellow:

- Implementing hazardous waste generator register as regulated;
- Separating waste at sources: separating domestic and hazardous waste at sources as regulated in Circular No. 12-2011/TT-BTNMT;
- Storing: hazardous waste will be stored at red bins, providing at least bins at waste generating areas such as maintenance and storage areas;
- Storage of hazardous substances must in the places, which facilitated with: i) roof; ii) concrete ground and water resistant; iii) edge around the storage areas; iv) away from water bodies and high fire risk areas;
- Labeling the toxic symbol on the bins;
- Signing contract with company, who has a work permit to treat hazardous waste according to MONRE's Circular 12/2011/TT-BTNMT, dated 14 April 2011 for transportation and treatment.

10.2.4. Measures to prevent and mitigate impacts of wastewater

Mitigation measures for domestic and run-off wastewaters are as follows.

- Hygiene toilets with septic tanks to collect the wastewater shall be sufficiently equipped at every floor of the depot.
- For car washing wastewater and run-off wastewater, wastewater treatment system at the depot shall be designed with appropriate capacity including necessity of preliminary treatment such as mesh screens to remove garbage and hoppers to settle suspended particles and one compartment to remove oil/grease (flotation tank) before discharge to the city drainage system.

10.2.5. Measures to prevent and mitigate impacts of accidents and traffic congestion

In order to ensure easy and safe accessibility to the bus stations the location and design of the stations shall be thoroughly studied at design stage.

Signal and lighting system shall be properly installed along the routes, at every stations and at the depot. For example signal boards near by the intersections and at bus stop stations shall be set up.

Coordinate with traffic polite groups along the BRT route in traffic managing during rush hours. Flagmen shall be assigned to regulate traffic flow in and out the depot especially at peak hours to minimize traffic jam. Bus drivers shall be trained to follow safety when operating vehicles on the routes.

10.2.6. Measures to prevent and mitigate impacts of risks and incidents

As the risks and incidents mainly occur at the depot where is crowded of operating staffs, prior to operation of the depot the emergency response plan shall be developed. Adequate resources and provisions for the plan shall be strictly implemented throughout operation phase. The plan shall consist of measures for incidents (fire, accidents, spills of hazardous substances, etc.) and evacuation actions in case of accidents. The plan also shall cover all components of the station.

Regarding fire prevention and fire fighting, the following measures should be implemented (in line of Vietnamese Standard TCVN 3255:1986 – Explosion safety and Vietnamese Standard and TCVN 3254:1989 - Fire safety).

Coordinate with firefighting agencies to establish fire prevention measures to prevent fire incident and to organize training and practice of fire prevention for all staff of the stations to understand the importance and measures of fire prevention as well as be expertise and ready to respond promptly.

Regularly check power lines, circuit breakers and electrical & fire fighting equipment for prevention.

Prepare effective fire prevention and fighting facilities:

- Ensure communication system quickly and timely in case of fire;
- Fully equipped with fire facilities (dry sand, wet sacks, fire foam, water sources, etc);
- Ensure the road system is wide enough for fire engine to travel in and out.
- Ensure sufficient emergency lights with power backup sources in case of electricity cut.

10.3. Implementation cost for prevention and mitigation measures

The following table is calculation cost of implementing mitigation measures for construction of the depot and 8 flyovers.

Table 10-1. Cost for Implementing mitigation measures during construction phase

No.	Item	Implementation responsibility	Unit price (VND)	Number	Total cost	
					(Mil. VND)	(USD)
1	Temporary barriers to minimize noise and dust during construction	Contractor	100,000,000	9 (1 set/ construction site)	900	41,341
2	Wastewater treatment	Contractor	150,000,000	9 (1 system/ construction site)	1,350	62,012
3	Mobile hygiene toilets	Contractor	20,000,000	18 (2 toilets/ construction site)	360	16,537
4	Bins for collect garbage, oil and grease	Contractor	5,000,000	9 (1 set/ construction site)	45	2,067
5	Training on occupational health and safety	Contractor	20,000,000	9 (1 time/ construction site)	180	8,268
	Total cost				**2,835**	**130,225**

Note: the exchange rate is USD 1 = VND 21,770 (the rate is from Vietcombank on 2015 July 02)

11. Environmental management plans (EMP)

Environmental management and supervision are obligatory during each period of the project and are undertaken by the construction contractors, project management unit in cooperating with specialized environment organizations.

Purposes of management and supervision program are:

- To check environmental impacts and control the implementation of environment protection measures during the project periods based on the report of environmental impact assessment.
- To propose supplementary methods to minimize the new negative impacts to the environment that have not been predicted yet.

11.1. Institutional organizations for implementation of EMP

The project executing agency of the project is responsible for implementing the project in an environmentally responsible manner. In order to realize the above mentioned EMP related activities, the Project Supervision Consultant (PSC) who is employed by the executing agency will supervise the EMP implementation and periodically organize environmental monitoring.

The contractors shall implement necessary preventive and mitigation measures to ensure environmental protection during pre-construction and construction phases. Details of organizations and their responsibilities are described in Table 11-1.

Table 11-1. Roles and Responsibilities for Implementing the EMP

Organization	Responsibilities
The executing agency	– Prepare contractual requirements and ensure that contractors follow the EMP – Ensure that construction contractors implement mitigation measures via environmental protection provisions in construction contracts – Provide DONRE and JICA monitoring reports related to EMP implementation – Inform local authorities and communities on status of the project and EMP implementation – Coordinate with relevant parties in solving complaints from local people and authorities
Design Consultants	– Conduct design for the structures (flyovers, bus stations, depot, etc.) with consideration of proper drainage system, plants and green areas for noise and dust reduction, safety for passengers
Project Supervision Consultant (PSC)	– Conduct environmental monitoring for three phases of the project – Recommend additional mitigation measures during the construction stage, if necessary – Conduct monitoring of the contractor's environmental performance with regard to implementation of EMP provisions and prepare quarterly monitoring reports – Undertake regular spot inspections to ensure that the contractor is following the EMP, and advise the Project Director in case of any failures in the implementation

Organization	Responsibilities
	– Coordinate activities with the contractor and the executing agency
Contractors	– Implement environmental mitigation and preventive measures as described in the EIA report as well as additional measures as necessary or as required by the executing agency or PSC – Undertake regular site inspections to ensure best practices are used – Document and address comments or complaints from the local residents.
BRT Operator (in operation phase)	– Operate and maintain properly the structures in operation phase – Ensure environmental protection measures such as measures for controlling wastewater quality at the depot, traffic management, etc.

11.2. Implementation of environmental management plan

Table 11.2 shows the recommended environmental management plan (EMP) for the impacts assessed as "A-", or "B-" and "C-". The EMP includes the relevant recommended mitigation measures, organizations in charge of EMP implementation, organizations in charge of supervision the implementation of EMP, and financial sources.

Table 11.2 Environmental Management Plan（EMP）

Impact	Recommended impact mitigation measures	Implementing organizations	Supervision organizations	Financial sources
Construction stage				
1. Air pollution (B-)	1) Site inductions would be provided to make construction workers aware of air quality control practices and responsibilities. 2) Construction activities would be modified, reduced or controlled during high or unfavorable wind conditions if they would potentially increase off-site dust emissions. 3) Measures would be implemented to control dust emissions, such as the use of water carts, sprinklers, sprays and dust screens. The frequency of use would be modified in response to weather conditions. 4) Disturbed areas would be stabilized as soon as practicable to prevent or minimize windblown dust. 5) Controls, such as rumble grids or wheel wash facilities, would be implemented to minimize the tracking of dirt onto public roads. 6) Hardstand areas and surrounding public roads would be cleaned, as required. 7) Speed limits would be posted and observed by all construction vehicles on the construction site. 8) Haul trucks, plant and equipment would be switched off when not in operation for periods of greater than 15 minutes. 9) Construction plant, vehicles and machinery would be maintained in good working order and in accordance with manufacturers' specifications. 10) A formal dust observation program would be implemented during construction, involving daily reviews of weather forecasts, observations of meteorological conditions and on site dust generation. This would inform mitigation measures or alterations to construction activities to be implemented during unfavorable weather conditions (such as dry weather and strong winds).	Contractors	Binh Duong Province DOT / PMU / Construction Supervision Consultant	Project cost / contract cost
2. Wastes (B-)	1) No burning of debris, construction wastes or vegetation shall be allowed on-site. 2) Waste shall be segregated on-site to facilitate re-use, recycling, and collected and disposed by licensed companies.	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision	Project cost / contract cost

Impact	Recommended impact mitigation measures	Implementing organizations	Supervision organizations	Financial sources
	3) Raw material requirements shall be planned at the outset of each construction activity to avoid excess material storage and wastage on-site. 4) Wastes shall be stored and handled in dedicated areas with bounded sides such a way as to avoid loss or leakage and subsequent pollution. 5) The Contractor shall segregate construction waste materials on-site to facilitate re-use, recycling and waste disposal practice in accordance with the best available technology. 6) Contractor shall liaise with the Municipal Environmental Company of Binh Duong Province to determine the appropriate location for reuse. 7) Waste oils, chemicals, paints and other such materials used for machinery maintenance and construction shall be collected and stored in bundled areas on-site for resale/re-use or managed disposal. 8) In locations remote from the site offices the Contractor shall provide latrine pits in suitable locations for the convenience of the construction workforce. 9) Sewage from site toilets, kitchens and similar, shall be discharged to a septic tank and soak-away system. Grease traps shall be installed where canteen waste is collected.		Consultant	
3. Noise, vibration (B-)	1) Construction Noise and Vibration Management Plan would be prepared and implemented, and would include the following: ・ Identification of nearby residences and other sensitive land uses. ・ Description of approved hours of work. ・ Description and identification of all construction activities, including work areas, equipment and duration. ・ Description of what work practices (generic and specific) would be applied to minimize noise and vibration. ・ A complaints handling process. ・ Noise and vibration monitoring procedures. ・ Overview of community consultation required for identified high impact works. 2) Induction and training would be provided to relevant staff and sub-contractors outlining their responsibilities with regard to noise. 3) A protocol would be developed to identify the need for and provision of respite measures for residential receivers. Respite measures may include the restriction to the hours of construction activities resulting in impulsive or tonal noise (such as rock breaking, rock hammering, pile driving), or other appropriate measures agreed between the contractor and residential receiver. 4) Equipment would be regularly inspected and maintained to ensure it is in good working order. 5) Noisy equipment would be orientated away from residential receivers. 6) Where feasible and reasonable, the use of temporary noise hoardings would be considered where ancillary construction facilities are in proximity to sensitive receivers. 7) Noise monitoring would be conducted at the commencement of construction activities and periodically during the construction program.	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision Consultant	Project cost / contract cost
4. Local economy such as employment and livelihood (B-)	1) The contractors will be encouraged to employ project-affected residents and other local residents to work as construction worker. 2) Construction vehicle operation plan should be appropriately made, and routes for construction vehicles should be properly planned to mitigate impacts to local business activities.	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision Consultant	Project cost / contract cost

Impact	Recommended impact mitigation measures	Implementing organizations	Supervision organizations	Financial sources
	3) For proper control of traffic or when/ where necessary, flagmen shall be assigned to direct the movement of traffic on access roads to the construction site. 4) In order to minimize disruption to traffic flows the construction site shall be enclosed with temporary fence to provide a visual barrier between the construction site and adjacent traffic. 5) In case of blocking traffic for transport of heavy equipment the contractor shall inform and co-operate with local authorities and people in advance to minimize impacts to local traffic and local people.			
5. Existing social infrastructures and service (B-)	1) Construction vehicle operation plan should be appropriately made, and routes for construction vehicles should be properly planned to mitigate traffic jam on the local road network. 2) The relocation of electric cables, communication cables, water supply pipes, irrigation ditches, drainage gutters, etc. should be carefully planned and duly implemented so as these relocation works will not interrupt local residents' daily life activities and production activities for long time.	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision Consultant	Project cost / contract cost
6. Misdistribution of benefit and damage (B-)	1) Measures described in Items 1. & 3. & 5. above shall be implemented to mitigate impacts of dust, noise, traffic jam, etc., to residents who riside near the construction sites.	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision Consultant	Project cost / contract cost
7. Cultural, historical heritage (B-)	1) Measures described in Items 1. & 3. above shall be implemented to mitigate impacts of dust, noise, etc., to Ham An Pagoda and Doan Thi Diem Primary School.	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision Consultant	Project cost / contract cost
8. Working environment (including working safety) (B-)	The following measures should be taken by the Contractor during construction phase: 1) Provide construction workers with sufficient personal protection equipment (PPE) such as hard hats, earpiece, safety shoes, and others; 2) Provide seminars on safety issues for local public, particularly for school students; 3) Install warning signs whereas the potential dangers are present; 4) Erect temporary fence around high risk areas to control public access and light them at night if that is on the regular roads used by the locals; 5) Assign construction staffs on or near places where construction vehicles are crowded to ensure safety.	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision Consultant	Project cost / contract cost
9. Accident (B-)	1) The location of the bus stops, pedestrian crossings, and other safety auxiliaries should be properly designed to ensure traffic safety for pedestrians, and mitigate impediment to local resident movement. 2) Construction vehicle operation plan should be appropriately made, and routes for construction vehicles should be properly planned to avoid concentration of machinery and vehicles in limited roads. 3) For proper control of traffic or when/ where necessary, flagmen shall be assigned to direct the movement of traffic on access roads to the construction site. 4) In order to minimize disruption to traffic flows the construction site shall be enclosed with temporary fence to provide a visual barrier between the construction site and adjacent traffic. 5) In case of blocking traffic for transport of heavy equipment the contractor shall inform and co-operate with local authorities and people in advance to minimize impacts to local traffic and local people. 6) Drivers of vehicles bringing equipment and materials	Contractors	Binh Duong Province DOT / PMU/ Construction Supervision Consultant	Project cost / contract cost

Impact	Recommended impact mitigation measures	Implementing organizations	Supervision organizations	Financial sources
	should be properly trained to ensure that they observe the driving rules, driving routes, etc.			
Operation stage				
10. Water pollution (B-)	1) Plan to treat wastewater and waste oil from the depot project should be prepared to mitigate negative impacts to the surrounding ditchs, ponds, etc. 2) Domestic wastewater from the depot shall be treated by septic tank. Based on the estimated volume of wastewater at the depot in 2040, the capacity of the septic tank shall be more than 48 m3. 3) Wastewater generated from car washing that contains organic substances, oil and suspended solids shall be collected and screened to extract out solid wastes, before moving to a stabilization tank. Then wastewater shall be stabilized before being discharged into a flotation tank, where oil and suspended solids are removed. Then it shall be discharged into a coagulation and sedimentation tank with supporting of coagulating chemicals. The wastewater needs to be disinfected before discharged to drainage system. 4) Rain water from the ground of the depot shall be directly discharged to local drainage system. Solid waste on the ground shall be regularly cleaned to prevent pollutants from running into the drainage system and potentially cause water pollution.	Depot Management Company (under contract with BRT Operator)	Binh Duong Province DOT / BRT Operator	BRT operation cost
11. Wastes (B-)	1) Solid waste generated from the depot and bus stops should be properly collected and treated. 2) Hazardous wastes such as waste batteries, tires, oily waste, etc., generated from the operational and maintaining activities of BRT buses should be separated, collected, transferred and treated properly to avoid negative impacts on environment as well as public health.	Depot Management Company and BRT Operator	Binh Duong Province DOT / BRT Operator	BRT operation cost
12. Soil pollution (B-)	1) Measures described in Item 10 above should be duly implemented to prevent soil pollution caused by waste oil and polluted water from the depot.	Depot Management Company	Binh Duong Province DOT / BRT Operator	BRT operation cost
13. Noise, vibration (B-)	1) BRT buses should be regularly and properly maintained to keep the buses in good condition and reduce noise level at the sources (buses). 2) It needs to monitor the noise levels along the road, and take proper measures to mitigate impact of noise to the sensitive receptors, such as school, religious facility.	BRT Operator	Binh Duong Province DOT	BRT operation cost
14. Cultural, historical heritage (B-)	1) Regular monitoring of noise level near Ham An Pagoda (Hiep Thanh Ward) and Doan Thi Diem Primary School (Binh An Ward) should be conducted. Planting trees or installation of fences may be considered if the impact becomes seriously. 2) Examination of mitigation measures shall be consultated with affected people and local authorities where the excessive noise level is observed. 3) Use of horn shall be limited or prohibited at sensitive areas along the roads such as schools, pagodas.	BRT Operator	Binh Duong Province DOT	BRT operation cost
15. Accident (B-)	1) Bus drivers should be properly trained to ensure that they observe the driving rules, operate the bus in safety manner, etc.	BRT Operator	Binh Duong Province DOT	BRT operation cost

Source: JICA Study Team

12. Environmental monitoring plan (EMoP)

The purpose of the EMoP is to record and report on variations in ambient environmental quality indexes, and identify any outstanding issues and propose additional measures or retrofitting actions for improvement. The monitoring locations shall present physical and social characteristics. Ten (10) sampling sites are selected for the monitoring as they are representative for sensitive spots, residential areas and construction sites. The following table preliminarily propose environmental monitoring plan.

Table 12-1. Environmental monitoring plan

No	Item Monitoring	Construction Stage	Operation Stage
1	Air pollution	1) Monitoring location 10 sites as described in the note below 2) Monitoring frequency Every 3 months, during constrution period 3) Monitoring method TSP, CO, NO_2, SO_2, PM10, microclimate parameters Every 2hours in 16 hours from 6 a.m. to 10 p.m. Compared to criteria in QCVN 05:2009/BTNMT, QCVN 05:2013/BTNMT	1) Monitoring location 10 sites as described in the note below 2) Monitoring frequency Every 6 months, during 2 years 3) Monitoring method TSP, CO, NO_2, SO_2, PM10, microclimate parameters Every 2hours in 24 hours Compared to criteria in QCVN 05:2009/BTNMT, QCVN 05:2013/BTNMT
2	Water pollution (wastewater)	--	1) Monitoring location 1 site near the bus depot 2) Monitoring frequency Every 6 months, during 2 years 3) Monitoring method Temperature, pH, DO, SS, BOD5, COD, Coliform, oil content Compared to criteria in : a) QCVN 14 : 2008/BTNMT (National technical regulation on domestic wastewater) b) QCVN 29:2010/BTNMT (National Technical Regulation On the Effluent of Petroleum Terminal and Stations)
3	Wastes	1) Monitoring location At the waste storages around the construction sites, and at the waste dumping sites 2) Monitoring frequency Regular monitoring by CSC 3) Monitoring parameters The generated volume of wastes (waste soil and rock; demolition materials, domestic wastes, office wastes, etc.); The storage, collection, transportation and	1) Monitoring location At the waste storages in the bus depot, and around the bus stops 2) Monitoring frequency Periodic monitoring by BRT Operator 3) Monitoring parameters The generated volume of wastes (domestic wastes, office wastes, etc.); The storage, collection, transportation and disposal of.wastes

No	Item Monitoring	Construction Stage	Operation Stage
		disposal of.wastes Environmental conditions of the waste dumping sites	
4	Soil pollution	--	Similar to '2. Water pollution'
5	Noise, vibration	1) Monitoring location 10 sites as described in the note below 2) Monitoring frequency Every 3 months, during constrution period 3) Monitoring method Noise (Leq), Vibration (Laeq) Continuous 24 hours, every 2 hours/ time	1) Monitoring location 10 sites as described in the note below 2) Monitoring frequency Every 6 months, during 2 years 3) Monitoring method Noise (Leq), Vibration (Laeq) Continuous 24 hours, every 2 hours/ time
6	Local economy	1) Monitoring location Sampled business entities around the bus stops and flyovers 2) Monitoring frequency Every 3 months during the construction period 3) Monitoring method Interview based on monitoring format.	--
7	Existing social infrastructure and service	1) Monitoring location Relocation sites of electric cables, communication cables, water supply pipes, irrigation ditches, drainage gutters, etc. 2) Monitoring frequency Regular monitoring by PMU during the pre-construction phase 3) Monitoring method Conduct on-site observation on the relocation works.	--
8	Misdistribution of benefits and damage	1) Monitoring location Sampled households and business entities around the bus stops and flyovers 2) Monitoring frequency Every 3 months during the construction period 3) Monitoring method Interview based on monitoring format.	--
9	Cultural, historical heritage	--	1) Monitoring location Ham An Pagoda and Doan Thi Diem Primary School 2) Monitoring frequency Periodic monitoring by BRT Operator 3) Monitoring method Interview based on monitoring format.
10	Infectious diseases such	--	1) Monitoring location All commune health care stations along

No	Item Monitoring	Construction Stage	Operation Stage
	as HIV/AIDS		the BRT route. 2) Monitoring frequency Periodic monitoring by BRT Operator 3) Monitoring method Interview based on monitoring format.
11	Working environment	1) Monitoring location All construction sites and worker camps 2) Monitoring frequency Regular monitoring by CSC 3) Monitoring method Check reports on construction site management prepared by contractors Conduct on-site observation at the construction sites	--
12	Accidents	1) Monitoring location All construction sites 2) Monitoring frequency Regular monitoring by CSC 3) Monitoring method Check reports on working safety management prepared by contractors Conduct on-site observation around the construction sites	1) Monitoring location Traffic signs, signals, safety facilities, etc., along the BRT route 2) Monitoring frequency Periodic monitoring by BRT Operator 3) Monitoring method Check complaints raised by local residents Conduct on-site observation to check the conditions and performance of the traffic safety auxiliaries.

Note: Sampling sites:

- *Site 1: km00+000 MP-TV (starting point of My Phuoc –Tan Van Road)*
- *Site 2: km02+000 – Near Doan Thi Diem Elementary School*
- *Site 3: km07+000 –Near Tan Ninh Pagoda*
- *Site 4: km07+471 – Nguyen Thi Minh Khai intersection*
- *Site 5: km10+600 – Near An Phu Intersection*
- *Site 6: km11+950 – An Phu 16*
- *Site 7: km14+650 – Near DT746 Intersection*
- *Site 8: km17+870 – Near DT743 Intersection*
- *Site 9: km20+630 – Near Hoa An Pagoda*
- *Site 10: Near BRT Depot in Binh Duong New City*

The total cost for implementation of EMP and mitigation measures is presented in the following table (Detailed calculation is in the Appendix 5).

Table 12-2. Cost for implementation of EMP and mitigation measures

No.	Item	Implementation responsibility	Total cost	
			(VND)	(USD)
1	**Environmental monitoring program**	**Project executing agency/PSC**	**1,245,400,000**	**57,207**
1.1	Pre-construction phase	Project executing agency/PSC	119,800,000	5,503
1.2	Construction phase	Project executing agency/PSC	736,800,000	33,845
1.3	Operation phase	Project executing agency/PSC	388,800,000	17,859
2	**Cost for implementation of mitigation measures in construction phase**	**Contractor**	**2,835,000,000**	**130,225**
	Total cost		**4,080,400,000**	**187,432**