Bien Hoa - Vung Tau Expressway Company
Viet Nam

The Preparatory Survey on Bien Hoa – Vung Tau Expressway Project in Viet Nam

Final Report

April 2013

Japan International Cooperation Agency (JICA)

Japan Expressway International Company Limited
Central Nippon Expressway Company Limited
Sojitz Corporation
Nippon Koei Co., Ltd.
KRI International Corp

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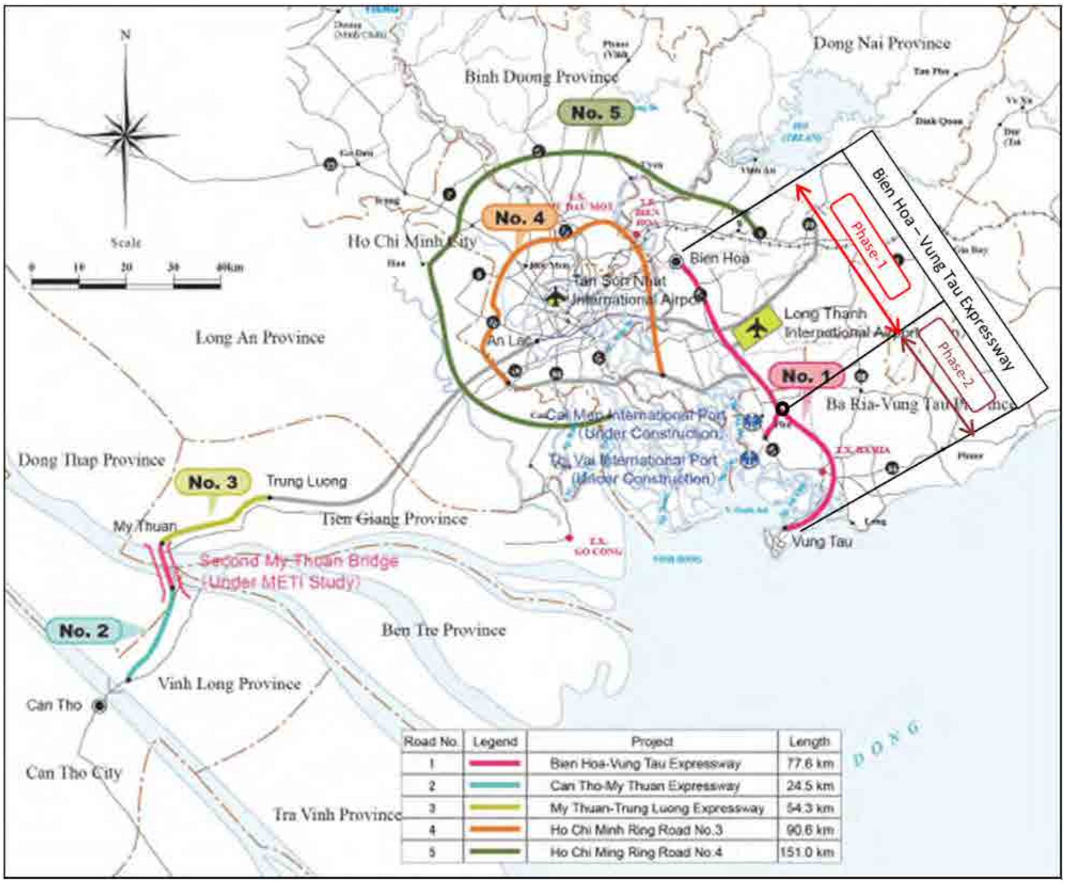

Study Location Map

The Preparatory Survey on Bien Hoa – Vung Tau Expressway Project

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FINAL REPORT

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
ADF	Asian Development Fund
BEDC	BIDV Expressway Development Company
BHVT	Bien Hoa – Vung Tau
BIDV	Bank for Investment and Development Company
BOT	Build Operate Transfer
BT	Build Transfer
BTO	Build Transfer Own
BVEC	Bien Hoa - Vung Tau Expressway Company
CCTV	Closed-Circuit Television
CPC	Commune People's Committee
DCC	District Compensation and Site Clearance Committee
D/D	Detail Design
D/E	Debt and Equity
DMS	Detailed Measurement Survey
DONRE	Department of Natural Resource and Environment
DPC	District People's Committee
DRVN	Directorate for Roads of Vietnam
DSCR	Debt Service Coverage Ratio
DSRC	Dedicated Short Range Communication
EA	Environmental Assessment
ECA	Export credit agency
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environment Management Plan
ENPV	Economic Net Present Value
EPC	Engineering, Procurement and Construction
ETC	Electric Toll Collection
F/C	Foreign Currency
FDI	Foreign Direct Investment
FIRR	Financial Internal Rate of Return
F/S	Feasibility Study
GDP	Gross Domestic Product
GGU	Government Guarantee and Undertaking

GRDP	Gross Regional Domestic Product
HCMC	Ho Chi Minh City
HCM-LT-DG	Ho Chi Minh-Long Thanh- Dau Giay
IC	Interchange
IDA	International Development Association
IDICO	Vietnam Urban and Industrial Zone Development Investment Corporation
IEE	Initial Environmental Examination
IOL	Inventory of Loss
IRP	Income Restoration Program
IRR	Internal Rate of Return
ITS	Intelligent Transport Systems
JBIC	Japan Bank for International Cooperation
JCT	Junction
JICA	Japan International Cooperation Agency
JV	Joint Venture
L/A	Loan Agreement
L/C	Local Currency
LURC	Land Use Right Certificate
MOC	Ministry of Construction
MOF	Ministry of Finance
MONRE	Ministry of Natural Resource and Environment
MOSTE	Ministry of Science, Technology and Environment
MOT	Ministry of Transport
MOU	Memorandum of Understanding
MPI	Ministry of Planning and Investment
NEXI	Nippon Export and Investment Insurance
NH51	National Highway 51
OBU	On Board Unit
OCR	Ordinary Capital Resource
OD	Origin and Destination
ODA	Official Development Assistance
O&M	Operation and Maintenance
PCMs	Public Consultation Meeting
PCU	Passenger Car Unit
PMU	Project Management Unit
PPC	Provincial People's Committee
PPP	Public and Private Partnership

Project IRR	Project Internal Rate of Return
PSIF	Private Sector Investment Finance
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
SA	Service Area
SBV	State Bank of Vietnam
SCF	Standaed Conversion Factor
SKEZ	Southern Key Economic Zone
SPC	Special Purpose Company
STRADA	System for Traffic Demand Analysis
TEDI	Transport Engineering Design Inc
TOR	Terms of Reference
USD	United States Dollar
VAT	Value Added Tax
VEC	Vietnam Expressway Company
VGF	Viability Gap Fund
VITRANSS	The Comprehensive Study on the Sustainable Development of Transport System in Vietnam
VND	Vietnamese Dong
WB	World Bank
WG	Working Group

1. Introduction

1.1. Background and Objectives of the Study

1.1.1. Background of the Study

Road plays an important role in the transportation system in Vietnam. According to transport statistics on different transport modes (road, railway, inland water transport, coastal service, air service) in 2008, road transportation accounts for 72.9% of all freight transport and 91.7% of all passenger transport. However, existing road network is not sufficient to accommodate rapid increase in traffic volume, generated by the recent economic growth in the country.

The Government of Vietnam (hereinafter GOV) gives priority to transport infrastructure development as the most important subject in "the 9th social economic development 5-year plan (2011-2015)". Accordingly, development projects on large-scale transport infrastructures such as airports, seaports, expressway, urban railways, have been implemented.

As for the expressway, "Expressway Development Plan (master plan)" established by Ministry of Transport (hereinafter MOT) was approved by the Prime Minister (PM) in December 2008. In the master plan, implementation plan of 39 sections (5,873 km in total) of expressways were established, while 2,235 km of 5,873 km were planned to be completed before 2020.

The southern part of Vietnam, the subject area of the Project, is a booming area of the country where the country's economic center Ho Chi Minh City and its suburban industrial parks are located, but the infrastructure development sufficient to support such rapid progress is still behind.

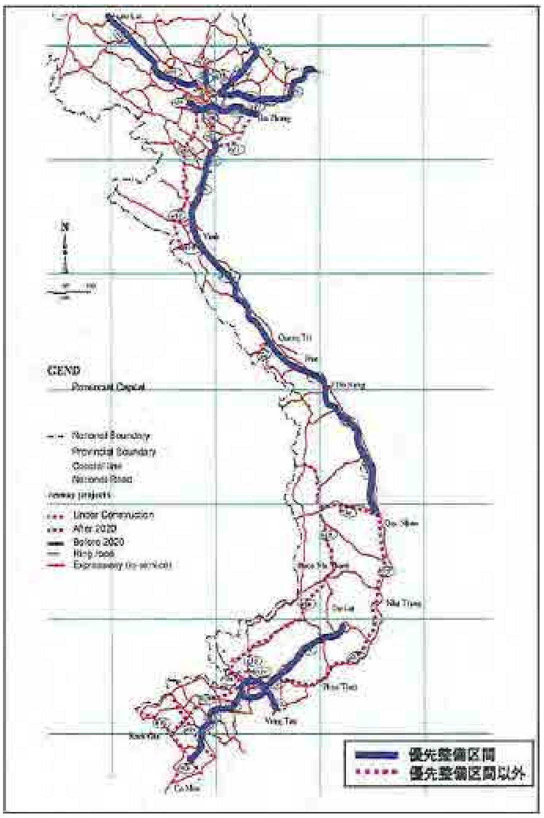


Figure 1.1.1-1 Expressway Master Plan (Decision 1734)

GOV is reinforcing their effort to construct more expressways, with the high priority put on construction of the north-south expressway that runs through the country.

Planned to be 3,236 km in total length, this north-south expressway will connect Hanoi and Can Tho along National highway No. 1, and the section connecting major cities such as Hanoi, Ho Chi Minh and Da Nang is particularly regarded highly important.

In accordance with the present status and development policy for the transport infrastructure development mentioned above, Japan International Cooperation Agency (hereinafter JICA) conducted "The Comprehensive Study on the Sustainable Development of Transport System in

Vietnam (hereinafter VITRANSS 2)"(November 2007 – May 2010) to support the development of the overall transport sector master plan covering all transportation sectors in Vietnam. For the expressway development sector, VITRANSS 2 supported the formulation of "North-South Expressway master plan". Consequently, its preliminary feasibility study was carried out.

Table 1.1.1-1 Discription of The Comprehensive Study on the Sustainable Development of Transport System in Vietnam (VITRANSS 2)

Item	Details
Objectives	Based on requests from Vietnam, formulating and proposing the following in the shipping and transportation field: (i) a long-term (through 2030) development strategy in the shipping and transportation field, (ii) a medium-term (through 2020) master plan, and (iii) a short-term (through 2015) investment plan. Through doing so, making clear the means by which Vietnam can proceed with development of a shipping and transportation network with a balance between optimal use of existing facilities and new construction, under conditions of limited resources. Also, as part of these efforts preparing a master plan and preliminary feasibility studies for priority sectors on the North–South Expressway project and formulating a basic plan (outline study) for the North-South High-Speed Railway project, both of which were requested in an October 2006 Japan-Vietnam Joint Statement.
Subjects of Study	1. Reviewing and collecting information on existing plans, laws, regulations, etc. concerning the transportation sector as a whole 2. Socioeconomic survey and transportation (passenger, freight) demand forecasting 3. Based on item 2 above, formulating long-, medium-, and short-term shipping and transportation development plans 4. Formulating a master plan for the North–South Expressway network consistent with items 2 and 3 above 5. Formulating an outline study of plans for the North–South High-Speed Railway consistent with items 2 and 3 above
Outputs	Planning ・ Formulating a sustainable shipping and transportation development strategy (target year: 2030) ・ Formulating a shipping and transportation master plan (target year: 2020) ・ Formulating priority investment programs (target years: 2011 – 2015) ・ Outline study of plans for the North–South Expressway project ・ Formulating a master plan for the North–South Expressway network

	(including preparation of preliminary feasibility studies for priority sectors)
Details in the Expressway Field	The following activities will be conducted in formulating a master plan for the North–South Expressway network: 1) Formulating plans for expressways and facilities 2) Formulating investment plans and organizational plans toward completion of the expressway network 3) Confirmation and classification of Vietnamese legal systems related to environmental and social considerations and methods of implementing a strategic environmental assessment (hereinafter SEA) 4) Studying sustainable toll systems, maintenance methods, and the possibility of private-sector participation 5) Choosing priority projects 6) Implementing studies at the preliminary feasibility study level 7) Conducting a survey of environmental and social considerations
Outline of Study Findings	1. Demand forecasts: Transportation and shipping demand in Vietnam will increase massively through 2030. Passengers and cargo tonnage per kilometer are projected to rise by 700 – 800% in comparison with 2008. This will bring about an excess of passengers and road use exceeding capacity in many areas, with the regular railways in the Hanoi and Ho Chi Minh City areas unable to accommodate demand and insufficient capacity at airports in Hanoi, Da Nang, and Ho Chi Minh City as well. Similarly, for freight transportation as well demand is rising rapidly for rail transport and transport on inland waterways, with many ports exceeding capacity, particularly in the Mekong Delta and elsewhere. 2. Proposal of plans Development of a multimodal transportation and shipping network at the national and international level is proposed, including effective linkage of local transportation and shipping networks with regional- and national-level transportation and shipping systems. Under VITRANSS 2, a comprehensive long-term general development strategy is being proposed for the transportation and shipping field through the target year of 2030, a comprehensive medium-term general plan is being formulated for transportation and shipping through the target year of 2020, and short-term investment plans, a general plan for the North-South Expressway network, and an initial plan for the North-South High-Speed Railway are being formulated for the years 2011 – 2015, among other activities. However, fulfillment of these objectives will involve considerable costs. According to JICA estimates,

	Vietnam's multimodal transportation and shipping development program through 2030 consists of a total of 396 projects requiring USD 166,753,000,000 (estimated at 2008 values). Specifically, the VITRANSS 2 proposal calls for implementing 210 projects from now through 2020 (including 131 transportation and shipping projects approved by the government), for a total investment amount of USD 49,071,000,000. When the two segments of the North-South High-Speed Railway to be completed by 2020 (Ho Chi Minh City - Nha Trang, Hanoi – Vinh) are included, the total investment amount rises to USD 70 billion. While these projects are included in the Vietnamese government's long-term transportation development goals, to increase their feasibility there is a need for numerous additional analyses of their economic potential and of public finances. JICA is researching 44 expressway projects expected to open to traffic in 2020. Among these, the projects that would have the greatest economic impacts are the Bien Hoa – Vung Tau, Cau Gie – Ninh Binh, Vinh – Ha Tinh, Ho Chi Minh City – Moc Bai, Long Thanh – Ben Luc, Ho Chi Minh City – Dau Giay, Ninh Binh – Thanh Hoa, Ho Chi Minh City – Trung Luong, Lang – Hoa Lac, Hanoi Ring Road No. 4, and Ho Chi Minh City Ring Road No. 3 routes. In addition, north-south transport and transport in the Mekong Delta can be facilitated and chaotic transportation conditions avoided by advancing expressway development together with the development of inland waterways. This is recommended as a way of making a significant contribution to Vietnam's future economic development.

Source : JICA VITRANSS2

As a result of the preliminary feasibility study by VITRANSS 2, necessary budget for the development of North-South Expressway network was estimated to be about USD 66 billion. Projects for implementation which has been approved by GOV are estimated to be about USD 12 billion and most of the required funding needs support from Official Development Aid (hereinafter ODA) of Japanese government, World Bank(hereinafter WB), Asian Development Bank(hereinafter ADB) and so on. The rest of the USD 54 billion should be secured from various financial sources. Since it is difficult for the project to be subsidized only by the public funds from GOV and ODAs, it is strongly expected to mobilize private sector investment.
For the introduction of private sector investment, it is necessary to study the case of 100% private investment (Build-Operate-Transfer hereinafter BOT) and public-private-partnership (hereinafter PPP) investment. VITRANSS 2 suggested the possibility of implementing many

projects through PPP, and emphasized that further detailed study is necessary in order to materialize a concrete business model of PPP and its practical implementation process.

On the other hand, requests have been made from GOV and project implementing organizations for provision of support to survey on the Bien Hoa - Vung Tau Expressway (hereinafter BHVT Expressway). In particular, there is a high industrial intensification along the BHVT Expressway, with many industrial parks located in the area. This expressway will also form an expressway network together with an expressway linking Ho Chi Minh - Long Thanh - Dau Giay Expressway, which is currently under construction, and the Ho Chi Minh Ring Road No. 3 and 4 and is therefore expected to play the most important role in boosting up the national economic growth. Considering this, this project has a high necessity.

The Feasibility Study on Private Investment in Highway Projects in Southern Vietnam (hereinafter the Preliminary Survey) conducted in June 2011 given those circumstances also identified this project as one of high priorities for investment.

Table 1.1.1-2 Discription of the study on measuring the possibility of private investment in expressway projects in Southern Vietnam (the Preliminary Survey)

Item	Details
Objectives	This study will verify whether it would be possible to promote development of Vietnam's expressway network entirely through private-sector financing, what kind of PPP options are available if full private-sector financing were difficult, and project feasibility through the PPP method, to examine the possibility of private-sector investment in expressway development based on the conclusions and recommendations of VITRANSS2 In consideration of the facts that the Vietnamese government has made a strong request for aid, that freight and passenger volume have increased rapidly in recently years on main roads centered on Ho Chi Minh City, and that greater private-sector investment could be expected in Ho Chi Minh City due to its role as the economic center of Vietnam, this study will be implemented with a focus on five expressway projects in southern Vietnam, centered on Ho Chi Minh City.
Subjects of Study	1. Collecting basic information on private-sector investment in expressway projects in Vietnam 2. Study and recommendations concerning risks and security packages when implementing expressway projects in Vietnam through private-sector initiative or the PPP method. 3. Studying the feasibility of individual expressway projects through private-sector initiative or the PPP method (subject projects: Bien Hoa – Vung Tau expressway project, Can Tho – My Thuan expressway project, My

	Thuan - Trung Luong expressway project, Ho Chi Minh City Ring Road No. 3 route, Ho Chi Minh City Ring Road No. 4 route). 4. Conducting studies to supplement the feasibility studies 5. Sorting out the issues related to implementing project schemes through private-sector initiative or the PPP method.
Outline of Study Findings	The study has concluded that use of private-sector investment would be sufficiently feasible for the BHVT expressway project. However, the government would need to commit to conditions such as aid, incentives, and guarantees. Also, a JICA PSIF loan is an essential condition, and it is thought that without the leverage effects of such a loan use of private-sector investment would be difficult.

Source: The Preliminary Survey

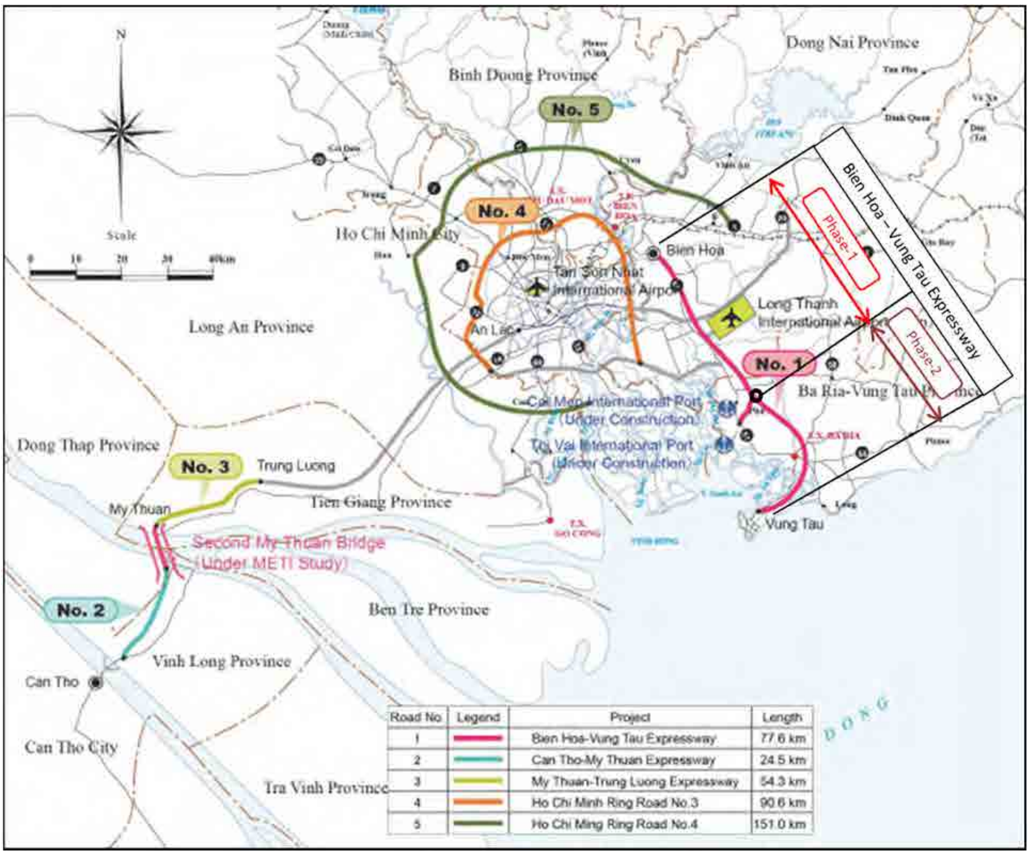
1.1.2. Objectives of the Survey

The objects of the Study are to organize tasks necessary to promote the expressway project using the private finance scheme; conduct (1) formulation of the project implementation plan, (2) survey and review on project viability and profitability improvement, (3) implementation of basic design with improvement of project profitability taken into consideration, and (4) survey on environmental and social considerations; and formulate the optimal overall implementation plan and propose a private participation scheme for submission to the stakeholders in Japan and Vietnam, thereby promoting consensus building of all the stakeholders.
With respect to proposal of a private participation scheme, a project that uses a project scheme, in which the entire project including construction and operation of all necessary infrastructures is implemented by a private project while mobilizing investments and loans from public organizations, and capitalizes on ODA funds including JICA Private Sector Investment Finance(hereinafter JICA PSIF) .

1.2. Study Area and Scope of the Study

1.2.1. Study Area

The subject area is the southern part of Vietnam, as shown in the layout map below.



Source: JICA Pre-F/S

Figure 1.2.1-1 Study Area of the Study

1.2.2. Scope of the Study

1.2.2.1. Subjected Project on the Study

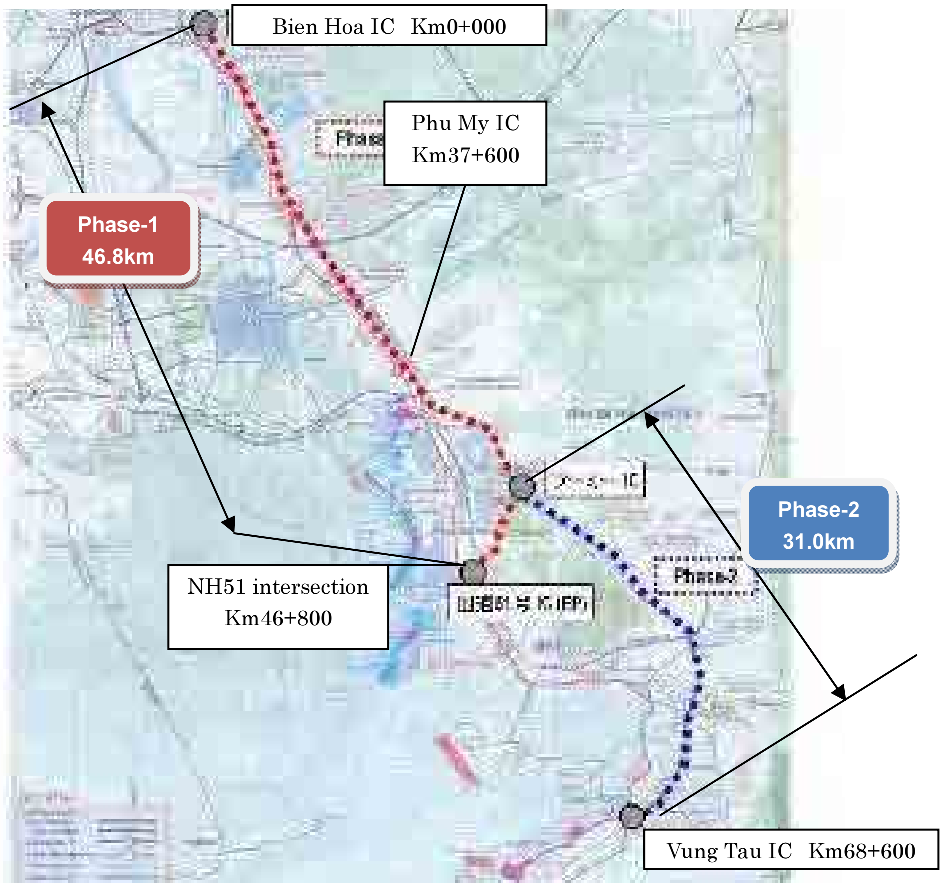
The subject expressway project, BHVT Expressway, is composed of two sections, one from Bien Hoa IC to Phu My IC and National Highway 51 (hereinafter NH 51) intersection (Phase 1) and Phu My IC to Vung Tau IC (Phase 2).

With respect to setting of those sections, it was judged that Phase 2 Section, which is found to main serve sightseeing transportation by the Preliminary Survey, will make no profitable business that justifies private investments. Thus, Phase 1 Section is chosen as the subject of feasibility study for private investment based on the consultation with the Vietnamese supervising agency, MOT and the implementing organization Bien Hoa - Vung Tau Expressway Development Corporation (hereinafter BVEC) as this section will serve an artery linking Ho Chi Minh City, its suburban industrial parks and the Cai Mep - Thi Vai International Terminals. Therefore, Phase 1 Section (Bien Hoa IC - Phu My IC and NH 51 intersection), which is judged to be feasible as a private investment project, is the subject of project viability in this Study.

For Phase 2 Section considered not an appropriate commercial project that can beckon private investments (from Phu My IC to Vung Tau IC), it is basically regarded as a public works project using governmental funds including ODA.

1.2.2.2. Description of the Project

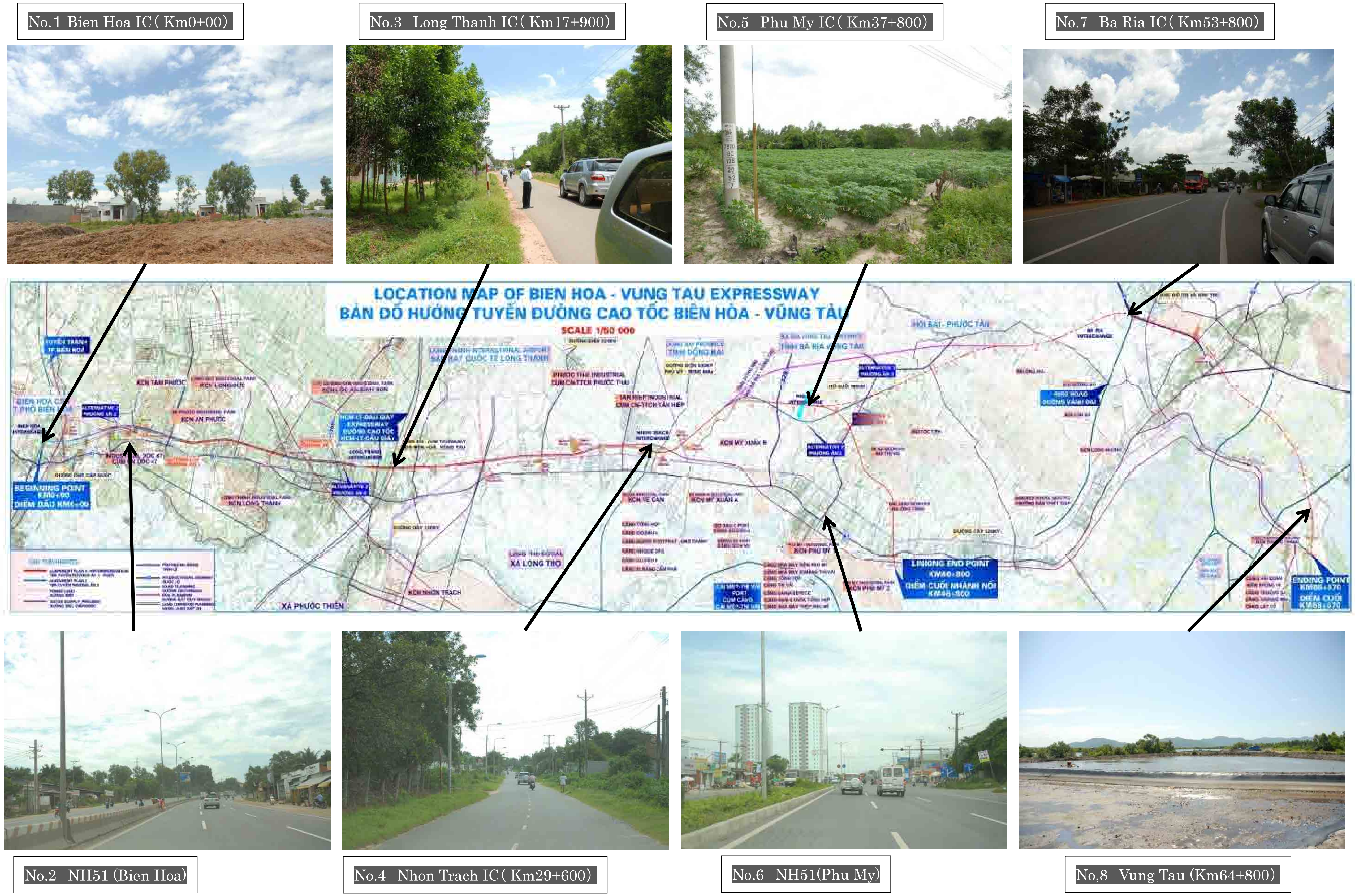
The outline of Phase 1 and Phase 2 is shown below.



Source: BVEC F/S

Figure 1.2.2-1 Route Map of Bien Hoa-Vung Tau Expressway

Figure 1.2.2-2 Route map and pictures of Bien Hoa-Vung Tau Expressway



Soource: JICA Study Team

Table 1.2.2-1 Description of the BHVT Expressway Project

Route	Bien Hoa-Vung Tau Expressway			
Project section	Phase1		Phase2	
	Bien Hoa IC to Phu My IC	Phu My IC to NH51 intersection	Phu My IC to Vung Tau IC	Vung Tau IC to NH51C intersection
Implementer	BVEC		MOT/PMU (expected in case it is implemented as ODA project)*	
Project method (current)	BOT		Not yet determined (public works project)*	
Road standard	Expressway Class A	National Highway Class II	Expressway Class A	Urban Road
Design speed	120km/h	100km/h	120km/h	80km/h
Length	37.6km	9.2km	28.4km	2.6
No. of lanes	4 (when opened)	4 (when opened)	4	4
	6 to 8 (when fully completed)	6 (when fully completed)		

Source：BVEC F/S

Table 1.2.2-2 Tentative schedule of the implementation Project

No.	Year	2012	2013	2014	2015	2016	2017	2018	2019	2020
A	Phase 1 Section (Bien Hoa-Phu My) Project will be conducted as a private project									
A100	Formulation of the Project implementation SPC Establishment	■	■							
A200	Land Acquisition			■	■					
A300	Detailed Design		■	■						
A400	Procurement of contractors				■					
A500	Construction				■	■	■	■		
A600	Open to the Public							■		
B	Phase 2 Section (Phu My- Vung Tau) Project will be conducted as a public works									
B100	Confirmation of the methods of preparatory study for implementation of Phase 2	■	■							
B200	Preparatory Study for using ODA loans		■							
B300	Loan Agreement (ODA)			■						
B400	Detailed Design			■	■					
B500	Land Acquisition			■	■	■				
B600	Procurement of contractors					■				
B700	Construction						■	■	■	
B800	Open to the Public									■

Source：JICA Study Team

1.2.2.3. Contents of the Study

The contents of the Study described in the Terms of Reference are shown below:

Table 1.2.2-3 Contents of the Study

Contents of the Study
1. Preparation
2. Reconfirmation of the necessity and background of the Project
3. Formulation of Project implementation
(1) Confirmation of the purpose of the Project
(2) Review of the scope of the Project
(3) Review of the scheme of the Project
(4) Economic and financial analysis
(5) Review of risks and security packages related to implementation of the Project
(6) Options of government support
(7) Project Implementation system and planning
(8) Scheduling of the Project Implementation
4. Survey and review on project viability and profitability improvement
(1) Demand Forecasting for the Project
(2) Transportation Planning
(3) Study for Promotion of Utilization
5. Basic Design for higher viability
(1) Basic Design
(2) Construction Plan
(3) Operation and maintenance plan
(4) Calculation of the preliminary project cost
6. Project viability of Phase 2 Section (from Phu My to Vung Tau)
(1) Sort-out of policies about the entire project of Bien Hoa – Vung Tau Expressway
(2) Confirmation of the methods of survey and review necessary for implementation of Phase 2 Section
7. Survey on Environmental and Social Considerations

Source：JICA Study Team

This is a Preliminary Survey for realization of the construction of the Expressway as a viable project using a business scheme that justifies private investments.

(1) Formulation of a feasible business implementation plan

For this Study, the basic purpose is to implement the construction of Phase 1 Section as a project scheme that utilizes Japanese and Vietnamese private funds. In this respect, a project implementation plan is expected, which realizes consensus building of the related stakeholders by analyzing as quantitatively as possible the risks that were qualitatively identified by the previous year's Preliminary Survey, identifying hidden risks as much as possible, reducing the risks by taking every possible measure, and implementing appropriate allocation of work among private and public participants, risk reduction particularly with the help of governmental support, and appropriate risk allocation.
It is also necessary to establish a project scheme that clearly justifies participation of Japanese investors and create profits for relevant Vietnamese organizations, which hold the original right of project, by working together with the Japanese participants through the said project scheme. Considering those circumstances, in order to review a project scheme that guarantees mutual profits for the government (MOT) and private businesses, a project implementation system that reflects the allocation of work among the public and private participants and the appropriate fund-raising plan will be established while maintaining consistency with Vietnam's legal system and existing contracts. In addition, methods to cope with major risks will be studied, and feasible government support measures will be proposed.

1) Maintenance of consistency with the Vietnamese legal system and existing contracts

It is necessary to provide support that is based on the laws of Vietnam in order to promote an infrastructure project in which private businesses participate.
Vietnam has two laws related to this Project, or BOT Law and Pilot PPP Law.
A viable project scheme utilizing private funds while maintaining consistency with those laws will be proposed.

2) Allocation of work among public and private participants

The allocation of work among public and private participants is shown in the following:

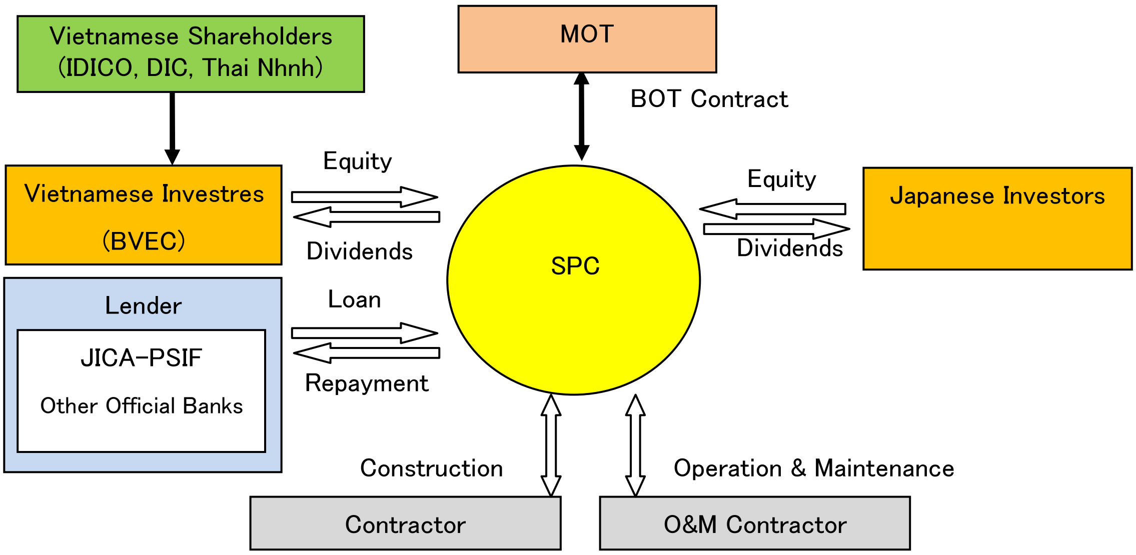
Table 1.2.2-4 Allocation of work among the public and private (proposed)

Public roles （MOT）	Private roles （SPC including BVEC)
• Granting of the project right • Acquisition of land • Support of negotiation with relevant governmental agencies • Preservation of the right to collect tolls • Role as the supervising administration of business implementers (SPC) (including approval of toll revision) • Permission of exchange of project profits in foreign currency and relocation of the profits out of the country	• Procedures necessary for implementation of BHVT Expressway Project • Efficient project promotion for design, construction, operation and maintenance • Provision of quality service to expressway users through project implementation

Source：JICA Study Team

3) Proposal of project implementation system

The proposed project implementation system is shown below:



Source：JICA Study Team

Figure 1.2.2-3 Proposed project implementation system

Special Purpose Company (hereinafter SPC) is the very organization that implements the Project; it should serve as a united body of Japanese and Vietnamese private investors including BVEC and carry out the Project under a BOT contract with MOT. It will also procure funds from public financing institutions including JICA and Japanese and Vietnamese private banking facilities. SPC will conduct general management, covering survey, design, procurement, construction, construction management, maintenance, property management and operation that is necessary to cover all services of BHVT Expressway including construction, operation and maintenance. After the expiration of the contract, SPC will be disbanded as per the BOT Law and transfer all its properties to MOT.

4) Financing

It is hoped that financing to be conducted by the financial analysis of the private part (SPC) will be essentially project financing by means of syndicated loans with private banks. But considering the present severe financial condition triggered by Europe's credit crisis and particularly European private banks' reluctance to grant loans, we should practically have no choice but to procure the amount equivalent to 80% of the project fund by PSIF loans by JICA.

5) Proposal of major methods to cope with risks

There are various risks expected to occur with respect to implementation of the Project. For qualitatively and quantitatively analyzed, examined and identified risks, it is necessary to discuss and determine how to share what risks among the funding stakeholders, or MOT, SPC, and sponsors and how to control them. It is then important to incorporate the results of such discussion into various pacts, agreements and contracts and come up with a security package that is acceptable to financiers. Although the Study does not include preparation of documents, it will check the items and contents to be included in those documents.

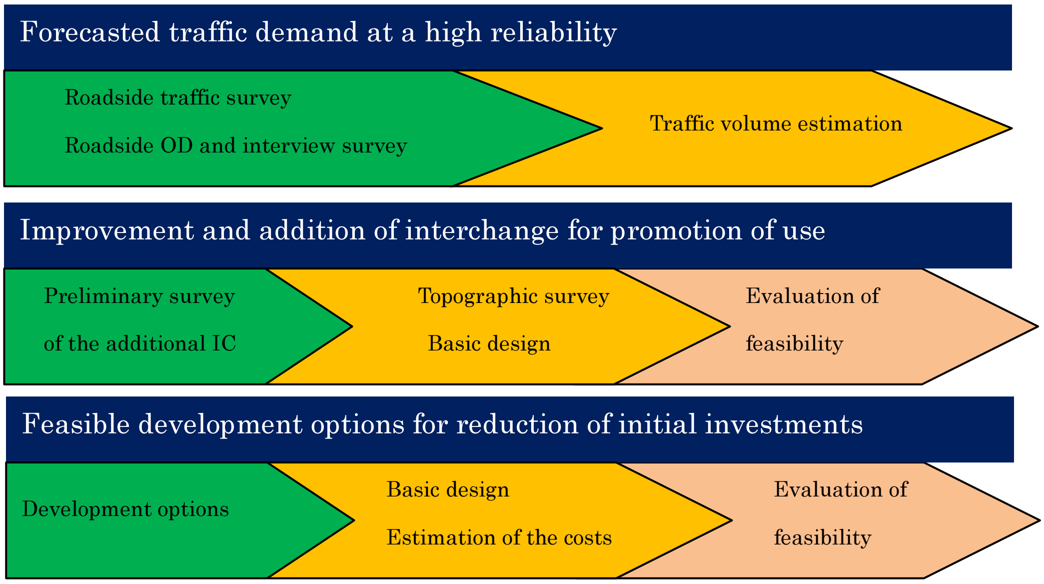
6) Review of feasible government support measures

If risk analysis reveals risk factors that cannot be taken by the private sector, government support to provide risk avoidance will be requested. In this respect, government support options that can be available as per the new BOT Law and pilot PPP Law will be clarified. It is also necessary to evaluate the benefit of each support option, such as which option will make how much contribution to the betterment of the cash flow, in conjunction with financial analysis.

Based on that evaluation, optimal government support plans will be selected from the viewpoint of the level of contribution to project profitability and the degree of the government's financial burden.

(2) Implementation of survey and review for improvement of project viability and profitability

Estimation of traffic demand is one of pivotal factors for judgment on investment or loan when it comes to formulation of the appropriate project implementation plan and consensus building of private investors, financial institutions and other stakeholders about project participation. The Study will forecast traffic demand at a high reliability in order to conduct quantitative evaluation of economic efficiency of the Project necessary for judgment on investment or financing. In addition, since it is necessary to meet the demand of the stakeholders for further improvement or project profitability, feasible development options will be studied, including promotion of use by improvement or addition of interchanges or reduction of initial investments.

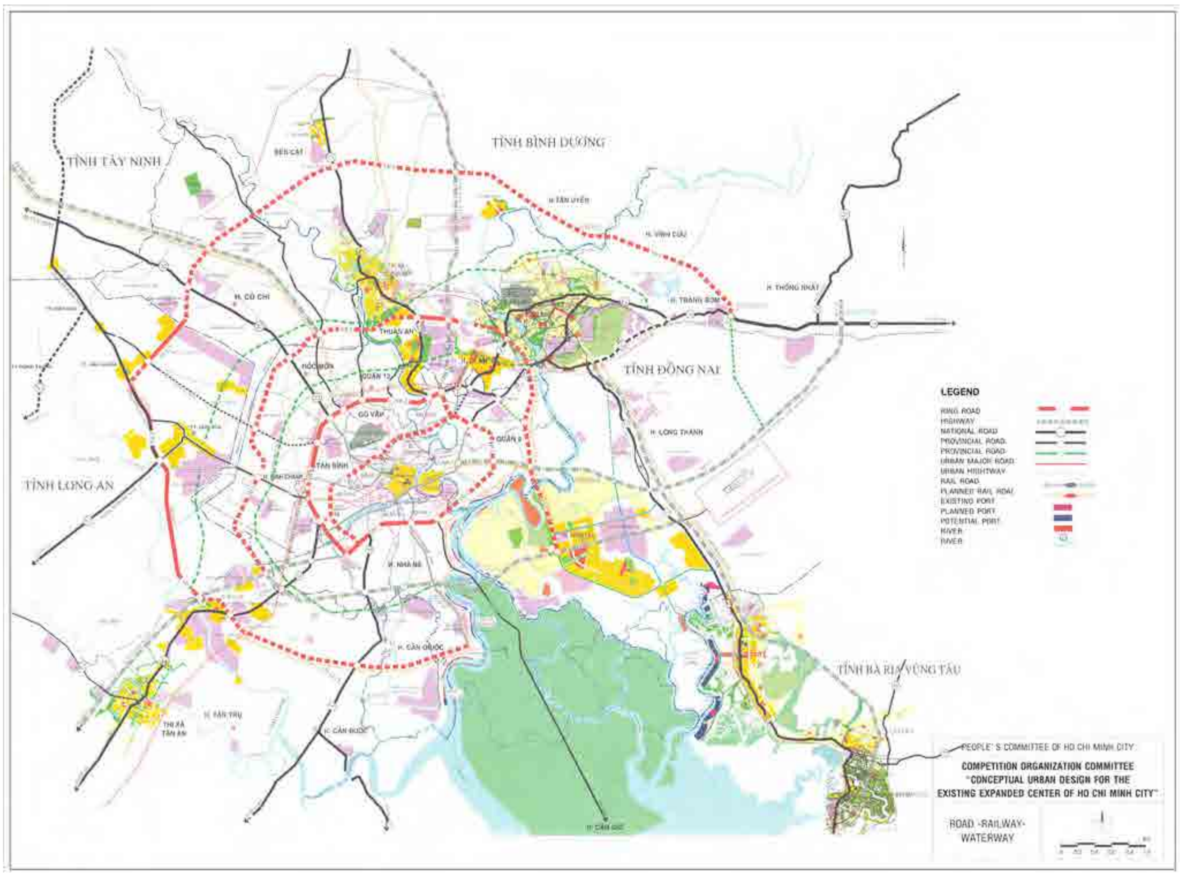


Source：JICA Study Team

Figure 1.2.2-4 Work flow for survey and review of project viability and profitability improvement

1) Implementation of highly reliable traffic demand forecasting

In forecasting of traffic demands that greatly affect the project profitability, a complementary traffic survey will be conducted including a detailed interview survey with people working in industrial parks located along the route and with port and harbor operators, and then accurate forecasting from the viewpoint of the private investors will be conducted. To be specific, new traffic demands from large-scale projects including the Long Thanh International Airport and Cai Mep - Thi Vai International Terminals and many industrial parks both existing and being planned along the route will be anticipated. On the other hand, many factors that will have a major impact on traffic demand forecasting such as the expressway network and the plans to build roads that may become competitors of the Project road will be examined for reflection in traffic demand forecasting.



Source : HCMC People's Committee

Figure 1.2.2-5 Transport planning of Hochi Minh City Area

2) Review of promotion of use by improvement or addition of interchanges to be constructed

The existing road plans will be scrutinized, and addition or improvement of interchanges (hereinafter IC) and junctions (hereinafter JCT) to be constructed in the Project will be proposed to enhance profitability by use promotion and to improve operation and maintenance.

Table 1.2.2-5 Proposal on addition and improvement of interchanges and junctions, etc.

Number	Proposal
1	**Construction of additional interchange between Bien Hoa IC and Long Thanh JCT** Around the area between Bien Hoa IC and Long Thanh IC, there are industrial parks and many villages. The interval of interchange is as long as 17.8 km. It is expected that adding a new IC would increase traffic demand.
2	**Raising the road grade of Phu My IC - NH51 intersection (connecting to Cai Mep - Thi Vai Ports)** This section has been developed as an ordinary national toll-free highway (design speed: 100km/h). In Phase 1, an intersection will be added to provide access to side roads. The plan also shows that a guardrail will be placed along the paved road and motorcycles will then be permitted to drive on the shoulder of the road. This section will therefore be upgraded to the superior class of toll expressway (120 km/h),

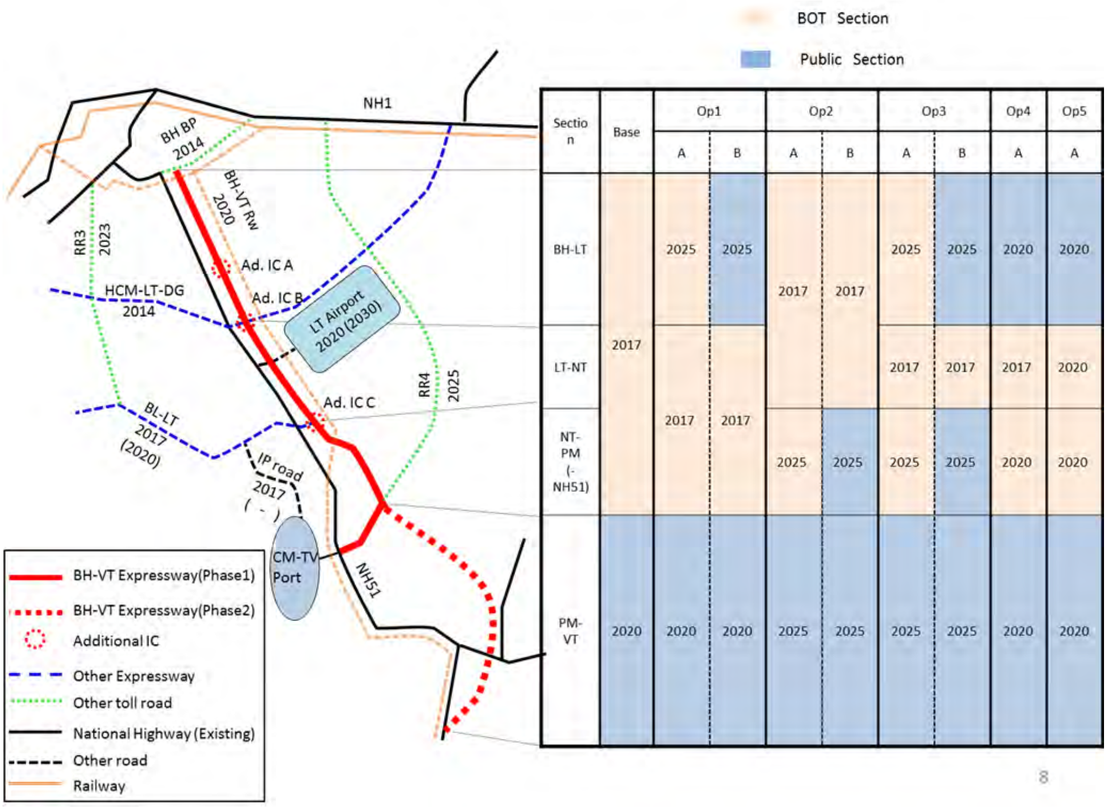
Number	Proposal
	equivalent to the section between Bien Hoa IC and Phy My IC, to increase the running speed and traffic safety. With this upgrade, there will be some changes in the type of Phy My IC (JCT) (connection method): the route for the Nhon Trach JCT - NH51 intersection will be the main line and the route for the Baria IC - NH51 intersection will be a ramp way. In consideration of the connection between this JCT and HCMC Ring Road No. 4, a future change to the four-way system is necessary.
3	**Construction of temporary Nhon Trach IC** Nhon Trach JCT, which connects BHVT Expressway to Ben Luc - Long Thanh Expressway, will be constructed in Phase 2 under the Ben Luc - Long Thanh Expressway Project. Because this junction cannot be ready by the time the BHVT Expressway is completed, a temporary IC connecting to ordinary roads will be constructed to improve traffic demand and traffic control and maintenance.

Source: JICA Study Team

3) Proposal of development options

Feasible development options (including section separation or the number of lanes to build) shown in the following table will be evaluated and compared with the existing basic development plan so as to verify the Basic Approaches.

Development options (base)	Phase1(BOT) Bien Hoa-Phu My-Nh51 intersection, 4lanes, open to the public in 2017 Phase2(Public works) Phu My-Vung Tau, 4lanes, open to the public in 2020



Source: JICA Study Team

Figure 1.2.2-6 Development options

(3) Implementation of basic design with improvement of project profitability taken into consideration

Since it will be necessary to verify the measures to promote use of the expressway and to reduce investment cost proposed in 1.2.2.3(2), basic design with those proposals fully considered will be implemented, efficient construction programs and operation and maintenance programs that match the sustainable road characteristics will be developed, and the preliminary project cost necessary for economic and financial analysis will be calculated.

1) Implementation of basic design based on the use promotion measures and profitability improvement plans

The basic design will be based on the plans to improve profitability, such as the use promotion measures to be proposed in 1.2.2.3(2) and re-evaluation of the originally planned number of lanes, which was studied in the Preliminary Survey as a measure to reduce the initial investment. The design will also ensure efficient accommodation of future demands and changes such as expansion of the road width or connection to other road routes.

2) Development of efficient construction plan

According to the Preliminary Survey, the feasibility study report does not contain detailed descriptions on construction planning. Since it will be a private initiative, reduction in the period of construction and acceleration of opening to the traffic will help improve project profitability. On the contrary, construction work behind schedule will mean deteriorating profitability. Therefore, work delay risks will be identified, and preventive measures be proposed.

3) Development of operation and maintenance plans that match the sustainable road characteristics

The Study will analyze the available information including past surveys, determine specific operation and maintenance services that are considered to be absolutely essential, efficient and suited to the road characteristics in terms of operation and maintenance of the Expressway with high-speed traveling and safety taken into consideration, and clarify the contents of those services and their level based on the assumption of phased development. The Study will also include reviews on considerations in the stage of design and construction and incorporate them into the outline design of the Study as required.

4) Calculation of the rough project cost

Construction cost as per the outline design created based on the use promotion measures and profitability improvement plans will be revised. The rough cost will also be calculated for project cost items assuming the use of BOT/PPP project approach, and the calculated cost will be input to economic and financial analysis.

(4) Support of review on project viability of Phase 2 Section as a public works project

The Study puts top priority on promotion of project viability of Phase 1 Section using the private investment scheme. For Phase 2 Section of which project realization with private investment is considered difficult and which is to be promoted as a public works project by GOV using ODA funds including yen loans, survey items that will be necessary in the future, such as technical survey, will be clarified so as to provide support to the relevant Japanese and Vietnamese organizations.

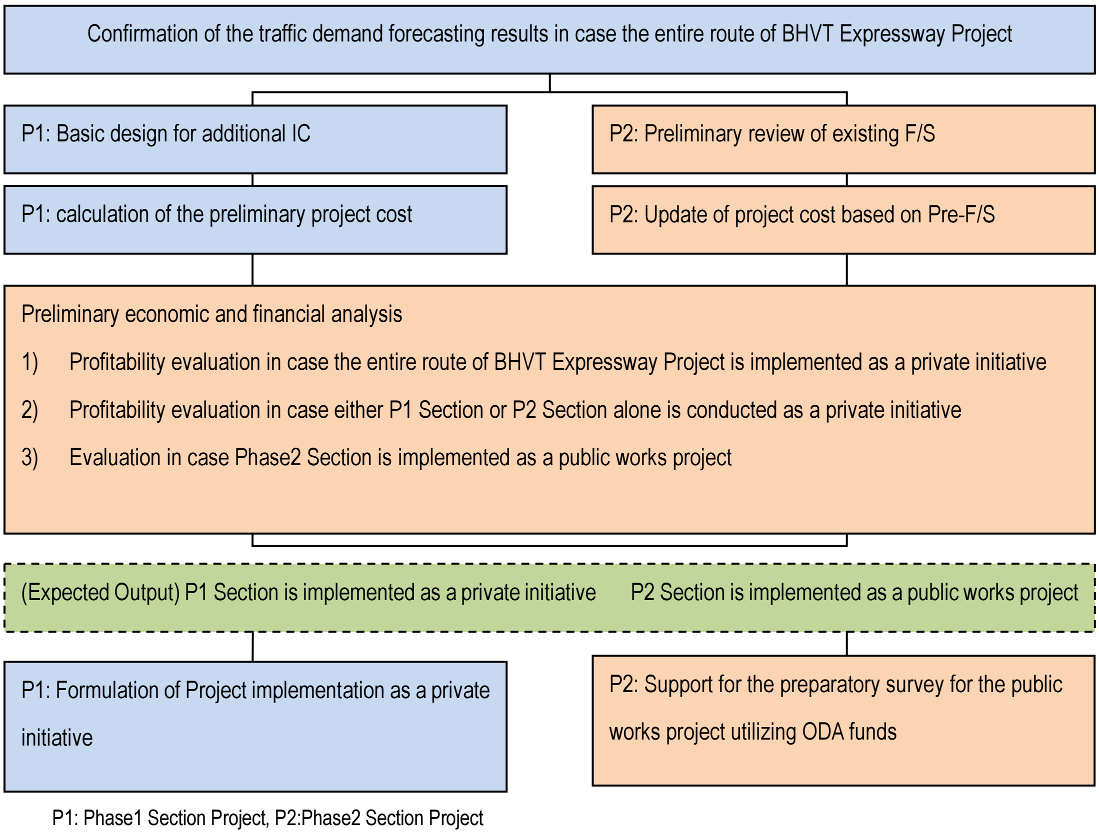
In this respect, the work under this policy will involve, for Phase 2 Section, collection and sort-out of existing literature, preliminary review of past FS reports, update of rough project cost at the pre-FS level, and confirmation of the traffic demand forecasting results.

Based on those results, the following review will be conducted to evaluate the project methods for Phase 1 Section and Phase 2 Section, and the range that suggests viability as a private investment project will be quantitatively determined using Internal Rate of Return (hereinafter IRR):

1) Profitability evaluation in case the entire route of BHVT Expressway Project is implemented as a private initiative.
2) Profitability evaluation in case either Phase 1 Section or Phase 2 Section alone is conducted as a private initiative.
3) Evaluation in case Phase 2 Section is implemented as a yen loan project

For evaluation of i) and ii) above, the outcome should be more than the equity IRR set for this Study. For iii), the target should be 12% in Economic Internal Rate of Return(hereinafter EIRR).

It is necessary to clarify the method of survey and review for implementation of Phase 2 Section. The prerequisite here is that Phase 2 Section be implemented as a yen loan project. Based on this assumption, the contents of the preparatory survey will be confirmed and sorted out in order to complement the information shortage related to the existing fiasibility study or Environment Impact Assessment(hereinafter EIA) reports and review alternative plans from the viewpoint of the project validity in terms of technical and financial aspects and the environmental and social considerations.



Source: JICA Study Team

Figure 1.2.2-7 Flow of review on project method for each phase

(5) Implementation of environmental and social considerations for realization of project viability

As the Project is the route that will contribute to the economic growth of Vietnam, it is of high necessity and therefore smooth implementation is essential. But if there is a difference between the requirements of the donor in terms of environmental and social considerations and the institutional system and procedures of the lender, it can be a critical factor for realization of a project. Given this, it is indispensable to ensure appropriate environmental and social considerations.

The risk analysis conducted in the Preliminary Survey concluded that land acquisition is a high risk factor as is technical risk, sponsor risk, exchange risk and other project-related risks because of the expected difficulty in conducting procedures for land acquisition or expected increase in acquisition cost. The results of the review in the Preliminary Survey of the EIA Report for Phase 1 Section prepared at the time of FS pointed out several items not covered in the past as well as suggested the necessity of a system for environmental management and monitoring such as environmental monitoring during construction and after completion or livelihood monitoring related to land acquisition.

The Study intends to clarify differences between JICA's Guideline for Environmental and Social Considerations (April 2010) (hereinafter JICA's Guideline) and Vietnam's procedures or institutional systems for environmental and social considerations, to identify critical points related to environmental and social considerations for realization of the Project such as JICA's responsibilities for environmental and social considerations and their procedures or the requirements to be fulfilled by Vietnam, and to provide support to solutions appropriate in terms of JICA's Guideline for Environmental and Social Consideration, thereby promoting implementation of appropriate environmental and social considerations.

1) Confirmation of differences between JICA's Guideline and Vietnam's relevant laws and regulations

Considering differences between JICA's Guideline and Vietnam's EIA and resident resettlement laws as shown in Table 1.2.2-6, it is necessary that not only the implementing organizations but also the relevant organizations such as local or provincial administrative sections in charge of land acquisition provide support to preparation of EIA and resident resettlement plans (hereinafter RAP) that satisfy both requirements.

Table 1.2.2-6 Major differences between JICA's Guideline and Vietnam's relevant laws

Item	Major differences
EIA	When to hold stakeholder consultation and how to do it; review of alternative plans
Land acquisition and resident resettlement	Eligibility requirement, payment of compensation by reacquisition price, support to illegal occupants, negotiation with residents, monitoring

Source: JICA Study Team

2) Proposal on land acquisition and a system for implementation of environmental and social monitoring

Since the Project is planned to be implemented and maintained by an SPC, it is necessary to set up a division dedicated to environmental considerations including risk reduction of land acquisition and environmental/social monitoring in planning, construction and in-service stages. Since road development projects have been conducted in Vietnam with the Japanese government, the WB and ADB as donors, the Study will propose a feasible implementation system that fits the conditions of Vietnam based on the roles of relevant organizations as per the relevant laws and regulations and the analyses of systems for implementation of environmental and social considerations in similar projects.

1.3. Organization of the Study Team

The survey organizational chart is shown in the following.

Source:JICA Study Team

Figure 1.3-1 Organization of the Survey

Table 1.3-1 List of the Study Team

Name	Position	Company
Mr. TSUJI Takehiko	Team Leader/ Survey Management	JEXWAY
Mr. MIYAKE Hiromichi	Deputy Team Leader/ Specialist (Expressway Development Planning)	NEXCO
Mr. TSUBOI Shinji	Deputy Team Leader/ Design Engineer (Expressway)	NK
Mr. ISHIMOTO IchiZuru	Specialist (Project Coordination for Stakeholders)	NK
Mr. IWASAKI Masayoshi	Specialist (Project Scheme)	KRI
Mr. KIKUCHI Kenichi	Specialist (Economic and Financial Analysis)	KRI
Mr. SHIRATO Arata	Specialist (Funding Plan)	JEXWAY
Mr. YAGI Toshiharu	Specialist (Risk Analysis and Security Package 1)	SOJITZ
Mr. HIRATA Kenji	Specialist (Risk Analysis and Security Package 2)	JEXWAY
Mr. MORI Nobuhiro	Specialist (Government Support)	KRI
Mr. TANIGUCHI Yasushi	Specialist (Demand Forecasting)	NEXCO
Mr. Okamura Goro	Specialist (Regional Development Plan/ Investment Environment)	SOJITZ
Mr. EMA Tomohiro	Specialist (Transportation Planning/ Promotion of Utilization	NEXCO
Mr. HORIKIRI Kan	Specialist (Traffic Survey)	NK
Mr. MAGARIO Akira	Design Engineer (Interchange)	NK
Mr. CHUJO Takashi	Design Engineer (Bridge and Road Structure)	NK
Mr. NOZUE Yasuhiro	Design Engineer (Geotechnical)	NK
Mr. IMADA Shimpei	Engineer (Construction Plan/ Cost Estimation)	NK
Mr. MARUO Katsumi	Expert (Expressway Operation and Maintenance)	NEXCO
Mr. SATO Shinsuke	Expert(Environment Considerations)	NK
Ms. OTA Tomoko	Expert (Social Consideration)	NK

JEXWAY: Japan Expressway International Company Limited , NEXCO: Central Nippon Expressway Company Limited, SOJITZ: Sojitz corporation, NK: Nippon Koei Co.,Ltd, KRI: KRI International Corp.

Source:JICA Study Team

1.4. Schedule of the Study

The progress chart of the Study is shown in Table 1.4-1

Table 1.4-1 Schedule of the Study

Contents of the Survey	2012										2013		
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Preparation													
2. Reconfirmation of the necessity and background of the Project													
3. Formulation of Project implementation plan													
(1) Confirmation of the purpose of the Project													
(2) Review of the scope of the Project													
(3) Review of the project scheme													
(4) Economic and financial analysis													
(5) Review of risks and securitiy packages related to implementation of the Project													
(6) Review of government support													
(7) Project implementation system and planning													
(8) Project planninng schedule													
4. Survey and review on project viability and profitability improvement													
(1) Demand forecasting for the Project													
(2) Transportation planning													
(3) Promotion for the utilization													
5. Basic design for higher viability													
(1) Basic design													
(2) Construction plan													
(3) Operation and maintenance plan													
(4) Caluculation of the preliminary project cost													
6. Project viability of Phase 2 Section (from Phu My to Vung Tau)													
(1) Sort-out of policies about the entire project of Bien Hoa - Vung Tau Expressway													
(2) Confirmation of the methods of survey and review necessary for implementation of Phase 2 Section													
7. Survey on Environmental and Social Considerations													
8. Compiling report													
9. Explaneatory and Discussion													
(1) Inception report	●												
(2) Interim report									●				
(3) Draft final report												●	
Activities of Applicant Companies as a investor													
1. Discussion with Relevant Agencies in VN/JP													
2. Consultation with stakeholders													
Subjects of discussion with GOV and BVEC													
(1) Basic approach, methods, schedule and organization for the Survey	○												
(2) Basic approach for formulation of Project implementation	○												
(3) Policy of development for BHVT Expressway	○												
(4) Detailed contents of survey and review	○												
(5) Results of survey and review on project implementation								○					
(6) Results of basic design								○					
(7) Results of survey on Environmental and Social Considerations								○					
(8) Policy of development for Phase 1 Section								○					
(9) Policy of development for Phase 2 Section								○					
(10) Draft proposed Project implementation plan								○					
(11) Proposed Project implementation plan												○	
(12) Finalization of the Survey												○	

Source: JICA Study Team

2. Background and Necessity of the Project

2.1. Current status of the Socio-Economic Condition in Vietnam

(1) Overview of Socio-Economic Conditions in Vietnam

In 2011, the Vietnamese economy faced high inflation as a result of gradual price increases since the second half of 2010. In order to curb inflation and stabilize the macro economy following an increase of the trade deficit and further inflation caused by active domestic demand, the State Bank of Vietnam devaluated the dong by 9.3% against the US dollar and introduced financial control policies on February 11, 2011.

However, despite the introduction of various policies, domestic prices continued to rise due to the increase in the prices of electricity and gasoline in March, and thereafter, the inflation rate reached 23% YoY in August. The price fluctuation reached its peak in and after September owing to the government's financial control policies; however, the annual inflation rate ended with 18% in 2011.

On the other hand, the financial control policies gave rise to an increase in the domestic loan rate, which reached about 24% of the dong lending interest rate at its peak period. While the cash flows of Vietnamese companies worsened rapidly, Japanese companies which had already entered Vietnam had to strengthen credit control of Vietnamese companies.

In response to the price escalation, the revision of the minimum wage, which had been expected to take effect in January 2012, was moved forward to October 2011, thus making Japanese companies struggle with labor management related to the wage revision.

Nevertheless, even under such circumstances, foreign exports showed favorable growth. In 2011, the country marked a record high of over 98 billion dollars in foreign exports, as well as a decrease in trade deficit to 9.5 billion dollars, the level below 10 billion dollars.

Table 2.1-1 General matters of Vietnam

Item	Contents
Country name	• Social Republic of Viet Nam
Location	• Located in the east of the Indochina Peninsula, 1,650km north-south elongated as S-shaped • Southeastern Asia, bordering the Gulf of Thailand, Gulf of Tonkin, and South China Sea, as well as China, Laos, and Cambodia
Area	• 331,689 sq km
Population	• 86,930,000 people（2010,GSO)
Major cities	• Hanoi（6,449,000 people） • Ho Chi Minh City（7,123,000people），December 31, 2009.
Ethnic groups	• Kinh(Viet):90%, Chinese3%, other 53 ethnic minorities

Item	Contents
Languages	• Vietnamese (official), other minorities
Religions	• Buddhist（80%）,Catholic(10%),Hoa Hao, Cao Dai
Education	• Literacy: age 15 and over can read and write 90%（male 94%,female 87%） • School life : 5-4-3 education system, 5-year term of compulsory education

Source: JICA Study Team

(2) Basic economic indicators

Table 2.1-2 Basic economic indicators in Vietnam

Item	2009	2010	2011
GDP			
Real GDP（%）	5.3	6.8	5.9
Nominal GDP (million VND)	1,658,389,000	1,980,914,000	2,535,008,000
Nominal GDP (million USD)	97,180	106,427	n.a.
Nominal GDP per capita (USD)	1,068	1,174	1,374
Consumer Price Index			
Inflation rate (consumer prices)（%）	6.9	9.2	18.6
（Remarks）	the year before=100	the year before=100	The year before=100
Consumer Price Index	191.8	209.5	248.6
（Remarks）	2005=100	2005=100	2005=100
Unemployment rate（%）	4.6	4.3	3.6
Energy and Industrial Production Index			
Industrial Production Index	108.5	115.3	106.8
（Remarks）	1994=100	1994=100	1994=100
Growth rate of Industrial Production Index（Year-on-year）（%）	-4.7	6.3	-7.4
International Balance of Payments			
Current Balance (International Balance of Payment basis)（million USD）	-6,100	-4,300	-600
Balance of trade (International Balance of Payment basis)（million USD）	-12,853	-12,610	-9,844
Reserves of foreign currency (million USD)	16,447	12,467	n.a.
（Remarks）	Except for the Gold	Except for the Gold	
External Debt (million USD)	38,700	45,400	50,300

Item	2009	2010	2011
Exchange rates（Average, USD rate）	17,065.1000	18,612.9000	n.a.
Exchange rates（Year-end, USD rate）	17,941.0000	18,932.0000	n.a.
Growth rate of money supply（%）	26.2	29.7	n.a.
Exports (million USD)	57,096	72,191	96,906
Exports to Japan (million USD)	6,335	7,727	10,781
Imports (million USD)	69,949	84,801	106,750
Imports from Japan (million USD)	6,836	9,016	10,400
Direct Investment Acceptance(million USD)	22,626	19,764	14,696
（Remarks）	including the new extension	including the new extension	Including the new extension

Source:

Real GDP, NominalGDP, Inflation rate, Unemployment rate, Industrial Production Index,：General Statistics Office of Vietnam

GDP per capita, Consumer Price Index：IMF"World Economic Outlook Database"

International Balance of payments, External debt：World Bank "A World Bank Economic Update for the East Asia and Pacific Region"

Reserves of foreign currency, Exchange rate：IMF "IF/S" CD-ROM

Direct investment acceptance：Agency of Foreign Investment（FIA）

Growth rate of money supply：IMF "International Financial Statistics Yearbook"

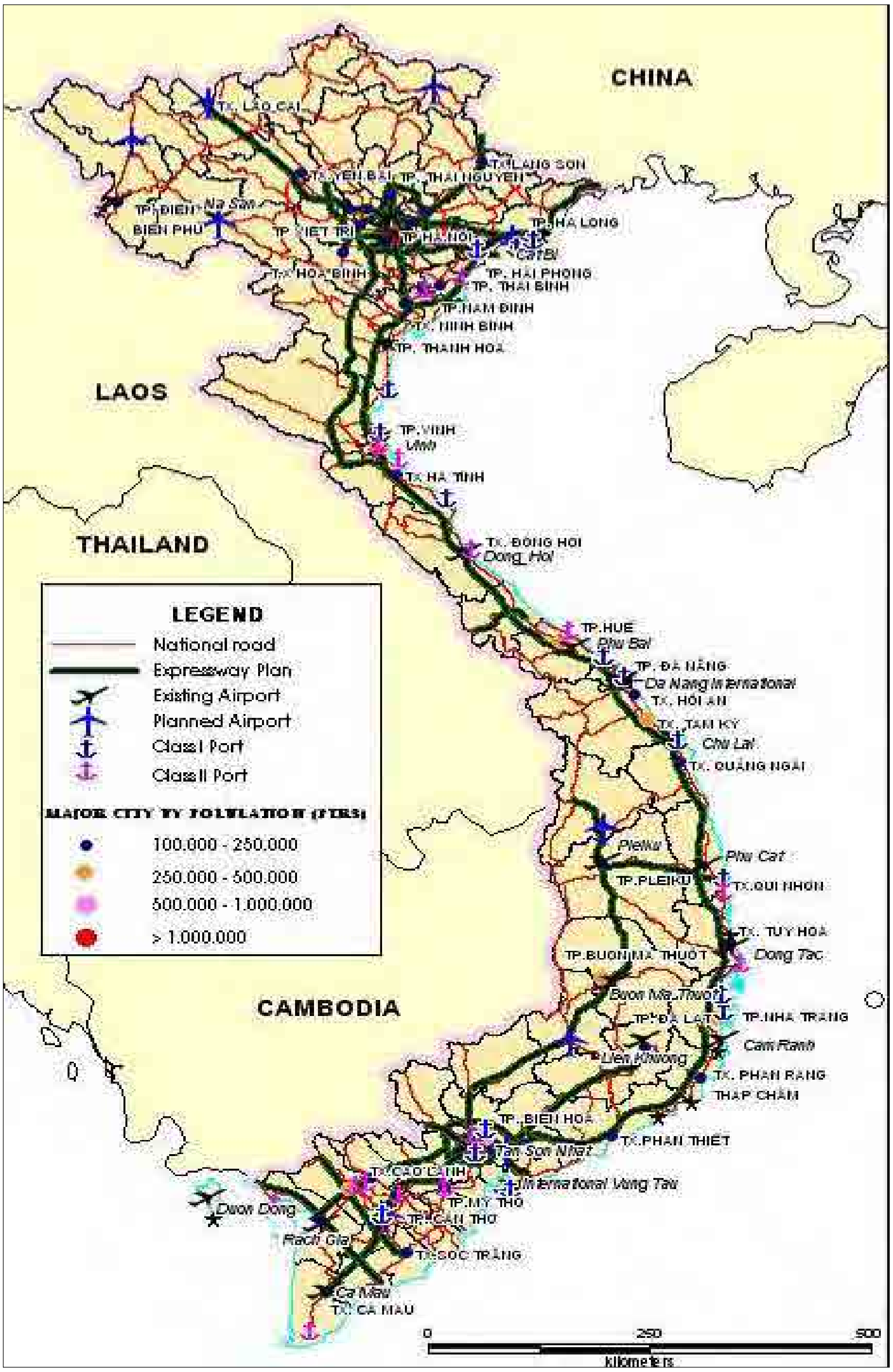
Exports and Imports：Directorate General of Customs

*Growth rate of money supply：IMF "International Financial Statistics Yearbook 2011",“Broad Money”

2.2. Current Status of Expressway Development in Vietnam

(1) Status of legislation on expressway development

The expressway development plan was issued as Prime Minister Decision No.1734/QD-TTg dated 1st December 2008, and is shown in Figure 2.2-1.



Source: MOT Master Plan (No.7056/TTr-BGTVT dated 5 November 2007)

Figure 2.2-1 Expressway Development Plan (Decision No.1734)

Table 2.2-1 List of expressway projects (MOT)

No.		Section	MOT Master Plan (2007)		MOT Development Plan (2012)	
			Length (km)	No. of Lanes	Length(km)	No.of Lanes
North–South Expressway	1	Eastern (Phap Van–Can Tho)	1,941	4-6	1,941	4-6
	2-1	Western(Phu Tho–Pho Chau)	457	4-6	457	4-6
	2-2	Western(Ngoc Hoi-Rach Gia)	864	4-6	864	4-6
Northern Expressways	3	Lang Son–Bac Giang–Bac Ninh	130	4-6	130	4-6
	4	Hanoi–Hai Phong	105	4-6	105	6
	5	Hanoi–Viet Tri-Lao Cai	264	4-6	264	4-6
	6	Ha Noi-Ha Long-Mon Cai	294	4-6	294	4-6
	7	Hanoi–Thai Nguyen-Bac Kan	90	4-6	90	4-6
	8	Ha Noi–Hoa Lac-Hoa Binh	56	4-6	56	4-6
	9	Ninh Binh–Hai Phong–Quang Ninh	160	4	160	4
Central Expressways	10	Hong Linh–Huong Son	34	4	34	4
	11	Cam Lo–Lao Bao	70	4	70	6
	12	Quy Nhon–Pleiku	160	4	160	4
Southern Expressways	13	Bien Hoa–Vung Tau	76	6	76	6
	14	Dau Giay–Da Lat	209	4	209	4
	15	HCMC–Thu Dau Mot–Chon Thanh	69	6-8	69	6-8
	16	HCMC–Moc Bai	55	4-6	55	4-6
	17	Chau Doc–Can Tho–Soc Trang	200	4	200	4
	18	Ha Tien–Rach Gia–Bac Lieu	225	4	255	4
	19	Can Tho–Ca Mau	150	4	150	4
Ring Road System in Hanoi	20	Ring road No 3	56	4-6	56	4-6
	21	Ring road No 4	125	6-8	125	6-8
Ring Road System in HCMC	39	Ring road No 3	83	6-8	90	6-8
	40	Ring road No.4	-	-	198	6-8
Total			5,873		6,108	

Source: MOT Master Plan (No.7056/TTr-BGTVT dated 5 November 2007) and MOT Document (The 6th Seminar on Expressway in Japan dated 29 October 2012)

(2) Capital Requirement for Expressway

The following table shows a comparison between the MOT investment plan included in the Expressway Seminar in August 2011 and that of October 2012.

Table 2.2-2 Comparison of Investment Plan

Description	Issue	Till 2020		After 2020	
		Target construction length（km）	Necessary Funds(10 billion USD)	Target construction length（km）	Necessary Funds(10 billion USD)
5th Expressway Seminar	2011/8	1,870	19	4,000	21.5
6th Expressway Seminar	2012/10	3,000	26	3,108	24
Changes		+1,130	+7	-892	+2.5

Source: 5th Expressway Seminar, August 2011 and 6th Expressway Seminar, October 2012

As of 2012, the target construction length by 2020 has increased by approximately 1,130 compared to the previous year's plan. It is intended that MOT develops its medium-term development targets ahead of schedule. On the other hand, in terms of funds, there has been an expected increase of 70 billion USD, including the fact that it is ahead of schedule.
In addition, total length of expressways in the 2012 investment plan is 6,108km which has increased from 5,873km in the Master Plan because of additions such as Ring Road No.4 in HCMC (198km) has been added.

(3) Land-use planning for expressway construction

According to information from MOT in 6th Expressway Seminar 2012, the total amount of land planned for expressway construction is 42,000ha. The land acquired for constructing expressways is more than 3,000 ha and there are 39,000ha of additional l.

(4) Current Status of Expressway Projects

1) Priority Expressway Projects

The following table shows the High priority expressway projects for investment MOT has been assumed. (14 projects 1,293km)

Table 2.2-3 Priority Projects for Investment

No	Section	Length(km)
1	Ring Road No.3 Ha Noi	56
2	Ha Noi-Hai Phong	105
3	Ha Noi-Thai Nguyen	62
4	Ha Noi-Lao Cai	264
5	Lang-Hoa Lac-Hoa Binh	56
6	Cau Gie-Ninh Binh	50
7	Ninh Binh-Thanh Hoa	115
8	Da Namg-Quang Ngai	131
9	Dau Giay-Long Thanh-HCMC	55
10	Long Thanh-Ben Luc	55
11	Dau Giay-Phan Thiet	98
12	Trung Luong-My Thuan-Can Tho	92
13	Bien Hoa-Vung Tau	76
14	Ring Road No.3 HCMC	83
	Total	1,298

Source: 6th Expressway Seminar, October 2012

2) Current Status of Expressway Projects

Table 2.2-4 Current Status of Expressway Projects

No	Expressway /Project	Length (km)	Lanes	Total investment (billion VND)	Construction period	Progress	Status
Eastern North-South Expressway							
1	Phap Van-Cau Gie Expressway Project	28	6	4,743	2012-2019	Project being formed	Stage 1: Upgrading 4-lane expressway Stage 2: Expanding 6-lane expressway MOT and NEXCO-Central are currently completing the proposal to submit to the Prime Minister for approval
2	Cau Gie-Ninh Binh Expressway Project	50	4-6	8,974	2006-2012	Open to traffic	Completed and opened on 30 June 2012 Managed by VEC Distance-based toll charge system
3	Ninh Binh-Thanh Hoa Expressway Project	121	6	27,000	-	Project being formed	Feasibility study report being performed Calling for investment in PPPscheme Managed by MOT/PMU1
4	Thanh Hoa-Ha Tinh Expressway Project	96	6	22,185	-	Project being formed	Feasibility study report being performed Calling for investment in PPPscheme Managed by MOT/PMU6
5	Da Nang-Quang Ngai Expressway Project	131	4 (Stage 1)	28,518 (1,600 mil.USD)	2011-2014	Implementation process	Detailed Design being carried out Managed by VEC Co-financed by IDA, IBRD,and JICA loans

No	Expressway /Project	Length (km)	Lanes	Total investment (billion VND)	Construction period	Progress	Status
6	Quang Ngai-Qui Nhon Expresway Project	108	4-6	26,654		Project being formed	
7	Dau Giay-Phan Thiet Expressway Project	98	4-6	17,230	2012-2016	Project being formed	Calling for investment in PPP pilot scheme supported by WB First investor is BITEXCO
8	HCMC-Long Thanh-Dau Giay Expressway Project	55	4-6	15,000	2009-2013	Under construction	Managed by VEC Co-financed by JICA＋ADB loans Implementation process is slow due to landacquisition
9	Ben Luc-Long Thanh Expressway Project	58	4	32,100	2012-2017	Implementation process	Detailed Design completed ADB assists are hiring consultants to adjust F/S and T/D to avoid increasing total investment cost, resulting in slow implementation process Managed by VEC Co-financed by ADB,and JICA loans
10	HCMC-Trung Luong Expressway Project	39.8	4-8	9,884	2004-2011	Open to traffic	Completed and opened on 3 February 2010 Managed by PMU My Thuan(Cuu Long CIPM) Distance-based toll charge system
11	Trung Luong-My Thuan Expressway	54.3	4	20,000	-	Project being formed	Project was planned initially in BOT scheme invested by BEDC, but BEDC pulled out

No	Expressway /Project	Length (km)	Lanes	Total investment (billion VND)	Construction period	Progress	Status
	Project						Managed by CuuLongCIPM Feasibility study report being performed by JICA in PPP scheme
12	My Thuan-Can Tho Expressway Project	24.5	6-8	15,000	-	Project being formed	
Northern Expressways							
13	Hanoi-Lang Son Expressway Project	140	4-6	22,120	-	Project being formed	Expected ADB,and JICA loans Feasibility study report being reviewed by ADB Managed by VEC
14	Hanoi-Hai Phong Expressway Project	105	6	24,566	2008-2011	Under construction	Impementation by VIDIFI（VDB）with BOT contract Implementation process is 20 months show due to land acquisition.
15	Noi Bai-Lao Cai Expressway Project	245	4-6	21,233	2009-2013	Under construction	Managed by VEC ADB loans, government budget Process is slow due to land acquisition and contractor's low capacity
16	Hanoi-Thai Nguyen Expressway Project	61	2-4	8,104	2009-2013	Under construction	Upgrating NH3 Hanoi-Soc Son: 4 lanes

No	Expressway /Project	Length (km)	Lanes	Total investment (billion VND)	Construction period	Progress	Status
							Soc Son-Thai Nguyen:2 lanes Managed by PMU2-MOT JICA's ODA Fund, Government Fund Process is slow due to land acquisition and contractor's low capacity
17	Lan-Hoa Lac Expressway Project	29.2	6	7,527	2005-2010	Open to traffic	Completed and open to traffic on 29 September 2010 Central budget, local budget Construction by VINACONEX with BT contract Free toll
18	Hoa Lac-Hoa Binh Expressway Project	30	6	6,000	2011-2016	Project being formed	In progress investment by Geleximco BT contract
19	Bac Ninh-Ha Long Expressway Project	147	4	20,557	2015-2020	Project being formed	Study investment by GITEC (China) BOT contract
20	Ha Long-Mong Cai Expressway Project	130	4	19,000	2015-	Project being formed	Feasibility study report being performed Expected ADB Managed by VEC（PMU TL）
Southern Expressways							
21	Dau Giay-Da Lat Expressway Project	230	4	19,590	2012-2017	Project being formed	Dau Giay-Lien Kuong Section: Calling for investment in PPP scheme

No	Expressway /Project	Length (km)	Lanes	Total investment (billion VND)	Construction period	Progress	Status
							Managed by MOT（PMU1） South Korea's Incheon Urban DevelopmentCorporation (IUDC) made a memorandum of understanding (MOU) with MOT for investment of approx. 1 billion USD and plans to build and operate under the BOT scheme
22	Bien Hoa-Vung Tau Expressway Project	76	4-6	16,033	2013-2020	Project being formed	Planned to apply BOT scheme for Phase 1 Section. Investor is BVEC Phase2 Section uses government funds via JICA's ODA loans.
Ring roads for Hanoi							
23	Hanoi Ring Road No.3	56	4-6	17,990	2004-2018	Under construction/ Project being formed	Mai Dich-Phap Van Section: JICA's ODA loans and State budget Completed and opened in 2011 Thanh Tri Bridge-Southern RR3 Section: JICA's ODA Completed and opened in 2010 Managed by MOT（PMUTL） Mai Dich-Noi Bai Section (20km):

No	Expressway /Project	Length (km)	Lanes	Total investment (billion VND)	Construction period	Progress	Status
							Project being assigned to VEC for research Requested to use Chinese ODA Tu Hiep-Noi Bai Section(21km): Not formed yet
24	Hanoi Ring Road No.4	136	6-8	72,000	2011-2020	Project being formed	Project being formed in BT and BOT scheme Managed by MOT
Ring roads for HCMC							
25	HCMC Ring Road No.3	90	6-8	43,000	2011-2020	construction/ Project being formed	57 km section under construction Managed by Cuu Long CIPM

Source: JICA Study Team based on information from MOT

3) Implementation of and Difficulties in Expressway Projects

Consideration of the current conditions of expressway projects underway or in the planning stages results in the following findings.

A. Matters common to both expressway projects underway and those in the planning stages

Since each project is being implemented by multiple organizations (VEC, CLCIPM, and BOT), project coordination and project management by the MOT, the agency with jurisdiction over the projects, is complicated.

In addition, risks are involved in the mutual relations among organizations in formation of network functions. These include project delays.

B. Projects in the planning stages

Raising funds for projects is proving difficult due to the limitations of Vietnam's national government budget. While private-sector funding such as PPPs is being used on a trial basis, in light of the outlook for project profitability it is difficult to get private-sector businesses to participate. Also, development of related legal systems and organizational structures to improve the situation is moving slowly.

Vietnam is experiencing marked inflation, so that amounts of investment also are in a significant increasing trend. As such, the investment environment for these projects is a tough one, from both the public- and private-sector sides.

C. Projects underway

Delays in land acquisition due to national government budget shortfalls have a significant impact on project progress. The MOT is forced to respond urgently to this situation.

In some cases the progress of construction is delayed due to insufficient capabilities on the part of the construction contractors awarded contracts.

Individual main projects are outlined below.

(a) Phap Van-Cau Gie Expressway

28km of length, operated as NH1 By-pass since 2002 with a scope of 4 lanes.

In order to ensure an integrated standard for expressways from Phap Van to Ninh Binh after the completion of Cau Gie-Ninh Binh Expressway, MOT has initially assigned it to Vietnam Expressway Compnay (hereinafter VEC) to propose an upgradingproject for the Phap Van-Cau Gie section to fulfill the above.

Scope of Investment: divided into two stages with a total investment of 386.5 million USD, as follows:

Stage 1: Pre-Expressway with 4 lanes, with improved pavement, no land acquisition (except for the Toll Gates), total investment of 74 million USD.

Stage 2: Complete with 6 lanes, total investment of 312.5 million USD.
MOT has applied to the government to allow NEXCO-Central apply the BOT model for Stage 1. The investor will call for 30% of the total investment, while the rest will be a loan from JICA-PSIF.

(b) Da Nang-Quang Ngai Expressway

The length of this route is 131.49km with 4 lanes. Its total investment funds are 29,203 billion VND co-financed by WB+JICA+VEC. The proposed funds from JICA are about 673.6 million USD accounting for 48% of the total investment cost, and a credit agreement was signed to borrow 15.912 billion JPY (199 million USD) from JICA. The WB funded the amount of 43.7% (613.5 million USD) , and the last proposition from VEC is counterpart funds of 3.988 billion VND (116.6 million USD, accounting for 8.3%).
The progress of this project: VEC is preparing to submit the bidding documents. The opening is supposed to be launched in Quarter Ⅲ, of 2012. On 17 July 2012, MOT had local governments (Da Nang City, Quang Nam Province and Quang Ngai Province) handle the land clearance component.

(c) Ho Chi Minh-Long Thanh-Dau Giay Expressway

The length of this route is 55km with 4 lanes (6-8 lanes at the completed stage). Its total investment funds are 932.4 million USD including Component 1 (Section An Fhu-Ring Road 2, 4km in length), and Component 2 from Km 4+514-Km54+983
Co-financed by JICA, ADB and VEC
JICA: 2 agreements were signed with total funds of 41,677 billion JPY for Component 1 and the section from KM4-Km23+900 (interchange NH51), and Intelligent Transport Systems (hereinafter ITS) for the whole project.
Ordinary Captital Resource (hereinafter OCR) Loan from ADB with total funds of 410.2 million USD
VEC fund: 5.7 million USD
The progress of the project:
Component 1: The bidding process for civil works packages are implemented by VEC for the An Phu-VD2 section.
Component 2: All six packages have been constructed and the planned progress is acceptable.
For land clearance: This work has basically been finished, but 1 household and an 11KV electric line remain on site.

(d) Ben Luc-Long Thanh Expressway

The length of this route is 57.8km with 8 lanes.

The total length of bridges is 25.71km.
Implementer: VEC
Total investment (the road length is 31.14km) : 1,067 millioon USD from ODA, co-financed by JICA (50.04%) and ADB (49.96%)
Project progress: Regarding to its technical detailed design, the total investment fund increases is around 32% more than the approved one. MOT is reviewing solutions for this issue.
Bidding process: Bidding documents were submitted to ADB and JICA by VEC.

(e) New National Highway No.3- Hanoi-Thai Nguyen Expressway

The length of this road is 61km with 2-4 lanes.
Total investment is 8,104 billion VND, including current JICA fund of 28.955 billion JPY.
Project progress: Four packages are under construction with 6-9 months of delay behind the schedule due to obstacles in land clearance and the capacity of the contractors. Due to price escalation, its total investment fund has now increasesed.

(f) Noi Bai-Lao Cai Expressway

The length of this route is 245km with 4-6 lanes.
Total investment fund of this project is 1,249 million USD, including Asian Development Fund(ADF) (ADB) of 200 million USD, OCR (ADB) of 896 million USD, and a counterpart fund (VEC) of 153 million USD.
The project launched on 1 July, 2009 and is scheduled to be completed in 2013. The contractors have now carried out their civil works.
The amount of construction work and its disbursement are still delayed because of obstacles in land clearance. On the other hand, for sections without land clearance problems, the contractors have not mobilized enough equipment, or manpower to ensure their construction.
VEC is currently concerned with adjusting the total investment for land clearance components due to price escalation and other problems related to land acquisition policy.
ADB approved the arrangement of an un-located budget from the loan to use for land clearance, resettlement, and an income restoration program.

(g) Trung Luong-My Thuan Expressway

The length of this project is 54.3km with 4 lanes.
Total investment fund is 1,338 million USD
At the Mid-term report meeting, JICA recommended six financial methods with terms and Finamcial Internal Rate of Return (hereinafter FIRR) from 7.3% to 16.5%. MOT requested the Consultant to revise the total investment cost, estimated traffic volume, tickets, and to

perform further study on the other investment plans stated in the final report, and the decision to use ODA in order to report to the Prime Minister.

(h) Thanh Hoa-Ninh Binh-Bai Vot Expressway

The total investment cost for 219 km is 4,574 million USD, including the Ninh Binh-Thanh Hoa(121km-2,193 million USD) and Thanh Hoa-Bai Vot section(98km;2,341 million USD). WB and JICA consultant have now carried out the study from Quarter IV of 2011.

(i) Dau Giay-Phan Thiet Expressway

This project is 98.7km in length with a total investment of 1,730 million USD (1,538 million USD for the first stage and 192 million USD for the second). In the first stage, the embankment is designed with 6 lanes, while the road pavement has 4 lanes, and there are other main structures such as main bridges with complex structures and tunnels. For the second stage, the project shall be upgraded with 6 lanes.
An independent consultant (SYSTRA MVA Singapore) has been selected by WB and was mobilized from March 2012 in order to appraise the its technical design, and total investment cost and to estimate the revenue of the project or create a strategy for selling tickets in the long term. Currently, the consultant is reviewing its F/S to investigate the starting and ending points and the traffic volume.
A financial consultant (Crisit infrastructure risks and solutions Ltd) has been selected by WB and was mobilized from September 2011. The consultant made up a Financial Relationship Management (hereinafter FRM), including methods to analyze, monitor and manage tentative debt related to the responsibilities of the Vietnamese government as well as to use this FRM for other PPP projects in the future.

4) Administrative organization for the Expressway

The organizational structure for the expressway sector in Vietnam is shown below.

a) Central Government

The structure of the central government after the July 2002 reorganization of the Vietnamese government is shown below.

Table 2.2-5 Structure of Central Government in Vietnam

No	Ministry
1	Ministry of National Defense
2	Ministry of Public Security
3	Ministry of Foreign Affairs
4	Ministry of Justice

No	Ministry
5	Ministry of Finance
6	Ministry of Transport
7	Ministry of Construction
8	Ministry of Education and Training
9	Ministry of Agriculture and Rural Development
10	Ministry of Industry and Trade
11	Ministry of Planning and Investment
12	Ministry of Health
13	Ministry oF/Science and Technology
14	Ministry of Natural Resources and Environment
15	Ministry of Information and Communication
16	Ministry of Home Affairs
17	Government Inspectorate
18	State Bank of Vietnam
19	Committee for Ethnic Minorities
20	Government office
21	Ministry of Labor, War Invalids and Social Affairs
22	Ministry of Culture, Sports and Tourism

Source: Government of Vietnam HPP

b) Ministry of Transport（MOT）

MOT is one of the minisitries of the Vietnamese government and is responsibile for planning, managing and maintaining national transport infrastructure such as roads, railways, inland waterways, and maritime and aviation routes. Also, MOT’s authorities include the Directorate for Road of Vietnam (hereinafter DRVN), Vietnam National Maritime Bureau (VINAMARINE), Civil Aviation Administration of Vietnam (CAAV), Vietnam Railways Administration (VNRA), Vietnam Inland Waterway Administration (VIWA), Vietnam Register Administration (VR), and the Transport Construction Quality Control and Management Bureau (TCQM).

c) Ministry of Planning and Investment (hereinafter MPI)

The MPI is an agency of the Vietnamese government. It is responsible for the planning and investment fields, including formulating strategies and plans for national socio-economic development plans under the jurisdiction of the central government, economic management mechanisms and policies, domestic and international investment, and management of ODA funds.

d) Ministry of Finance (hereinafter MOF)

The MOF is an agency of the Vietnamese government. It is responsible for management of planning and execution related to national public finances, including formulating the national budget, taxation, systems of public charges (including road tolls), national public funds, and national investment.

5) Organizational structure for management of expressways

Currently, some expressway projects are open in Vietnam, such as Ho Chi Minh City-Trung Luong Expressway (toll road), Lang-Hoa Lac Expressway (free) and Cau Gie-Ninh Binh Expressway (toll road). In addition, an expressway with a total length of 525,9km is in progress and the target for opening is still 2015.

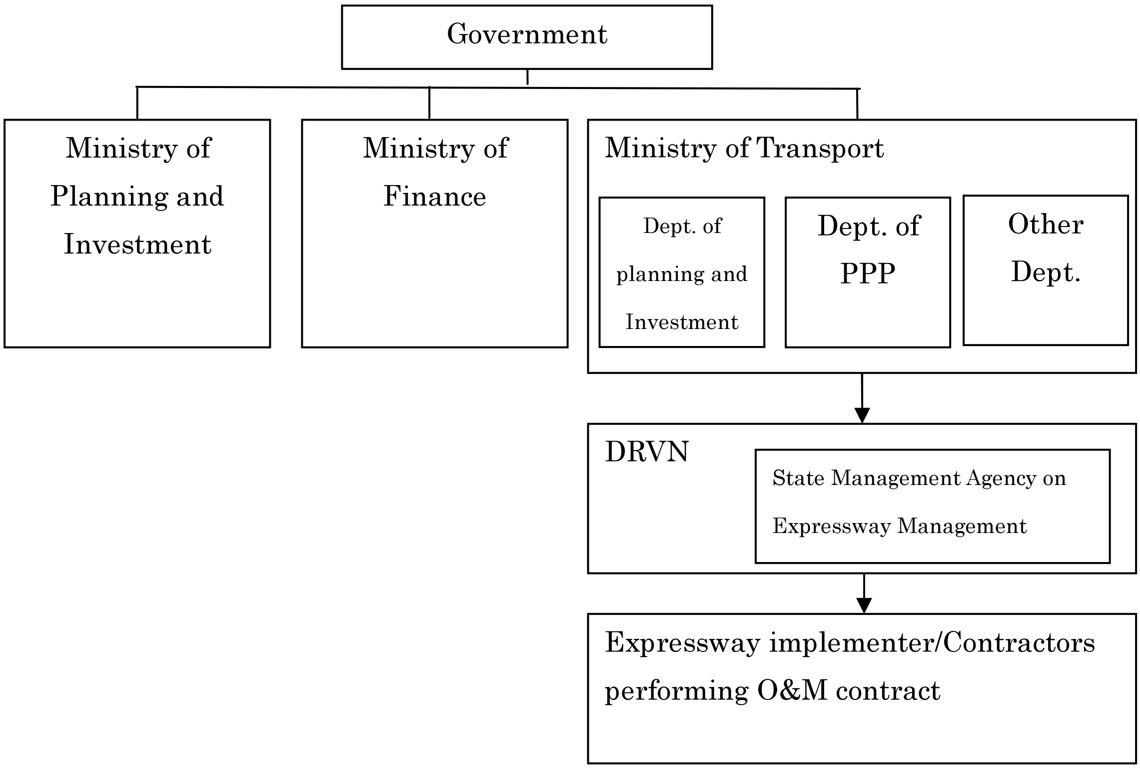
Some issues related to the management of expressways are shown below.

MOT is a regulatory agency for expressways under the relevant laws and regulations and DRVN (Expressway Management Office) is directly responsible for the organization as instructed by MOT.

The Expressway Management Office (EMO) was established as an organization in MOT under Decision No.633/QD-BGTVT, dated 1 April 2011.

At the beginning, EMO was to be reorganized to the Directorate for Expressway in the future. However it was incorporated into DRVN by Decision No.892/QD-BGTVT dated 24 April 2012.

On the other hand, Decision No.1815/QD-BGTVT, dated 3 August 2012, newly established the management of the Department of Private and Public Partnerships (Department of PPP). This organization has duty authority on transportation infrastructure projects according to the scheme of PPP, BOT, Build Transfer (hereinafter BT), and Build Transfer Own (hereinafter BTO), and is responsible for advising the Minister of Transportation regarding the management of PPP projects.



Source: JICA Study Team

Figure 2.1-2 Expressway administration, management, maintenance and operation structure in Vietnam

Advisory organizations to the Minister of Transport regarding investment, construction, management, and development of expressways are the Department of Planning and Investment, the Department of Science and Technology, the Department of Transport Infrastructure, the Department of PPP, and the Department of Quality Control.
Other relevant organizations include the VEC, Vietnam Development Bank (hereinafter VDB), and the Bank for Investment and Development Company (hereinafter BIDV) as private companies based on the BOT contract, which carried out the construction, operation, and management of the expressway project.

- For regulations and cooperation for the expressway operators
  MOT has issued tentative operation and maintenance standards for each expressway which is open to public, in which the terms of standards related to the liability of expressway operators such as general rules, traffic management, operation, and maintenance are described.
  And at the same time, Provincial People's Committee is responsible for traffic police, traffic safety audits, health, and safety throughout the expressway as the relevant local organization.

2.3. Current Status and Future Prospects of Project-related Legislation in Vietnam

2.3.1. Legislation related to the PPP regulation

The existing legislation for PPP/BOT investment in Vietnam is defined by the following regulations.
GOV has enacted Decree No.108/2009/ND-CP, dated 7 November 2009, on " Investment on the Basis of BOT, BTO, and Build-Transfer(hereinafter BT) Contracts"
This Decree was issued to encourage the participation of the private sector in the projects for the construction and operation of new infrastructure or upgrading, expanding, and rehabilitating existing infrastructure such as roads, bridges, tunnels, railways, airports, clean water supply systems,water drainage systems and other infrastructure facilities.

A state agency competent to sign and perform a project contract, such as MOT is a party to the project contract and has the rights, obligations and responsibilities as agreed with the investor in the project contract.
Decision No.71/2010/QD-TTg on Public-Private Partnership Investment Piloting (hereinafter referred to PPP Regulation) was issued on 9 November 2010.
The main objectives of this PPP Regulation are that it improves the profitability of the project and that financial support is properly provided by the government.

This decision is based on the definition that investment by the private sector is 70%, 30% of which needs to be supported by major investors, other portions of which are to be financed by supporters other than the guarantee by the government. Governmental financial support is limited to 30% of the total investment fund.

According to the Ministry of Planning and Investment (hereinafter MPI), the introduction of the PPP scheme in accordance with international standards is expected to facilitate the raising of private capital including foreign investment and to improve existing legislation focused on making the BOT scheme more effective.
However, there are challenging matters to overcome in introducing the PPP scheme. The profitability of the proposed projects is not sufficient for investors.

In particular, the rules on capital recovery through toll roads, which is a traffic sector project, are stipulated in the toll collection mechanism rules in Circular No.90/2004/TT-BTC established by the Ministry of Finance (hereinafter MOF); however, the fee standard remains low because it has not been updated for a long time. This prolongs the period of capital recovery of the project.

The Pilot PPP Regulation is not adequate for actual application of the PPP scheme, and it contains a number of problems because many parts are not clear in the implementation phase. The relevant organization always has to receive the confirmation of the superior organization. The Regulation defines neither how government funds are used and spent and how providers are selected, nor the combination of financial support (ODA, foreign private investment, government budget, etc.). The authorities concerned and local organizations are not actually controlled because there have arisen many issues regarding how to bear costs incurred for the agreed PPP pilot scheme. Although the PPP scheme has great potential for Vietnam, the Pilot PPP Regulation alone is not enough to control it. There is a need to develop an environment in which private investments are promoted and improve the related law systems to simplify the procedures between authorities.

Table 2.3.1-1 The comparison of Pilot PPP Regulation and BOT Regulation

	Prime Minister Decision No. 71 QD-TTg on Public-Private Partnership Investment Piloting (2010)	Government Ordinance No. 108 New BOT law (2009)	Notes
Project Form	Infrastructure development project implemented through public-private partnership (PPP) method	Investment project based on BOT, BTO, and BT contractual forms	Definition of public-private partnership not clear
Government Support (Maximum)	No more than 30% of amount of investment (Article 9), with government support included in the amount of investment (Article 2)	For urgent and priority projects, government support of up to 49% of amount of investment, and this amount is not included in the amount of investment (Article 6)	Effectively the share of public funding is decreasing
Details of Government Support (Public Funding)	National budget, ODA, government bonds, credit provided through government guarantees, credit provided through development investment by national government, development investment capital from state-owned enterprises, etc.	National budget, credit provided through government guarantees, credit provided through development investment by national government, development investment capital from state-owned enterprises, etc.	ODA and government bonds are included under “etc.” in the BOT law.
Uses of Government Support	Reserve facilities, compensation, land expropriation, clearance, relocation expenses	Same as at left	
Capital Subscription/ Loan Ratio	Capital subscription up to 30% of private-sector investment. No government guarantees for loan	Capital-subscription ratio not less than 15% for projects with amounts of investment of up to	Since the share of public funding has decreased under the

	Prime Minister Decision No. 71 QD-TTg on Public-Private Partnership Investment Piloting (2010)	Government Ordinance No. 108 New BOT law (2009)	Notes
	portion.	VND 1.5 trillion. Not less than 15% of amount up to VND 1.5 trillion for projects with amounts of investment of more than VND 1.5 trillion. Not less than 10% of amounts in excess of this amount.	PPP law, there is a need for considerable stable funding covered by private-sector investors using their own funds.
Fields of Investment	Roads, railways, urban transportation, airports, water supply, electricity supply, hospitals, waste processing (Article 4) Underlined fields indicate new subjects for PPP projects.	Roads, railways, airports, water supply, electricity supply, etc.	It is not possible to determine which law applies to fields included in the subjects of both laws.
Project Portfolio, Feasibility Study Report	Project list decided by Prime Minster after screening and approval by the MPI (Article 14). Feasibility study report submitted to Prime Minister, decisions made on government support and guarantees, and final decision made by MPI and MOF (Article 18). Cost of feasibility study eligible for government support (Article 6) => Cost of preparing feasibility studies paid later by chosen investors.	Basically, the regulators have responsibility for the project list. The Prime Minister approves feasibility study reports for projects involving amounts of investment of more than VND 1.5 trillion, those involving expropriation of 200 hectares or more in land, and those requiring government guarantees (Article 12). Feasibility study paid for by private-sector investors (Article 8).	
Land Expropriation		Compensation, land expropriation, and relocation expenses paid for by private-sector investors, except for urgent projects as defined in Article 6 (Article 30).	

	Prime Minister Decision No. 71 QD-TTg on Public-Private Partnership Investment Piloting (2010)	Government Ordinance No. 108 New BOT law (2009)	Notes
Charges	Application made to regulators for revision of charges based on costs, profit, users, and national policies (Article 37)	Same as at left (Article 33) Government guarantees for charges (Article 34)	Setting and revision of charges both effectively prescribed by MOF regulations
Incentives	Mitigation, reduction, and exemption from corporate taxes, import duties, and land use charges (Article 41)	Same as at left (Article 38)	
Competitive Bidding and Selection Criteria for Selection of Investors	Competitive bidding (no explicit noncompetitive terms) Selection criteria not described in particular.	While competitive bidding is used in principle, noncompetitive measures are used in some cases. Selection criteria (e.g., capabilities, experience) prescribed by lower-level laws and regulations.	For investor-proposed projects, even the investor that proposed the project formally faces conditions identical to those of other investors.
Related Institutions etc.	MPI, MOF, Ministry of Justice (MOJ), State Bank of Vietnam (SBV), etc. Authorization of MPI strengthened. Inter-sectoral Task Force formed.	MPI, MOF, MOJ, local-level people's commissariats, etc. Inter-branch working group formed.	While under the BOT law the inter-branch working group basically handles operations after project selection, under the PPP law the ITF is expected to take part beginning at a stage prior to public announcement. => It is difficult to coordinate interests among agencies in a large-scale project.

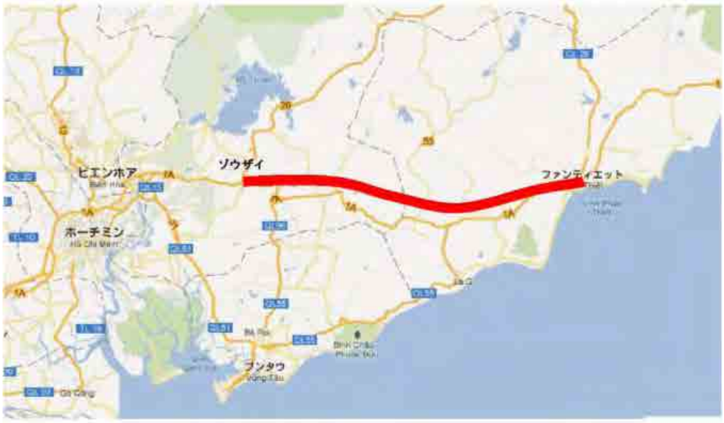
Source : Survey team

(1) Public-Private Partnership (PPP) Expressway projects in Vietnam

In the listed projects under PPP scheme, Dau Giay-Phan Thiet Expressway is the only "PPP" project under taken by the private company and approved by Prime Minister supported by WB.

The outline of this project is as follows:

Table 2.3.1-2 Outline of Dau Giay-Phan Thiet Expressway Project

Name of Project	Dau Giay-Phan Thiet Expressway
Outline	The Project is important section in Southern Vietnam connecting Phan Thiet city and Dau Giay where it extends to National Highway No.1 A . Total length is about 101km with 4 lanes in the 1st phase and 6 lanes in the 2nd phase at road grade A. Design speed is 100km/h- 120km/h There are 9 interchanges, 15 bridges traversing rivers, 19 flyovers and 12 over-bridges. ITS including ETC and traffic management system and service area are to be installed. 
Total Cost	23,223 billion VND
Executing Organization	Decision 1495/BGTVT dated July, 2011, original investors were changed as follows: The first investor: BITEXCO (Binh Minh Import-Export Co.) The second investor: one selected through international competitive bidding
Implementing Scheme	As this is the first PPP project in Vietnam financed by WB, the final implementing scheme will be decided after the international consultant selected by WB reviewed it.
Funding	Investment from local and foreign investors. Loan from national budget and WB.
Construction Schedule	4 years of construction period after starting in 2012

Source: Mayer Brown Publications, 10 August 2010,"Vietnam's First Trial PPP Project"

On 21 February, 2012, with the support of consultants from WB, MOT completed a draft mechanism for pilot management and implementation of the Dau Giay-Phan Thiet Expressway Project under PPP and sent it to the relevant agencies (Ministry of Planning and Investment, Ministry of Finance, WB, the first investor of BITEXCO, and members of the interdisciplinary working group) for comment.
At this point, the mechanism has been completed and is still waiting for government approval before implementing the next step.

Basically, the project implementation mechanism is described as follows:
Principles and application mechanism:

1. The first investor is the limited liability company – BITEXCO group (because this unit has activity studied FS for the project from the first time).
2. The second investors were selected through international bidding in accordance with the mechanism and the sponsor's instructions. The second investor and the first investor form a business to conduct the project.
3. The equity of each investor in the project shall not be less than 20% of the total construction cost. The proportion of owner's equity participation between investors will be agreed upon based on the resources of each investor during the process of implementation.
4. Compensation for land acquisition, resettlement, relocation of social-welfare facilities, and the cost of mine clearance are made by the State budget in accordance with the provisions of Vietnamese law and donor requirements.
5. The government will bail out for the first investor to borrow from the WB's IBRD and this is one of the main incentives for investment projects. IBRD loans are counted as the investor's participation in the project.

Capital for the project is as follows:

1. Capital mobilized by the private sector includes:
   a) Corporate equity contributed by investors.
   b) The WB's IBRD loans guaranteed by the government for the first investor.
   c) Other capital arranged by project coorporation and the investors themselves.
2. Capital mobilized by the government includes:
   a) Viability Gap Fund (hereinafter VGF) for the project: to be determined through the international bidding process conducted by MOT and approved by the Prime Minister

in accordance with the mechanism. VGF for this project will be arranged through the WB International Development Association (hereinafter IDA) loans.

b) State budget will be used to pay for the land acquisition, compensation, support and resettlement, demining, relocation of facilities and infrastructure construction costs (if any) to implement the project.

c) Funds from international donors comply with the relevant agreements between the donors and the Government of Vietnam.

2.3.2. Collection of tolls on toll roads

Existing regulations related to collection of tolls on toll roads in Vietnam are as outlined below.

(1) Ordinance on Charges and Fees No. 38/2001/PL-UBTVQH10 of August 28, 2001

(2) Decree No. 57/2002/ND-CP of June 3, 2002 stipulating details in the implementation of the Ordinance on Charges and Fees

(3) Decree No. 24/2006/ND-CP of the Government on amendment and supplement to some articles of Decree No. 57/2002/ND-CP of the Government dated 03/06/2002 providing in detail the implementation of the Ordinance of Fees and Charges

(4) Circular No. 109/2002/TT-BTC of December 6, 2002 guiding the regime of collection, remittance, management and use of road tolls

(5) Circular No. 90/2004/TT-BTC of September 7, 2004 guiding the regime of collection, remittance, management and use of road tolls (replaces Circular No. 109/2002/TT-BTC)

The above detailed rules on implementing collection of road tolls (Circular No. 90/2004/TT-BTC) constitute an official notice from the MOF concerning the system of collection, remittance, management, and use of road tolls. Key points of the system of collection of tolls on existing toll roads prescribed by these detailed rules are listed below:

(1) Tolls on roads for which investment was provided from the government budget shall be standardized at all toll booths as prescribed in the toll table attached to the detailed implementation rules.

(2) The face value of passes issued for passenger vehicles (with seating capacity of 12 persons or fewer) shall be VND 10,000 per passage.

(3) The distance between two neighboring toll booths shall be no less than 70 kilometers.

(4) Tolls for roads and other facilities funded using private-sector funds such as BOT facilities shall not exceed double the tolls on roads for which investment was provided from the government budget.

(5) Firms handling collection of road tolls may deduct and retain a part of such tolls based on the prescribed percentage (%) prior to delivering collected tolls to the national budget.
(6) Firms collecting road tolls may deduct 20% of tolls collected. Of this 20%, 5% shall be remitted to the Directorate for Roads of Vietnam (DRVN) as funding for investment in modernization of toll-collection technologies and the remaining 15% shall be used for toll-collection work.

A recent development is the approval by the Prime Minister of Vietnam at the end of November 2012 of a policy for increasing tolls, proposed by the MOT. According to this policy, by 2016 the amount of tolls will increase by 3.5 times from the toll levels prescribed in Circular No. 90/2004/TT-BTC from the MOF. The toll for passenger vehicles with seating capacities of 12 persons or fewer will rise from the current level of VND 10,000 per passage to VND 35,000 per passage, and the toll for trucks with capacities of 18 tons or more will rise from VND 80,000 per passage to VND 280,000 per passage. The MOT plans to increase tolls first on the widened segment of National Highway No. 1 (between Hanoi and Can Tho) and on the Ho Chi Minh Highway (in the Thai Guyen segment).

The toll collection system on the HCMC-Trung Luong Expressway in service in southern Vietnam employs a closed method in which entry and exit at special expressway interchanges are controlled and tolls are charged by distance travelled. MOF Report No. 77/BC-BTC dated 28 July, 2009 prescribes tolls on the HCMC-Trung Luong Expressway, setting a level of VND 1,000 per kilometer for passenger vehicles with seating capacities of 12 persons or fewer. Tolls for other vehicle types are set based on the percentage differences in tolls by vehicle type prescribed in Circular No. 90/2004/TT-BTC. In addition, during the period they collect tolls on these roads the operators are permitted to revise tolls by increasing them by 30% every five years.

2.4. Status of the subject area of the Project

(1) Current status of the social infrastructure in the southern region

1) Roads

The major routes in Ho Chi Minh include NH1, connecting to Hanoi, and NH22, leading to Cambodia. NH1 was the only route connecting to the Don Nai Province (two lanes on each side).

Construction of the main highway in the east-west direction, including the tunnel crossing the Saigon River, was undertaken in order to mitigate traffic congestion and then completed in 2011 under a yen loan project (the Saigon east-west highway construction project, which started in 2000). This road is a 22 km-long urban expressway that runs across the city, and each end of the road connects to NH1 in the southwest and northeast of Ho Chi Minh. This expressway is expected to help reduce the number of vehicles flowing into the metropolitan area, and as a result, relieve traffic congestion.

Moreover, a 55 km-long expressway connecting the east-west highway to Dau Giay through NH51 (Long Thanh City) is also under construction as a yen loan project, and is expected to open in 2014. This expressway will make it possible for drivers to travel between Ho Chi Minh and Long Thanh in about one hour. It is also expected that the commutation area will expand dramatically because of the connection with Ring Road No. 2.

NH22 is a two-lane pavement road, which is about 60 km long or one hour's drive from the suburbs of Ho Chi Minh to the Cambodian border. The section from the city to the suburbs, which is currently under expansion, is another hour's drive. In addition, NH50 connects Ho Chi Minh to the end of Long An Province, while NH51 connects Bien Hoa to Vung Tau.

2) Public Transport

In response to the survey results showing that 75% of the means of transportation in Ho Chi Minh are motorcycles, the Ho Chi Minh People's Committee intends to reduce the volume of motorcycles by 25% from the current level by 2010 and lower the percentage to 50% by 2020. It also aims to further mitigate the city's traffic congestion and air pollution through the construction of the east-west highway and subway.

Ho Chi Minh City is proceeding with the construction of Subway Line No.1, which began in 2010, with the support of ODA from Japan. This subway line, which is expected to open in 2014 or 2015, is an urban railway connecting the Ho Chi Minh metropolitan area (Ben Thanh) to the northeast part of the city (Suoi Tien) (19.7 km of total distance, which includes 2.6 km of underground lines) (subway and elevated railroad). It has also been reported that there is an initiative on the construction of Subway Line No. 2 to No. 7, which has attracted the attention of China, Germany, France, Russia, and Australia as well as Japan, according to the Ho Chi Minh subway development plan.

3) Railways

Railways in southern Vietnam include the North-South Vietnam Railway, which runs vertically through the country. The entirety of this 1,726 km single railway operates about ten daily trains linking Ho Chi Minh and Hanoi at a time of about 30 hours. Although the locomotives, passenger cars, and freight cars are shabby and the performance of railway stations is poor, this railway service is convenient for transporting heavy and high-volume goods because of the low cost.

4) Ports

Saigon Port, which consists of 24 harbors along the Saigon River, handles a large amount of cargo and containers. However, because it is a river port, it is only accessible to ships weighing up to 30,000 tons. As the port is a 10-minute drive from Ho Chi Minh City, it faces challenges with traffic jams, requiring the implementation of traffic controls for large vehicles. In order to respond to the increase in volume of cargo handled at the harbors following the economic expansion, development of Cai Mep - Thi Vai International Ports began along the Thi Vai River in Baria - Vung Tau Province, with investment by public and private participants, to serve as an international gateway. Of the 26 berths in all the projects, two private ports have already been opened.

5) Airports

Tan Son Nhat International Airport, which is located about 7 km from the downtown area of Ho Chi Minh, has two 3,000 m-long runways. In response to the rising demand for international flights, a new terminal was built beside the airport land with ODA from Japan and opened in September 2007. The new, four-story terminal has a floor area of 100,000 m^2 and is capable of handling 8,000,000 to 10,000,000 passengers. Although the existing terminal is currently used for domestic flights, Tan Son Nhat International Airport is expected to be filled to capacity within a few years. Thus, the New Long Thanh International Airport is planned to be built about 25 km east of Ho Chi Minh City.

6) Telecommunication

There are no serious power shortages in Ho Chi Minh and the surrounding area because electricity is supplied through the gas-fired power station in Vung Tau. Although ADSL has been developed, communications sometimes fail at heavy traffic hours because of the small line capacity.

7) Southern Industrial zone

The south of Vietnam is home to many industrial parks, export processing zones, and hi-tech parks in which many Japanese companies have made great investments. Around 60% of the total investments in the southern area are concentrated in Ho Chi Minh City, Don Nai Province, and Binh Duong Province. Characteristically, a number of industrial parks are built along NH1 around Ho Chi Minh and the border of Binh Duong Province and along NH13, which runs through the country from south to north.

(a) Dong Nai Province

i) Area and population of Dong Nai Province

Area: 5,903.940km2 (1.76% natural area of the whole country)

Population: 2,483,211 people (2009)
Population density: 386.511 people per square kilometers (2009)
Divided into sex: Male 1,232,182 people Female 1,251,029 people (2009)
Birth rate of the province in 2008 is: 15.24%

ii) Economic structure growth and transformation of the province

A high economic growth rate is maintained, economic structure transformation is performed properly and is improving the socio-economic infrastructural structure gradually and promoting the processes of industrialization and modernization.

The Gross Domestic Product (hereinafter GDP) increased to 13.2% per year on average. Therein, industry and construction increased to 14.5% per year, service increased to 15% per year, agriculture, forestry, and seafood increased to 4.5% per year. Although the resolution goals (14 – 14.5% per year) were not met for the above GDP increase rate, it was still higher than the increase of 12.8% per year during the period of 2001 to 2005, 1.5 times higher than the growth rate of the Southern key economic area, and 1.9 times higher than the general growth rate nationwide.

GDP per capita (upon actual price until 2010 up to 29.6 million Vietnam dong (equal to US$ 1,629)) increased 2.1 times higher than that of 2005 and beyond the resolution goal (29,4 million Vietnam dong).

conomic structure continued to transform in a positive way, in the right orientation and meeting specified goals. The GDP structure in the sector was transformed along with the direction of gradual increase in industry density - construction from 57% in 2005 to 57.2% in 2010, and service from 28% to 34.1%, with agriculture, forestry and seafood dropping from 14.9% to 8.7% in 2010. Economic structure in the economic sector was transformed along with the direction of gradual reduction in the contributive density of the state economic sector in GDP (from 24.7% in 2005 to 19% in 2010) and an increase in that in the GDP of the private economic sector (from 75.2% to 81%), in which there was a strong increase in foreign-invested economic sector (from 39.2% to 43%).

In parallel with the process of transformation of the economic structure, the labor structure saw strong transformation along with direction of reducing labor density in agriculture from 45.5% in 2005 to 30% in 2010. Non-agricultural labor increased from 54.5% in 2005 to 70% in 2010.

iii) Industry

Industrial production developed well along with the direction of modernization, and there were strong increases in production capacity. The production value of the whole sector increased to 18.1% per year on average, of which foreign-invested enterprises made up

83.8%. The internal structure of the industry underwent transformation in a positive direction, with the group of key industrial sectors accounting for over 70% of the production value of the whole sector, and achieved a growth rate was of 20% year. At the same time, it developed some high-tech industrial sectors (production of high quality electronic spare parts, some automobile parts, medical scanners, cosmetics etc).

The construction area achieved rather positive results. Construction output value increased to 20% per year on average, and the operational capacity of the sector showed progress both in the construction and manufacturing force of building materials, meeting the development requirements of the economy.

The planning and development of industrial parks was promoted and proved to be efficient. Eleven industrial parks were developed in the past five years, and at present, there are 30 industrial parks with an area of 9.573ha. Out of these, about 61% of the land area is leased (higher than the 47% nationwide and the 56% of the Southern key economic area).

The industrial parks play a very important role in the development of the industrial sectors as a motivational force for the process of urbanization, and they serve to facilitate remarkable contributions into local socio-economic development.

iv) Trade and service

The trading area developed rapidly. There were many supermarkets being built and commissioned, and the retail market was well utilized, meeting people's consumption demands. The total value of retail sales of goods and services increased to 26.9% per year on average. Special attention is paid to trade promotion, which contributed to supporting enterprises in discovering and expanding their markets. Total export turnover in 2010 acquired more than 7 billion USD (accounting for about 10% of total export turnover nationwide), increasing to 17.2% per year on average (higher than 16.6% than 5 years ago). The structure of export articles was mostly focused on industrial goods with a density of over 87%. Import turnover increased to 12.2%/year on average.

Service activity developed rather rapidly in some areas in scale, professions, and market thanks to the participation of the economic sectors. Added value increased to 15% per year on average (higher than the GDP growth rate in the region), contributing to employing more than 191 thousand employees working in service sectors until 2010, which makes up 30.9% of the total employees working in society. Some high quality services were developed, as were services for the industrial parks, and the quality of public transportation services were improved. A powerful information communications system was developed. Telephone subscription density per 100 people was increased up to 103 subscribers by 2010 (4.3 times greater than in 2005) and internet subscription density to 30 subscribers (7.7 times greater than in 2005).

v) Agriculture

The production value increased to 5.6% per year on average (higher than 5 years ago). The agricultural land use coefficient increased from 1.27 times in 2005 to 1.37 times in 2010. Average production value per 1 ha farming land in 2010 was 49.8 million VND, more than 2.4 times what it was in 2005

vi) Investment environment

The investment environment has improved considerably, so there were rather positive results in attracting foreign and domestic investment. Total foreign direct investment attracted over a 5 year period reached more than 11 billion USD, accounting for over 60% of the total Foreign Direct Investment (hereinafter FDI) from 1991 until now.

High results were achieved in the mobilization of resources for development investment. Total development investment for a five year period reached more than 121 thousand billion VND, making up 45% of the annual GDP (beyond the resolution goal). There were also positive transformations in investment structure, in which domestic investment made up 48% of the total investment, mostly from inhabitants, the private sector, and credit capital. Apart from investment of budget, which despite its small density (7.4%) is a key source of capital for investment in infrastructural structures and social infrastructures, especially in infrastructure for agriculture, rural areas, medical fields, education projects, key works, important fields, etc., creating a basic motivational force for the process of socio-economic development of the province.

The total budget revenues for the five year period reached 61 thousand billion VND, increasing 12.5% per year on average. The rate of budget revenue on annual GDP is 23%. Total budget expenditure for five years reached 24 thousand billion VND, increasing 9.1% per year on average, of which development investment made up more than 32%.

b) Ba Ria-Vung Tau Province

Baria - Vung Tau Province, with a population of about one million people, is located in the southeast of Ho Chi Minh City. This area is well known in Vietnam as a tourist region, developed by France during the colonial period about 100 years ago, and the marine industry, including fisheries, was developed long ago. The current major industries of the province include tourism, fishery, oil fields, steel, and electricity. In particular, the energy industry for oil and gas development has achieved the greatest level of development in Vietnam, and electricity and steel production is first place countrywide. Moreover, harbor development has been emphasized in recent years. Thanks to the development of the new

Cai Mep - Thi Vai International Ports, direct ships to North America began operation, enabling transportation without using intermediate port, such as Singapore, Hong Kong, and Taiwan. The existing harbor functions of Ho Chi Minh will be transferred into this port in the future. Centering on harbor development, the Province is promoting a shift from an agricultural population to an industrial population, in the aim of becoming an area where modern industry is integrally developed with harbors for physical distribution.

The oil development sector is controlled directly by the central government. With regard to the heavy and chemical industry sector, investments have been made in over 10 projects by corporations, including China Steel (Taiwan) and Posco (South Korea); however, there are a few projects in the supporting industries that have received investment.

With regard to industry parks that have been developed in the Province, 14 parks are presently open and half of the total foreign investment in the Province covers the costs of corporate entry to these industrial parks.

On the other hand, the Province regards the development of supporting industries as an important issue and focuses on supporting the development of technical workers in order to shift the business from agriculture to industry. The monthly wage for plant workers in this province is about 2 million dong (about 8,000 yen) to 3 million dong (about 12,000 yen), which is nearly half the level of Ho Chi Minh City, the area with the highest labor cost.

2.5. Current Status of Foreign Companies

Foreign companies, especially South Korean and Chinese companies, are participating in business- related expressway development in ways such as consulting service for survey and design, as contractors for civil works, and construction management in the construction stage.

In term of investment plans, Noi Bai-Ha Long Expressway Project is listed and the Economic and Technical Cooperation International Guanxi (GITEC) from China is conducting a feasibilitiy study.

Also, for the Dau Giay-Lien Khuong Expressway Project, South Korea’s Incheon Urban Development Corporation (hereinafter IUDC) made a memorandum of understanding (hereinafter MOU) with MOT for investment of approx-imately. 1 billion USD and plans to build and operate under the BOT scheme.

2.6. Necessity of the Project

The studied area is located in the Southern Key Economic Zone (hereinafter SKEZ) including the provinces of Dong Nai, Binh Duong, Ba Ria-Vung Tau, Tai Ninh, Binh Phuoc, and Long An, as well as HCMC.

This region has achieved the highest economic growth rate in the country and contributes the most to the national economy. It is a hub for gathering and transport by road and aviation, it plays role of an international gateway, and it attracts foreign investment. The infrastructure, especially transportation infrastructure, plays an important role in ensuring the development of the region, and it is the main driving force thereof.

Currently, there are many transport infrastructure improvement projects in progress as improvement projets for major national highways in this region, including the National Highway 1A development project, National Highway 51 widening project, National Highway 22 (HCMC-Moc Bai section) development project and many others.

However, in the country and this economic zone, there are still transport infrastructure situations that would support the increasing demand of social growth but that have not been satisfied yet.

According to the transportation sector development strategies (2020-2030) approved by the Prime Minisier (Decision No.35/2009/QD-TTg dated 3 March 2009), transportation infrastructure in the SKEZ will be developed for regional transportation improvement.

Some examples are the Ho Chi Minh-Long Thanh-Dau Giay Expressway Projects (under construction), the Ben Luc-Long Thanh Expressway Project (in detailed design), and the Bien Hoa-Vung Tau Railway Project (in the plan) in progress.

The BHVT Expressway project has been planned since 1996. MOT announced the approval of this project in Decision No.1949/QD-BGTVT, dated 2 July 2010, after the approval of the Prime Minister (official later No.298/KTN dated 24 January 1996).

Then, MOT has selected BVEC as an investor for the BHVT expressway project in order to meet the demands of the transportation infrastructure and ensure the regional socio-economic development plan.

The BHVT Expressway plays a very important role. This route will be the main factor in speeding up the economic development, and it plays an important role for the region and the country as well. This route is going to be constructed to bear the NH51 traffic burden and enhance the transport capacity from HCMC to ports and vice-versa. The construction of this expressway is a premise for developing industry Zones (IZs), the urban zones of the region and helping to complete the transport infrastructure, which is considered one of the most important factors in building up the international airport-Long Thanh as well as other transport hubs. As the eastern hub of HCMC, Long Thanh Airport is designated to share transport pressure with the Tan Son Nhat Airport, and accordingly, the urban transport of HCMC will also be improved. Not only will transportation activities benefit, but if done early, the BHVT Expressway will facilitate the development of the urban satellites of HCMC such as Long Thanh, Nhon Trach, Phu My, and so on.

At the same time, the importance of this expressway is deeply related to the Cai Mep - Thi Vai International Ports Project. In recent years the Cai Mep - Thi Vai deep-water port area’s role as a hub port has attracted attention in light of the limitations on cargo handling capacity at the Saigon and Cat Lai port areas. It is attracting particularly strong attention from the sea transport and trucking industries. Companies located in industrial parks in surrounding areas such as Ba Ria-Vung Tau, Dong Nai, and Binh Duong provinces, and those located in industrial parks in Ho Chi Minh City, expect to use the Cai Mep - Thi Vai deep-water port area as a main logistics facility, and as such this expressway is expected to be used for access from the industrial park to the deep-water port area. The deep-water port area is seen as a promising candidate for a future hub port with a sphere of influence extending as far as Cambodia, new industrial parks are planned in the SKEZ, an important economic zone in southern Vietnam, and use of the Bien Hoa-Vung Tau Expressway can be expected to increase more and more, including increases arising as a result of synergy effects with the Cai Mep - Thi Vai Port.

2.7. Economic Growth Forecasts, Projections, etc. for the Project Target Region

1) Current conditions

The average annual growth rate in the SKEZ where this project is located is 12%, and this zone accounts for 60% of Vietnam's industrial production, 70% of its export income, and 40% of its GNP.

The SKEZ is an important region as a target for investment in Vietnam, and 54% of the total amount of FDI in the nation over the past 20 years has been invested in this SKEZ region. Although FDI in Vietnam fell in 2009 to one-third the level of the previous year as a result of the global economic crisis, FDI in the SKEZ remained strong.

A look at current conditions shows that economic growth in Vietnam as a whole slowed in 2012 due to continued tight monetary policies intended to restrain the high inflation of the previous year, although these policies were successful at keeping inflation down. As a result, economic conditions in Ho Chi Minh City, the leading district in the southern region, clearly slowed from 2011, but it has been announced that the rate of growth in gross domestic product (GDP) in 2012 is projected to be a little over 9% in the region (The rate is 5% for the nation as a whole). While there is a variety of factors that conceivably could be important drivers of economic growth in Ho Chi Minh City, since FDI has not fallen much and personal consumption is strong, economic growth in the city can be said to be markedly more vibrant than in other cities and rural communities in Vietnam.

2) Future economic growth

The "Socio-Economic Development Strategy for 2011-2020" approved in the 11th Congress of Vietnam Communist Party in January 2011 identified as an overall goal for the nation making Vietnam basically a modern industrial state by 2020. The nation's political and social conditions are stable and marked by consensus. Democracy, order, and the material and psychological standards of living of the citizenry are improving. The country is able to preserve its independence and sovereignty and maintain its territorial integrity, and Vietnam's position in international markets is strengthening. Now it is identifying as a goal the creation of a strong foundation for the next stage.

Vietnam's targets in the field of economics are listed below:

- Strong productivity growth, building appropriate production relationships, and integrating a market economy with a socialist orientation.
- Linking economic growth to environmental protection, and growing the green economy.
- Shifting the growth model based on broad-ranging development to a growth model based on development with balance between breadth and depth, focusing on improving quality and efficiency while growing in scale.
- Promoting economic structural transformations, realizing economic restructuring, and in the process of doing so promoting coordination of restructuring of enterprises with market power, focusing chiefly on restructuring in each production and service field in economic zones, to improve domestic production as well as economic value added and competitive strength in products and other areas.
- Achieving the target of an average rate of growth in gross domestic product (GDP) of 7 – 8%/year.
- Growing GDP in 2020 to 2.2 times its 2010 level.
- Achieving real GDP per capita of USD 3,000 – 3,200.
- Securing macroeconomic stability.
- Building modern, effective industrial, agricultural, and service economic structures.
- Ensuring that the relative importance of industry and services to total GDP is roughly 85 percent.
- Achieving a value of high-technology products accounting for approximately 45% of total GDP.
- Ensuring that the value of manufacturing-industry products accounts for approximately 40% of industrial production.
- Developing agriculture in the directions of modernity, effectiveness, and sustainability and supplying numerous high-value-added products.
- Ensuring that workers in the agricultural field account for 30% of all workers in society.
- Achieving a contribution of total productivity to growth of no lower than 35% and a rate of reduction of 2.5 – 3%/year in energy consumption attributable to GDP.
- Realizing savings in use of all resources.

- Integrating infrastructure-related structures and completing a number of modern construction projects.
- Achieving an urbanization rate of 45% or higher.
- Achieving a rate of approximately 50% of all villages satisfying the “new village” standards.

Economic growth in the SKEZ, the target region of this project, is expected to drive achievement of these national-level economic-growth numerical targets as well, and furthermore there also are plans for intensive investment in infrastructure development in this region.

3. Study and Proposal on Implementation Plan

3.1. Objectives of the Project

3.2. Review of the scope of the Project

3.3. Issues related with structuring Project Schemes

3.4. Study on risks

3.5. Proposed Project Scheme and Issues to consider

3.6. Economic and Financial analysis

3.7. Government Support

3.8. Examination of Security Package

3.9. Term Sheet on Major Contract Conditions

3.10. Status of discussion with Vietnamese stakeholders

3.11. Suggested next step

Note: Chapter 3 (Page 3-1 to Page 3-100) in this report is not disclosed, because they contain relevant information such as confidentials on the commercial and contract.

4. Implementation of survey and review for improvement of project viability and profitability

4.1. Traffic Demand Forecast

4.1.1. Traffic Survey

Traffic survey consisted by roadside survey and logistics interview survey was carried out to understand the present traffic condition around the study area and to obtain the basic data for the traffic demand forecast. Overview of the conducted traffic survey is shown in Table 4.1.1-1.

Table 4.1.1-1 Overview of Traffic Survey Components

Survey Type	Objectives	Description of Survey		Quantity
		Hour	Day	
(1) Roadside Traffic Survey	To obtain the actual traffic volumes and trip information around the study area	-	-	-
i) Traffic Volume Count Survey	To obtain traffic volumes by vehicle classification	24 hours from 7 A.M.	2 selected days	6 stations (on NH51)
		16 hours from 7 A.M.	1 typical weekday	12 stations
ii) Origin – Destination (OD) Interview Survey	To capture trip information by sampling interview	16 hours from 7 A.M.	1 typical weekday	6 stations (on NH 51)
		12 hours from 7 A.M.	1 typical weekday	12 stations
(2) Logistics Interview Survey	To capture trip behavior and demand for the expressway of logistics sector by sampling interview	-	-	-
i) Interview to Industrial Park management company	To capture overall profile and current trip information of each IP, and their future plan	-	-	70 companies
ii) Interview to Industrial Park tenant company	To capture current trip information, future plan and demand for the expressway	-	-	402 companies
iii) Interview to port management company	To capture current trip information, future plan and demand for the expressway	-	-	21 companies

Source: JICA Study Team

(1) Roadside Traffic Survey

1) Implementation

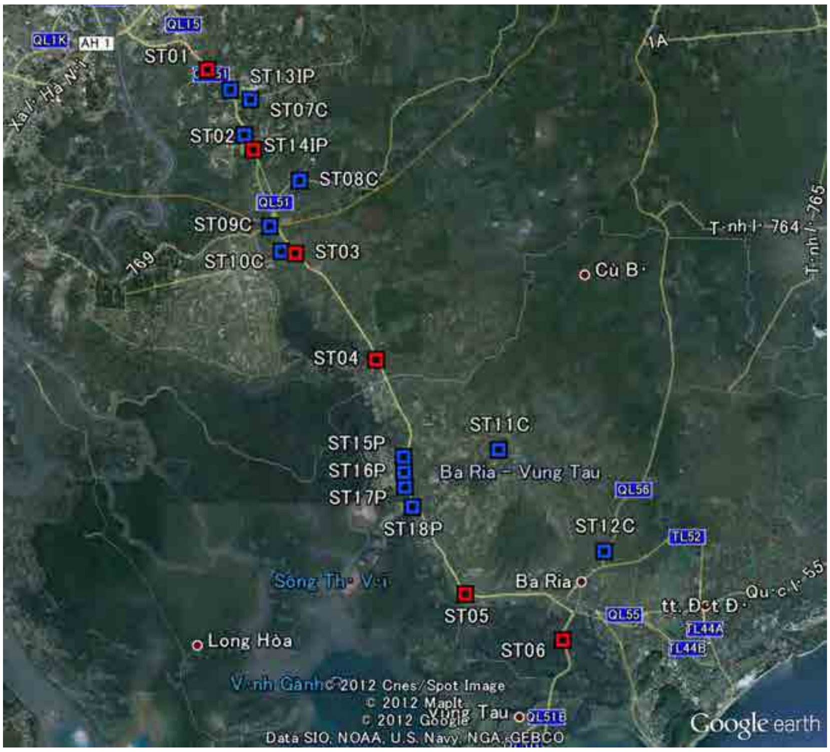
<u>Location</u>

Roadside traffic survey was carried out at 18 stations, including 6 stations on NH51 and the others on its connecting roads, as shown in Table 4.1.1-2 and Figure 4.1.1-1.

Table 4.1.1-2 Location of Roadside Traffic Survey Station

Station ID	Road No.	Description of Location (Between / Landmark)	
ST01	NH51	Intersection of NH51 and NH15	Entrance of KCN Tam Phuoc
ST02	NH51	Entrance of KCN Long Thanh	North end of split of NH51
ST03	NH51	Access to Khon Trach (North	Phuoc Thai
ST04	NH51	Phuoc Thai	Entrance of KCN Go Dau
ST05	NH51	Entrance of Cai Mep Port	Diversion to Long Son
ST06	NH51	Ba Ria	Vung Tau
ST07	(Rural Road)	Rural road on south of KCN Tam Phuoc	
ST08	PH769	PH769	
ST09	(Access Road)	Access to Khon Trach (North)	
ST10	(Access Road)	Access to Khon Trach (South	
ST11	(Rural Road)	Tân Thành	Châu Pha
ST12	NH56	NH56	
ST13	(Access Road)	Entrance of KCN Tam Phuoc	
ST14	(Access Road)	Entrance of KCN Long Thanh	
ST15	(Access Road)	Entrance of Thi Vai Port	
ST16	(Access Road)	Entrance of Thi Vai Port	
ST17	(Access Road)	Entrance of Thi Vai Port	
ST18	(Access Road)	Entrance of Cai Mep Port	

Source: JICA Study Team



Source: JICA Study Team

Figure 4.1.1-1 Location Map of Roadside Traffic Survey Station

Schedule

Survey had been conducted from April 20, 2012 until May 5, 2012. Traffic count survey was continuously carried out for 48 hours from Friday morning at the stations on NH51, to see the fluctuation of traffic volume for weekday and holiday. For the other stations, traffic count survey was carried out for 16 hours on a typical weekday.

OD interview survey was carried out from morning on a weekday, for 16 hours at the stations on NH51, and for 12 hours at the others.

Table 4.1.1-3 Schedule of Roadside Traffic Survey

Station ID	Traffic Count Survey		OD Interview Survey
	Weekday	Holiday	
ST01	April 20, 2012 (Fri)	April 21, 2012 (Sat)	April 20, 2012 (Fri)
ST02	April 20, 2012 (Fri)	April 21, 2012 (Sat)	April 20, 2012 (Fri)
ST03	April 20, 2012 (Fri)	April 21, 2012 (Sat)	April 20, 2012 (Fri)
ST04	May 04, 2012 (Fri)	May 05, 2012 (Sat)	May 04, 2012 (Fri)
ST05	May 04, 2012 (Fri)	May 05, 2012 (Sat)	May 04, 2012 (Fri)
ST06	May 04, 2012 (Fri)	May 05, 2012 (Sat)	May 04, 2012 (Fri)
ST07	April 23, 2012 (Mon)	-	April 23, 2012 (Mon)
ST08	April 24, 2012 (Tue)	-	April 24, 2012 (Tue)
ST09	May 03, 2012 (Thu)	-	May 03, 2012 (Thu)
ST10	April 24, 2012 (Tue)	-	April 24, 2012 (Tue)
ST11	April 25, 2012 (Wed)	-	April 25, 2012 (Wed)
ST12	April 25, 2012 (Wed)	-	April 25, 2012 (Wed)
ST13	April 23, 2012 (Mon)	-	April 23, 2012 (Mon)
ST14	May 03, 2012 (Thu)	-	May 03, 2012 (Thu)
ST15	April 24, 2012 (Tue)	-	April 24, 2012 (Tue)
ST16	April 24, 2012 (Tue)	-	April 24, 2012 (Tue)
ST17	April 25, 2012 (Wed)	-	April 25, 2012 (Wed)
ST18	April 25, 2012 (Wed)	-	April 25, 2012 (Wed)

Source: JICA Study Team

Methodology

i) Traffic Count Survey

Surveyors sitting roadside recorded the number of vehicles passing through the road by direction on the prepared survey form. Vehicles were classified into 11 types as listed below. The traffic volume was recorded every 15 minutes.

Classification of vehicle type

- Bycycle
- Motorcycle
- Car, Van, Taxi
- Mini Bus ($\leq$ 24 seats)
- Large Bus ($\geq$ 25 seats)

- Pickup truck
- 2-Axle truck
- 3-Axle truck
- 4 or more axle truck
- Trailer truck
- Others

ii) OD Interview Survey

Vehicles were flagged down by police and were lead to roadside space for safe interview. The driver was then interviewed based on the questionnaire. Interview items consist of 1) origin and destination of the trip, 2) trip purpose, 3) number of passenger, 4) willingness to pay, and for freight traffic, 5) loading capacity, 6) loading type, 7) loading status, and 8) commodity type.

Source: JICA Study Team

Picture 4.1.1-1 Survey Photos of Roadside Traffic Survey

Survey Result

i) Traffic Count Survey

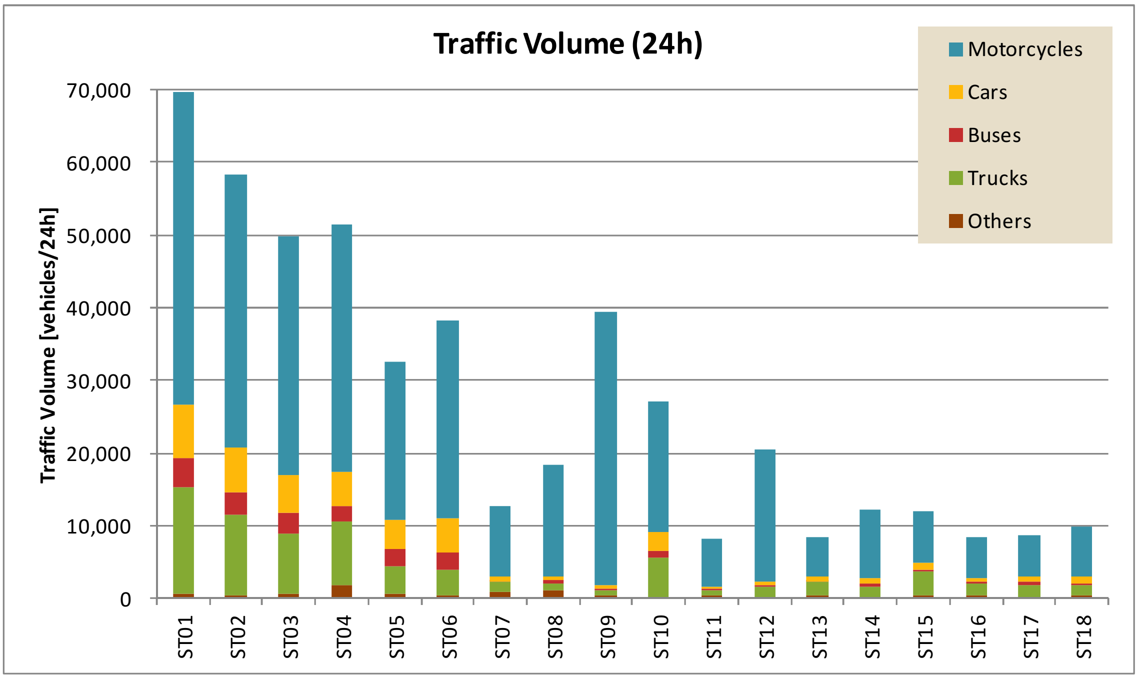
Survey results are shown in Table 4.1.1-4 and in Figure 4.1.1-2. Traffic volume is larger in the northern section of NH51, and becomes smaller in the southern section. The access roads to Khon Trach (ST09 and ST10) have larger traffic, compared with other roads except NH51.

Table 4.1.1-4 Result of Traffic Count Survey (24 hours)

Station ID	Motorcycle	Car	Bus	Truck	Others	Total
ST01	43,010	7,422	4,051	14,594	670	69,747
ST02	37,686	6,208	3,021	10,976	483	58,374
ST03	32,838	5,252	2,883	8,315	579	49,867
ST04	34,017	4,718	2,312	8,688	1,803	51,538
ST05	21,787	4,137	2,326	3,736	664	32,650
ST06	27,092	4,784	2,376	3,672	278	38,202
ST07	9,872	634	49	1,264	953	12,772
ST08	15,214	587	348	1,093	1,025	18,267
ST09	37,559	532	195	788	317	39,391
ST10	17,976	2,613	900	5,328	202	27,019
ST11	6,717	312	82	735	415	8,261
ST12	18,344	511	210	1,262	251	20,578
ST13	5,354	677	148	1,748	474	8,401
ST14	9,517	802	394	1,353	227	12,293
ST15	7,293	844	289	3,335	301	12,062
ST16	5,485	647	162	1,701	341	8,336
ST17	5,891	681	283	1,701	224	8,780
ST18	6,978	837	241	1,526	316	9,898

Note: Result of 16 hours survey (at ST07~ST18) were expanded based on the 24 hours survey result at the closest station.

Source: JICA Study Team



Note: Result of 16 hours survey (at ST07~ST18) were expanded based on the 24 hours survey result at the closest station.

Source: JICA Study Team

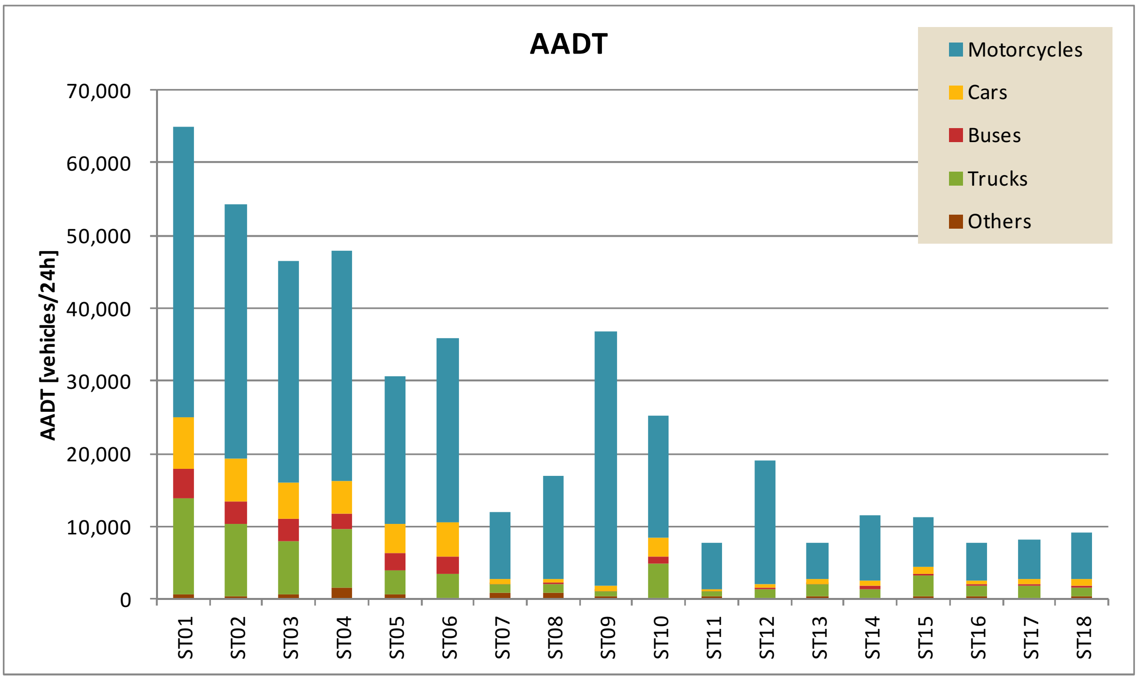
Figure 4.1.1-2 Result of Traffic Count Survey (24 hours)

The result was converted into Anual Average Daily Traffic (AADT) by incorporating the daily traffic volume data at toll collection gate on NH51 since 2010. AADT is shown in Table 4.1.1-5 and Figure 4.1.1-3.

Table 4.1.1-5 AADT at Survey Station

Station ID	Motorcycle	Car	Bus	Truck	Others	Total
ST01	40,091	7,054	4,054	13,151	625	64,975
ST02	35,129	5,901	3,024	9,890	449	54,393
ST03	30,609	4,992	2,885	7,494	541	46,521
ST04	31,709	4,484	2,314	7,830	1,680	48,017
ST05	20,309	3,932	2,328	3,367	619	30,555
ST06	25,254	4,546	2,378	3,309	259	35,746
ST07	9,202	603	49	1,139	888	11,881
ST08	14,181	557	348	985	956	17,027
ST09	35,010	505	195	710	296	36,716
ST10	16,756	2,483	900	4,801	188	25,128
ST11	6,261	296	82	662	388	7,689
ST12	17,099	486	210	1,137	234	19,166
ST13	4,990	643	148	1,575	442	7,798
ST14	8,871	762	394	1,218	211	11,456
ST15	6,798	802	289	3,004	280	11,173
ST16	5,113	615	162	1,533	318	7,741
ST17	5,491	648	283	1,534	209	8,165
ST18	6,504	796	241	1,375	295	9,211

Source: JICA Study Team



Source: JICA Study Team

Figure 4.1.1-3 AADT at Survey Station

ii) OD Interview Survey

The interview result is utilized for the traffic demand forecast. Overview of interviewees is briefed here.

Sample Rate

Total sample rate was 2.3%, and the sampling rate except motorcycle was 5.7%, as shown in Table 4.1.1-6. This low rate is probably because of the huge number of motorcycle obstructing the polices to stop vehivles, and also because of the shortage of police supporting for the survey.

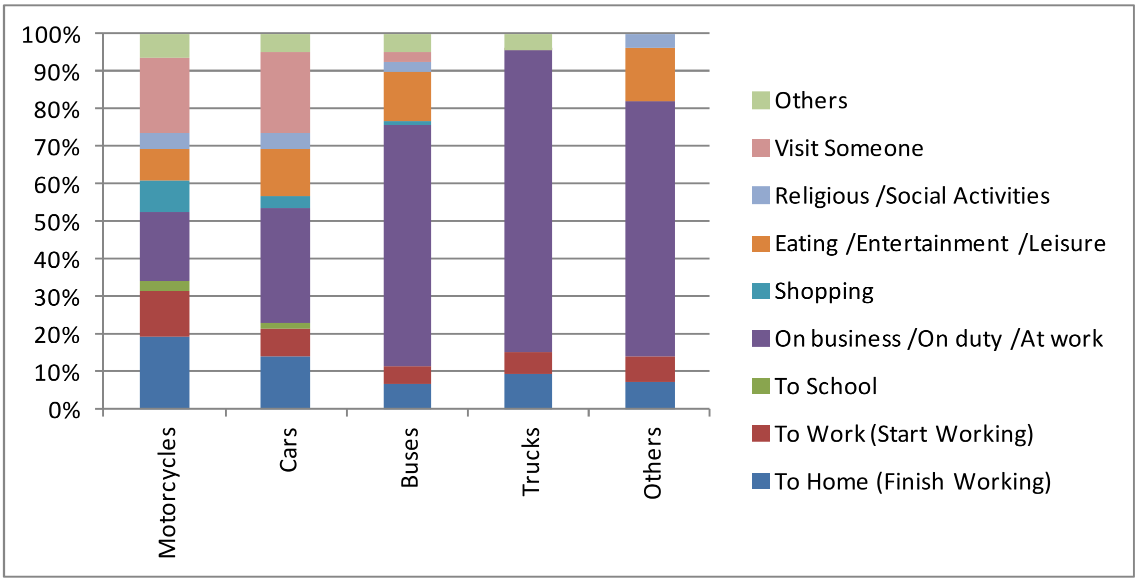
Table 4.1.1-6 Sample Rate for OD Interview Survey

Station ID	Motorcycle	Car	Bus	Truck	Others	Total	Total (w/o Motorcycle)
ST01	0.5%	1.5%	2.0%	3.0%	1.9%	1.2%	2.4%
ST02	0.5%	2.0%	4.3%	4.0%	0.0%	1.5%	3.4%
ST03	1.1%	3.0%	4.5%	6.0%	0.8%	2.3%	4.7%
ST04	1.4%	7.3%	7.6%	5.7%	3.5%	3.0%	6.4%
ST05	1.8%	2.9%	6.1%	25.3%	0.0%	4.7%	11.2%
ST06	0.8%	4.5%	8.1%	21.3%	0.0%	3.7%	10.8%
ST07	5.5%	12.5%	25.7%	8.0%	22.2%	6.4%	10.3%
ST08	0.2%	10.9%	2.2%	9.6%	0.0%	1.3%	8.5%
ST09	0.4%	4.2%	9.7%	17.0%	1.0%	0.9%	10.7%
ST10	0.9%	1.7%	3.3%	2.2%	0.0%	1.3%	2.1%
ST11	1.0%	22.9%	0.0%	11.9%	0.0%	2.7%	12.9%
ST12	1.0%	5.2%	6.9%	9.1%	0.0%	1.6%	7.5%
ST13	0.5%	3.1%	8.0%	10.0%	0.0%	3.2%	8.0%
ST14	0.2%	3.3%	8.7%	14.6%	1.7%	2.4%	9.9%
ST15	1.3%	3.8%	0.0%	6.3%	0.0%	2.7%	5.2%
ST16	1.9%	4.9%	1.6%	4.9%	0.0%	2.7%	4.5%
ST17	3.2%	8.2%	9.3%	11.0%	0.0%	5.0%	9.5%
ST18	0.9%	3.5%	3.2%	6.8%	0.0%	2.0%	5.0%
全体	1.0%	3.7%	5.0%	7.2%	1.7%	2.3%	5.7%

Source: JICA Study Team

Trip Purpose

Trip purpose by mode is shown in Figure 4.1.1-4. Commuting and business purpose are major for all modes, while private purpose such as shopping and leisure are also major for motorcycles and cars.



Source: JICA Study Team

Figure 4.1.1-4 Trip Purpose by Mode

(2) Logistics Interview Survey

1) Implementation

Interviewed Companies

i) Industrial Park management company

ii) Industrial Park tenant company

70 industrial parks in Binh Duong Province, Dong Nai Province, Ho Chi Minh City, Ba Ria - Vung Tau Province were selected, and their 70 management companies and 402 tenant companies were interviewed. The interviewed industrial parks are listed in Table 4.1.1-7.

Table 4.1.1-7 Interviewed Industrial Park

NO.	Industrial Park	No. of Interviewed Tenants	NO.	Industrial Park	No. of Interviewed Tenants
Binh Duong Province (23 IPs)			**Dong Nai Province(24 IPs)**		
1	Bao Bang (My Phuoc 5)	4	40	Thanh Phu	4
2	My Phuoc 1	3	41	Bien Hoa 1	8
3	My Phuoc 2	10	42	Bien Hoa 2	7
4	My Phuoc 3	12	43	LOTECO (Long Binh Industrial Park)	7
5	Tan Dong Hiep B	7	44	Amata	16
6	Ascendans Protrade Singapore Tech	0	45	Song May	10
7	Rach Bap An Dien	1	46	Ho Nai	9
8	Thoi Hoa	0	47	Bau Xeo	0
9	Dong An 2	7	48	Song Thao	0
10	Phu Gia	1	49	Dau Giay	0
11	VSIP 2, VSIP 2 expansion	9	50	Giang Dien	0
12	Nam Tan Uyen	10	51	Tam Phuoc	8
13	Dat Quoc	5	52	Long Thanh	7
14	Kim Huy	0	53	An Phuoc	4
15	Song Than 3	8	54	Long Duc	0
16	Dai Dang (Da Den)	10	55	Loc An - Binh Son	0
17	Viet Huong 1	3	56	Nhon Trach 1	4
18	VSIP 1	10	57	Nhon Trach 2	4
19	Song Than 2	4	58	Nhon Trach 2 Loc Khang	4
20	Tan Dong Hiep A	0	59	Nhon Trach 3 Phase 2	7
21	Dong An	9	60	Nhon Trach 5	5
22	Song Than 1	10	61	Nhon Trach 6	4
23	Viet Huong 2	7	62	Go Dau	5
Ho Chi Minh City(16 IPs)			63	Ong Keo	0
24	Tay Bac Cu Chi	13	**Ba Ria - Vung Tau Province(7 IPs)**		
25	Tan Thoi Hiep	8	64	My Xuan B1, Tien Hung	0
26	Quang Trung Software City	9	65	My Xuan A	9
27	Vinh Loc	8	66	My Xuan A2	7
28	Tan Binh	8	67	Phu My 1	7
29	Le Minh Xuan	16	68	Phu My 2	1
30	Tan Tao	17	69	Cai Mep	0
31	Hiep Phuoc	8	70	Phu My 3	0
32	Tan Thuan	6			
33	Cat Lai 2	7			
34	Saigon Hi-Tech Park	10			
35	Linh Trung 1	0			
36	Binh Chieu	4			
37	Linh Trung 2	8			
38	Xuan Thoi Son	6			
39	Binh Dang	7			

Source: JICA Study Team

iii) Port Management Company

21 Port Management Companies based in Ho Chi Minh City, Dong Nai Province and Ba Ria - Vung Tau Province were interviewed. The interviewed port terminals are listed in Table 4.1.1-8.

Table 4.1.1-8 Interviewed Port Terminals

Ho Chi Minh City (7 terminals)	
1	Ben Nghe terminal
2	Sai Gon terminal
3	Cat Lai (Tan Cang) terminal
4	Hiep Phuoc terminal
5	Tan Thuan Dong terminal
6	Sai Gon shipping terminal
7	Lotus terminal
Dong Nai Province (5 terminals)	
8	Go Dau B terminal
9	Vedan Phuoc Thai terminal
10	Phu Dong terminal
11	Dong Nai terminal
12	Go Dau A terminal
Ba Ria - Vung Tau Province (9 terminals)	
13	Tan Cang Cai Mep Port (TCCT, TCIT)
14	CMIT Port
15	Phu My terminal
16	SITV Port
17	Vietsovpetro termnial
18	Cang container quốc tế Việt Nam
19	PTSC petroleum terminal
20	SP-PSA Port

Source: JICA Study Team

Schedule

Logistics Interview Survey was carried out from April 17, 2012 until May 12, 2012.

Methodology

Request letter and questionnaire were delivered to the interviewed companies in advance, and then the interviewer visited the company to carry out the interview. Main interview items are presented in Table 4.1.1-9.

Table 4.1.1-9 Main interview items for Logistics Interview Survey

	IP management company	IP tenant company	Port management company
General	- Total area, area under lease, remaining area - Number of tenants, remaining tenant capacity - List of tenants and their business - Number of employees of management company and tenants - Residence area of employees of management company and tenants - Yearly total amount of goods of IP	- Business overview - Number of employees - Residence are of employees - Goods and its material - Yearly total amount of goods	- Business overview - Number of employees - Residence are of employees - Yearly total amount of goods
Current Traffic	- Origin and Destination of management company - Yearly total volume of enter/exit traffic and its type composition - Transport served for employees by management company and tenants	- Origin and Destination - Route (composition of land and river logistics) - Unit / daily / yearly costs of logistics - Yearly total volume of enter/exit traffic and its type composition - Transport served for employees	- Origin and Destination - Route (composition of land and river logistics) - Unit / daily / yearly costs of logistics - Yearly total volume of enter/exit traffic and its type composition - Transport served for employees
Others	- Expansion plan for IP - Other plan for next business - Demands for BHVT Expressway - Opinion on road network	- Willingness to pay - Demands for BHVT Expressway - Opinion on road network	- Expansion plan for port - Other plan for next business - Willingness to pay - Demands for BHVT Expressway - Opinion on road network

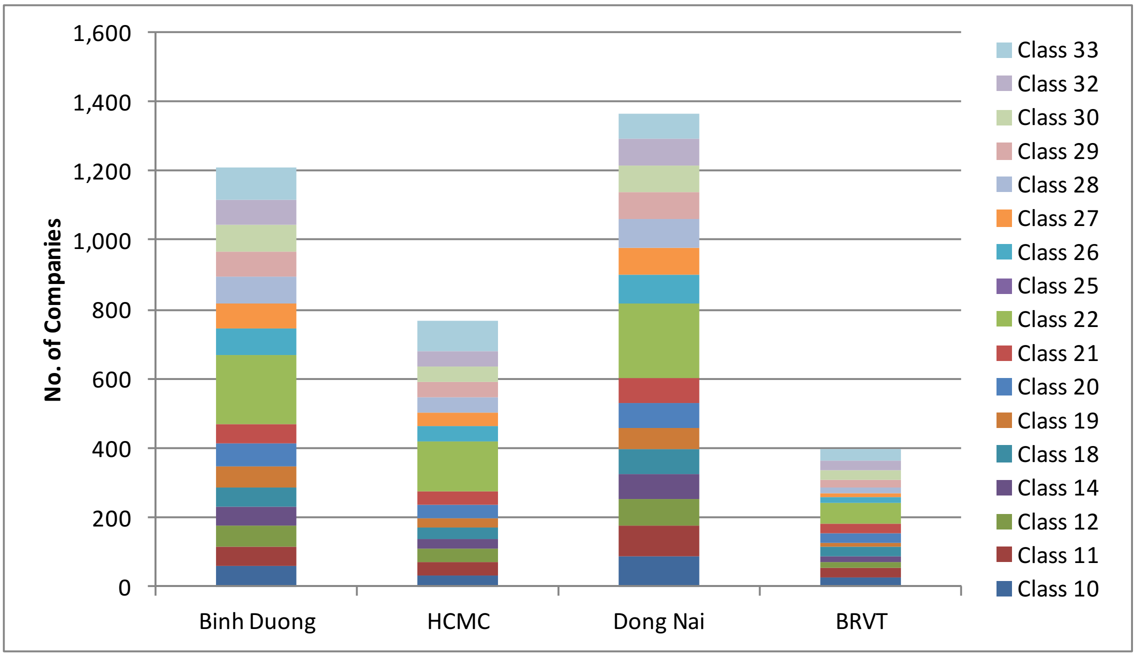
Source: JICA Study Team

2) Survey Result

The interview result is utilized for the traffic demand forecast. Overview of interviewees is briefed here.

<u>Overview of Tenants in Interviewed Industrial Parks</u>

The total number of tenants in interviewed industrial parks is 3,743, and the most major sector based on the Vietnam Standard Industrial Classification 2007 (VSIC 2007) is Sector 9 (Manufacture of rubber and plastics products), engaged by 622 companies.



Source: JICA Study Team、

Class 10	Manufacture of food products
Class 11	Manufacture of beverages
Class 12	Manufacture of tobacco products
Class 14	Manufacture of wearing apparel
Class 18	Printing and reproduction of recorded media
Class 19	Manufacture of coke and refined petroleum products
Class 20	Manufacture of chemicals and chemical products
Class 21	Manufacture of pharmaceuticals, medicinal chemical and botanical products
Class 22	Manufacture of rubber and plastics products
Class 25	Manufacture of fabricated metal products (except machinery and equipment)
Class 26	Manufacture of computer, electronic and optical products
Class 27	Manufacture of electrical equipment
Class 28	Manufacture of machinery and equipment n.e.c
Class 29	Manufacture of motor vehicles
Class 30	Manufacture of other transport equipment
Class 32	Other manufacturing
Class 33	Repair, maintenance and installation of machinery and equipment

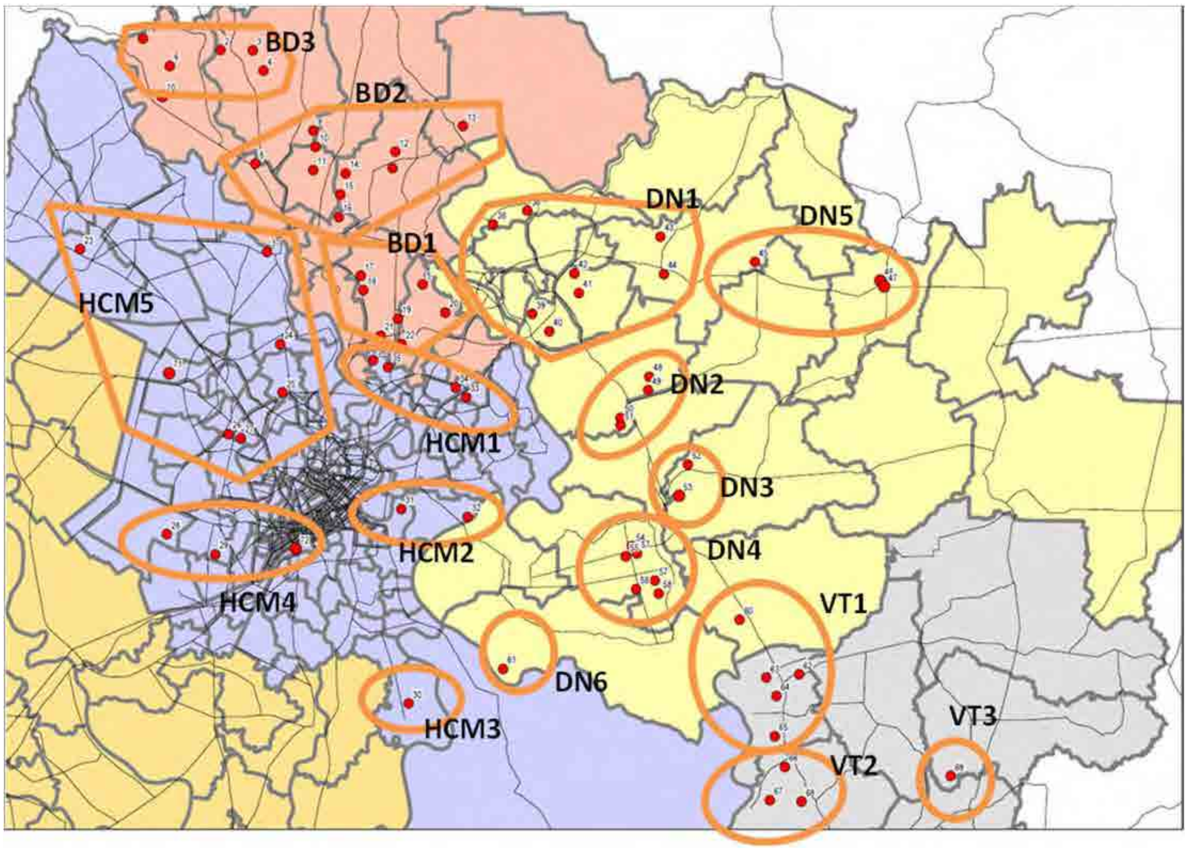
Source: Prepared by Study Team based on Vietnam Standard Industrial Classification 2007 (VSIC 2007)

Figure 4.1.1-5 Tenant Companies by Classification in Industrial Park

4.1.2. The evaluation of growth potential on industrial zone

A large number of industrial zones stand in the investigation target area of BHVT expressway project, especially on the periphery of National Highway 51 in accordance with government policy, geographical conditions, and so on. Further new and expansion projects are planned in the area aftertime. Since the heavy traffic demands are anticipated from the development of new and existing industrial zones in the area, we conducted the interviews and taking the documents of master plans for the development projects from four industrial zone authorities, e.g. Ho Chi Minh City Export processing & Industrial Zones Authority, Binh Duong Industrial Zones Authority, Dong Nai Industrial Zones Authority and Ba Ria Vung Tau Industrial Zones Authority, whose traffic volume will be severely impacted by the development of the area. We also worked out the interviews with important operation company of industrial zone and the on-site inspection of Cai Mep Thi Vai International Ports in Ba Ria Vung Tau province. On the basis of these works, we evaluated the growth potential of each industrial zone group. The followings are the method of grouping and evaluation.

The industrial zones on the periphery of our target area are sectionalized into seventeen groups in accordance with geographical conditions as per the following Figure 4.1.2-1.



Source: JICA Study Team

Figure 4.1.2-1 The groups of industrial zone

Each sectionalized industrial zones is given the evaluation score about the following five categories. In terms of the growth potential of industrial zone, we set down A as an excellent factor, B as a good factor, C as a neither good nor bad factor and D as a bad factor for contributory point to the growth potential of industrial zone.

Category 1) Prioritized industrial area or expansion planned area:

Prioritized industrial zones which were described by industrial zones authority or in their master plan for industrial development project are given A. Industrial zones which were included in the development plan of industrial zones are given B. The other industrial zones are given C in principle, but especially, the cancelled industrial zones are given D.

Category 2) Geographical conditions:

Site locations with shorter distance from main facilities and major roads are given A, B, C or D in sequence.

Category 3) Available capacity:

Tenant availabilities with larger land area including expansion plan are given A, B, C or D in sequence.

Category 4) Recent trend of tenant and prospective tenant:

Industrial zones which concluded a tenant contract with major company in these days or have a plan to absorb the major company who has secured permission of advance last year or later are given A.

Category 5) Good promotion factor to tenant:

Foreign investors except for Japanese company are likely to put their investment on hold, meanwhile, Industrial zones which have rental factory and allocate Japanese person in charge have become a trend of investment. These industrial zones are given A, and other industrial zones which have other investment promotions are given B.

We finally make an overall evaluation to each group of industrial zones in terms of its growth potential on the basis of aforesaid evaluation score on each industrial zone. We set down A for a group of industrial zones whose growth potential is expected greatly, B for a group of industrial zones whose growth potential is expected to some extent, C for a group of industrial zones whose growth potential is not expected and D for a group of industrial zones who is likely to decline. The following Table 4.1.2-1 is the results of overall evaluation on growth potential of each group of industrial zones;

Table 4.1.2-1 The evaluation of growth potential on groups of industrial zone

Group	Province	Industrial Zone	Overall Evaluation
BD1	Binh Duong Province	Tan Dong Hiep B	B
	Binh Duong Province	Viet Huong 1	
	Binh Duong Province	VSIP 1	
	Binh Duong Province	Song Than 2	
	Binh Duong Province	Tan Dong Hiep A	
	Binh Duong Province	Dong An	
	Binh Duong Province	Song Than 1	
BD2	Binh Duong Province	Thoi Hoa	B
	Binh Duong Province	Dong An 2	
	Binh Duong Province	Phu Gia	
	Binh Duong Province	VSIP 2, VSIP 2 expansion	
	Binh Duong Province	Nam Tan Uyen	
	Binh Duong Province	Dat Quoc	
	Binh Duong Province	Kim Huy	
	Binh Duong Province	Song Than 3	
	Binh Duong Province	Dai Dang (Da Den)	
BD3	Binh Duong Province	Bao Bang (My Phuoc 5)	A
	Binh Duong Province	My Phuoc 1	
	Binh Duong Province	My Phuoc 2	
	Binh Duong Province	My Phuoc 3	
	Binh Duong Province	My Phuoc 4	
	Binh Duong Province	Ascendans Protrade Singapore Tech	
	Binh Duong Province	Rach Bap An Dien	
	Binh Duong Province	Viet Huong 2	

Group	Province	Industrial Zone	Overall Evaluation
HCM1	Ho Chi Minh City	Saigon Hi-Tech Park	C
	Ho Chi Minh City	Linh Trung 1	
	Ho Chi Minh City	Binh Chieu	
	Ho Chi Minh City	Linh Trung 2	
HCM2	Ho Chi Minh City	Tan Thuan	B
	Ho Chi Minh City	Cat Lai 2	
HCM3	Ho Chi Minh City	Hiep Phuoc	B
HCM4	Ho Chi Minh City	Le Minh Xuan	C
	Ho Chi Minh City	Tan Tao	
	Ho Chi Minh City	Binh Dang	
HCM5	Ho Chi Minh City	Tay Bac Cu Chi	C
	Ho Chi Minh City	Tan Phu Trung	
	Ho Chi Minh City	Tan Thoi Hiep	
	Ho Chi Minh City	Quang Trung Software City	
	Ho Chi Minh City	Vinh Loc	
	Ho Chi Minh City	Tan Binh	
	Ho Chi Minh City	Dong Nam	
	Ho Chi Minh City	Xuan Thoi Son	
DN1	Dong Nai Province	Thanh Phu	A
	Dong Nai Province	Bien Hoa 1	
	Dong Nai Province	Bien Hoa 2	
	Dong Nai Province	LOTECO (Long Binh Industrial Park)	
	Dong Nai Province	Amata	
	Dong Nai Province	Song May	
	Dong Nai Province	Ho Nai	

Group	Province	Industrial Zone	Overall Evaluation
DN2	Dong Nai Province	Giang Dien	A
	Dong Nai Province	Tam Phuoc	
	Dong Nai Province	Long Thanh	
	Dong Nai Province	Long Thanh High Tech Park	
	Dong Nai Province	An Phuoc	
DN3	Dong Nai Province	Long Duc	A
	Dong Nai Province	Loc An - Binh Son	
DN4	Dong Nai Province	Nhon Trach 1	A
	Dong Nai Province	Nhon Trach 2	
	Dong Nai Province	Nhon Trach 2 Loc Khang	
	Dong Nai Province	Nhon Trach 3 Phase 2	
	Dong Nai Province	Nhon Trach 5	
	Dong Nai Province	Nhon Trach 6	
DN5	Dong Nai Province	Bau Xeo	C
	Dong Nai Province	Song Thao	
	Dong Nai Province	Dau Giay(Dau Day)	
	Dong Nai Province	Cam My	
	Dong Nai Province	Gia Kiem	
	Dong Nai Province	Suoi Tre	
DN6	Dong Nai Province	Ong Keo	C
VT1	Dong Nai Province	Go Dau	A
	Ba Ria - Vung Tau Province	Phuoc Binh	
	Ba Ria - Vung Tau Province	My Xuan B1, Tien Hung	
	Ba Ria - Vung Tau Province	My Xuan A	
	Ba Ria - Vung Tau Province	My Xuan A2	

Group	Province	Industrial Zone	Overall Evaluation
	Ba Ria - Vung Tau Province	Phu My 1	
VT2	Ba Ria - Vung Tau Province	Phu My 2	B
	Ba Ria - Vung Tau Province	Cai Mep	
	Ba Ria - Vung Tau Province	Phu My 3	
VT3	Ba Ria - Vung Tau Province	Chau Duc	C

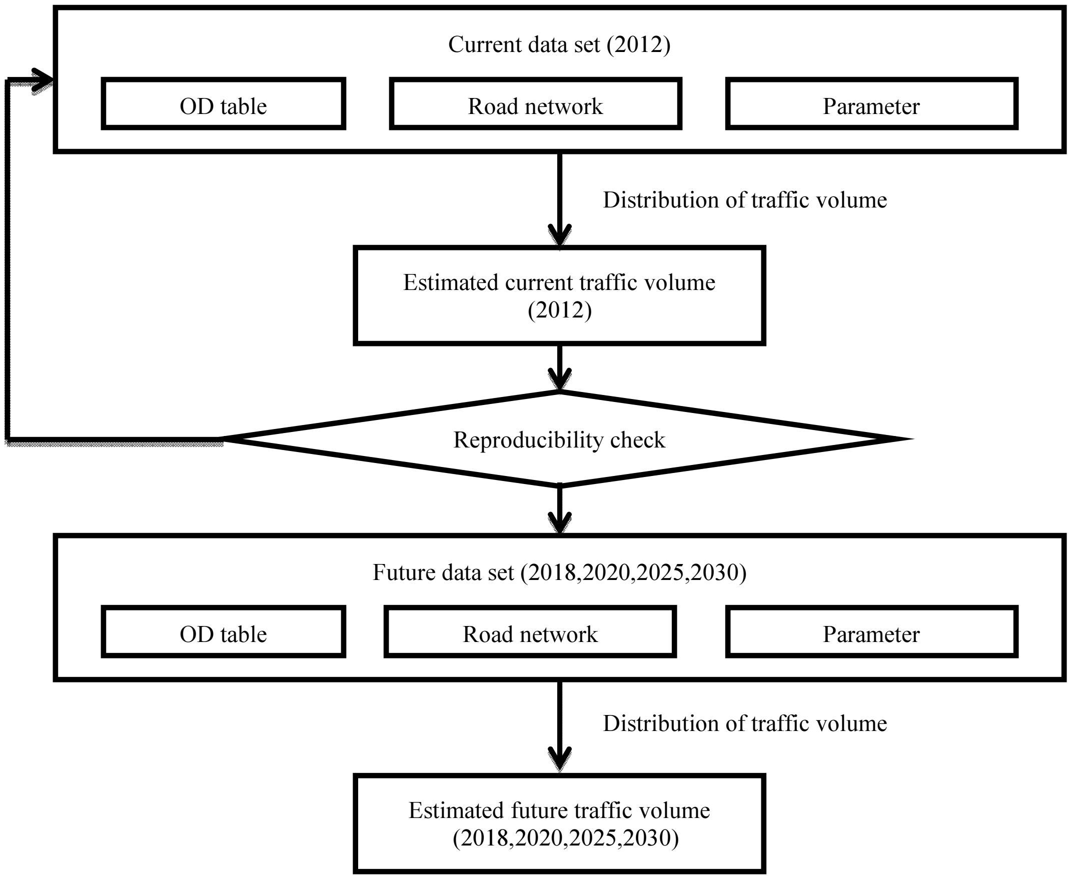
Source: JICA Study Team

4.1.3. Basic Methodology of Demand Forecast

In demand forecast for this study, wide-area road network around BHVT expressway should be taken into consideration, since BHVT expressway, the target road for this study, forms a road network with national highway 51 running in parallel with BHVT expressway, Bien Hoa bypass, HCMC-Long Thanh-Dau Giay expressway, Ben Luc-Long Thanh expressway and other roads in areas around HCMC.

Therefore, this study utilizes the following two traffic demand forecasts conducted by JICA, which cover the wide-area road network including the target area. One is HOUTRANS, "the Study on Urban Transport Master Plan and Feasibility Study in HCM Metropolitan Area". Another is VITRANSS2, "The Comprehensive Study on the Sustainable Development of Transport System in Vietnam". Traffic volume and interview data obtained in traffic survey for this study is also used to reflect the latest traffic condition around BHVT expressway.

The basic methodology of demand forecast is shown in Figure.4.1.3-1.



source：JICA StudyTeam

Figure 4.1.3-1 The flow of traffic demand forecast

4.1.4. Development of the current OD table

The OD table of current situation is created following steps listed below.（Figure.4.1.5-1）

ｉ）The OD table of the project area is developed utilizing traffic data (traffic count and OD interview data) obtained in the survey conducted along NH51.

ⅱ）It is expected that the traffic currently running other roads will also use the BH-VT expressway when the road network in the project area is formed. Thus the current OD table for the broad HCMC region surrounding the project area is made based on the HOUTRANS OD table in 2003, as well as HOUTRANS traffic generation model utilizing the socioeconomic indicator (population, employed population and student population).

ⅲ) In order to reflect the observed traffic condition, a part of the OD table made in the second step is replaced with the OD table data for the project area made in the first step. Then the inter-provincial traffic data from VITRANSS2 is added and adjusted to develop the current OD table.

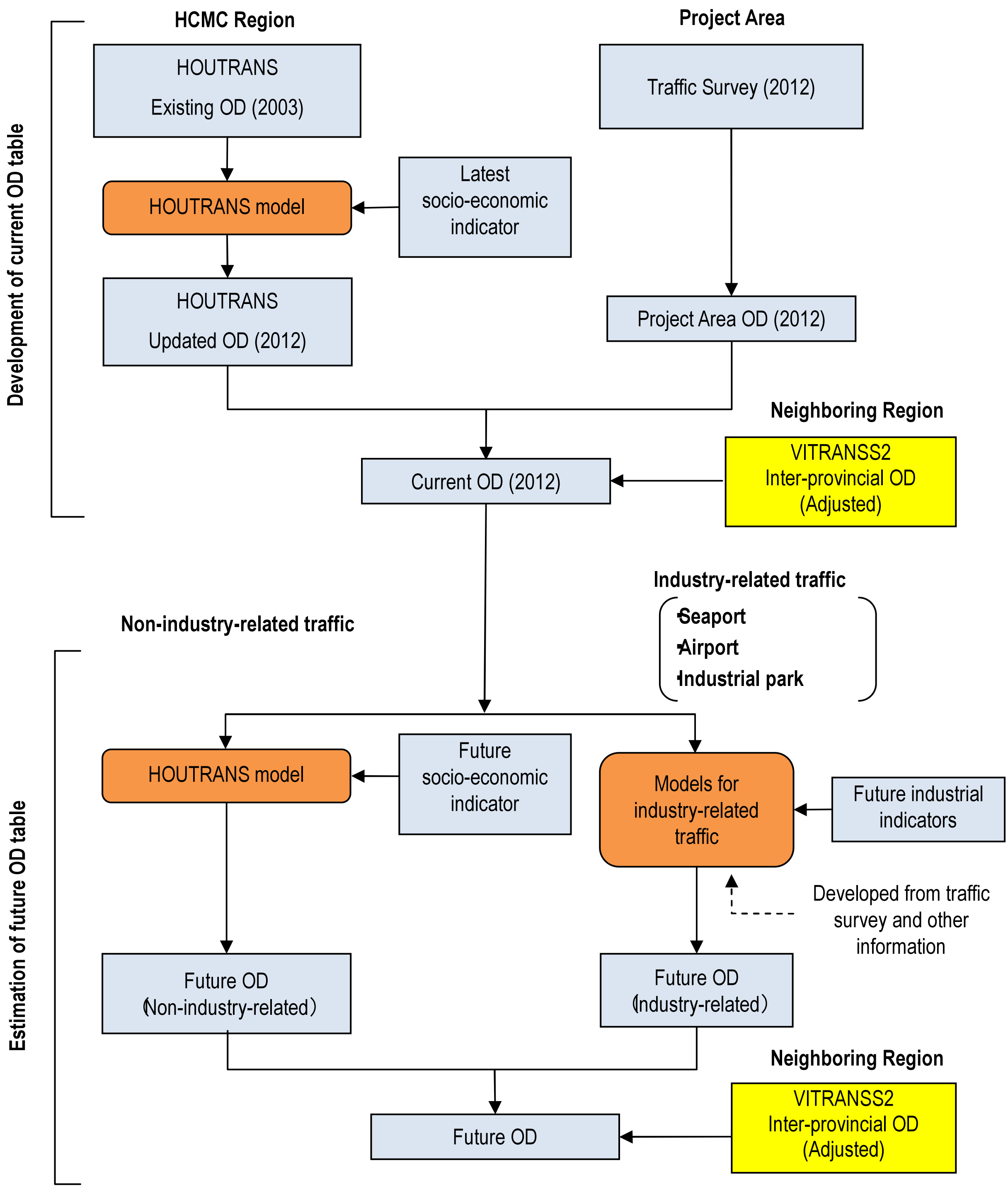
4.1.5. Estimation of the future OD table

It is assumed that the traffic in the target area highly relates to traffic to an airport, seaports, and industrial parks. Such industry-related traffic demand can affect traffic on BHVT expressway significantly. Therefore, future OD tables are generated for both industry-related traffic and non-industry-related traffic separately, in consideration of the independent future planning of each industry.(Figure.4.1.5-1)

ⅰ) Non-industry traffic is estimated by utilizing HOUTRANS model.

ⅱ) Industry-related traffic is estimated for three categories: airport-related traffic, seaport-related traffic, and industrial park-related traffic.
In the estimation of future industry-related traffic, a forecast model is used. This model is developed using industrial indicators (such as handling volume at ports and industrial output volume of the district), based on the result of traffic survey and interviews conducted for this survey, as well as the data from other studies and plans. Future industrial-related traffic is estimated by applying future industrial indicators to the model. As for airport-related traffic volume, reliable forecasts made in other studies are utilized.

ⅲ) Non-industry-related traffic (or all traffic outside the project area) mentioned in the first step and industry-related traffic described in the second step are integrated and adjusted based on VITRANSS2 inter-provincal traffic to develop the future OD table for the target years.



Source: JICA Study Team

Figure 4.1.5-1 Approch for OD table development

(1) Demand forecast of Non-industry-related traffic

Non-industry-related traffic is estimated with HOUTRANS model using three sock-economic indexes: population, the number of workers and number of students.

Based on the Population and Housing Census conducted in 2009 and the future population in all provinces estimated by MPI, future population in each province is estimated. The population in each district is allocated in accordance with socio-economic development plans of major cities and past trends.

The number of workers and number of students in each district are calculated respectively by reference to the population pyramid and land use plans of each province.

(2) Demand forecast of Industry-related traffic

Along the BHVT expressway, large-scale projects such as Cai Mep–Thi Vai international port and Long Thanh international airport are being planned, and a lot of industrial parks are in operation or being planned. Traffic related to these projects is considered to have a great impact on BH-VT expressway and neighboring road network, and less dependent on socio-economic indexes such as population. Thus, future traffic volume is estimated for the above industrial projects-related traffic and non-industry-related traffic obtained by HOUTRANS model respectively.

ｉ）Seaport access traffic

As for seaport-related truck traffic, traffic demand is estimated based on the data on Master Plan "Detailed Plan on the Seaport Group in Southeast Vietnam (Group 5)" issued by MOT, following the prosedures listed below.

- The current truck traffic relating to seaports around the project area is calculated based on the data of traffic survey.
- Seaports are divided into several groups according to geographic conditions, and future handling volume for each group is calcurated based on the data of Master Plan (low growth scenario).
- Future traffic volume is estimated from the current traffic volume by adopting the aforementioned growth rate.

The future seaport access traffic is showen in Table.4.1.5-1.

Table 4.1.5-1 Estimated seaport access traffic

			Estimated Port Handling Volume (mil ton/year)			Growth Rate in Port Demand		PCU/day (Truck using NH51 or BH-VT expressway, in&out)		
			2012	2020	2030	2020/2012	2030/2012	2012 (actual)	2020	2030
HCMC	I	Saigon river	38.0	7.8	13.1	0.2	0.3	91	19	31
	II	Dong Nai river	32.8	23.3	39.0	0.7	1.2	1,915	1,361	2,275
	III	Nhe Be river	10.6	9.5	15.9	0.9	1.5	101	90	151
	IV	Soai Rap river	9.9	29.4	49.1	3.0	5.0	95	279	469
S	V	Soai Rap river within Long An province and Tien Giang Province	-	17.1	28.6	-	-	-	-	-
	Total		91.3	87.1	145.7	1.0	1.6	2,202	1,749	2,926
Dong Nai	I	Dong Nai river	2.6	18.9	31.5	7.3	12.2	168	1,222	2,044
	II	Nha Be river	0.3	2.2	3.7	8.3	13.9	17	145	243
	III	Long Tau river	0.2	6.3	10.6	40.3	67.4	10	410	685
	IV	Thi Vai river	4.3	12.1	20.2	2.8	4.7	684	1,916	3,207
	Total		7.3	39.5	66.1	5.4	9.0	879	3,693	6,179
Vung Tau	I_north	Cai Mep-thi Vai river	30.8	95.9	160.3	3.1	5.2	441	835	1,209
	I_south							81	793	1,517
	II	Dinh river and Ganh Rai bay	2.0	12.5	20.9	6.3	10.6	758	4,799	8,021
	III	Con Dao	0.2	0.0	0.0	0.1	0.1	-	-	-
	Total		32.9	108.4	181.2	3.3	5.5	1,280	6,427	10,747
Bing Duong (Binh Duong General Terminal)[1)]			-	-	-	1.8	3.0	108	193	323
Port Group 5			131.5	235.0	393.0	1.8	3.0	8,830	23,931	40,027

Source: The Detailed Plan on the Seaport Group in Southeast Vietnam (Group5) (No.1745/QD-BGTVT,2011) & JICA Study Team

ⅱ) Airport access traffic

In the project area the Long Thanh International Airport (LTIA) is in the planning stage. It is scheduled to open in 2020.

The future airport access traffic is estimated with reference to the Long Thanh International Airport Master Plan (2010) and the data of the traffic survey (traffic count and interview) at Tan Son Nhat International airport in 2010.

The future airport access traffic is showen in Table.4.1.5-2.

Table 4.1.5-2 Estimated airport access traffic

Airport	Mode	2010 (per day)			2020 (per day)			2030 (per day)		
		Pax	Ton	PCU	Pax	Ton	PCU	Pax	Ton	PCU
LTIA	MC	-	-	-	8,892	-	1,778	14,290	-	2,858
	Car	-	-	-	22,130	-	11,937	33,722	-	18,288
	Bus	-	-	-	57,091	-	5,387	93,417	-	8,864
	Truck	-	-	-	-	1,199	3,773	-	2,220	6,983
	Total	-	-	-	88,114	1,199	22,875	141,429	2,220	36,993
TSNIA	MC	54,229	-	12,514	40,084	-	8,017	58,426	-	11,685
	Car	44,938	-	31,053	32,771	-	22,433	48,944	-	34,375
	Bus	24,478	-	6,437	15,732	-	2,928	21,994	-	4,093
	Truck	-	742	2,533	-	1,199	1,739	-	2,220	3,380
	Total	123,645	742	52,538	88,587	1,199	35,118	129,364	2,220	53,534
Total		123,645	742	52,538	176,700	2,399	57,992	270,793	4,439	90,527

Source: Long Thanh International Airport Master Plan (Southern Airport Corporation, 2010) & JICA Study Team

ⅲ) Traffic from/to industrial parks

Since the number of industrial parks around the BHVT expressway shows an upward trend, the traffic from/to industrial parks is expected to increase with the development of industrial parks. The future traffic from/to industrial parks is estimated by means of multiplying the current traffic based on the traffic survey by the growth rate of the industrial output volume derived from the future provincial Gross Regional Domestic Product (hereinafter GRDP). The procedures are as below.

- As the growth rate of industrial output was 1.5 times faster than the growth rate of GRDP secondary sector during the period from 2008 to 2011, the gross growth rate of industrial output is set as 7.2% for the period from 2012 to 2020, and as 6.2% from 2020 to 2030.
- The industrial output growth rate of each group is set by adding +2.5% for groups evaluated as level A, 0% for B, and -2.5% for C.
- With an assumption that the proportion between the traffic from/to industrial parks and the industrial output in each industrial park group is similar, the future traffic is estimated by expanding current traffic according to the industrial output growth rate.

The future traffic from/to industrial parks is showen in Table.4.1.5-3.

Table 4.1.5-3 Estimataed traffic from/to industrial parks

IZ Area		Evalua-tion of Potential	GRDP(Secondary) (Bil VND, 1994 Const)			Annual Increase of GRDP (Secondary) (%)		Annual Increase of Industrial Output		PCU/day (Truck using NH51 or BH-VT expressway, in&out)		
			2012	2020	2030	12-20	20-30	12-20	20-30	2012 (actual)	2020	2030
Binh Duong	I	B	9,458	16,163	34,650	6.9	7.9	7.2	6.2	1,694	2,963	4,791
	II	B						7.2	6.2	757	1,324	2,141
	III	A						9.7	8.7	380	799	1,557
	Total	-						-	-	2,831	5,086	8,488
HCMC	I	C	57,558	83,232	122,277	4.7	3.9	4.7	3.7	202	293	391
	II	B						7.2	6.2	1,380	2,414	3,903
	III	B						7.2	6.2	0	0	0
	IV	C						4.7	3.7	222	322	430
	V	C						4.7	3.7	112	162	217
	Total	-						-	-	1,916	3,190	4,940
Dong Nai	I	A	21,159	33,173	67,561	5.8	7.4	9.7	8.7	1,526	3,209	6,251
	II	A						9.7	8.7	5,044	10,608	20,662
	III	A						9.7	8.7	84	177	344
	IV	A						9.7	8.7	4,614	9,704	18,901
	V	C						4.7	3.7	26	38	50
	VI	C						4.7	3.7	0	0	0
	Total	-						-	-	11,294	23,735	46,208
Vung Tau	I	A	21,788	27,749	40,630	3.1	3.9	9.7	8.7	3,134	6,591	12,838
	II	B						7.2	6.2	11,125	19,458	31,462
	III	C						4.7	3.7	13	19	25
	Total	-						-	-	14,272	26,068	44,325
Total		-	109,962	160,316	265,118	4.8	5.2	7.2	6.2	30,313	58,079	103,962

Source: JICA Study Team

4.1.6. Prerequisites for demand forecast

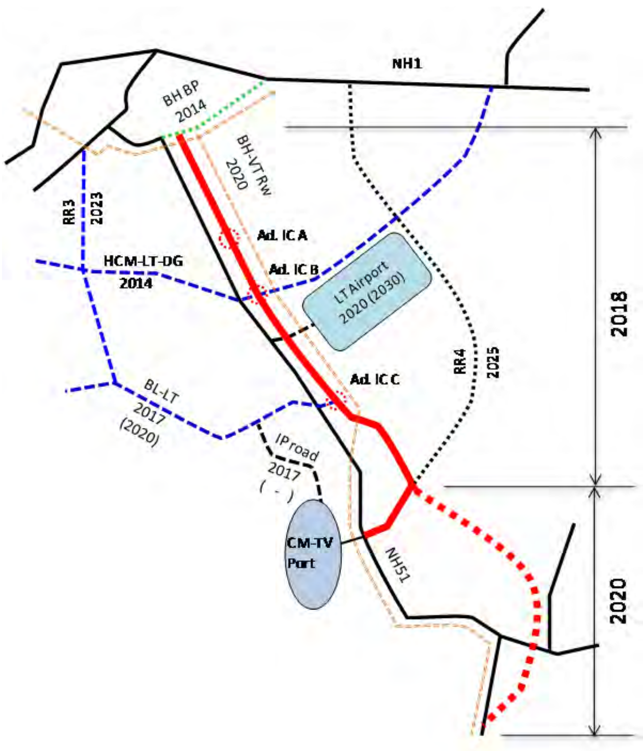
(1) Road network

The development plan for the peripheral road network of the project area is created according to the information and written reports from authorities concerned. The design data of major arterial roads are shown in Table.4.1.6-1 and Figure.4.1.6-1.

Table 4.1.6-1 Expressway and Ring Road Projects

Project	Length (km)	Class	No. of Lanes	Expected Schedule	2012	Assumed Number of Lanes (Base Case)			
						2018-	2020-	2025-	2030-
Expressway									
Bien Hoa–Vung Tau	76	Expressway	4 lanes	−20 (−18 (phase 1))					
Bien Hoa–Phu My					-	4	4	4	4
Phu My–Vung Tau					-	-	4	4	4
Phu My–NH51		Class II			-	4	4	4	4
HCMC–Long Thanh–Dau Giay	55	Expressway	6-8 lanes	−30 (−14 (phase 1))					
HCMC–Long Thanh					-	4	4	4	8
Long Thanh–Dau Giay					-	4	4	4	6
Ben Luc–Long Thanh	58	Expressway	8 lanes	−30 (−17 (phase1))					
Ben Luc–NH51					-	4	4	4	8
NH51–Long Thanh					-	4	4	4	8
Ring Road 3 and 4									
RR3 Tan Van-Nhon Trach	26	Urban Expressway	8 lanes	−30 (−23(phase 1))	-	-	4	4	8
		Class III	4 lanes		-	-	4	4	4
RR4 Phu My-Trang Bom	46	Urban Expressway	8 lanes	−25	-	-	-	-	-
		Class IV	4 lanes		-	-	-	4	4
Other Road									
Bien Hoa Bypass	17	Class I	4 lanes	-14	-	4	4	4	8
NH51	74	Class I	6 lanes	-12	4-6	6	6	6	6
Inter Port Road	12	Class III	4 lanes	-17	-	4	4	4	4

Source: Study team



Source: JICA Study Team

Figure 4.1.6-1 Expressway network scenario

(2) Toll rate

Tolls for expressways including BHVT expressway are assumed to follow the toll rate of HCMC-Trung Luong expressway, with a 30% increase every five years. Toll rates set for 2017 are shown in Table.4.1.6-2.

The toll for NH51 is set up based on the present toll rate. (The minimum distance between two toll booths on successive roads must be 70km or longer, and 20,000 VND for one-time charge stipulated in the case of car)

Tolls for other toll roads, such as Bien Hoa Bypass, Ring Road 3 and the service road for Ring Road 4, are set as a distance-based charge system in accordance with Circular No.90/2004/TT-BTC (The minimum distance between two toll booths on successive roads must be 70km or longer, and 10,000 VND for one-time charge stipulated).

Table 4.1.6-2 Toll rate

Toll Rate Regime		Motorcycle	Car	Bus	Truck
Current Toll System (Open System)	VND	0	10,000	22,000	40,000
Toll Index		0	1.00	2.20	4.00
Expressway	VND/km	-	1,300	2,860	5,200
NH51	VND/km	0	286	629	1,143
BH Bypass and RR3 & RR4 Sevice Road	VND/km	0	143	314	571

Source: JICA Study Team

(3) Willingness-to-pay

Drivers' willingness-to-pay is set as shown in Table4.1.6-3 based on the results of interviews conducted in the traffic survey.

In the calculation of future traffic demand in this study, inflation is not taken into consideration, since both toll rate and willingness-to-pay are considered to increase in proportion to the price growth.

Table 4.1.6-3 Willingness-to-pay

USD/hour

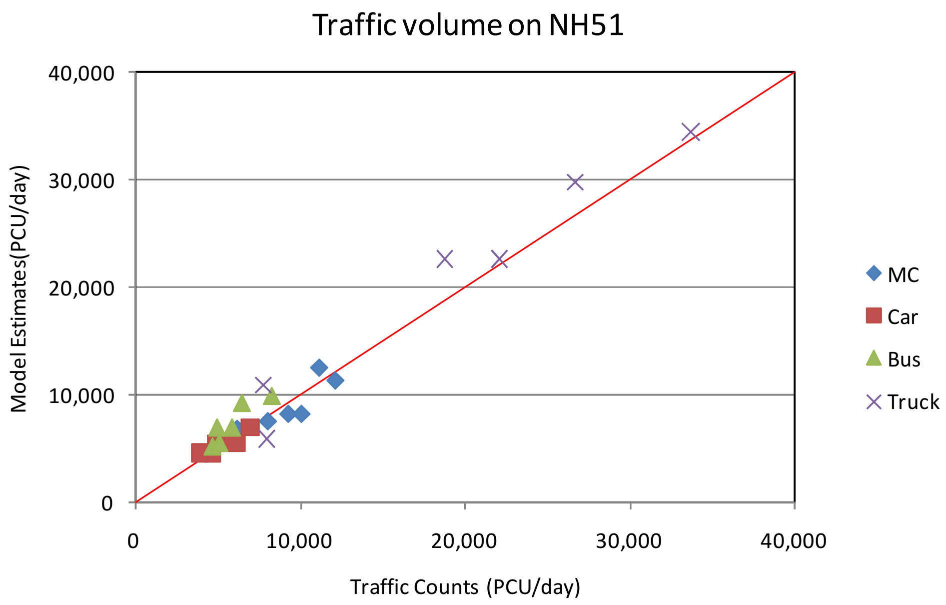
Motorcycle	Car	Bus	Truck
2.07	5.00	9.17	8.84

Source: JICA Study Team

(4) Reproducibility of demand forecast model

In order to check the reproducibility of the demand forecast model, the estimated traffic volume with developed OD input data in 2012 are compared with the counted traffic volume from traffic survey in 2012. The comparison of each traffic volume at the traffic survey spot on NH51 is shown in Figure.4.1.6-2.

Since both traffic volumes basically matches, the model is considered adequate.



Source: JICA Study Team

Figure 4.1.6-2 Comparison of estimated/counted traffic volume

4.1.7. Future traffic volume

Estimated results of future traffic volume from 2018 to 2030 are given as follows.

Table 4.1.7-1 Traffic volume of BHVT expressway

PCU/day

Section	2018	2020	2025	2030
Bien Hoa - Long Thanh	32,268	27,839	34,971	69,784
Long Thanh - LT Airport	34,830	31,185	50,876	75,764
LT Airport - Nhon Trach	34,830	21,359	40,870	57,607
Nhon Trach - Phu My	21,473	32,611	65,579	80,367
Phu My - NH51	21,473	9,703	20,171	25,030
Phu My - Ba Ria	-	22,908	33,072	46,030
Ba Ria - Vung Tau	-	16,742	24,041	34,982

Source: JICA Study Team

Estimated traffic volumes of each vehicle type and in target year are given as follows.

Table 4.1.7-2 Traffic volume of BHVT expressway with various vehicle types（2018）

PCU/day

Section	Car	Bus	Truck	Total
Bien Hoa - Long Thanh	16,564	11,826	3,878	32,268
Long Thanh - LT Airport	19,065	12,351	3,414	34,830
LT Airport - Nhon Trach	19,065	12,351	3,414	34,830
Nhon Trach - Phu My	12,648	8,344	481	21,473
Phu My - NH51	12,648	8,344	481	21,473
Phu My - Ba Ria	-	-	-	-
Ba Ria - Vung Tau	-	-	-	-

Source: JICA Study Team

Table 4.1.7-3 Traffic volume of BHVT expressway with various vehicle types（2020）

PCU/day

Section	Car	Bus	Truck	Total
Bien Hoa - Long Thanh	15,981	9,838	2,020	27,839
Long Thanh - LT Airport	18,198	9,336	3,651	31,185
LT Airport - Nhon Trach	12,605	7,347	1,407	21,359
Nhon Trach - Phu My	17,689	10,645	4,277	32,611
Phu My - NH51	3,599	1,833	4,271	9,703
Phu My - Ba Ria	14,090	8,812	6	22,908
Ba Ria - Vung Tau	10,306	6,436	0	16,742

Source: JICA Study Team

Table 4.1.7-4 Traffic volume of BHVT expressway with various vehicle types（2025）

PCU/day

Section	Car	Bus	Truck	Total
Bien Hoa - Long Thanh	19,168	8,741	7,062	34,971
Long Thanh - LT Airport	29,571	12,459	8,846	50,876
LT Airport - Nhon Trach	24,851	10,981	5,038	40,870
Nhon Trach - Phu My	33,471	13,564	18,544	65,579
Phu My - NH51	6,935	1,935	11,301	20,171
Phu My - Ba Ria	21,950	9,805	1,317	33,072
Ba Ria - Vung Tau	16,652	7,389	0	24,041

Source: JICA Study Team

Table 4.1.7-5 Traffic volume of BHVT expressway with various vehicle types（2030）

PCU/day

Section	Car	Bus	Truck	Total
Bien Hoa - Long Thanh	32,133	12,340	25,311	69,784
Long Thanh - LT Airport	41,076	14,530	20,158	75,764
LT Airport - Nhon Trach	33,265	12,201	12,141	57,607
Nhon Trach - Phu My	45,142	13,960	21,265	80,367
Phu My - NH51	9,697	2,073	13,260	25,030
Phu My - Ba Ria	28,721	9,563	7,746	46,030
Ba Ria - Vung Tau	22,891	7,438	4,653	34,982

Source: JICA Study Team

Estimated traffic volumes of BHVT expressway and NH51 are given as follows.

Table 4.1.7-6 Traffic volume of BHVT expressway and NH51

PCU/day

Section	2012 (Actual)	2018	2020	2025	2030
■Bien Hoa - Vung Tau Expressway					
Bien Hoa - Long Thanh	-	32,268	27,839	34,971	69,784
Long Thanh - LT Airport	-	34,830	31,185	50,876	75,764
LT Airport - Nhon Trach	-	34,830	21,359	40,870	57,607
Nhon Trach - Phu My	-	21,473	32,611	65,579	80,367
Phu My - Ba Ria	-	21,473	9,703	20,171	25,030
Ba Ria - Vung Tau	-	-	22,908	33,072	46,030
■NH51					
Bien Hoa - Long Thanh	65,028	51,867	51,160	64,529	66,437
Long Thanh - LT Airport	-	43,896	41,901	46,535	51,196
LT Airport - Nhon Trach	41,365	47,298	48,438	48,633	54,164
Nhon Trach - Phu My	42,336	56,185	54,382	61,957	76,645
Phu My - Ba Ria	23,907	39,254	25,588	35,409	34,914
Ba Ria - Vung Tau	26,176	27,097	14,731	24,370	27,969
■Bien Hoa - Vung Tau Expressway & NH51					
Bien Hoa - Long Thanh	65,028	84,135	78,999	99,500	136,221
Long Thanh - LT Airport	-	78,726	73,086	97,411	126,960
LT Airport - Nhon Trach	41,365	82,128	69,797	89,503	111,771

Section	2012 (Actual)	2018	2020	2025	2030
Nhon Trach - Phu My	42,336	77,658	86,993	127,536	157,012
Phu My - Ba Ria	23,907	39,254	48,496	68,481	80,944
Ba Ria - Vung Tau	26,176	27,097	31,473	48,411	62,951

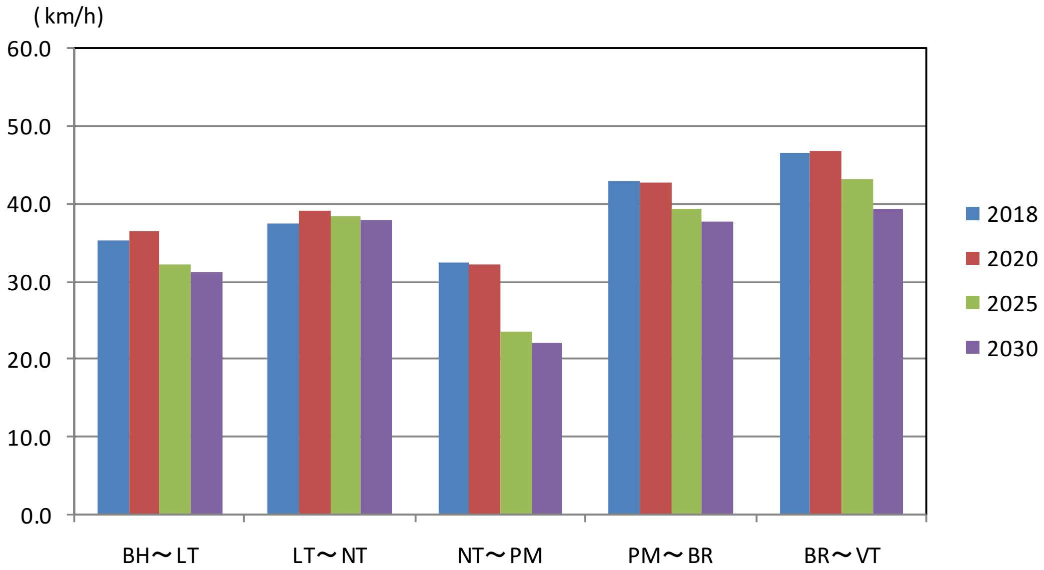
Source: JICA Study Team

4.2. Inquest of transportation planning

It is predicted that the traffic of BHVT expressway is greatly affected by construction methodology and the availability of the Long Thanh international airport and peripheral roads such as Ben Luc–Long Thanh expressway and Inter-port road.
This chapter examines the effects of these factors.

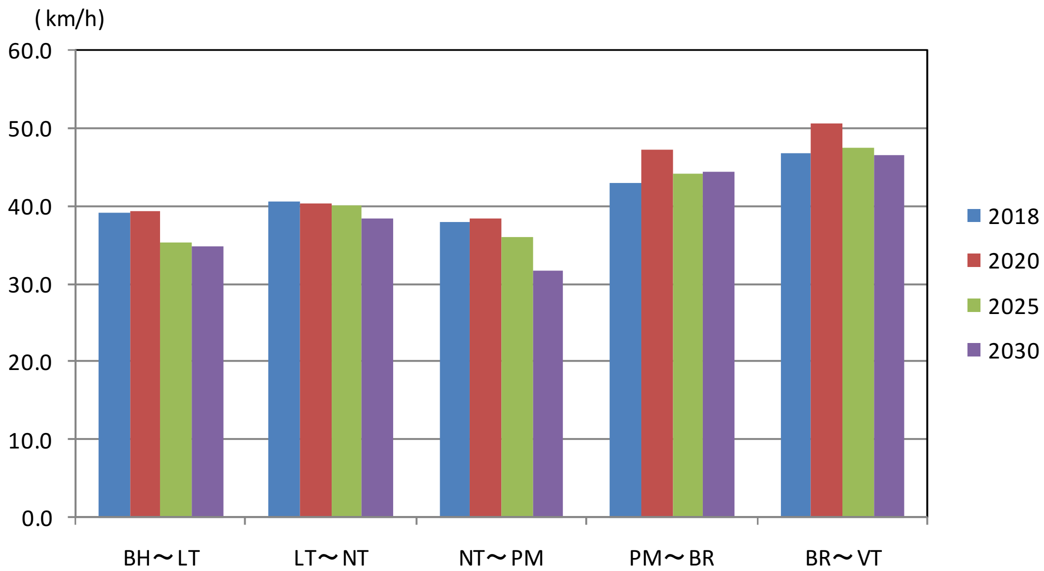
(1) BHVT Expressway

The transportation planning of BHVT expressway was checked based on the result of the projected traffic demand.
First, the necessity of BHVT expressway was checked based on the effect of the absence of BHVT expressway on NH51. Since traffic capacity of each road is determined by traffic demand forecast technique, estimated traffic volume does not exceed the capacity. Then, our attention was paid to the average running speed of traffic as shown in the following figure. If BHVT expressway is not constructed, the average running speed of traffic on NH51 decrease by 5-10km/h compared to the case where BHVT expressway is available. Furthermore, the average running speed of traffic on NH51 is expected to be below half of that on BHVT expressway. Therefore, it is thought that the necessity for the BHVT expressway is high, for it ensures high-speed traffic service.
Then, the required number of lanes on BHVT expressway was checked. By reference to the estimated traffic volume and the hourly peak rate obtained in the traffic survey of each section, reference hourly peak traffic volume was calculated and used to check the required number of lanes. Since the hourly traffic capacity of four-lane expressway is about 4000 PCU/hour according to the design criteria (TVCN4054) of Vietnam, six lanes may be needed in some sections in 2025 and 2030. From the viewpoint of minimizing the initial investment, it is reasonable to pursue the plan of widening BHVT expressway in the future while monitoring the actual traffic volume and congestion.



Source: JICA Study Team

Figure 4.2-1 Average running speed of traffic on NH51 (without BHVT expressway)



Source:JICA Study Team

Figure 4.2-2 Average running speed of traffic on NH51 (with BHVT expressway)

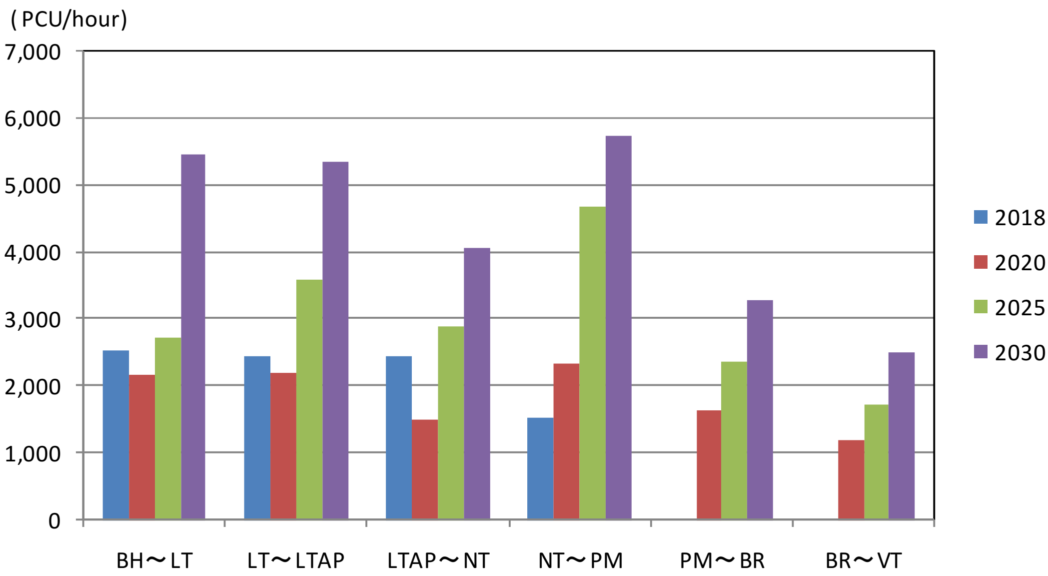
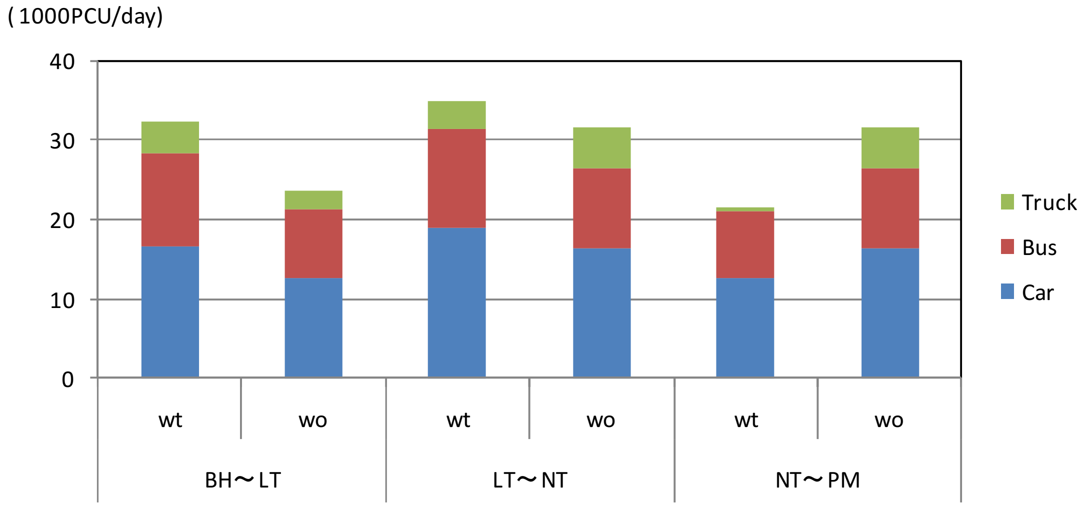


Figure 4.2-3 Reference hourly peak traffic volume of BHVT expressway

(2) Ben Luc-Long Thanh Expressway

Second, the effect of delay in construction of peripheral roads and airport was checked. Since the more time advances, the more traffic runs and the more the capacities of roads in project area are saturated, the check with the presence or absence of such roads or airport was conducted for the first service year of each plan.

Then, the effect of delay in the start of service of Ben Luc-Long Thanh expressway (BL-LT expressway), which connects to BHVT expressway directly, on BHVT expressway, was checked. If the completion of BL-LT expressway is delayed, traffic running between Ho Chi Minh City and Ba Ria Vung Tau province needs to travel via Ho Chi Minh City-Long Thanh-Dau Giay expressway (HCMC-LT-DG expressway). As a result, traffic is estimated to increase in the section between Nhon Trach and Phu My due to route changes from NH51 to the BHVT expressway. Traffic in the section between Long Thanh and Phu My is estimated to decrease slightly, because the increased traffic volume is canceled by the reduction of traffic using BL-LT expressway from Long Thanh. Since HCMC-LT-DG expressway is projected to suffer from congestion caused by traffic from BL-LT expressway, the traffic of BHVT expressway between Bien Hoa and Long Thanh is likely to decrease due to route changes to the route via NH1.

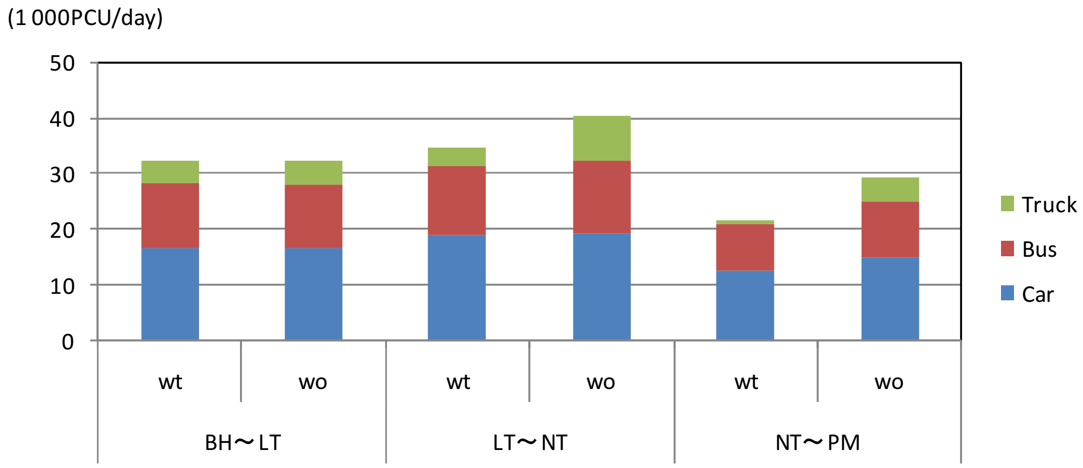


Source: JICA Study Team

Figure 4.2-4 Traffic volume with/without Ben Luc–Long Thanh Expressway in 2018

(3) Inter-port road

The effect of the Inter-port road, which runs parallel to BHVT expressway, was then checked. Without the Inter-port road, traffic volume in the section between Nhon Trach and Phu My is estimated to increase by about 1.5 times of that on BHVT expressway, and the increase in traffic volume is also expected in the section between Long Thanh and Nhon Trach, where a part of traffic shifted from the Inter-port road start to use BHVT expressway. In these sections, the majority of the increased traffic is trucks.

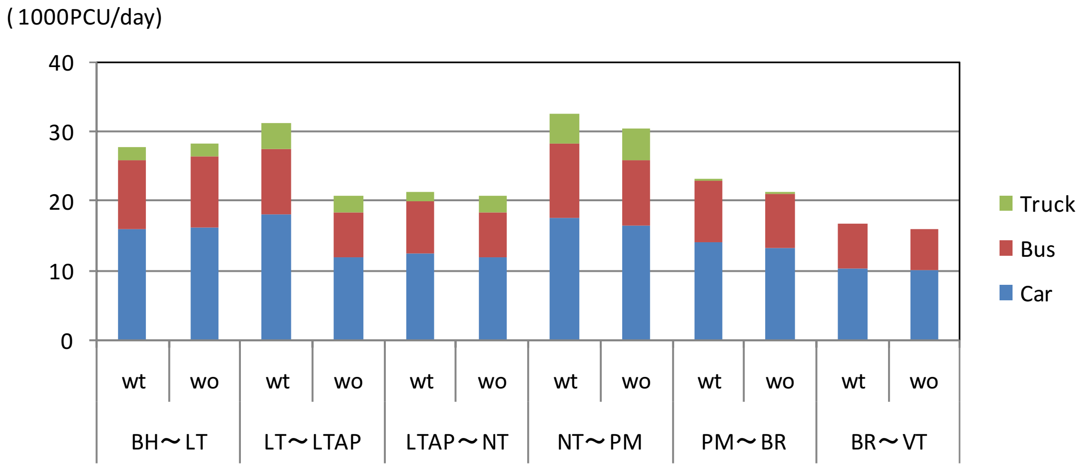


Source:JICA Study Team

Figure 4.2-5 Traffic volume with/without Inter-port road in 2018

(4) Long Thanh International Airport (LTIA)

The effect of the Long Thanh International Airport (LTIA), which is scheduled to be in service in 2020, was checked. In the case without LTIA, the traffic between Ho Chi Minh City region and LTIA, which occupies the great portion of traffic from/to LTIA, is expected to decrease. This decrease in traffic may also cause the reduction of the traffic by about 10,000 PCU in the section between Long Thanh JCT and LTIA IC, by which LTIA is connected to HCMC-LT-DG expressway.



Source: JICA Study Team

Figure 4.2-6 Traffic volume with/without Long Thanh International Airport in 2020

4.3. Inquest of BHVT expressway promotion

This chapter examines measures to promote the utilization of BHVT expressway, including installation of additional IC and application of expressway standard to the connecting road between Phu My IC and NH51 intersection, in order to improve the business profitability and convenience for road users.

(1) Additional IC

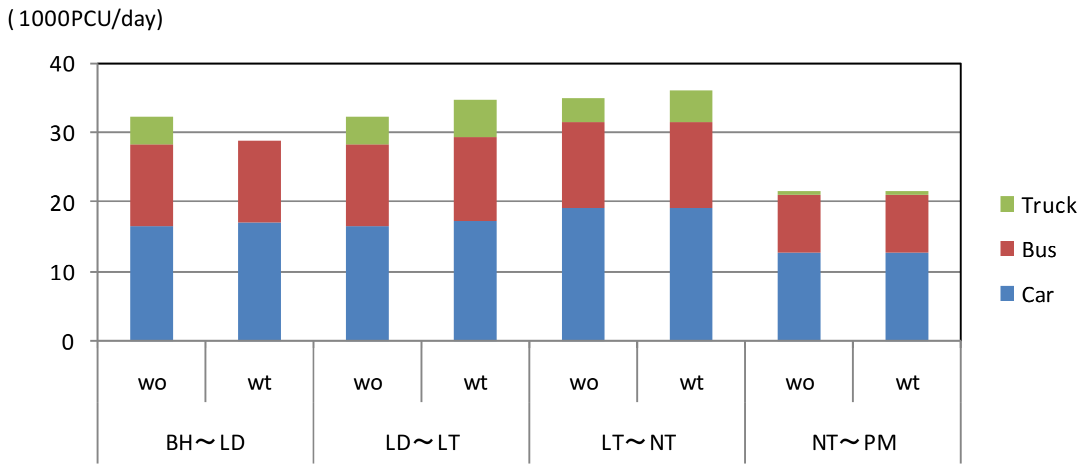
Change in traffic volume due to the installation of an additional IC (Long Duc IC) planned between Bien Hoa IC and Long Thanh IC is shown in the figure below.

Traffic from/to places with high traffic demand, such as an industrial complex between Bien Hoa and Long Thanh, is expected to use Long Duc IC to change their route from NH51 to BHVT expressway. On the other hand, traffic in sections north of Long Duc IC, especially trucks, is estimated to decrease, and the traffic using Bien Hoa IC is expected to shift from BHVT expressway to NH51. From the viewpoint of traffic volume, there are both sections with increased traffic and sections with reduced traffic. Based on this, it is necessary to conduct financial analysis to assess the improvement of business profitability, including a construction cost of the additional IC. The access traffic volume at Long Duc IC in 2018 is projected to be 7,300 PCU/day.

As a result of the financial analysis, it was found that the project IRR was falling (about-0.2%) a little, and thus the traffic demand forecast indicates that the increase in traffic due to added Long Duc IC is inadequate to compensate for the construction cost of the additional IC.

However, the greater convenience of land transport due to the improved accessibility to expressway that may be achieved by the additional IC will be an advantage for Japanese companies that have expanded or will expand their business to this area. In addition, since the additional IC offers a detour route at the time of a road closure and allows shorter routes for maintenance vehicles to travel to the destination, the expressway service level is expected to be improved.

Additional ICs for other two proposals is not discussed in this chapter. This is because these additional ICs have been examined to supplement functions of the existing junction, or as a measure against the delay in the construction of IC. The function to promote the utilization of the expressway is not expected for these additional ICs.



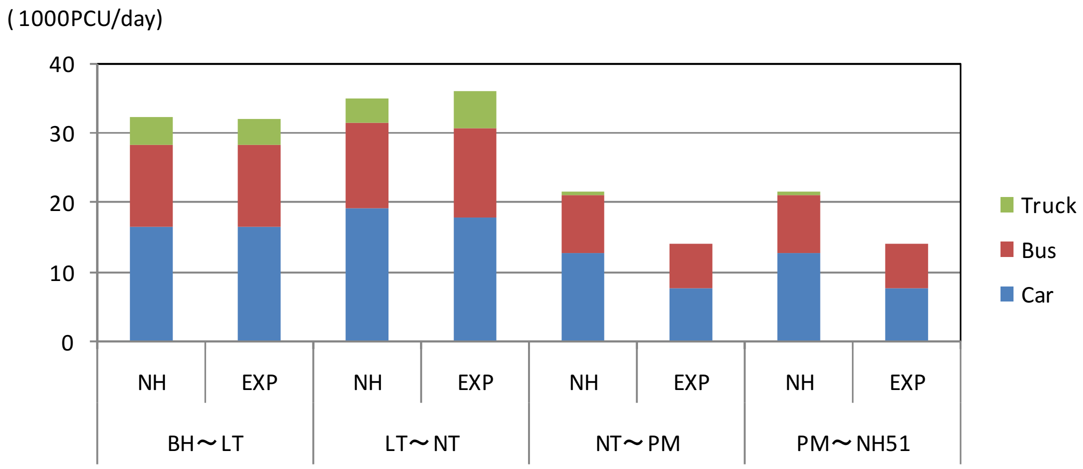
Source: JICA Study Team

Figure 4.3-1 With/without Long Duc IC in 2018

(2) Adoption of expressway standard

In the current plan, the connecting road between Phu My IC and NH51 intersection IC is planned to be build with the national highway standard. This connecting road is not very good as an access road for BHVT expressway, as it is designed to accommodate motorcycles and have the open access intersection on the way, as well as having the lower speed limit than that of expressways.

In the following paragraph, therefore, applying expressway standard to the connecting road to enable high-speed driving was examined as a measure to promote the utilization of BHVT expressway. The change in traffic volume in this case is shown in the figure below.
Since the expressway standard is applied in this case, however, the connecting road is treated as a toll expressway in the traffic demand forecast. This has caused reduction in traffic volume in the section between Nhon Trach and Phu My. Although the convenience of high-speed transportation is ensured for expressway users, no significant increase is observed in other sections, meaning the measure does not contribute to the promotion of the utilization of BHVT expressway under the condition.



Source: JICA Study Team

Figure 4.3-2 Highway/expressway standard for connecting road in 2018

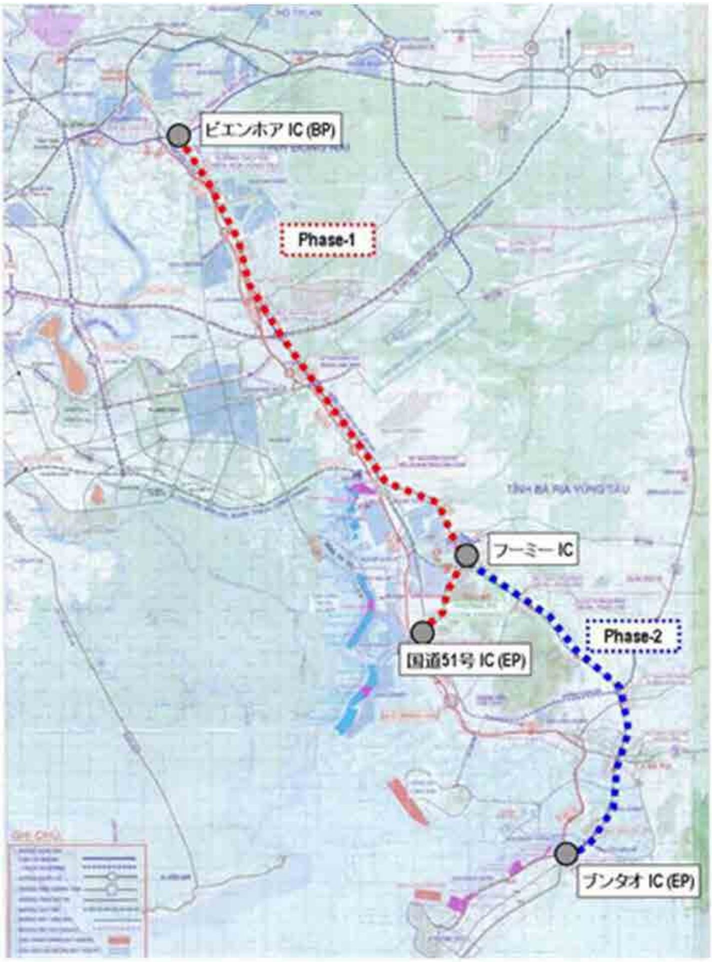
5. Basic Design for Higher Viability

5.1. Outline of the Existing Feasibility Study

5.1.1. Outline of the Plan of Bien Hoa – Vung Tau Expressway Project

The Feasibility Study (hereinafter BVEC F/S) for the BHVT Expressway construction project was carried out by BVEC. BVEC contracted out the study to TEDI, which carried it out from August 2010 until March 2011. TEDI completed the final report and submitted to BVEC in March 2011. Afterwards, the addition and the correction to F/S were executed by TEDI, and the revised edition was submitted in October, 2012.

The BHVT Expressway is a toll expressway of 68.6km long connecting Bien Hoa city of the capital of the Dong Nai province and Vung Tau city of the capital of the Ba Ria-Vung Tau province. National Highway of 9.2km long from Phu My IC which is located in Ba Ria-Vung Tau province to the NH51 intersection connected with the access road to the Cai Mep-Thi Vai port is included in this project. The section from Phu My IC to the intersection with seaside road (connecting to Cua Lap Bridge) is planned as an expressway, and the section from this intersection to the NH51 intersection in Vung Tau city which is the end point of the project is planned as the urban road. The stage construction is planned as phase 1 for the section from Bien-Hoa IC to Phu My IC and the section from Phu My IC to NH 51 intersection connecting to Cai Mep-Thi Vai port, and as phase 2 for Phu My IC to NH51 intersection of the Vung Tau city. The BHVT expressway is connected with HCM-Long Thanh-Dau Gai expressway by Long Thanh IC, and with Ben Luc-Long Thanh expressway by Nhon Thach IC. The location map and outline of BHVT Expressway of BVEC F/S are shown in Figure 5.1.1-1 and Table5.1.1-1



Source: JICA Study Team

Figure 5.1.1-1 Location Map of BHVT Expressway project (F/S)

Table 5.1.1-1 Outline of BHVT Expressway project (F/S)

Project section	Phase		Phase	
	BH IC to PM IC	PM IC to NH51 intersection connecting to Cai Mep-Thi vai Port	Phu My IC to Vung Tau intersection	Vung Tau intersection to NH51 intersection
Section(km)	0+000-37+600	37+600-46+800	37+600-66+000	66+000-68+653.42
Length(km)	37.6	9.2	28.4	2.65342
Road Classification	Expressway Class A	National Highway Class II	Expressway Class A	Main Urban Road
Design Standard	TCVN5729 (1997)	TCVN4054 (2005)	TCVN5729 (1997)	TCXDVN104 (2007)
Design Speed	120km/h	100km/h	120km/h	80km/h
No.of lanes	4(when opened)	4 (when opened)	4	4

	6 to 8 (when fully completed)	6 (when fully completed)		
Interchange/ Intersection	Bien Hoa IC (km0+000) Long Thanh IC (km17+760)	NH51 Intersection (km46+360)	Phu My IC(km37+800) Ba Ria IC(km53+050) Vung Tau Intersection(km66+000)	,NH51 Interswction (km68+653.42)
Service Area	Phu My SA (km36+500)	None	None	None
Toll Gate	Main Road (km1+200) Long Thanh IC	Main Road (km39+200)	Main Road (km65+260)	None

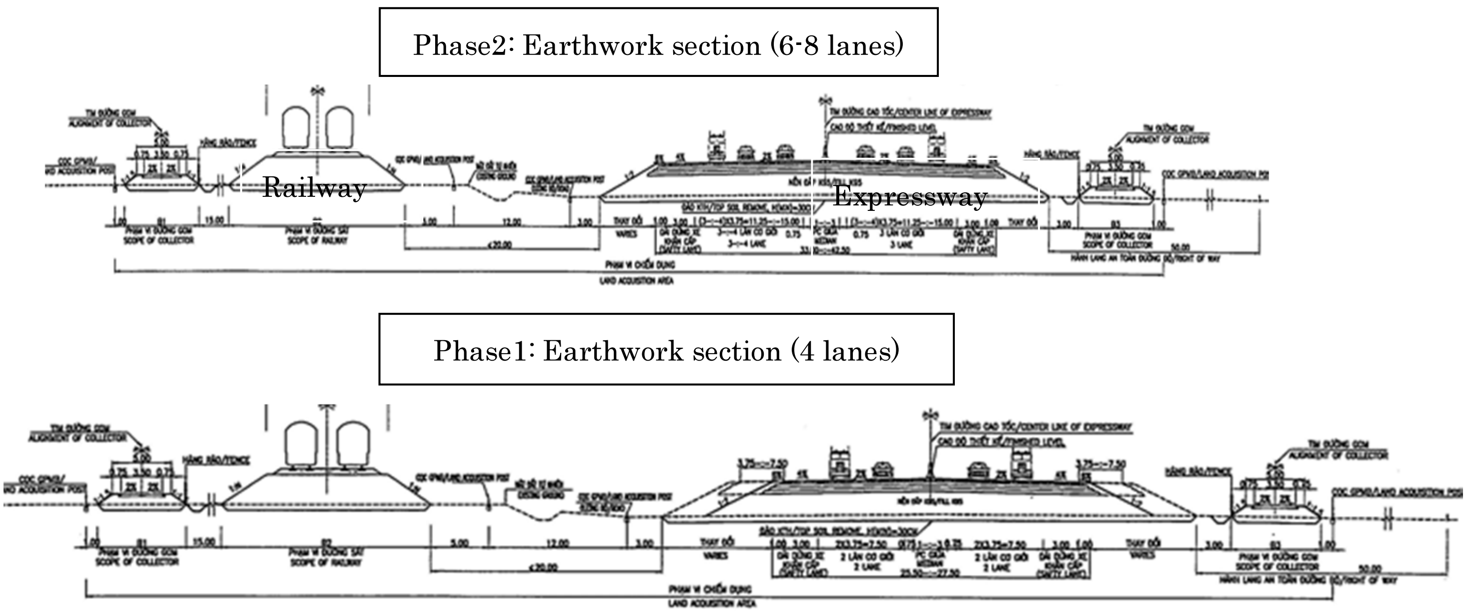
Source: JICA Study Team

5.1.2. Typical Cross Section

(1) Bien Hoa IC (Km0+000) - Phu My IC (Km37+600) Section

The expressway is planned as 4 lanes for phase 1 and 6 to 8 lanes for phase 2. The planned Bien Hoa - Vung Tau Railway runs parallel to the expressway, which is located at the east side of the expressway between Bien Hoa IC and the boundary of Dong Nai Province and Ba Ria-Vung Tau Province. The alignment of expressway is planned controlling the railway.

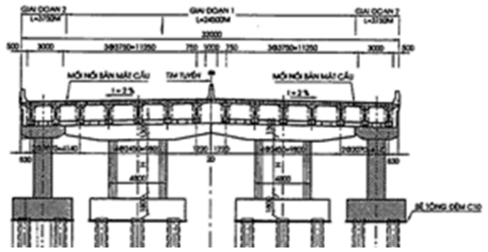
The typical cross section for embankment section and bridge section are shown in Figure 5.1.2-1 and Figure5.1.2-2, respectively.



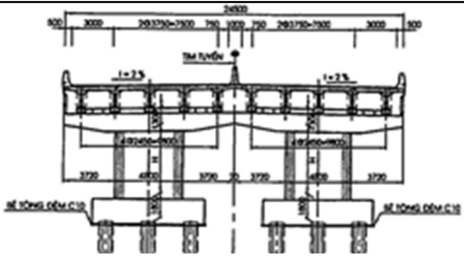
Source: BVEC F/S

Figure 5.1.2-1 Typical Cross Section of Embankment Section for Bien Hoa IC (Km0+000) - Phu My IC (Km37+600)

Phase2: Bridge section (6 lanes)



Phase1: Bridge section (4 lanes)



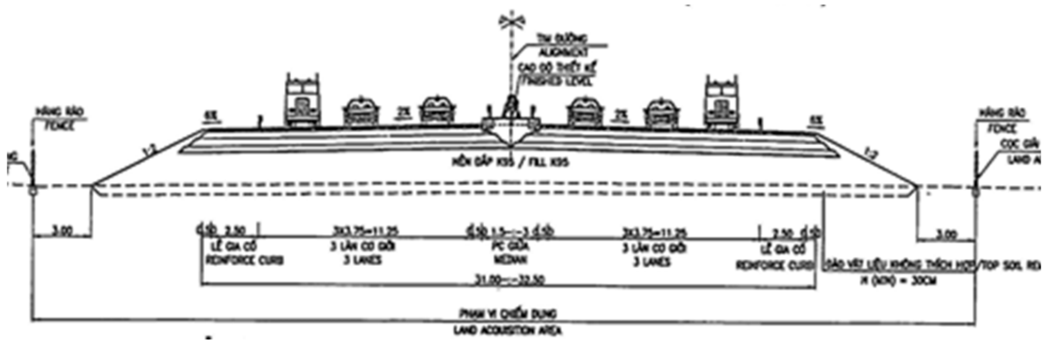
Source:BVEC F/S

Figure 5.1.2-2 Typical Cross Section of Bridge Section for Bien Hoa IC (Km0+000) - Phu My IC (Km37+600)

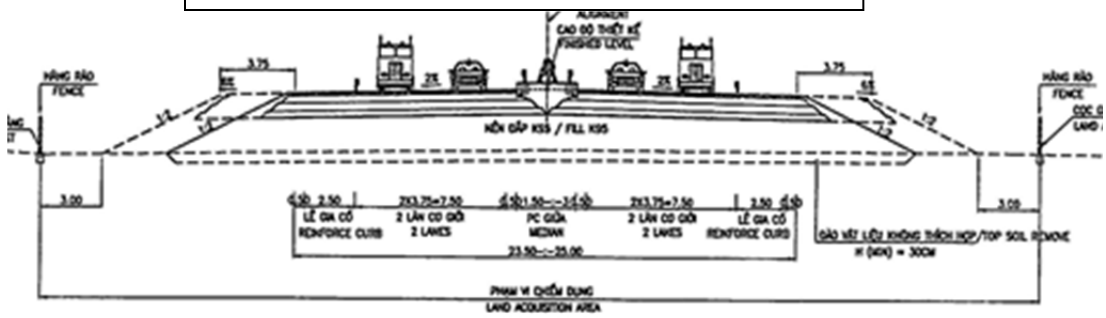
(2) Phu My IC (Km37+600)-NH51 intersection (Km37+600) Section

This section is classified as National Highway and planned 4 lanes for phase 1 and 6 lanes for phase 2. The typical cross section for embankment section is shown in Figure 5.1.2-3. The Bridge is not planned in this section.

Phase2: Embankment section (6-8 lanes)



Phase1: Embankment section (4 lanes)



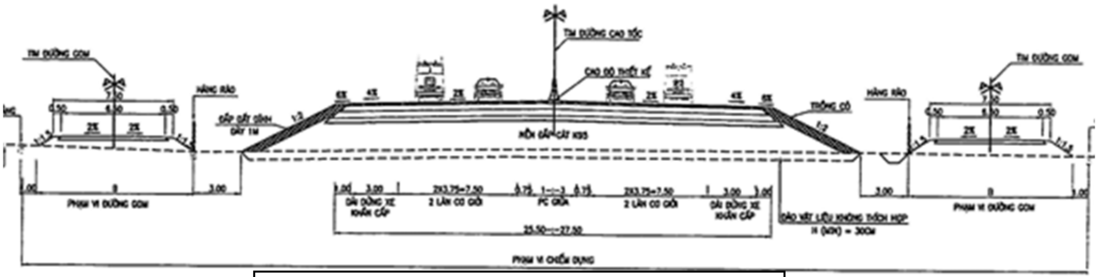
Source: BVEC F/S

Figure 5.1.2-3 Typical Cross Section of Phu My IC (Km37+600)-NH51 intersection (Km37+600)

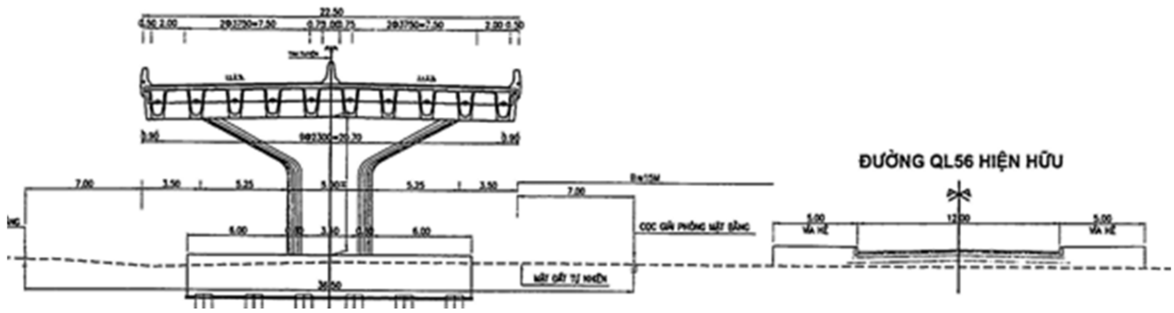
(3) Phu My IC (Km37+600) -Vung Tau intersection (66+000) Section

The expressway is planned to construct as 4 lanes in the phase 2 stage. The typical cross sections for embankment section and bridge section are shown in Figure 5.1.2-4.

Phase2: Earthwork section (4 lanes)



Phase2: Bridge section (4 lanes)



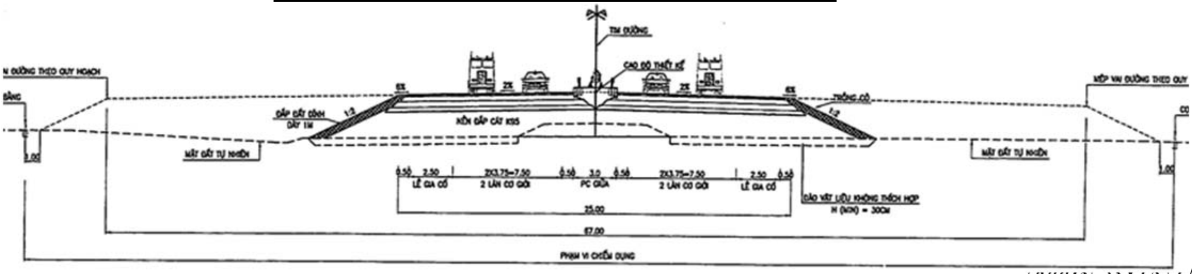
Source: BVEC F/S

Figure 5.1.2-4 Typical Cross Section for Embankment section and Bridge section for Phu My IC (Km37+600) -Vung Tau intersection (Km66+000)

(4) Vung Tau intersection (Km66+000) – NH51 intersection (68+653.42) Section

The urban road is planned to construct as 4 lanes in phase 2 stage. The typical cross section for embankment section for phase 2 is shown in Figure 5.1.2-5. The Bridge is not planned in this section.

Phase2: Embankment section (4 lanes)



Source: BVEC F/S

Figure 5.1.2-5 Typical Cross Section for Embankment section for Phase 2 for Vung Tau intersection (Km66+000) – NH51 intersection (Km68+653.42)

5.2. Review of the Existing Feasibility Study

5.2.1. Documents and Information Received

The planning and design were reviewed based on the latest F/S documents and information which were received from BVEC and TEDI.

+ Final Report (October of 2012)

+ Final Drawings of Route and Work Design (October of 2012)

Composition of the Final Report and drawings are shown in Table 5.2.1-1.

Table 5.2.1-1 Composition of F/S Final Reports and Drawings

Volume I	Final Report: Project Presentation
	PART 1 : NECESSITY OF INVESTMENT
	CHAPTER 1 : PROJECT OVERVIEW
	CHAPTER 2: SOCIO-ECONOMIC DEVELOPMENT ORIENTATION AND REALITIES OF THE STUDY AREA
	CHAPTER 3 : OTHER RELEVANT PLANNINGS AND PROJECTS
	CHAPTER 4 :TRAFFIC SURVEY AND TRANSPORT DEMAND FPRECAST
	CHAPTER 5 :NECESSITY FOR INVESTMENT
	PART 2 : NATURAL CONDITIONS OF THE STUDY AREA
	CHAPTER 6 : NATURAL CONDITIONS OF THE STUDY AREA
	CHAPTER 7 : SURVEY OF CONSTRUCTION MATERIAL SOURCES
	PART 3 : ANALYZING TO SELECTION SCALE,MAIN TECHNICAL STANDARDS
	CHAPTER 8 :SELECTION OF SCALE,MAIN TECHNICAL STANDARDS
	CHAPTER 9 :STUDY OF ALIGNMENT OPTION
	PART 4 : WORK ITEMS UNDER THE PROJECT; ANALYSIS AND SELECTION OF ENGINEERING & TECHNOLOGY OPTIONS
	CHAPTER 10 :MEASURES AND RESULTS OF ALIGNMENT AND INTRESECTION DESIGN

	CHAPTER 11 : MEASURES AND RESULTS OF BRIDGE AND TUNNEL DESIGN CHAPTER 12 :SOLUTIONS AND RESULTS OF DESIGN FOR WORKS MANAGEMENT AND EXPLOITATION PART 5 : IMPLEMENTATION SOLUTIONS CHAPTER 13 :LAND USE DEMAND.LAND CLEARANCE PLAN AND RESETTLEMENT CHAPTER 14 :EXECUTION SEGMENT,EXECUTION PROGRESS AND PROJECT MANAGEMENT FORM CHAPTER 15 :PLAN OF OPERATING INCIDENTA MAINTENANCE PART 6 : ENVIRONMENT IMPACT ASSESSMENT CHAPTER 16 : ENVIRONMENT IMPACT ASSEEMENT CHAPTER 17 :TOTAL INVESTMENT OF THE PROJECT CHAPTER 18 :EVALUATION OF ECOMOMIC EFECT OF THE PROJECT CHAPTER 19 :EVALUATION OF FINANCIAL EFFICIENCY OF PROJECT CHAPTER 20 : CONCLUSION AND RECOMMENDATION Appendix:Total Investment
Volume II	Basic Design: Drawings of Route & Work Design
	Book II-1-1: Typical drawing, Alignment Plan, Longitudinal Profile, Intersection Design (km0+000-km37+000) Book II-1-2: Drawings of Bridge & Work Design (km0+000-km37+000) Book II-1-3-1: Detail of Cross Section (km0+000-km12+000) Book II-1-3-2: Detail of Cross Section (km12+000-km24+000) Book II-1-3-3: Detail of Cross Section (km24+000-km37+000) Book II-2-1: Typical drawing, Alignment Plan, Longitudinal Intersection Design (km37+000-km68+653.42) Book II-2-2: Drawings of Bridge & Work Design (km37+000-km68+653.42) Book II-2-3: Detail of Cross Section (km37+000-km68+653.42) Book III-3-1: Drawings of Route & Bridge Phu My-NH51 section (km37+600-km46+800) Book III-3-2: Detail of Cross Section Phu My-NH51 section (km37+600-km46+800)

Source: JICA Study Team

5.2.2. Scope of Review of BVEC F/S

As mentioned in foregoing section, BHVT Expressway project is divided into Phase 1 and Phase 2. The BHVT Expressway plays industrial trunk road which connects between HCMC and suburban industrial parks, international ports, and formulate national expressway network as intercity expressway in the region. Therefore, development of whole section of Bien Hoa – Vung Tau is essential. However, the Study Team found that appropriate profitability for private financed project will not be secured in case that the project incorporate Phu My – Vung Tau section (Phase 2 section) according to preliminary F/S review.

- ➢ Bien Hoa – Phu My section is connected to Long Thanh international airport, Cai Mep – Thi Vai international port, Phu My industrial park, and other industrial parks, and huge traffic demand can be expected.
- ➢ Tourism purpose traffic is dominant on Phu My – Vung Tau section due to less scale of road side industrial park comparing with Bien Hoa – Phu My section.
- ➢ According to BVEC F/S, traffic demand of Phu My – Vung Tau section in year 2030 and 2035 are 55.8% and 60.5% of the traffic demand of Bien Hoa – Phu My section.
- ➢ Project cost of Phu My – Vung Tau section is 87.7% of the project cost of Bien Hoa – Phu My section.
- ➢ Estimated FIRR for Bien Hoa – Phu My section in BVEC F/S is 9.2% even in expectation of income from road side development right.

As described in paragraph 1.2,2,1, therefore, the scope of the study for the BOT/PPP project is limited to the Phase 1 Section (Bien Hoa IC - Phu My IC and NH 51 intersection), and Phase 2 Section (Phu My IC - Vung Tau IC) is considered to be developed by public investment project using governmental funds including ODA.

Accordoing to the above scope of the study, the F/S of Phase 1 section was reviewed from viewpoints of the investors and several design changes for reduction of the construction cost and improvement of safety were proposed in this study. As for the F/S of Phase 2 section, it was preliminary reviewed and proposed scope of the next study (e.g. preparatory study in case of ODA project).

Subsequently, the F/S for the Phase 1 section was reviewed considering the following items. Review results are also reported in this chapter.

- ✓ Highway Planning and Design;
- ✓ Bridge Planning and Design;
- ✓ Road Structure Design;
- ✓ Soft Soil Treatment Design
- ✓ Construction Planning;
- ✓ Construction Cost Estimate;
- ✓ O&M Plan;

5.2.3. Confirmation of result of BVEC F/S and collection of latest information

(1) BVEC F/S Reports and Drawings

The reports and the drawings concerning the obtained BHVT Expressway project are as shown in Table 5.2.1.-1

(2) Site Reconnaissance

The site reconnaissance was carried out the locations of Phase 1 for Bien Hoa IC connecting with Bien Hoa Bypass at the beginning point of the project, Long Thanh IC connecting with HCM-Long Thanh-Dau Gay Expressway,Non Trach IC connecting with Ben Luc-Long Thanh Expressway and NH51 Intersection connecting with Cai Mep-Thi Vai Port access Road.

Moreover, Site reconnaissance was carried out the locations of Phase 2 for Ba Ria IC connection with Ba Ria Ring Road, the continuous long viaduct and the long span bridge crossing over river, soft soil area , Vung Tau intersection and NH51 intersection.

(3) Information

1) Selection of the optimum route alignment

The route alignment of expressway between km3+500-km6+100 was determined after the comparative study to avoid the pumping station and factories, and between km11+900 and km17+300 which runs near cemetery was determined in the area of cemetery after study the distance from railway. Consequently, the route was approved by Dong Nai Province.

2) Typical Cross Section of Phase1

The method of exterior widening from 4 lanes to 6/8 lanes for the embankment in Phase 2 was approved by MOT.

3) The changing of crossing method of BHVT Expressway and HCM-Long Thanh-Dau Giay Expressway in the area of Long Thanh IC

The Bien Hoa-Vung Tau railway which is parallel to the BHVT Expressway is planned on the ground. Therefore vertical alignment of the BHVT Expressway is required to change from overpass to underpass, and this change was approved by MOT. Then modification of basic design of F/S and the study of Long Thanh IC connecting the BHVT Expressway and the HCM-Long Thanh-Dau Giay Expressway are conducting by TEDI. The construction of the HCM-Long Thanh-Dau Giay Expressway is under implementation. Therefore change of construction from embankment to viaduct is required when construction of the BHVT Expressway will start during . opening the traffic on the HCM-Long Thanh-Dau Giay Expressway.

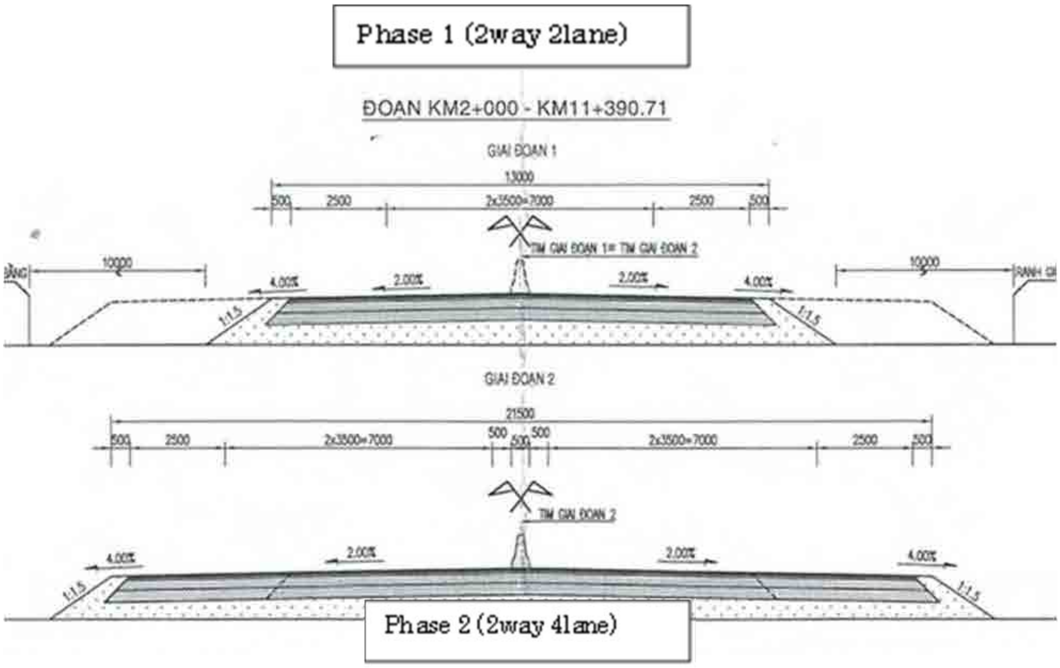
4) Construction of Nhon Trach IC

It was confirmed that Nhon Trach IC belongs to the Ben Luc-Long Thanh Expressway project and will be constructed in Phase 2 of this project. And the detailed design of this project is reviewing now.

5) Relocation of Toll Gate between Phu my IC and NH51 intersection connecting Cai mep-Thi Vai port access road. The Toll Gate is relocated from before NH51 intersection to after Phu My IC

6) Construction of Bien Hoa City Bypass

The Bien Hoa City Bypass which is connected to the BHVT Expressway at Bien Hoa IC is planned as a national highway with 4 lanes and design speed 80km/h. Typical cross section is shown in Figure 5.2.3-1. The construction of the Bypass is under construction.



Source: D/D of Bien Hoa Bypass

Figure 5.2.3-1 Typical Cross Section of Bien Hoa Bypass

7) Construction of Cai Mep-Thi vai Port Access Road

The Cai Mep-Thi Vai Port access road which is connected to NH51 Intersection is planned as a provincial road with 4 lanes and design speed 80km/h. The typical cross section is shown in Figure 5.2.3-2. Construction of the road is under construction.

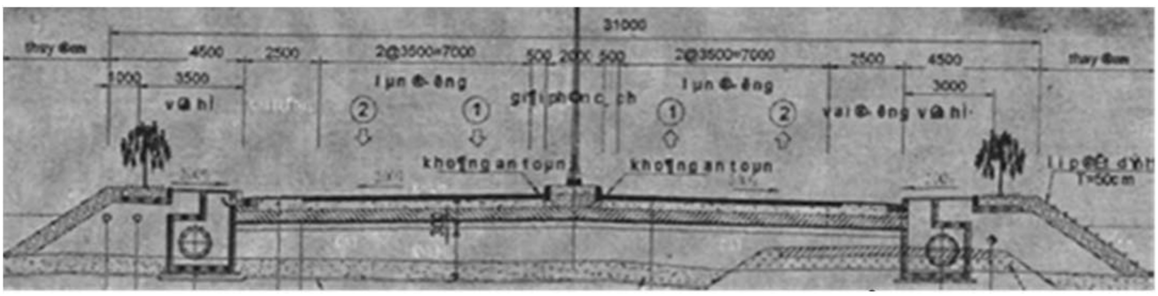


Figure 5.2.3-2 Typical Cross Section of Cai Mep-Thi vai Port access road

8) Construction of widening of NH51 between Bien Hoa and Vung Tau

NH51 is a national highway of 85.62 km long from Bien Hoa city to Vung Tau city. The widening from 4 lanes to 6 lanes is under construction. It is scheduled to be completed at the end of 2012. Pictures of 6 lanes of NH51 were shown below.

Picture 5.2.3-1

Picture 5.2.3-2

5.2.4. Natural Condition Survey in F/S

The following surveys were conducted for the design in BVEC F/S.

- **Topographic Survey**

The Plan and profile survey, cross-section survey for the main road and interchange, and the topographic survey for bridge and box/pipe culverts were executed in BVEC F/S.

The topographic survey including plan, profile, cross section survey were executed for the design of Long Duc IC in this study.

- **Geological Survey**

The geological survey was executed for the design of earthwork, bridge, overpass, culvert, soft ground and pavement in BVEC F/S.

- **Hydrological Survey**

The hydrological survey was executed for the design of embankment, bridge and culvert in BVEC F/S. The meteorological data such as rainfalls, rainfall intensities, air temperature, and wind speed were collected.

- **Material Survey**

The material survey of construction materials supply including investigation, sampling of construction materials, mines and laboratory tests were executed for the design of earthwork and pavement in BVEC F/S.

5.2.5. Design Standards and Design Policy in BVEC F/S

(1) Design Standards6pt

1) Highway Design Standards

TCVN 5729(1997) was applied for the expressways , TCVN4054(2005) was applied for national highways and TCXDVN104(2007) was applied for urban road. The geometric design criteria for expressway, national highway and urban road are summarized in Table 5.2.5-1, Table 5.2.5-2 and Table 5.2.5-3

Table 5.2.5-1 Geometric Design Criteria for Expressway

Design Elements			Type /Value	Remarks	Reference
1	Expressway Classification		Expressway Type A Grade 120		TCVN5729
2	Terrain		Flat		TCVN5729
3	Design Speed (km/h)		120		TCVN5729
4	Cross-Sectional Elements	Number of Travelled Way	4:Phase1,6-8:Phase2	() is at particular section for the flyover crossing	F/S
		Formation Width (m)	25.5(27.5):phase1 33.0(42.5):phase2		F/S
		Travelled Way Width(m)	2 x 7.5:Phase1 2x11.25(15.0):phase		TCVN5729
		Outer Shoulder Paved Width (m)	3.0		TCVN5729
		Outer Shoulder Earthen Width (m)	1.0		TCVN5729
		Median Width (m)	1.0(3.0)		TCVN5729
		Median Marginal Strip (m)	0.75		TCVN5729
		Crossfall of Roadway (%)	2.0		TCVN5729
		Slope of Earthworks			
		Fill	V : H = 1:2.0		F/S
		Cut	V : H = 1:1.0		F/S
	t Dist	Stopping Sight Distance (m)	230 (160)		TCVN5729
7	Horizontal Alignment	Horizontal Curve			
		Desirable Minimum Radii of Horizontal Curve	1000		TCVN5729
		Absolute Minimum Radii of Horizontal Curve	650		TCVN5729
		Superelevation (Se)			TCVN5729
		Maximum Se for Desirable Min. Radius (%)	5.0		TCVN5729
		Maximum Se for Absolute Min. Radius (%)	7.0		TCVN5729
		Minimum Radii w/o Superelevation (m)	>4000		TCVN5729
		Transition Curve			
		Minimum Length for Desirable Min. Radius (m)	210		TCVN5729
		Minimum Length for Absolute Min. Radius (m)	150		TCVN5729
8	Vertical Alignment	Maximum Grade-Up (%)	4.0		TCVN5729
		Maximum Grade-Down (%)	5.5		TCVN5729
		Minimum Grade (%)	0.5		TCVN5729
		Critical Maximum Length of Grades			
		For 4.0 % (m)	600		TCVN5729
		Minimum Length of Grade (m)	300		TCVN5729
		Vertical Curve			
		Minimum Length of Vertical Curve (m)	100		TCVN5729
		Minimum Radius of Crest Curve (m)			
		Absolute Minimum Radius (m)	12000		TCVN5729
		Desirable Minimum Radius (m)	17000		TCVN5729
		Desirable Radius (m)	20000		TCVN5729
		Minimum Radius of Sag Curve (m)			
		Absolute Minimum Radius (m)	5000		TCVN5729
		Desirable Minimum Radius (m)	6000		TCVN5729
		Desirable Radius (m)	12000		TCVN5729
9	Lateral Clearance (m)		Travelled width		TCVN5729
	Vertical Clearance (m)		4.75		TCVN5729

Source: JICA Study Team

Table 5.2.5-2 Geometric Design Criteria for National Highway

Design Element			Type /Value	Remarks	Reference
1	Expressway Classification		National Highway Class II		TCVN4054
2	Terrain		Flat		TCVN4054
3	Design Speed (km/h)		100		TCVN4054
4	Cross-Sectional Elements	Number of Travelled Way	4:phase1,6:phase2	() is at particular section for the flyover crossing	F/S
		Formation Width (m)	23.5(25.0):phase1 31.0(32.5):phase2		F/S
		Travelled Way Width(m)	2x7.5:phase1 2x11.25:Phase2		TCVN4054
		Outer Shoulder Paved Width (m)	2.5		TCVN4054
		Outer Shoulder Earthen Width (m)	0.5		TCVN4054
		Median Width (m)	1.5(3.0)		TCVN4054
		Median Marginal Strip (m)	0.5		TCVN4054
		Crossfall of Roadway (%)	2.0		TCVN4054
		Slope of Earthworks			
		Fill	V : H = 1:2.0		F/S
		Cut	V : H = 1:1.0		F/S
	Sight Dist.	Stopping Sight Distance (m)	150		TCVN4054
7	Horizontal Alignment	Horizontal Curve			
		Desirable Minimum Radii of Horizontal Curve (m)	700		TCVN4054
		Absolute Minimum Radii of Horizontal Curve (m)	400		TCVN4054
		Superelevation (Se)			TCVN4054
		Maximum Se for Desirable Min. Radius (%)	4.0		TCVN4054
		Maximum Se for Absolute Min. Radius (%)	8.0		TCVN4054
		Minimum Radii w/o Superelevation (m)	>4000		TCVN4054
		Transition Curve	shall not be smaller than length of super-elevation		
		Minimum Length for Desirable Min. Radius (m)			TCVN4054
		Minimum Length for Absolute Min. Radius (m)	Runoff		TCVN4054
8	Vertical Alignment	Maximum Grade (%)	4.0	()is in difficult situation	TCVN4054
		Minimum Grade (%)	0.5(0.3)		TCVN4054
		Critical Maximum Length of Grades			
		For 4.0 % (m)	800		TCVN4054
		Minimum Length of Grade (m)	250		TCVN4054
		Vertical Curve			
		Minimum Length of Vertical Curve (m)	85		TCVN4054
		Minimum Radius of Crest Curve (m)			
		Absolute Minimum Radius (m)	6000		TCVN4054
		Desirable Minimum Radius (m)	10000		TCVN4054
		Minimum Radius of Sag Curve (m)			
		Absolute Minimum Radius (m)	3000		TCVN4054
		Desirable Minimum Radius (m)	5000		TCVN4054
9	Lateral Clearance (m)		Travelled width		TCVN4054
	Vertical Clearance (m)		4.75		TCVN4054

Source: JICA Study Team

Table 5.2.5-3 Geometric Design Criteria for Urban Road

Design Elements			Type /Value	Remarks	Reference
1	Expressway Classification		Main Urban Road Primary		TCXDVN 104
2	Terrain		Flat		TCXDVN104
3	Design Speed (km/h)		80		TCXDVN104
4	Cross-Sectional Elements	Number of Travelled Way	4	() is at particular section for the flyover crossing	F/S
		Formation Width (m)	25.0		F/S
		Travelled Way Width(m)	2 x 7.5		TCXDVN104
		Outer Shoulder Paved Width (m)	2.5		TCXDVN104
		Outer Shoulder Earthen Width (m)	0.5		TCXDVN104
		Median Width (m)	3.0		TCXDVN104
		Median Marginal Strip (m)	0.5		TCXDVN104
		Crossfall of Roadway (%)	2.0		TCXDVN104
		Slope of Earthworks			
		Fill	V : H = 1:2.0		F/S
		Cut	V : H = 1:1.0		F/S
	Sight Dist.	Stopping Sight Distance (m)	100		TCXDVN104
7	Horizontal Alignment	Horizontal Curve			
		Desirable Minimum Radii of Horizontal Curve (m)	400		TCXDVN104
		Absolute Minimum Radii of Horizontal Curve (m)	250		TCXDVN104
		Superelevation (Se)			
		Maximum Se for Desirable Min. Radius (%)	4.0		TCXDVN104
		Maximum Se for Absolute Min. Radius (%)	8.0		TCXDVN104
		Minimum Radii w/o Superelevation (m)	>2500		TCXDVN104
		Transition Curve	shall not be smaller than lenth of super-elevation		TCXDVN104
		Minimum Length for Desirable Min. Radius (m)			TCXDVN104
		Minimum Length for Absolute Min. Radius (m)			TCXDVN104
8	Vertical Alignment	Maximum Grade (%)	5.0	()is in difficult situation	TCXDVN104
		Minimum Grade (%)	0.5(0.3)		TCXDVN104
		Critical Maximum Length of Grades			
		For 4.0 % (m)	700		TCXDVN104
		Minimum Length of Grade (m)	150		TCXDVN104
		Vertical Curve			
		Minimum Length of Vertical Curve (m)	70		TCXDVN104
		Minimum Radius of Crest Curve (m)			
		Absolute Minimum Radius (m)	3000		TCXDVN104
		Desirable Minimum Radius (m)	4500		TCXDVN104
		Minimum Radius of Sag Curve (m)			
		Absolute Minimum Radius (m)	2000		TCXDVN104
		Desirable Minimum Radius (m)	3000		TCXDVN104
9	Lateral Clearance (m) Vertical Clearance (m)		Travelled width 4.75		TCXDVN104

Source: JICA Study Team

2) Drainage design Criteria

TCVN5729(1997) was applied for expressways , TCVN4054(2005) was for national highways and TCXDVN104(2007) was applied for the urban road.

3) Pavement design criteria

22TCN211 was applied for the flexible pavement (asphalt concrete) and 22 TCN233 for the rigid pavement (cement concrete).

4) Traffic safety facility design criteria

22TCN237 and 22TCN331 were applied for the traffic signs and pavement markings.

5) Lighting design criteria

TCXDVN259 was applied for the lighting design

5.2.6. Design Policy

The following cost reduction policy in the BVEC F/S aims to improve the profit of the toll road. The design policy is shown in Table 5.2.6-1.

Table 5.2.6-1 Design Policy in the BVEC F/S

No.	Design Policy
1	Apply low embankment in order to reduce the earthwork volume, with adopting of flyover of cross-road instead of overpass of main road.
2	Apply absolute minimum width of media strip in order to reduce the earthwork volume.
3	Apply high embankment at the abutment in order to reduce the bridge length.
4	Excavate six-lane width at cut sections in order to utilize excavated soil for embankment with short hauling distance.
5	Build full box culverts considering the length of phase-2, in phase-1.

Source: BVEC F/S

5.2.7. Review of Highway Design

(1) Horizontal Alignment of Expressway Section

The design elements of the horizontal alignment of the expressway section from KM 0+000 to KM 66+000 are shown in Table 5.2.7-1.

The minimum radius of horizontal curve is 1200 m and minimum length of transition curve is 133.50 m (clothoid parameter is 400.25 m) is applied. These designed values satisfy the criteria.

Table 5.2.7-1 Horizontal Alignment of Expressway Section (Phase 1 and Phase 2)

No.		Station	Coordinate		Beginning Radius (m)	Clothoid Parameter (m)	Ending Radius (m)	Length (m)
			X	Y				
1	BP	0+000.00	1205416.667	407000.860	0.000		0.000	789.18
2	TS	0+789.18	1204741.812	407409.981	0.000	707.107	-2000.000	250.00
3	SC	1+039.18	1204530.812	407543.986	-2000.000		-2000.000	330.23
4	CS	1+369.41	1204276.426	407753.961	-2000.000	707.107	0.000	250.00
5	ST	1+619.41	1204104.856	407935.736	0.000		0.000	1643.37
6	TS	3+262.77	1203001.994	409154.073	0.000	400.250	1200.000	133.50
7	SC	3+396.27	1202910.595	409251354.	1200.000		1200.000	784.26
8	CS	4+180.53	1202217.823	409588.316	1200.000	400.250	0.000	133.50
9	TS	4+314.05	1202084.850	409611.952	0.000		0.000	133.50
10	TS	4+314.05	1202084.850	409611.952	0.000	400.250	-1200.000	133.50
11	SC	4+447.05	1201952.391	409611.952	-1200.000		-1200.000	358.310
12	CS	4+805.36	1201608.829	409708.895	-1200.000	400.250	0.000	133.50
13	ST	4+938.36	1201489.744	409768.082	0.000		0.000	860.019
14	TS	5+798.54	1200726.657	410165.093	0.000	569.210	1800.000	180.00
15	SC	5+978.54	1200565.631	410245.488	1800.000		1800.000	204.00
16	CS	6+182.54	1200375.757	410319.800	1800.000	569.210	0.000	180.00
17	ST	6+362.54	1200202.949	410370.068	0.000		0.000	276.76
18	TS	6+639.30	1199935.953	410442.927	0.000	707.107	-2000.000	250.00
19	SC	6+889.30	1199696.237	410513.739	-2000.000		-2000.000	554.17
20	CS	7+443.47	1199203.095	410762.653	-2000.000	707.107	0.000	250.00
21	ST	7+693.47	1199003.754	410913.456	0.000		0.000	314.54
22	TS	8+008.02	1198756.911	411108.410	0.000	1106.80	3500.000	350.00
23	SC	8+358.02	1198478.699	411320.708	3500.000		3500.000	934.36
24	CS	9+292.35	1197654.578	411755.014	3500.000	1106.80	0.000	350.00
25	ST	9+642.35	1197322.184	411864.502	0.000		0.000	2237.18.
26	TS	11+879.56	1195185.913	412528.919	0.000	1106.80	-3500.000	350.00
27	SC	12+229.56	1194853.519	412638.407	-3500.000		-3500.000	332.23
28	CS	12+561.78	1194547.503	412767.426	-3500.000	1106.80	0.000	350.00
29	ST	12+911.78	1194237.056	412928.965	0.000		0.000	1420.60
30	TS	14+332.38	1192987.956	413605.613	0.000	632.46	2000.000	200.00
31	SC	14+532.38	1192810.558	413697.922	2000.000		2000.000	167.15
32	CS	14+699.54	1192656.948	413763.713	2000.000	632.46	0.000	200.00
33	ST	14+899.54	1192467.731	413828.429	0.000		0.000	35.60
34	TS	14+953.13	1192433.862	413839.385	0.000	632.46	-2000.000	200.00
35	SC	15+135.13	1192244.645	413904.101	-2000.000		-2000.000	184.45
36	CS	15+319.58	1192075.470	413977.426	-2000.000	632.46	0.000	200.00
37	ST	15+519.58	1191898.876	414071.265	0.000		0.000	698.76
38	TS	16+218.34	1191287.375	414409.391	0.000	1732.05	-10000.000	300.00
39	SC	16+518.34	1191025.569	414555.869	-10000.000		-10000.000	421.89
40	CS	16+940.23	1190663.998	414773.194	-10000.000	1732.05	0.000	300.00

No.		Station	Coordinate		Beginning Radius (m)	Clothoid Parameter (m)	Ending Radius (m)	Length (m)
			X	Y				
41	ST	17+240.23	1190411.801	414935.660	0.000		0.000	1200.93
42	TS	18+441.15	1189405.493	415591.072	0.000	1732.05	-10000.000	300.00
43	SC	18+741.15	1189154.934	415756.052	-10000.000		-10000.000	558.45
44	CS	19+299.60	1188700.551	416080.586	-10000.000	1732.05	0.000	300.00
45	ST	19+599.60	1188463.213	416264.077	0.000		0.000	2706.95
46	TS	22+306.56	1186329.955	417930.453	0.000	1341.64.	6000.000	300.00
47	SC	22+606.56	1186092.011	418113.149	6000.000		6000.000	18.19
48	CS	22+624.75	1186077.383	418123.964	6000.000	1341.64	0.000	300.00
49	ST	22+924.75	118532.954	418297.888	0.000		0.000	2539.76
50	TS	25+464.51	1183751.393	419753.051	0.000	935.41	-3500.000	250.00
51	SC	25+714.51	1183548.227	419898.710	-3500.000		-3500.000	20.00
52	CS	25+734.51	1183532.292	419910.789	-3500.000	935.41	0.000	250.00
53	ST	25+984.51	1183337.181	420067.071	0.000		0.000	2136.65
54	TS	28+121.16	1181685.557	421422.583	0.000	663.33	2000.000	220.00
55	SC	28+341.16	1181512.991	421558.994	2000.000		2000.000	544.30
56	CS	28+885.48	1181035.785	421817.322	2000.000	663.33	0.000	220.00
57	ST	29+105.48	1180827.219	421887.230	0.000		0.000	302.79
58	TS	29+408.27	1180538.409	421978.181	0.000	474.34	-1500.000	150.00
59	SC	29+558.27	1180396.123	422025.610	-1500.0000		-1500.000	1237.21
60	CS	30+795.45	1179530.793	422860.470	-1500.000	474.34	0.000	150.00
61	ST	30+945.45	1179478.296	423000.965	0.000		0.000	2373.34
62	TS	33+318.79	1178684.747	425237.713	0.000	600.000	1800.000	200.00
63	SC	33+518.79	1178614.406	425424.906	1800.000		1800.00	1140.96
64	CS	34+659.70	1177880.220	426273.227	1800.000	600.000	0.000	200.00
65	ST	34+859.70	1177705.058	426369.701	0.000		0.000	2480.76
66	TS	37+373.76	1175510.302	427526.077	0.000	2439.26	-7000.000	850.00
67	SC	38+223.76	1174766.590	427937.364	-7000.000		-7000.000	2339.24
68	CS	40+563.03	1173004.964	429459.901	-7000.000	2439.26	0.000	850.00
69	ST	41+413.03	1172490.299	430136.203	0.000		0.000	3970.92
70	TS	45+383.95	1170150.004	433344.188	0.000	1673.320	5000.00	560.00
71	SC	45+943.95	1169811.623	433790.294	5000.00		5000.00	1379.350
72	CS	47+323.30	1168802.380	434724.104	5000.00	1673.320	0.000	560.000
73	ST	47+883.30	1168331.383	435026.881	0.000		0.000	25.090
74	TS	47+908.39	1168310.026	435040.053	0.000	1673.320	-5000.000	560.000
75	SC	48+468.39	1167839.028	435342.830	-5000.000		-5000.000	1454.720

No.		Station	Coordinate		Beginning Radius (m)	Clothoid Parameter (m)	Ending Radius (m)	Length (m)
			X	Y				
76	CS	49+923.11	1166782.470	436335.303	-5000.000	1673.320	0.000	560.000
77	ST	50+483.11	1166450.851	436786.460	0.000		0.000	1928.470
78	TS	52+411.58	1165337.899	438361.372	0.000	678.233	2000.000	230.000
79	SC	52+641.58	1165201.607	438546.599	2000.000		2000.000	1184.180
80	CS	53+825.76	1164239.835	432907.495	2000.000	678.233	0.000	230.000
81	ST	54+055.76	1164018.058	439268.320	0.000		0.000	2320.58
82	TS	56+376.34	1161768.768	4398839.100	0.000	866.023	2500.00	300.000
83	SC	56+676.34	1161476.613	439907.049	2500.000		2500.000	1431.110
84	CS	58+107.45	1160071.700	439769.341	2500.000	866.023	0.000	300.000
85	ST	58+407.45	1159798.300	439645.957	0.000		0.000	722.610
86	TS	59+130.06	1159145.726	439335.601	0.000	1081.665	-3000.000	390.000
87	SC	59+520.06	1158790.049	439175.800	-3000.000		-3000.000	874.58
88	CS	60+394.64	1157942.144	438974.436	-3000.000	1081.665	0.000	390.000
89	ST	60+784.64	1157552.596	438957.259	0.000		0.000	913.690
90	TS	61+698.33	1156639.140	438936.793	0.000	836.660	2500.000	280.000
91	SC	61+978.33	1156359.415	438925.299	2500.000		2500.000	577.340
92	CS	62+555.67	1155794.146	438814.317	2500.000	836.660	0.000	280.000
93	ST	62+835.67	1155530.841	438719.195	0.000		0.000	939.600
94	TS	63+775.27	1154653.253	438383.510	0.000	758.288	2500.000	230.000
95	SC	64+005.27	1154440.078	438297.250	2500.000		2500.000	579.240
96	CS	64+584.51	1153953.389	437986.911	2500.000	758.288	0.000	230.000
97	ST	64+814.51	1153785.250	437830.024	0.000		0.000	1705.200
98	TS	66+519.71	1152561.011	436643.024	0.000	836.660	2500.000	280.000

Source: BVEC F/S

(2) Horizontal Alignment of Urban Road

The design elements of the horizontal alignment of the urban road section from KM 66+000 to KM 68+653.42 are shown in Table 5.2.7-2.

The minimum radius of horizontal curve is 1050m and the minimum length of transition curve is 150.00 m(clothoid parameter is 396.863 m) is applied. These designed values satisfy the criteria.

Table 5.2.7-2 Horizontal Alignment of Urban Road Section (Phase 2)

No.		Station	Coordinate		Beginning Radius (m)	Clothoid Parameter (m)	Ending Radius (m)	Length (m)
			X	Y				
99	ST	64+814.51	1153785.250	437830.024	0.000		0.000	1705.200
100	TS	66+519.71	1152561.011	436643.024	0.000	836.660	2500.000	280.000
101	SC	66+799.71	1152363.687	436444.424	2500.000		2500.000	444.580
102	CS	67+244.29	1152092.892	436092.564	2500.000	836.660	0.000	280.000
103	ST	67+524.29	1151951.447	435850.966	0.000		0.000	1146.110
104		68+670.40	1151390.936	434851.273	0.000			

Source: BVEC F/S

(3) Horizontal Alignment of National Highway Section

The designed elements of the horizontal alignment of the national highway section from KM 37+600 to KM 46+800 are shown in Table 5.2.7-3.

The minimum radius of horizontal curve is 1050 m and the minimum length of transition curve is 150.00 m(clothoid parameter is 396.863 m) is applied. These designed values satisfy the criteria. However, the design speed is reduced to 80 km/h in the section of intersection with NH51, and thus, the following values are adopted. Minimum radius of horizontal curve is 500 m and minimum length of transition curve is 44.00 m (clothoid parameter is 148.324 m) is applied before the intersection with NH51.

Table 5.2.7-3 Horizontal Alignment of National Highway Section (Phase 1)

No.		Station	Coordinate		Beginning Radius (m)	Clothoid Parameter (m)	Ending Radius (m)	Length (m)
			X	Y				
1	BP	37+600.000	1175310.146	427631.536	0.000		0.000	492.44
2	TS	38+092.437	1174874.481	427861.079	0.000	600.000	1800.000	200.00
3	SC	38+292.437	1174695.868	427951.002	1800.000		1800.000	1859.57
4	CS	40+152.012	1172924.645	427796.188	1800.000	600.000	0.000	200.00
5	ST	40+352.012	1172764.340	427675.642	0.000		0.000	1388.59
6	TS	41+740.603	1171666.758	426826.055	0.000	396.863	-1050.000	150.00
7	SC	41+890.603	1171546.067	426737.041.	-1050.000		-1050.000	569.58
8	CS	42+460.179	1171011.416	426561.860	-1050.000	396.863	0.000	150.00
9	ST	42+610.179	1170861.451	426562.192	0.000		0.000	377.54
10	TS	42+987.721	1170484.037	426572.015	0.000	396.863	1050.000	150.00
11	SC	43+137.721	1170334.071	426572.347	1050.000		1050.000	940.10
12	CS	44+077.821	1169533.337	426142.080	1050.000	396.863	0.000	150.00
13	ST	44+227.821	1169450.847	4260016.840	0.000		0.000	1938.37
14	TS	46+166.193	1168423.463	424373.134	0.000	323.265	-950.000	110.00
15	SC	46+276.193	1168363.380	424281.012	-950.000		-950.000	32.14
16	CS	46+308.234	1168344.356	424255.108	-950.000	323.265	0.000	110.00
17	ST	46+418.334	1168274.436	424170.210	0.000		0.000	146.77
18	TS	46+565.115	1168178.955	424058.731	0.000	148.324	500.000	44.00
19	SC	46+609.115	1168150.828	424024.899	500.000		500.000	43.22
20	CS	46+652.335	118125.687	423989.760	500.000	148.324	0.000	44.00

No.		Station	Coordinate		Beginning Radius (m)	Clothoid Parameter (m)	Ending Radius (m)	Length (m)
			X	Y				
21	ST	46+696.335	1168102.748	423952.217	0.000		0.000	103.55
22	EP	46+800.000	1168050.059	423863.072				0.00

Source: BVEC F/S

(4) Vertical Alignment of Expressway Section

The design elements of the vertical alignment of the expressway section from KM 0+000 to KM 66+000 (Phase1 and Phase2)are shown in Table 5.2.7-4.

The maximum grade is 4%; the minimum vertical curve radius for crest is 12000 m; and 5000 m for sag.

These designed values satisfy the criteria.

However, design speed is reduced to 80 km/h before Bien Hoa IC, and thus, the following values are adopted. Consequently, the maximum grade adopted is 4%, and the minimum vertical curve radius for crest is 4000 m near Bien Hoa IC, which is located at the beginning point of the expressway.

Table 5.2.7-4 Vertical Alignment of Expressway Section (Phase1 and Phase2)

VIP	Station (KM)	Crest/Sag	EL(m)	Grade(%)	V. Curve	
					Length(m)	Radius(m)
	0+0.000		15.660			
VIP1	0+668.340	Crest	22.678	1.05	201.880	4000
VIP2	1+056.250	Sag	7.161	-4.00	224.920	5000
VIP3	1+590.840	Crest	9.834	0.50	200.000	20000
VIP4	2+040.840	Sag	7.584	-0.50	220.000	20000
VIP5	2+592.580	Crest	10.895	0.60	180.000	20000
VIP6	3+038.710	Sag	9.556	-0.30	197.960	6000
VIP7	3+565.840	Crest	25.370	3.00	299.900	12000
VIP8	4+065.840	Sag	27.870	0.50	194.920	6000
VIP9	4+419.110	Crest	41.118	3.75	501.900	12000
VIP10	5+142.000	Sag	38.009	-0.43	125.240	30000
VIP11	5+629.760	Crest	37.912	-0.02	216.760	20000
VIP12	6+390.840	Sag	29.540	-1.10	168.000	8000
VIP13	6+840.840	Crest	34.040	1.00	100.000	20000
VIP14	7+285.840	Crest	36.265	0.50	192.660	12000
VIP15	7+937.320	Crest	29.033	-1.11	167.280	12000
VIP16	8+527.840	Sag	14.270	-2.50	149.980	5000
VIP17	9+088.600	Sag	17.074	-0.50	205.960	10000
VIP18	9+528.820	Crest	28.344	2.56	259.160	12000
VIP19	10+343.350	Crest	31.602	0.40	180.000	20000
VIP20	10+833.350	Crest	29.152	-0.50	120.000	20000
VIP21	11+528.350	Crest	21.507	-1.10	102.240	60000
VIP22	12+297.350	Sag	11.741	-1.27	100.220	6000
VIP23	12+657.350	Crest	13.181	0.40	200.000	20000
VIP24	13+182.350	Sag	10.031	-0.60	105.000	35000
VIP25	13+936.950	Sag	7.767	-0.30	223.060	15000

VIP	Station (KM)	Crest/Sag	EL(m)	Grade(%)	V. Curve	
					Length(m)	Radius(m)
VIP26	14+300.590	Crest	12.094	1.19	327.680	12000
VIP27	14+696.780	Sag	5.993	-1.54	204.360	10000
VIP28	15+648.850	Crest	10.753	0.50	100.000	20000
VIP29	16+269.670	Sag	10.753	0.00	124.980	5000
VIP30	16+770.920	Crest	23.284	2.50	600.000	12000
VIP31	17+170.390	Sag	13.298	-2.50	130.200	8000
VIP32	17+577.290	Sag	9.758	-0.87	205.820	10000
VIP33	17+988.970	Crest	14.657	1.19	286.340	12000
VIP34	18+384.620	Sag	9.908	-1.20	168.120	15000
VIP35	19+193.420	Sag	9.262	-0.08	118.860	150000
VIP36	19+699.520	Sag	9.262	0.00	171.640	15000
VIP37	20+055.690	Crest	13.322	1.14	274.620	12000
VIP38	20+355.690	Sag	9.902	-1.14	153.620	10000
VIP39	20+785.690	Crest	11.579	0.39	133.800	15000
VIP40	21+461.690	Sag	8.199	-0.50	100.000	20000
VIP41	22+061.690	Sag	8.199	0.00	100.000	50000
VIP42	22+615.690	Sag	9.307	0.20	139.460	15000
VIP43	22+924.440	Crest	12.796	1.13	269.260	12000
VIP44	23+277.440	Sag	8.878	-1.11	169.120	8000
VIP45	23+700.410	Crest	13.107	1.00	224.880	20000
VIP46	24+336.440	Sag	12.344	-0.12	111.180	30000
VIP47	24+887.440	Crest	13.722	0.25	265.460	17000
VIP48	25+506.440	Sag	5.551	-1.32	186.920	6000
VIP49	25+806.440	Crest	10.951	1.80	324.000	12000
VIP50	26+106.440	Sag	8.251	-0.90	168.000	8000
VIP51	26+624.440	Crest	14.467	1.20	150.380	12000
VIP52	27+460.310	Sag	14.049	-0.05	123.420	50000
VIP53	27+825.310	Sag	12.954	-0.30	115.000	10000
VIP54	28+393.570	Crest	17.784	0.85	182.920	12000
VIP55	28+836.590	Sag	14.816	-0.67	293.580	25000
VIP56	29+293.470	Crest	17.100	0.50	318.460	12000
VIP57	29+740.970	Sag	7.497	-2.15	257.700	5000
VIP58	30+356.820	Crest	25.955	3.00	636.000	12000
VIP59	30+923.820	Sag	12.914	-2.30	162.800	14000
VIP60	31+391.730	Sag	7.579	-1.14	206.820	5000
VIP61	31+786.320	Crest	19.417	3.00	575.980	12000
VIP62	32+266.320	Sag	10.777	-1.80	169.520	8000
VIP63	32+796.320	Sag	12.473	0.32	140.500	12000
VIP64	33+145.320	Crest	17.673	1.49	256.960	12000
VIP65	33+601.320	Sag	14.709	-0.65	224.080	10000
VIP66	33+901.320	Crest	19.479	1.59	130.720	12000
VIP67	34+292.320	Crest	21.434	0.50	180.000	15000
VIP68	34+902.320	Sag	17.164	-0.70	152.500	5000
VIP69	35+502.320	Crest	31.262	2.35	282.000	12000

VIP	Station (KM)	Crest/Sag	EL(m)	Grade(%)	V. Curve	
					Length(m)	Radius(m)
VIP70	35+802.320	Sag	31.262	0.00	—	—
VIP71	36+308.320	Sag	32.173	0.18	—	—
VIP72	36+643.320	Crest	33.848	0.50	241.980	12000
VIP73	37+003.300	Crest	28.376	-1.52	177.940	12000
VIP74	37+275.670	Sag	20.205	-3.00	179.960	6000
VIP75	37+692.520	Sag	20.205	0.00	128.980	6000
VIP76	38+232.940	Crest	31.825	2.15	157.680	20000
VIP77	38+779.770	Crest	39.262	1.36	388.560	17000
VIP78	39+527.610	Sag	41.496	-0.92	211.240	12000
VIP79	40+612.700	Crest	46.305.	0.84	111.400	50000
VIP80	41+066.430	Sag	46.305	1.06	246.740	40000
VIP81	41+612.630	Crest	55.482	1,68	172,710	20000
VIP82	42+001.350	Crest	58.630	0.81	312,400	20000
VIP83	43+467.64	Sag	47.633	-0.75	165.000	6000
VIP84	43+853.310	Crest	55.347	2.00	599.98	12000
VIP85	44+754.65	Sag	28.307	-3.00	899.80	30000
VIP86	45+642.46	Crest	28.307	0.00	170.00	17000
VIP87	45+942.46	Sag	25.307	-3.00	120.00	12000
VIP88	46+760.92	Sag	25.307	0.00	250.00	50000
VIP89	47+274.92	Crest	27.877	0.50	250.00	50000
VIP90	47+722.31	Crest	27.877	0.00	254.98	17000
VIP91	48+258.79	Sag	19.829	-1.50	792.68	30000
VIP92	48+878.59	Crest	26.895	1.14	364.70	20000
VIP93	49+653.36	Crest	21.627	-0.68	163.74	20000
VIP94	50+121.35	Sag	14.607	-1.50	260.50	20000
VIP95	51+528.68	Sag	11.792	-0.20	237.62	14000
VIP96	51+828.68	Crest	16.292	1.50	360.00	12000
VIP97	52+128.68	Sag	11.792	-1.50	227.44	14000
VIP98	53+154.82	Sag	13.023	0.12	285.00	12000
VIP99	53+833.00	Crest	29.985	2.50	449.98	12000
VIP100	54+715.16	Sag	18.962	-1.25	170.16	30000
VIP101	55+383.49	Sag	14.418	-0.68	213.48	30000
VIP102	57+356.94	Crest	15.010	0.03	125.22	70000
VIP103	59+213.75	Crest	12.224	-0.15	149.33	30000
VIP104	60+578..91	Sag	3.350	-0.65	214.78	10000
VIP105	60+878.91	Crest	7.851	1.50	360.00	12000
VIP105	61+183.71.	Sag	3.279	-1.50	215.00	10000
VIP106	61+558.51	Crest	5.715	0.65	156.00	12000
VIP107	61+858.51	Sag	3.765	-0.65	195.00	30000
VIP108	62+339.74	Sag	3.765	0.00	179.96	6000
VIP109	62+796.96	Crest	17.482	3.00	720.00	12000
VIP110	63+257.51	Sag	3.665	-3.00	179.96	6000
VIP111	64+333.81	Sag	3.665	0.00	149.98	6000
VIP112	64+727.31	Crest	13.503	2.50	600.00	12000
VIP113	65+110.41	Sag	3.925	-2.50	149.98	6000
VIP114	67+287.19	Sag	3.925	0.00	200.00	40000

(5) Vertical Alignment of Urban Road Section

The design elements of the vertical alignment of the urban road section from KM 66+000 to KM 68+653.42 (Phase2)are shown in Table 5.2.7-5.

The maximum grade is 0.5%; the minimum vertical curve radius for crest is 20000 m; and 40,000m for sag. These designed values satisfy the criteria.

Table 5.2.7-5 Vertical Alignment of Urban Road Section (Phase2)

VIP	Station(KM)	Crest/Sag	EL(m) (m)	Grade(%) (%)	V. Curve	
					Length (m)	Radius (m)
VIP113	65+110.41	Sag	3.925			
VIP114	67+287.19	Sag	3.925	0.00	200.00	40000
VIP115	67+776.70	Crest	6.373	0.50	200.00	20000
VIP116	68+342.21	Sag	3.545	-0.50	200.00	40000
VIP117	68+529.08		3.545			

Source: BVEC F/S

(6) Vertical Alignment of National Highway Section

The design elements of the vertical alignment of the national highway section from KM 37+600 to KM 46+800 are shown in Table 5.2.7-6.

The maximum grade is 2.62%; the minimum vertical curve radius for crest is 12000 m; and 6000 m for sag. These design value satisfy the criteria value.

However, the design speed is reduced to 80 km/h in the section of intersection with NH51, and thus, the following values are adopted. Consequently, the maximum grade is 4%; the minimum vertical curve radius for crest is 4000 m; and 4000 m for sag before the intersection with NH51.

Table 5.2.7-6 Vertical Alignment of the National Highway (Phase1)

VIP	Station(KM)	Crest/Sag	EL(m) (m)	Grade(%) (%)	V. Curve	
					Length (m)	Radius (m)
	37+0.000		27.890			
VIP1	37+275.67	Sag	19.620	-3.00	179.960	6000
VIP2	37+692.510	Sag	19.620	0.00	128.980	6000
VIP3	38+637.000	Crest	39.926	2.15	969.000	255000
VIP4	39+453.300	Sag	26.457	-1.65	399.440	47000
VIP5	40+142.150	Sagt	20.947	-0.80	499.500	37000
VIP6	41+203.300	Sag	26.783	0.55	197.960	6000
VIP7	41+644.030	Crest	38.330	2.62	299.900	12000
VIP8	42+187.260	Crest	38.982	0.12	397.680	48500
VIP9	43+387.270	Sag	30.603	-0.70	149.98	100000
VIP10	44+449.160	Crest	24.743	-0.55	251.160	16000
VIP11	45+103.300	Sag	10.886	-2.12	202.460	12500
VIP12	45+669.620	Crest	8.055	-0.50	149.980	100000
VIP13	46+072.290	Sag	5.437	-0.65	185.940	4000

VIP14	46+338.290	Crest	16.077	4.00	320.000	4000
VIP15	46+603.020	Sag	5.488	-4.00	159.400	4000
VIP16	46+800.000		5.488	-0.01		

Source: BVEC F/S

(7) Location and type of Interchange and Intersection

The locations and types of interchanges/intersections are summarized in Table 5.2.7-7. The interchanges are planned to connect expressway and other road. The intersections are planned at the terminal which connect to NH51. The layout and description of the interchange and intersection of Phase1 are shown below.

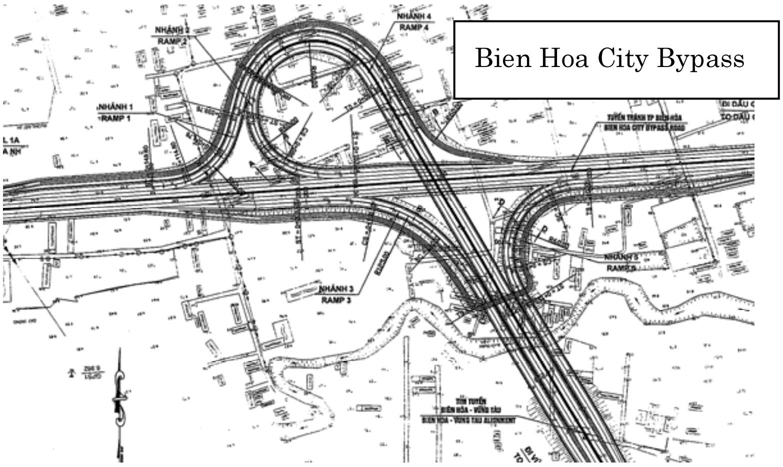
Table 5.2.7-7 Locations and Types of Interchanges and Intersections

No.	Interchange	Chainnage	Type	Interval	Rampway		Remarks
					Design Speed	Minimum Radius	
1	Bien Hoa IC (Connecting with Bien Hoa City Bypass)	km0+000	Trumpet		V=40km/h	R=60m	Constructing in Phase1
2	Long Thanh IC (Connecting with Ho Chi Minh-Long Thanh - Dau Giay Expressway)	km17+760	Double Trumpet	17.76km	V=60km/h	R=125m	Constructing in Phase1
3	Long Thanh Airport International IC	Km21+300	Trumpet	3.54km			
4	Nhon Trach IC (Connecting with Ben Luc-Long Thanh Expressway)	km29+400	Trumpet	8.1km	V=60km/h	R=125m	Construction in Phase2 of Ben Luc-L Thanh Expressway project
5	Phu My IC (Connecting with Extension of Bien Hoa-Vung Tau Expressway)	km37+800	Trumpet	8.4km	V=50km/h	R=125m	Constructing in Phase2
6	NH51 Intersection in Phu My City (Connecting with NH51 and Cai Mep-Thi Vai Pport Access Road)	km46+360	At grade Intersection with Flyover	8.56km	V=80km/h (Flyover)		Construction in Phase1
7	Ba Ria IC (Connecting with Ba Ria Ring Road)	km53+050	Trumpet	15.25km	V=40km/h	R=60m	Construction in Phase2
8	Vung Tau Intersection (Connecting with Vung Tau City Road)	km66+000	At grade Intersection (Three legs)	12.95km			Construction in Phase2
9	NH51 Intersection in Vung Tau City (Connecting with NH51)	km68+653.42	At grade Intersection (Round about)	2.65342 km			Construction in Phase2

Source: BVEC F/S

1) Bien Hoa IC

The plan of Bien Hoa IC is shown in Figure 5.2.7-1.



Source: BVEC F/S

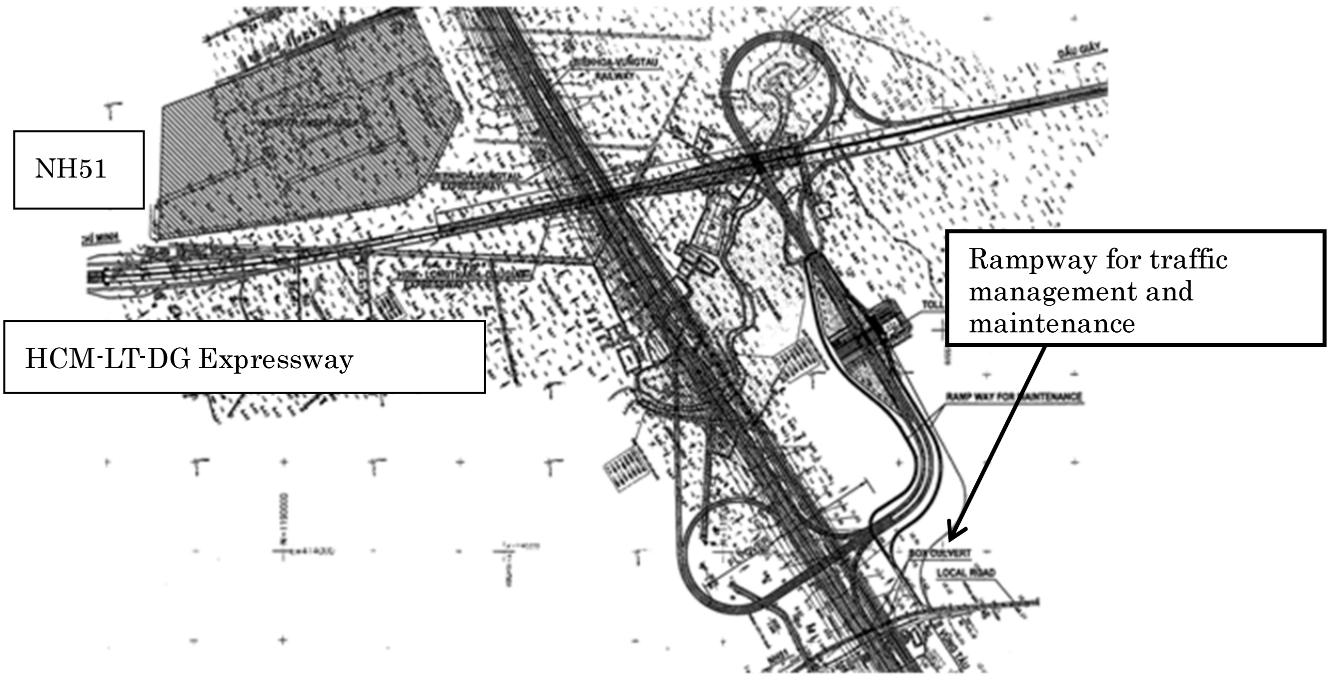
Figure 5.2.7-1 Bien Hoa IC

+ A Toll Gate is planned on the main road near Bien Hoa IC (km1+200).

+ Consequently, the design speed of main road is reduced to 80 km/h.

2) Long Thanh IC

The plan of Long Thanh IC is shown in Figure 5.2.7-2.



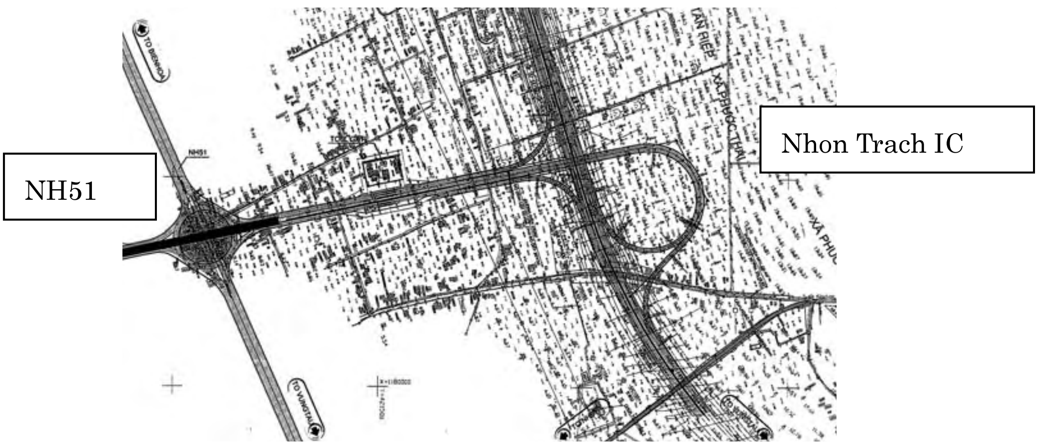
Source: BVEC F/S

Figure 5.2.7-2 Long Thanh IC

- The Bien Hoa-Vung Tau Railway was planned on the ground therefore vertical alignment of the HCM-Long Thanh- Dau Giay Expressway was modified to overpass the Railway. The BHVT Expressway which is planned in parallel to the railway was changed to on the ground and it's vertical alignment was modified. And this is approved by MOT.
- The location and type of Long Thanh IC is studying based on this modification considering development plan of surrounding area by TEDI.
- The double trumpet type located in the south of the HCM-Long Thanh-Dau Giay Expressway was selected as the optimum type. And Basic Design of Long Thanh IC is executing by TEDI.
- NH51 IC of HCM-Long Thanh-Dau Giay Expressway is located near Long Thanh IC. Therefore, it is necessary to study weaving between these interchanges considering traffic safety and capacity.
- Long Thnah JCT is connecting with BHVT Expressway and HCM-Long Thanh-Dau Giay Expressway. And it is connected with NH51 at NH51 IC of HCM-Long ThanH -Dau Giay, which is inconvenient to connect with BHVT Expressway and NH51 and to implementation of traffic management and maintenance work because of 4km long driving between BHVT Expressway and NH51. To solve this issue, the rampway is planned connecting from the toll gate of Long Thanh JCT and the local road which is located in the south of HCM-Long Thanh-Dau Giay Expressway,and U-turn road is connecting to rampway.

3) Nhon Trach IC

The plan of Nhon Trach IC is shown in Figure 5.2.7-3.



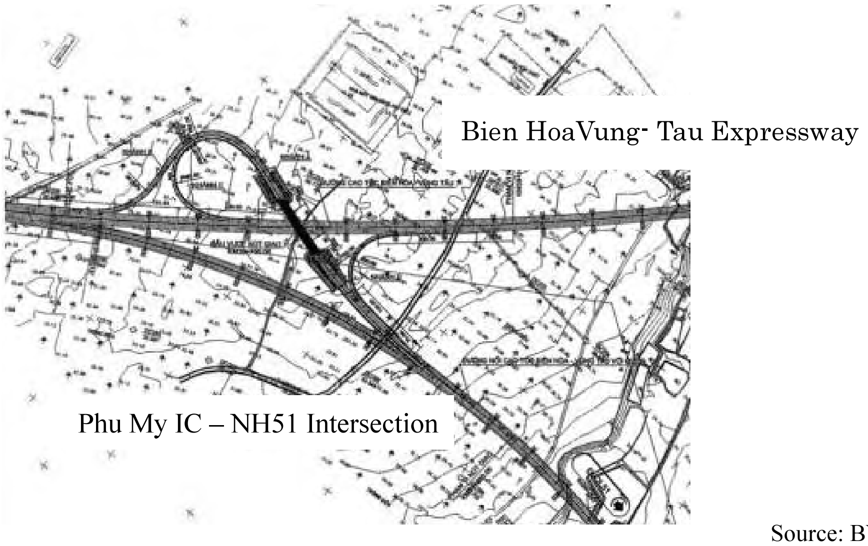
Souce: BVEC F/S

Figure 5.2.7-3 Nhon Trach IC

- Nhon Trach IC is connecting with BHVT Expressway, Ben Luc-Long Thanh Expressway and NH51.
- The construction of Nhon Trach IC is planned in Phase 2 of Ben Luc-Long Thanh Expressway Project. Therefore it is concerned that construction of Nhon Trach IC will be delay for the construction of BHVT Expressway Project.
- Nhon Trach IC was planned "Trumpet –A" type (loop rampway is connecting to acceleration lane) is avoiding the cemetery in the north of the loop rampway.
- NH51 IC and Toll Gate are planned along the Ben Luc-Long Thanh Expressway near Bien Hoa IC. Therefore, it is necessary to study the rampway alignment connecting Interchange, Toll Gate and Intersection of NH51 considering traffic safety.
- Toll gate on the thruway is required at the connecting section between Ben Luc - Long Thanh Expressway and BHVT Expressway.

4) Phu My IC

The plan of Phu My IC is shown in Figure 5.2.7-4.



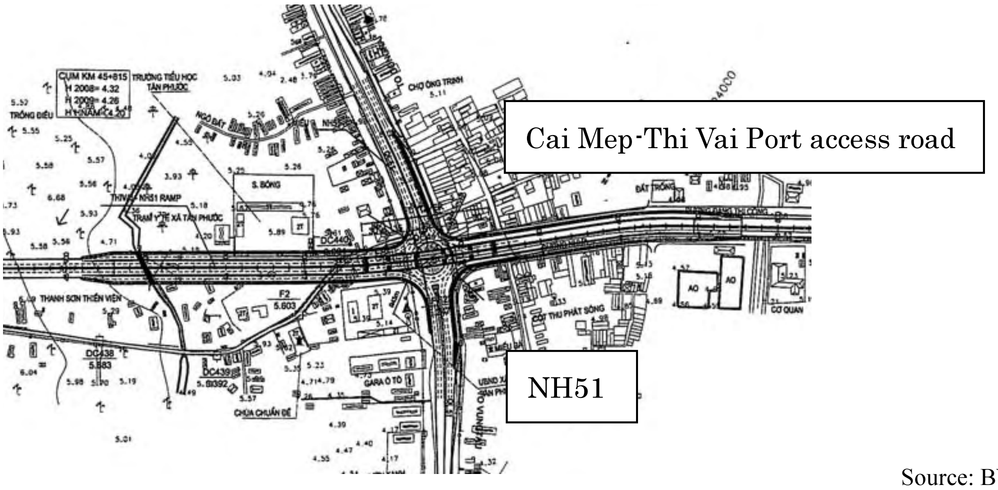
Source: BVEC F/S

Figure 5.2.7-4 Phu My IC

- Phu My IC is planned on the extension of the BHVT Expressway in phase2.
- It is necessary to change the traffic flow (NH51 Intersection→Bien Hoa) from main road to rampway for Phase2 construction.

5) NH51 Intersection (connecting to Cai Mep - Thi Vai Port)

The plan of NH51 Intersection is shown in Figure 5.2.7-5.



Source: BVEC F/S

Figure 5.2.7-5 NH51 Intersection

- The roundabout intersection connecting with NH51 and Cai Mep -Thi Vai Port access road is planned.
- Design speed of National Highway is reduced to 80km/h near the roundabout intersection because of the viaduct crossing over it.
- It is necessary to study channelization and signalization based on the Traffic Volume considering traffic safety and capacity.
- At the roundabout intersection, sight distance will not be ensured depending on the location of abutment of flyover bridge. Traffic safety shall be paid attention on this issue.

(8) Number of Lane of Toll Gate

Number of lanes of the toll gate is calculated based on the forecasted traffic volume shown in Table 5.2.7-8. When traffic volume is revised, it is necessary to perform recalculation.

Table 5.2.7-8 Number of Lanes of Toll Gate

	Main Road			Interchange		
	Expressway (km1+200)	National Highway (km45+250)	Expressway (km65+260)	Long Thanh IC	Nhon Trach IC	Ba Ria IC
Phase	1	1	2	1	1	2
Entrance	3	6	4	7	3	3
Exit	5	12	7	11	4	3

Source: Drawing BVEC F/S

5.2.8. Earth Work Design (Embankment/Cutting Slope)

The ratio of embankment slope is decided to be 1:2, and the berm shall be installed when the height of the embankment exceeds 6 m. The ratio of cutting slope of soil layer is decided to be 1:1, and the berm shall be installed when the height of the embankment exceeds 6 m. The ratio of cutting slope of rock layer is decided to be 1:0.75, and the berm shall be installed when the height of the embankment exceeds 8m. These values are in accordance with TCVN5729 and TCVN 4054.

5.2.9. Drainage Design

The side ditch is planned to be installed at the toe and at the berm of the cutting slope. The u-ditch with grating cover is planned to be installed at the marginal strip (safety lane) to collect rain water on the superelevated curves.

The box culverts and pipe culverts which cross the roadway are planned to be installed, considering terrain, profile of expressway, hydrographical condition and principles of span selection. The length of box culverts to be constructed are planned to accommodate 6 lanes of the road way in Phase-2. The size of box culverts and pipe culverts are decided considering the hydrological frequency for the culverts, which is 1% for expressways, and 2% for national highways, in accordance with TCVN5045. The planned box culverts and pipe culverts for Expressway and National Highway are summarized respectively in Table 5.2.9-1 and Table 5.2.9-2.

Table 5.2.9-1 Summary of Planned Box Culverts and Pipe Culverts (Expressway Phase1 and Phase2)

	Box-culvert			Pipe-Culvert		
	Location	Size	length(m)	Location	Size	Length(m)
1	1+190.88	2.0x205	46	1+926.66	D1.5	48
2	3+007.86	2.0x2.0	54	3+363.39	D.5	42
3	3+169.65	2.0x2.0	45	4+584.81	D1.2	36
4	3+650.00	2.0x2.0	45	7+200.00	D1.2	52
5	3+948.46	2.0x2.0	55	7+600.00	D1.2	40
6	5+015.43	1.2x1.2	38	14+532.00	D1.2	45
7	6+354.04	2(3.0x3.0)	47	17+790.00	D1.2	42
8	7+871.22	1.2x1.2	34	22+205.27	D1.2	41
9	9+270.62	3.0x3.0	38	22+384.18	D1.2	34
10	10+300.00	1.2x1.2	35	31+950.00	D1.2	35
11	10+820.99	1.2x1.2	32	32+975.53	2D1.5	41
12	11+460.00	1.2x1.2	35	33+512.52	D1.2	39
13	11+879.00	1.2x1.2	33	39+466.00	D1.2	57
14	12+177.24	1.2x1.2	32	52+469.22	D.1.2	36
15	13+158.74	1.2x1.2	33	53+0.076	D1.50	36
16	15+506.00	2(2.5x2.5)	45	66+542	D1.0	21
17	15+560.00	1.2x1.2	33	66+760	D10	21
18	15+910.00	1.2x1.2	36	67+856	D100	
19	18+441.16	1.2x1.2	40			
20	18+880.00	1.2x1.2	40			
21	19+210.00	1.2x1.2	40			
22	21+750.00	1.2x1.2	40			
23	21+967.23	1.2x1.2	30			
24	23+136.25	1.5x1.5	33			
25	24+500.00	1.2x1.2	40			
26	25+457.83	2(3.0x3.0)	45			
27	26+008.72	2(3.0x3.0)	50			
28	26+580.00	1.5x1.5	36			
29	27+422.03	3.0x3.0	50			
30	28+800.00	2(2.0x2.0)	40			

	Box-culvert			Pipe-Culvert		
	Location	Size	length(m)	Location	Size	Length(m)
31	32+367.93	1.2x1.2	36			
32	34+834.54	2(3.0x3.0)	40			
33	35+475.82	1.2x1.2	38			
34	36+300.00	1.2x1.2	33			
35	45+770.00	2.5x2.5	36			
36	48+352.06	2.5x2.5	38			
37	48+987.90	3.0x3.0	38			
38	49+772.96	3.0x3.0	42			
39	51+237.14	2.0x2.0	36			
40	64+200.00	2(3.0x3.0)	42			

Source: JICA Study Team

Table 5.2.9-2 Summary of Planned Box Culverts and Pipe Culverts (National Highway Phase1)

	Box-culvert			Pipe-Culvert		
	Location	Size	length(m)	Location	Size	Length(m)
1	39+460.00	2.5x2.5	42	40+680.00	2D1.25	31
2	40+158.00	2(3.0x3.0)	27	41+260.00	D1.5	43
3	40+380.00	2.0x2.0	26	42+300.00	D1.35	37
4	41+590.00	2.0x2.0	37	44+300.00	D1.5	27
5	42+870.00	2.0x2.0	48			
6	43+140.00	3.0x3.0	41			
7	43+938.00	2(2.0x2.0)	76			
8	45+450.00	2(2.0x2.0)	27			
9	46+000	2.0x2.0	48			

Source: JICA Study Team

5.2.10. Pavement Design

(1) General

The asphalt concrete pavement was designed for the expressway and the national highway based on the forecasted traffic data, hydro-geological situation and local material sources, and by applying standard 22TCN211-06. The design life duration for the pavement is 15 years, starting in 2015 (base year). It will end in 2030 when the design life of pavement expires (it will then proceed with improvement and overhaul of the pavement, and expansion of the number of carriage lanes). An axle load of 120 kN is considered for the expressways and the national highways. For other crossroads, the design axle load is 100 kN.

(2) Design Traffic

The forecasted traffic volume on the expressways and the national highways in 2030 is shown in Table 5.2.10-1.

Table 5.2.10-1 Forecasted traffic volume on Expressway in 2030

Unit: Vehicle/day and night/2 directions

	Expressway		Expressway/ National Highway
	Bien Hoa IC-Long Thanh IC	Long Thanh IC-Nhon Trach IC	Nhon Trach IC -NH51 Intersection
Car	10974	13796	11775
Minibus	5164	7666	6853
Bus	3762	5584	4992
Light truck	3357	5615	2899
Heavy truck	1916	3204	1654
Heavy truck	2041	3414	1763
>3 axles	1350	2258	1166
Total	28564	41537	31102

Source: JICA Study Team

(3) Design Elastic Modulus

The elastic modulus corresponding to section is shown in the Table 5.2.10-2.

Table 5.2.10-2 Elastic Modulus Corresponding to Section

	Expressway		Expressway/ National Highway
	Bien Hoa IC-Long Thanh IC	Long Thanh IC-Nhon Trach IC	Nhon Trach IC -NH51Intersection
Eyc (Mpa)	201	210	200

Source: JICA Study Team

(4) Design Pavement Structure

The pavement structure for the expressways and the national highways are calculated based on Standard 22TCN211-06 as shown in Table 5.2.10-3. The pavement structure for rampway (asphalt concrete) and toll plaza (cement concrete) are also shown in said table.

Table 5.2.10-3 Pavement Structure

	Expressway	National Highway	Rampway	Toll Plaza
Wearing Course	3cm	3cm		
Asphalt Concrete Surface Course	5cm	5cm	5cm	
Asphalt Concrete Binder Course	7cm	7cm	7cm	
Crusher Mixed Bituminous	10cm	10cm	10cm	
Cement Concrete				25cm
Aggregate Base	35~40cm	40cm	35cm	30cm
Total	60~65cm	65cm	57cm	55cm

Source: JICA Study Team

5.2.11. Frontage Road and Service Road

The frontage road connected with existing roads are planned to be provided at the left and right side of the expressway.

The frontage road is 5 m (1-lane) wide, and the standard for rural roads (class-A) is applied.
The service road for the construction of expressway is planned utilizing the national highway, the provincial highway, the existing local road and the planned frontage road.

5.2.12. Traffic Safety Facilities

The traffic signs such as regulatory signs, warning signs and guide signs are planned to be installed on the throughways and rampways.
The road markings are planned to be provided on the throughways and rampways, and at the toll gate section.
The guard rails are planned to be provided at the shoulders and median strips of throughways and rampways.
The fences (barbed wire fence) are planned to be installed at the exterior edge of the road way along a necessary section

5.2.13. Lighting

The lighting system is planned to be provide for large bridges, interchanges, tollgates, rest areas/service stations and operating/ maintenance centers at expressways.

5.2.14. tems to be Forwarded to the Detailed Design Stage

It proposes to improve the items to improve safety and comfort for the detailed design though it satisfies with the design standard as a result of reviewing.
Items to be forwarded to highway design at detailed design stage of Phase 1 are shown in Table 5.2.14-1

Table 5.2.14-1 Item to be forwarded to highway design at detail design Stage

Item			Suggestion
1	Alignment of Main Road	Horizontal Alignment	Short curve length between clothoid curve is not smooth handling. This causes drivers to commit mistakes by driving on a smaller radius than the actual radius.
			Horizontal alignment between km22+000 and km23+000 is Clothoid:A=1342m(L=300m)-R=6000m(L=18m)-clothoid: A=1342m (L=300m),and between km25+000 and km26+000 is Clothoid:A=935m(L=250m)-R=3500m(L=20m)-clothoid: A=1342m (L=300m) . It is better to replace the clothoid to a larger curve with a radius of say 10000 m
		Vertical	Level and small gradient section are not preferable for road surface drainage

Item			Suggestion
		Alignment	Vertical alignment between km 5+143~km5+630, km15+610~ km16+230, and km18+340~km19+650,km21+430~km22+570, km23+650~km24+850,km26+580~km27+430,km35+470~km36+270 ,km37+280~37+690 , km41+630~km42+180,km It is better to change gradient to a value higher than 0.3%.
			Big gradient and small Vertical curve radius of Interchange section is not preferable considering traffic safety
			Vertical alignment between km29+100~km30+630(Nhon Trach IC) .Gradient is 3% and vertical curve radius(凸) is 1200m. It is better to change to smaller gradient (2%) and to larger vertical radius (23000m) considering sight distance at rampway terminal as recommended in TCVN5729-1197(7.6) .
2	Cross Section of Main Rroad	Median Strip	Taper length of width of median strip from 3m to 1m is too short.
			Width of median strip change from 1m(normal section) to 3m at the of flyover location. It is better to enlarge the taper length considering smooth handling. *AASHTO standard stipulates L≧75m (L=0.625x12okm/hx1m)
		Vertical Clearance	Vertical clearance does not satisfy the height of trailer loaded with shipping container
			Vertical clearance adopted is 4.75 m based on TCVN5729-1997. It is better to change said clearance to 5.0~5.1 m considering the height of loaded shipping container.
3	Interchange	Speed change lane	Parallel type of speed change lane does not match with the driver's usual practice in case of two-lane rampways.
			Parallel type of speed change lane is adopted for acceleration and deceleration lanes. It is better to adopt direct connecting type or additional lane type for two-lane rampway for both lanes considering traffic safety.
4	Drainage	Road surface	Drainage side ditch is installed at the safety line(marginal strip) of median at the superelevated section . It is dangerous to install the side ditch for the traffic passing inner lane.
			It is better to install side ditch within the wide median strip (W=3m).

Source: JICA Study Team

5.2.15. Outline of Proposed Design for Highway Planning

The proposal for highway planning in order to improve traffic demand, traffic management and maintenance work are summarized in Table 5.2.15-1. The detail of proposals for each items are described in section 5.2.16.

Table 5.2.15-1 Ploposal for Highway Planning of F/S

No.	Proposal
1	<u>Providing additional Interchange between Bien Hoa IC and Long Thanh JCT</u> The area between Bien Hoa-Long thanh JCT is densely inhabited and industrial zones exist And interval of Bien Hoa IC and Long Thanh JCT is 17.8 km, which is the longest in this project.Therefore additional Interchange is proposed to improve traffic demand.
2	<u>Upgrading of Road Standard to Expressway for the section between Phu My JCT and NH51 Intersection (connecting Cai Mep-Thi Bai port)</u> This is the section of National Highway of 100km/h and non-toll road. And it is permitted to pass the motorbike in the shoulder separated by gird rail and the shoulder is connected with crossing road at the intersection in Phase1. Then, it is proposed to upgrade the standard to expressway of 120km/h which is same as Bien Hoa IC and Phu My JCT considering the mobility, access and safety. Moreover, it is proposed to modify the connection method at Phu My JCT from rampway method to main road method in Phase 2. It will be necessary that Phu My JCT change to four branch type structure of Phu My JCT considering the connection of HCMC Ring Road 4 in the future.
3	<u>Providing Temporary Nhon Trach IC</u> Nonh Trach JCT is connecting with Bien Hoa-Vung Tau Expressway and Ben Luc-Long Thanh Expressway and it will be constructed in Phase 2 of Ben Luc-Long Thanh Expressway project. In other words, Non Trach JCT is not constructed at the Bien Hoa -Vung Tau Expressway construction. Therefore it is proposed to construct temporary IC instead of JCT for improvement of the traffic demand, the traffic management, and maintenance.
4	<u>Providing Temporary Phu My SA</u> Phu My SA is planned between Non Trach JCT and Phu My JCT. It is forecasted that traffic volume utilizing Phu My SA is not many in Phase 2 of project. Therefore it is proposed to construct temporary SA providing minimum service such as parking space and toilet only

Source: JICA Study Team

It is defined that Junction is the facility connect expressway and expressway, and Interchange is the facility connect expressway and general road (National Road and Provincial Road, etc).

5.2.16. Details of Proposal for Each Items

(1) Providing additional Interchange between Bien Hoa IC and Long Thanh JCT

There is the tendency of number of industrial zone between Bien Hoa IC and Long Thanh JCT increases in recent years. It is estimated that the traffic volume originated industrial zone to sea ports such as Cai Mep-Thi Vai port will be increased.

The Bien Hoa-Vung Tau Railway is planned in the east side of the BHVT Expressway and parallel to it in the future. Therefore study of additional study was carried out considering said railway.

1) Selection of Optimum Location for Additional Interchange

The comparative study for the first selection was made for below two places by a general trumpet type.

The location map of additional IC is shown in Figure 5.2.16-1.

A3(km9+500): The connecting road is Thai Lan-Trang Bom Road which is 2 way 2 lane, connecting NH51 and NH1A, and accessibility from those roads is high.

The connecting road crosses over expressway by flyover.

And it is not safe of traffic at the intersection with connecting road and rampway which is located bottom of flyover

The rampway passes expressway over by flyover, and the cost of construction is high.

As for the under passing method of rampway, the depressed part becomes deeper than the river and natural drainage system cannot be applied.

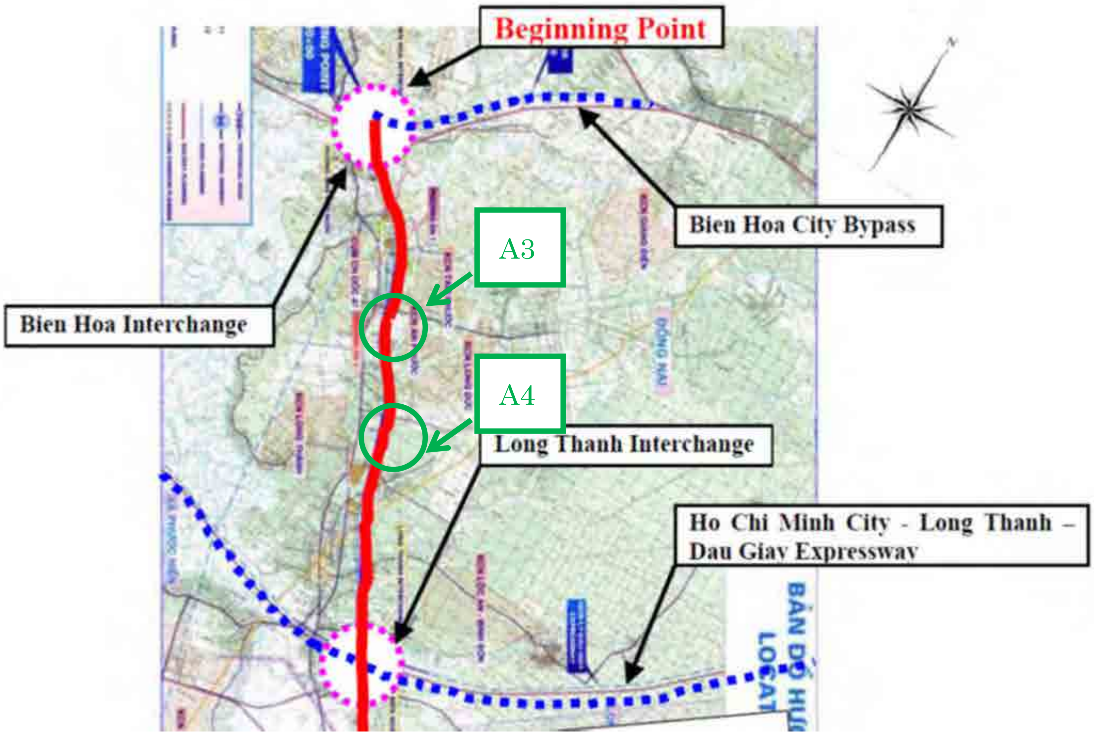
A4(km10+150):

The connecting road is Long Duc Community Road which is 2 way 4 lane, connecting to Long Duc Industrial Zone. But it will be extend to Provincial Road 769 which connect to NH1A in the future.

The connecting road crosses under expressway by box-culvert.

And it is safe of traffic at the intersection with connecting road and rampway which is flat.

The rampway passes expressway under by box-culvert , and the cost of construction is low .

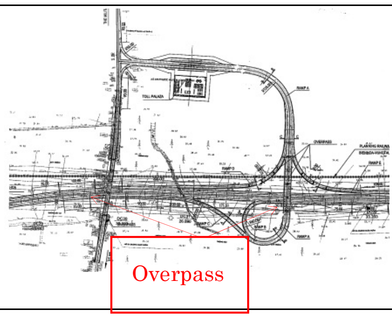
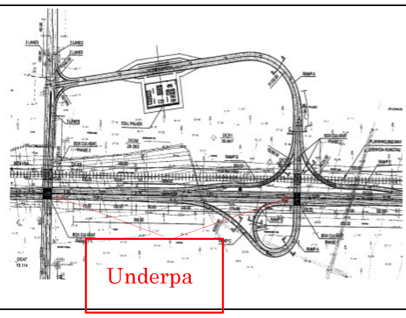


Source: JICA Study Team

Figure 5.2.16-1 Location of Additional IC (Alternatives of A3 and A4)

A4 was selected as the optimum place based on the comparative study as shown in Table 5.2.16-1.

Table 5.2.16-1 Comparative of A3 and A4

Alternative	A3 (km6+650)	A4 (km10+150)
Access Road	Thai Lan-Trang Bom Road	Long Duc Community Road
Layout (Trumpet Type)		
Accessibility to NH51 and NH1A	○ (Direct connection to NH1A)	△ (Indirect connection to NH1A)
Traffic safety at ntersection with rampway	X (Flyover of connecting road)	○ (Flat alignment of connecting road)
Construction Cost	X (Flyover of rampway)	○ (Box Culvert of rampway)
Evaluation		Recommend

Source: JICA Study Team

2) Selection of Optimum Type of Interchange

The comparative study of the trumpet type (A4-1) and the partial cloverleaf type (A4-2) was made for the selected location of A4.

A4-1: Trumpet Type

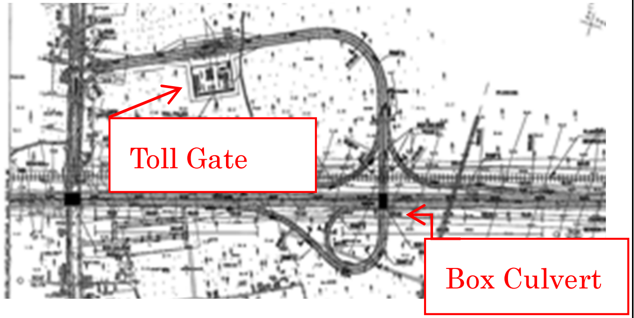
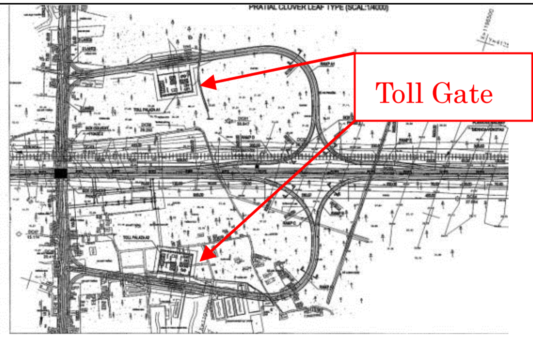
The crossing with the expressway and the rampway is underpass by Box-Culvert. It is necessary to lower the vertical alignment of rampway in consideration of crossing with railway in the future.

A4-2: Partial cloverleaf Type

There is no crossing with expressway and rampway. It is necessary to lower the vertical alignment of rampway in consideration of crossing with railway in the future.

A4-1(Long Duc IC) was selected as optimum interchange as shown in Table 5.2.16-2.

Table 5.2.16-2 COMPARATIVE STUDY OF TYPE OF INTERCHANGE

ALTANATIVE	IC A4-1	IC A4-2
Type of IC	Trumpet	Partial Cloverleaf
Layout of IC		
Ramp alignment	R min.=60m	R min.=125m
Ramp Length	2 lane:900m, 4 alne:1300m	2 lane:800m, 4 alne:2600m
Structure Length	Box Culvert:33m	
Land Area	8.4ha	11.1ha
No.of Toll Gate	1	2
No.of Intersection	1	2
Construction Cost	△	△
Land Acquisition Cost	○	X
Total Cost	○	X
Evaluation	Recommend	

Source: JICA Study Team

3) Basic Design of Long Duc IC

The basic design of A4-1 (hereafter, it was called Long Duc IC) was executed based on the topographical survey conducted in this preparatory survey.

It is necessary the drainage pipe to lead the rain water from the depressed point of rampway to river.

Moreover, the formation height of expressway was elevated 2m in order to prevent deep excavation for the drainage pipe considering vertical alignment of rampway crossing expressway.

The drawings based on the above mentioned design standards were as follows.

- Plan (S=1/4000):
- Profile (H=1/5000,V=1/500): Main Road ,rampway
- Typical Cross Section (S=1/100): Embankment , Cutting
- Details: Slope Protection, Intersection

The design standard of TCVN5729(1997) and TCVN4054(2005) were applied for basic design of interchange. The result of the basic design is summarized as shown in Table 5.2.16-3.

Table 5.2.16-3 Summary of Result of Basic Design of Long Duc IC

Item			Standard	Designed Value
Expressway			V=120km/h	
Connection Road(Long Duc Com.Road)			V=60km/h	
IC Type			Trumpet	
Rampway Design Speed			V=60～35km/h	V=40km/h
No.of lanes			1 way 2 lane、2 way 4 lane、2way 6 lane	
Alignment	Main Road (km9+500～km10+800)	Horizontal	Rmin.=650m(1000m) *Interchange Section Rmin.=2000m(1500m)	A=1107～R=∞
		Vertical	i max=4% *Interchange Section i max=2%(3%)	i=0.4%～-0.3%、
			VCR(凸)=12000 VCR(凹)=5000 *Interchange Section VCR(凸)=Rmin.=45000m VCR(凹)=Rmin.=23000m	VCR(凸)=12000
	Rampway	Horizontal	Rmin.=60m、	Rmin,=60m
		Vertical	imax.=7%	imax.=4.5%

Item			Standard	Designed Value
			VCRmin.(凸)=1000m(700m)、VCRmin.(凹)=700m(450m)	VCRmin.(凸)=1400mVCRmin.(凹)=1440m
Earth work	Embankment Slope:		1:1.5	1:1.5
	Cutting Slope:		1:1.0 (Stone Pitching	1:1.0
Structure			Box Culvert:10.5x5.0, 8.75x5.0x2	
Pavement(ranpway)			t=57cm(Asphalt Concrete)	
Drainage			Drainage Pipe (D1.5m):Setting from depressed point of rampway to river(km9+275)	

Source: JICA Study Team

The photos for the connecting road of Long Duc Community Road and the signboard of Long Duc industrial Zone which are constructed along this road are shown below.

Picture 5.2.16-1 Long Duc Community Road

Picture 5.2.16-2 Signboard of Long Duc Industrial Zone

4) Estimated Project Cost of Long Duc IC

The estimated project cost (construction cost and land acquisition cost) of Long Duc IC was calculated based on the above mentioned drawings. The project cost of Long Duc IC is shown in Table 5.2.16-4.

Table 5.2.16-4 Project Cost of Long Duc IC (A4-1)

Item		Cost: million VND
Construction Cost (A)	Sub total	195,072
	1. Embankment, Pavement, Traffic Control and Miscellaneous	152,545
	2.Toll gate	42,527
Land Acquisition Cost (B)		12,921
Other Cost (consulting services, project management cost etc) (C)		23,166
Physical Contingency (D)		23,116
Project Cost (A+B+C+D)		254,275

Note: excluding price contingency

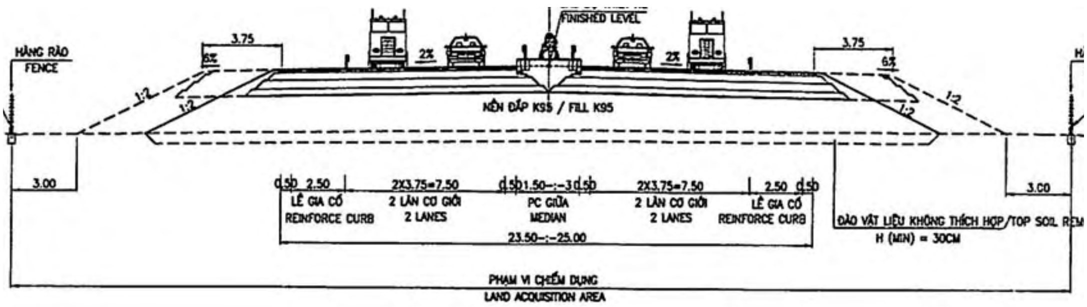
Source: JICA Study Team

(2) Upgrading of road standard to expressway for the section between Phu My JCT and NH51 Intersection (connecting Cai Mep-Thi Bai port)

1) Modification of Cross Section

The components of cross section of the national highway in Phase1 consist of 1.5m of median strip, 0.5m of marginal strip,7.5m of carriageway, 2.5m of shoulder and 0.5m protection of shoulder (earth shoulder), and in total 23.5m. The guard rail is installed outside of the carriageway and it is permitted to pass motorbike within the shoulder. And the shoulder is planned to be connected with the local road.

The typical cross section of the national highway is shown in Figure 5.2.16-2.



Source: BVEC F/S

Figure 5.2.16-2 Typical Cross Section of National Road

It is dangerous for the traffic of main road because without the shoulder located outside of the carriage way. And it causes of reduction of the traffic capacity of the main road in case of temporary stopping.

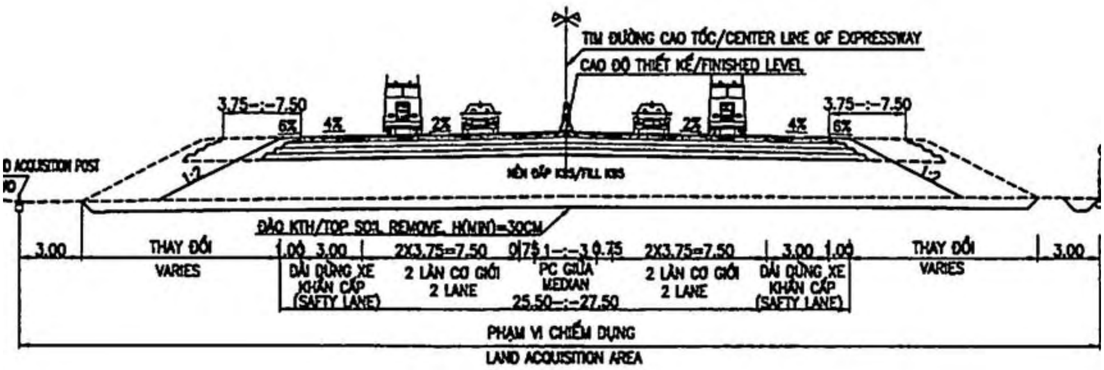
It is proposed to change to typical cross section to the expressway by upgrading to expressway standard.

The components of cross section of expressway in Phase1 consist of 1.0m of median strip, 0.75m of marginal strip,7.5m of carriageway, 3.0m of shoulder and 1.0m protection of shoulder (earth shoulder), and in total 25.5m.

The traveling time becomes short because of the design speed changes to 120km/h.

The traffic safety is improved because it is not permitted to pass motorbike and to be connected with the local road.

The typical cross section of the national highway is shown in Figure 5.2.16-3.



Source: JICA Study Team

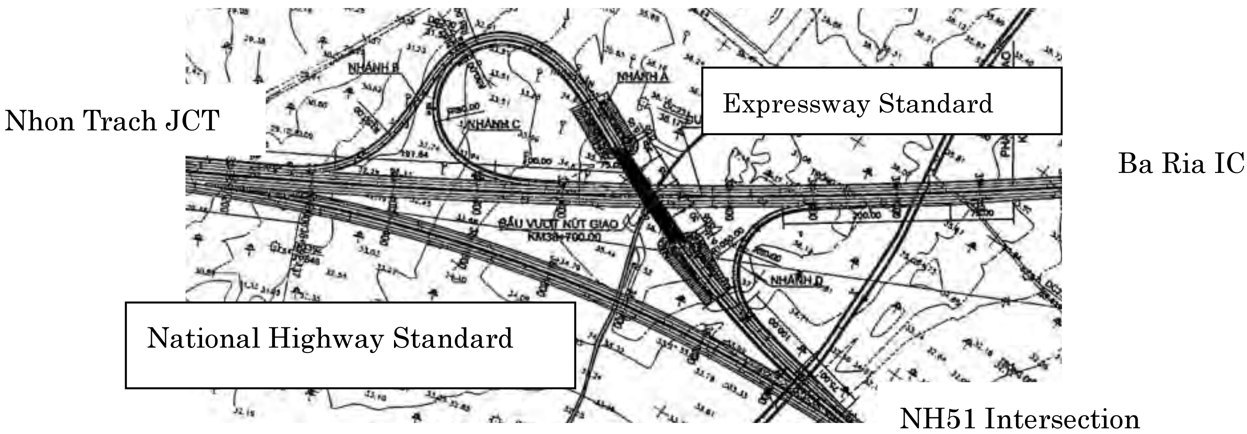
Figure 5.2.16-3 Typical Cross Section of Expressway

The minimum horizontal curve radius is 1050m, the maximum vertical gradient is 3% .These value are satisfied the geometric standard. But it is required to change super elevation from 2% to 6%.

2) Modification of Junction Type

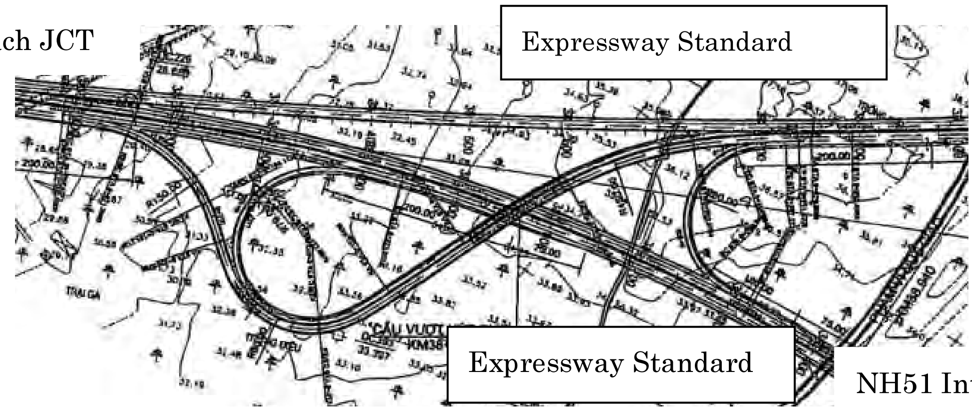
It is estimated that the major traffic is both direction between Nhon Trach JCT and NH51 itersection (access to Cai Mep- Thi Vai port) based on the result of forecasted traffic volume. Therefore it is not preferable that the traffic from NH51 intersection passes the rampway with small horizontal radius(125m) and big gradient (4%) of type of Phu My IC in BVEC F/S. By this reason, it is proposed to modify the connection method at Phu My JCT from rampway method to main road method in Phase 2.

The layout of Phu My IC of BVEC F/S (Option A) and the layout of proposed Phu My JCT (Option B) are shown in Figure 5.2.16-4 and Figure 5.2.16-5.



Source: JICA Study Team

Figure 5.2.16-4 Layout of Phu My IC of F/S



Source: JICA Study Team

Figure 5.2.16-5 Layout of proposed Phu My JCT

It will be necessary that Phu My JCT change to 4 legs type from 3 legs type considering additional connection of HCMC Ring Road 4 in the future.

3) Additional Cost for upgrading to Expressway

Construction cost consists of modification of cross section which is cost for widening of roadway and for additional flyover ,and modification of JCT type. Additional land acquisition is not originated because widening is within the Right of Way of Phase1.

Additional project cost for upgrading to expressway is shown in Table 5.2.16-5.

Table 5.2.16-5 Additional project cost for upgrading to expressway

Item		Cost :million VND
Construction Cost (A)	Sub total	41,086
	1.Earthwork, Pavement 2.Flyover	16,086 25,000
Land Acquisition Coast (B)		0
Other Cost (consulting services, project management cost etc) (C)		4,666
Physical Contingency (D)		4,575
Project Cost (A+B+C+D)		50,327

Note: excluding price contingency

Source: JICA Study Team

(3) Providing Temporary Nhon Trach IC

1) Alternative Study of Nhon Trach IC

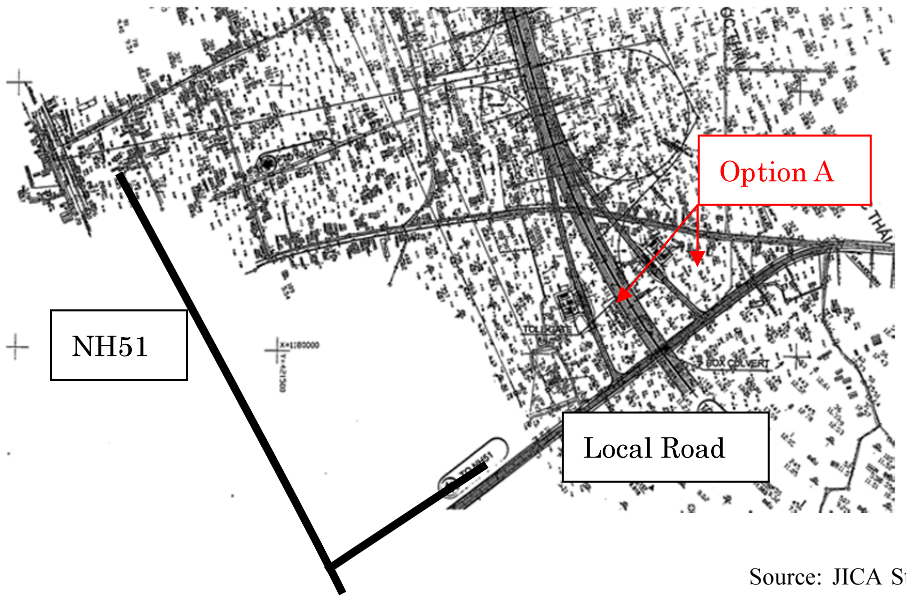
Nhon Trach JCT will be constructed in 2017 as phase 2 of Ben Luc –Long Thanh Expressway project. But it is feared the delay of the completion of construction of Ben Luc-Long Thanh Expressway including Nhon Trach JCT.

Therefore it is proposed providing of temporary Nhon Trach IC connecting with BHVT Expressway and NH51.

The alternative study of Nhon Trach IC was carried out for two options in case of half interchange providing only for the north. The option A is half diamond type connecting with local road case of small traffic volume and the option B is partial trumpet type (utilizing some part of completion trumpet type) connecting with NH51 in case of big traffic volume.The toll gate is installed for both options.

As a result, it is possible to improve the traffic demand, and traffic management and maintenance work.

The layout of option A and option B are shown in Figure 5.2.16-6 and Figure 5.2.16-7, respectively.



Source: JICA Study Team

Figure 5.2.16-6 Layout of Half Diamond Type

Source: JICA Study Team

Figure 5.2.16-7 Layout of Partial Trumpet Type

2) Construction Cost of Alternatives

Additional project cost for providing rampway for maintenance is shown in Table 5.2.16-6.

Table 5.2.16-6 Additional project cost of Temporary Nhon Trach IC

Item			Cost :millionVND
Option A	Construction Cost (A)	Sub total	89,639
		1.Earthwork, Pavement, Box Culvert 2. Flyover 3. Toll Gate	25,848 0 63,791
	Land Acquisition Coast (B)		0
	Other Cost (consulting services, project management cost etc) (C)		10,179
	Physical Contingency (D)		9,982
	Project Cost (A+B+C+D)		109,800
Option B	Construction Cost (A)	Sub total	187,730
		1.Earthwork, Pavement, Box Culvert 2. Flyover 3. Toll Gate	89,689 34,250 63,791
	Land Acquisition Coast (B)		0
	Other Cost (consulting services, project management cost etc) (C)		21,319
	Physical Contingency (D)		20,905
	Project Cost (A+B+C+D)		229,954

Note: excluding price contingency

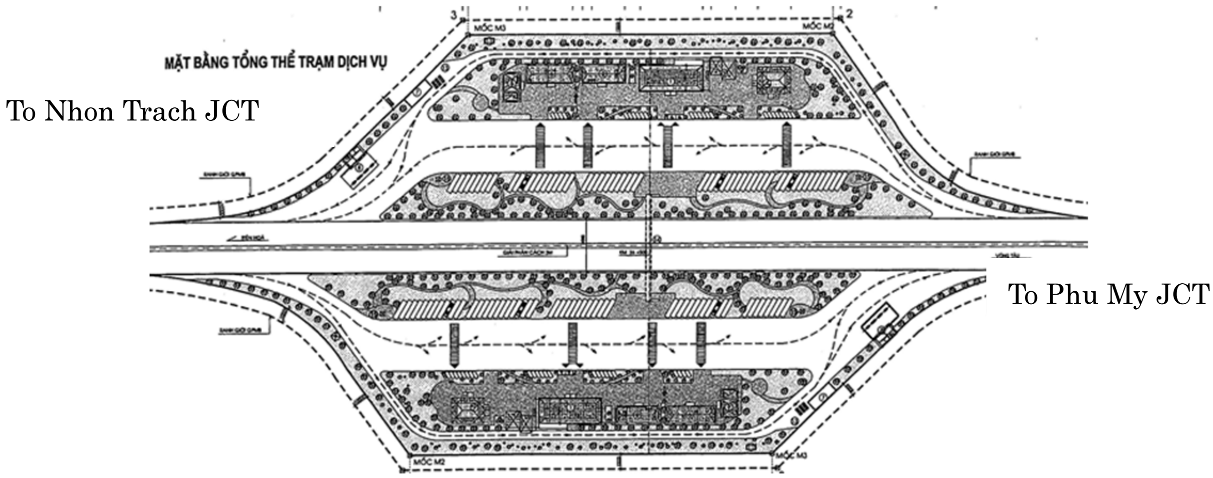
Source: JICA Study Team

(4) Providing Temporary Phu My SA

Phu My SA was planned between Nhon Trach JCT and Phu My JCT which is provided parking lot, restaurant, hotel, gas station and toilet in original BVEC F/S. But it is estimated small traffic volume which use Phu My SA in Phase1. Therefore it is proposed temporary SA which is provided only parking lot and toilet in Phase 1.

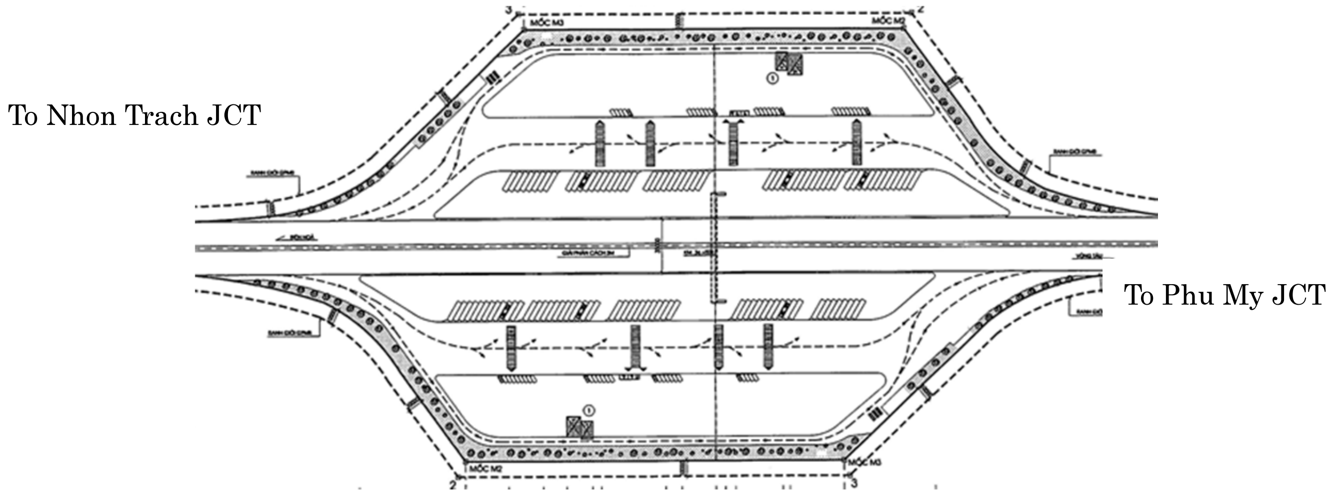
Accordingly, the initial investment cost can be saved VND93,847 million. Finally, this proposal was adopted by BVEC and reflected in the latest F/S (ctober 2012).

The layout of SA of BVEC F/S as option A (with facilities) and temporary SA (without facilities as option B are shown in Figure 5.2.16-8 and Figure 5.2.16-9.



Source: BVEC F/S

Figure 5.2.16-8 Layout of F/S Phu My SA(Option A)



Source: JICA Study Team

Figure 5.2.16-9 Layout of Temporary Phu My SA(Option B)

Drawings of these proposals are included in the appendix of the interim report which title is "DRAWINGS FOR PROPOSED DESIGN".

5.2.17. Bridge Planning and Design

(1) Review for Cost Saving and Design Improvement

The BHVT Expressway is designed with a high standard such as the highway geometric design for travel speed of as high as 120 km/h and the high road embankment to withstand a 100 year probability flood. Also, the Expressway needs dozens of bridges to cross with other highways and railways by grade separation as well as to pass over rivers and water channels. In consequence, the bridge construction cost is expected relatively high in this project. Especially, there is a 6 km long elevated expressway bridge planned to cross the center of an urbanization promoting area to the north of Vung Tau and that shall plus increase the project construction cost. In this context, if saving of bridge construction cost is possible by reviewing design, it will contribute significant to the project economy. Furthermore, through a process of eliminating redundant design of bridges, it is expected for the bridge design itself to be improved toward a more rational design to fit site condition.

It is noted that various bridge illustrations are presented in this report for explanation but these illustrations are for reference only not based on design analysis.

Technical design proposals on bridge were made in this study based on the bridge design in BVEC F/S listed in Table 5.2.17-1.

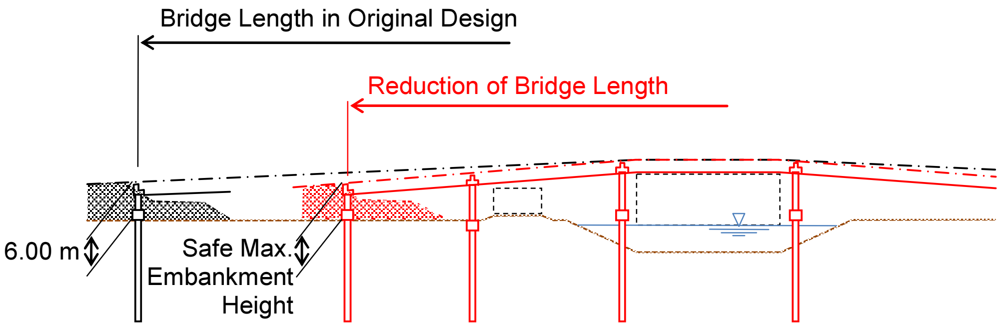
Table 5.2.17-1 List of Bridge in BVEC F/S

No	Bridge name	Item	Location	Dimension			Bridge structure			Province
				Bridge length (m)	Span arrangement (m)	Bridge (Underpass) width (m)	Superstructure	Substructure		
								Foundation	Pile length (m)	
1	Song Buong	Bridges on the expressway	KM2+558.0	99.2	3x33	23.5	I girder	D1000	12.0	Dong Nai province
2	Nuoc Trong	Bridges on the expressway	KM8+600.0	42.15	2x21	23.5	I girder	400x400	17.0	
3	Suoi Phen	Bridges on the expressway	KM12+628.0	33.1	1x33	23.5	I girder	D1000	33.0	
4	Quan Thu	Bridges on the expressway	KM14+119.0	63.2	3x21	23.5	I girder	400x400	29.0	
5	Da Vang	Bridges on the expressway	KM20+024.0	33.1	1x33	23.5	I girder	D1000	31.0	
6	Suoi Ca	Bridges on the expressway	KM22+848.0	99.2	3x33	23.5	I girder	D1000	33.0	
7	Suoi Nhum	Bridges on the expressway	KM37+450.0	198.5	39.15+3x40+39.15	23.5	ST girder	D1000	18.5	Ba Ria - Vung Tau
8	Tam Phuoc 1	Overpass	KM4+446.0	132.25	4x33	11	I girder	D1000	40.0	Dong Nai province
9	Tam Phuoc 2	Overpass	KM5+035.0	168.45	8x21	26	Slab girder	D1000	40.0	
10	Sy Quan Luc Quan 2	Overpass	KM6+148.0	228.42	39.15+3x40+30+39.15	11	Super T	D1000	44.0	
11	Nha may	Overpass	KM11+124.0	268.42	39.15+2x40+30+2x40+39.15	6.5	Super T	400x400	33.0	
12	Nong truong Binh Son	Overpass	KM16+231.0	165.3	5x33	6.5	I girder	400x400	33.0	
13	Bau Can	Overpass	KM24+124.0	297.5	9x33	6.5	I girder	D1000	36.0	
14	Ngang Duong	Overpass	KM26+907.0	228.42	39.15+2x40+30+40+39.15	6.5	Super T	D1000	36.0	
15	Cho Tan Hiep	Overpass	KM28+044.0	231.4	7x33	6.5	I girder	D1000	35.0	
16	Hac Dich 1	Overpass	KM34+209.0	132.25	4x33	11	I girder	D1000	28.0	
17	Hac Dich 2	Overpass	KM36+120.0	165.3	5x33	11	I girder	D1000	28.0	Ba Ria - Vung Tau
18	Km0+123	Underpass	KM+123.2	23		4.5		Shallow footing		Dong Nai province
19	Km1+554	Underpass	KM1+554.0	33		4.0		Shallow footing		
20	Km3+650	Underpass	KM3+650.0	33		4.0		Shallow footing		
21	Km7+250	Underpass	KM7+250.0	33		4.0		Shallow footing		
22	KCN Long Đuc	Underpass	KM9+452.0	33		7.0		Shallow footing		
23	Binh Son	Underpass	KM14+264.0	42		11.0		Shallow footing		
24	Go Bao May	Underpass	KM17+948.0	44		7.0		Shallow footing		
25	Đa Vang 1	Underpass	KM20+005.0	40.5		4.0		Shallow footing		
26	Đa Vang 2	Underpass	KM20+032.0	40.5		4.0		Shallow footing		
27	Suoi Ca 1	Underpass	KM22+847.0	43.8		4.0		Shallow footing		
28	Suoi Ca 2	Underpass	KM22+929.0	43.8		4.0		Shallow footing		
29	Thai Thien	Underpass	KM31+040.0	34.8		4.0		Shallow footing		
30	Km33+170	Underpass	KM33+170.0	32.5		7.0		Shallow footing		
31	Hoa Hung - Trang Bom	Bridge over railway	KM+680.0	358.4	39.15+7x40+39.15	23.5	Super T	D1000	15.0	Dong Nai province
32	Bien Hoa - Vung Tau	Bridge over railway	KM30+320.0	1154.4	39.15+11x40+30+15x40+39.15	23.5	Super T	D1000	35.0	
33	Bridge on expressway	Bien Hoa Interchanges	KM+0.0	355.4	39.15+37+6x40+39.15	18.0	Super T	D1000	15.0	
	Bridge on ramp 1 over river Quan			84.25	4x21	9.0	I girder	D1000	15.0	
	Bridge on ramp 2 over river Quan			84.25	4x21	9.0	I girder	D1000	15.0	
34	Bridge on expressway	Long Thanh - Dau Giay Interchanges	KM16+600.0	842.4	39.15+3x30+40+32.5+2x35.75+10x40+3x30+40+39.15	30.0	Super T	D1000	35.0	Dong Nai province
	Bridge N01 over river Bung Mon			63.2	3x21	18.0	I girder	D1000	40.0	
	Bridge N02 over river Bung Mon			63.2	3x21	25.0	I girder	D1000	40.0	
	Bridge on ramp 6			63.15	3x21	9.0	I girder	D1000	40.0	
	Bridge on ramp 7			72.15	3x24	9.0	I girder	D1000	40.0	
	Bridge on ramp 8			90.15	3x30	9.0	I girder	D1000	35.0	
	Bridge overpass LT-DG expressway			198.35	6x33	16.0	I girder	D1000	40.0	
	Bridge on LT-DG expressway (widening)			72	3x24	2x7.5	I girder	D100	35.0	
35	Overpass No 1 (Phu My IC)	Bridges overpass expressway	KM38+700.0	130.1	30+2x35+30	16.0	Hollow slab	D1000	45.0	Ba Ria - Vung Tau province
36	Overpass No 2 to Cai Mep - Thi Vai port	Bridges overpass expressway	KM40+050.0	59.1	13+33+13	8.0	Hollow slab	400x400	23.5	
37	Overpass No 3 (NH.51 IC)	Bridges overpass expressway	KM46+340.0	165.1	30+3x35+30	18.5	Hollow slab	D1000	41.0	

Source: BVEC F/S

(2) Reduction of Bridge Length

The difference of road construction cost between earth embankment road accompanied by soft ground treatment and elevated road supported by bridge is estimated approximately at 75 million VND/m vs. 890 million VND/m, while land acquisition cost and value added tax are not included. Thus, the shorter the bridge length is, the more saves the road construction cost. See 5.2.17-1 below.



Source: JICA Study Team

Figure 5.2.17-1 Reduction of Bridge Length

For reduction of bridge length, it is suggested to examine the following design conditions:

1) Confirmation of Roadway, Railway and Waterway Traffic Clearances

Confirm roadway, railway and waterway traffic clearances (width and height) required for intersection with the Expressway.

2) Confirmation of Flood Water Level and Breadth for Water Channels

For where the BHVT Expressway crosses over rivers or water channels, figure out design flood water level and breadth based on design rainwater runoff.

3) Lowering of Geometric Profile Elevation

Examine the geometric profile elevations of bridge sections if which can be lowered, as a matter of course, within the geometric design limits for the design travel speed of 120 km/h as well as after reserving the water traffic and flood clearances required at rivers and water channels.

The profile elevations can be lowered also by reducing bridge span length and consequently girder depth.

4) Road Maximum Embankment Height

In general, road embankment will be the highest at bridge abutments, that is, the higher the road embankment is possible, the shorter the bridge length can be designed.

The maximum embankment height will be evaluated by investigating:

- Consolidation settlement of soft ground and its required preloading time - based on the acceptable future residual consolidation settlement of 30 cm for embankment and 10 cm behind bridges in highway construction according to the Vietnamese highway design standard, and
- Safety of embankment against sliding.

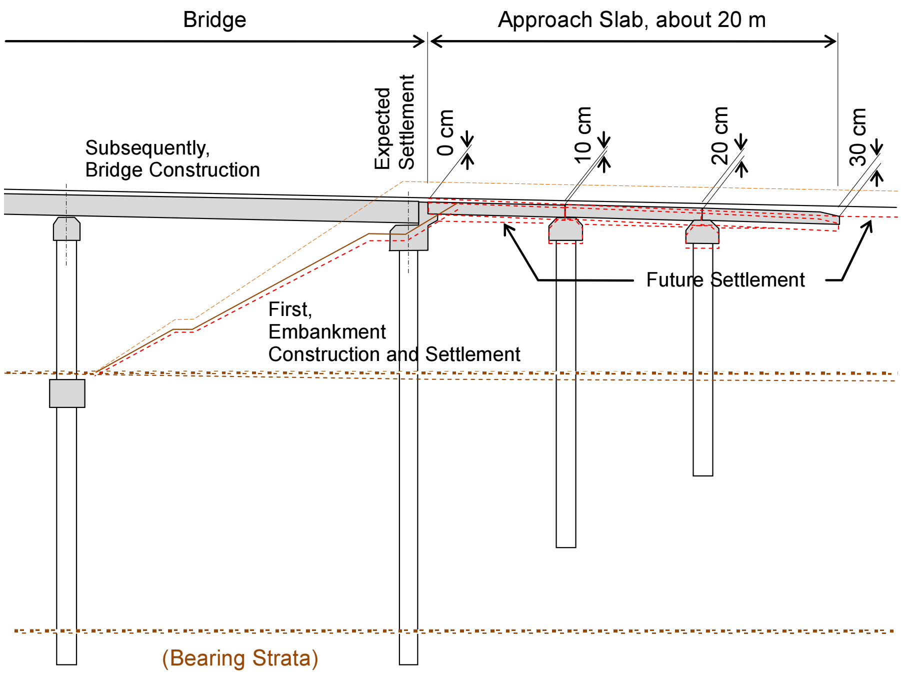
Evaluation for Embankment on Soft Ground

According to TEDI, a Vietnamese consultant who prepared the original design of the BHVT Expressway, bridge segments were extended in general until the embankment height did not exceed 6 m concerning with consolidation settlement of soft ground. However, after field reconnaissance and review of the soil boring data given in the original design, the JICA engineer has come to a moderately optimistic view on the ground settlement problem. That is, the soil boring data shows that soft soils are seen only at rivers or low drainage basins and their deposit are not so deep. Therefore, just a little higher embankment, for instance 7 to 8 m but probably not exceeding 10 m, may be constructible in most places of the Expressway.

The possible maximum embankment height is now under evaluation in TEDI to accept the residual consolidation settlement of up to 30 cm using current soil boring data, on the request of the JICA engineer assuming a road embankment construction period of 18 months and the PVD minimum spacing of 1.1 m.

(3) Approach Slab behind Abutment

Consolidation settlement of ground is inevitable in embankment road, but bridge section in general will not sink down if supported by piles. To alleviate the difference in level on the road surface caused by different ground settlement between embankment and bridge, approach slab is a useful technique executable at relatively small cost. Figure 5.2.17-2 is a sample design proposed for the embankment-bridge interface.



Source: JICA Study Team

Figure 5.2.17-2 Sample Design of Embankment-Bridge Interface

(4) More Compact Design for Overpass Bridges

The BHVT Expressway crosses many local roads and highways by grade separation with a clearance of 4.75 m including the grade separations in interchanges. In addition, there is a future railway plan on which the BHVT Expressway shall pass over with a clearance of 6.55 m. Consequently, there are numerous overpass bridges designed along the BHVT Expressway. Reviewing these overpass bridge designs, the JICA engineer found that there was still room for improvement and construction cost saving in the original design and design changes were recommended as noted below.

1) Reduction of Bridge Length

As mentioned above in paragraph 5.2.17 (2) 4), the original design determined the bridge length by employing a criteria for the embankment height at abutments not to be higher than 6 m, but that is considered overly on the safe side focusing on the worst soft ground condition throughout the Expressway length to apply longer bridges uniformly everywhere. If higher embankment is proved constructible in other locations, bridges can be reduced to save construction cost.

2) Recommendation of Shorter Span Bridge Girder and Cast-insitu Construction Method

- Precast Girder in Original Design

The original design apparently employed two main bridge girder types, PC (Prestressed Concrete) I girder of 30 to 35 m span length or PC super- girder of 35 to 40 m span length, and both the types are of pre-casting method which needs erection work. It is probably because such girder types of such span ranges have recently become widely used in highway bridge construction in Vietnam and therefore a lot of design samples thereof were available now. These girder types were also adopted to overpass bridges without any change.

- Recommendation of Shorter Span Girder by Cast-insitu Construction Method

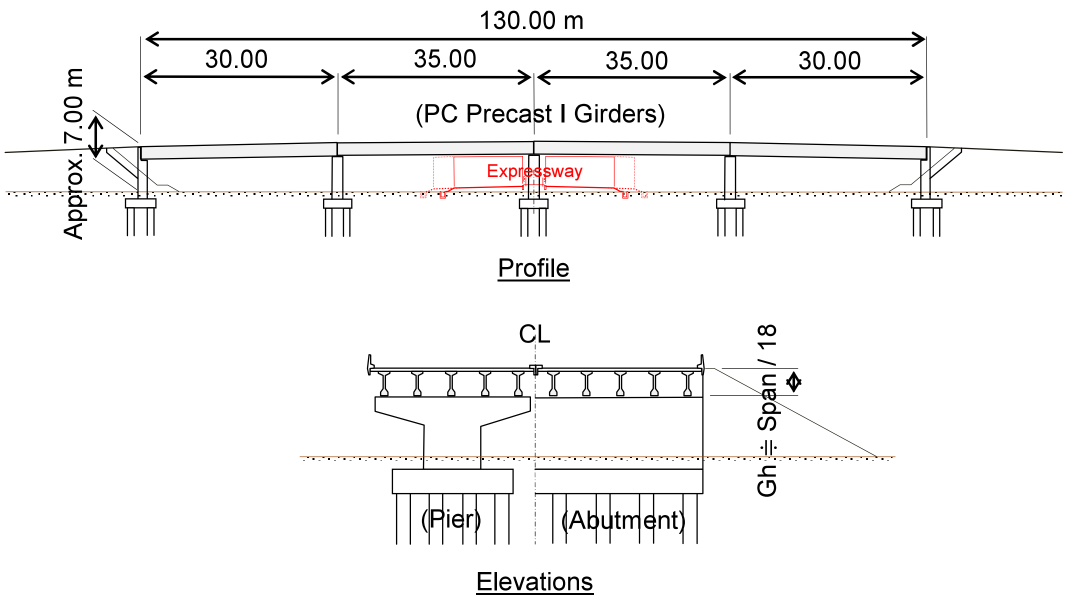
However, the JICA engineer has a different perspective on the overpass bridge design to suggest a girder structure of shorter span length and by cast-insitu construction method. It is recommended to place a pier column on the median strip of the BHVT Expressway in order to shorten the bridge span length, reduce the girder depth, and consequently lower the overpass profile elevations. For construction of overpass bridge girders, cast-insitu construction method is recommended rather than pre-casting/erection method of the original design from economic advantage of the cast-insitu construction method and the site condition favorable for the method for landscape is flat with no obstruction so that it is easy to place false-work in the field.

3) Recommendation of Compact Abutment on Embankment Top

As regards sequence of a bridge construction, embankment construction should precede bridge construction and construction of abutments should be begun after the ground settlement of the adjoining embankment has adequately advanced, because the ground settlement around abutments occurred after completion of bridge will be a cause of bridge damage in the future. Considering this point, a high-walled abutment adopted in the original design will not be profitable, because the construction of this type abutment involves deep excavation of the embankment once completed.

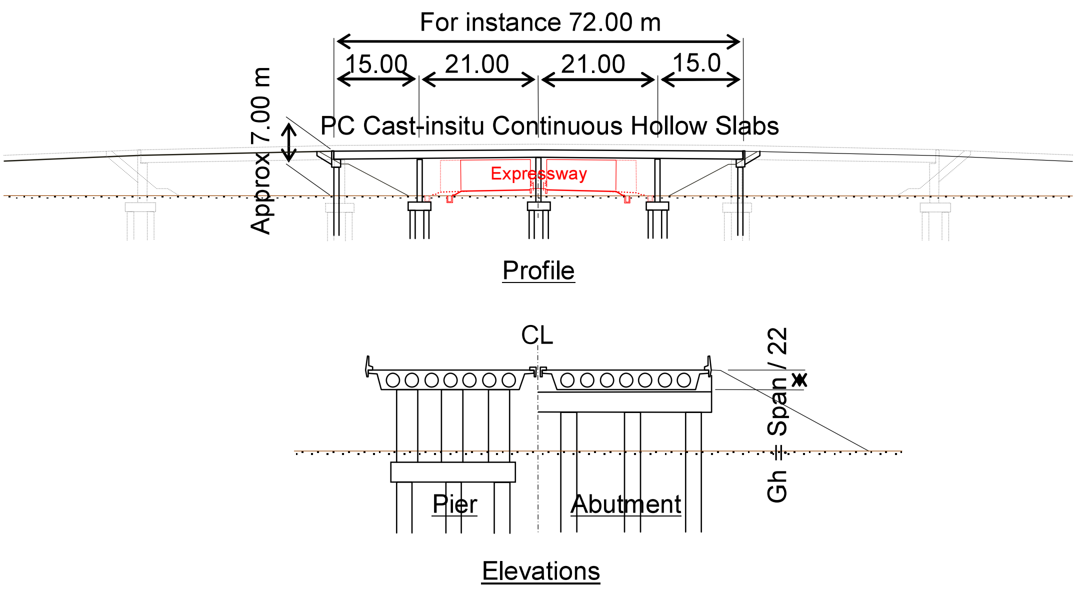
Therefore, as an alternative, another type abutment, compact in size, constructed on top of the completed embankment, and supported by piles, is recommended. It is because a compact size abutment for itself will be less costly in construction compared with that of the original design, as well as it is expected to improve the bridge side appearance as a whole by creating a triangular space with a diagonal line of embankment in front of abutment and a parallel bridge girder lines.

Figure 5.2.17-3 below traces the side view of a typical overpass bridge included in the original design, and then, Figure 5.2.17-4 presents an alternative design proposed for overpass bridges by the JICA engineer based on the above technical discussions.



Source: JICA Study Team

Figure 5.2.17-3 Typical Overpass Bridge in Original Design



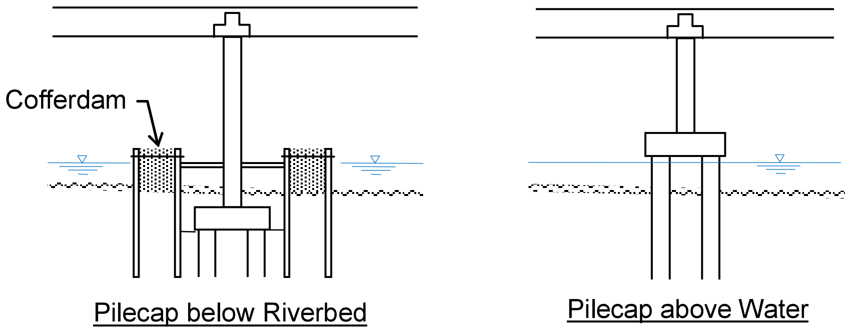
Source: JICA Study Team

Figure 5.2.17-4 Alternative Design Proposed for Overpass Bridge

In the original design shown in Figure 5.2.17-3 the embankment height at abutment is measured at about 7 m which is actually higher than the highest embankment of 6 m suggested by TEDI. While, in the alternative design as shown in Figure 5.2.17-4, the embankment height can be kept low at about 7 m the same as that of the original design by reducing the span length and girder height and in consequence lowering the road profile elevations, although abutments are relocated to shorten the bridge length.

(5) Pilecap above Water

In design of river bridges, to save the cost of temporary cofferdam for foundation construction, it is advised to raise the position of pilecap above water level. See Figure 5.2.17-5 below.



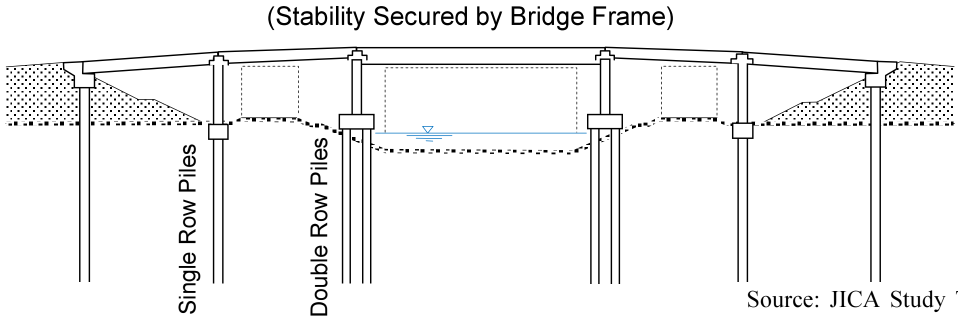
Source: JICA Study Team

Figure 5.2.17-5 Position of Pile cap

(6) Single Row Piles

The original design adopted bored RC piles of diameter 1.00 m for bridge foundation and the pile of such a size has relatively high capacity. In case this size of pile supports shorter span bridges, the number of piles in double row layout may provide excess capacity, and therefore, in such a case, the fewer number of piles in single row layout is recommended.

A bridge pier supported by single row piles is at risk of leaning in bridge direction for it stands alone during construction, but after connecting all spans each other with girders, the stability of a bridge is secured by a total bridge structural frame. See Figure 5.2.17-6 below.



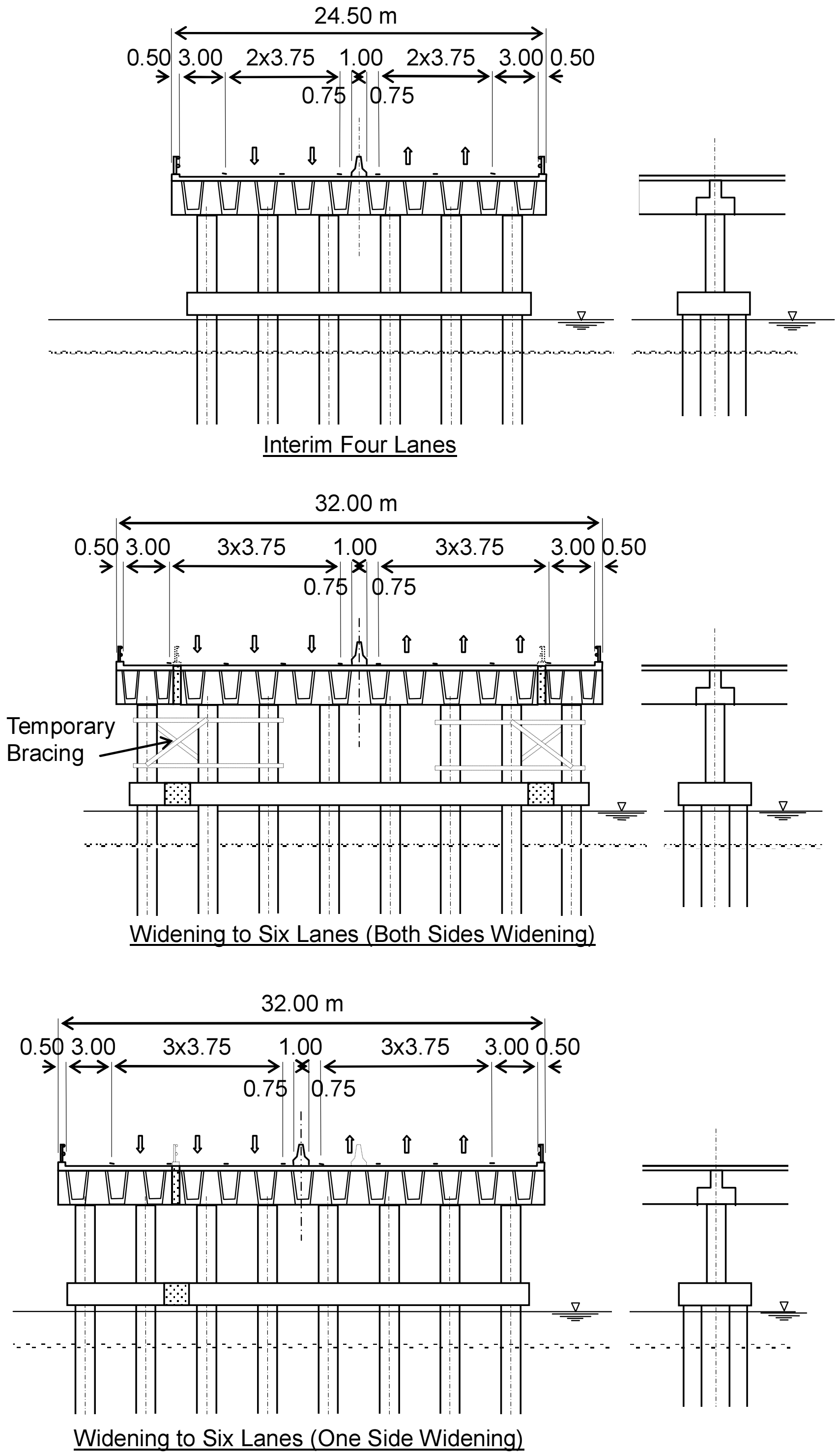
Source: JICA Study Team

Figure 5.2.17-6 Stability of Bridge Secured by Bridge Structural Frame

(7) Bridge Widening Method

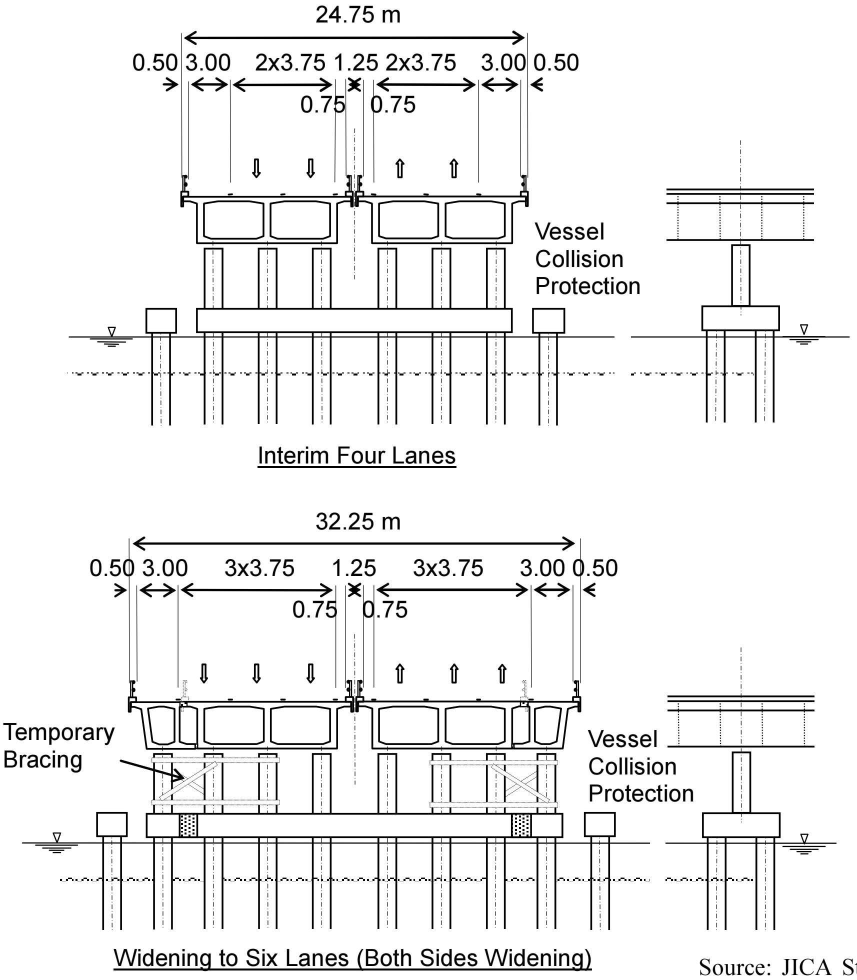
It is scheduled that the BHVT Expressway in the initial phase will be constructed with 4 lanes and be widened to 6 lanes in the future according to increase of traffic volume. At that time, bridges also need to be widened to 6 lanes.

In fact, there have been some highway projects which proposed to construct 6 lanes bridges from the initial phase of 4 lanes road service considering technical difficulty of bridge widening in the future. However, this BHVT Expressway project proposed to construct bridges with only 4 lanes in the initial phase in order to curb the initial construction cost. Therefore, the bridge design needs consideration for the future widening construction. Here are some bridge widening methods introduced in Figures 5.2.17-7 and 5.2.17-8 below.



Source: JICA Study Team

Figure 5.2.17-7 Bridge Widening Method for Precast Girder



Source: JICA Study Team

Figure 5.2.17-8 Widening Method for Cast-insitu or Segmental Box Girder Bridge

Symmetrical widening can maintain the initial position of the road center line also after widened, but this method needs to carry out widening construction on each side of bridge as well as temporary bracing may be required during construction to hold a narrow widening structure of only 3.75 m. While, one-sided widening is economical for one time widening construction but the position of the road center line will shift after widened. The shift of road center line on the widened bridge needs to be adjusted on the approach road.

<u>Technical Notes for Bridge Widening</u>

The followings are common technical essentials for bridge widening construction:

- ✓ The time for connecting the two bridges, filling of a gap between the old and new bridges, should be as delayed as possible.

- ✓ Use of low-shrinkage concrete for the new bridge construction will reduce the internal force redistribution between the two bridges.
- ✓ Optimization of prestressing design of the new bridge can improve the stress states in both the old and new bridges.
- ✓ Settlements of piers of the new bridge must be strictly controlled after connecting the two bridges.

(8) Actual Design Changes after Review

As described in this report, the JICA engineer has presented various improvement proposals for better design and reduction of construction cost of bridges. However, through discussions with TEDI and then with BVEC, the Vietnamese side indicated a policy to accept the reduction of bridge length but not to accept the alteration of span lengths and bridge structural types.

In consequence, the review of bridge design ended up with only reduction of bridge length in comparison with constructible embankment height as shown in Table 5.2.17-2. Other proposals which were not adopted in the BVEC F/S are to be reviewed at detailed design stage.

Table 5.2.17-2 List of Updated Bridge with Design in BVEC F/S (Oct. 2012)

No	Bridge name	Item	Location	Original Design		Proposed Design		Bridge structure			Province
				Bridge length (m)	Span arrangement (m)	Bridge length (m)	Span arrangement (m)	Superstructure	Substructure: Foundation	Substructure: Pile length (m)	
1	Song Buong	Bridges on the expressway	KM2+558.0	99.2	3x33			I girder	D1000	12.0	
2	Nuoc Trong	Bridges on the expressway	KM8+600.0	42.15	2x21			I girder	400x400	17.0	
3	Suoi Phen	Bridges on the expressway	KM12+628.0	33.1	1x33			I girder	D1000	33.0	
4	Quan Thu	Bridges on the expressway	KM14+119.0	63.2	3x21	no change	no change	I girder	400x400	29.0	Dong Nai
5	Da Vang	Bridges on the expressway	KM20+024.0	33.1	1x33			I girder	D1000	31.0	
6	Suoi Ca	Bridges on the expressway	KM22+848.0	99.2	3x33			I girder	D1000	33.0	
7	Suoi Nhum	Bridges on the expressway	KM37+450.0	198.5	39.15+3x40+39.15			ST girder	D1000	18.5	Ba Ria - Vung Tau
8	Tam Phuoc 1	Overpass	KM4+446.0	132.25	4x33	66.15	2x33	I girder	D1000	40.0	
9	Tam Phuoc 2	Overpass	KM5+035.0	168.45	8x21	66.25	12+2x21+12	Slab girder	D1000	40.0	
10	Sy Quan Luc Quan 2	Overpass	KM6+148.0	228.42	39.15+3x40+30+ 39.15	92.50	39.15+30+23.15	Super T	D1000	44.0	
11	Nha may	Overpass	KM11+124.0	268.42	39.15+2x40+30+2x40+39.15	92.50	39.15+30+23.15	Super T	400x400	33.0	
12	Nong truong Binh Son	Overpass	KM16+231.0	165.3	5x33	90.20	33+24+33	I girder	400x400	33.0	Dong Nai
13	Bau Can	Overpass	KM24+124.0	297.5	9x33	99.20	3x33	I girder	D1000	36.0	
14	Ngang Duong	Overpass	KM26+907.0	228.42	39.15+2x40+30+40+39.15	128.40	29.15+40+30+29.15	Super T	D1000	36.0	
15	Cho Tan Hiep	Overpass	KM28+044.0	231.4	7x33	132.25	4x33	I girder	D1000	35.0	
16	Hac Dich 1	Overpass	KM34+209.0	132.25	4x33	66.15	2x33	I girder	D1000	28.0	
17	Hac Dich 2	Overpass	KM36+120.0	165.3	5x33	48.15	2x24	I girder	D1000	28.0	Ba Ria - Vung Tau
18	Km0+123	Underpass	KM+123.2	23					Shallow footing		
19	Km1+554	Underpass	KM1+554.0	33					Shallow footing		
20	Km3+650	Underpass	KM3+650.0	33					Shallow footing		
21	Km7+250	Underpass	KM7+250.0	33					Shallow footing		
22	KCN Long Đuc	Underpass	KM9+452.0	33					Shallow footing		
23	Binh Son	Underpass	KM14+264.0	42					Shallow footing		
24	Go Bao May	Underpass	KM17+948.0	44		no change	no change		Shallow footing		Dong Nai
25	Đa Vang 1	Underpass	KM20+005.0	40.5					Shallow footing		
26	Đa Vang 2	Underpass	KM20+032.0	40.5					Shallow footing		
27	Suoi Ca 1	Underpass	KM22+847.0	43.8					Shallow footing		
28	Suoi Ca 2	Underpass	KM22+929.0	43.8					Shallow footing		
29	Thai Thien	Underpass	KM31+040.0	34.8					Shallow footing		
30	Km33+170	Underpass	KM33+170.0	32.5					Shallow footing		
31	Hoa Hung - Trang Bom	Bridge over railway	KM+680.0	358.4	39.15+7x40+39.15	no change	no change	Super T	D1000	15.0	
32	Bien Hoa - Vung Tau	Bridge over railway	KM30+320.0	1148.4	39.15+11x40+30+15x40+39.15	no change	no change	Super T	D1000	35.0	Dong Nai
33	Bridge on expressway	Bien Hoa Interchanges	KM+0.0	355.4	39.15+37+6x40+ 39.15	275.4	36.15+5x40+39.15	Super T	D1000	15.0	
	Bridge on ramp 1 over river Quan			84.25	4x21	no change	no change	I girder	D1000	15.0	
	Bridge on ramp 2 over river Quan			84.25	4x21	no change	no change	I girder	D1000	15.0	
34	Bridge N01 over river Bung Mon	Long Thanh - Dau Giay Interchanges	KM16+600.0	63.2	3x21	Changing design of interchange option	Changing design of interchange option	I girder	D1000	40.0	Dong Nai
	Bridge N02 over river Bung Mon			63.2	3x21			I girder	D1000	40.0	
	Bridge on ramp 6			63.15	3x21			I girder	D1000	40.0	
	Bridge on ramp 7			72.15	3x24			I girder	D1000	40.0	
	Bridge on ramp 8			90.15	3x30			I girder	D1000	35.0	
	Bridge overpass LT-DG expressway			198.35	6x33			I girder	D1000	40.0	
	Bridge on LT-DG expressway (widening)			72	3x24			I girder	D100	35.0	
35	Overpass No 1 (Phu My IC)	Bridges overpass expressway	KM38+700.0	130.1	30+2x35+30	no change	no change	Hollow slab	D1000	45.0	
36	Overpass No 2 to Cai Mep - Thi Vai port	Bridges overpass expressway	KM40+050.0	59.1	13+33+13	no change	no change	Hollow slab	400x400	23.5	Ba Ria - Vung Tau
37	Overpass No 3 (NH.51 IC)	Bridges overpass expressway	KM46+340.0	165.1	30+3x35+30	no change	no change	Hollow slab	D1000	41.0	

Source:JICA Study Team

5.2.18. Soft Soil Treatment

(1) Outline of the Geographical and Geological Conditions

1) Geographical condition

Geographical condition can be roughly divided into the following 2 sections in the whole of Phase1 and Phase2 sections. The expressway alignment of the former part passes through almost high elevation area, and the ground condition is rather good. In the latter part, there is the section in which the soft clay layer (N value is 0 to 4) deposit 10 to 20m thickness.

- From The Start Point (KM0+00) to The intersection of the BHVT Expressway and NH51

The planned route passes through many low hills of upturned bowl shape, high terrain compared to cannal in the area. The route bypasses small residential areas, the area of industrial crops such as rubber, cashew, eucalyptus, some rice fields and field crops. For the road linked to Cai Mep – Thi Vai Port, the route passes closely to the foot of Ong Trinh mountain with terrain higher than that of the whole route (passing through the area of quarries).

- From Phu My to the end point

The connection section to Cai Mep-Thi Vai, the route runs closely to Ong Trinh Mountain, a higher terrain than the other section (through stone mines).
From NH55 to the route end is the coastal area, low terrain (mangrove), and lower than the tidal level of channel system, thus it will get flooded when tide appears.

2) The geotechnical investigation results

The geotechnical investigation was carried out from Jan/2011 to Apr/2011 for the F/S design of this project. In this report, the review and study was conducted referring to the reports shown as Table5.2.18-1.

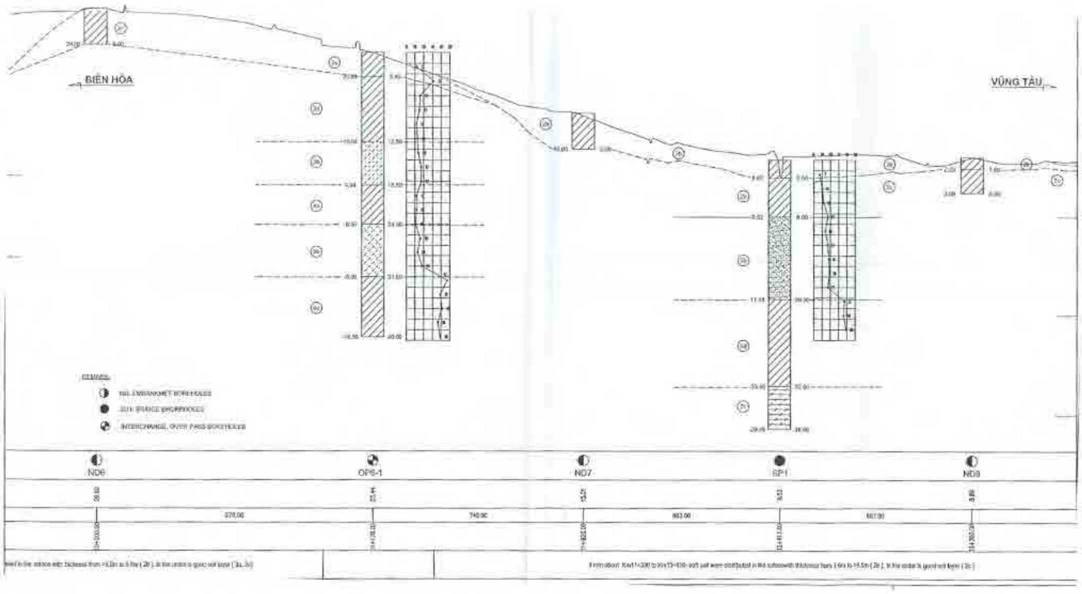
Table 5.2.18-1 Geotechnical Investigation Reports

No.	Document Name	Section
Volume II-1-Book1	Report on Soil Investigation For Road Section	KM0+000-KM37+000
Volume II-1-Book2	Report on Soil Investigation For Road and Culvert Section	KM0+000-KM37+000
Volume II-1-Book3a	Report on Soil Investigation For Roadbed Section	KM56+540-KM68+540
Volume II-1-Book4	Report on Soil Investigation For Road, Over pass and Interchange Branch Connection	PHU MY - NH51
Volume II-2-Book2	Report on Soil Investigation For Bridges access river	KM37+00-KM56+00

Volume II-3-Book2	Report on Soil Investigation For Overpasses	KM37+00-KM56+00
Volume II-4-Book2	Report on Soil Investigation For Interchanges	KM37+00-KM56+00

Source: JICA Study Team

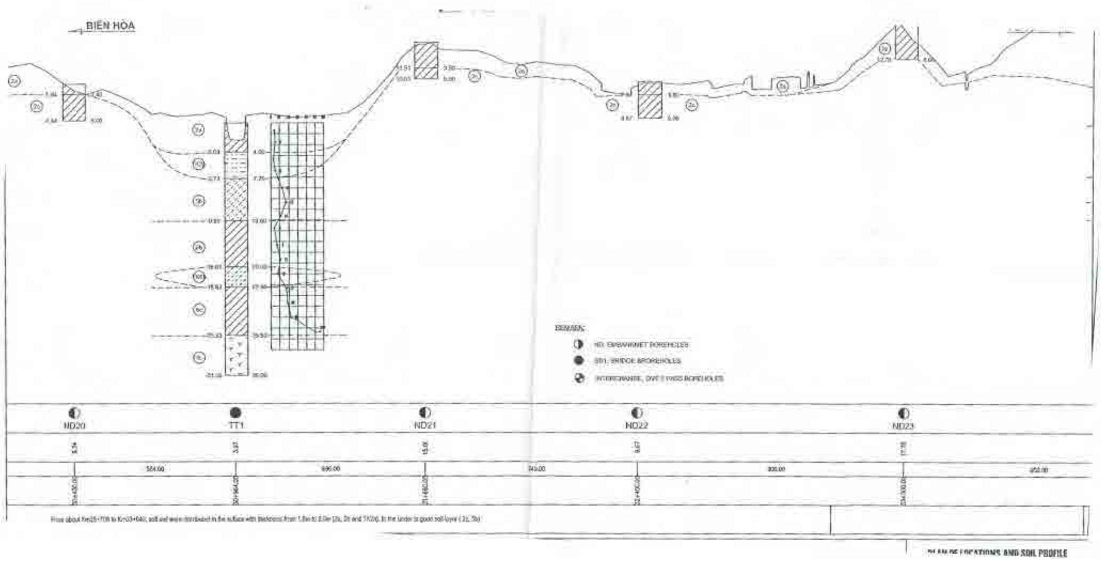
The representative geotechnical condition in the Phase1 section is shown below. Figure 5.2.18-1 shows the geotechnical condition around KM+10. The soil layers in this section consist of rather high strength fine grain soil and rather high density sand layer, and there is no soft soil layers. The many part of the planned expressway passes on such as the ground condition.



Source: Soil investigation report(Volume II-1-Book1)

Figure 5.2.18-1 Geotechnical Condition(Km10～Km13.5)

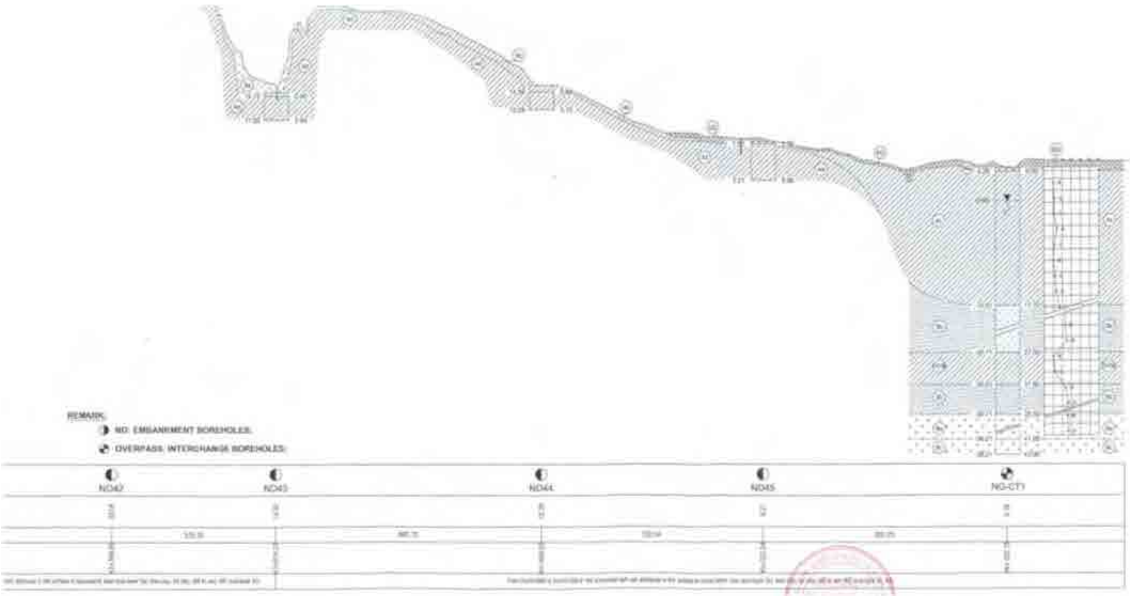
Figure5.2.18-1 shows that the example of soft soil deposit section at old drowned valley, the soft soil section like this can be found in spots in the expressway alignment. In these sections, the sand drain method was applied as soft soil treatment.



Source: Soil investigation report(Volume II-1-Book1)

Figure 5.2.18-2 Geotechnical condition (Km30.5~Km33.5)

Figure5.2.18-3 shows the geotechnical condition in Phu My to the intersection of NH51 and this road. The planned road passes through or near the hills and mountains, and almost all the route passes on the shallow rock ground. The deep deposited soil is around the NH51 intersection, but the layer is fine grained soil of which N values is about 10. Thus, The ground condition is good for construction and the soft soil treatment was not planned for this road.



Source: Soil investigation report(Volume II-1-Book4)

Figure 5.2.18-3 Geotechnical condition(Phu-My to the intersection of NH51(Km43.5~Km46.5)

(2) Review of The F/S, outline of the design

1) The Design Standards

There is no description about the design standards in the BVEC F/S report. But According to the hearing survey from TEDI corporation, the referred design standards were confirmed as shown in Table5.2.18-2. These standards are generally used for the expressway and embankment design in Viet Nam.

Table 5.2.18-2 The design Standards

No.	Standard
TCVN 5729-1997	Expressway - Requirement for design
TCVN 4054-05	Highway - Specification for design
22TCN211-06	Flexible pavement design
22TCN262-2000	Standard for investigation and design of embankment on soft ground

Source: JICA Study Team

2) The Design Criteria

The design criteria is in conformity with the above standards and it is shown in table5.2.18-3.

Table 5.2.18-3 The Design Criteria

		許容値	Remarks
Stability	During Construction	Safety factor F/S≧1.2	Bishop method
	During Operation	Safety factor F/S≧1.4	〃
Settlement	Embankment section	Residual Settlment Sr≦30cm	Consolidation settlment analysis
	Near box culvert	Residual Settlment Sr≦20cm	〃
	Abutment backfill area	Residual Settlment Sr≦10cm	〃

Source: JICA Study Team

3) The Study Conditions

The study conditions were determined referring to the investigation results (borehole logs and laboratory test results).

4) Outline of the study method

There were not enough description of the study method in the F/S report. According to the hearing survey from the design engineer, stability analysis and consolidation analysis was carried out and then the necessity of soft soil treatment was determined.

Division of the sections was conducted considering the thickness of the soft soil layer and height of the embankment, the representative calculation models of each sections was made and the calculation was carried out. Selecting the appropriate countermeasure method was carried out according to these calculation results and the table as shown in Table5.2.18-4

Table 5.2.18-4 The Alternatives of the soft soil treatment

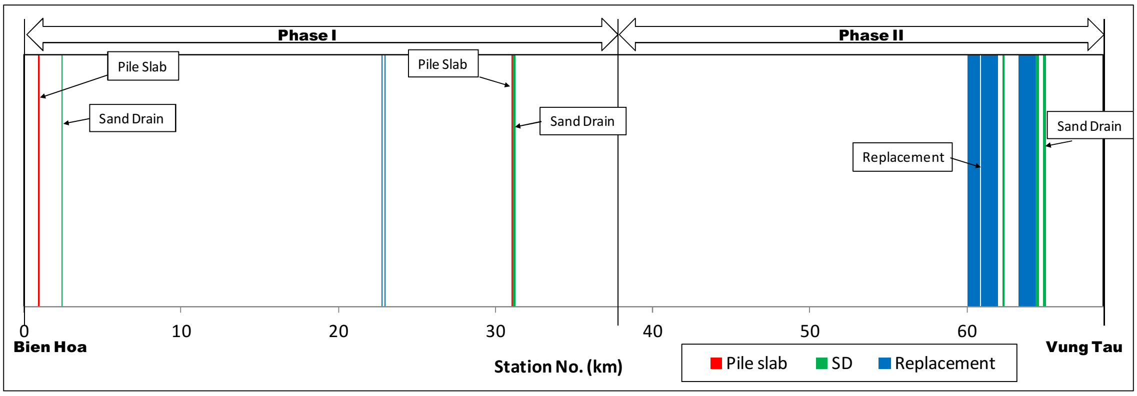
method	outline	the criteria for selecting
Soil replacement	The method to excavate soft and weak soil layer cause instability and settlement and to replace for good condition soil material.	Earth replacement is only applicable to the sub-grade where the depth of bottom layer of soft soil is less than 3.0m.
PVD method (Prefabricated Vertical Drain Method)	To install prefabricated drainage material into the ground at regular intervals. This countermeasure promote to discharge the pore water and occurrence of consolidation settlement.	PVD is only applicable to the embankment where its height is less than 4.0m and the depth of bottom layer of soft soil is less than 15.m or the subsidence is smaller than 1.5m.
Sand drain method (Sand Drain Method)	To install sand pile into the ground by the specific machine. This countermeasure promote to discharge the pore water and occurrence of consolidation settlement.	SD is only applicable to the embankment where its height is over 4.0m and the depth of bottom layer of soft soil is more than 15.0m or the subsidence is more than 1.5m.
Geo-Textile Method	The geo textile material is made from the steel or high polymer material in the factory. The material is allocated in the embankment bed and inner of the embankment in order to improve soil shear strength and keep the embankment stability.	The intensified geo-textile (woven) is used to strengthen the sub-grade after applying these above-mentioned measures but the stable coefficient during the construction period is not reachable.
RC Piled Slab	Driving concrete piles into the ground and constructing concrete pile slab above these piles. The slab support the load of the embankment.	For near abutment section, this countermeasure is applicated in case residual settlement cannot be reduced within allowable value or the embankment stability cannot be kept with above countermeasures.
U-retaining wall with Concrete pile	Constructing U-retaining wall with piles. The structure support the load of the embankment.	This method is applicated for high embankment section and over 25m soft soil depositting section.

Source:JICA Study Team

5) Outline of the design

The design was carried out in accordance with above mentioned method.

The applied alternatives of each section is shown in Figure5.2.18-4 and Table5.2.18-5. This figure shows that the total length of the soft soil treatment section is short in the whole section and there is a section in which SD and Replacement is continuously applied in near Vung Tau area. The typical cross sections of each methods are made as shown in Figure5.2.18-4.



Source:JICA Study Team

Figure 5.2.18-4 Applied Soft soil treatment method

Table 5.2.18-5 The results of the study for soft soil treatment (FS)

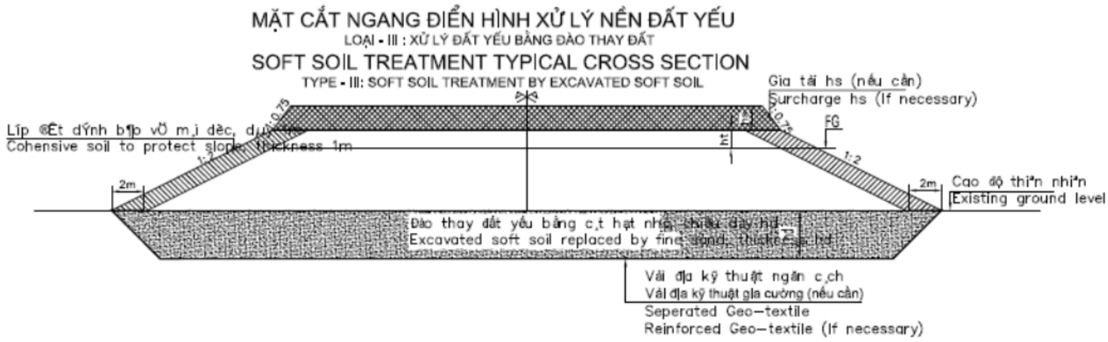
bien hoa - vung tau expressway project

Feasibility stage

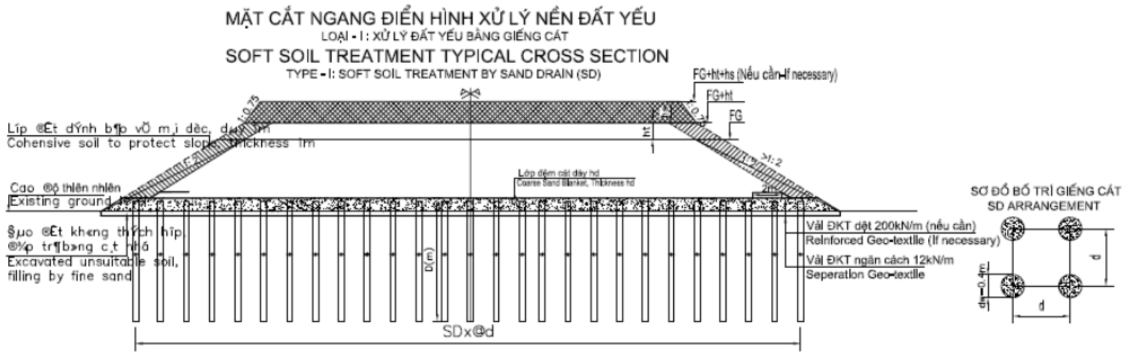
summary of soft soil treatment design

No	Station	Distance	Calculation of cross - section			Without treatment				Soft soil treatment content																		Results of treatment				
			Thick. of stiff soil layer (m)	Thick. of soft soil layers (m)	Height of EM (m)	Factor safety Fs	Con. Sett. Sc (m)	Total. Sett. S (m)	Sett. Within 15 years affter pavemet (m)	Treatment by SD or Replacement: SD	Spacing (m)	Depth (m)	Height of surchar. (m)	Thick. Of sand blanket (m)	Filling, Stage 1: H1 (m)	Rate of filling (cm/day)	Waiting time (day)	Stage 2: H2 (m)	Rate of filling (cm/day)	Waiting time (day)	Stage 3+4: H3 (m)	Rate of filling (cm/day)	Waiting time (days)	Total of construc. Time (days)	Berm: B (m)	H (m)	Reinfor. Geotex. 200kN/m (layer)	Factor of safety affter complete Fs	U (%)	Resi. Sett. (cm)	Rate of Sett. (cm/year)	Compensated Sett. (m)
1	Km00+900.00 - Km00+930.00	30.0								Load Relief Slab																						
2	Km00+930.00 - Km01+065.00	135.0		10.5	4.6	1.760	0.34	0.41		Filling waiting time 360 day																						
3	Km01+065.00 - Km01+635.00	570.0		11.5	5.2	1.59	0.31	0.37		Filling waiting time 360 day																						
4	Km02+403.00 - Km02+503.00	100.0		9.0	5.0	1.260	0.26	0.31		SD	2.0	9.0		0.6		5	90							194			1	1.500		0.10		0.21
5	Km22+784.00 - Km22+834.00	50.0		18.5	5.5	1.160	0.15	0.18		Replacement		3.0																1.880				
6	Km22+943.00 Km22+993.00	50.0		18.5	5.5	1.160	0.15	0.18		Replacement		3.0																1.880				
7	Km31+025.00 - Km31+055.00	30.0								Load Relief Slab																						
8	Km31+055.00 - Km31+275.00	220.0		7.7	4.5	1.140	0.35	0.42		SD	2.0	7.7		0.6		5	90							184			1	1.440		0.23		0.20
9	Km60+082.00 - Km60+350.00	268.0		3.0	4.7		0.07	0.08		Replacement		3.0																				
10	Km60+350.00 - Km60+650.00	300.0		3.0	3.0		0.05	0.06		Replacement		3.0																				
11	Km60+650.00 - Km60+830.00	180.0		3.0	6.0		0.08	0.09		Replacement		3.0																				
12	Km60+929.00 - Km61+100.00	171.0		3.0	4.7		0.07	0.08		Replacement		3.0																				
13	Km61+100.00 - Km61+355.00	255.0		4.4	2.5		0.23	0.28		Replacement		3.0																				
14	Km61+355.00 - Km61+550.00	195.0		5.4	4.4		0.14	0.17		Replacement		4.0																				
15	Km61+575.00 - Km61+700.00	125.0		5.4	4.4		0.14	0.17		Replacement		4.0																				
16	Km61+700.00 - Km62+000.00	300.0		3.5	2.5		0.23	0.28		Replacement		3.0																				
17	Km62+250.00 - Km62+383.00	133.0		9.0	4.6		1.70	2.04		SD	1.60	9.0		0.6	4.00	5	90	FG+Hg+0.7	5	60				274			4	1.496	95.6	0.07		2.00
18	Km63+300.00 - Km64+167.00	867.0		4.5	2.0		0.14	0.17		Replacement		3.0																				
19	Km64+167.00 - Km64+355.00	188.0		4.0	4.0		0.15	0.18		Replacement		3.0																				
20	Km64+355.00 - Km64+550.00	195.0		9.0	6.0		1.99	2.39		SD	1.6	9.0		0.6	4.00	5	90	FG+Hg+0.5	5	60				304			6	1.414	96.5	0.07		2.30
21	Km64+835.00 - Km65+050.00	215.0		9.0	5.5		1.91	2.29		SD	1.6	9.0		0.6	4.00	5	90	FG+Hg+0.6	5	60				296			6	1.536	96.2	0.07		2.20

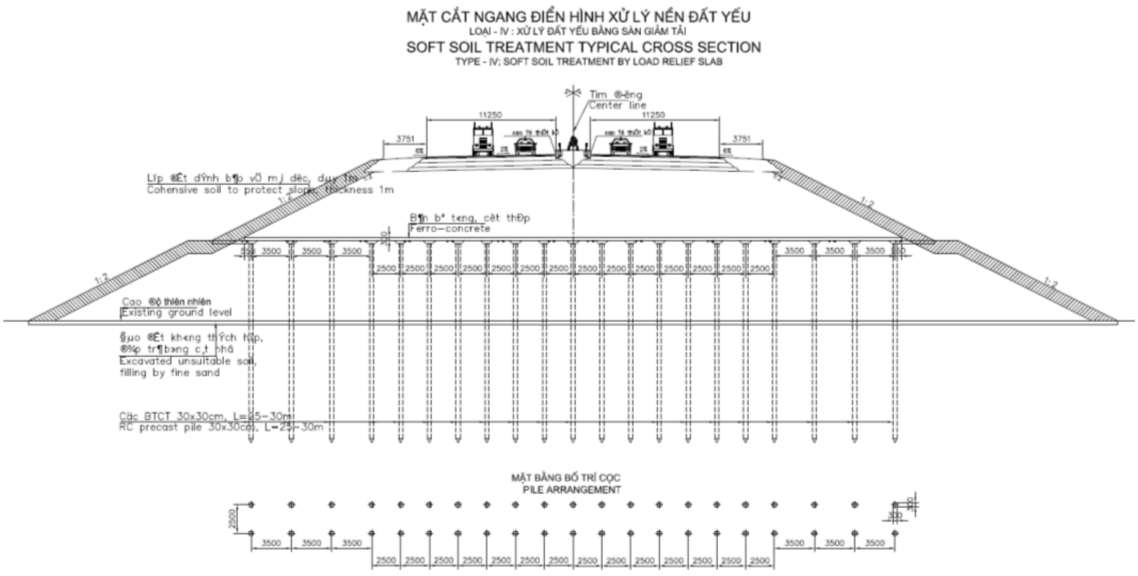
Source: BVEC F/S



(a) Soil replacement



(b) Sand drain method



(c)Pile Slab method

Source: BVEC F/S

Figure 5.2.18-5 Soft soil treatment drawings

(3) The evaluation for the F/S design

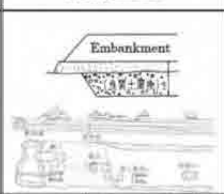
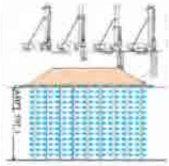
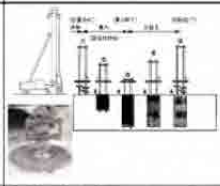
The estimation of the geotechnical condition and the outline of the design for Phase1 were mentioned above.
Geotechnical investigation were carried out with about 70 points of Borehole survey in the total length of 47km section. The elevation of the planned expressway is rather high and the geotechnical condition is relatively good. The estimation of the geotechnical condition was done reasonably in the F/S according to the soil investigation results.
The study method of the soft soil treatment method such as consolidation and settlement analysis is in conformity with generally using method in Vietnam. But there are not enough reasonably criteria to select SD or others in the method of selecting alternatives, the selection policy lacks rationality.
Surcharge embankment, allocation of the clay layer for the slope surface protection and geotextile are shown properly in the design drawings of the sand drain method and soil replacement. About the pile slab method, concrete slab is allocated not on the existing ground surface but on the same level as first step of the embankment. In this design, there are some disadvantages such as consolidation occuring, lateral movement of the abutment and void occurring under the slab. Generally the slab is allocated on the existing ground surface. Thus modifying the design of the slab allocated level is strongly recommended.

(4) proposing modifying design

1) Outline

As described above, the selection policy of the alternatives lacks rationality. In this study, preliminaly comparing alternatives was considered as shown in Table5.2.18-6, and the additional study of PVD method application was carried out for the section applied SD method. Consolidation settlement and Stability analysis were conducted to estimate the applicability of the PVD method.

Table 5.2.18-6 Comparing alternatives

	Solutions	Soil Replacement	PVD	SD	Deep cement mixing column (DCM)
general description	*Concept draw (or photo)*				
	description	To excavate and replace soft and weak soil layer cause instability. Generally, this method can be applied in case as follows: the thickness of replacement is rather thin (within about 3m), there is little construction problem (for example, to deal with underground water is easy.)	To install prefabricated drainage material into the ground at regular intervals. This countermeasure promote to discharge the pore water and occurrence of consolidation settlement.	To install sand pile into the ground by the specific machine. This countermeasure promote to discharge the pore water and occurrence of consolidation settlement.	To add and mix the cement material into the ground by the specific machine in order to increase bearing capacity. The bearing capacity of created column will be improved as about 0.2-1.0Mpa.
Technical Issues	*Consolidation Settlement*	Controlled by soil replacement thickness	High	High	Low
	Residual Settlement	Controlled by soil replacement thickness	Controlled by spacing of PVD and Surchage period	Controlled by SD spacing and Surchage period	Controlled by length of pile
	Stability	Increase Factor of Safety due to replacement with firmer soil	Increase Factor of Safety due to increase in soil strength during consolidation	Increase Factor of Safety due to increase in soil strength during consolidation	Increase Factor of Safety due to High load bearing capacity of DCM columns
Economic Issues	*Maintenance Cost*	Low	High	High	Low
	Construction Cost	Depend on replacement depth	Low	Low	high
Other Related Issues	*Construction Period*	Moderate – Depend on equipment used, material supply and surcharge time	Longest - depend on surcharge time	Longest - depend on surcharge time	Fast– Depend on equipment used.
	Long Term Performance	Good	Moderate	Moderate	Good
	Right of Way	In area of roadbed occupancy	Need large area for counter weight when deep soft soil, high embankment	Need large areas for counter weight when deep soft soil, high embankment	No need area for counter weight.
	Local Experience in Construction	Good – Mainly earthwork	Moderate	Moderate	Little used
	Use in Vietnamese Road project before	Many	Many	Many	Little
	Market Supply	No problem, mainly fine sand	No problem, except sand mat supply	Need a big quantity medium sand to make sand drain and sand mat layer	No problem, except import of construction equipment
	Likelihood of Usage	Suitable solution for thin soft clay deposit	Attractive method with low cost but requiring long construction period	Attractive method with low cost but requring long construction period	Attractive method with high cost and requiring experience in construction management, need more tests: pilot test, shear test, bearing capacity test etc...

Source: JICA Study Team

2) Study Conditions

Study conditions were basically determined in conformity with the existing F/S study. For the PVD applicability study, spacing of the PVD was determined to be 1.1m as minimum spacing of Viet Nam experience, and the maximum waiting period was 540days (1.5years).

3) Results of the study

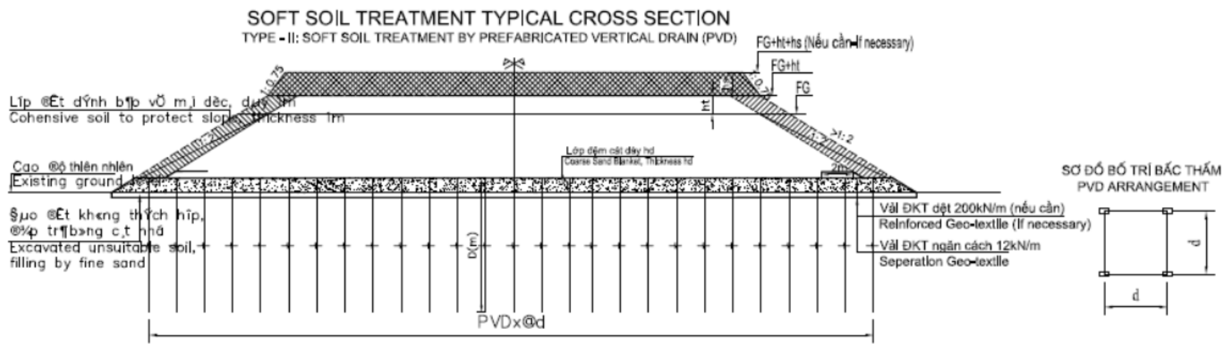
Table5.2.18-7 shows that the PVD can be applicable for all the section for which SD is applied in the F/S design according to the calculation results. It becomes clear that the PVD spacing is shorter and the waiting time is longer than in case of SD application. But the residual settlement can be reduce within 30cm. Thus the method was determined to be applicable for these sections. The cost and quantity of this treatment method were estimated separately, and it has became obvious that the cost of PVD is lower than of SD. Therefore the design change is strongly reccomended.

Table 5.2.18-7 Study Results

Station No.	Sand Drain			Prefablicated Vertical Drain			Results
	Spacing (m)	Period (day)	Residual Settlement (cm)	Spacing (m)	Period (day)	Residual Settlement (cm)	
Km02+403 -Km02+503	2.0	194	10	1.1	288	11	PVD Applicable
Km31+055 -Km31+275	2.0	184	23	1.1	298	21	PVD Applicable

Source: JICA Study Team

The typical crosssection drawing of the PVD method is as shown in Figure5.2.18-6. The componet items are almost same as of SD method, but the drain material is only change.



(d)PVD method

Source: JICA Study Team

Figure 5.2.18-6 Proposed modified treatment method

(5) The Problems of F/S design and The Proposal of Additional Study

The BVEC F/S design is conducted almost reasonably as described above. Meanwhile there is some problem to conduct the detailed design as followings

1) The Additional Soil Investigation

The soil investigation was conducted with about 70 points of borehole surveys in the whole phase 1 section (47km). The borehole survey was carried out by 1 or 2 points per 1km. This planned road passes on relatively good soil condition ground, but there are some section in which soft soil layer deposits. Thus the additional borehole survey is required for D/D considering this matter. The Vietnamese standards of expressway construction regulate the quantity of the survey for especially soft soil sections as 1 borehole each of 75m and add 2 boreholes both side from centerline by each of 150m. Therefore the additional boreholes are required as shown in below Table5.2.18-8.

Table 5.2.18-8 Additional borehole survey for D/D

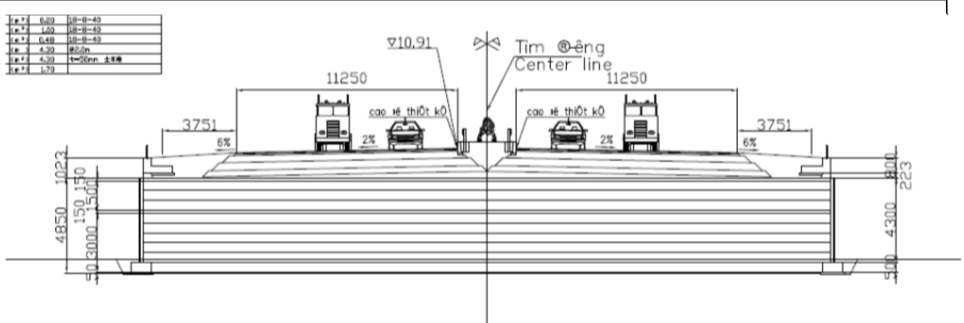
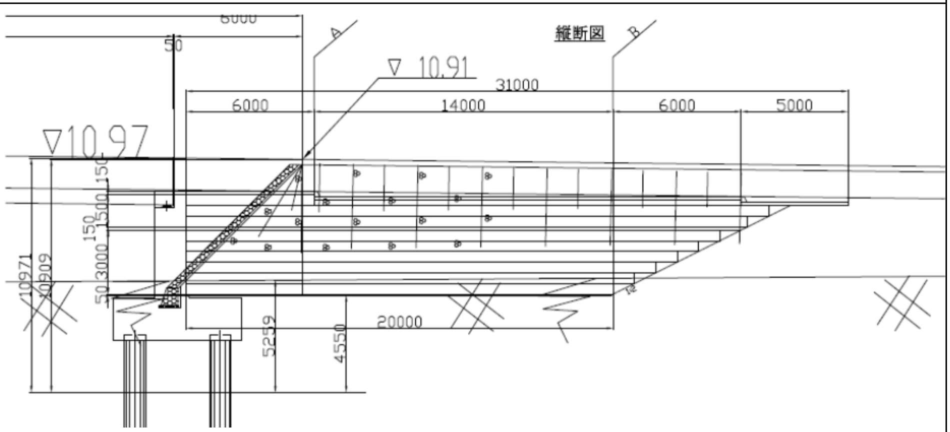
Section	Station No.	length (m)	existing num. of boreholes (num)	additional borehole num (num)	remarks
Phase1	KM00+900 -KM01+635	735m	1	19	temporary assumed depth of boreholes is 15m
	KM02+403 -KM02+503	100m	0	4	temporary assumed depth of boreholes is 15m
	KM31+025 -KM31+275	250m	0	8	temporary assumed depth of boreholes is 15m

Source: JICA Study Team

2) The proposal of additional study on alternatives

In the soft soil section, the Vietnamese standards regulate that the residual settlement near abutment section is within 10cm which is smaller than 30cm in general embankment sections. As a results of this regulation and the study, pile slab method are applied for some section in F/S design. Pile slab method is general method for soft ground in Vietnam. Meanwhile the method have some problems such as requiring high cost, the possibility occuring uneven settlement on border and structural health of slab in the ground. Thus its contemplated that the study of the other alternatives are beneficial for improving the design.

For example, the deep cement mixing method and the extra light weight fill method can be proposed as the alternatives, there are many experiences of these method application in other countries. Its strongly recommended to study these alternatives in the D/D. Figure5.2.18-7 shows the extra light weight fill method as one sample of the alternatives.

The sample of proposed alternatives	
Outline	The expanded polystyrene (EPS) civil construction method is a light-weight embankment method using EPS blocks as fill material. The method was developed as a measure for ground subsidence in Oslo, Norway in 1972.
	【 Merit】
	➢ Easy to construction It is able to construct 200m^3 fill per day (1party with 5 persons). Thus this method is often used for urgent post-disaster restoration. ➢ Advantageous effect of the method The method have the advantage to have the ability of reducing settlement and keeping the stability of embankment.
	【 weak point】
	➢ high cost of the materials ➢ floating force of the block ➢ melting by the oil
Typical Cross section	
Typical longitudinal drawing	

Source:JICA Study Team

Figure 5.2.18-7 Outline of the EPS method

5.2.19. Accessory of Road

(1)-1 Electronic facility

1) Lighting facility

Lighting facility refers to MOT standard of Vietnam, such as TCVN2010, TCXDVN2004, TCVN2005, 2001, 1989, TCN2006, and ISO standard: CIE115 (1995). It is installed at the place where vehicle speed changes by concentration and the dispersion of the vehicle, the point of origin and destination, Interchange, Bridges, service station, control center and Operation office. Moreover it is settled at median strip in order to consider maintain and widen traffic lanes in near future.

<Reference>Installation standard of other expressways

Expressways	Installation standard
HCMC- Trung Luong Expressway	Installed at Interchange, 500m before and after tollgate, Urbanization, a part of viaduct.
Japanese Expressways	- The section influenced by the lighting of the building, roadside and heavy traffic - The section where traffic is congested remarkably by night - The section where fog is easy to be generated, and special climatic condition - The section where linear, and road width, shoulder width are special Interchange, Junction, toll gate area, Service area, Parking area, bus stop, Long bridge

Source:JICA Study Team

(1)-2 Power reception and distribution

Power reception and distribution is installed at 13 places thought to be the need in electric preservation.
In addition, it depends on the Electric Toll Collection (hereinafter ETC) introduction to use "uninterruptive power supply facilities" (UPS) to feed electric power to ETC replaced by a generator. UPS has been already introduced into Vietnam.
Furthermore, the generator for emergency is established at the important facilities installed a traffic control system or toll collection system, to feed electric to UPS in the case of an emergency.

(1)-3 Telecommunication System

A telecommunication system is a system communicating with Closed-Circuit Television(hereinafter CCTV) camera system or an variable message sign board other terminal equipment, and it is necessary an optical fiber communication cable. It prefers to be settled the cable at median strip for maintenance and traffic lane widening in near future.

(2) Building facilities plan

Building facilities include 4 facilities, an operation center, a maintenance office, a tollgate and a service station. It is not include out-sourcing ETC service company office and the service station company office.

1) Operation Center

Operation Center is planned at and intermediate location on the entire expressway included the length of phase 2 on the F/S, referred to Table 5.2.19-1.

Table 5.2.19-1 Operation Center Plan

Item	Contents
Location	1 location（ st.37+000）
Area	Land for acquisition:57,316㎡, Site area:33,000㎡
Staff	80 People
Facilities	Office:1,870㎡, Service house:2,700㎡, Vehicle parking and Storage:180㎡, Culture house:450㎡, Parking: 72㎡
Equipment	<Common Space> Transformer station, Wastewater treatment station, pumping station, PC and LAN system, printer <Road Control Center> Closed television system, Control equipment, Data storage equipment

Source: BVEC F/S

2) Maintenance Office

Major function of the maintenance office is to undertake routine maintenance, such as cleaning and inspection activities, in compliance with the O&M service plan.

Maintenance office is planned at an intermediate location of the entire expressway at phase 1 stage. The proposed location of the maintenance office will facilitate access from the whole stretch of the expressway (see Table 5.2.19-2).

Table 5.2.19-2 Maintenance Office Plan

Items	Contents
Location	1 location（ st.16+000）
Area	Land for acquisition:13,700㎡, Site Area: 5,900㎡
Staff	33 People
Facilities	Office: 484㎡, Worker's dormitory:700㎡, Vehicle parking and Storage: 113㎡, Canteen: 260㎡

Equipment	Transformer station, Wastewater treatment station, pumping station, PC and LAN system, printer

Source: BVEC F/S

3) Service Station

Service station is planned at an intermediate location of the entire expressway including phase 2 (see Table 5.2.19-3).

Table 5.2.19-3 Service station Plan

Items	Contents
Location	1 location on both sides (st.36+000)
Area	Land for acquisition:130,490㎡, Site area: 92,220㎡
Staff	130 people (includes staff in hotel, shop and gas station)
Equipment	Service house, hotel, toilets, supermarket, office, O&M station and gas station

Source: BVEC F/S

(3) Vehicle Allocation for O&M

O&M vehicles allocate and operate shown in Table 5.2.19-4 for the traffic patrol, inspection, quick repair and so on.

Cost for O&M vehicle is estimated based on "Consulting Services for Updating and Finalizing the Feasibility Study Report for Da Nang-QuangNgnai Expressway Construction Project" by WB.

Table 5.2.19-4 Vehicle Allocation for O&M

Vehicle	Operation center	Maintenance office	Traffic Operation Unit	Road Maintenance Unit	ITS Maintenance	Toll collection gate	Ramp	Total
Superintendent Car	3	1						4
Staff Car	2	1				1	3	7
Patrol Car			3	1	1			5
Road Maintenance car				2	2			4
Sweeper				1				1
Water Sprinkler				1				1
Sign Truck				1	1			2
Truck				1	1			2
Wrecker Truck			1					1
Cargo Truck				1				1
Aerial Platform Tuck				1	1			2
Fire Fighting Car			1					1
Ambulance Car			1					1
Total	5	2	6	9	6	1	3	32

Source: JICA Pre-F/S

5.3. Construction Planning

5.3.1. Documents / Information Received

In the BVEC F/S report, the survey of construction material supply is described in Chapter 7, and its main content is supply capacity and quality of materials at the sand pit and quarry site. Construction packaging, implementation program, and construction organization are described in Chapter 14. However, construction planning was not described in detail.

5.3.2. Contract Packaging

(1) Contract Packaging in the F/S

The contract packaging was divided into seven packages in the F/S considering the following comments of the Preliminary F/S :

- Equal work volume and cost at each package
- The contractor's ability and capacity
- Approach from existing road system
- Location of interchange
- Administrative boundaries
- Separating supporting management and operation facilities from civil work

Table 5.3.2-1 Contract Packaging (BVEC F/S)

Package	Work	Section（length）	Major Work Items	Construction Cost（billion VND）
1	Civil work(1)	Km0+000-Km6 (6.0km)	Bien Hoa IC, Soft soil treatment	951 (JPY3.6billion)
2	Civil work (2)	Km6+000-Km15+800 (9.8km)	-	866 (JPY3.3billion)
3	Civil work (3)	Km15+800 - Km19+000 (3.2km)	Long Thanh JCT	768 (JPY2.9billion)
4	Civil work (4)	Km19+000 - Km29+000 (10km)	-	888 (JPY3.4billion)
5	Civil work (5)	Km29+000 - Km37+600 (8.6km)	Soft soil treatment	1,344 (JPY5.1billion)
6	Civil work (6)	Km37+600 - Km46+800 (9.2km)	Access Road of National Highway Class II	852 (JPY3.2billion)
7	O&M Facilities	Km0+000-Km46+800 (46.8km)	ITS, Toll Gates, O&M Buildings, Facilities of Service Station	919 (JPY3.5billion)

Note: Contingencies (price and physical) are not included in the construction cost.

Source: BVEC F/S

(2) Review of the Contract Packaging

The study team reviewed the contract packaging for civil works and other works, and found that it was basically appropriate plan. Since work items of the package-7 includes several different kinds of works such as ITS facilities and building works, further division to building works, ITS work and O&M equipment Packages 7, 8, and 9 is recommended. Updated contract packaging is shown in table 5.3.2-2 based on the updated construction cost described in chapter 5.5.

Table 5.3.2-2 Updated Contract Packaging

Package	Work	Section（length）	Major Work Items	Construction Cost（billion VND）
1	Civil work(1)	Km0+000-Km6 (6.0km)	Bien Hoa IC, Soft soil treatment	961 (JPY3.65billion)
2	Civil work (2)	Km6+000-Km15+800 (9.8km)	-	869 (JPY3.30billion)
3	Civil work (3)	Km15+800 - Km19+000 (3.2km)	Long Thanh JCT	776 (JPY2.95billion)
4	Civil work (4)	Km19+000 - Km29+000 (10km)	-	891 (JPY3.39billion)
5	Civil work (5)	Km29+000 - Km37+600 (8.6km)	Soft soil treatment	1,427 (JPY5.42billion)
6	Civil work (6)	Km37+600 - Km46+800 (9.2km)	Access Road of National Highway Class II	870 (JPY3.31billion)
7	Building work	Km0+000-Km46+800 (46.8km)	Toll Gates, O&M Buildings	289 (JPY1.10billion)
8	ITS	Km0+000-Km46+800 (46.8km)	ITS, Electric Facilities	159 (JPY0.61billion)
9	O&M	Km0+000-Km46+800	Initial O&M Facilities (vehicles)	139 (JPY0.53billion)

	Equipment	(46.8km)		

Note: Contingencies (price and physical) are not included in the construction cost.

Source: JICA Study Team

5.3.3. Construction Plan

(1) Outline of Construction Plan in the F/S

Expressway and Interchange Work: The investigation of filling material, pavement materials, sand for soft soil treatment, and stone for bridge structures were executed in the BVEC F/S for the supply of required construction materials. And, the outline of the preparation work, temporary and ancillary works, and the safety equipment and facilities are described with regards to the construction of the expressway. As for the construction of connection road, the necessity of considerations on traffic management, obstacles and environment are also described. However, it was noted that these issues should be studied in detail at the detailed design stage.

Bridge Work: The basic construction method of foundation, pier, superstructure was described in the BVEC F/S report. Furthermore, the procedure of bridge construction work was described in the drawings of the BVEC F/S report.

(2) Review on the Construction Plan

Major work items in phase-1 are excavation, embankment, soft soil treatment and bridge works. The longest length of bridge is 1,148.4m which overpass railway at Km30+320 and its type of bridge is super-tee girder (pre-tension PC girder) and diameter 1.0m bored pile foundation. There is no bridges with longer span than 40m. This is common bridges in Vietnam. As for soft soil treatment, replacement method is generally applied since soil condition is good in general, and PVD method is limited to use for high embankment of approach bridge section.

Table 5.3.3-1 shows quantities of major work items by each package. Outline of building, ITS and O&M facilities works is referred to Chapter 5.4.

Table 5.3.3-1 Quantities of major work items by each package in Phase 1

Major Item	Unit	Phase-1 (Initial Stage 4-lane)						Total
		Bien Hoa - Phu My - NH51 Section						
		Package-1	Package-2	Package-3	Package-4	Package-5	Package-6	
		KM0+000 - KM6+000	Km6+000 - Km15+800	Km15+800 - Km19+000	Km19+000 - Km29+000	Km29+000 - Km37+600	Km37+600 - Km46+800	
Excavation	m^3	160,672	215,666	137,846	220,067	174,769	445,101	1,354,121
Rock Excavation	m^3	19,272	31,477	10,278	32,119	19,782	0	112,928
Embankment	m^3	511,412	607,962	478,742	620,370	449,146	409,578	3,077,211
thruway	m^3	302,619	494,277	270,362	504,364	378,144	369,877	2,319,643
interchange	m^3	139,190	0	136,308	0	0	37,444	312,943
frontage road	m^3	69,603	113,685	72,072	116,005	71,002	2,258	444,626
PVD	m	45,180	0	0	0	80,300	0	125,480
Asphalt Concrete Pavement	m^2	227,668	344,168	202,588	351,192	335,641	219,623	1,680,881
thruway	m^2	130,262	212,761	95,299	217,103	191,744	193,150	1,040,319
interchange	m^2	16,953	0	54,105	0	0	14,700	85,758
frontage road (bituminous surface	m^2	80,454	131,408	53,184	134,089	143,897	11,773	554,804
Bridge : total length	m	1,113.9	323.5	712.4	492.2	1,461.2	354.3	4,457.5
on the expressway	m	457.6	138.5	126.4	132.3	1,346.9	165.1	2,366.8
interchange	m	523.9	0.0	495.8	0.0	0.0	0.0	1,019.7
overpass	m	132.4	185.0	90.2	359.9	114.3	189.2	1,071.0

Source: JICA Study Team

From the above general review result, a point of construction plan in phase 1 is procurement and transportation of filling material with approximately 3 million m^3. It is confirmed that the location and reserve of sand pit was investigated and transportation length was considered in the cost estimate in the BVEC F/S. required quantity of filling material each package, transportation distance to the site and the location and the reserve quantity are summarized in Table 5.3.3-2 and the location map of the sand pit is shown in Figure 5.3.3-1.

As for the transportation of filling material to the site from the sand pit, National Highway No.51 is useful up to near construction site, then the material can be transported to the site by using existing local roads. It is required to investigate the supply capacity per day in the detailed design stage.

Table 5.3.3-2 Conditions of Embankment Work

	Package 1	Package 2	Package 3	Package 4	Package 5	Package 6
Qty of Embankment (m^3)	511,412	607,962	478,742	620,370	449,146	409,578
Quarry Site	TAN CANG	TAN CANG	TAN CANG	TAN CANG	SUOI LUP	SUOI LUP
Reserve (m^3)	2,820,965				2,300,000	
Transportation Distance to the Site (km)	6.00	10.78	17.28	23.88	19.80	14.20

Source: JICA Study Team

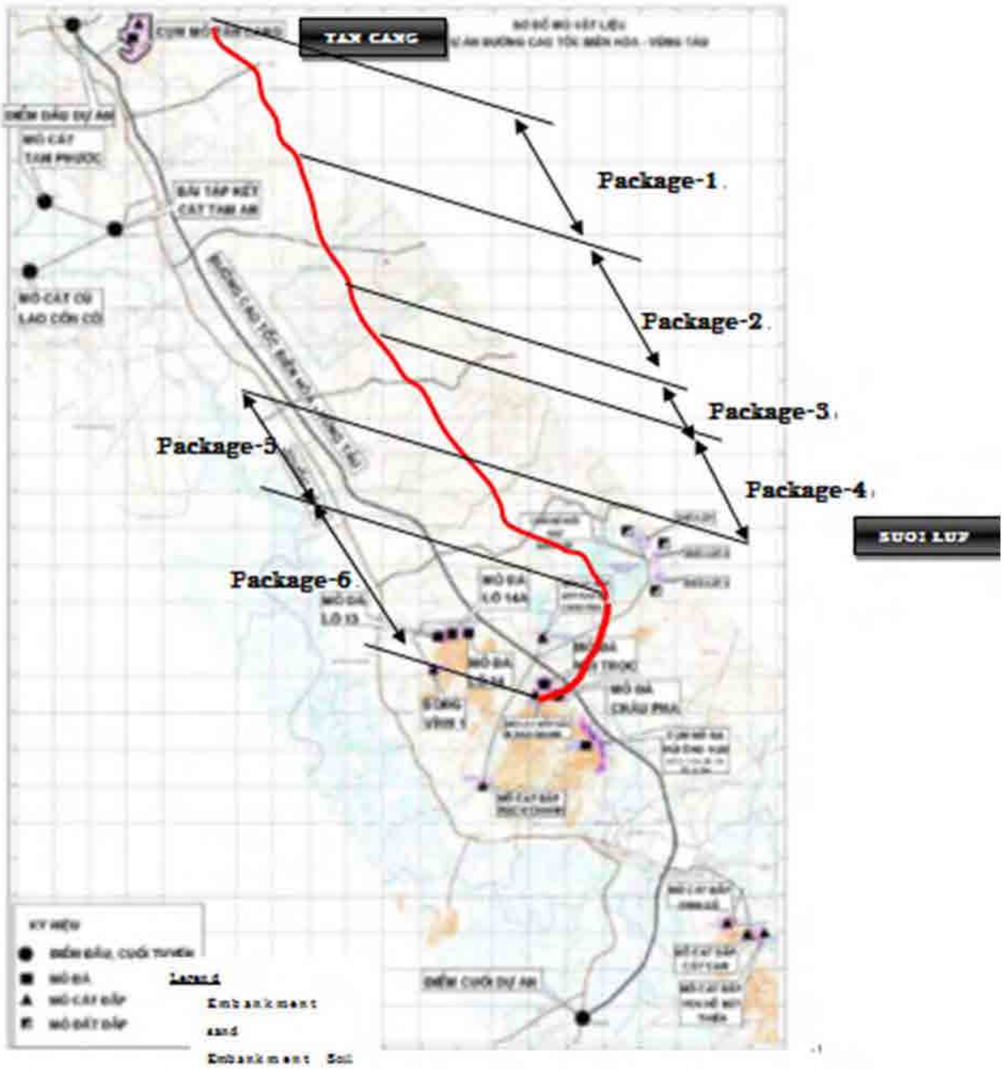


Figure 5.3.3-1 Location map of sand pit and quarry site along BHVT Expressway

5.3.4. Construction Schedule

(1) Construction Period in the F/S

Construction period was estimated at 48 months without detail study of the construction planning, and it is mentioned that its detail would be studied in the detailed design stage.

(2) Review of Construction Schedule

In this Study, the construction period was reviewed and estimated at 36 months from the basis of the actual construction schedule in other expressway construction project in Southern Vietnam. The general project schedule and standard construction schedule are shown in Table 5.3.4-1 and 5.3.4-2 respectively.

The major schedule until completion of the work is as follows:

- Land Acquisition and Resettlement : middle of 2014 – end of 2016 (30 months)
- Detailed Design : beginning of 2015 – middle of 2016 (18 months)
- Procurement of Contractors :
  middle of 2016 – end of 2016 (6 months for civil works)
  beginning of 2018 – middle of 2018 (6 months for building and O&M facilities)
- Construction Works and Construction Supervision : beginning of 2017 – end of 2019 (36 months)
- Traffic open: beginning of 2020

Table 5.3.4-1 General Project Schedule of Phase

ACTIVITIES	DURATION (Months)	CY 2014 (6–12)	CY 2015 (1–12)	CY 2016 (1–12)	CY 2017 (1–12)	CY 2018 (1–12)	CY 2019 (1–12)
Land Acquisition and Resettlement	18						
Detailed Design	12						
Procurement of Contractors (Civil)	6						
Procurement of Contractors (O&M Works)	6						
Construction Supervision	36						
Construction Works	36						
Open to the Public							

Source: JICA Study Team

Table 5.3.4-2 Standard Construction Schedule

ACTIVITIES	DURATION (Months)	CY 2017												CY 2018												CY 2019											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1. Construction Work																																					
(1)Civil Work Cost	36	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
1) Earth work	26		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■									
2) Soft soil treatment	24		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■											
3) Pavement	9																									■	■	■	■	■	■	■	■	■			
4) Drainage	12													■	■	■	■	■	■	■	■	■	■	■	■												
5) Road Facilities	3																																		■	■	■
6) Bridges on the Expressway/Interchange	27				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
7) Overpass/Underpass	27				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
(2) O&M Work																																					
1) Building Work	18																			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
2) Electrical and Communication Facility Work	18																			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
3) Initial O&M Equipment	6																			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Source: JICA Study Team

5.4. O&M Plan

(1) Purpose of O&M

It becomes very important to manage the appropriate road maintenance at a good time to cross the road structure taken over to future generation for more than 100 years. In addition, it should be conducted the crisis control correspondence such as car trouble, a traffic accident, the disaster promptly for 365 days for 24 hours to promote safety, relief, and comfortable to the user.

(2) Scope of O&M

O&M is divided into four categories: toll collection, traffic patrol, inspection and asset management, and cleaning, planting, or maintenance work as followed Table 5.3.4-1.

Table 5.3.4-1 O&M service

No	Categories	Contents
1	Toll Collection	Toll Collection, Traffic regulation at IC
2	Traffic Patrol	Traffic patrol, Traffic control Inspection and the control of the overloading vehicles Primary correspondence to traffic accidents or disaster
3	Inspection and asset management	Daily and Periodical Inspection, Management, and Improvement work of road and ITS facilities
4	Cleaning, Planting, and Maintenance work	Cleaning, Planting, Traffic regulation, Repairing Inspection and repair O&M vehicles

Source: JICA Study Team

5.4.1. The Applied Standards

The following documents and standards and interview to related organizations are referred to this report.

Bien Hoa - Vung Tau Expressway final report, TEDI, 2011/10
Bien Hoa - Vung Tau Expressway final report, JICA, 2011/6
Temporary Manual on O&M Management for HCMC – Trung Loung Expressway, TEDI
Feasibility Study Report of Danag – Quang Nghai Expressway project, TEDI, 2011/10

5.4.2. Examination of O&M Standard

Future traffic demand forecast result shows sectional average of about 30,000 pcu in 2017 and increases steeply traffic after 2017. Moreover, large share of heavy vehicles in the traffic is also forecasted because of the connection of BHVT Expressway to international sea port, large-scale industrial park and urban areas. The deterioration level of road structures is anticipated to be more serious than ordinary expressways.
On the basis of above traffic condition, the study team proposed to introduce O&M service level as shown in Table 5.4.2-1 based on “Temporary Manual on O&M Management for HCM-Trung Loung Expressway”.
In addition, this report mentions about frequency, the system and a service standard in Japanese example, because there is not mention enough about frequency, the systems such as cleaning, inspection and repair works. Furthermore, it is necessary to provide every stage in 4 provisional traffic lanes and completion 6/8 traffic lanes.

Table 5.4.2-1 The Standard of Temporary Manual

Items	Categories	Contents
Inspection	Type of Inspection	As stipulated in Draft Manual
Repair Work	Plan and Frequency	As stipulated in Draft Manual
Cleaning	Plan and Frequency	Items are stipulated in Draft Manual No frequency value and detail method
Traffic Control	Traffic Control Frequency and Organization system	Items are stipulated in Draft Manual No Detail method
ITS	Periodic Service and Measures against hindrance	As stipulated in Draft Manual

Source: Preliminary Survey

On the basis of above traffic condition, the study team proposed to introduce O&M service level as 50,000pcu/day in Japanese expressways.

This service level is applicable for 10 years after opening the road to traffic, and the service level shall be reviewed based on prevailing traffic conditions after 10 years. The required O&M service level for ITS equipment inspection depends on the traffic condition.

■ Suggestion on O&M Standard

O&M service level as proposed in previous part is based on Japanese O&M current practices. However, BHVT Expressway is expected to be implemented using private financing and as such increased incentive to maintain safety levels, O&M standard and service level shall be considered. Long-term transition from frequency-based O&M service level to performance-based O&M service level shall be taken into account.

This transition to performance-based service level takes into consideration future impact of O&M activities build and technical innovations in ensuring sound business operation of the O&M Company. Furthermore, the quality standard should be shift to the performance based regulation from frequency based regulation.

■ Frequency based regulation:

Frequency based regulation is stated clearly as type of method, the number of workers, or frequency.

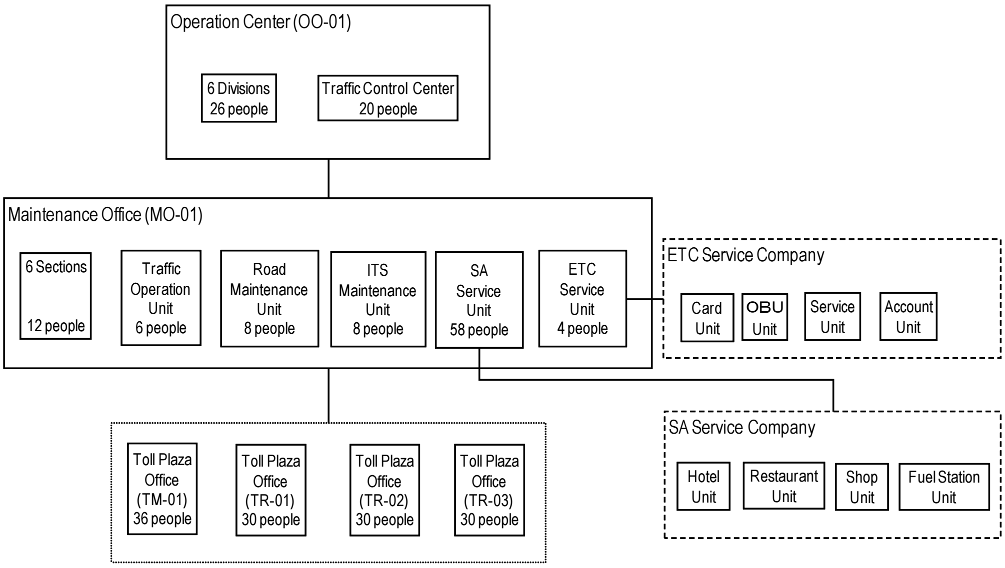
■ Performance based regulation:

Performance based regulation is the rule to adopt the performance that was shown in the contract.

5.4.3. Organization Plan

Operation center, maintenance offices, and toll plaza office are located at this route to conduct O&M works.

Operation center supervises two maintenance office (located each phase), and takes responsibility for traffic control at this route. Maintenance Office controls road maintenance, and toll plaza office deals with toll collection and customer service.



Source: JICA Study Team

Figure 5.4.3-1 O&M Organizations

(1) Operation Center

Operation Center mainly divided into standard 6 divisions and traffic control center.

1) Standard 6 divisions

Standard 6 divisions are composed of general affairs division, administration division, toll management division, engineering division, and road maintenance division.

Table 5.4.3-1 Organization of the Operation Center

	Director General	Deputy Director General	Manger	Staff	Total
	1	2			3
General Affairs Division			1	5	6
Administration Division			1	2	3
Toll Management Division			1	2	3
Engineering Division			1	2	3
Road Maintenance Division			1	2	3
ITS Maintenance Division			1	2	3
Total	1	2	6	15	24

Source: BVEC F/S

Table 5.4.3-2 The Duties of Operation Center

Organization	Duties work
General Affairs Division	General affairs, Personnel affairs, the accounting, advertising
Administration Division	The real estate acquisition, traffic management
Toll Management Division	Toll collection, customer service
Engineering Division	Budgeting, Asset management, disaster management
Road Maintenance Division	Planning and execution of Maintenance work, inspection of pavement or bridge, Improvement work
ITS Maintenance Division	Planning and execution of inspection of ITS facilities and Improvement work

Source: BVEC F/S

2) Traffic Control center

Traffic control center manages traffic control to affect smooth traffic. This proposal is examined independent use each other although integration of traffic system is efficient in order to control and exchange traffic information with other expressway.

(2) Maintenance Office

Maintenance Office is to undertake routine maintenance such as cleaning and inspection activities, in compliance with the O&M service plan. On the other hand, ETC Service Unit and Service Station Unit are assumed to be outsourced for the purpose of the efficiency of duties and rationalization.

Table 5.4.3-3 Organization of Maintenance Office

	Director General	Deputy Director General	Manger	Staff	Total
	1	2			3
General Affairs Section			1	2	3
Administration Section			1	6	7
Toll Management Section			1	4	5
Engineering Section			1	2	3
Road Maintenance Section			1	8	9
ITS Maintenance Section			1	8	9
Service Station Section			1	4	5
計	1	2	7	34	44

Source: BVEC F/S

Table 5.4.3-4 The Duties of Maintenance Office

Sections	Duties Work
General Affairs Section	General affairs, Personnel affairs, the accounting, advertising
Administration Section	The real estate acquisition, traffic management
Toll Management Section	Toll collection, customer service
Engineering Section	Budgeting, Asset management, disaster management
Road Maintenance Section	Planning and execution of Maintenance work, inspection of pavement or bridge, Improvement wor
ITS Maintenance Section	Planning and execution of inspection of ITS facilities and Improvement work
Service Station Section	Service management at Service Station

Source: JICA Study Team

1) ETC Service Unit

Service work for ETC cards is assumed to be outsourced. Therefore, only management personnel are proposed for assignment on different ETC service units such as card, On Board Unit (hereinafter OBU), service, and accountant sections.

2) Service Station Unit

The Service Station Unit is comprised of a restaurant, a shop, a gas stand, and a hotel. This unit is assumed to be outsourced. It is held adjustment with other organizations, budgeting and KPI management in the office.

3) Toll Collection Unit

Toll Collection Unit is divided into toll collection and affairs, which is to collect and analyze toll collection data. There are two toll gates on thruway in three booths, two toll gates on ramp in three booths.

Table 5.4.3-5 Organization of Toll Collection Gate

Location	Section	Chief	Officer	Collector	Security	Total
Thruway	Office Staff	3	6			9
	Collector	3		18	6	27
Lamp	Office Staff	3	6			9
	Collector	3		12	6	21
Total		12	12	30	12	66

Source: JICA Study Team

Table 5.4.3-6 The Duties of Toll Collection Gate

Section	Duties
Office Staff	ETC and cash handling, Collecting and Analysis data
Collector	Ticket in the booth, traffic guidance, Traffic regulation at IC

Source: JICA Study Team

5.4.4. O&M Standard

(1) Cleaning

Cleaning is conducted appropriate work considering traffic, a large vehicle mixture rate and local condition (See Table 5.4.4-1).

Table 5.4.4-1 The Standard of Cleaning

Items	frequency	Organization system
Thruway (machine)	3times / week	1party(2person)×2.5hour/times
Thruway (Manual)	Over once / year	1party(2person)×3hour/times
Service Station	Once / 5 years	1party(5person)×2hour/times
Interchange	Once / 2 days	1party(1person)×1hour/times
Drainage System	Once / year	1party(2person)×1.5day/times

Source: The Preliminary Survey

Reference: Cleaning Frequency on Japanese expressway

Traffic Volume (Vehicles/day)	Cleaning A		Cleaning B
	Roadside(left)	Roadside(right)	
25,000～50,000	Once/2days	Once/week	Once/Week
50,000～70,000	Once/a day	Once/Week	Once/Week
Over 70,000	Over once/a day	Over Once/Week	Over Once/Week

Cleaning A : cleaning by sweeper
Cleaning B : cleaning manually

Service Area twice / month
Interchange twice / month
Drainage twice / year

(2) Inspection of Road Structure

The frequency of inspection for road structure as followed Table 5.4.4-2.

Table 5.4.4-2 Frequency of Inspection of Road Structure

Item	Frequency	Organization System
Daily Inspection	3 times / week	1 party(2person) / time
Periodical Inspection	Over once / year	1 party(2person) / 3 days
Detailed Inspection	Once / 5years	1 party(5person) / 24 days

Source: JICA Study Team

(3) Inspection of ITS facilities

The frequency of inspection for ITS facilities is adopted Expressway standard in Japan as followed Table 5.4.4-3.

Table 5.4.4-3 Frequency of Inspection of ITS facilities

Items	Frequency	Organization system
Vehicle Detection System	Once / year	1 party(2person) / time
Weight in Motion	Once / year	1 party(2person) / time
CCTV Camera system	Once / 6 months	1 party(2person) / time
Weather Observation system	Once / 6 months	1 party(2person) / time
Mobile Radio Communication System	Once / year	1 party(2person) / time
Variable Message Sign	Once / year	1 party(2person) / time
Traffic Control System	Once / 6 months	1 party(2person) / time
Toll Collection System (ETC)	Once / month Once / year	1 party(2person) / time

Source: JICA Study Team

(4) Improvement Works

Improvement works include improving pothole, land subsidence, rutting, planting and bridge slab, and replacement of joint.

(5) O&M Materials and Equipments

O&M Materials and Equipments, as shown Table 5.4.4-4, should be prepared to use quick repair as finding out by daily traffic patrol. These equipments keep in the storage at Maintenance Office and filling up all the time.

The cost is decided with reference of ”Consulting Services for Updating and Finalizing the Feasibility Study Report for Da Nang – Quang Ngnai Expressway Construction Project” by WB and interview results from F/S contractor.

Table 5.4.4-4 O&M Materials and Equipments

Items		規格
Temporary Regulation	Regulation Sign	No Basement
	Rubber cone	
Pavement Repair	Asphalt Mixture	20Kg
Prevention for disaster	Sandbag	48cm×62cm
	Sandy Soil	
	Polyethylene Sheet	#3000, 10m×10m
	Timber Stake	□4.5cm×60cm
	Pine Stake	φ15cm×150cm
Countermeasure of Traffic Accident	Oil Mat	100 seets
	Oil Adsorption Materials	Perlite

Source: The Prelimiary Survey

5.4.5. Traffic Patrol

The expressway becomes the structure to secure an efficient and comfortable traffic flow on the expressway by restricting entrance and exit of the tollgate. It is important to control traffic condition appropriately by collecting and offering traffic information. Service Standard of traffic patrol refers to Japanese expressways as shown Table 5.4.5-1.

Because of difference of rout of traffic patrol as opening phase 2, frequency and organization system of traffic patrol should be examined.

Table 5.4.5-1 Service Standard of Traffic Patrol

Items	Frequency	Organization System
Traffic Patrol	10 times / day	1 party (2 persons)/ 3 shift・24 hours

Source: The Preliminary Survey

5.4.6. Toll Collection

Toll collection System is divided into automatic collection system by ETC and manual collection system, which is manned collection type and prepaid type.

The introduction of the automatic collection system in heavy traffic contributes to the reduction of the expense of toll collection and to improve the tollgate traffic congestion.

However, it is necessary to consider construction and maintenance cost as introducing ETC system. Furthermore, toll collection system and toll table are should be update because of difference of the contents of toll collection between phase 1 and 2.

(1) Toll System

Toll system is divided into per-distance rate system and flat rate system as shown Table 5.4.6-1. Because this expressway is planned to connect with HCM- Long Tanh- Dau Giay expressway and Ben Luc- Long Than expressway, the appropriate toll system is the per-distance rate system. Therefore, integrating toll system should be coordinated with the other management companies.

Table 5.4.6-1 Comparison of toll system in Expressway

Categories	Contents	Note
Per-Distance Rate System	Per-Distance Rate System is a system in which a toll rate is calculated and collected depending on the distance between entry in an interchange and exit to another interchange. This system sum up overhead cost (terminal charge) and variable cost (the charge depending on distance).	
Flat Rate System	Flat Rate System sets a constant rate regardless of the mileage. Because it is a flat rate, rate receipt is easy. But the burden on short-range user grows big.	The degree of the short-range users is unidentified

Source: JICA Study Team

■Vehicle Classification

Although vehicle classification of toll system includes trailer, large freight car, standard car, compact car, toll system in this study is selected into 2 categories as large and standard car in terms of efficiency of toll collection.

■Type of Discount

There is discount system for users of large freight car and standard car in Japan. The discount system for large freight car is a system to pay on credit for each month. The mileage service for standard car is a system to have points using free of charge to improve service and usage. For the time being, the discount system is not adopted.

(2) Extent of Toll Charging

Closed Toll System: Tolls are charged to all users of the expressway. The toll road is physically designed so that no users may escape from paying the toll. Bike is banned on this expressway.

(3) Toll Collection Method

Toll gates on both exit and entrance: This arrangement is a system which installs tollgates on both sides of on-ramps and off-ramps. Generally, a ticket is issued for identification at the entrance, and payment of the toll charge at exit based on the information.

(4) Setting of Toll Collection Booth

Toll collection booth is set, as followed Table 5.4.6-2, including the section of phase 1 and phase 2. The number of toll collection booth should be reconsidered practically in the future in traffic volume and the processing capacity per hour of the ETC gate.
It is taken into account backup at the time of the facilities trouble in exit ETC lane.

Table 5.4.6-2 Toll Collection System Plan

Location		Contents
Toll Plaza on Main (2)	In (4)	ETC Gate : 2 lanes One-Stop Gate: 1 lane
Sta.1+200 Sta.65+250	Out (7)	ETC: 3 lanes One-Stop Gate: 3 lanes
Toll Plaza on Lamp (4) Sta.16+600	In (3)	ETC: 1 lane One-Stop Gate: 1 lane
Sta.29+500 Sta.45+250 Sta.53+700	Out (4)	ETC: 2 lane One-Stop Gate: 1 lane

Source: JICA Study Team

5.4.7. ITS System

The more traditional type of expressways normally has controlled access only at toll gates to maintain efficient and fast traffic flow. Therefore it is important to collect and provide traffic information using by ITS system.
ITS system is divided into 4 systems which are Data Collection System, Traffic Information Provision System, Traffic Control System and Toll Collection System as followed Table 5.4.7-1. Furthermore, those systems are delivered by optical fiber cable.

Table 5.4.7-1 ITS system Plan

Categories	Items	Location
Data Collection System	Emergency Telephone System	No install
	Traffic Volume Measuring System	Both sides for every interchange interval
	CCTV Camera System	One each at origin and destination One at every 2Km
	Weighing In Motion System	No install
	Weather Observation System	One at Maintenance Office
	Mobile Radio Communication System	65 sets
Traffic Information Provision System	Variable Message Sign	One each at merging section on Interchange and thruway
Traffic Control System		1 set
Toll Collection System		ETC method

Source: JICA Study Team

(1) Data Collection System

1) Emergency Telephone System

Emergency Telephone System is installed on shoulder to receive the report of traffic accident or road condition by driver

The spread of Mobile phones advances in the Vietnam, and further mobile phone diffusion rate is anticipated in the service five years later. Using mobile phone is the most useful to collect condition of traffic accident or other information, therefore Emergency Telephone System is not installed.

On the other hand, it is necessary to inform the accurate positional information and emergency telephone number to an expressway user.

It is effective to install kilometer post-indication (positional information) in the 100m pitch, and users communicate with operation center by mobile phone. It is called “road emergency dial" in Japan.

【 Reference】Emergency Telephone System of Other Expressways

Expressways	Contents
HCMC- Trung Luong Expressway	Not install
Japanese Expressways	Both sides for every 2 Km The mobile phone spread of Japan is 92%, and the future directionality is uncertain.

2) Traffic Volume Measuring System

Traffic Volume Measuring device is installed one each lane for every interchange section to collect traffic volume and velocity automatically, to estimate future traffic volume and to analyze traffic congestion and traffic accident.

In addition, the kind of traffic volume Measuring device is selected Loop coil installed in Vietnam national road (see Table 5.4.7-2).

When traffic volume increases in the future, it should be installed thruway, interchange and junction for much more data.

Table 5.4.7-2 Type of Traffic Volume Measuring System

Type	Ultrasonic	Loop Coil	CCTV Camera
Outline	Measure the size of the car, speed, number	Measure the size of the car, speed, number by Loop Coil in pavement	Recognized by the image analysis processing with the camera
Pros	・Cheep ・easy to maintain	・High accuracy	・easy to share surveillance camera ・many kind of function
Cons	・Low accuracy	・Need to road regulation for maintenance work	・Expensive ・Low accuracy
assessment	Δ	○	×

Source: JICA Study Team

3) CCTV Camera System

The CCTV camera installs in every 2 Km, one each at merging and branching section, and one each at origin-destination to be necessary to grasp the situation of a traffic congestion and the accident.

It should be used to monitor traffic condition in CCTV because it is not install a traffic measurement system in the 2km pitch at first

4) Wight In Motion System

Weight in Motion System is a vehicle weight measurement system to prevent the overloading such as large vehicles. Because many long bridges and consecutive viaducts do not exist in Phase1, this system is not installed at first.

It is desirable to install it when this system will be installed at Phase2.

The site (vacant land) necessary for facilities setting shall consider it more at first. Because it is predicted that a mixture rate of the large car is high in the future as an industrial road in this expressway.

This system should be installed wide lane in tollgate for large size vehicle in each tollgate, and an organization locates patrols measuring discovery and the weight of the overloading vehicle.

5) Weather Observation System

Weather Observation System is the system to observe precipitation and the wind velocity. Because there are few changes of the topography influencing the weather, this system is set in only the maintenance office.

6) Mobile Radio Communication System

Mobile Radio Communication System collects and provides the on-site information for an accident and the traffic jam in quickness and accuracy.

This system is set on the road management vehicles and a number of the maintenance officer as followed Table 5.4.7-3.

Table 5.4.7-3 Volume of Mobile Radio Communication System

Items	Volume	Remark
O&M vehicles	32	BVEC F/S
Maintenance officer	33	Final Report
Total	65	

Source: JICA Study Team

(2) Traffic Information Provision System

1) Variable Message Sign

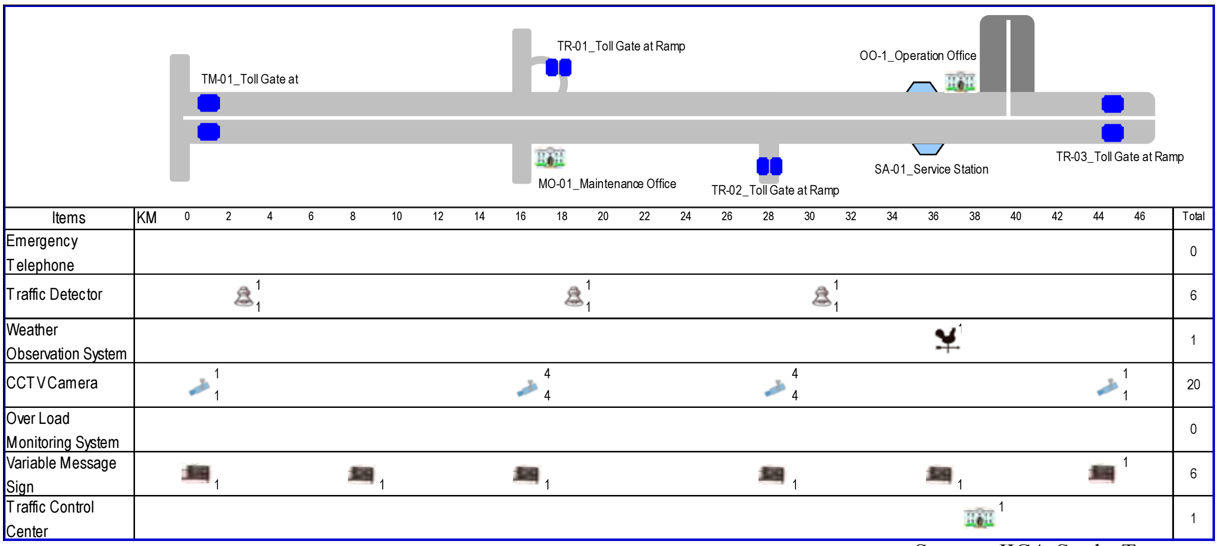
Variable Message Sign shares the information such as the regulation situation, traffic congestion, the traffic accident or the road-surface condition. This information obtains from CCTV camera, Traffic Volume Measuring System and Weather Observation System. Variable Message Sign is installed one each at merging section on Interchange, and tollgates at origin-destination of Phase1.

(3) Traffic Control System

The traffic control system manages unified traffic center processing collection system and offer system dealing with a member of collected phenomenon automatically including traffic congestion and the weather information. In addition, the operation center should be installed to perform central control. The traffic control system manages a collection and provision system as followed Figure 5.4.7.-1.

Because the networking with other routes is uncertain in the investigation, this system introduces independently. After networking of expressways, it is effective and important to integrate traffic information of these expressways.

Furthermore, it is planned by other routes installed a lot of CCTV cameras as acquisition means of the vehicle information, but it is necessary to examine initial and maintenance cost adequately.



Source: JICA Study Team

Figure 5.4.7-1 Traffic Control System

(4) Toll Collection System

Toll Collection System is divided into the manned collection method and the automated collection method. The manned collection method includes the one-stop type (toll collector provides ticket at entrance gate and receive toll at exit) and the non-stop type (toll collector check monthly ticket at the gate). The automated toll collection method (ETC) includes the OBU type and pre-paid IC card type.

The communication method of the ETC has active Dedicated Short Range Communication (hereinafter DSRC) method, passive DSRC method and an infrared Ray method. In the view of future traffic to increase, active DSRC should be introduced.

In addition to that, it is necessary to consider the jointly operative nature to be able to exchange information, because it is prevented from entailing enormous costs at the time of update

Table 5.4.7-4 Toll Collection System

Items	Contents
Location	Toll Plazas on Main: Sta.1+2000,Sta.65+250（15,090㎡） Toll Plazas on Lamp: Sta.16+6000, Sta.29+500,Sta. 45+250, Sta.53+700(14,350㎡)
Communication method	Active DSRC, Passive DSRC, infrared Ray method

Source: JICA Study Team

5.4.8. Annual Cost for O&M Works

An annual expense for O&M work is estimated as shown Table 5.4.8-1 and Table 5.4.8-2

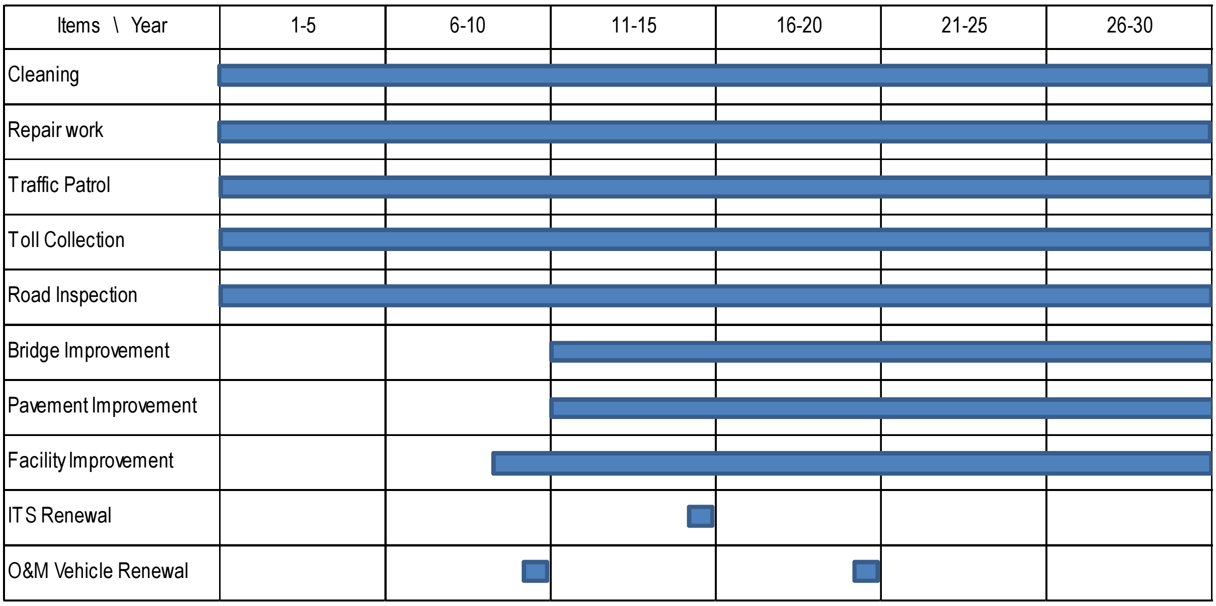
This report is not including urgent road repairrment and restoration work because of disaster, therefore it is need adjustment and agreement for grant with Vietnam government.

Table 5.4.8-1 Annual O&M Work and Cost Breakdown

Item			Labor Cost	Machine Fuel	Material Cost	Others
Patrol			○	○		
Toll Collection			○	○		
Cleaning	Expressway	Machine	○	○	○	
		Mannual	○	○	○	
	Drainage		○	○	○	
	IC/JCT		○	○	○	
	SA/PA		○	○	○	
Road Maintenance	Inspection	Routine	○	○		
		Periodic	○	○		
		Detailed	○	○		
		Vehicle	○		○	
	Repair	Pavement	○	○	○	
		Slope	○	○	○	
		Bridge	○	○	○	
	Improvement	Pavement	○	○	○	
		Slope	○	○	○	
		Bridge	○	○	○	
ITS facilities	Inspection	Routine	○	○		
		Periodic	○	○		
		Detailed	○	○		
		Vehicle	○		○	
	Repair	CCTV camera	○	○	○	
		ETC system	○	○	○	
		VMS	○	○	○	
	Improvement	CCTV camera	○	○	○	
		ETC system	○	○	○	
		VMS	○	○	○	
	Facility Maintenance (Utilities Cost)	Operation Center	○			○
		Maintenance Office	○			○
		Toll gate	○			○

Source: JICA Study Team

Table 5.4.8-2 Inspection, repairmen and improvement schedulel



Source: JICA Study Team

(1) Labor Cost

1) Amount Calculation

O&M activities on the BHVT Expressway will be conducted by an O&M Company, therefore unit cost for each work item is not prepared, instead, the number of workers in each class, from Company Director to site worker, is examined, and labor cost is calculated by applying unit labor cost for each class to the corresponding number of workers.

2) Unit Price

The unit price is decided with reference to the WB Report "Consulting Services for Updating and Finalizing the Feasibility Study Report for Da Nang-QuangNgnai Expressway Construction Project" and interview results from F/S contractor.

(2) Cost for Machine and Fuel

1) Amount Calculation

The ownership of any machine including vehicles required for each type of O&M work are with SPC, and the necessary costs during operation period be borne by the O&M company are only for fuel and insurance.

2) Unit Price

The unit price is decided with reference to the WB Report "Consulting Services for Updating and Finalizing the Feasibility Study Report for Da Nang-QuangNgnai Expressway Construction Project" and interview results from F/S contractor.

(3) Cost for Materials

1) Amount Calculation

The cost in the project is applied the unit material cost per Km in Japan and cost of vehicle maintenance, average cost per vehicle in Japan is applied as well.
Also, vehicle requires renewal, and the period of renewal should be 10 years. ITS facilities excluding power supply facility and optical fiber cable renew each 15 years.

2) Unit Price

The unit price is decided with reference to the WB Report "Consulting Services for Updating and Finalizing the Feasibility Study Report for Da Nang-QuangNgnai Expressway Construction Project" and interview results from F/S contractor.
Vehicles replace each 10 years depending on Vietnam condition. Furthermore the accident processing burden by unidentified causer of traffic accident is not include it for lack of data this time.

(4) Other Cost (heating, lighting, and water)

The Cost for heating, lighting and water are verified based on interview with F/S contractor.

5.5. Project Cost (Base cost of 2012 Price)

5.5.1. Documents / Information Received

Total investment cost is described in Chapter 17 of the F/S report. The latest F/S was that which was submitted to BVEC from the F/S Consultant (TEDI) in February 2012 when the JICA Study was started. After that, the revised F/S was prepared in October 2012 taking into considerations of design change of Long Thanh Junction (changes from overpass over HCM-Long Thanh – Dau Giay expressway to underpass) which was officially approved by MOT, and some designs such as shorten bridge lengths and application of PVD instead of Sand Drain proposed by JICA study team. In this revised F/S, the unit price of cost estimate was also updated to one as of the 2nd quarter of 2012 from the 4th quarter of 2011, and this is the latest F/S as of Interim Report.
The cost estimates of the above two F/S is summarized in Table 5.5.1-1 and 5.5.1-2, respectively. The cost of phase-1 covers the section beginning at Bien Hoa to Phu My intersection, and the access road from Phu My IC to NH51 intersection. Phase-2 cost includes the section from Phu My IC to the ending point at Vung Tau. Phase 1 has the widening cost from 4 lanes to 6 or 8 lanes.

Table 5.5.1-1 Project Cost in the BVEC F/S (Feb. 2012)

(unit: billion VND)

No.	Category	Description	Project Cost			
			Phase1		Phase 2	Total
			Initial (4-lane)	Widening (6,8-lane)		
I	Construction cost and Equipment cost	Construction and Equipment	7,358 (JPY27.5billion)	975 (JPY 3.6 billion)	6,946 (JPY 25.9 billion)	15,279 (JPY 57.0 billion)
II	Project Management, Consulting Services, Other Cost	-	883 (JPY 3.3 billion	117 (JPY 0.4 billion)	833 (JPY 3.1 billion)	1,833 (JPY 6.8 billion)
III	Contingency	Price Contingency 24.8%, Physical contingency 10%	2,868 (JPY 10.7 billion)	380 (JPY 1.4 billion)	2,707 (JPY 10.1 billion)	5,955 (JPY 22.2 billion)
IV	Land Acquisition and Resettlement	Incl. contingency of 10%	2,078 (JPY 7.8 billion)	0 (0)	865 (JPY 3.2 billion)	2,943 (JPY 11.0 billion)
Total (excl. interest during construction)			13,187 (JPY 49.2 billion)	1,472 (JPY 5.5 billion)	11,351 (JPY 42.4 billion)	26,010 (JPY 97.1 billion)

Note 1: time of cost estimate is the 4th of quarter of 2011

Note 2: exchange rate 1JPY=267.97VND (State bank of Vietnam on 30 Dec. 2011)

Source: BVEC F/S

Table 5.5.1-2 Project Cost in the BVEC F/S (October 2012)

(unit: billion VND)

No.	Category	Description	Project Cost			
			Phase1		Phase 2	Total
			Initial (4-lane)	Widening (6,8-lane)		
I	Construction cost and Equipment cost	Construction and Equipment	6,589 (JPY 25.1 billion)	986 (JPY 3.7 billion)	7,030 (JPY 26.7 billion)	14,605 (JPY 55.5 billion)
II	Project Management, Consulting Services, Other Cost	-	791 (JPY 3.0 billion)	117 (JPY 0.4 billion)	844 (JPY 3.2 billion)	1,751 (JPY 6.7 billion)
III	Contingency	Price Contingency 18%, Physical contingency 10%	2,066 (JPY 7.9 billion)	306 (JPY 1.2 billion)	2,205 (JPY 8.4 billion)	4,577 (JPY 17.4 billion)
IV	Land Acquisition and Resettlement	Incl. contingency of 10%	2,084 (JPY 7.9 billion)	0 (0)	865 (JPY 3.3 billion)	2,949 (JPY 11.2 billion)
Total (excl. interest during construction)			11,530 (JPY 43.8 billion)	1,409 (JPY 5.4 billion)	10,943 (JPY 41.6 billion)	23,882 (JPY 90.8 billion)

Note 1: time of cost estimate is the 2nd quarter of 2012

Note 2: exchange rate 1JPY=263.00VND (State bank of Vietnam on 29th June, 2012)

Source: BVEC F/S

The main reasons of change of the project cost in BVEC F/S are update of unit price (increase VND394billlion) and design change (decrease VND1,068billion), and the rate of price contingency is changed from 24.8% to 18%. The amount of change and its reason are summarized in Table 5.5.1-3.

Table 5.5.1-3 Comparison of the Project Cost of BVEC F/S between the 4th quarter of 2011 and the 2nd quarter of 2012

(unit: billion VND)

No.	Category	Dec. 2011 (4th quarter of 2011) <A>	Oct. 2012 (the 2nd quarter of 2012) <B>	Difference <B>-<A>	Mani reason of the difference
I	Construction cost and Equipment cost	15,279	14,605	-674	Update of unit price(price escalation):+394 Design change(Long Thanh JCT, shorten bridge, soft soil treatment):-1,068
II	Project Management, Consulting Services, Other Cost	1,833	1,751	-82	According to reduction of construction cost
III	Contingency	5,955	4,577	-1,378	The rate of price contingency from 24.8% to 18%
IV	Land Acquisition and Resettlement	2,943	2,949	+6	Slight increase due to design change
Total (excl. interest during construction)		26,010	23,882	-2,128	

Source: BVEC F/S

The cost estimate of the BVEC F/S is appropriately prepared in accordance with the Vietnam's law and regulations. In the JICA study, the project cost was reviewed and updated based on the proposed expressway route, section divisions, and implementation schedule and considering adaption of the BOT/PPP Scheme.

It is noted that the project cost (base cost as of 2012 price) here is excluded price contingency cost and interest during construction, and the project cost including such costs is described in chapter of financial analysis.

As for the project cost (base cost as of 2012 price) of phase 2 section where is assumed as implementation by ODA, it was preliminary reviewed and updated for economical and financial analysis for whole section of BHVT expressway. The result is referred to Chapter 6.1.2(2).

5.5.2. Law and Regulations on Cost Estimate

The main laws and regulations related to the estimate of construction cost is listed in Table 5.5.2-1. The JICA Study Team confirmed that the latest law and regulations were applied to the cost estimate of BVEC F/S.

Table 5.5.2-1 Related Law and Regulations

Item	Related Law and Regulations
Cost Estimate Standard	Circular No.04/2010/TT-BXD dated on 25 June 2010 issued by MOC
Norm of Construction Cost Estimate	Decision No.957/2009/QD-BXD dated on 29 September 2009 issued by MOC Decision No.1019/2010/QD-BXD dated on 16 November 2010 issued by MOC

Item	Related Law and Regulations
	Norm No.1776/2007/BXD-VP dated on 16 August 2007 issued by MOC Norm No.38/2005/QD-BXD and No.37/2005/QD-BXD dated on 2 November 2005 issued by MOC
Unit Cost	The unit cost of construction works of Dong Nai Province – Construction investigation component, construction component, installation component The unit cost of basic repair works of Dong Nai Province The tarifF/S of construction machines of Dong Nai Province The unit cost of construction works of Ba Ria-Vung Tau Province – Construction investigation component, construction component, installation component Land cost by all types in Dong Nai Province in 2012 Land cost by all types in Ba Ria〜Vung Tau Province in 2012 Material cost information in Dong Nai Province in 2012 Material cost information in Ba Ria〜Vung Tau Province in 2012

Source: BVEC F/S

5.5.3. Project Cost Structure for BOT/PPP Scheme

Basic structure of construction cost is based on Circular No.04/2010/TT-BXD. The cost structure is updated to conform and be consistent with a BOT/PPP Scheme. The proposed cost structure is as shown in Table 5.5.3-1.

In addition to the cost items in the Circular 04/2010/TT-BXD, the following cost items are considered in this study.

<u>Costs during construction stage:</u>

- HIV prevention program cost
- Environmental monitoring cost
- Feasibility study cost
- SPC establishment cost

<u>Costs during operational stage:</u>

- O&M cost
- SPC Operation cost
- Environmental monitoring cost

Table 5.5.3-1 Project Cost Structure

Cost Estimation Items			
A Construction Phase	1 Construction Cost		Sum{(1)~(5)}
		(1) Civil Work Cost	Sum{a)~b)}
		a) Expressway	Sum{1)~5)}
		1) Earth work	
		2) Soft soil treatment	
		3) Pavement	
		4) Road Facilities	
		5) Drainage	
		b) Structure	Sum{6)~7)}
		6) Bridges on the Expressway/Interchange	
		7) Overpass/Underpass	
		(2) O&M Work	Sum{1)~3)}
		1) Building Work	
		2) ITS, Electrical and Communication Facility Work	
		3) Initial O&M Equipment	
		(3) All Risk Insurance Premium	(1)+(2) *1.0%
		(4) HIV Prevention Program	(1)*0.1%
		(5) Environmental Monitoring	
	2 Engineering Cost		Sum{(6)~(8)}
		(6) Feasibility Study	
		(7) Detailed Design	1*4.0%
		(8) Procurement and Construction Supervision Service	1*3.0%
	3 SPC Establishment Cost	(9) Establishment and Initial SPC Operation	
	4 Contingency	(10) Price Contingency	Sum{(1)~(9)}*rate%
		(11) Physical Contingency	Sum{(1)~(10)}*10%
	5 Value Added Tax(VAT)	(12) Value Added Tax(VAT)	Sum{(1)~(11)}*10%
	6 Project Management Cost	(13) Project Management	1*0.356%
	7 Other Cost	(14) Others	1*4.0%
	8 Land Acquisition/ Compensation Cost	(15) Land Acquisition/Compensation	
	9 Contingency	(16) Price Contingency	Sum{(13)~(15)}*rate%
		(17) Physical Contingency	Sum{(13)~(16)}*10%
B Operation Phase	10 O&M Cost	(18) Operation and maintenance cost	
	11 SPC Operation Cost	(19) SPC Operation	
	12 Environmental Monitoring	(20) Environmental Monitoring during concession	
	13 Contingency	(21) Price Contingency	Sum{(18)~(20)}*rate%
		(22) Physical Contingency	Sum{(18)~(21)}*10%
	14 Value Added Tax(VAT)	(23) Value Added Tax(VAT)	Sum{{(18)~(22)}*10%

Source: JICA Study Team

5.5.4. Methodology of Cost Estimate

(1) Construction Cost

According to the Circular 04/2010/TT-BXD, cost-based estimate is basically applied as the methodology. The basic methodology for cost estimate in this study is based on the general unit cost (GUC). The GUC consists of direct cost (material, labor, and equipment), other direct costs, and indirect costs. Construction cost is computed based on the GUC and the estimated quantity.
For other items relating to the construction cost, all risk insurance premium is considered at 1.0% of construction cost. In addition, the costs for update of Environmantal Assessment (hereinafter EA)/Environmental Management Plan (hereinafter EMP), preparation of RAP, environmental monitoring, and internal and external monitoring for land acquisition/resettlement are estimated.

(2) Engineering Cost

Detailed design cost and construction supervision cost are estimated at 4.0% and 3.0% of construction cost, respectively. In addition, actual cost of F/S by BVEC is considered.

(3) Establishment Cost of SPC

Under the BOT/PPP Scheme, Investor's due diligence cost, SPC advisory cost (legal, financial) are estimated at approximately VND 137.5billion as table below. This cost is required for only phase 1 section where is assumed as the BOT/PPP scheme.

Table 5.5.4-1 SPC Establishment Cost

	Item	Cost (million VND)
i)	Legal fees for BOT and Loan/collateral agreements.	55,000
ii)	Financial Advisory fees for Project Implementation Plan, cashflow projection and negotiation with banks	27,500
iii)	Office rent	8,250
iv)	Personnel expenses	13,750
v)	Corporate registration fee	8,250
vi)	General consultation fees in relation to the Project	8,250
vii)	Inauguration and promotion fees	11,000
viii)	Other expenses	5,500
	Total	137,500

Source: JICA Study Team

(4) Project Management Cost and Other Cost

Project management cost and other costs (disarming of UXOs, audit, appraisal etc.) incurred during construction stage are estimated based on Circular No.04/2010/TT-BXD.

(5) Land acquisition and Compensation Cost

The cost with the conditions of the land acquisition and resettlement is described in section 7.2.11.

(6) O&M Cost

Operation and maintenance cost for toll collection and road maintenance etc, is described in section 5.5.7.

(7) SPC Operation Cost

Operation cost of SPC is described in section 5.5.7.

(8) Environmental Monitoring Cost

Environmental monitoring cost during operation is described in section 5.5.7.

5.5.5. Conditions of Construction Cost Estimate

(1) Time reference of Cost Estimate

The unit price of the cost estimate is as of the 2nd quarter of 2012.

(2) Currency

Since the financing for the project is assumed to be sourced from PSIF, JPY is used for the foreign currency and VND is used for local currency.

(3) Exchange Rate

Following exchange rates are used (29th June 2012 at State Bank of Vietnam):

1 JPY = 263.00VND

1 US$ = 20,943VND = 79.63 JPY

(4) Classification Condition of Currency

Table 5.5.5-1 shows the classification condition of currency in this Study

Table 5.5.5-1 Classification Condition of Currency

Item	Classification
A. Construction Stage	
1 Construction Cost	
(1) Civil Work Cost	Divided into F/C and L/C taking accounts of procurement of Labour, material and equipment
(2) Equipment Cost	Divided into F/C and L/C taking accounts of procurement of Labour, material and equipment
(3) All Risk Insurance Premium	F/C assuming insurance at contractor's home country
(4) HIV Prevention Program Cost	Divided into F/C and L/C based on assumption of employment of international NGO
(5) Environmental Monitoring Cost	L/C cost
2 Engineering Cost	
(6) Feasibility Study Cost	L/C cost
(7) Detailed Design Cost	Divided into F/S and L/C assuming procurement of international consultant
(8) Construction Supervision Cost	Divided into F/S and L/C assuming procurement of international consultant
3 SPC Establishment Cost	
(9) SPC Establishment Cost	Divided into F/C and L/C taking accounts of SPC jointed by Japanese and Local Investors
4 Contingency	
(10) Price Contingency for items (1) - (9)	according to classification of items (1)-(9)
(11) Physical Contingency for items (1) - (10)	according to classification of items (1)-(10)
5 Value Added Tax for items (1) - (11)	
(12) Value Added Tax	according to classification of items (1)-(11)
6 Project Management Cost	
(13) Project Management Cost	L/C cost
7 Other Cost	
(14) Other Cost	L/C cost
8 Land Acquisition and Resettlement	
(15) Land Acquisition and Resettlement	L/C cost
9	
(16) Price Contingency for items (13) - (15)	according to classification of items (13) - (15)
(17) Physical Contingency for items (13) - (16)	according to classification of items (13) - (16)
B. Operation Stage	
10 Operation and Maintenance Cost	
(18) Operation and Maintenance Cost	Divided into F/C and L/C
11 SPC Operation Cost	
(19) SPC Operation Cost	Divided into F/C and L/C
12 Environmental Monitoring Cost	
(20) Environmental Monitoring Cost	L/C cost
13 Contingency for (18) - (20)	
(21) Price Contingency for (18) - (20)	according to classification of items (18) - (20)
(22) Physical Contingency for (18) - (21)	according to classification of items (18) - (21)
14 Value Added Tax for (18)-(22)	
(23) Value Added Tax	according to classification of items (18)-(22)

Source: JICA Study Team

(5) Price Escalation Rate

Price escalation rate is described in Section 3.4.2(3)7).

(6) Physical Contingency Rate

Physical contingency rate applied is same 10% as that of BVEC F/S.

(7) Value Added Tax (VAT)

VAT 10% is taxed on local currency portion. For foreign currency portion, however, 10% of taxes is considered because of other taxes such as import tax.

(8) Value of Estimated Cost

The project cost (base cost of 2012 price) is estimated by the 2012 present value. The project cost that considers the future escalation is summarized in Section 3.4.2(3)4)b).

5.5.6. Updated Project Cost (Base Cost of 2012 Price) at Preparation and Construction Stage

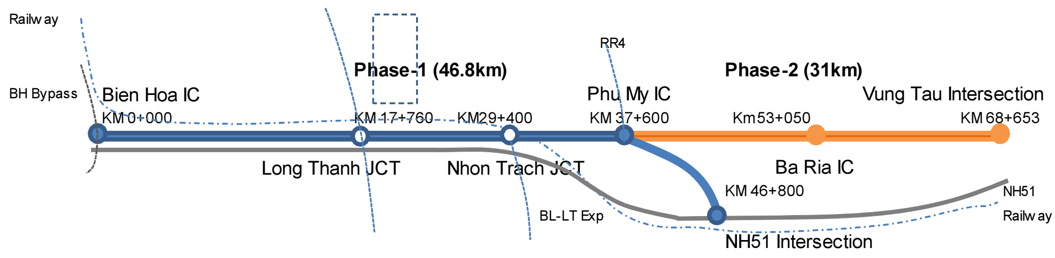
(1) Project Cost(Base Cost of 2012 Price)

Project Cost(Base Cost of 2012 Price) at Preparation and Construction Stage is shown in Table 5.5.6-1 and the cost by sections is summarized in Figure 5.5.6-1.

Table 5.5.6-1 Project Cost（Base Cost of 2012 Price）

Item	Phase-1 (initial stage only)		
	FC Portion (million JPY)	LC Portion (billion VND)	Combined into VND (billion VND)
Project Cost (Base Cost 2012 Price)	**6,357.8**	**8,846.5**	**10,518.6**
1. Construction Cost	**4,197.1**	**4,698.1**	**5,802.0**
(1) Civil Work Cost	**3,188.2**	**4,357.7**	**5,196.2**
1) Earth work	257.6	609.8	677.6
2) Soft soil treatment	10.4	24.6	27.4
3) Pavement	688.3	1,629.2	1,810.2
4) Drainage	46.4	109.9	122.1
5) Road Facilities	718.4	440.9	629.8
6) Bridges on the Expressway/Interchange	1,127.0	1,185.6	1,482.0
7) Overpass/Underpass	340.0	357.6	447.0
(2) O&M Work	**963.5**	**275.3**	**528.7**
1) Building Work	98.9	234.1	260.1
2) Electrical and Communication Facility Work	436.2	28.7	143.4
3) Initial O&M Equipment	428.3	12.5	125.2
(3) All Risk Insurance Premium	41.5	46.3	57.2
(4) HIV Prevention Program	4.0	4.2	5.2
(5) Environmental Monitoring	0.0	14.7	14.7
2. Engineering Cost	**772.1**	**217.8**	**420.9**
(6) Feasibility Study	0.0	14.8	14.8
(7) Detailed Design	441.2	116.0	232.1
(8) Procurement and Construction Supervision Service	330.9	87.0	174.1
3. SPC Establishment Cost	**285.2**	**50.0**	**125.0**
(9) Establishment and Initial SPC Operation	285.2	50.0	125.0
4. Contingency	**525.4**	**496.6**	**634.8**
(10) Price Contingency of item (1)-(9)	0.0	0.0	0.0
(11) Physical Contingency of item (1)-(10)	525.4	496.6	634.8
5. Value Added Tax (VAT) on item (1)-(11)	**578.0**	**546.3**	**698.3**
(12) Value Added Tax (VAT)	578.0	546.3	698.3
6. Project Management Cost	**0.0**	**22.7**	**22.7**
(13) Project Management	0.0	22.7	22.7
7. Others	**0.0**	**331.4**	**331.4**
(14) Others (audit, appraisal cost etc)	0.0	331.4	331.4
Others (Disarming mine & UXOs)	0.0	0.0	0.0
8. Land Acquisition/Compensation Cost	**0.0**	**2,225.5**	**2,225.5**
(15) Land Acquisition/Compensation	0.0	2,225.5	2,225.5
9. Contingency	**0.0**	**258.0**	**258.0**
(16) Price Contingency of item (13)-(15)	0.0	0.0	0.0
(17) Physical Contingency of item (13)-(16)	0.0	258.0	258.0

Source: JICA Study Team



Unit:billion VND

Phase	Phase-1				Phase-2		
Section	BH-LT	LT-NT	NH-PM	PM-NH51	PM-BR	BR-VT	Total
Project Cost by Section	3,730	2,637	2,403	1,748	2,590	6,643	19,751
Project Cost by Phase	10,518				9,233		19,751

Note: - Not included widening cost, price contingency, loan interest
- 1JPY=263VND State Bank of Vietnam at end of June 2012

(for reference) Unit:million JPY

Section	BH-LT	LT-NT	NH-PM	PM-NH51	PM-BR	BR-VT	Total
Project Cost by Section	14,183	10,027	9,137	6,646	9,848	25,259	75,099
Project Cost by Phase	39,992				35,106		75,099

Note: Details of phase-2 cost is referred to section 6.1.3.

Source: JICA StudyTeam

Figure 5.5.6-1 Project Cost（Base Cost of 2012 Price）by Sections

(2) Annual Disbursement Schedule

Annual disbursement schedule is shown in Table 5.5.6-2. Annual fund requirement is estimated based on the construction schedule as shown in Section 5.3.4.

Table 5.5.6-2 Annual Disbursement Schedule

Phase1	2014		2015		2016		2017		2018		2019	
	F/C (million JPY)	L/C (billion VND)	F/C (million JPY)	L/C (billion VND)	F/C (million JPY)	L/C (billion VND)	F/C (million JPY)	L/C (billion VND)	F/C (million JPY)	L/C (billion VND)	F/C (million JPY)	L/C (billion VND)
Amount	0.0	428	579	998	147	906	756	931	1,113	1,278	2,659	2,771

Note: excl. contingency(price& physical) , VAT, IDC

Source: JICA Study Team

(3) Comparison with the BVEC F/S

Project cost of Phase 1 in this study is estimated at VND10,518 billion compared with VND10,410 billion (excluding price escalation) in the BVEC F/S. There is only 1.0% increase comparing with the cost from BVEC F/S. The main reasons of the increased cost are due to SPC establishment cost and land acquisition/Resettlement cost. Table5.5.6-3 summarizes the comparison of the cost with BVEC F/S and reasons of change.

Table 5.5.6-3 Comparison of Project Cost between JICA Study and BVEC F/S

(unit: billion VND)

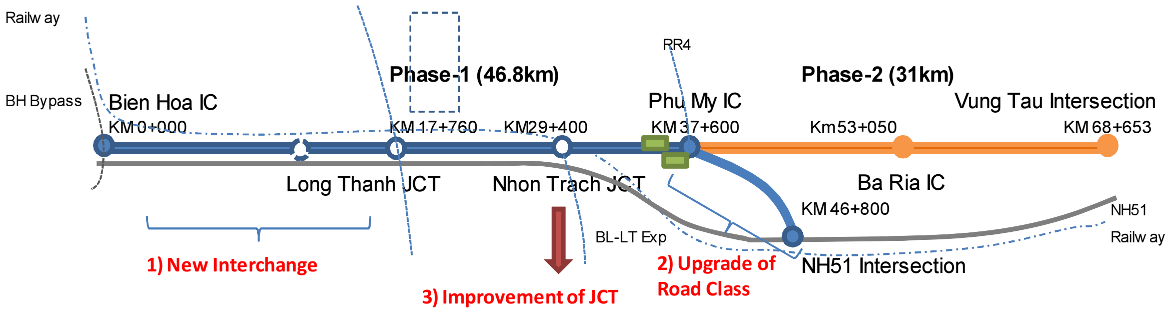
No.	Item	BVEC F/S (2012 Q2) <A>	JICA Study (2012 Q2) <B>	Difference <B>-<A>	Main reason of Difference
I	Construction and Equipment Cost	6,589	6,382	-207	(+)addition of All Risk Insurance Premium、HIV prevention program、Environmental monitoring (-)Optimization of ITS System
II	Project Management, Engineering, Other costs	791	955	164	(+)Addition of SPC establishment cost、BVEC F/S cost
III	Physical Contingency	946	956	164	
IV	Land Acquisition/Resettlement	2,084	2,226	332	(+)update of unit price (application of market price)
	Total	10,410	10,518	317	

Note: the cost of 2012 price excl. price contingency

Source: JICA Study Team

(4) Cost of Option of Proposed Designs

The cost including land acquisition/resettlement for proposed design changes on plan/design of the expressway as mentioned in section 5.2.14 is shown in Figure 5.5.6-2.



No.	Options of Design Change	Project Cost (billion VND)
1)	Additional Interchange between Bien Hoa IC and Long Thanh JCT (Long Duc IC)	+254.3
2)	Upgrading road classification for section of Phu My IC - NH51 Intersection	+50.3
3)	Temporary IC (in case of delay of Ben Luc - Long Thanh Expressway Project) - half diamond type connecting with local road - partial trumpet type connecting with NH51	 +109.8 +230.0

Source: JICA Study Team

Figure 5.5.6-2 Cost of Proposed Design Changes

5.5.7. Updated Project Cost (Base Cost of 2012 Price) at Operation Stage

(1) Operation and Maintenance Cost

O&M cost is estimated based on the O&M plan mentioned in Section 5.4.8, and the result of the cost estimate is shown in Table 5.5.7-1. O&M cost is accumulated at VND2,600billion during 30 years of operation phase.

Table 5.5.7-1 O&M Cost

<< Phase1 >> Unit: Million VND

Year	Labor	Material Cost				Vehicle Maintenance	Machine Cost				Electricity & Water	Consumable Equipment	ITS Renewal	O&M Vehicle Renewal	Total
		Opeaning & Repair	Bridge Improvement	Pavement Improvement	Facility Improvement		Patrol, Inspection, Opeaning & Repair	Bridge Improvement	Pavement Improvement	Facility Improvement					
2017	11,285	656				4,981	3,404				29,104	177			49,607
2018	11,285	656				4,981	3,404				29,104	177			49,607
2019	11,285	656				4,981	3,404				29,104	177			49,607
2020	11,285	656				4,981	3,404				29,104	177			49,607
2021	11,285	656				4,981	3,404				29,104	177			49,607
2022	11,285	656				4,981	3,404				29,104	177			49,607
2023	11,285	656				4,981	3,404				29,104	177			49,607
2024	11,285	656				4,981	3,404				29,104	177			49,607
2025	11,285	656			4,501	4,981	3,404			237	29,104	177			54,345
2026	11,285	656			4,501	4,981	3,404			237	29,104	177			54,345
2027	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177		160,124	246,086
2028	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2029	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2030	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2031	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177	54,743		140,706
2032	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2033	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2034	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2035	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2036	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2037	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177		160,124	246,086
2038	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2039	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2040	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2041	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2042	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2043	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2044	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2045	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
2046	11,285	656	7,149	18,718	4,501	4,981	3,404	5,365	386	237	29,104	177			85,963
														Total	2,599,790
														Km Cost	1,852

Note: the Cost is as of 2012 price

Source: JICA Study Team

(2) SPC OperationCost

The annual operation cost of SPC after traffic open is estimated at VND 49 billion including personnel expense, rental office, car operation cost etc.

(3) Environmental Monitoring Cost

The annual cost of Environmental monitoring is estimated at VND910 million. The environmental monitoring will be carried out only two years after start of operation of the expressway.