HO CHI MINH CITY PEOPLE'S COMMITTEE
SOCIALIST REPUBLIC OF VIETNAM

DATA COLLECTION SURVEY ON FLOOD CONTROL BY INSTALLING INTERCEPTORS AND PRIVATE FINANCE VIABILITY FOR SEWAGE AND FLOOD CONTROL IN VIETNAM

FINAL REPORT

FEBRUARY 2019

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
NIHON SUIDO CONSULTANTS CO., LTD.

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Abbreviation

BT	:	Build and Transfer
CDM	:	Cement Deep Mixing
EIA	:	Environmental Impact Assessment
EIRR	:	Economic Internal Rate of Return
FIRR	:	Financial Internal Rate of Return
F/S	:	Feasibility Study
GDP	:	Gross Domestic Product
HCMC	:	Ho Chi Minh City
HCMCPC	:	Ho Chi Minh City People's Committee
ICB	:	International Competitive Bidding
JICA	:	Japan International Cooperation Agency
JPY	:	Japanese Yen
JST	:	JICA Study Team
LCB	:	Local Competitive Bidding
LUR	:	Land Use Right
MARD	:	Ministry of Agriculture and Rural Development
METI	:	Ministry of Economy, Trade and Industry
MOC	:	Ministry of Construction
MOF	:	Ministry of Finance
MONRE	:	Ministry of Natural Resource and Environment
MOPI	:	Ministry of Planning and Investment
ODA	:	Official Development Assistance
O&M	:	Operation and Maintenance
PC	:	Pre-stressed Concrete
PHC	:	Pre-stressed High-strength Concrete
PPP	:	Public Private Partnership
PS	:	Pumping Station
PVD	:	Prefabricated Vertical Drain
RC	:	Reinforced Concrete
SD	:	Sand Drain
SPC	:	Special Purpose Company
The F/S	:	F/S report for Xuyen Tam Canal Project
UCCI	:	Urban Civil Works Construction Investment Management Authority
USD	:	United State Dollars
VGF	:	Viability Gap Funding
VND	:	Vietnam Dong
WEIP I	:	Water Environment Improvement Project Phase I
WEIP II	:	Water Environment Improvement Project Phase II
WEIP III	:	Water Environment Improvement Project Phase III
WWTP	:	Wastewater Treatment Plant

CHAPTER 1 INTRODUCTION

1.1 Background

The sewerage coverage ratio of urban areas in Vietnam was only about 16% in 2012, although a targeted sewerage coverage for 2025 is set at 70 - 80% for urban area in Vietnam through Decision No.1930/QD-TTg of November 20th, 2009, approving orientations for the development of water drainage in Vietnamese urban centers and industrial parks until 2025, with a vision towards 2050.

There are projects being carried out aimed to reinforce the sewer system including Water Environment Improvement Project Phase II (hereinafter called "WEIP II") funded by Japan International Cooperation Agency (hereinafter called "JICA"), which includes an expansion of a wastewater treatment plant and pipe construction, and a sewer system construction project funded by World Bank (hereinafter called "WB"). However, these projects have covered the center of Ho Chi Minh City (hereinafter called "HCMC") only. Currently, Water Environment Improvement Project Phase III (hereinafter called "WEIP III") is under consideration and when implemented the know-how obtained and lessened from previous projects should be reflected to the implementation of a new sewer system project. And it is expected that the implementation of the WEIP III would become one of the precedents for the realization of the Decision No.1930/QD-TTg.

On the other hand, the amount of foreign debt is approaching the upper limit of 65% against GDP as confirmed by the National Assembly. Therefore the government of Vietnam will not approve the provincial authority to borrow all project costs from ODA fund. Instead, the government of Vietnam decided that the implementation organization should bear a part of the ODA project cost. A subject rate of the HCMC has been set at 80%.

Considering this condition, HCMC decided to combine an ODA loan and private investment, and to apply it for the WEIP III in order to increase the possible adoption of the project by the government of Vietnam.

A Build-Transfer project (hereinafter called "BT project") has been proposed by an investor and the project will be implemented in the near future. The project scheme and method is considered as one of the most appropriate methods for constructing a sewer system by using private investment. The BT project improves the canal capacity and also includes construction of basic infrastructure such as sewer pipes and roads by private investment. The investor will receive the development rights for the land around the improved canals, in turn, for the cost to develop the infrastructures.

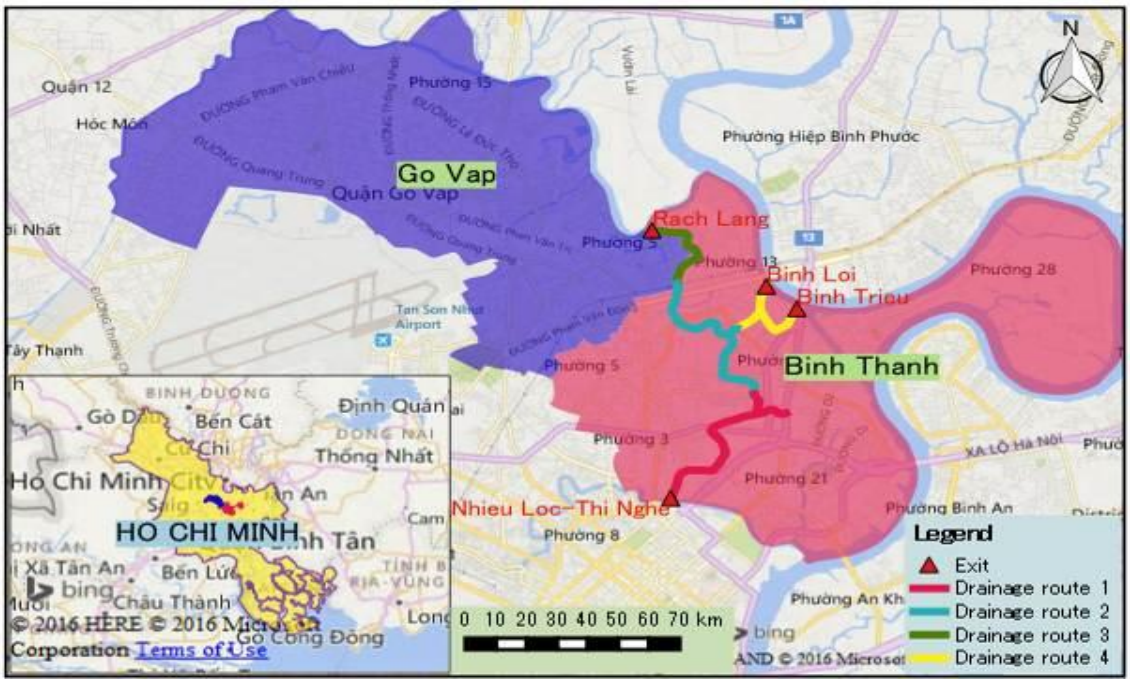
This Survey will: study the F/S for the BT project and confirm the feasibility of applying the BT project method to a sewer system construction project to be carried out under the WEIP III.

1.2 Objective

The survey objective is to formulate a preliminary sewer pipe plan for the WEIP III at District 7. In addition, the JICA study team will conduct a study of feasibility of BT scheme application for the sewer system construction project to be carried out under the WEIP III.

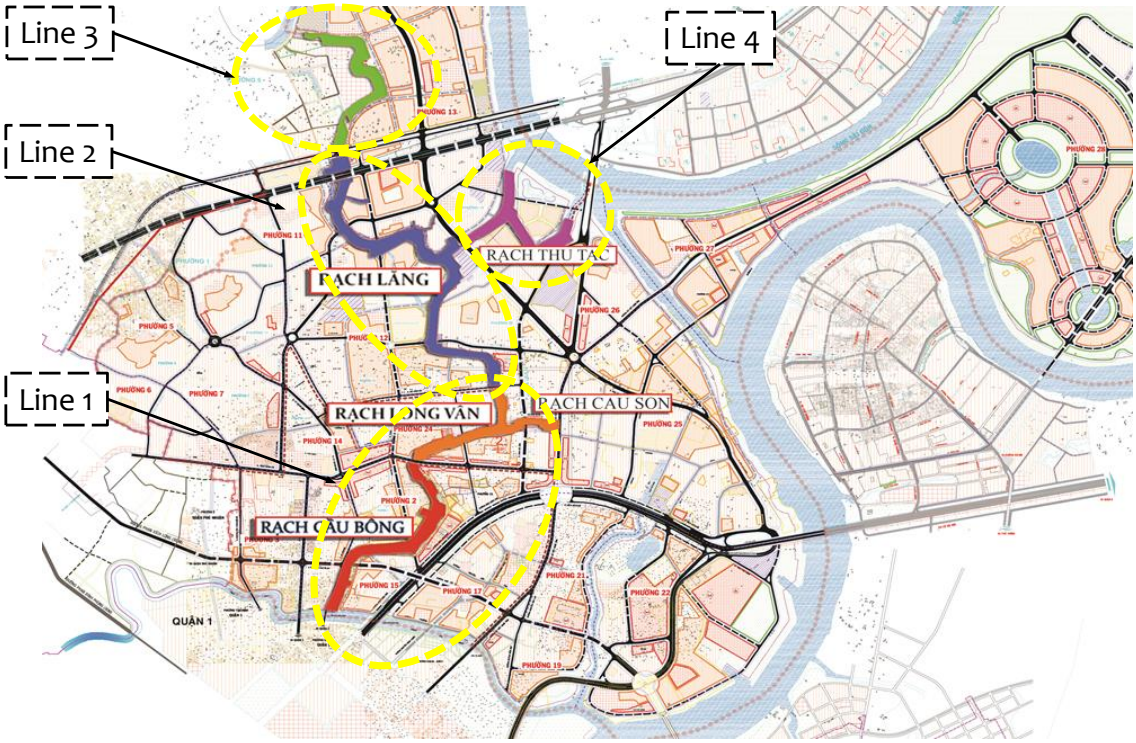
1.3 Survey Area

The area of the BT project is shown in Figure 1.3-1 and Figure 1.3-2, and the area of the WEIP III is shown in Figure 1.3-3.



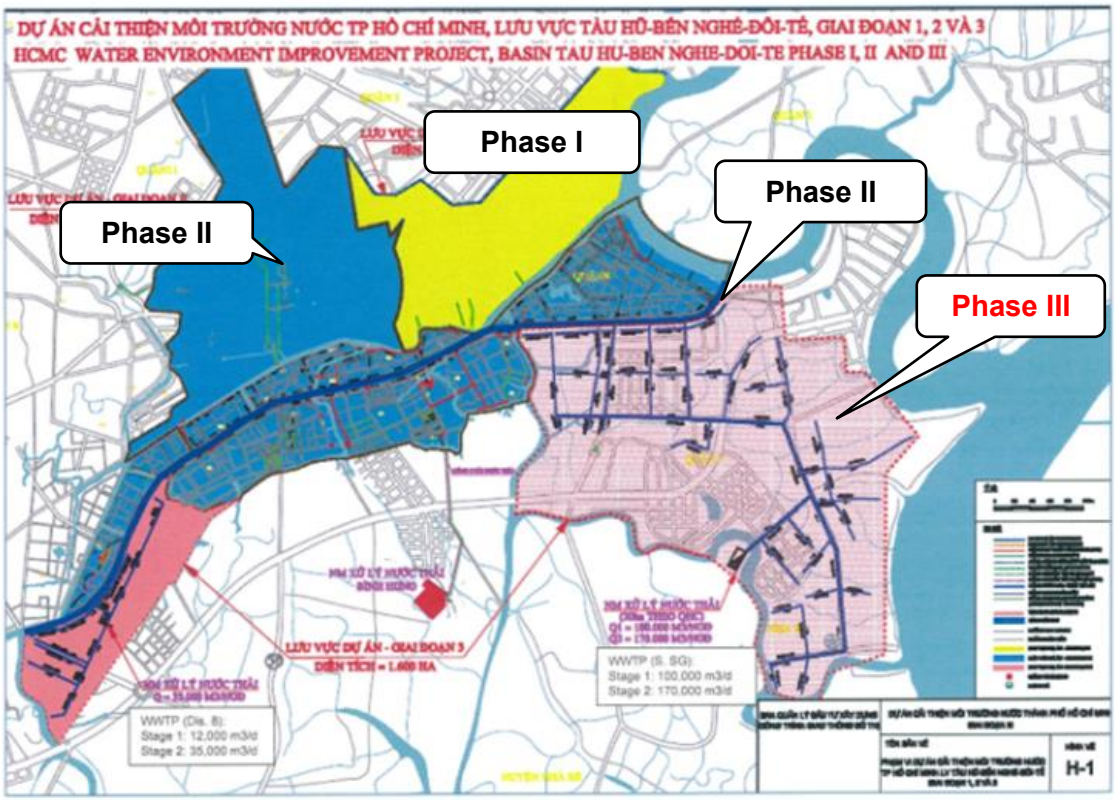
Source: F/S report for Xuyen Tam Canal Project

Figure 1.3-1 Area of the BT Project (1) (Xuyen Tam Canal Project)



Source: F/S report for Xuyen Tam Canal Project

Figure 1.3-2 Area of the BT Project (2) (Xuyen Tam Canal Project)



Source: Pre-F/S for Ho Chi Minh City Water Environment Improvement Project, Phase III

Figure 1.3-3 Area of the WEIP III (District 7 Sewer System)

[Review of the F/S]

CHAPTER 2 OUTLINE OF THE F/S

2.1 Basic Information of the Project

Basic information of the project is shown in Table 2.1-1. Hereinafter, F/S of the project is called "the F/S".

Table 2.1-1 Basic Information of the Project

Item	Information
Name of Project	- Project on dredging, environmental rehabilitation, infrastructure construction and exploitation of land along Xuyen Tam canal (from Nhieu Loc Thi Nghe canal to Vam Thuat river), Binh Thanh and Go Vap districts in the form of BT contract
Organizations of implementation	- Competent State Authority; The People's Committee of Ho Chi Minh City
Location and Scope	- Binh Thanh District and Go Vap District, Ho Chi Minh City - Including the main route of 6.3 km long with the starting point from Nhieu Loc Thi Nghe canal to the end point intersecting with Vam Thuat river and 3 branch routes of 1.5 km (including Son bridge, Binh Trieu bridge and Binh Loi bridge). - Focusing on dredging and renovating canals, constructing four-lane traffic routes on both sides of the canal and on reinforced concrete structures; constructing a sewage collection system connected to the sewage collection system of the city. - Land cleared on both sides of the canal is planned into residential areas, offices and urban works.
Type of project contract	- Investment in the form of PPP, type BT contract. - Investor mobilizes capital to implement the project, return of the capital is generated from the project in the form of implementing other projects on the basis of land funds granted by the city.
Financial Plan	- The financial plan was built on the basis of a total investment of 8,465 billion VND, of which no state capital was used in the project. - The project investor mobilizes capital for the construction of the project and receives the value of land use fees of the corresponding land areas in the city from the People's Committee of Ho Chi Minh City by the BT project contract. - Investor invests other projects in the above land to recover the investment capital for BT project.
Duration of the project contract	- Project implementation period is from 2017 to 2025.

Source: F/S report for Xuyen Tam Canal Project

Image of developed structures along the canal are shown in Figure 2.1-1, Figure 2.1-2 and Figure 2.1-3.

Source: F/S report for Xuyen Tam Canal Project

Figure 2.1-1 Image of Developed BOX Culverts and Open Ditch

Source: F/S report for Xuyen Tam Canal Project

Figure 2.1-2 Image of Developed Reinforced Concrete Floor

Source: F/S report for Xuyen Tam Canal Project

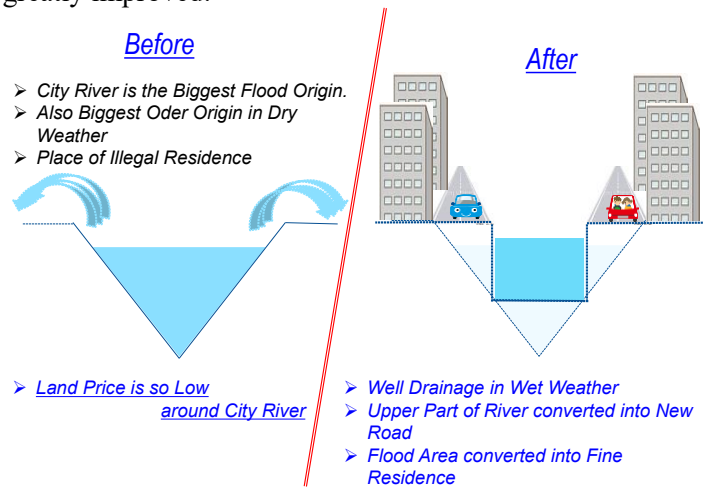
Figure 2.1-3 Image of Developed Pre-stress Reinforced Concrete Sheet Pile

2.2 Outline of the Project Scheme

2.2.1 Concept of Urban Flood Mitigation and Real Estate

The developing concept of urban flood mitigation and real estate is shown in Figure 2.2-1. The project canal is one of the worst flood prone areas in HCMC. Moreover, there are many illegal residents/dwellings with unsuitable sewer systems. Therefore, the water quality of the canal is extremely poor and it is also the cause of bad odor.

By developing the area, the flood condition will improve and at the same time, the quality of living environment will be greatly improved.

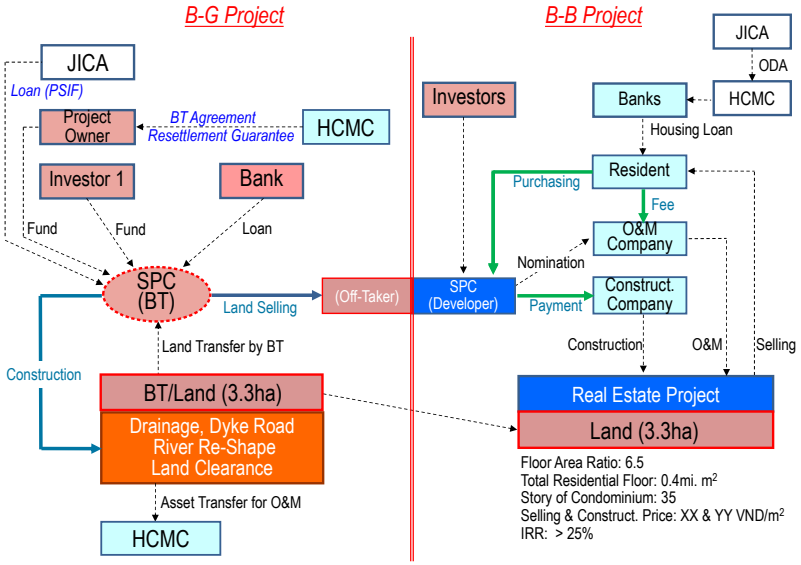


Source: presentation material by JICA for Open Call for Investment in Projects for the Rehabilitation of the Canal Region and Urban Renewal in Ho Chi Minh City, on February 01, 2018

Figure 2.2-1 Concept of Urban Flood Mitigation and Real Estate

2.2.2 Urban Flood Mitigation by PPP/BT Scheme

The PPP/BT scheme is shown in Figure 2.2-2. Development and improvement of the area will be achieved by private investment, without relying on public funds from the city budget, by applying the PPP/BT scheme.



Source: presentation material by JICA for Open Call for Investment in Projects for the Rehabilitation of the Canal Region and Urban Renewal in Ho Chi Minh City, on February 01, 2018

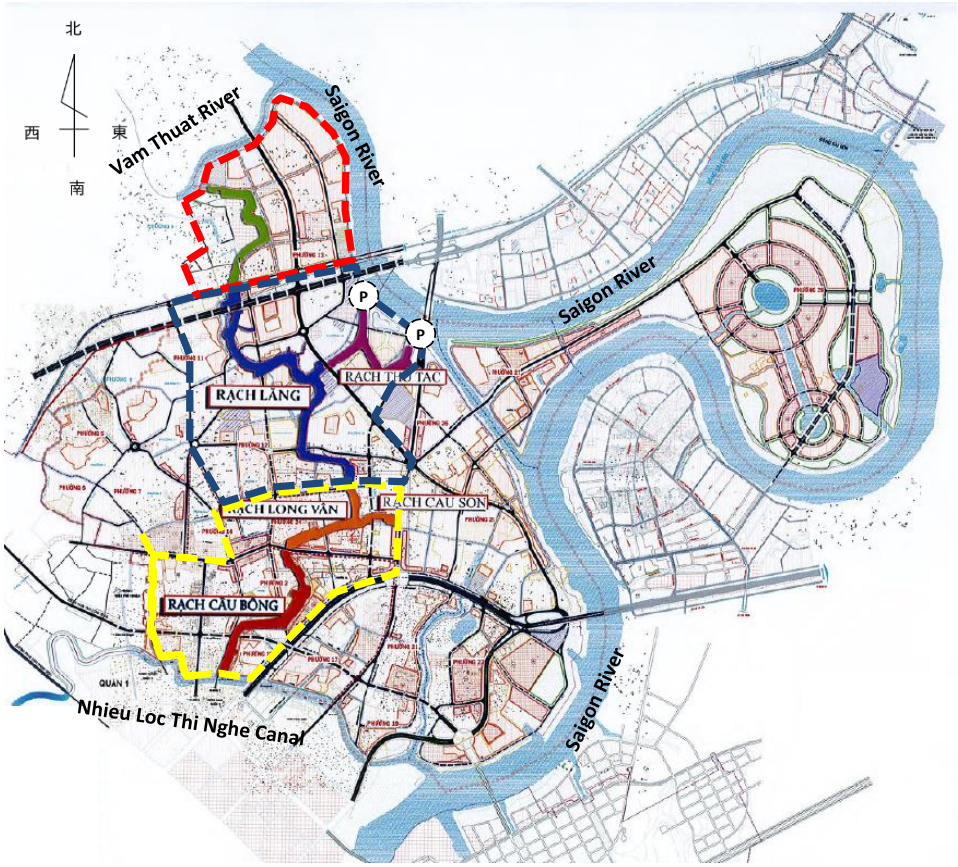
Figure 2.2-2 Scheme Image by PPP/BT Project

By this scheme, the special purpose company (hereinafter called “SPC”) of BT project on the left side of the scheme in Figure 2.2-2 will implement the improvement of canal conditions and the construction of infrastructure, like roads, bridges, water supply pipe, sewer pipe, drainage pipe, lighting and other necessary infrastructures. The SPC will get the development right of land along the improved canal as a payment and will transfer the infrastructures to public authorities. After getting the development right, the SPC will sell this right to other companies and get a profit.
SPC on the right side of scheme in Figure 2.2-2 will buy the land or development right from the SPC of BT project and construct buildings for office, commercial and residence. Then the SPC would get a profit by selling or rent these buildings to other companies or citizens.

2.3 Outline of Project

2.3.1 Outline of Improving Water Drainage Canal

A solution for the arrangement of rainwater drainage system was studied on the F/S report. The drainage capacity was calculated by using Autodesk Storm and Sanitary Analysis software 2017 which can analyze and design urban drainage systems, rainwater drainage system, sewer drainage system. The software can simulate completely the hydrological, hydraulic power and water quality in urban drainage systems.
Drainage system for the area is simulated by calculating the most disadvantage case, which when a heavy rain occurs simultaneously with rise of tide. As a result, in order to ensure the drainage to be satisfied, an installation of new pumps with a total capacity of 100,000 m^3/hr at Binh Loi gate and a total capacity of 60,000 m^3/hr at Binh Trieu gate was proposed in addition to the existing Rach Lang Pump Station with a total capacity of 60,000 m^3/hr.
The proposed locations of pump stations are shown in the Figure 2.3-1.

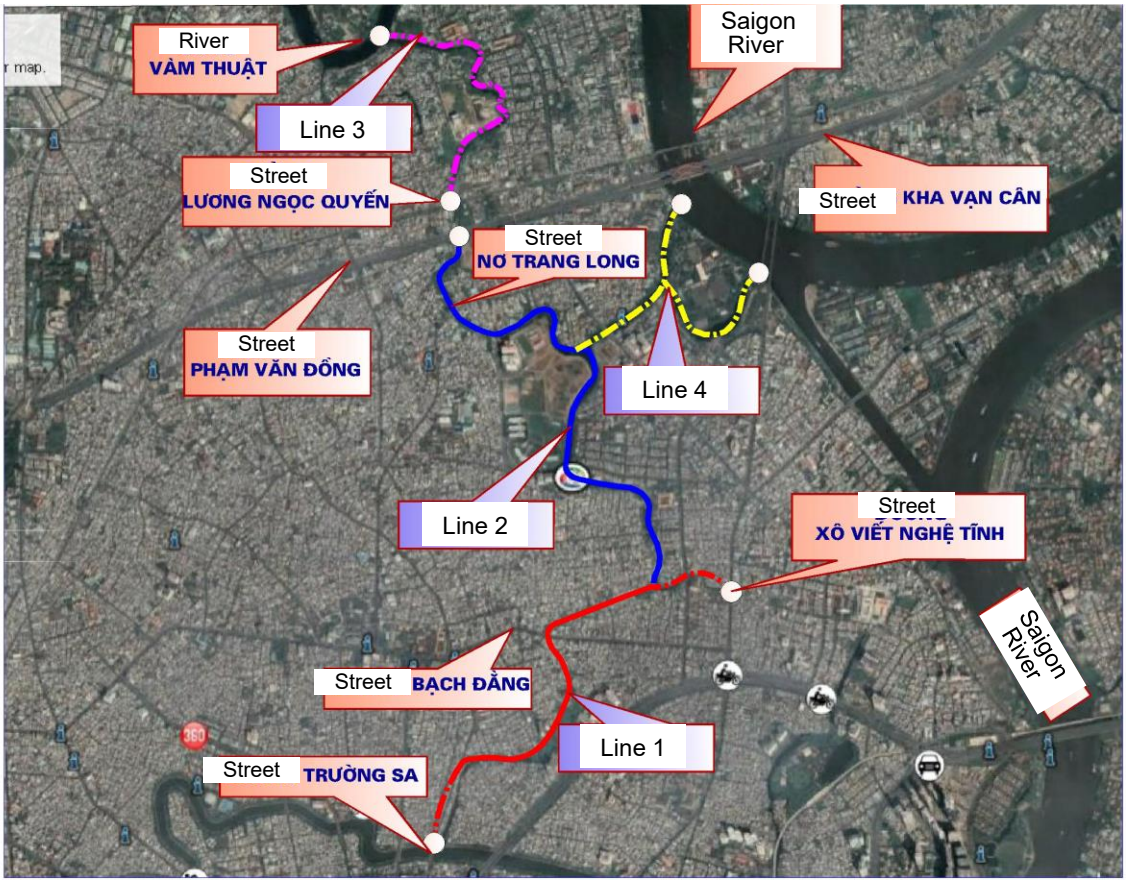


Source: F/S report for Xuyen Tam Canal Project

Figure 2.3-1 Proposed Location of Pump Stations

2.3.2 Outline of Road Design Solution

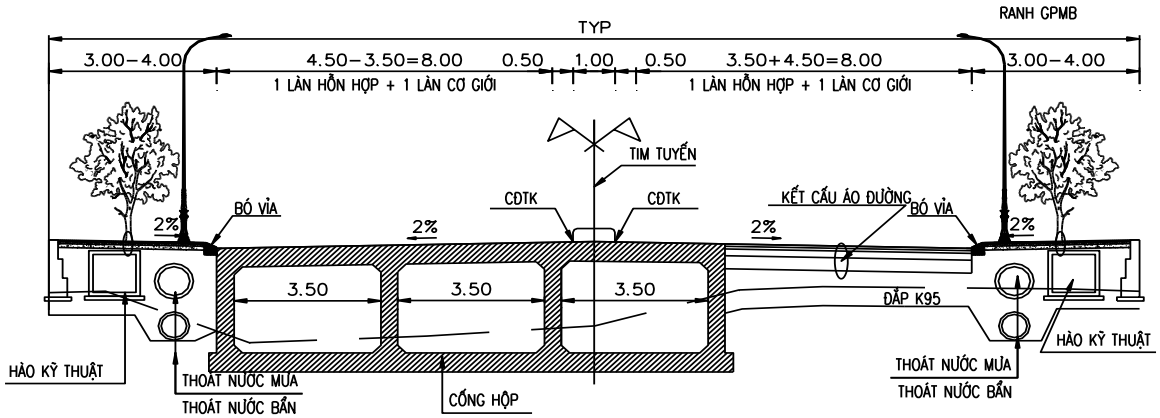
The road alignment followed the approved Xuyen Tam Canal's alignment and was adjusted according to the results of the current conditions. Figure 2.3-2 shows the overall alignment of roads in the area.



Source: F/S report for Xuyen Tam Canal Project

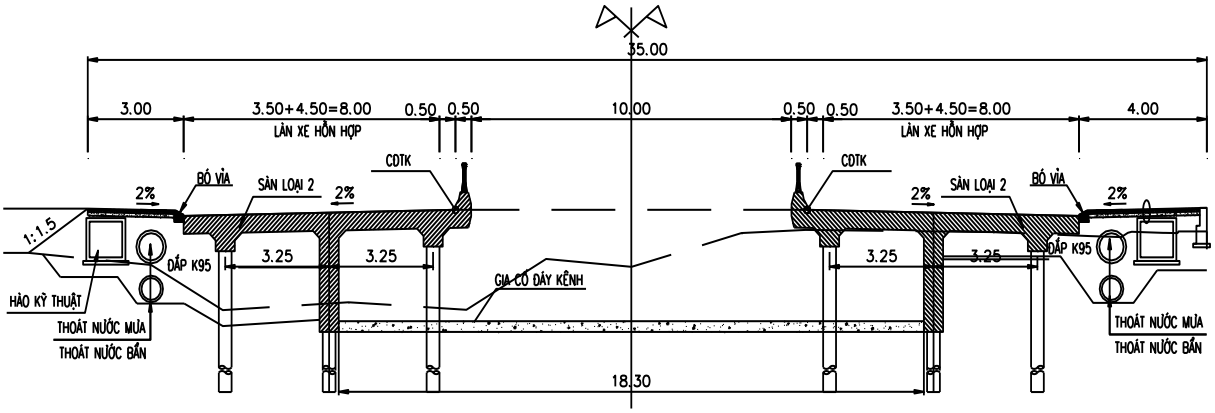
Figure 2.3-2 Overall Alignment for the Area

The longitudinal profile and cross section of the proposed road was carefully studied. Typical cross sections are shown in Figure 2.3-3, Figure 2.3-4 and Figure 2.3-5.



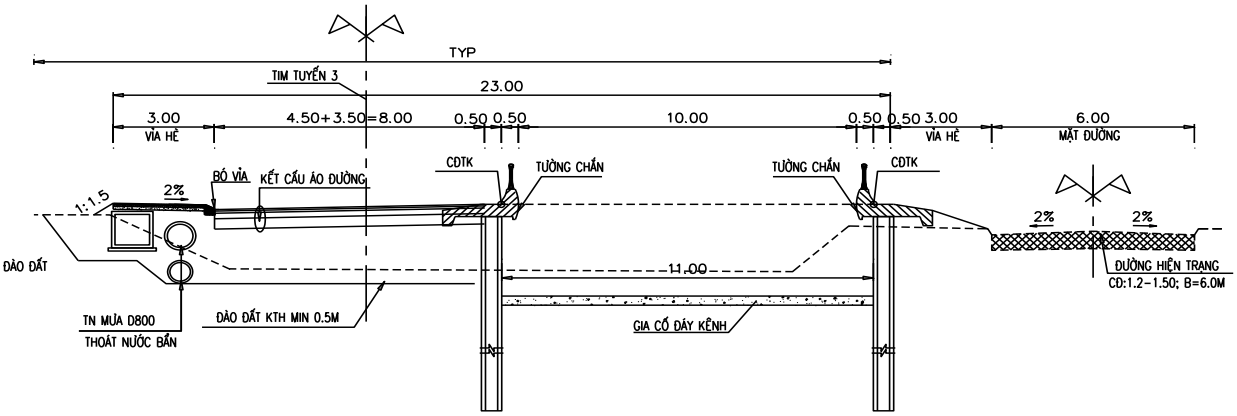
Source: F/S report for Xuyen Tam Canal Project

Figure 2.3-3 Typical Cross Section by Box Culvert



Source: F/S report for Xuyen Tam Canal Project

Figure 2.3-4 Typical Cross Section by Reinforced Concrete Floor



Source: F/S report for Xuyen Tam Canal Project

Figure 2.3-5 Typical Cross Section by Pre-stress Reinforced Concrete Sheet Pile

CHAPTER 3 APPROVAL PROCESS OF BT PROJECT

3.1 Relevant Laws, Decrees and Circulars

Laws, decrees and circulars mentioned below are important ones in particular, although there are many relevant laws, decrees and circulars for implementation of the PPP project including the BT project.

- Construction Law No. 50/2014/QH13 dated 18/6/2014;
- Investment Law No. 67/2014/QH13 dated 26/11/2014;
- Law on Tendering No. 43/2013/QH13 dated 26/11/2013;
- Land Law No. 45/2013/QH13 dated 29/11/2013;
- Law on Environmental Protection No. 55/2014/QH13 dated 26/3/2014;
- Decree No. 15/2015/ND-CP dated 14/02/2015 of the Government on investment in the form of public-private partnership;
- Decree No. 63/2018/ND-CP dated 4/04/2018 of the Government on Public Private Partnership (PPP) investment form
- Circular No. 02/2016/TT-BKHDT dated 01/03/2016 of the Ministry of Planning and Investment guiding the preliminary selection of projects, preparation, appraisal and approval of project proposals and feasibility study report of investment projects in the form of public-private partnership;
- Circular No. 55/2016/TT-BTC dated 23/03/2016 of the Ministry of Finance providing some financial management contents for investment projects in the form of public-private partnership and the cost of selecting investor.
- Decision No. 23/2015/QD-TTg dated 26/06/2015 of the Prime Minister stipulating the State's mechanism for payment by land fund to investors when carrying out construction investment projects in the form of build-transfer.

3.2 Approval Process for BT project

3.2.1 Overall Steps

The overall steps for investment in the form of Public-Private partnership is stipulated on Article 9 of Decree No. 15/2015/ND-CP in the following order.

a) Formulate, evaluate, approve and announce the projects according to the regulation in Chapter III of this Decree.

b) Prepare, evaluate, and approve the feasibility study reports according to the regulation in Chapter IV of this Decree.

c) Select investors; negotiate and sign the investment agreement, project contracts according to the regulation in Chapter V of this Decree.

d) Follow the procedures for the issuance of Investment Registration Certificate and set up the project management enterprises according to the regulation in Chapter VI of this Decree.

e) Carry out the projects according to the regulation in Chapter VII of this Decree.

f) Complete the financial reporting and transfer of the project according to the regulation in Chapter VIII of this Decree.

The Xuyen Tam canal project is now stage b) mentioned above, and waiting for getting approval from the People's Committee.

The same procedures are mentioned in the latest Decree No. 63/2018/ND-CP, however it stated that these procedures are not applicable for projects with BT contracts. On the Decree No. 63/2018/ND-CP, Chapter 5 which derived from Decree No. 15/2005/ND-CP is added and the implementing procedure of BT contract is mentioned as below.

a) Formulate and evaluate the pre-feasibility study report, make an investment policy decision, and announce the project in accordance with Chapter 3 of this Decree;

b) Formulate, evaluate and approve the feasibility study report in accordance with Chapter 4 of this Decree;

c) Formulate, evaluate and approve the design and the estimated budget in accordance with the law on construction or the relevant specialized law;

d) Organize selection of an investor, negotiate and sign the project contract in accordance with Chapter 6 of this Decree;

e) Commence construction of the project facility; conduct accounting finalization and transfer the facility in accordance with Chapter 7 and 8 of this Decree.

3.2.2 Necessary Contents of F/S Report

Necessary contents of F/S report by PPP/BT scheme is mentioned in Article 25 of Decree No. 15/2015/ND-CP as below.

a) A detailed analysis of the need for the investment and the advantages of the project in comparison with other form of investment; type of the project contract.

b) An evaluation report on conformity of the project with the planning, the development plan and the conditions prescribed in Clause 1 Article 15 of this Decree.

c) The target, the scope, the components (if any) and the location of the project; the demand for land and other resources.

d) A description of the technique, technology to satisfy the requirements for the quality of the works, products or the supply services.

e) An assessment on the current conditions of works, machinery, devices, the value of property (applied to the O&M contracts); the conditions for carrying out other project (applied to the BT contracts).

f) The project progress and time limit; the duration of the construction and development of the works; the plan for the management, operation or service supply.

g) A general plan for indemnity, site clearance and resettlement.

h) The project financial plan (including the contents prescribed in Point h Clause 2 Article 16 of this Decree).

i) The capital mobilization for the project; evaluation of the need and the liquidity ratio of the market; the survey on the interest of the investors and the lenders in the project.

j) An analysis of risk, responsibilities of the parties for the risk management during the execution of the project.

k) A petition for investment incentive and guarantee (if any).

l) The socio-economic effect and the impacts of the project on environment, society and national defense and security.

In this connection, it was confirmed that the F/S report for the Xuyen Tam Canal project by form of BT project covers the above contents.

However, the below contents are required for feasibility study report by article 29 of Decree No. 63/2018/ND-CP. The F/S report for the Xuyen Tam Canal project was prepared based on Decree No.15/2015/ND-CP, so the investor is updating the F/S report based on new decree and instruction from concern authorities. Due to this modification the F/S has not gotten an approval as of December 2018.

a) Detailed analysis of the necessity for the investment and the advantages of delivering the project [in the PPP form] as compared to other investment forms; a survey of opinions regarding the impact of investment in implementation of the project from one or more of the following agencies and organizations: people's council, people's committee, and the National Assembly delegation from the province or city in which the project is to be implemented; and also from any professional association relevant to the investment sector;

b) Assessment of compliance of the project with the investment sector, and the developmental master plan and developmental plans of the locality;

c) Project objective, scale, components (if any) and location for project implementation, and requirements for land use and for sources of natural resources;

d) Explanation of technical and technological requirements in order to satisfy requirements on quality of the project facility or of the products or services to be supplied; assessment of the current condition [or status] of facilities, machinery, equipment and the value of assets (for an O&M contract); preliminary design in accordance with the law on construction (for a project with a construction component);

e) Socio-economic effectiveness of the project and its impact on the environment, society, national defense and security.

f) Plan of payment of compensation, site clearance and/or resettlement;

g) The project's financial plan (comprising the items prescribed in article 18.3(g) of this Decree);

h) Ability to raise capital to implement the project; assessment of market demand and market payment; a survey of the concern level of interest of the investor and lender in the project;

i) Type of the project contract;

j) Schedule and duration for project implementation; duration of construction and exploitation of the project facility; plan on arranging management, business or service supply;

k) Analysis of the risks and sharing of responsibilities of the parties for management, business or service supply;

l) Recommendations on investment incentives and guarantees (if any);

m) Other necessary items as provided by specialized law.

3.2.3 Procedure for Land Allocation to Investors

A procedure for land allocation to investors by BT scheme is mentioned in Decision No.23/2015/QD-TTg. Article 5 of use of land to make payment for BT projects of the Decision mentioned a procedure as below;

1. For un-cleared land

On the basis of the location and area of the land fund to be paid by the provincial-level People's Committee, the request of the competent state agencies signing the BT contract and the request of the investor, provincial-level People's Committees shall make written commitments to investors on the use of land funds for payment of BT project; At the same

time, assign local authorities and investors to:

a) Formulate detailed plans of a 1:500 scale and submit them to competent state agencies for approval.

b) Formulate compensation and ground clearance plans and submit them to competent state agencies for approval.

c) Pay in advance funds for compensation and ground clearance according to regulations.

d) Carry out the compensation and ground clearance according to approved plans.

Based on the results of compensation and ground clearance, provincial-level People's Committees shall issue decisions to allocate or lease land to investors. The valuation of land areas used to make payment and the payment for BT contracts must comply with Clause 2 of this Article.

CHAPTER 4 REVIEW OF F/S INFRASTRUCTURE PLAN

4.1 Review of Flood Control Plan

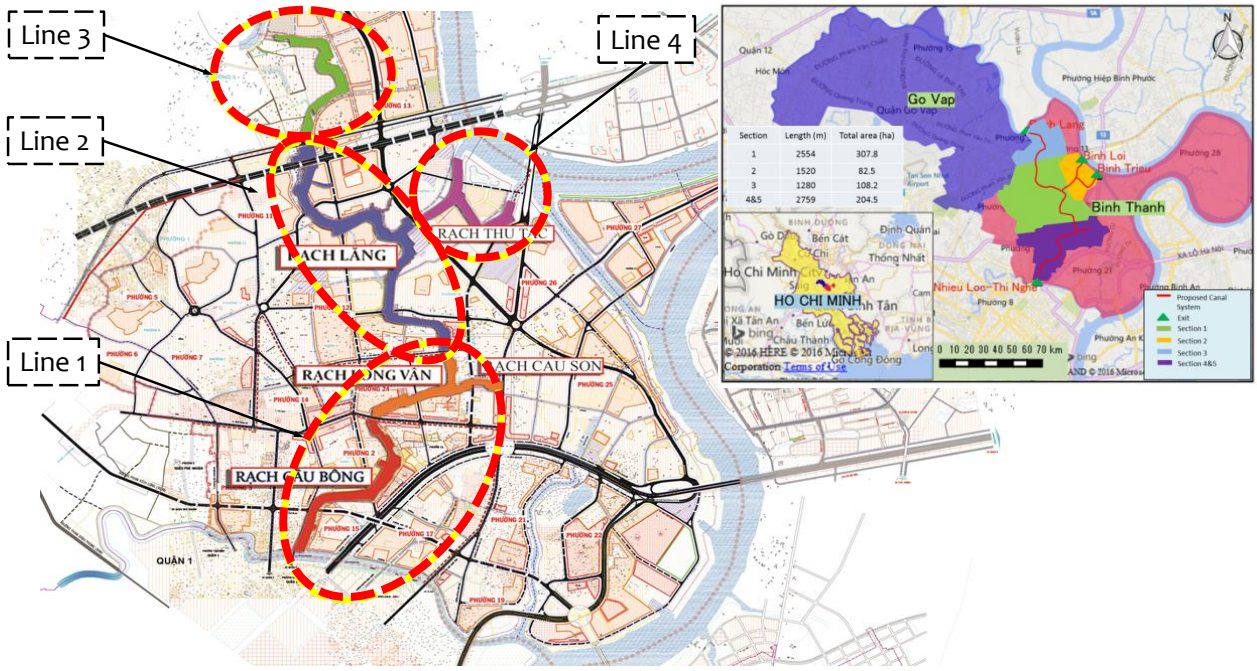
4.1.1 Flood Control Analysis by the F/S

(1) Project Location

The project area spreads over 660 ha, and covers the area of Ward 1, 2, 3, 11, 12, 13, 15, 24, 26 in Binh Thanh District and Ward 5 in Go Vap District. The Xuyen Tam Canal has 5 drainage routes as identified below:

- Line 1: From Son Bridge Canal to Nhieu Loc -Thi Nghe Canal
- Line 2: From the intersection of Route No. 1 in a junction between Long Van Canal, Son Bridge Canal, and Lang Canal, to Luong Ngoc Quyen Street
- Line 3: From Luong Ngoc Quyen Street to Vam Thuat River
- Line 4: From the junction of Lang Canal (the intersection of Route no. 2) to Saigon River, and
- Line 4.1: From the junction between Thu-Tac Canal and Lang Canal (the intersection of route no. 4) to Saigon River.

The overview of the project is shown in Figure 4.1-1.



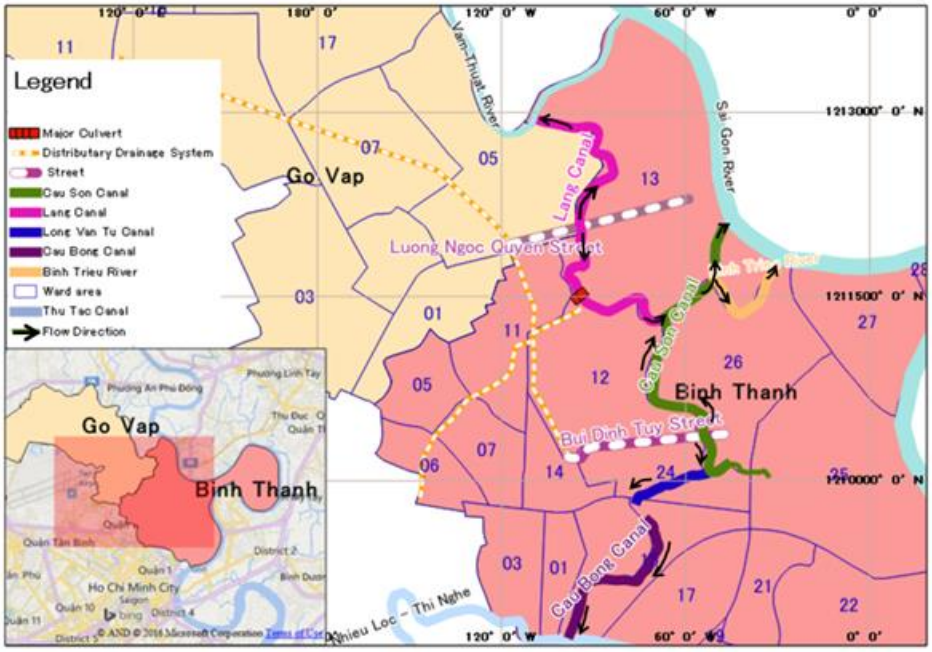
Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-1 Overview of Canal City Project

(2) Existing Canal Situation

Xuyen Tam Canal is one of the major tributaries of Vam Thuat River with a basin of about 700 hectares. From the junction of three canals: Long Van, Son Bridge and Lang to Vam Thuat River is about 4,300m long, 20m to 40m wide. In the Bui Dinh Tuy area, water tends to flow in two directions: to Vam Thuat River and to Thi Nghe Canal. In fact at this place, the depth of the canal is only 0.3m. At Luong Ngoc Quyen street, the water currently tends to flow in two directions: to Vam Thuat River and to the junction with Lang Canal. The actual depth of the canal bottom is only 0.8m. In some sections of the canal, there are stone or concrete embankments, but these embankments are heavily damaged in certain areas. In many sections of the canal, the width is only 5 to 10m. The depth of the canal is from 0.8m to 1.5m.

Figure 4.1-2 shows flow direction of Xuyen Tam Canal.



Source: JICA Study Team

Figure 4.1-2 Flow Direction of Xuyen Tam Canal

The following figures show existing condition of Xuyen Tam Canal,

Current situation of contaminated Xuyen Tam Canal

Stagnant pond

Xuyen Tam Canal near Binh Trieu Bridge

Source: JICA Study Team

Figure 4.1-3 Existing Condition of Xuyen Tam Canal

(3) Flood Control Analysis

1) Rain Fall Returned Period

- According to the Decision No.752/QĐ-TTg dated June 19th 2001 by Prime Minister regarding Approval of the General Planning for drainage system of Ho Chi Minh City up to the year of 2020, inundation cycle for grade-3, grade-4 culverts is 2 years; Grade-2 culvert is 3 years; canal is 5 years;
- According to TCVN 7957 - 2008 "Drainage - external network and works - design standard", Rainfall return period for large, grade-1 cities is 10 years for canal, 5 years for main drainage culvert and 2 years for regional branch culvert.

Table 4.1-1 Design Rainfall Return Period

Item	Rainfall Return Period (year)		
	According to Decision No.752/QD-TTg	According to TCVN 7957-2008	Applicable Return Period (Year)
Canal	**5**	10	10
Main culvert	**3**	5	5
Branch culvert	**2**	2	2

Source: F/S report for Xuyen Tam Canal Project

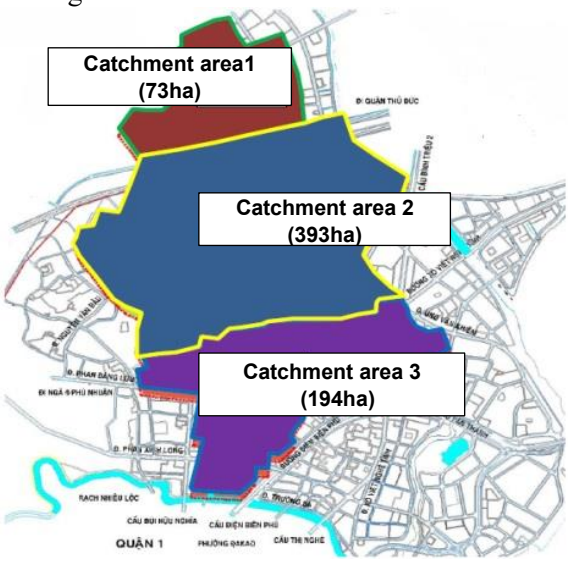
2) Selection of Drainage Calculation Model

Autodesk Storm and Sanitary Analysis (hereinafter called "SSA") 2017 was used in the F/S to calculate the model. It is very comprehensive and powerful in analyzing and designing urban drainage systems, rainwater drainage systems and sewerage drainage systems. SSA software can emulate completely the hydrological, hydraulic power and water quality in urban drainage systems.

3) Catchment Area

There are three catchment areas to be divided in the project area and rainwater in each catchment area drains into three different directions as shown in Figure 4.1-4.

- Catchment area 1 (73ha): Drainage from Luong Ngoc Quyen Street to Vam Thuat River through the Lang Canal tide gate.
- Catchment area 2 (393ha): Drainage from Luong Ngoc Quyen Street, Bui Dinh Tuy Street to Saigon River through Binh Trieu, Binh Loi tidal gate;
- Catchment area 3 (194ha): Drainage from Bui Dinh Tuy Street to Nhieu Loc - Thi Nghe Canal through Cau Bong Canal.



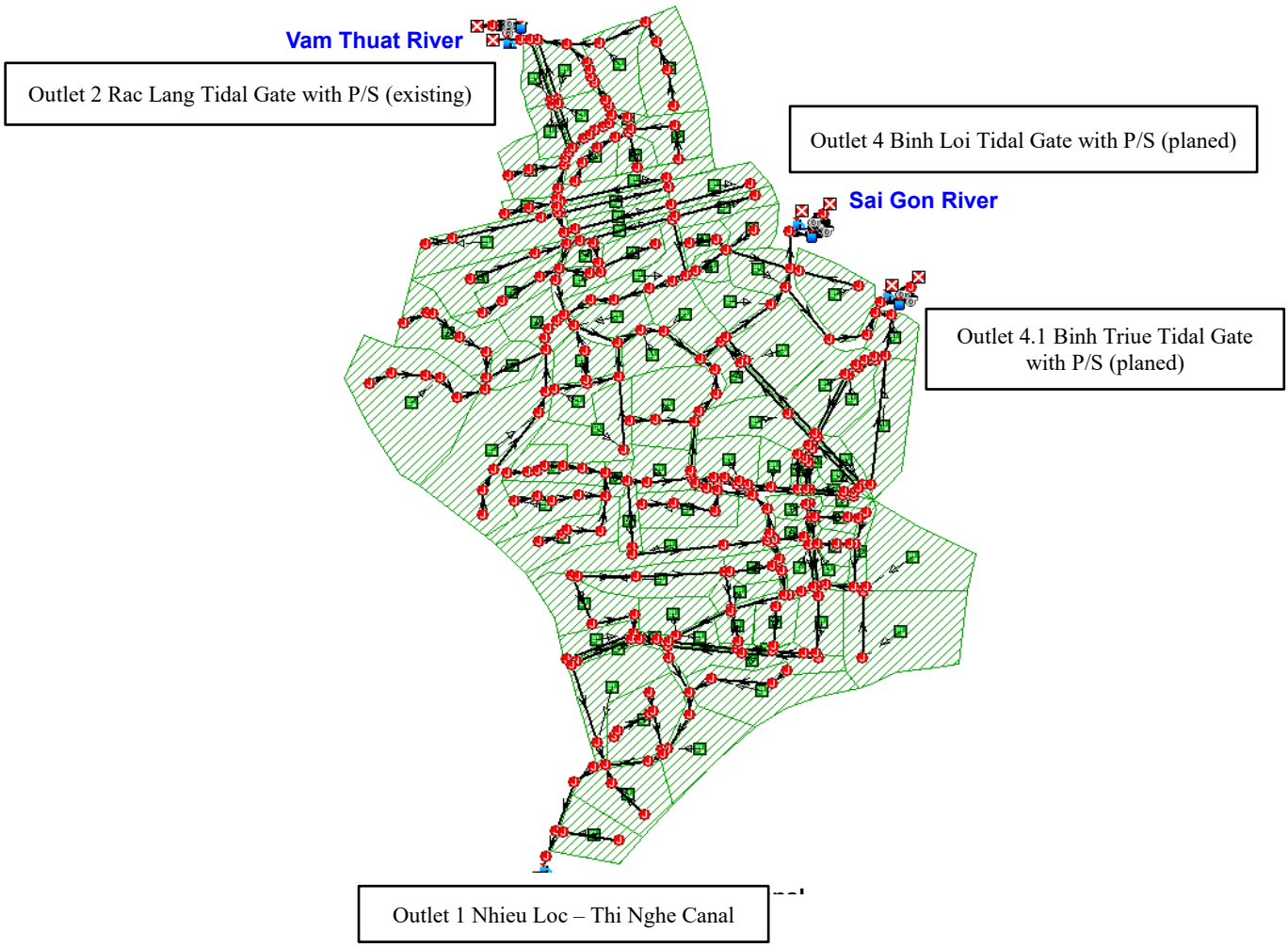
Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-4 Catchment Areas in the Project Area

4) Drainage Network

The drainage network is emulated on the basis of the drainage plan of 1/2000 of wards 1, 2, 3, 5, 6, 7, 11, 12, 13, 14, 15, 24 and 26 in Binh Thanh District and Ward 5 of Go Vap District. Minimum canal bottom slope i = 0.07%. So to divide the drainage basin for each culvert section to the outlet, the whole system has 4 outlet positions to the outside including:

- Outlet 1: freely drains to Nhieu Loc - Thi Nghe Canal, bottom elevation of outlet is -2.00m;
- Outlet 2: drains to Vam Thuat River through Rac Lang Tidal Gate and pumping station, bottom elevation of outlet is -1.90m;
- Outlet 4: drains to Saigon River through Binh Loi Tidal Gate and pumping station, bottom elevation of outlet is -2.00m;
- Outlet 4.1: drain to Saigon River through Binh Trieu Tidal Gate and pumping station, bottom elevation of outlet is -2.00m.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-5 Drainage Network in Project Area

5) Design Condition

a) Tide Table

The highest high water table of +1.68m recorded on Oct. 10, 2014 was applied as the boundary condition for the flooding analysis. Previously +1.32m in decision No. 752/QD-TTG dated June 19, 2001 by the Prime Minister has been used.

b) Condition of Tide Gate Operation

When the tide in Saigon River reaches +0.45m, tidal gates shall be pulled by the hydraulic power system to stop tide from Saigon River backflow into the Xuyen Tam canal system.

When the tide is below +0.45m, tidal gates shall be pushed down to the river bed elevation by the hydraulic power system so that the water in the canal can flow out;

c) Condition of Pump Operation

Rach Lang Pump Station: there are 6 pumps with a total capacity of 60,000m^3/h which are under operation at the moment (See Figure 4.1-6 below)

Binh Loi Pump Station: There is structure for installation of pumps, however, there is no pumps at the moment. 10 pumps with a total capacity of 100,000m^3/h shall be installed in the future. (See Figure 4.1-7 below)

Binh Trieu Pump Station; There is space for installation of pumps but there is no pumps at the moment. 6 pumps with a total capacity of 60, 000m^3/h shall be installed in the future. (See

Figure 4.1-8 below)

When the tidal level of the river is high, the tidal gate will be closed. During that time, when there is heavy rain causing the water level in the canal to rise and if the water level in the canal exceeds +0.50m, pumps will be operated such as pumps No. 1, 2, 3, 4, 5 (Binh Loi Station); pumps No.11, 12, 13 (Rach Lang station) and pumps No.17, 18, 19 (Binh Trieu Station).

Even after the above eleven (11) pumps are operated, if the water level in the canal continues to increase beyond +0.55m, pumps No.6, 7, 8, 9, 10 (Binh Loi Station); pumps No.14, 15, 16 (Rach Lang Station) and pumps No. 20, 21, 22 (Binh Trieu Station) shall be operated.

Twenty-two pumps will be all operated until the water level in the canal lows down to +0.50m and turns off the entire pumps when the water level in the canal down to +0.45m.

Source: JICA Study Team

Figure 4.1-6 Rac Lang Tidal Gate and Pump Station

Source: JICA Study Team

Figure 4.1-7 Binh Loi Tidal Gate and Pump Station

Source: JICA Study Team

Figure 4.1-8 Binh Trieu Tidal Gate and Pump Station

Parameters of the 3 tidal gates are shown in the following table.

Table 4.1-2 Tide Gate Parameter

Name of Station/Gate	Gate Bottom Level	Gate Crest Level	Gate Height (m)	Gate Width (m)
Rach Lang	-3.5	1.7	5.2	20
Binh Loi	-3.5	1.9	5.4	20
Binh Trieu	-3.5	1.9	5.4	20

Source: F/S report for Xuyen Tam Canal Project

6) Design Rainfall

In order to decide design rainfall it is necessary to have a monitoring period of 20-25 years with a self-recorded rain gauge, to set the maximum rainfall time is 150-180 minutes, and to select a design rain diagram on some typical rainfalls.

According to Decision No.752/QĐ-TTg by the Prime Minister regarding approval of the General planning of water drainage system in Ho Chi Minh City until 2020, specifically:

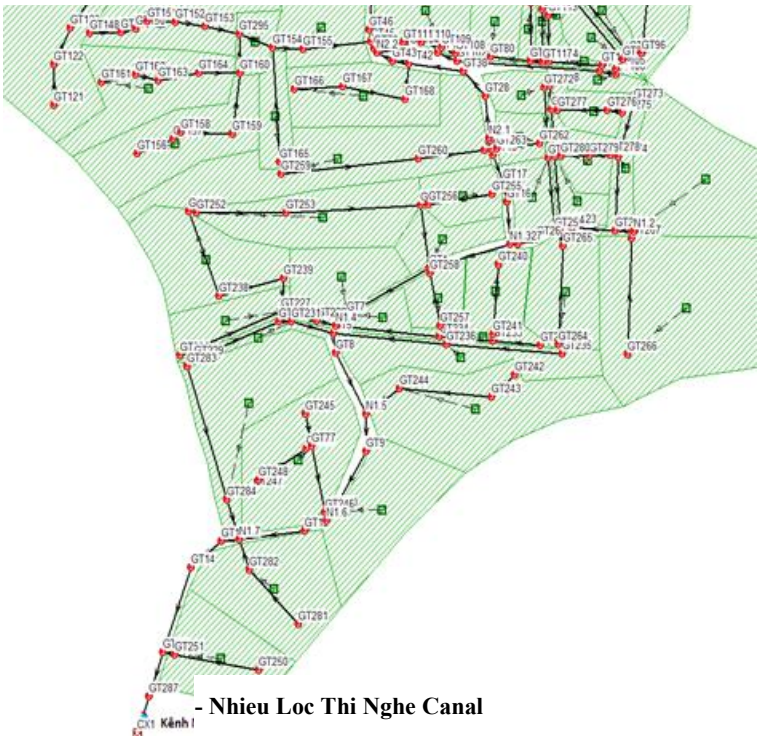
- To grade-3 culvert route: 75.88mm within 3 hours;
- To grade-2 culvert route: 85.36mm in 3 hours;
- To grade-1 main channel, canal: 95.91mm in 3 hours;

According to rainfall data collected at Tan Son Nhat Station from 1982 to 2016, the rainfall in 60 minutes corresponding to the 10-year flood cycle is 104mm/h, which is higher than the rainfall value in Decision No.752/QĐ-TTg. Therefore, a rainfall value of 104mm/h shall be selected for calculation analysis.

4.1.2 Result of Flood Control Analysis by the F/S

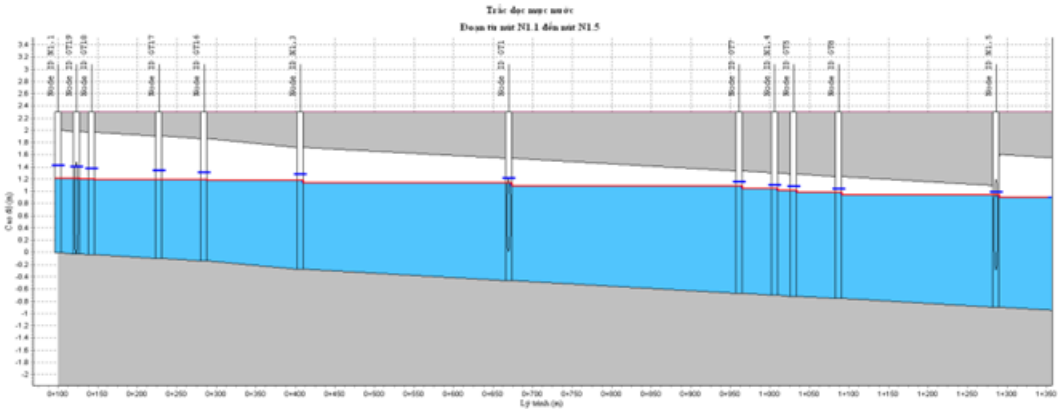
(1) Drainage Branch No.1

Flood control analysis result of the drainage branch No.1 is shown in the following drawing:



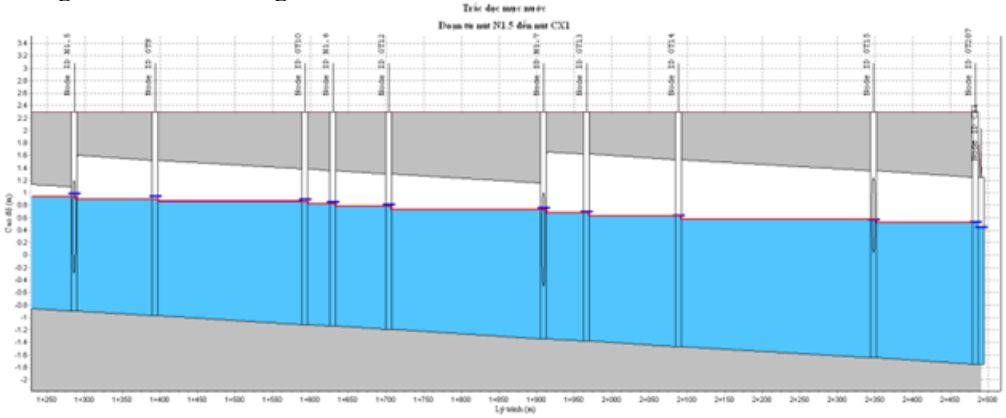
Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-9 Layout of Drainage Branch No.1



Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-10 Longitudinal Profile of Water Level from Node N1.1 to N1.5

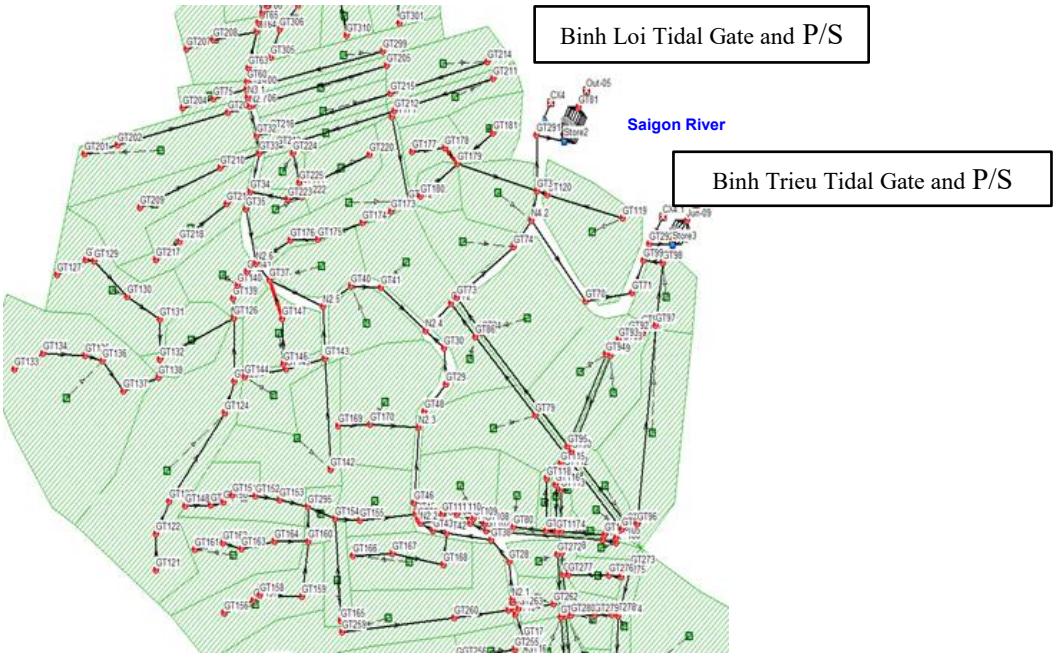


Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-11 Longitudinal Profile of Water Level from Node N1.5 to CX1

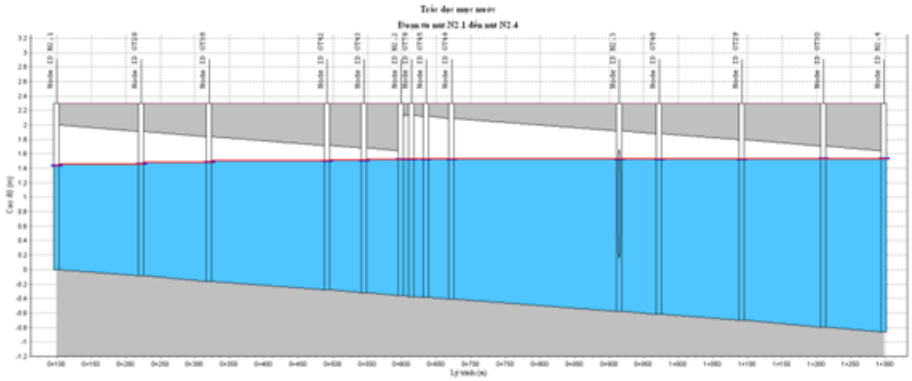
(2) Drainage Branch 2

Flood control analysis result of the drainage branch No.2 is shown in the following drawing,



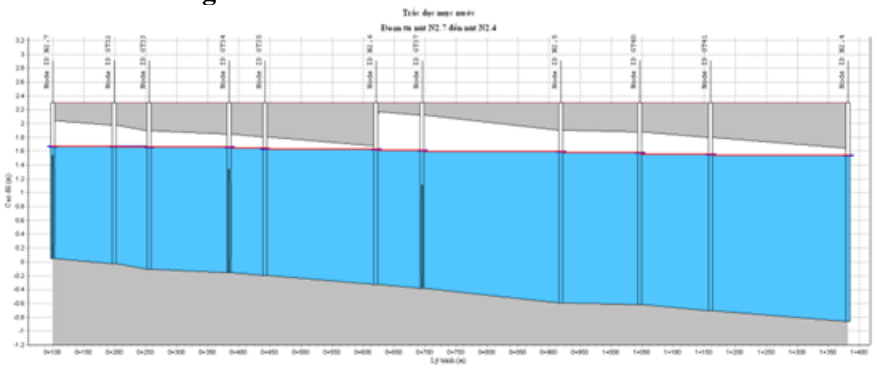
Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-12 Layout of Drainage Branch No.2



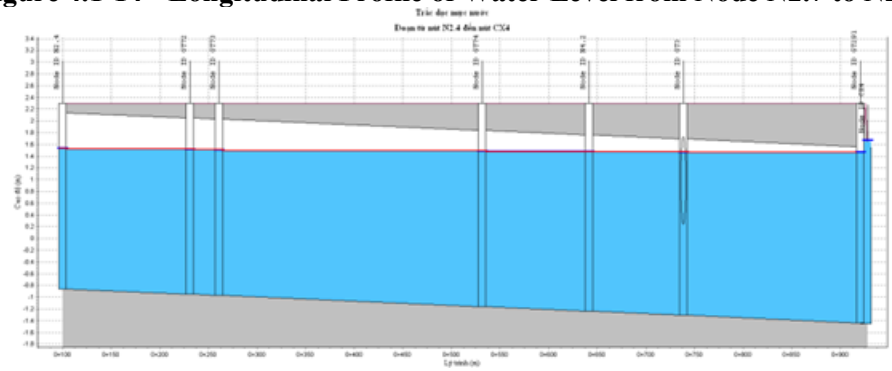
Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-13 Longitudinal Profile of Water Level from Node N2.1 to N2.4



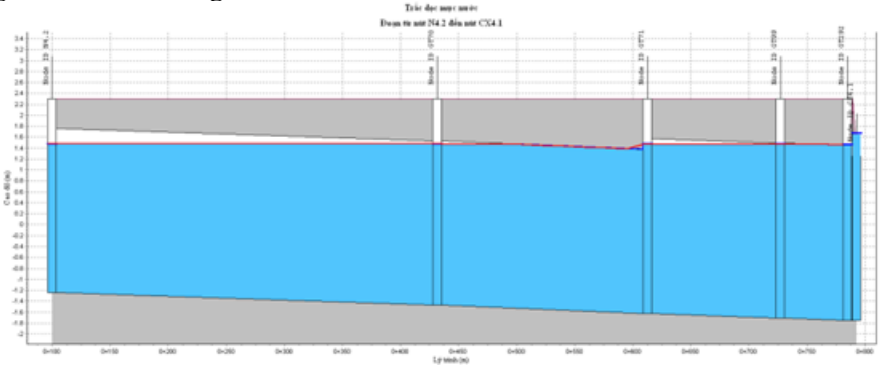
Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-14 Longitudinal Profile of Water Level from Node N2.7 to N2.4



Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-15 Longitudinal Profile of Water Level from Node N2.4 to CX4

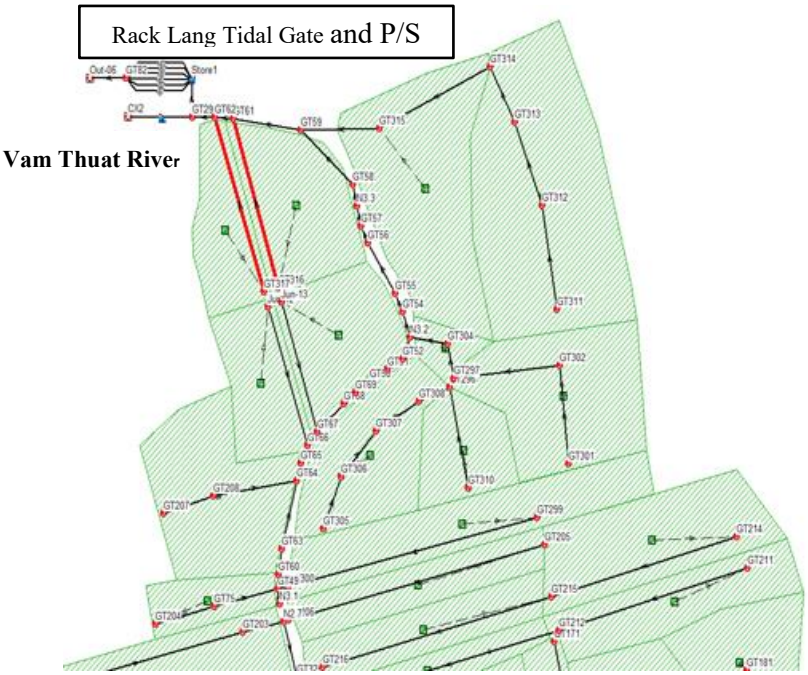


Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-16 Longitudinal Profile of Water Level from Node N4.2 to CX4.1

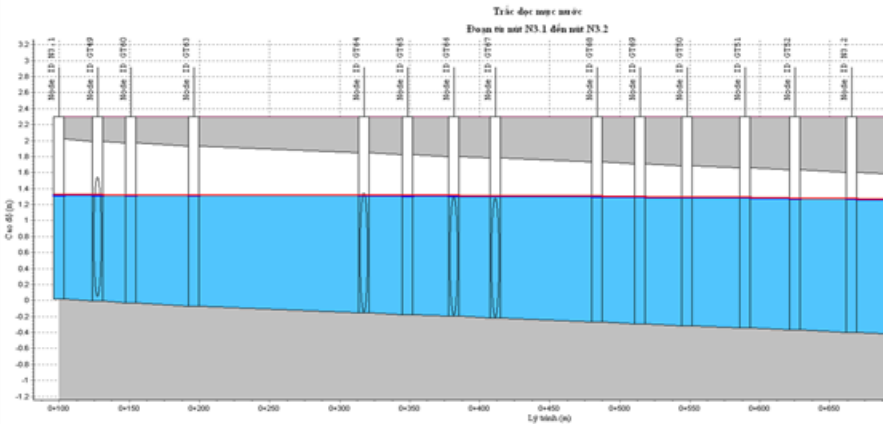
(3) Drainage Branch 3

Flood control analysis result of the drainage branch No.3 is shown in the following drawing,



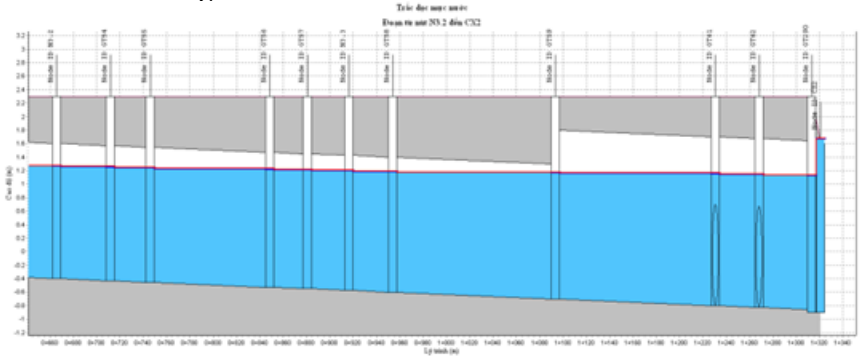
Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-17 Layout of Drainage Branch No.3



Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-18 Longitudinal Profile of Water Level from Node N3.1 to N3.2



Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-19 Longitudinal Profile of Water Level from Node N3.2 to CX2

4.1.3 Required Improvement of Existing Canal by the F/S

(1) Outline of Improvement

Based on the result of flood control analysis the required width of improvement/expansion of the existing canal is shown in Table 4.1-3.

Table 4.1-3 Required Improvement/Expansion of the Existing Canal

No.	Station		Proposed drainage channel width (m)	Channel bottom elevation (m)		Note
				Elevation of start point of channel	Elevation of end point of channel	
A	**Section No.1:**					
1	Km0+000 (N1.2)	Km0+400 (N1.3)	**3(3.5x3.5)**	-1.20	-1.33	Sơn Bridge - (Lang Canal – Long Van – Son Bridge T-junction)
2	Km0+400 (N1.3)	Km1+030 (N1.4)	**15.0**	-1.33	-1.53	(Lang canal – Long Van – Son bridge T-junction) - Bach Dang bridge
3	Km1+030 (N1.4)	Km2+513 (CX1)	**20.0**	-1.53	-2.00	Bach Dang Bridge – Nhieu Loc-Thi Nghe Canal (Bui Huu Nghia Bridge area)
B	**Section No.2:**					
1	Km0+000 (route 2.1)	Km0+296 (route 2.1)	**10.0**	-1.33	-1.20	(Lang Canal – Long Van – Son Bridge T-junction) - Bui Dinh Tuy Street
2	Km0+296 (route 2.1)	Km0+227 (route 2.2)	**10.0**	-1.20	-1.34	Bui Dinh Tuy Street - Chu Van An Street
3	Km0+163 (route 2.3)	Km0+800 (route 2.3)	**20.0**	-1.34	-1.50	Chu Văn An – Lang Canal T-junction
4	Km0+800 (route 2.3)	Km0+385 (route 2.5)	**20.0**	-1.50	-1.29	Lang Canal T-junction - Bang Ky Bridge (No Trang Long Street)
5	Km0+385 (route 2.5)	Km0+744 (route 2.5)	**10.0**	-1.29	-1.20	Bang Ky Bridge – Lang Canal Bridge (Pham Van Dong Street)
C	**Section No.3:**					
1	Km0+000 (route 3)	Km0+900 (route 3)	**10.0**	-1.20	-1.74	Luong Ngoc Quyen Street - Lang Canal T-junction
2	Km0+900 (route 3)	Km1+196 (CX2)	**20.0**	-1.74	-1.90	Lang Canal T-junction – Tidal Gate
D	**Section No.4:**					
1	Km0+000 (route 4.1)	Km0+814 (CX4)	**25**	-1.50	-2.00	Lang Canal T-junction – Binh Loi Tidal Gate, Saigon River
			Installing pump with a capacity of 100,000m^3/h as planning at Binh Loi gate			
2	Km0+000 (route 4.2)	Km0+717 (CX4.1)	25	-1.80	-2.00	Cross section of Lang Canal and Thu Tac – Binh Trieu Tidal Gate, Saigon River
			Addition of pump with a capacity of 60,000 m^3/h at Binh Trieu Gate			

Source: F/S report for Xuyen Tam Canal Project

Improvement of new drainage system is analyzed in the most critical case which the heavy rain occurs simultaneously during the high tide. In order to ensure the drainage system for the catchment area No.2, pumps with a total capacity of 100,000m^3/h at Binh Loi Tidal Gate must be installed in accordance with the planning (currently the suction pit has been built, however, pumps have not yet been installed).

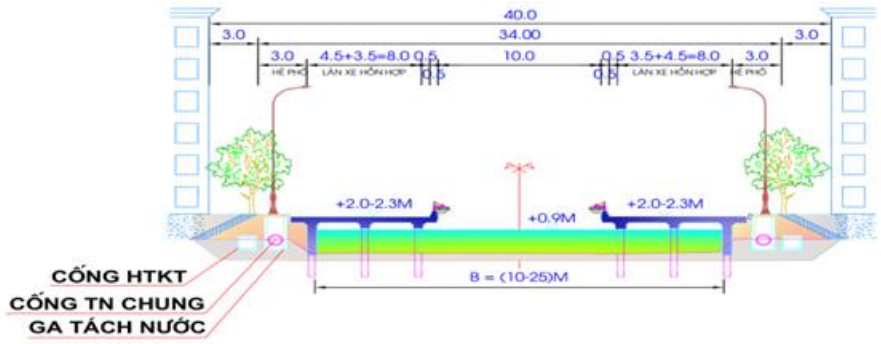
Furthermore, pumps at Binh Trieu Tidal Gate with a total capacity of 60,000m^3/h should be added.

(2) Proposed Drainage System in the Project Area

The main drainage channel shall be constructed along the traffic route and a rectangular structure made from concrete shall be constructed in the middle of the road. The width of the main drainage channel varies from 10m to 25m depending on the location

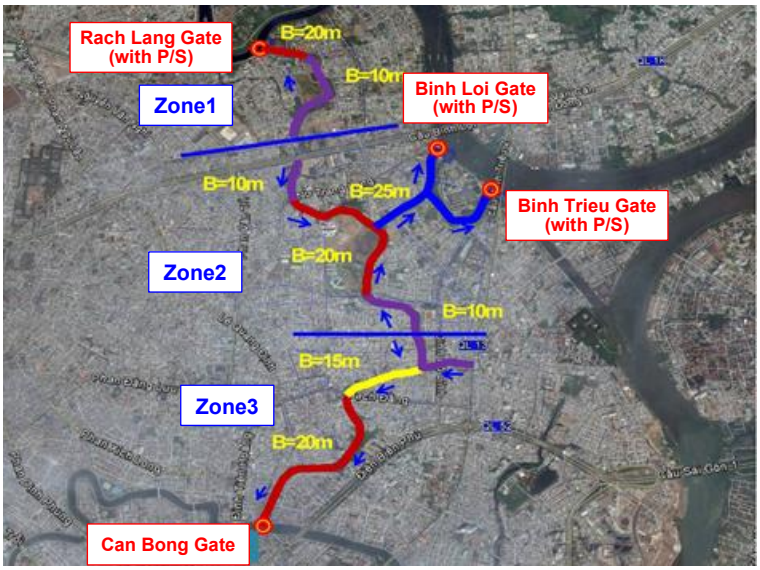
The D800mm culvert is proposed to be installed along both side of the road for collection of the rain water and sewage from the pavement and residential area. Collecting rain water shall flow into the main channel through the D800mm culvert.

Figure 4.1-20 shows typical cross section of main drainage channel and sub-main drainage D800mm culvert and Figure 4.1-21 shows width of main drainage channel.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-20 Proposed Typical Cross Section of Main Drainage Channel and Sub-Main D800mm

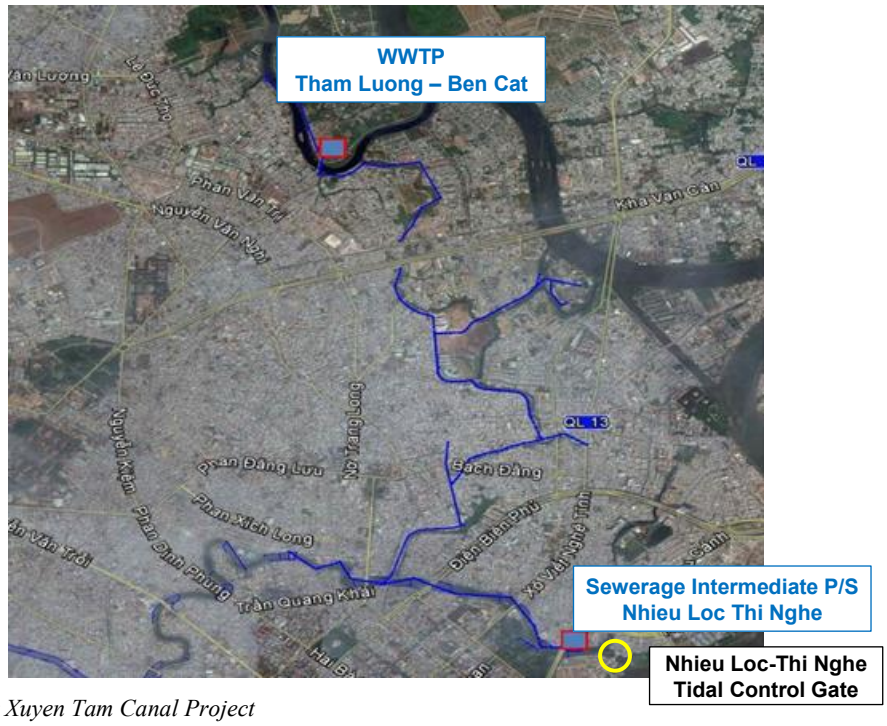


Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-21 Proposed Width of Main Drainage Channel

(3) WWTP and Intermediate P/S for the Sewerage System near the Project Area

There is one wastewater treatment plant, Tham Luong-Ben Cat WWTP, and one intermediate pumping station, Nhieu Loc-Thi Nghe pumping station for combined sewerage system, near the project area. The locations are shown in the following Figure 4.1-22 and photos of intermediate P/S are shown in the Figure 4.1-23.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.1-22 Location of WWTP and Sewerage Intermediate P/S

Source: JICA Study Team

Figure 4.1-23 Nhieu Loc-Thi Nghe Sewerage Intermediate P/S

(4) Nhieu Loc-Thi Nghe Tidal Control Gate and P/S

There is a tidal control gate and pumping station with capacity of 172,800m^3/h at the mouth of Nhieu Loc-Thi Nghe Canal near Saigon River shown in Figure 4.1-24. Catchment area for Nhieu Loc-Thi Nghe Tidal Control Gate is 3,393ha including 7 districts (Districts 1, 3, 10, Binh Thanh, Go Vap, Phu Nhuan and Tan Binh). This control gate and P/S were constructed in order to mitigate the flooding damage and maintain the low water level of the existing canal, Nhieu Loc-Thi Nghe.

Outline of the control gate and P/S is summarized below;

- Width, height and numbers of the control gate; W x H =22.5m x 6.2m, 2sets
- Material of the gate and accessories; SUS 304

- Elevation of the top of the gate; +2.5m
- Pump capacity; 21,600m^3/h/one pump
- No. of pumps; 8 (Total capacity; 172,800m^3/h)
- Total head; 3.0m
- Pump output; 300kW
- Size of impeller; 1,200mm

Outline of the control gate and P/S are as below;

Panorama view of the Tidal Control Gate from Downstream

Tidal Control Gate on the left bank

Installed four pumps at the left bank

Inlet of four pumps on the right bank

Installed four pumps at the right bank

Main Tidal Control Gate Office

Source: JICA Study Team

Figure 4.1-24 Nhieu Loc-Thi Nghe Tidal Control Gate and Pump Station

4.1.4 Conclusion and Recommendation

As mentioned in sections of 4.1.3(1) and (2), 10 new pumps with a total capacity of 100,000m^3/h at Binh Loi Tidal Gate and P/S and new 6 pumps with a total capacity of 60,000m^3/h at Binh Trieu Tidal Gate and P/S should be installed in order to mitigate the flooding damage and in order to improve the existing canal.

In the F/S report there is no plan to install a tidal gate and to construct a P/S near the Bui Huu Nghia Bridge which is near the Nhieu Loc-Thi Ngeh Canal. There is an existing control gate and P/S with a total capacity of 172,800m^3/h (See Figure 4.1-24) at the mouth of Nhieu Loc-Thi Nghe Canal. The capacity of the P/S is relatively small compared with total catchment area of 3,393ha. However, the P/S is operated to control water level of Nhieu Loc-Thi Nghe Canal below +0.5m in order to mitigate flooding of the catchment area.

By reviewing the F/S as mentioned in this chapter, planned canal size and gradient, tidal gate plan and P/S plan are considered as appropriate.

4.2 Review of Infrastructure Plan

Generally, public facilities installed by private enterprises under a BT scheme tends to simplify infrastructure specifications compared with cases of publicly funded projects because of cost efficiency. For this reason, the infrastructure plan will be reviewed for differences in infrastructure specifications between the F/S and WEIP II, considering an applicability of a BT project scheme to WEIP III.

4.2.1 Review Method of Main Construction

(1) Main Construction Contents of the F/S

The main construction contents of the F/S are infrastructure such as bridges, roads, canals, water supply pipes, sewer pipes, drain pipes, road signs, lighting, etc. The following main construction contents of the F/S shall be reviewed as important infrastructures.

(1) Intersection improvement
(2) Canal improvement
(Box culvert, Reinforced concrete floor, Pre-stressed reinforced concrete sheet pile)
(3) Pile foundation
(4) Road embankment and soil improvement
(5) Sewage drainage system

(2) Main Construction Contents of WEIP II

WEIP II has 7 packages as below.

- Package F1: Pump Drainage Improvement (ICB)
- Package F2: Canal Improvement (ICB)
- Package G: Construction of Interceptor Sewer System" (ICB)
- Package H: Construction of Combined Sewer Systems in District 8" (LCB)
- Package I: Expansion of Wastewater Intermediate Pumping Station, Construction of Conveyance Sewer and three Storm Water Pumping Stations (ICB)
- Package J: Expansion of Wastewater Treatment Plant (ICB)
- Package K: Hang Bang Drainage Improvement (ICB)

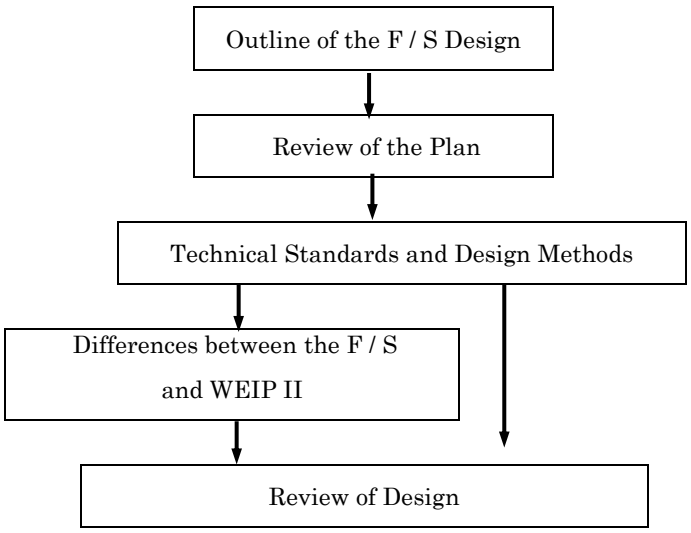
Among the above-mentioned packages, the main construction contents which can be compared with the F/S contents are box culvert, reinforced concrete floor, pre-stressed reinforced concrete sheet pile and pile foundation.

(3) Flowchart for Review

Main contents of the F/S shall be reviewed by organizing the differences from the infrastructure specification of the main construction contents of WEIP II and reflecting the BT project scheme to WEIP III.

On the other hand, the main construction contents of the F/S shall be reconsidered from the viewpoint of applicability by the organizing citations of Vietnamese standards and general design methods.

Flowchart for review is shown in Figure 4.2-1.



Source: JICA Study Team

Figure 4.2-1 Flowchart for Review

4.2.2 Review Result of Intersection Improvement

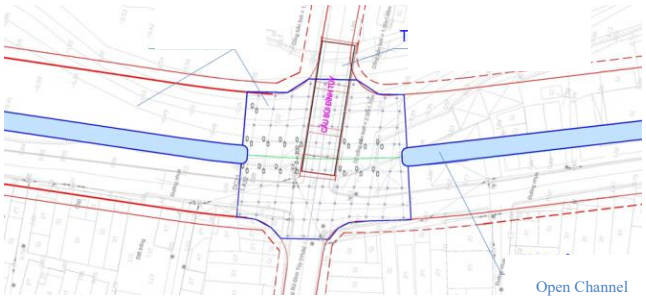
(1) Outline of the F/S Design

1) Solutions for Design of Works at Intersections

Routes run along Xuyen Tam Canal and intersect with existing bridges crossing the Xuyen Tam canal system. When designing interchanges with existing roads, these bridges are within the intersection, therefore, the connection between the new road surface and the old bridges are very complex. Especially for weak bridges, which have the potential problem for cracking along the road surface along the two outer edges of the bridges (due to the existence of the hammock of the bridges over the road). To ensure the technical requirements of the route and alignment (connection between the roads at the intersections with the existing bridges satisfies the smoothness when entering the intersections) the design solutions are as follows:

a) For Old Bridges

Demolish existing bridges, to be replaced by a reinforced concrete floor system with an aperture is suitable to the drainage design scale. Applicable bridges are old bridges with small scale bridges or old bridges with deteriorated load capacity such as Long Van Bridge, Lien Phuong Bridge (Nguyen Xuan On Bridge), old Do Bridge that are small iron bridges with deteriorated load capacity, and some RC bridges and composite steel girder bridges have been built a long time ago, such as Bui Dinh Tuy Bridge, Chu Van An Bridge, and Dinh Bo Linh Bridge. The typical plan of the design solution connecting to the old bridge (Bui Dinh Tuy Bridge) is shown in Figure 4.2-2

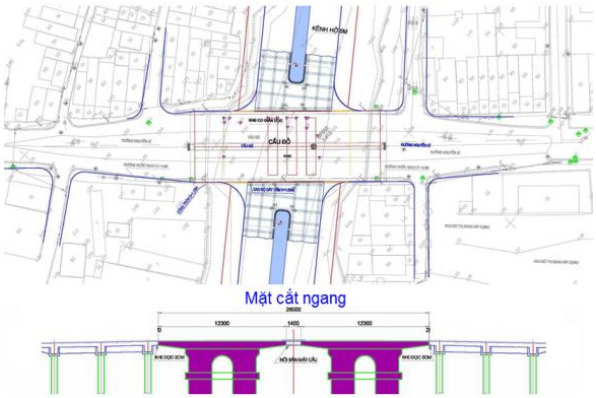


Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-2 Typical Plan of the Design Solution for the Old Bridge (Bui Dinh Tuy Bridge)

b) For Newly Built Permanent Reinforced Concrete Bridges

For newly built permanent reinforced concrete bridges such as Do Bridge, Bach Ky Bridge, Rach Lang Bridge, the bridge deck is used as the road surface in the intersection design. In particular, the main span is maintained and connected through the boundary span section after the removal and construction of new reinforced concrete floor on pre-stressed reinforced concrete piles. Particularly for Do Bridge, a continuous reinforced concrete arch structure with pillars in the middle should be able to be connected in the middle of the bridge. Plan of the design solution connecting to the bridge (Do Bridge) is shown in Figure 4.2-3.

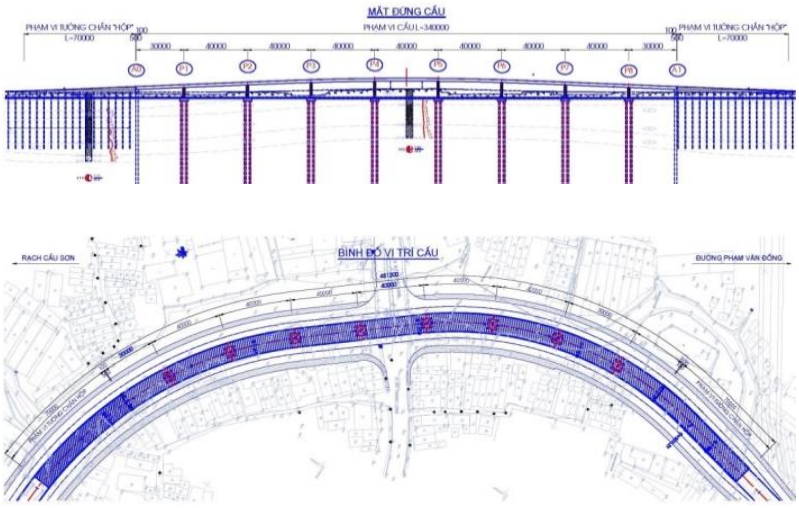


Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-3 Plan of the Design Solution Connecting to the Bridge (Do Bridge)

2) Solutions for Design of Works at Grade Separations

According to the results of traffic demand survey at the current traffic flows on Bach Dang, Chu Van An, No Trang Long and Nguyen Xi streets, the intersections with these 4 roads will cause traffic congestion when the Xuyen Tam Canal Route is formed. In order to solve the traffic jams, the F/S consultant has proposed to apply grade separation at the interchanges between Xuyen Tam Canal with Bach Dang Road and No Trang Long Road. At these intersections, Xuyen Tam Canal Road will run on a higher elevation, and existing roads will run on a lower elevation. On Xuyen Tam Canal Route, it is necessary to arrange an overpass in the middle of the open canal bed with continuous span structure to cross the intersections. Plan of the overpass along the route at the intersection of Bang Ky Bridge and at Bach Dang Intersection is shown in Figure 4.2-4 and Figure 4.2-5 respectively.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-4 Plan of the Overpass along the Route at the Intersection of Bang Ky Bridge

Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-5 Plan of the Overpass along the Route at Bach Dang Intersection

(2) Review of Plan

Regarding the overpass, structural options were compared for the overpass main structure, foundation and retaining wall of the bridge approach in the F/S. In this section, JST reviewed the appropriateness of the F/S plan.

1) Review of Overpass Structure

A comparison of overpass structure of the F/S is shown in Table 4.2-1.

Table 4.2-1 Comparison of Overpass Structural Options

Criteria	Option 1: Steel box beam	Option 2: Pre-stressed reinforced concrete box beam
Structural features	- Structure of round groove steel box girder with constant height, Composite reinforced concrete bridge surface. Continuous beam span with aperture from 30m to 45m; The ability to exceed span is relatively good. - Good torsion resistance, structure is lighter than pre-stressed reinforced concrete beam option. - The height in the middle of the span is large so longitudinal section of bridge is long.	- Structure of pre-stressed reinforced concrete box beam with constant height. Continuous beam span with aperture from 30-45m; The ability to exceed span is relatively good. - The best torsion resistance, the structure is heavier and higher than the option using steel beams. - Maximum height among options leading to the maximum height of abutment (compared to the same length of the bridge). - Static loading of the beam itself is large leading to the increase in the size of the foundation structure.
Construction conditions	- Industrialization is very high, should increase the quality. - Made simple because the beam section does not change the height. Manufacturing time is faster than Option 2. - Fabrication is much simpler than open box girder structure. Especially for curved bridges and in demand conditions to shorten the progress. - The structure is more stable when installing the crane, especially for a curved bridge. - The span length is shorter than the ability to install cranes conveniently.	- Construction of pour-in-place concrete for each beam section at the construction site will take a long time, occupying the construction site. - The workload at the construction site increases the construction time, making it difficult to mitigate effect to the traffic.
Maintenance	Must have periodic maintenance for the steel span structure. Maintenance is required for both inside and outside the box	The reinforced concrete structure needs less maintenance than the other options.
Exploitation conditions	Due to the layout of the structure between the node areas, thus reducing the visibility, affecting the organization of traffic during the process of construction and exploitation.	Due to the layout of the structure between the node areas, thus reducing the visibility, affecting the organization of traffic during the process of construction and exploitation.
Architectural aesthetics	The span structure is more aesthetic than option 2	The span structure is less aesthetic than option 1 due to height of upper structure.
Costs	Average	Lower
Assessment	Recommended to apply	

Source: F/S report for Xuyen Tam Canal Project

The result of JST's review for the plan for overpass structure is shown in Table 4.2-2. From this, JST considers the F/S plan for overpass structure is reasonable.

Table 4.2-2 Review Result of Overpass Structure

Criteria	Option 1: Steel box beam	Option 2: Pre-stressed reinforced concrete box beam
Function · Performance	○	○
Characteristics of construction	○	○
Construction cost	◎	○
Maintenance cost	△	○
Architectural beauty	○	△
Construction period	◎	○
Comprehensive evaluation	◎	○

＊Explanatory notes ◎:Excellent , ○:Good , △Fair , ×No good

Source: JICA Study Team

2) Review of Overpass Foundation Structure

A comparison of overpass foundation structure of the F/S is shown in Table 4.2-3.

Table 4.2-3 Comparison of Overpass Foundation Structural Options

Criteria	**Option 1:** Bored piles	**Option 2:** Pre-stressed RC piles
Characteristics of construction	- Drilling holes, lowering the steel cage, pouring concrete piles. - Low construction occupancy area. - Bulky equipment, pipe with large diameter	- Pre-cast piles. - Little impact on the environment during construction. The construction time is relatively long. - The occupied construction area is relatively large.
Force bearing capacity	- High load bearing capacity, suitable for supporting long spans. - Great length, which can be placed on very hard soils that cannot be penetrated by driven piles. - The pile load bearing capacity is greater than that of the driven pile, so it can reduce the size of concrete pile, minimizing the occupied area, less impact on the underground works.	- Limited load capacity, suitable only for short spans and limited depth. Therefore, more numbers of piles and footings are required than bored pile option (considering the same load from the upper structures). - It is difficult to fit numbers of piles into a footing with complex size due to limited load capacity per pile
Construction conditions	- The length of the pile is up to 60m. - Construction of a pile needs about 2 ~ 3 days. Fast construction time due to a fewer number of piles. - Bentonite mortar rotation is required to protect the borehole.	- The maximum length of the pile is about 50m, hard pressed into the gravel layers. - 2-3 piles can be completed every day. - Long period of construction due to the number of piles.
Environmental impact	- Noise and vibration when installing and removing cages and steel planks. - A drainage system is needed to prevent bentonite from leaking out of the construction area.	- Low noise and vibration level during pile driving.
Construction costs	Average	Lower
Contractor Response Level	In line with the construction capacity of Vietnamese contractors	In line with the construction capacity of Vietnamese contractors
Recommendation	Applied for overpass	Applied for the retaining wall at the bridgehead

Source: F/S report for Xuyen Tam Canal Project

A result of JST's review for the plan of overpass foundation structure is shown in Table 4.2-4. From this, JST considers the result of F/S to apply the 2 options separately for each purpose is reasonable.

Table 4.2-4 Review Result of Overpass Foundation Structure

Criteria	**Option 1:** Bored piles	**Option 2:** Pre-stressed RC piles
Function · Performance	◎	○

Characteristics of construction	△	○
Construction cost	△	○
Environmental Considerations	◎	△
Actual results	○	○
Construction period	△	○
Comprehensive evaluation	○	○

＊Explanatory notes ◎:Excellent , ○:Good , △Fair , ×No good

Source: JICA Study Team

3) Comparative Review of Retaining wall at Bridge Approach

A comparison of retaining wall at the bridge approach of the F/S is shown in Table 4.2-5.

Table 4.2-5 Comparison of Options for Retaining Wall at Bridge Approach

Criteria	Vertical box retaining wall	U-shape retaining wall
Structural features	- The vertical box structure on the pile foundation; - The cross-section of the two-walled box, the above sheet in reinforced concrete using panels combined with pour-in-place concrete.	- U-shape structure on pile foundation; - U-shape cross section in reinforced concrete supporting embankment and pavement.
Advantages	- Absolute subsidence prevention for road at the bridgehead; - The structure is hollow, light and closed so the number of piles is reduced.	- Absolute subsidence prevention for road at the bridgehead; - Widespread use for roads in the city;
Disadvantages	- Suitable for retaining wall with height > 3m; - The duration of construction of reinforced concrete structure is longer;	- The larger structural volume due to covering embankment in the retaining wall so a number of piles required are much greater than the empty box type.
Costs	Lower	Higher
Comment	Recommended to apply	

Source: F/S report for Xuyen Tam Canal Project

The result of JST's review for the plan of retaining wall at the bridge approach is shown in Table 4.2-6. From this, JST considers the F/S plan for retaining wall at the bridge approach is reasonable.

Table 4.2-6 Review Result for Retaining Wall at Bridge Approach

Criteria	Vertical box retaining wall	U-shape retaining wall
Function · Performance	○	○
Characteristics of construction	◎	○
Construction cost	◎	○
Maintenance cost	○	○
Environmental Considerations	○	○
Actual results	○	○
Construction period	△	○
Comprehensive evaluation	◎	○

＊Explanatory notes ◎:Excellent , ○:Good , △Fair , ×No good

Source: JICA Study Team

(3) Technical Standards and Design Methods

Design standards, design load and earthquake design load which are used for preliminary design in the F/S are shown below.

1) Design Standards of Works

- Design standards of bridge 22TCN 272-05;
- Design standards of bridge ASSHTO 2007;
- Other relevant standards.

2) Design Load

- Reinforced concrete floor Load HL-93.

- Overpass along the route Load 0.5xHL-93 (equivalent to other steel overpass built in the city)

3) Earthquake Design Load

According to QCVN 02:2009 and TCVN 9386:2012, the earthquake acceleration coefficient in the construction area in Ho Chi Minh City is as follows:

- +Binh Thanh district A=0.0853g;
- +D Go Vap district A=0.0832g;

Accordingly, the project is in the area of earthquake level VII (MSK scale) has the base acceleration coefficient A> 0.06 for the cycle of repetition T = 500 years.

(4) Review of Design

Reviewing the F/S design, JST concludes the design contents as follows:

1) Design Content

- Intersection improvement works are properly designed complying with Vietnamese design standards, design loads, earthquake design loads, etc., in the FS.
- Where the intersection improvement work is required on an old bridge, it shall be removed and replaced by RC floor which is supported by PC pile foundations with an aperture suitable to the drainage design scale.
- On the other hand, in the case of a new bridge, a method is adopted that was connected through the boundary span section after the removal and construction of new reinforced concrete floor on pre-stressed reinforced concrete piles.
- Where the intersection improvement work is required on a newly constructed existing bridge, its bridge deck is used as the road surface. The main span is maintained and connected to the new RC floor through its longitudinal portions in where the parapet in the both sides shall be removed. The new slab shall be constructed in the gap between two bridge beams.
- At the intersections of Bach Dang Road/ Xuyen Tam Canal and No Trang Long Road/ On Xuyen Tam Canal, the new Xuyen Canal road will run on a higher elevation, and existing roads will run on a lower elevation. On Xuyen Tam Canal route, it was designed to arrange an overpass in the middle of the open canal bed with continuous span structure to cross the intersections.

2) Conclusion

JST concludes the following.

a) The design for the overpass structure, the overpass foundation and the bridge approach, stated in the above item 4.2.2 (2) Review of Plan, was compared and properly selected for the bridge.
b) Referring to the Item 4.2.2 (3,) Technical Standard and Design Methods, the technical standards and the design methods were set appropriately.
c) Referring to the Item 4.2.2 (4), Review of Design, the design methods and contents were properly confirmed with the technical standards set in Item 4.2.2(3).

JST considers that intersection improvement design of the F/S design is appropriate.

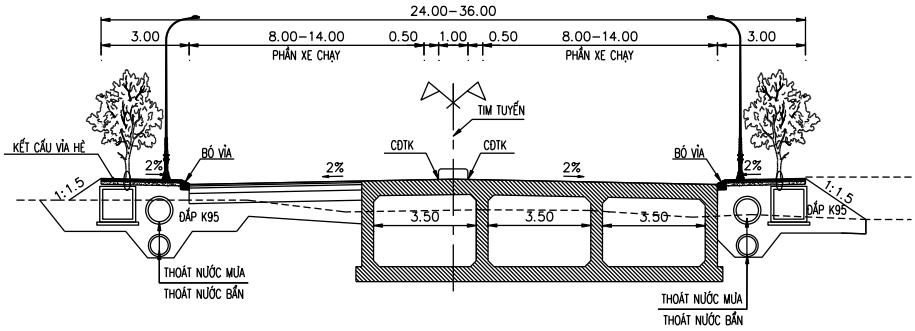
4.2.3 Review Result of Canal Improvement

(1) Outline of the F/S Design

Current conditions of Xuyen Tam Canal is a natural flow without culverts and revetment. By this BT project, the canal will be improved to a box culvert, reinforced concrete floor and pre-stressed reinforced concrete sheet pile, in combination with a new road.

1) Box Culvert

The box culvert cross section has a flow area width of 10.5m and a road width of 11.9m to 23.9m which requires soft soil treatment to be constructed. Where the box culvert is applied, the total usable width is about 24m to 36m. Moreover, soft soil treatment is expensive, the construction period is long and it will affect the surrounding ground, therefore it is applied only to small cross sections at short distances. A typical cross section of a box culvert is shown in Figure 4.2-6.



Source: F/S report for Xuyen Tam Canal Project

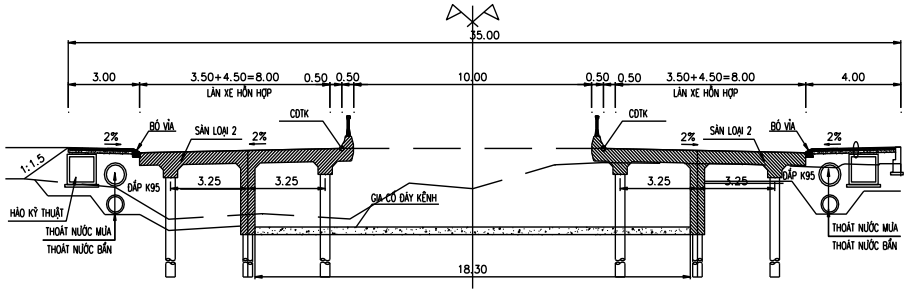
Figure 4.2-6 Typical Cross Section of Box Culvert

2) Reinforced Concrete Floor

The reinforced concrete floor (herein after "RC floor") cross section has a flow area width of 16m and an open channel width of 10m to 25m. Where the RC floor is applied, the total usable width is 34m to 81m.

The construction period of the RC floor is shorter than that of the box culvert and the influence on the surrounding ground is smaller.

RC floor is applied to the main route from the viewpoint of the landscape, beauty of the constructed roads and open channels. A typical cross section of RC floor is shown in Figure 4.2-7.

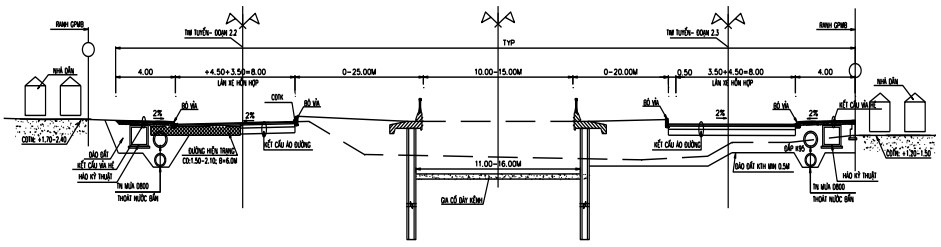


Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-7 Typical Cross Section of RC Floor

3) Pre-stressed Reinforced Concrete Sheet Pile

The pre-stressed reinforced concrete sheet pile cross section has an open channel width 11m to 16m and road width 8m x 2 places on both sides, at a place away from the open channel. Where the pre-stressed reinforced concrete sheet pile is applied, the usable total width is about 23m to 74.5m. In addition, the construction period of the pre-stressed reinforced concrete sheet pile is shorter than that of the box culvert. Although during the construction it causes noises and vibration to the surrounding ground, the pre-stressed reinforced concrete sheet pile is applied to the existing route because it provides an open canal and a high aesthetic environment after completion. A typical cross section of pre-stressed reinforced concrete sheet pile is shown in Figure 4.2-8.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-8 Typical Cross Section of Pre-stressed Reinforced Concrete Sheet Pile

(2) Review of Plan

A comparison for canal improvement plan was conducted in the F/S. In this section, JST reviews the appropriateness of the F/S plan.

A comparison of canal improvement plan of the F/S is shown in Table 4.2-7.

Table 4.2-7 Comparison of canal improvement plan

Criteria	Option 1: Culvert box combined with retaining wall	Option 2: Reinforced concrete floor	Option 3: Pre-stressed reinforced concrete sheet pile
Structural features	Reinforced concrete box culvert structure on pre-stress reinforced concrete pile, multiple cross-section according to water drainage requirements in each section, combined with retaining walls and soft soil treatment methods.	Reinforced concrete floor, span length is about 4-6m with a floor height of 0.35-0.5m placed on the pre-stressed reinforced concrete pile system D0.4--0.6m.	SW840 sheet pile, length is about 30m, for the height of large river bank arranged with reinforced concrete anchor piles.
Characteristics of construction	Construction under the method of pouring in place, using steel sheet pile to stabilize the hole along the route during the construction. In addition, some sections need to treat soft soil resulting in a long construction time.	Can be semi-assembled in the construction process. The construction of the floor on the suspended formwork on the pile head should facilitate and accelerate the process of construction.	Piles are produced at the factory, transported and packed in the field. Construction of stone wall and anchor piles (if any).
Environmental impact	Due to the construction by the method of pouring in place, combined with the treatment of soft soil along the route, affect to the surrounding environment of the construction site will occur.	Prefabricated and assembled construction is therefore less likely to affect the surrounding environment.	Impact of noise and vibration
Architectural style	Aesthetic is not as advantageous as option 2.	Architectural beauty and aesthetics due to open canal width of 10m in the middle.	Open canal, high aesthetic.
Occupancy of cross section	Closed canal surface, the width occupied depends on the drainage section, the cross-sectional dimension of the route is less varied, the site clearance is greater than Option 2.	Open canal surface, the width occupied does not depend on the drainage section, the cross-sectional dimension of the route is less change, less site clearance.	The large drainage section thus occupies large area, site clearance with the largest volume.
Assessments	The study only applies to small cross sections with short lengths.	Recommendation applied on the main route.	Recommendation for the use of existing routes.

Source: F/S report for Xuyen Tam Canal Project

The result of JST's review for the plan of canal improvement is shown in Table 4.2-8. Option 2 of RC floor is adopted as the option for the main route. Option 3 of pre-stressed reinforced concrete sheet pile is adopted as the option for the existing route. Option 1 of box culvert combined with retaining wall is recommended to adopt it as a short route with a narrow cross section.

As shown in Table 4.2-8, JST considers the F/S plan for canal improvement is reasonable.

Table 4.2-8 Comparative Review of Canal Improvement Plan

Criteria	Option 1: Culvert box combined with retaining wall	Option 2: Reinforced concrete floor	Option 3: Pre-stressed reinforced concrete sheet pile
Function · Performance	○	◎	○
Characteristics of construction	○	○	○
Road stability (Necessity of soft soil treatment)	△	◎	△
Construction cost	△	○	◎
Maintenance cost	○	○	○
Architectural beauty	△	◎	○

Environmental Considerations	○	○	○
Actual results	○	○	○
Construction period	△	○	◎
Comprehensive evaluation	△	◎	○

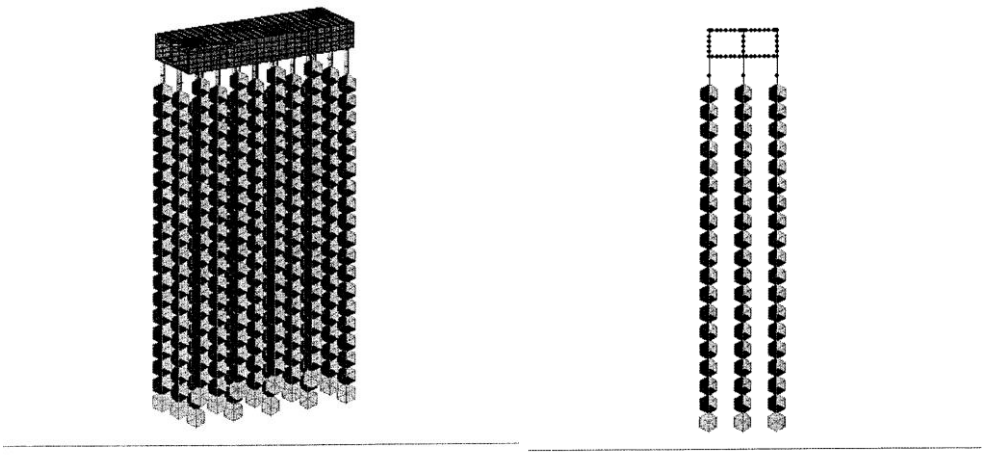
＊Explanatory notes ◎:Excellent , ○:Good , △Fair , ×No good

Source: JICA Study Team

(3) Structural Analysis Model

1) Box Culvert

A box culvert W3.5m x H2.5m x L20m x 2 and PHC pile D600 is calculated by the structure analysis model. The box culvert structural analysis model diagram is shown in Figure 4.2-9.



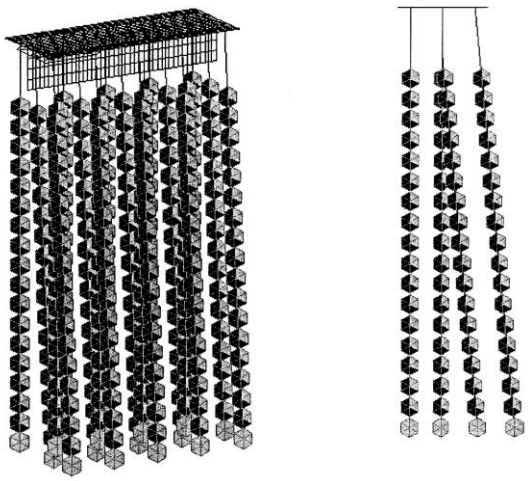
Model 1 Structural Model　　Model 2 Cross Section

Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-9 Box Culvert Structural Analysis Model Diagram

2) Reinforced Concrete Floor

A RC floor W9.0m x L40.0m x H 4.25m (Shape: T type) and PHC pile D600 x 3 is calculated by the structure analysis model. The RC floor structural analysis model diagram is shown in Figure 4.2-10.



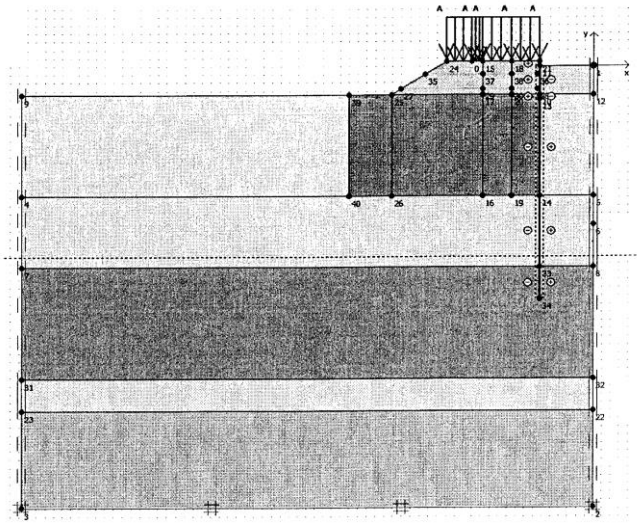
Model 1 Spring Pile　　Model 2 Cross Section

Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-10 RC Floor Structural Analysis Model Diagram

3) Pre-stressed Reinforced Concrete Sheet Pile

A pre-stressed reinforced concrete sheet pile D0.996m x L29.0m is calculated by the structure analysis model. The pre-stressed reinforced concrete sheet pile analysis model diagram is shown in Figure 4.2-11.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-11 Pre-stressed Reinforced Concrete Sheet Pile Analysis Model Diagram

(4) Technical Standards and Design Methods

1) Box Culvert

- Design speed is 50km/h. Some locations facing difficulty to obtain sufficient road turning radius will have a design speed of 30-40km/h.
- On the basis of the road grade and design speed chosen, the main geometrical standards of the road are selected in accordance with QCVN 07: 2016/BXD.
- Structure diagram of box culvert on pile D600 is calculated by SAP2000 software (V14.1). This software can show the entire structure of the project. Interaction of structural elements and foundation of the project is pursuant to theory of Winkler.

2) Reinforced Concrete Floor

- Design speed is 50km/h. Some locations facing difficulty to obtain sufficient road turning radius will have design speed of 30-40km/h.
- On the basis of the road grade and design speed chosen, the main geometrical standards of the road are selected in accordance with QCVN 07: 2016/BXD.
- Structure diagram of RC floor on pile D600 is calculated by SAP2000 software (V14.1). This software can show the entire structure of the project. Interaction of structural elements and foundation of the project should be pursuant to theory of Winkler.

3) Pre-stressed Reinforced Concrete Sheet Pile

- Design speed is 50km/h. Some locations facing difficulty to obtain sufficient road turning radius will have design speed of 30-40km/h.
- On the basis of the road grade and design speed chosen, the main geometrical standards of the road are selected in accordance with QCVN 07: 2016/BXD.
- The structure diagram of pre-stressed reinforced concrete sheet pile is calculated based on design standards of the road bridges 22TCN 272-05.
- Structure diagram of pre-stressed reinforced concrete sheet pile is calculated by geotechnical software of PLAXIS.

(5) Differences between the F/S and WEIP II

1) Box Culvert

The F/S designs box culvert x 3 lines. On the other hand, WEIP II's box culvert is built by 2 lines only.

The box culvert x 3 lines of the F/S and the box culvert x 2 lines of WEIPII were conducted by the same structure analysis method. (Both are calculated with SAP 2000 software (V 14.1).)

2) Reinforced Concrete Floor

The F/S designs RC floor. On the other hand, the WEIP II designed vertical concrete revetment.

The reinforced concrete floor of the F/S and the vertical concrete revetment of WEIP II were both designed by the same structure analysis method. (Both are calculated with SAP 2000 software (V 14.1).)

3) Pre-stressed Reinforced Concrete Sheet Pile

The F/S and WEIP II designs pre-stressed reinforced concrete sheet pile.

The pre-stressed reinforced concrete sheet pile of the F/S is applied by Vietnamese standard of bridges 22TCN 272-05. On the other hand, a pre-stressed reinforced concrete sheet pile of WEIP II was applied by Vietnamese standard of TCVN7888:2008 and JIS A 5373.

Also, a pre-stressed reinforced concrete sheet pile of the F/S is calculated by geotechnical software of PLAXIS. On the other hand, pre-stressed reinforced concrete sheet pile of WEIP II was calculated by SAP 2000 software (V 14.1).

(6) Review of Design

Reviewing the F/S design, JST concludes the design contents as follows:

1) Design content

a) Technical Standards and Design Methods for Box Culvert

The design of box culvert was conducted based on Vietnamese standards related to road works, geometric standards, and appropriate structural analysis methods.

b) Technical Standards and Design Methods for Reinforced Concrete Floor

The design of RC floor was conducted based on Vietnamese standards related to road works, geometric standards, and appropriate structural analysis methods.

Also, the RC floor of the F/S and standing concrete revetment of WEIP II were conducted by the same structure analysis method. Both of them were calculated by SAP 2000 software (V 14.1).

c) Technical Standards and Design Methods for Pre-stressed Reinforced Concrete Sheet Pile

The design of pre-stressed reinforced concrete sheet pile was conducted based on Vietnamese standards related to road works, geometric standards, and appropriate structural analysis methods.

Also, the design of pre-stressed reinforced concrete sheet pile of the F/S and standing concrete revetment of WEIP II were conducted by different structure analysis methods. The pre-stressed reinforced concrete sheet pile of the F/S was calculated by geotechnical software PLAXIS. On the other hand, pre-stressed reinforced concrete sheet pile of WEIP II was calculated by SAP 2000 software (V 14.1).

2) Conclusion

JST Evaluates the F/S as follows:

- Structural stability, construction workability, aesthetics, environmental influence of box culverts, reinforced concrete floors and pre-stressed concrete piles are effective as a canal renovation method in item 4.2.3 (1) and (2) have been compared and examined in detail and properly.
- The structure analysis model of item 4.2.3 (3) is properly selected.

- In item 4.2.3 (4), the structural design criteria and the linear design criteria for each structure are adequately described. Structural calculations are also performed using appropriate software.
- In item 4.2.4 (5), it was confirmed that the same structural software was used for the design of box culvert and reinforced concrete floors for both the F/S and WEIP II. For pre-stressed concrete sheet piles, material standards and structure calculation software are different between WEIP II and the F/S. This is considered to be because the F/S is designed according to the new criteria issued after 2010 where WEIP II was designed.

From these, the JST considers that the design of the F/S canal renovation works is generally appropriate.

4.2.4 Review Result of Pile Foundation

(1) Outline of the F/S Design

1) Specification of Pile

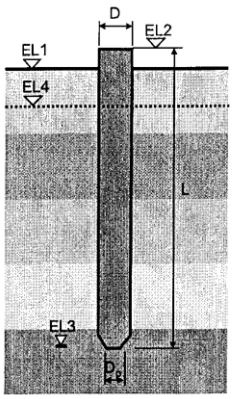
- Pile type：Centrifugal pile
- Pile diameter：D600mm
- Pile length：Route1=42.5-43.5m, Route2 =34.5-42.5m, Route4＝ 41.5-44.5m
- Number of piles：Route1= 3,760 nos., Route2= 3,002 nos., Route4= 2,165 nos.
- Strength limit state：1,010-1,140KN/no.

2) Calculation Model and Input Data

A pile foundation D600 PHC was calculated by the calculation model and input data. PHC pile calculation model diagram and Input date are shown in Figure 4.2-12.

1. INPUT DATA

Ground Level of bored hole		=	1.270	m
Ground Level (after scour)	EL1	=	-1.500	m
Bottom of pile cap Level	EL2	=	1.500	m
Bottom of Pile Tip Level	EL3	=	-41.000	m
Water Level	EL4	=	0.000	m
Pile Length	L	=	42.500	m
Length of belled end:	L_e	=	0.000	m
Dimension of driven pile	D_s	=	600	mm
Tip dimension of driven pile	D_p	=	0.60	m
Pile Cross-Sectional Perimeter	P	=	1.885	m
Pile Cross-Sectional Area	A_s	=	0.131	m2
Pile Tip Cross-Sectional Area	A_p	=	0.283	m2
Spacing of pile :	s	=	3.250	m
Factor of group pile :	η	=	0.942	
Pile Concrete Strength	f'_c	=	80	MPa
Concrete Unit Weight	γ_c	=	24.5	kN/m3
Effective Unit Weight of Soil layer over Top-Pile	γ_{0-eff}	=	7.0	kN/m3
Effective Soil Overburden Pressure at bott. pilecap	P_d	=	0.00	kPa
Depth of penetration in bearing strata(mm)	D_b		1670	mm



Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-12 PHC Pile Calculation Model Diagram and Input Date

(2) Review of Pile Type

A comparison for pile type was conducted in the F/S. In this section, JST reviewed the appropriateness of the F/S plan.

The comparison of pile type of the F/S is shown in Table 4.2-9.

Table 4.2-9 Comparison of Pile Type

Criteria	Reinforced concrete piles 350x350-450x450mm	Centrifugal pile Pre-stressed reinforced concrete D400-600	Bored pile D800-1000
Advantages	- Easy to work without high technology; - Piles can be cast in place, active in production and construction.	- Construction is relatively easy; - Long piles reduce the number of joints; - Higher load bearing capacity than reinforced concrete pile should reduce the number of piles, thereby reducing the time of construction; - Due to pre-stressed, the piles are not cracked during transportation and operation (especially in soft soil area); - Due to pre-stressed and use of concrete with the high density, the pile has good corrosion and erosion resistance; - By centrifugation, creating the hollow part of the pile helps reduce the weight of the pile itself.	- Load capacity by ground is large; - Ability to withstand strong cutting force and shock load; - Ability to penetrate hard soil layers interleaved; - Achieve great lengths to put in good soil.
Disadvantages	- Due to the lower load bearing capacity compared to the remaining two types of piles, the number of piles, time of production and construction will increase; - Difficult to control joint quality. Many pile joints also make the time of construction to be extended; - Difficult to cross the good geological layers interleaved (hard clay).	- Due to material properties and technological requirements (tension with centrifugal rotation), it must be produced in the factory and will reduce the initiative construction time and cost; - Depth is more limited than bored piles; - Difficult to control joint quality; - It is still difficult to overcome the good geological layers interleaved (hard clay). But it is easier than precast RC piles with steel pile tip attached to the body.	- For reinforced concrete floor structures that are not subject to heavy loads (impact of large vessels), the lower structure cost is much higher than the upper structure; - Large pile size so it will increase the size of the floor structure making the cost of construction increase.
Assessments		Recommendation for reinforced concrete floor structure and reinforced concrete box culvert.	

Source: F/S report for Xuyen Tam Canal Project

The result of JST's review for the pile type is shown in Table 4.2-10. As show in Table 4.2-10, JST considers the F/S plan for pile type is reasonable.

Table 4.2-10 Review Result of Pile Type

Criteria	Reinforced concrete piles 350x350-450x450 mm	Centrifugal pile Pre-stressed reinforced concrete D400-600mm	Bored pile D800-1000 Mm
Function · Performance	○	◎	◎
Characteristics of construction	○	○	△
Construction cost	○	◎	△
Environmental Considerations	△	△	◎
Actual results	○	○	○
Construction period	○	○	△
Comprehensive evaluation	○	◎	△

＊Explanatory notes ◎:Excellent , ○:Good , △Fair , ×No good

Source: Source: JICA Study Team

(3) Technical Standards and Design Methods

Pile foundation is calculated based on design standards of the road bridges 22TCN 272-05 and pile foundation design standards TCVN 10304:2014 in the F/S.

(4) Differences between the F/S and WEIP II

Pile capacity calculation of the F/S and WEIP II has difference on calculation formula as shown below.

a) For the F/S

2. CALCULTION

2.1. Resistance Factor ***(22TCN272-05: Table 10.5.5.2)***

λ_v = 0.800	Resistance Factor	Strength limit state		Extreme limit state	
		For Clay	For Sand	For Clay	For Sand
	Side Resistance	0.56	0.36	1.00	1.00
	Base Resistance	0.56	0.36	1.00	1.00

2.2. Shaft Resistance

For Cohesive soil: (Using the α - Method) ***(22TCN272-05: 10.7.3.3.2a-1)***

The normal unit side resistance: $q_s = \alpha S_u$

where: S_u : Mean undrained shear strength

α : Adhesion factor

For Cohesionless soil: 1 ***(22TCN272-05: 10.7.3.4.2b)***

("1" = For driven displacement piles, "2" = For nondisplacement piles)

For driven displacement piles qs = 0.0019N For nondisplacement piles qs = 0.00096N

where: N :Average(uncorrected) SPT blow count along the pile shaft (Blows/300mm)

2.3. Tip Resistance

For Cohesive soil:

The normal unit tip resistance: $q_p = 9 S_u$ ***(22TCN272-05: 10.7.3.3-1)***

for which: Su : Undrained shear strength of the clay near the pile base(MPa)

For Cohesionless soil:

(Pile resistance estimate based on in-situ tests-using SPT) ***(22TCN272-05: 10.7.3.4.2a)***

qp = 0.013NcorrDb/Dp < 0.4Ncorr

where: Ncorr = [0.77lg(1.92/s'v)]N

Ncorr: Represent SPT blow count near the pile tip corrected for overburden pressure

D: Pile width(mm)

Db: Depth of penetration in bearing strata(mm)

N: Uncorrected SPT blow count (Blows/300mm)

sv': Vertical effective stress (Mpa)

The nominal unit tip resistance, in Kpa

b) For WEIP II

B. Bearing capacity calculation

1 Applied formula

Qa = 1/3*(αNaAp+(0.2NsLs+CLc)πb)

a	Pile type :	Rectangular type		(In case of rectangular type, πb=4b)
b	Width : b	0.3	m	
c	Base length	**39.0**	m	
d	α : Coefficient	30		(30 for driving pile, 15 for drilling pile)
e	Ap : Pile cross sectio	0.09	m2	
f	Na	24	nos	(SPT value of soil layer under the pile tip
g	Ns	17	nos	(Statistical average of SPT number in zone of sand soil layer above the pile tip le\
h	Ls	10.0	m	(Length of pile in sand soil layer above the pile tip level)
i	C	1.3	T/m2	(Average cohesion of clay layer above the pile tip level)
j	Lc	29.0	m	(Length of pile in clay layer above the pile tip level)
	Qa =	50.28	T/nos	> 32.00 OK
	1.2*Qa =	60.34	T/nos	> 49.76 OK

(5) Review of Design

Reviewing the F/S, the design contents and JST's conclusions are as follows:

1) Design content

In design of pile foundation of the F/S, 22TCN 272-05 the Vietnam's road bridge standard and TCVN 10304:2014 pile foundation design standards were applied.

On the other hand, TCVN205:1998: pile foundation-specification for design" was applied for the pile foundation design of WEIP II.

Due to a difference of design year, they applied other application year of standard, however, both projects applied same standards for pile foundation design. Based on the applied standard, design calculation and result, JST considered the pile foundation design of the F/S is reasonable.

2) Conclusion

JST evaluates the F/S as follows:

- The advantage and disadvantage of reinforced concrete piles, pre-stressed concrete piles and bored piles, that are effective as foundation methods in items 4.2.4 (1) and (2), are compared and examined in detail.
- The design criteria and specifications of item 4.2.3 (3) are appropriate.
- In the bearing capacity design of item 4.2.4 (4), the F/S and WEIP II use a different piling formula. Design standard TCVN 10304: 2014 is used for the F/S and TCVN 205: 1998 is used for WEIP II as an available latest standard.

From these, the JST considers that the F/S's pile foundation design is generally appropriate.

4.2.5 Review Result of Road Embankment and Soil Improvement

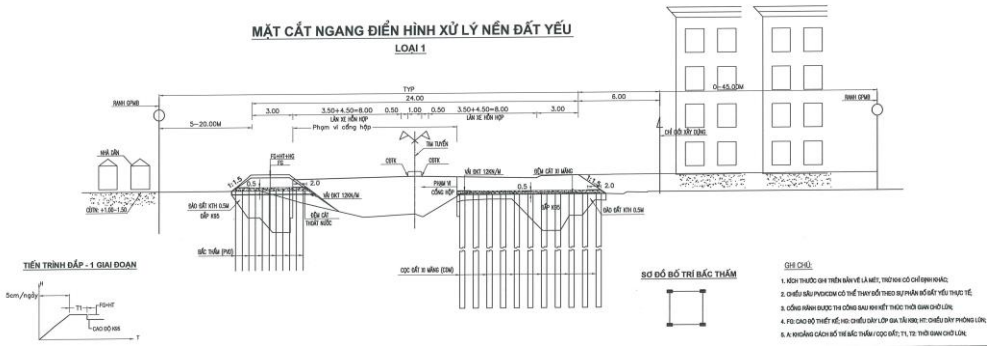
(1) Outline of the F/S Design

According to the geological investigation results in this stage, the soft soil layer appears in all boreholes, distributed below the embankment filling layer or garbage mud layer. With the geological condition of the soft soil layer along the road, the embankment filled directly on these layers will cause settlement, therefore it is necessary to study the soft soil treatment solution to ensure admissible settlement for embankment and construction works and to ensure the stability of the embankment.

Due to the geological condition, the F/S proposed vertical sand drain at first. However, with the sand drain method, the material source of medium-grain sand will be a big obstacle for the southern region because this kind of material is scarce and the price fluctuates. Therefore, it is difficult to ensure a stable supply. The construction of the sand drain will cause vibration that can damage/crack the structures around the study area. Accordingly, the solution of vertical drainage sand pile combining with additional surcharge filling will be difficult to apply to the study area.

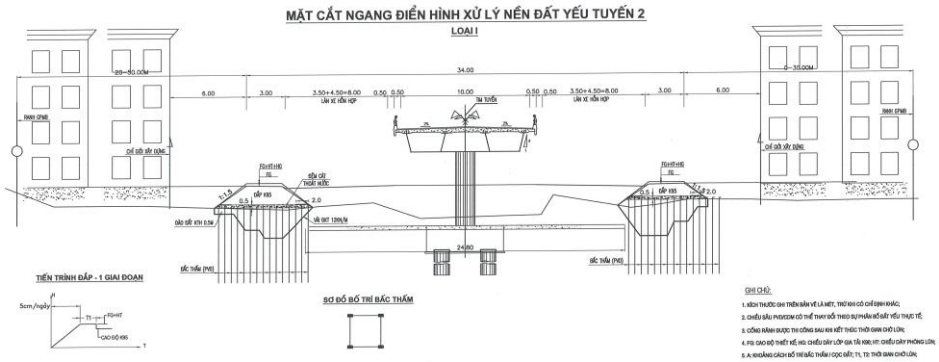
Considering the geological and surrounding condition, the F/S finally proposed cement deep mixing method (here in after CDM) and plastic vertical drain method (here in after PVD) for soft soil treatment. Also, CDM and PVD are applied for road section and sidewalk section respectively.

Typical cross sections of road embankment and soil improvement are shown in Figure 4.2-13, Figure 4.2-14 and Figure 4.2-15.



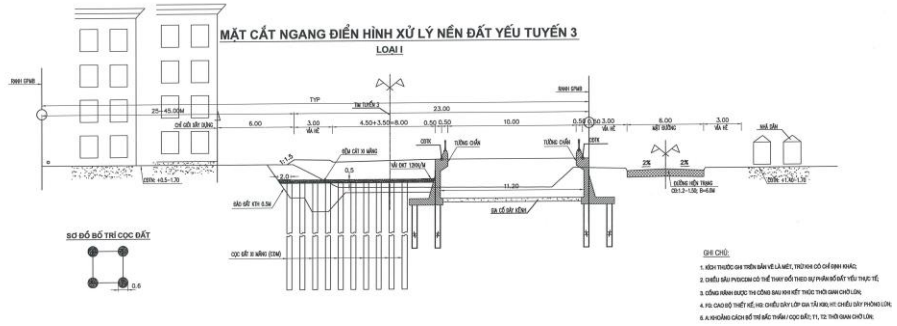
Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-13 Typical Cross Section of Soil Improvement -1 (PVD, CDM)



Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-14 Typical Cross Section of Soil Improvement -2 (PVD)



Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-15 Typical Cross Section of Soil Improvement -3 (CDM)

1) Road Embankment Height

- Line1 : h=3.5m (Right Bank) h=2.0-3.0m (Left Bank)
- Line2 : h=1.8-3.0m(Right Bank) h=1.8-3.5m(Left Bank)
- Line3 : h=2.3-3.0m(Right Bank) h=2.3-3.0m(Left Bank)
- Line4 : h=3.6-4.0m (Right Bank) h=3.6m(Left Bank)

2) Calculation Result of PVD Method

- Line1 : Interval=@1.0-1.1m , Total construction time=271-298days , Residual settlement S=0.06-0.08m , Consolidation rate U=93.4-94.3%
- Line2 : Interval=@1.0m , Total construction time=280-315days , Residual settlement S=0.05-0.07m , Consolidation rate U=93.7-94.4%
- Line4 : Interval=@1.0m , Total construction time=307-327days , Residual settlement S=0.07-0.08m , Consolidation rate U=94.5-95.2%

3) Calculation Result of CDM Method

- Line1 : Interval=@1.4m , Residual settlement S=0.08m , Safety factor Fs =1.73
- Line2 : Interval=@2.2m , Residual settlement S=0.05m , Safety factor Fs =1.46
- Line3 : Interval=@1.5-1.8m , Residual settlement S=0.05-0.07m , Safety factor Fs =1.64-1.77

(2) Review of Soil Improvement Method

The comparison for soil improvement method is conducted in the F/S. In this section, JST review an appropriateness of the F/S plan.

The comparison of soil improvement method of the F/S is shown in Table 4.2-11.

Table 4.2-11 Comparison of Soil Improvement Method

Method	Description	Applicable ability	Effectiveness	Cost	Impacts surrounding works
Option 1: Plastic vertical drain (PVD)	Water in soft soil shall drain vertically from the bottom up following plastic vertical drain (PVD) under the effect of filling load.	Favorable	Low	Low	None
Option 2: Sand drain (SD)	Water in soft soil shall drain vertically from the bottom up following sand drain (SD) under the effect of filling load.	Difficult	Low	Medium	Vibration to adjacent works
Option 3: Evacuated PVD	Water in soft soil shall drain vertically from the bottom up following PVD under the effect of evacuation load	Difficult	High	High	Impacts of settlement on surrounding works
Option 4: Concrete earth pile	Put an amount of concrete into the earth by mixing deeply to strengthen the soil layer;	Favorable	High	High	None

Source: F/S report for Xuyen Tam Canal Project

The result of JST's review for the soil improvement method is shown in Table 4.2-12. From this, JST considers the F/S plan for soil improvement method is reasonable.

Table 4.2-12 Review Result of Soil Improvement Method

Criteria	Option 1: Prefabricated vertical drain (PVD)	Option 2: Sand drain (SD)	Option 3: Evacuated PVD	Option 4: Concrete earth pile
Function · Performance	○	○	○	○
Characteristics of construction	○	○	○	○
Construction cost	◎	○	○	△
Environmental Considerations	△	×	△	◎
Actual results	○	○	○	○
Construction period	△	○	△	◎
Comprehensive evaluation	○	×	△	◎

＊Explanatory notes ◎:Excellent , ○:Good , △Fair , ×No good

Source: JICA Study Team

(3) Technical Standards and Design Methods

1) Main Roads in the Area

The project is designed with the speed of V = 50-60km/h. Therefore, calculation work is required to be compliance with Vietnamese Standard 22TCN 262 -2000.

2) Remaining Residual Resettlement

To ensure the smoothness of the embankment, the requirement for residual settlement must be satisfied by assessing the remaining settlement at the road centerline (Sr) after completion:

- Normal embankment section: Sr ≦40 cm;
- Embankment section with culvert or local underpass: Sr ≦30 cm;
- Embankment section near bridge abutment: Sr ≦20 cm;
- The transition embankment sections between the road and the bridge (culvert) should be ensured in accordance with the provisions of Document No.3095/QĐ-BGTVT dated 07/10/2013 regarding issuance of the provisional regulation on technical technology solutions transition embankment sections between the road and the bridge (culvert) on the highway.
- Within the treated depth scope, consolidation rate is required: U≧90%.

3) Slipping Stability

- Safety factor during construction of embankment: Fs1≧1.20 (according to Bishop method);
- Safety factor for exploitation: Fs2≧1.40 (according to Bishop method).

(4) Review of the Design

Reviewing the F/S, the design contents and JST's conclusions are as follows:

1) Design content

The F/S applied standard 22TCN 262-2000 to a design of road embankment with soil improvement. Moreover, in the calculation of the F/S, the permissible values of remaining residual resettlement, consolidation rate, slipping stability are satisfied the standard. For this reason, JST considers the design result for road embankment of the F/S is reasonable.

2) Conclusion

JST evaluates the F/S as follows.

- Efficiency, costs, and influence on surroundings by the sand drain method, sand pile construction method, plastic vertical drain method and cement deep mixing method, as for an effective method to cope with the soft ground in item 4.2.5 (1) and (2) of this report have been properly compared and reviewed.
- As stated in item 4.2.5 (3), the design residual settlement criterion of the F/Sis appropriate.

From these, JST considers that the F/S soft ground design measures are generally appropriate.

4.2.6 Review Result of Sewage Drainage System

(1) Outline of F/S Design

According to the zoning plan 1/2000, the local wastewater is divided into two basins, which lead to two different sewage treatment plants. The boundary between the two basins is the railroad, and the extension is Luong Ngoc Kien Street.

1) Basin 1

From Luong Ngoc Quyen street to Vam Thuat River, sewage shall be treated at the sewage treatment plant in Tham Luong - Ben Cat. Dimension of the culvert is from 600mm - 800mm. The main culvert route with dimension from D600mm to D800mm shall collect water from extension Luong Ngoc Quyen Street to Lang Canal opening, go along Lang Canal and be transferred to Tham Luong - Ben Cat Sewage Treatment Plant.

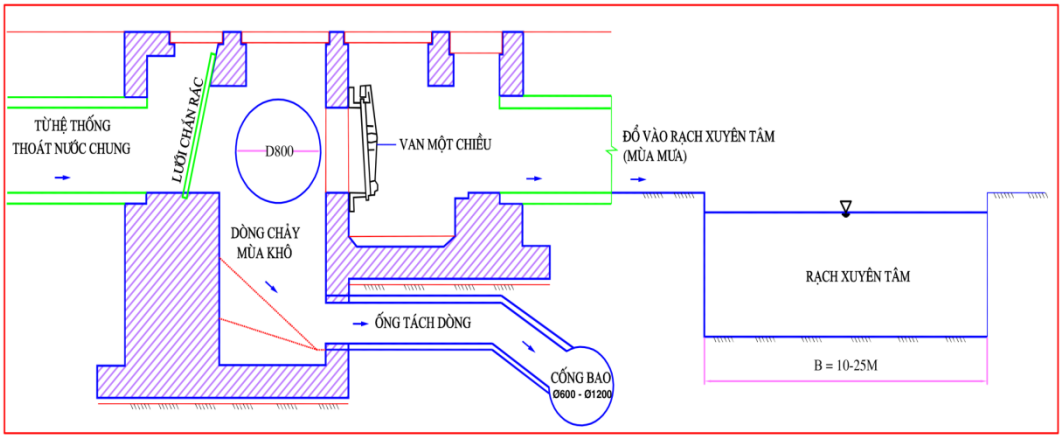
2) Basin 2

From Luong Ngoc Quyen Street to Nhieu Loc Thi Nghe Canal, sewage shall be treated at the basin sewage treatment plant in the Van Thanh Canal and Nhieu Loc Thi Nghe Canal T-junction. Dimension of the culvert is from D600mm to D1200mm with the slope of i=1/D. The main culvert route with dimension from D600mm to D1200mm shall collect water from Pham Van Dong Street, Binh Loi Tidal Gate, Binh Trieu Tidal Gate, go along the Xuyen Tam Canal, diverge to Bui Huu Nghia street, ending point of the culvert shall be connected with station C27A located at the corner of Bui Huu Nghia Street and Truong Sa Street. From this position, sewage is transferred to well S27 with well bottom elevation of -11.54m and flowed into culvert with diameter of D3000 under the Nhieu Loc thi Nghe Canal and transferred to Nhieu Loc Thi Nghe Pumping Station.

Regarding collection of wastewater and rainwater, the F/S proposed as below.

- All domestic wastewater and rain water of residential areas on both sides are flowed into the common drainage system D800 running along the road. Prior to pouring into the receiving source, the wastewater shall be separated by a diversion chamber. At this station, the water is divided into two parts, which flow in two separate directions: one shall be led to the treatment zone by interceptor sewer, and another which rainwater diversion sewer mixed with wastewater in admissible concentration shall be discharged into the main channel.

- In case of without rain, wastewater shall flow following the sewage diversion to 02 concentrated sewage treatment plants (Tham Luong – Ben Cat sewage treatment plant and Nhieu Loc Thi Nghe channel sewage treatment plant).
- When it starts raining, amount of rainfall is small and the impurity concentration in drainage mixture is high, rainwater and sewage shall follow interceptor sewer to the treatment plant. In the later period of rainfall, the amount of rainfall is high, then the impurity concentration in the drainage mixture will become smaller since mixture of wastewater is diluted with rainwater and led directly to the receiving source without treatment.
- Diversion chamber which separate sewage and rainwater is designed as Figure 4.2-16.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.2-16 Plan of Water Diversion Chamber

(2) Review of Design

1) Design content

Based on a site and document survey, the boundary of basin 1 and basin 2 is reasonable. In addition, the structure and function of the diversion chamber is almost same as WEIP II design. Due to these confirmations, JST considers the preliminary design of sewage is reasonable.

However, for cost estimation, it is necessary to confirm the construction method for deep sewer pipes. JST considers the main sewer pipe should be installed by pipe jacking method, because the depth of pipe becomes deeper than 6m.

2) Conclusion

JST Evaluates the F/S as follows.

- The drainage basin and rainwater discharge room of item 4.2.6 (1) are properly described.
- Details of the diversion chamber are the same as WEIP II.

From these, the JST considers that the design of sewage drainage system in the F/S is generally appropriate.

4.3 Review of Project Cost

4.3.1 Items for Which Additional Construction Costs are Anticipated

JST reviewed the construction cost of the F/S. Reviewing the report, it is appears that some items did not consider the actual construction conditions and traffic restrictions of HCMC. Regarding the bridge works, they refer to the prices of past ODA projects in Vietnam. The results of the review are shown below.

(1) Dredging Work

In the FS, the dredging work is estimated under the following conditions.

- Dredging is carried out by a 1.6m^3 excavator (backhoe). Dredged mud can be loaded directly into 10ton dump trucks and transported to Da Phuoc disposal area and dumped.
- The traffic restrictions are not considered for transportation of dredged mud.
- Distance from the project area to Da Phuoc disposal area is 17km.

Against the above, JST comments the followings;

- The width of the existing canal is more than 20m, except for some parts of Line 1, and a backhoe cannot reach the middle part of the canal; a clamshell is more appropriate.
- Vehicles 5tons or heavier are restricted to enter to the project area and transport routes from 6:00 to 24:00 in accordance with HCMC Decision No. 66/2011 / QD-UBND. Due to the limited working hours, the transport volumes of dredged mud are limited, which adversely affects the progress of the works.
- The distance from the project to the Da Phuoc disposal area is about 25km.
- Dredged mud is in a liquid state, so transport by dump truck is not suitable. Also, when the dump truck starts and stops or is in the slope, it is concerned that the dredged mud may be scattered on the urban road from the loading vessel of the dump truck, and serious environmental problems will also arise.

Transport of dredged mud by land is not realistic for the above reasons.

In accordance with the results examined by JST, it is extremely difficult to implement the dredging works by the method planned in the existing FS, and it is required to estimate the construction cost on the basis of a practical construction method.

JST selected the dredge and pneumatic transportation method as realistic construction method and estimate construction cost.

In this construction method, dredging is carried out with a backhoe of 0.35 m^3 or 0.6 m^3 mounted on a small size of plat barge, pumped dredged mud to the outside of the canal through a pressure feed pipe and an air pressure feeder installed on the canal water surface. The dredged mud is transported to Da Phuoc disposal area by barge. The Da Phuoc disposal area is currently managed and operated by Green Saigon Biological Technology Co. Ltd. and the unloading of dredged mud is done by this company for a fee.

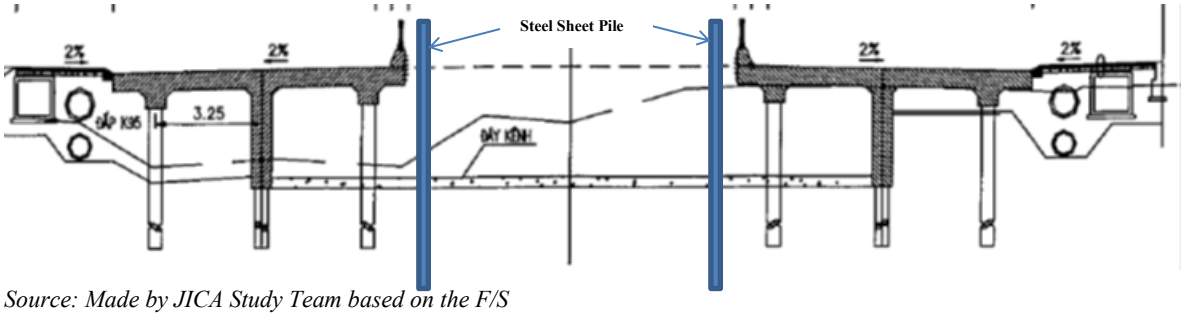
(2) Temporary Works to Maintain the Water Flow of Existing Canals

Since the existing canal functions as drainage channel of Binh Thanh District and Go Vap District, it is required to maintain these flow rates even during infrastructure construction on the canal. From the drawings in the FS, the existing water flow seems to be maintained by steel sheet pile cofferdam as temporary work, but there is no specific description, and its cost is not considered in the estimation.

JST selects the following four cases. The steel sheet pile wall is required for 3 out of 4 cases as a temporary cofferdam.

1) RC Floor on Both Banks

Where RC floor is constructed on both banks of the canal, two rows of steel sheet pile cofferdams shall be installed to maintain the flow of existing canal in the center part of the canal, structure works for RC floor is carried out both sides of the canal in dry condition.



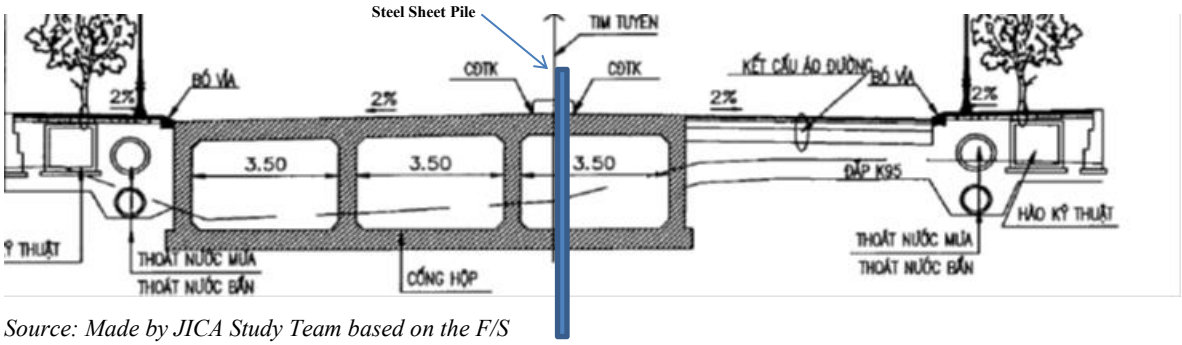
Source: Made by JICA Study Team based on the F/S

Figure 4.3-1 Image of Temporary Steel Sheet Pile (1)

2) Three Cell Box Culvert

Where three cell box culverts are constructed, one row of steel sheet pile cofferdam shall be installed in approximate middle of the canal. The flow of the existing canal is maintained in one side and two of three celled box culvert is constructed in the other side under dry condition.

After the completion of two cells of Box Culvert, the flow is diverted in the completed two cells and the other side is dried by dewatering for construction of the remaining one cell box culvert.

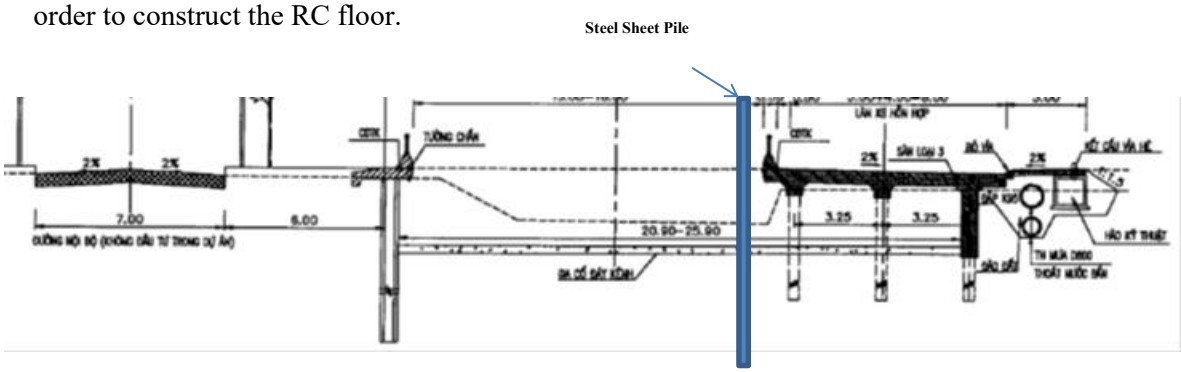


Source: Made by JICA Study Team based on the F/S

Figure 4.3-2 Image of Temporary Steel Sheet Pile (2)

3) RC Floor and PC Sheet Pile

Where the RC floor is constructed on one bank of the canal and PC sheet pile is constructed on the other bank, the flow of the existing canal is maintained between one row of steel sheet pile cofferdam and the PC sheet pile revetment at one side to keep the other side under dry condition in order to construct the RC floor.

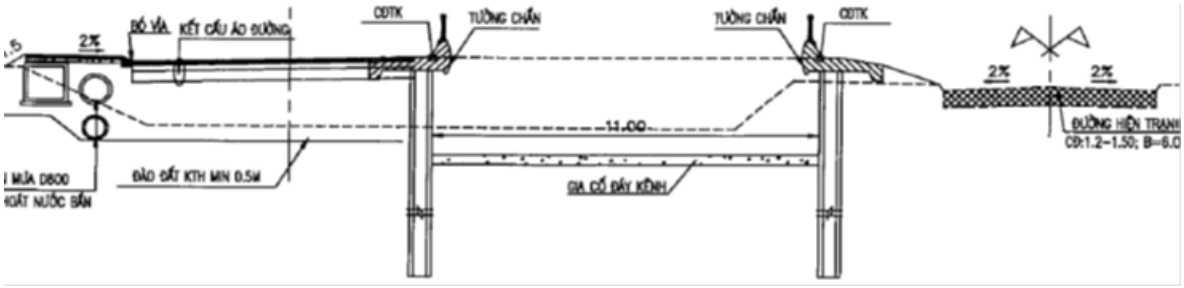


Source: Made by JICA Study Team based on the F/S

Figure 4.3-3 Image of Temporary Steel Sheet Pile (3)

4) PC Sheet Pile Revetment

Where PC sheet pipe revetment is constructed in both sides of bank, no particular temporary work is required.



Source: F/S report for Xuyen Tam Canal Project

Figure 4.3-4 Image of Temporary Steel Sheet Pile (4)

(3) Construction Cost for Wastewater Drainage

JST considers that the construction rates for wastewater drainage in the F/S are estimated low by the following reasons:

- Rates for rainwater drainage pipe and wastewater pipe are same in the same diameter in the F/S.
- According to Section 9.3.2.5 of the F/S, the pipe of 800mm diameter is designed on both sides along the road, and the rainwater from the project area is directly discharged to the rehabilitated canal. The installation depth of the pipe is approximate 5m or less, and it is constructed by the open-cut method.
- Meanwhile, wastewater passing through the diversion chamber and interceptor sewer pipe, the wastewater from Line 1, Line 2 and Line 4 is transferred to Nhieu Loc Thin Nghe Sewage Treatment Plant and the wastewater from Line 3 to Tham Luong-Ben Cat Sewage Treatment Plant treatment. The pipe diameters of the interceptor sewer pipe are 600mm - 1200mm with 6-10m deep.
- Since the depth of the interceptor sewer is 6m to 10m, the non-excavation method (Pipe Jacking Method) is adopted and the construction cost increases accordingly.

(4) Construction Cost of Bridge

The construction cost of the bridge is approximate VND 26.54 million/m^2 in accordance with the F/S. It seems to be inexpensive compared to the approximate rates for ODA projects in Vietnam

The additional cost is calculated from the construction cost calculated using the unit price of ODA project minus the construction cost of the F/S.

(5) Calculation Error in Construction Cost of PC Concrete Sheet Pile in Line 3

The construction cost of the PC concrete sheet pile in Line 3 is VND 204,701,388,161 in the summary of construction cost, of the existing FS, but correctly it is VND 403, 071, 388,161.

(6) Length of PC Concrete Sheet Pile

In the F/S, it is designed with PC sheet pile of 30 m in length, but it is considered that it is difficult to deliver in to the project area with this length.

- According to Section 11.2 of the F/S, the length of PC concrete sheet pile is about 30m.
- PC sheet pile revetment is presumed to be self-supporting (cantilevered), but it is considerably deflected and displaced substantially at the top of the pile sheet even though it is stable on the structure with a length of 30m (root insertion is around 27m).
- In accordance with the structural calculation of the JST, the length of PC sheet pile is about 20m (the embedded length is approximate 17m), but it is structurally stable with a deflection of 37mm. The PC sheet pile revetment is adopted except for Line 4, but it is expected that it is extremely difficult to bring PC sheet pile sheet of 30m length into the project area.
- In accordance with the investigation conducted by JST, PC concrete pile revetment has already been constructed by 18m long RC sheet pile at the revetment of Line 2 branching of Line 4 by the other contractor.

- Where it is difficult to deliver a long PC pile sheet, the shorter PC sheet pile with anchors shall be considered.
- If PC sheet pile length can be shortened, construction cost will be reduced, but the construction cost for anchor will be additionally required.

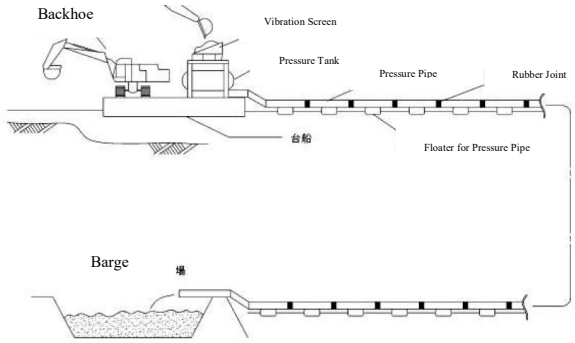
4.3.2 Estimation of Additional Cost

Calculation of additional cost is estimated for the above items as follows.

(1) Dredging Work

1) Construction Method for the Estimation of the Additional Construction Cost

Construction method that dredges with an excavator (backhoe) and transportation of the dredged mud with 10ton dump trucks in the existing FS is not practical. Here, the dredging work is implemented by a dredging and pneumatic transportation method with a small backhoe on a small plat barge and the dredged mud from Line 1 is pumped to Nhieu Loc Thi Nghe canal, Line 2 and Line 4 to Sigon River, and Line 3 to Van Thuat River. Furthermore, the dredged mud is transported to the Da Phuoc disposal area by barge.



Source: Japan Dredging and Pneumatic Transport Association

Figure 4.3-5 Image of Dredging Work

2) Construction Cost

Construction costs of each Line in the F/S are shown below.

Table 4.3-1 Dredging Cost of the F/S

Line No	Dredging Volume (m3)	Dredging Rate (VND/m3)	Dredging Cost (VND)	Transportation Rate (VND/m3)	Transportation Cost (VND)
Line 1	154,074	18,989	2,925,672,668	86,629	13,347,276,546
Line 2	82,781	18,989	1,571,907,714	86,629	7,171,235,249
Line 3	9,624	18,989	182,747,730	86,629	833,717,496
Line 4	70,678	18,989	1,342,086,873	86,629	6,122,764,462
Total	317,157		6,022,414,984		27,474,993,753
Total in JPY		89.42	28,359,552	407.94	129,379,746

Source: Made by JICA Study Team based on the F/S

Note: Exchange rate is 0.004709 JPY/VND

Construction by dredging and pneumatic conveying method is as follows.

Table 4.3-2 Cost for Dredging and Pneumatic Conveying Method

Line No	Dredging Volume (m3)	Dredging Rate (VND/m3)	Dredging Cost (1000VND)	Transportation Rate (VND/m3)	Transportation Cost (1000VND)	Unloading Rate (VND/m3)	Unloading Cost (1000VND)
Line 1	154,074	672,000	103,537,728	86,629	13,347,277	47,000	7,241,478
Line 2	82,781	672,000	55,628,832	86,629	7,171,235	47,000	3,890,707
Line 3	9,624	672,000	6,467,328	86,629	833,717	47,000	452,328
Line 4	70,678	672,000	47,495,616	86,629	6,122,764	47,000	3,321,866
Total	317,157		213,129,504		27,474,994		14,906,379
Total in JPY		3,169	1,003,626,834	408	129,379,746	221.32	70,194,139

Source: JICA Study Team

Note: Exchange rate is 0.004709 JPY/VND

Construction cost will increase dramatically due to the change of dredging method. Since the Da Phuoc disposal area is managed and operated by private enterprises, the costs will be the fee of unloading the dredged mud from the barge.

3) Additional Construction Cost of Dredger

Additional construction costs for dredging work are JPY 1,045,461,421 (= JPY 1,203,719 - JPY 157,739,298)

(2) Temporary Works to Maintain the Flow Rate of the Existing Canals

1) Quantity

The cost of the steel sheet pile cofferdam to secure the flow rate of the existing canal is appropriated as an additional cost. The steel sheet pile TYPE III of 10m length is used. One row or two row steel pile cofferdams are installed according to the layout of the structure.

The length of steel sheet pile cofferdam in the plan is as follows.

Table 4.3-3 Quantity of Steel Sheet Pile

Line No.	Length of steel sheet pile in the plan (m)	Number of Steel Sheet Pile (pce)	Weight of Steel Sheet Pile (ton)
Line 1	4,203	10,508	6,305
Line 2	5,920	14,800	8,880
Line 3	0	0	0
Line 4	3,000	7,500	4,500
Total	13,123	32,808	19,685

Source: JICA Study Team

2) Additional Cost

The length of the steel sheet pile is 10m and the embedded length is 7m. It is structurally self-standing and the length of the cantilever beam is 3m.

a) Material cost

19,685 ton x JPY 101,000 / ton = JPY 1,988,185,000

The steel sheet pile shall be re-used three times, and the reduced value is set at 40% of the purchase price after completion of construction.

Construction cost is JPY 1,988,185,000 x 60% / 3 = JPY 397, 637,000

b) Construction cost

JPY 1,500 / m for steel sheet piling installation unit price: 229,656m (32, 808 No. x 7m) for steel sheet piling cofferdam.

Extraction unit rate of steel sheet pile is JPY 600 / m

Construction cost is JPY 482,277,600 ((JPY 1,500 / m + JPY 600 / m) x 229,656m)

c) Additional cost
The total additional cost is JPY 397,637,000 + JPY 482,277,600 = JPY 879,914,600

(3) Construction Cost for Wastewater Drainage

JPY 260,000 / m is added as a construction cost to change as follows from the open-cut method to the non-open cut method (Pipe Jacking method) as follows.

Table 4.3-4 Cost for Wastewater Drainage

Line No	Length of Pipe (m)	Unit Cost (JPY/m)	Construction Cost (JPY)	Construction Cost (VND)
Line 1	2,906	260,000	755,560,000	160,450,201,741
Line 2	3,245	260,000	843,700,000	179,167,551,497
Line 3	1,580	260,000	410,800,000	87,237,205,351
Line 4	552	260,000	143,520,000	30,477,808,452
Total	8,283		2,153,580,000	457,332,767,042

Source: JICA Study Team

Note: Exchange rate is 0.004709 JPY/VND

The additional construction cost is JPY 2,153,580,000.

(4) Construction Cost of Bridge

In accordance with the investigation of JST, the approximate rates of the bridges of ODA projects in Vietnam are VND 30.00 million/ m^2 and VND 42.60 million / m^2 for concrete bridge and steel girder bridge respectively.

The bridge area of Line 1 and Line 2 is 5,760m^2/bridge. The construction cost is expected to be VND 245,376 million / bridge for the steel girder bridge.

Table 4.3-5 Cost for Bridge

No	Construction Cost in the F/S (VND)	Reviewed Construction Cost (VND)	Additional Construction Cost (VND)
Bridge 1	154,036,236,017	245,376,000,000	91,339,763,983
Bridge 2	151,679,006,749	245,376,000,000	93,696,993,251
Total	305,715,242,766	490,752,000,000	185,036,757,234

Source: JICA Study Team

Note: Exchange rate is 0.004709 JPY/VND

As above, the additional construction cost is VND 185,037 million (JPY 817.339 million)

(5) Error in Summary of Construction Cost of PC Sheet Pile in Line 3

The construction cost of the PC sheet pile in Line 3 is VND 204,701,388, 161 in the summary of construction cost, but correctly it should be VND 403,071,388,161. The difference VND198,370,000,000 shall be increased.

(6) The Length of PC Sheet Pile

The length of PC sheet pile length is likely to be shortened from 30m to 20m in accordance with the review of JST and its construction cost is considered to be reduced. However, no adjustment for the construction cost is considered in this report since additional cost may be occurred for additional provisions such as anchors, etc.

4.3.3 Construction Cost

Total construction cost including additional costs is summarized below.

Table 4.3-6 Construction Cost

Unit : Billin VND

		Valu After Tax				
		Line 1	Line 2	Line 3	Line 4	Total
1	Costs of compensaton, support and resettlement	1,736	648	141	357	2,882
	Within the boundary of building canals and roads	800	220	25	139	1,185
	Scope of construction of reciprocal projects and within planning boundary	936	428	116	218	1,697
2	Construction costs	1,568	1,861	623	956	5,008
3	Project management expenses, construction investment consultancy expenses, and other expenses (10%)	157	186	62	96	501
4	Provision expenses	692	539	165	282	1,678
	Provision for workload (10%)	346	269	83	141	839
	Provision for inflation (10%)	346	269	83	141	839
Total		4,153	3,234	992	1,691	10,069
					FS Report	8,465

Source: JICA Study Team

Table 4.3-7 Construction Cost for Line 1

Line 1 1 VND= 0.004709JPY

		Cost by FS for Line 1		Additional (million JPY)	Total (million JPY)	Ratio	Remarks
		Total (billion VND)	Total (million JPY)				
Bridge	Upper	97.9	460.8		460.8	6.24%	Adjust the cost based on other project unit cost
	Lower	37.8	177.8		177.8	2.41%	
	Retaing Wall	18.4	86.8		86.8	1.18%	
	Subtotal	**154.0**	**725.4**	**430.1**	**1,155.5**	**15.65%**	
Culvert & Slab Box Culvert	RC Structure	44.7	210.5		210.5	2.85%	Add the cost for temporaly steel sheet pile in order to secure the flow capacity during construction
	Pile	38.0	178.7		178.7	2.42%	
	PC Sheet Pile	0.3	1.6		1.6	0.02%	
	Pavement	1.8	8.4		8.4	0.11%	
	25% of Above Items	21.2	99.8		99.8	1.35%	
	Subtotal	**106.0**	**498.9**	**281.8**	**780.8**	**10.58%**	
Slab/PC Sheet Pile	RC Structure	181.6	855.3		855.3	11.59%	
	Pile	217.6	1,024.5		1,024.5	13.88%	
	PC Sheet Pile	73.1	344.0		344.0	4.66%	
	Railing	27.0	126.9		126.9	1.72%	
	Pipe Line D90	0.2	1.1		1.1	0.01%	
	Pavement	15.1	70.9		70.9	0.96%	
	25% of Above Items	128.6	605.7		605.7	8.20%	
	Subtotal	**643.1**	**3,028.3**	**0.0**	**3,028.3**	**41.02%**	
Preparation		**1.6**	**7.6**	**0.0**	**7.6**	**0.10%**	
Road and Canal	Road				0.0	0.00%	Dredging cost was changed based on other project unit cost Deep sewer pipe shall be constructed by Pipe Jacking Method, so unit cost was changed based on other project unit cost.
	Embankment	17.4	82.1		82.1	1.11%	
	Pavement	2.2	10.5		10.5	0.14%	
	Dredging & Revetment	38.0	179.1	507.9	687.0	9.31%	
	Soil Improvement	49.5	233.1		233.1	3.16%	
	Drainage	12.1	57.0		57.0	0.77%	
	Wastewater Pipe	88.2	415.2	755.6	1,170.8	15.86%	
	10% of Above 2 Items	10.0	47.2		47.2	0.64%	
	Road Marking	1.4	6.6		6.6	0.09%	
	Traffic Sign	6.2	29.1		29.1	0.39%	
	Subtotal	**225.1**	**1,059.9**	**1,263.4**	**2,323.4**	**31.47%**	
Other(1)		**9.6**	**45.3**		**45.3**	**0.61%**	
Other(2)	Pump	0.0	0.0		0.0	0.00%	
	Light	8.8	41.2		41.2	0.56%	
	Subtotal	**8.8**	**41.2**	**0.0**	**41.2**	0.56%	
Total		**1,148.2**	**5,406.7**	**1,975.4**	**7,382.1**	**100.00%**	

Source: JICA Study Team

Table 4.3-8 Construction Cost for Line 2

Line 2 1 VND= 0.004709JPY

		Cost by FS for Line 2		Additional (million JPY)	Total (million JPY)	Ratio	Remarks
		Total (billion VND)	Total (million JPY)				
Bridge	Upper	97.9	460.8		460.8	5.26%	Adjust the cost based on other project unit cost
	Lower	35.2	165.8		165.8	1.89%	
	Retaing Wall	18.6	87.6		87.6	1.00%	
	Subtotal	**151.7**	**714.3**	**441.2**	**1,155.5**	**13.19%**	
Culvert & Slab Box Culvert	RC Structure	18.4	86.6		86.6	0.99%	Add the cost for temporaly steel sheet pile in order to secure the flow capacity during construction
	Pile	15.8	74.3		74.3	0.85%	
	PC Sheet Pile	0.1	0.6		0.6	0.01%	
	Pavement	0.7	3.5		3.5	0.04%	
	25% of Above Items	8.8	41.3		41.3	0.47%	
	Subtotal	**43.8**	**206.3**	**396.9**	**603.2**	**6.88%**	
Slab/PC Sheet Pile	RC Structure	216.8	1,021.0		1,021.0	11.65%	
	Pile	243.0	1,144.4		1,144.4	13.06%	
	PC Sheet Pile	332.4	1,565.0		1,565.0	17.86%	
	Railing	19.3	90.7		90.7	1.04%	
	Pipe Line D90	0.3	1.4		1.4	0.02%	
	Pavement	15.1	71.0		71.0	0.81%	
	25% of Above Items	206.7	973.4		973.4	11.11%	
	Subtotal	**1,033.5**	**4,866.9**	**0.0**	**4,866.9**	**55.55%**	
Preparation		**1.9**	**8.7**	**0.0**	**8.7**	**0.10%**	
Road and Canal	Road				0.0	0.00%	Dredging cost was changed based on other project unit cost Deep sewer pipe shall be constructed by Pipe Jacking Method, so unit cost was changed based on other project unit cost.
	Embankment	28.2	132.6		132.6	1.51%	
	Pavement	2.6	12.0		12.0	0.14%	
	Dredging & Revetment	30.9	145.3	272.9	418.2	4.77%	
	Soil Improvement	21.7	102.3		102.3	1.17%	
	Drainage	10.8	50.9		50.9	0.58%	
	Wastewater Pipe	85.4	402.0	843.7	1,245.7	14.22%	
	10% of Above 2 Items	9.6	45.3		45.3	0.52%	
	Road Marking	1.4	6.4		6.4	0.07%	
	Traffic Sign	5.5	25.7		25.7	0.29%	
	Subtotal	**195.9**	**922.5**	**1,116.6**	**2,039.1**	**23.27%**	
Other(1)		**9.7**	**45.7**		**45.7**	**0.52%**	
Other(2)	Pump	0.0	0.0		0.0	0.00%	
	Light	9.1	42.9		42.9	0.49%	
	Subtotal	**9.1**	**42.9**	**0.0**	**42.9**	0.49%	
Total		**1,445.6**	**6,807.3**	**1,954.7**	**8,762.0**	**100.00%**	

Source: JICA Study Team

Table 4.3-9 Construction Cost for Line 3

Line 3 1 VND= 0.004709JPY

		Cost by FS for Line 3		Additional (million JPY)	Total (million JPY)	Ratio	Remarks
		Total (billion VND)	Total (million JPY)				
Bridge	Upper	0.0	0.0		0.0	0.00%	
	Lower	0.0	0.0		0.0	0.00%	
	Retaing Wall	0.0	0.0		0.0	0.00%	
	Subtotal	**0.0**	**0.0**		**0.0**	**0.00%**	
Culvert & Slab Box Culvert	RC Structure	0.0	0.0		0.0	0.00%	Add the cost for temporaly steel sheet pile in order to secure the flow capacity during construction
	Pile	0.0	0.0		0.0	0.00%	
	PC Sheet Pile	0.0	0.0		0.0	0.00%	
	Pavement	0.0	0.0		0.0	0.00%	
	25% of Above Items	0.0	0.0		0.0	0.00%	
	Subtotal	**0.0**	**0.0**	**0.0**	**0.0**	**0.00%**	
Slab/PC Sheet Pile	RC Structure	39.4	185.6		185.6	6.32%	
	Pile	0.0	0.0		0.0	0.00%	
	PC Sheet Pile	265.1	1,248.2		1,248.2	42.53%	
	Railing	18.0	84.6		84.6	2.88%	
	Pipe Line D90	0.0	0.0		0.0	0.00%	
	Pavement	0.0	0.0		0.0	0.00%	
	25% of Above Items	80.6	379.6		379.6	12.93%	
	Subtotal	**403.1**	**1,898.1**	**0.0**	**1,898.1**	**64.67%**	
Preparation		**0.0**	**0.2**	**0.0**	**0.2**	**0.01%**	
Road and Canal	Road				0.0	0.00%	
	Embankment	12.6	59.1		59.1	2.01%	Dredging cost was changed based on other project unit cost
	Pavement	8.5	39.9		39.9	1.36%	
	Dredging & Revetment	11.7	55.0	31.7	86.7	2.95%	
	Soil Improvement	53.0	249.6		249.6	8.50%	
	Drainage	3.4	15.9		15.9	0.54%	Deep sewer pipe shall be constructed by Pipe Jacking Method, so unit cost was changed based on other project unit cost.
	Wastewater Pipe	23.4	110.0	410.8	520.8	17.74%	
	10% of Above 2 Items	2.7	12.6		12.6	0.43%	
	Road Marking	0.3	1.5		1.5	0.05%	
	Traffic Sign	2.9	13.9		13.9	0.47%	
	Subtotal	**118.3**	**557.3**	**442.5**	**999.8**	**34.06%**	
Other(1)		**3.7**	**17.2**		**17.2**	**0.59%**	
Other(2)	Pump	0.0	0.0		0.0	0.00%	
	Light	4.2	19.8		19.8	0.67%	
	Subtotal	**4.2**	**19.8**	**0.0**	**19.8**	0.67%	
Total		**529.3**	**2,492.5**	**442.5**	**2,935.1**	**100.00%**	

Source: JICA Study Team

Table 4.3-10 Construction Cost for Line 4

Line 4 1 VND= 0.004709JPY

		Cost by FS for Line 4		Additional (million JPY)	Total (million JPY)	Ratio	Remarks
		Total (billion VND)	Total (million JPY)				
Bridge	Upper	0.0	0.0		0.0	0.00%	
	Lower	0.0	0.0		0.0	0.00%	
	Retaing Wall	0.0	0.0		0.0	0.00%	
	Subtotal	**0.0**	**0.0**		**0.0**	**0.00%**	
Culvert & Slab Box Culvert	RC Structure	0.0	0.0		0.0	0.00%	Add the cost for temporaly steel sheet pile in order to secure the flow capacity during construction
	Pile	0.0	0.0		0.0	0.00%	
	PC Sheet Pile	0.0	0.0		0.0	0.00%	
	Pavement	0.0	0.0		0.0	0.00%	
	25% of Above Items	0.0	0.0		0.0	0.00%	
	Subtotal	**0.0**	**0.0**	**201.2**	**201.2**	**4.47%**	
Slab/PC Sheet Pile	RC Structure	136.6	643.4		643.4	14.29%	
	Pile	186.2	876.9		876.9	19.48%	
	PC Sheet Pile	3.5	16.3		16.3	0.36%	
	Railing	19.7	92.7		92.7	2.06%	
	Pipe Line D90	0.2	0.8		0.8	0.02%	
	Pavement	12.2	57.5		57.5	1.28%	
	25% of Above Items	89.6	421.9		421.9	9.37%	
	Subtotal	**447.9**	**2,109.4**	**0.0**	**2,109.4**	**46.86%**	
Preparation		**1.2**	**5.5**	**0.0**	**5.5**	**0.12%**	
Road and Canal	Road				0.0	0.00%	
	Embankment	12.1	57.1		57.1	1.27%	Dredging cost was changed based on other project unit cost
	Pavement	0.0	0.0		0.0	0.00%	
	Dredging & Revetment	51.8	244.0	233.0	477.0	10.60%	
	Soil Improvement	12.5	58.7		58.7	1.30%	
	Drainage	7.8	36.9		36.9	0.82%	Deep sewer pipe shall be constructed by Pipe Jacking Method, so unit cost was changed based on other project unit cost.
	Wastewater Pipe	47.6	224.0	143.5	367.5	8.16%	
	10% of Above 2 Items	5.5	26.1		26.1	0.58%	
	Road Marking	0.6	2.9		2.9	0.06%	
	Traffic Sign	4.8	22.5		22.5	0.50%	
	Subtotal	**142.7**	**672.2**	**376.5**	**1,048.7**	**23.30%**	
Other(1)		**5.3**	**25.2**		**25.2**	**0.56%**	
Other(2)	Pump	230.8	1,087.0		1,087.0	24.15%	
	Light	5.3	24.7		24.7	0.55%	
	Subtotal	**236.1**	**1,111.8**	**0.0**	**1,111.8**	24.70%	
Total		**833.3**	**3,923.9**	**577.6**	**4,501.5**	**100.00%**	

Source: JICA Study Team

4.4 Review of Construction Schedule

4.4.1 Plan of Existing FS

Section 16.1.2 of the F/S describes the following process as a project execution plan.

- Stage 1: From the junction of the Lang Canal-Long Van Canal - Cau Son Canal to Luong Ngoc Quyen Street (along railway line) on the line (Line 2), and the extension distance is 2.635km.
  Construction period is 30 months starting in October 2018, completed in March 2021.
- Stage 2: From the junction of Lang Canal to the tidal gate Binh Loi and Binh Trieu (Line 4) and its extension distance is 1.65km.
  Construction period is 15 months starting in April 2021 and completed in June 2022.
- Stage 3: From Luong Ngoc Quyen Street (along the railway line) to the Vam Thuat River (Line 3), and its extension distance is 1.285km.
  Construction period is 15 months starting in July 2022, and completed in September 2023.
- Stage 4: From Cau Son Canal to the Nhieu Loc Thi Nghe Canal (Line 1) and the extension distance is 2.48km
  Construction period is 27 months starting in October 2023 completed in December 2025.

The construction schedule is summarized below.

Table 4.4-1 Construction Schedule by the F/S

Year		2018		2019				2020				2021				2022				2023				2024				2025			
Quarter Period		III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Stage 1	Line 2																														
Stage 2	Line 4																														
Stage 3	Line 3																														
Stage 4	Line 1																														

Source: JICA Study Team

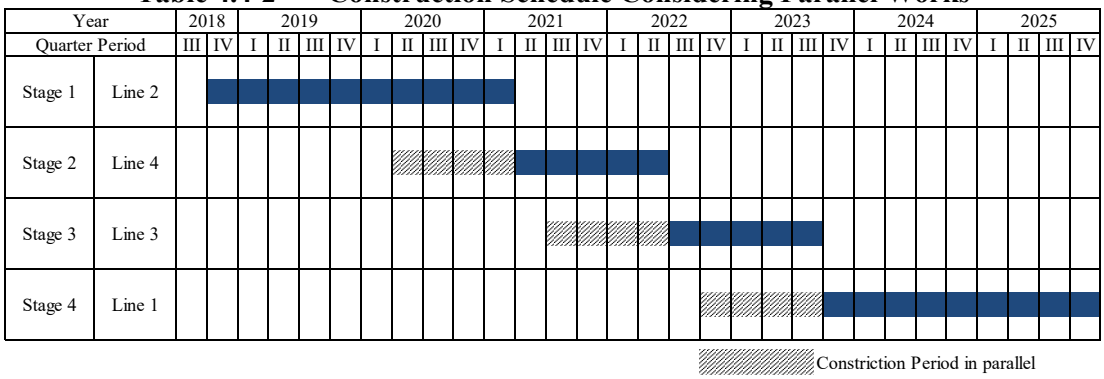
4.4.2 Comments on Existing FS Plan

The construction period of 15 months in Stage 2 (Line 4) is too short. In Line 4, vertical drains are required at 5 locations whose designed length is 0.52km out of the 2.48km length of the extension, and the construction period of the vertical drain work including the preloading period from the design is more than 10 months (316 days ~ 327 days). 15 months construction period of Line is not realistic. It is noted that the vertical drain is not designed in Stage 3 (Line 3).

In the construction schedule, it is shown that the next stage is started after completion of the previous stage, but in fact it is expected that two stages will be parallel construction, except the start of stage 2.

Similarly, Stage 1 and Stage 2, Stage 2 and Stage 3, Stage 3 and Stage 4 are assumed to be constructed in parallel.

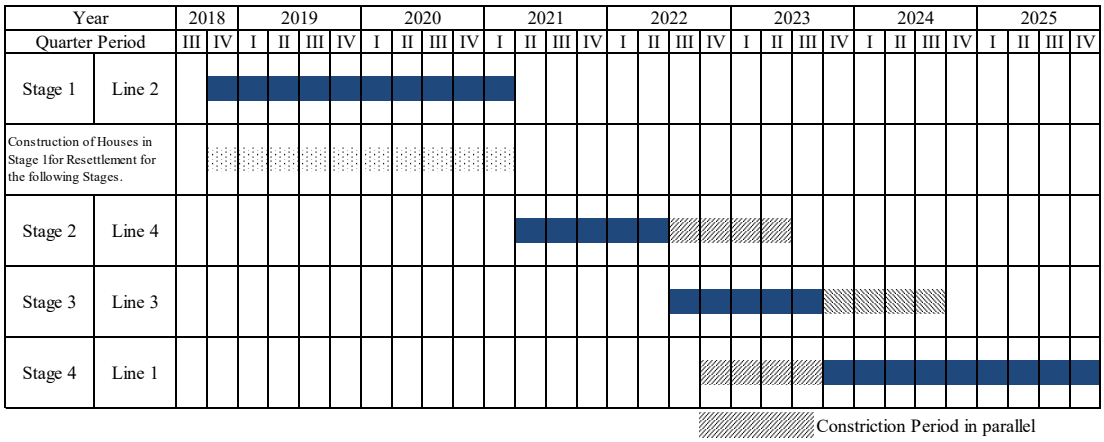
Table 4.4-2 Construction Schedule Considering Parallel Works



Source: JICA Study Team

JST understands that the residents of stage 1 shall be relocated to residential houses provided by Ho Chi Minh City, and the residential houses will be constructed by the developer for the residents to be relocated for stage 2 and the following stages of construction. Following the above construction sequence, the whole program is re-scheduled as follows.

Table 4.4-3 Re-scheduled Construction Schedule



Source: JICA Study Team

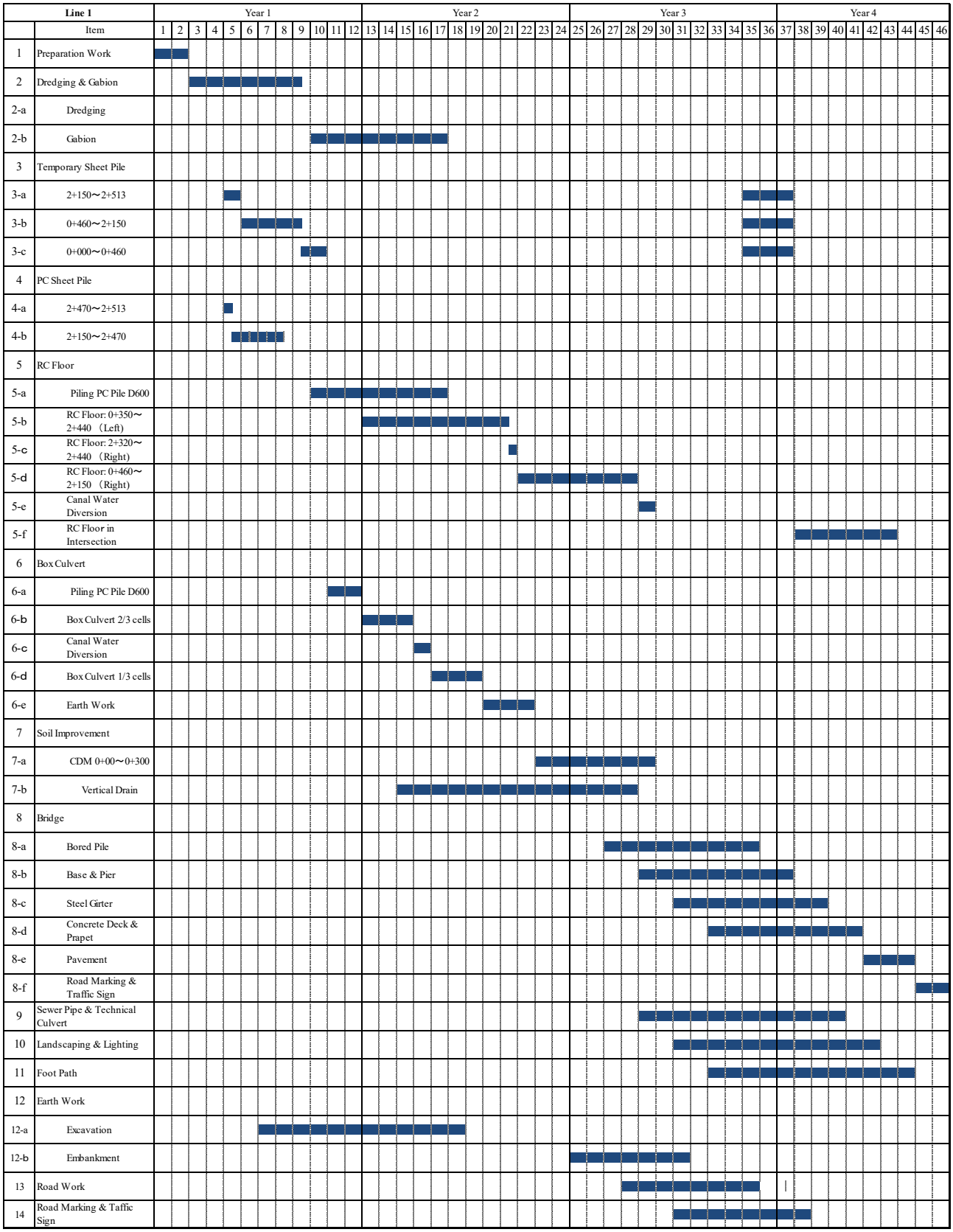
4.4.3 Realistic Construction Schedule

A realistic construction schedule is prepared in accordance with the following conditions.

- JST assumes the dredging and the pneumatic transportation method (dredging with backhoe and dredged mud transported by pneumatic transport pump into barge) is assumed to be employed, since it is difficult for the existing dredging method (dredging of backhoe and land transport by 10ton dump) assumed by the F/S to be carried out.
- In the FS, the CDM method (cement deep mixing method) and the PVD method (plastic vertical drain) are designed to minimize adverse effects due to consolidation settlement. For the PVD method, the preloading period is at least 10 months.
- Where RC floor is constructed on both sides with vertical drains in the foot pass area along RC floor, RC floor construction shall be concurrently carried out in both sides to shorten the construction schedule due to long construction period of PVD. Therefore, two rows of the temporary cofferdams are required.

In accordance with JST's evaluation, the construction period for each Line is 46 months for Line 1, 36 months for Line 2, 24 months for Line 3 and 36 months for Line 4. The construction schedule of each Line is shown below.

Table 4.4-4 Construction Schedule for Line 1



Source: JICA Study Team

Table 4.4-5 Construction Schedule for Line 2

Line 2		Year 1												Year 2												Year 3												Year 4			
	Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	Preparation Work																																								
2	Dredging & Gabion																																								
2-a	Dredging																																								
2-b	Gabion																																								
3	Temporary Sheet Pile																																								
4	PC Sheet Pile																																								
4-a	PC Sheet Pile																																								
4-b	Coping Concrete																																								
5	RC Floor																																								
5-a	Piling PC Pile D600																																								
5-b	RC Floor																																								
5-c	Water Diversion																																								
6	Box Culvert																																								
6-a	Piling PC Pile D600																																								
6-b	Excavation																																								
6-c	Box Culvert																																								
7	Bridge																																								
7-a	Bored Pile																																								
7-b	Base & Pier																																								
7-c	Steel Girter																																								
7-d	Concrete Deck & Prapet																																								
7-e	Pavement																																								
7-f	Road Marking & Traffic Sign																																								
8	Soil Improvement																																								
8-a	CDM																																								
8-b	Vertical Drain Left																																								
8-c	Vertical Drain Right																																								
9	Sewer Pipe & Technical Culvert																																								
10	Landscaping & Lighting																																								
11	Foot Path																																								
12	Earth Work																																								
12-a	Excavation																																								
12-b	Embankment																																								
13	Road Work																																								
14	Road Marking & Taffic Sign																																								

Source: JICA Study Team

Table 4.4-6 Construction Schedule for Line 3

Line 3		Year 1												Year 2												Year 3												Year 4			
ID	Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	Preparation Work																																								
2	Dredging & Gabion																																								
2-a	Dredging																																								
2-b	Gabion																																								
3	PC Sheet Pile																																								
3-a	PC Sheet Pile Left																																								
3-b	PC Sheet Pile Right																																								
3-c	Coping Concrete Left																																								
3-d	Coping Concrete Right																																								
4	Soil Improvement																																								
4-a	Earth Work																																								
4-b	CDM																																								
5	Earth Work																																								
5-b	Excavation																																								
5-b	Embankment																																								
6	Sewer Pipe & Technical Culvert																																								
7	Landscaping & Lighting																																								
8	Foot Path																																								
9	Road Work																																								
10	Road Marking & Traffic Sign																																								

Source: JICA Study Team

Table 4.4-7 Construction Schedule for Line 4

Line 4		Year 1												Year 2												Year 3												Year 4			
	Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	Preparation Work																																								
2	Dredging & Gabion																																								
2-a	Dredging																																								
2-b	Gabion																																								
3	Temporary Sheet Pile																																								
4	RC Floor																																								
4-a	Piling PC Pile D600																																								
4-b	RC Floor																																								
4-c	Water Diversion																																								
4-d	RC Floor in Middle																																								
5	Soil Improvement																																								
5	Vertical Drain : Left																																								
5-a	Vertical Drain : Right																																								
5-b	Sewer Pipe & Technical Culvert																																								
13	Landscaping & Lighting																																								
14	Foot Path																																								
15	Road Work																																								
16	Road Marking & Taffic Sign																																								
17	Earth Work																																								
18	Excavation																																								
19	Embankment																																								

Source: JICA Study Team

CHAPTER 5 CONFIRMATION OF FEASIBILITY BY BT PROJECT

5.1 Laws and Regulations regarding BT

5.1.1 Regulations on PPP and BT

The Decree No.15/2015/ND-CP on Investment under Public-Private Partnership Form dated February 2015, set forth the sectors, conditions, and procedures for implementation of projects developed under public private partnership (hereinafter referred to as PPP) and contains the following contents relevant to this BT Project. Based on the Decree No.15, 1) Xuyen Tam Canal project includes canal improvement and sewer system construction can be developed under PPP,and 2) the investor and the project enterprise can get some investment incentives, such as a) incentives on corporate income tax in accordance with the laws on corporate income tax, b) incentives in accordance with the laws on import and export duties for goods imported to implement a project, c) exemption from or reduction of land use fees for the area of land allocated by the State or exemption from or reduction of land rent for the whole project implementation term in compliance with the laws on land, and d) other incentives in accordance with the laws.

- Article 4. Investment project sectors and classification
  1. The projects on the construction, improvement, operation and management of infrastructural works, the supply of public equipment and utilities include:
  b) Lighting system; clean water supply system; water drainage system; sewage collection and disposal system; social housing; resettlement housing; cemetery;
- Article 55. Investment incentives
  1. Investors, the project enterprise shall be given the enterprise income tax incentives according to the laws on enterprise income tax.
  2. Goods imported for the execution of projects shall have opportunities to approach incentives according to the laws on export and import tax.
  3. Investors, project enterprises shall be entitled to exemption of land levies for the land allocated by the State or exemption from land rent during the execution of the project according to the laws on land.
  4. Investors, project enterprises shall be also entitled to other incentives according to the law.

After this Decree No.15/2015/ND was promulgated, the Prime Minister issued the Decision on Providing the Mechanism in June 2015 whereby the State[1] uses Land to Make Payment to Investors Implementing Construction Investment Projects in the Form of Build-Transfer (hereinafter BT) Contract. This Decision No.23/2015/QD-TTg provides the overall mechanism in the form of BT and took effect in August 2015.

- Article 3 provides the principles of BT scheme as "The use of land to make payment for a BT project shall adhere to the principle of parity and difference offsetting between the value of the BT project and the value of the land area used to make payment. The value of BT projects shall be determined in accordance with the law on construction investment; the value of land areas used to make payment shall be determined in accordance with the land law."
- Article 4 provides that investors may be allocated land with collection of land use levy or leased land with one-off rental payment for the entire lease period.
- Article 5 provides the difference offsetting procedures. In case the value of land area is valued higher than the value of such a project, the investor shall pay the difference in cash.

[1] State can be any level of government such as national government, city, district, and commune.

On the other hand, in case the project is valued higher than the value of the land area, the State shall pay a sum of money or use another land area to pay for the difference.

On 4 May 2018, the Government issued the Decree No. 63/2018/ND-CP on Public Private Partnership investment form to replace Decree No. 15/2015/ND-CP. Decree No.63/2018/ND-CP was in full force and effect from 19 June 2018. This decree enhances the investment sectors from 3 to 7 such as agriculture, education, and seems to reduce complicated administrative procedures and to clarify the tender procedures from the view point of transparency. The above contents Articles 4 and 55 in Decree No. 15/2015/ND-CP are unchanged as Article 4 and 59 in Decree No. 63/2018/ND-CP, respectively.

5.1.2 Land Valuations

In Vietnam private ownership of land is not permitted, however, the laws of Vietnam allow ownership of a right to use land called "Land Use Right" (hereinafter called as LUR). The State can allocate LUR by administrative decision to national entities only and the LURs can be subject to a land use fee or not, depending on the cases. In the case of PPP form, LUR is exempted during the whole operation period.[2]

Land price is determined in three situations: by the relevant People's Committee; via auction; or by land users upon transfer/lease, sublease of LURs, or contribution of LURs as capital. The Government determines land price based on the actual value of the land under normal circumstances. If there is a large discrepancy between their calculations compared to the market price, the Government must adjust the price.

The land valuation methods are specified in Circular No.:36/2014/TT-TNMT Details of Land Valuation Method; Building/Adjustment of Land Table; Specific Land Valuation and Advices to Determine Land Price.

The selection of land valuation method shall be based on the conditions stated in Clause 2 Article 5 of Decree No.44/2014/ND-CP according to Article 8, Circular No.:36/2014/TT-TNMT, as shown in the table below.

Table 5.1-1 Application of Land Valuation Method

No.	Name of Valuation Method	Condition of Application
1	Direct Comparison Method	• Comparable plots of land are sold on the market or at auction.
2	Subtraction Method	• Sufficient data on the real estate price on similar to the land sold or sold at auction is available.
3	Income-based Method	• Income and land use cost are already determined
4	Surplus-based Method	• Total estimated revenue and expenses for the land with development potential as a result of change of zoning or purposes of land can be determined
5	Co-efficient Method	• The State calculates the land use levy when the State allocates land or leases land with land use levy not through auction of land use rights, recognizes land use rights, or permits change of land use purposes for organizations that shall pay land use levy[1] • The State calculates the compensation amount upon land recovery by the State[1]

Note: 1. Limited to the case when the plot of the land is worth below VND 30 billion for centrally-run cities including HCMC, below VND 10 billion for land in highlands or below VND 20 billion for other provinces.
Source: Clause 4 Article 114 Land Law No. 45/2013/QH13, Clause 2 Article 5 and Clause 2 Article 18 Decree No. 44/2014/ND-CP

Considering the conditions, either the Surplus-based method or Co-efficient method will be applicable in this BT project.

[2] Land Regulations, Embassy of the Socialist Republic of Vietnam in the United States, checked on May 28, 2018 (http://vietnamembassy-usa.org/basic-page/land-regulations)

(1) Surplus-based Method

As described in Article 6, Circular No.:36/2014/TT-BTNMT, the land price of the lot is the difference between the net present value of the estimated total development revenues and costs assumed for the real estate. The total development costs include construction costs of real estate, technical and social infrastructure, temporary works, equipment costs, consultant costs, project management costs, sales and promotion costs, contingencies and other costs as regulated by laws, but does not include costs associated with compensation, support and resettlement.

(2) Co-efficient Method

The provincial People's Committee issues an official land price for each specific type of land every 5 years and the adjustment coefficient on the first of January every year. The official land price must not be 20% higher than the maximum price or 20% lower than the minimum price of the land price framework provided by the Government.[3]

In HCMC, the official land price applicable for the year was issued every year until 2014. These official prices are used as a base when the People's Committee allocates the land. Since 2015 it was changed that the land price is issued every 5 years and applicable for the next 5 years.

The currently effective Decision No.51/2014/QD-UBND determines the land price applicable from 1 January, 2015 through 31 December, 2019 as described in 5.3.2 in this Chapter. This official price is adjusted every year by the land price adjustment coefficients described in the decisions by HCMC PC. The latest coefficients as of December 2018 are determined by Decision No.: 09/2018/QD-UBND dated on 23 March 2018, "the Regulations on Price Adjustment Coefficient of 2018 of Land in HCMC". The applicable coefficient for this BT project area[4] is 1.9 in case the Government hands over land to an organization, without going through auction of land use right. If the land fronts onto more than two streets, the coefficient is incremented by 10%.

5.1.3 Tax Incentives

The project enterprises can enjoy corporate tax incentive for the income from the BT project. According to Circular No.78/2014/TT-BTC "Guiding the Implementation of the Government's Decree No.218/2013/ND-CP of December 26, 2013, Detailing and Guiding the Implementation of the Law on Enterprise Income Tax", the following tax incentives are applicable to this Project.

- Article 9 determines carry-forward of losses.
  1. Loss arising in a tax period is the negative difference of taxable income exclusive of losses carried forward from previous years.
  2. Enterprises that suffer a loss may carry forward continuously the whole loss to subsequent years' taxable incomes for five consecutive years, counting from the year following the year the losses arise.
- Article 17 provides the enterprise income tax rate for real estate transfer was reduced by 2% to 20% from the first of January, 2016.
- Article 19 provides project sections to which the preferential tax rate of 10% for 15 years is applied to incomes of enterprises from the implementation of new investment projects in the fields including investment in development of treatment of wastewater and drainage system.[5]

5.2 BT Project Scheme

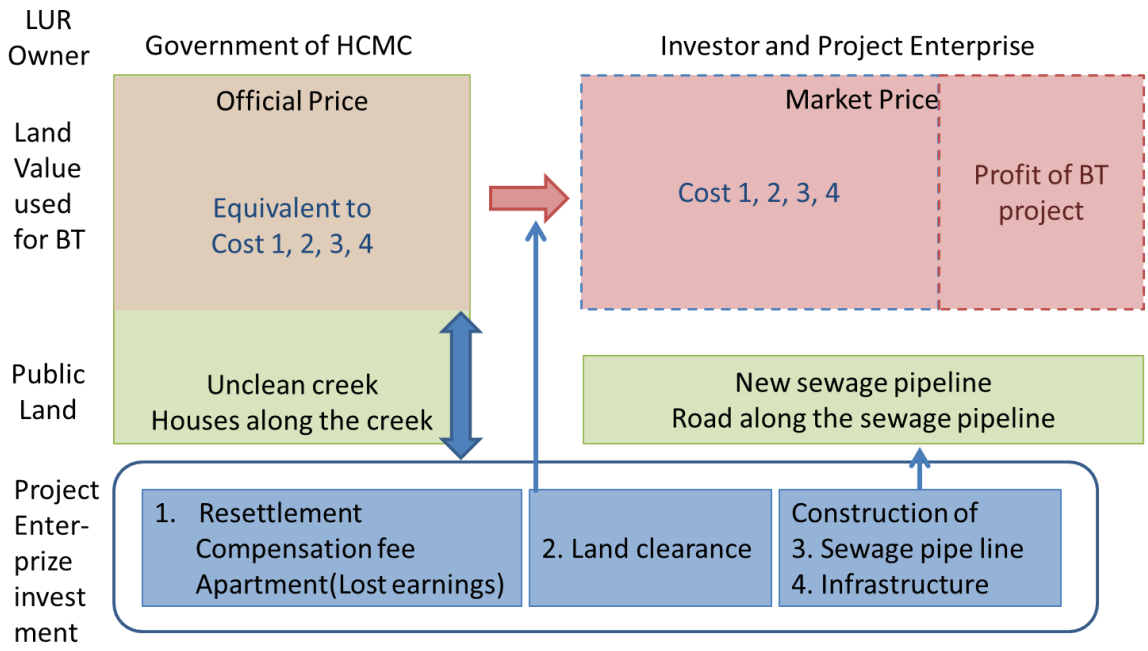
This BT project aims to install sewage and wastewater treatment and drainage systems such as interceptors for waste water to the land area allocated to make payment for the public works. The

[3] Land Regulations, Embassy of the Socialist Republic of Vietnam in the United States, checked on May 28, 2018 (http://vietnamembassy-usa.org/basic-page/land-regulations)

[4] Go Vap and Binh Thanh districts belong to Group 3, Area 2 in the classification.

[5] Circular No.78/2014/TT-BTC states that the preferential tax rate is applicable, and later, Circular No.96/2015/TT-BTC provides amendment as the preferential tax rate is applied.

project enterprises will also construct roads along the sewage pipelines and clear the land along the roads. The enterprises intend to make profit by raising the land value and selling it to real estate developers at a market price.
In this BT scheme, the land used for payment of the public works is along the canal owned by HCMC. Currently, it has almost no value other than for some people settling down without official approval. These land areas are cleared together with the canal for public works, and only infrastructures such as sewage pipelines and roads are transferred to HCMC and the remaining land is offered to the project enterprises as a payment for the resettlement including compensation, land clearance and infrastructure construction.
The Government of HCMC encourages compensating for resettlement even for these people who do not have official right for the land with the value close to the market price of the property.[6] The market price of the land is much higher than the official land price announced by HCMC PC.
In this BT scheme, compensation for resettlement is offered by a condominium developed on the target area. On top of that, each household is provided an agreed amount of cash to cover the living until a new condominium is built and provided. Project enterprises will make payments to the real estate developer for the condominiums used for resettlement by compensating for their lost earnings.
This BT scheme is shown as Figure 5.2-1.



Source: JICA Study Team

Figure 5.2-1 BT Scheme to Use Land for Payment for Public Works

5.3 Property Price Calculated by the Co-efficient Method

5.3.1 Official Land Price

The official land prices applicable for the co-efficient method of the land valuation from 2015 to 2019 are as follows. The land prices are listed by the name of street and the price under the road name which the land is fronting onto is applicable.
According to Decision No.51/2014/QD-UBND, the lower land rate bracket is applied to locations having no road frontage as follows.

- The location fronting onto at least an alley at least 5m wide equals 0.7 of the location with road frontage
- The location fronting onto at least an alley between 3m and 5m wide equals 0.56

[6] Interview with JLL Ho Chi Minh Office, 24 April, 2018.

- The remaining location equals 0.448

In addition, if the parcel of land is at least 100m away from the shoulder's inner edge of the road frontage, the land price shall be decreased by 10%.

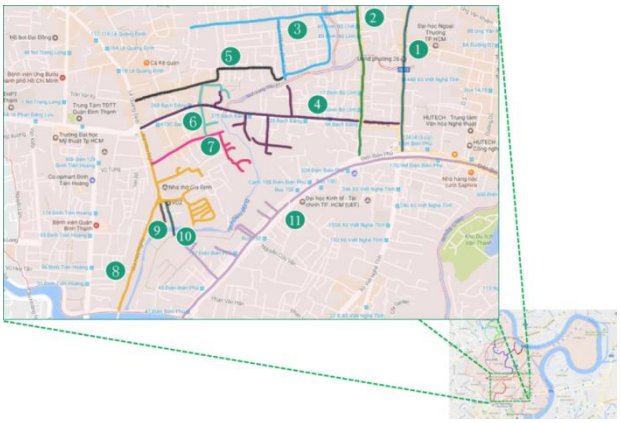
(1) Line 1 Area

Line 1 area is the south part of the target area and adjacent to the city center. Therefore, this area is relatively developed and the land value is high, especially 4. Bach Dang and 11.Dien Bein Phu.

Table 5.3-1 Official Land Price in Line 1

No.	Street Name	2015-2019 Price (mil VND/m^2)
1	Xo Viet Nghe Tinh	20.6
2	Dinh Bo Linh	23.1
3	Bui Dinh Tuy	23.6
4	Bach Dang	38.0
5	Huynh Dinh Hai	24.7
6	Phan Chu Trinh	22.0
7	Vu Tung	23.0
8	Bui Huu Nghia	28.1
9	Dong Da	13.6
10	Nguyen Xuan On	13.6
11	Dien Bien Phu	38.0
	Average	24.4

Source: Decision No. 51/2014/QD-UBND



Source: Survey Data by a Japanese Corporation

Figure 5.3-1 Location of Streets in Line 1 Area

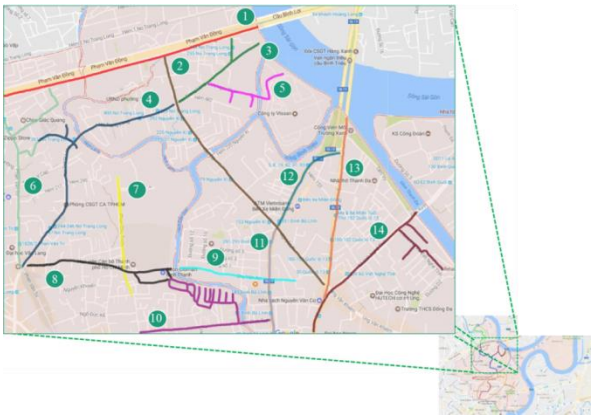
(2) Lines 2 and 4 Area

Lines 2 & 4 are located at the middle of the target area and have several major roads connecting the city center and the northeaster suburbs. The land value is relatively high along such major roads as 4. No Trang Long and 13. National Highway 13.

Table 5.3-2 Official Land Price in Lines 2 & 4

No.	Street Name	2015-2019 Price (mil VND/m^2)
1	Pham Van Dong	18.0
2	Nguyenxi	21.7
3	No Trang Long (1)	18.0
4	No Trang Long (2)	24.3
5	Vu Hgoc Phan	12.4
6	Phan Van Tri	18.0
7	Phan Chu Trinh	22.0
8	Chu Van an	20.8
9	Chu Van an	23.6
10	Bui Dinh Tuy	23.6
11	Dinh Bo Linh (1)	23.1
12	Dinh Bo Linh (2)	22.1
13	National Highway 13	24.0
14	Xo Viet Nghe Tinh	20.6
	Average	20.9

Source: Decision No. 51/2014/QD-UBND



Source: Survey Data by a Japanese Corporation

Figure 5.3-2 Location of Streets in Lines 2 & 4

(3) Line 3 area

The Line 3 area is in Go Vap District and at the north part of the target area. There is no major bridge across the Saigon River or arterial roadways. This area is relatively quiet and land value is lower than other areas.

Table 5.3-3 Official Land Price in Line 3

No.	Street Name	2015-2019 Price (mil VND/m^2)
1	Binh Loi	15.3
2	Duang Truc	14.6
	Average	15.0

Note: These roads are located in Binh Thanh District, but near the project area.
Source: Decision No. 51/2014/QD-UBND

Source: Survey Data by a Japanese Corporation

Figure 5.3-3 Location of Streets in Line 3

5.3.2 Market Price of Land

JST could obtain the current price for land for sale along some streets in the target area as of April 2018 and they are shown in the following table as compared to the official price. The market price is different depending on the land fronts a main street or an alley connecting to a main road.

Table 5.3-4 Comparison of Official and Market Price of Land

No. in the Figure	Street Name	Official Price (mil VND/m^2) (a)	Market Price (mil VND/m^2)		Price Comparison (c) / (a)
			in Alley Areas (b)	Along Main Street Areas (c)	
Line 1 No.4	Bach Dang	38.0	75 - 105	150 - 210	3.9 - 5.5
Line 1 No.11	Dien Bein Phu	38.0	75 - 100	150 - 200	3.9 - 5.3
Line 2 No. 1	Pham Van Dong	18.0	50 - 90	180 - 200	10.0 - 11.1
Line 2 No. 2	Nguyenxi	21.7	20 - 80	80 - 100	3.7 - 4.6
Line 2 No. 3	No Trang Long (1)	18.0	70 - 90	180 - 200	10.0 - 11.1
Line 2 No. 4	No Trang Long (2)	24.3	70 - 90	180 - 200	7.4 - 8.2
Line 2 No. 8	Chu Van An (1)	20.8	80 - 100	180 - 200	8.7 - 9.6
Line 2 No. 9	Chu Van An (2)	23.6	80 - 100	180 - 200	7.6 - 8.5
Line 2 No. 10	Bui Dinh Tuy	23.6	60 - 90	150 - 180	6.4 - 7.6
Line 3 No.1	Binh Loi	15.3	15 - 60	70 - 100	4.6 - 6.5
Line 3 No.2	Duang Truc	14.6	25 - 43	50 - 85	3.4 - 5.8

Source: Decision No. 51/2014/QD-UBND dated 31/12/2014, local real estate companies' homepage

Currently the market value of the land seems to be approximately VND 180 - 200 mil VND/m^2 for land adjacent to 4-6 lane major roads (2-3 lanes for each way) and VND 150 -180 mil VND/m^2 for two lane street (one lane for each way) in a busy area and VND 80 - 100 mil VND/m^2 for one-lane non-major street. Since this Project will construct an 8m-wide one-lane road along the canal and the land fronts on this road, the market value of the land will be assumed to be at least VND 80 - 100 mil VND/m^2, which is at least three times as much as the official land price.

5.3.3 Condominium Price

The real estate market has been doubled in the recent 10 years and is still expected to grow. Luxurious and high-end condominiums are supplied more than are in demand these days, therefore now the Government is promoting construction of mid-end condominiums to balance the demand and supply

in the real estate market.[7] Vin Group is shifting its main target to mid-end (USD 1,000/m^2) as high-end market (USD 1,500/m^2) has excess of supply.[8] Nevertheless, in HCMC, development of rental offices, housing such as condominiums and townhouses, commercial and resort areas appears promising.[9]

Condominiums are popular among young people because of the affordable price, convenience to the city center, and community network among residents in the same building. On the other hand, landed property such as villas and townhouses is popular because Vietnamese people believe that the land price is always increasing, and wealthy seniors prefer to buy and live in a landed property.[10]

(1) Existing Condominium in Binh Thanh District

There are numbers of new mid- and high-end condominiums in Binh Thanh District. The following table shows the sales price of recently completed condominiums.

Condominium development in this area has accelerated after 2010 and many condominiums are sold in market. High-rise condominiums with large apartments tend to sell at a higher price. It tends to cost more to construct high-rise buildings therefore, luxurious condominiums are developed at the higher floors. Even old condominiums built in such as 2005, 2006 and 2007 are still sold well at a similar price as new condominiums.

The selling price for the newest condominiums in 2016 is still stable and even increasing at second hand as the case of Saigores Plaza shows.

Table 5.3-5 Market Price of New Mid- and High-end Condominiums as of 2016

No.	Condominium Name	Maximum Height (floor)[1]	Number of Condo-minium	Condominium		Hand-over year
				Condomini-um area (m^2)	Price (USD/m^2)	
Handed over						
1	The HYCO4 Tower	16	330	53 - 132	USD 1,000 (2015)	2014
2	Saigon Pearl (Existing)	37	2,144	84 - 140	USD 2,550 (2016)	2010
	(Under construction)[3]	40	500	50 - 350	USD 2,100 (2016)	2019
3	City Garden[3]	30	927	69 - 355	USD 2,200(2009) USD 2,200(2016)	2012 2019
4	Dat Phuoug Nam	18	350	102 - 140	USD 600 (2004) USD 1,000 (2016)	2007
5	My Duc	21	440	43 - 113	USD 1,400(2015)	2010
6	Saigon Land	20	152	61 - 90	USD 1,200 (2014)	2015
7	Samland Riverview	12	70	84 – 89	USD 1,300 (2014) USD 1,500 (2016)	2013
8	SGC Nguyen Cuu Van	14	104	50 - 94	USD 1,150 (2013)	2013
9	Sunny Plaza	16	235	67 - 129	USD 1,100(2013)	2016
10	Morning Star Plaza	18	203	84 - 310	USD 900(2011)	2011
11	Soho Riwerview	18	105	58 - 117	USD 1,300(2015)	2016
12	The Manor	32	1,049	33 – 270	USD 3,000(2016)	2006
13	Pearl Plaza (SSG Tower)	18	123	55 -122	USD 2,100(2014)	2015
14	Thanh Da View	20	136	69 - 132	USD 1,200(2013)	2013
15	Cantavil Cau	18	203	120 - 153	USD 2,350(2011) USD 1,800(2014)	2010
16	4S2 Riverside Linh Dong	15	1,116	70 -81	USD 800 (2015)	2016
17	Vinhomes Central Park	60	10,000	NA	USD 2,200(2016)	2016
18	My Phuoc	18	544	41 - 93	USD 1,100(2016)	2005
19	Phu Dat	16	125	59 - 106	USD 1,000(2016)	2011
Started sales but not handed over						
21	Richmond City	25	300	66 - 87	USD 1,400 (2016)	2019

[7] Mr. Le Hoang Chau, Chairman of the HCMC Real Estate Association (HoREA), 14 December, 2017

[8] Mr. Le Khac Hiep, Vice Chairman of in Group, 14 December 2017.

[9] Mr. Le Hoang Chau, Chairman of HoREA, 14 December, 2017

[10] Interview with JLL Ho Chi Minh Office, 24 April, 2018.

22	Wilton Tower	22	494	58 - 98	USD 1,500 (2016)	2018
23	Samland Riverside	22	138	48 - 245	USD 1,500(2016)	2018
24	Tecco Central Home	15	100	59 - 97	USD 1,500 (2016)	2017
25	Saigores Plaza[4]	22	302	65 - 92	USD 1,100(2016)	2017
26	Sunwah Pearl	50	1,300	52 - 124	USD 2,250 (2016)	2019
27	Elite Park	24	208	61 – 134	USD 1,600 (2016)	2018
8	Soho Premier	14	168	63 - 95	USD 1,200 (2016)	2017

Note: 1. Hight of the tallest building
2. First takeover year if the condominiums were taken over in several phases.
3. Part of Saigon Pearl and City Garden were on sale but not handed over as of 2016.
4. Unfurnished 65 – 71 m2 Saigores Plaza apartments were on resale at second hand at approximately USD1,500/ m2 in April 2018.
Source: JST, Survey Data by a Japanese Corporation

5.4 Adequacy of BT Scheme

5.4.1 Land Value used for Payment

This BT Project aims to construct drainage systems and water collection systems for HCMC by clearing the site along the canal, including compensations for the people living on site, and building an 8m wide road on both sides of the canal. Payment for the public works will be made by allocation of a part of the cleared land and the project.
The HCMC PC allocates land equivalent to the cost of such works. The land value shall be assessed and adjusted to market value by HCMC PC. Since the site is left devastated and besides the approximately 1,500 illegal residents who built simple housings along the canal, nobody is considered to be able to utilize the land in its the current state. Therefore, it is reasonable to assume that the adjusted official price of the land used for BT payment, either surplus-based method or co-efficient method, is not as high as the market value of the neighboring areas which are in a good condition, but still close to the official land price.

5.4.2 Cost of Resettlement and Public Works

Resettlement is necessary but often a bottleneck of such an infrastructure project since the residents do not like to change their living and insist their right for full compensation. If they are offered a nice but distant place, they do not like to move far away from their workplace or/and school. Furthermore, HCMC PC encourages compensating for the living nearly equivalent to the market price of the housing even for illegal residents.[11]
In this Project, the compensation is considered in two steps. The residents are offered a new condominium when a new condominium is built on the area, but it takes time for construction. Therefore, at first, they are offered one-time a cash compensation based on the government formula as a temporary living until a new condominium is built and ready for move in. In this way, since the condominium has a market value, they can receive compensation at a market value and live in the same area. If they prefer cash, they can sell the condominium at the market value. The Project starts from Line 3, which has the fewest number of housings among four Lines and by the time the area with large number of housings starts resettlement, new apartment may be available in Line 3 area and people can move in there directly.
The condominium offered as compensation will be a part of condominiums built by the developers who purchase the land from the project enterprises. They could have sold the condominiums instead without the compensation. Therefore, this lost profit will be considered as a part of resettlement and discounted from the selling price of the land to developers.

5.4.3 Assessment of the Land Value as Payment of the Public Works

Assessment of the feasibility study by JST shows that relatively large area available for real estate development can be created along the canal and that the total land value for the cleared area available

[11] Interview with JLL Ho Chi Minh Office, 24 April, 2018, and Chapter VI, Land Recovery, Land Requisition, Compensation, Support and Resettlement, Land Law No. 45/2013/QH13.

after the public works is expected to be in the range of the estimated total BT project cost composed of resettlement, public works and land clearance. Therefore, BT Project will not need to bear additional payment to HCMC PC for allocation of the cleared land.

5.4.4 Prospects of Potential Developers

Project enterprises of this BT Project aim at earning profit by selling the land at a higher price, assuming that the new infrastructure facilities such as water treatment systems and road network and land preparation can contribute to the increase of the market value of the area.
According to the JICA Study, there are many new condominium developments in this area and these apartments have been sold at a good price. Since the real estate market is still growing, it is considered to be reasonable that the newly created land is attractive for real estate developers for new development of housing, offices and commercial facilities.
Furthermore, the project enterprises are entitled to preferential tax rate of 10% for income from the new investment in water treatment and drainage system projects.
As such, this BT scheme is considered adequate for both HCMC PC as a scheme to implement public works and for project enterprises as a business scheme.

5.5 Considerations for Land Acquisition and Involuntary Resettlement

5.5.1 Summary of Land Acquisition and Involuntary Resettlement

Based on the existing F/S of Xuyen Tam Canal project, a summary of land acquisition and involuntary resettlement for each line is shown in Table 5.5-1.

Table 5.5-1 Summary of Land Acquisition and Involuntary Resettlement

Line (Zone)	Area for Land Acquisition (m^2)	Area for Resettlement (m^2)	Households to-be-resettled	Estimated No. of Resettled Persons[1)]	Remarks
Line 1 (Zone 4)	120,627	73,243	1,373	5,629	The area of land acquisition and resettlement incudes road, canal and development.
Line 2 (Zone 1)	173,436	25,169	426	1,747	
Line 3 (Zone 3)	76,860	5,976	141	578	
Line 4 (Zone 2)	103,517	12,147	169	693	
Total	**474,440**	**116,535**	**2,109**	**8,647**	

Source: existing F/S report for Xuyen Tam Canal project and JICA Study Team
1): Estimated number of persons to-be-resettled is calculated based on the number of households to-be-resettled (2,109) and average population in each household (4.1 person/household, statistical data in 2011). (2,109×4.1=8,647).

5.5.2 Key Principles of JICA Policies on Land Acquisition and Involuntary Resettlement

The key principles of JICA policies on involuntary resettlement are as follows:

1) Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
2) When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
3) People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.

4） Compensation must be based on the full replacement cost[12] as much as possible.
5） Compensation and other kinds of assistance must be provided prior to displacement.
6） For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
7） In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.
8） When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
9） Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
10） Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, as it is stated in the JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principles based on World Bank OP 4.12 are as follows.

1） Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.
2） Eligibility of Benefits include, the PAPs (Project Affected Persons) who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
3） Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
4） Provide support for the transition period (between displacement and livelihood restoration).
5） Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
6） For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

[12] Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

In addition to the above core principles of the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

5.5.3 Recommendation for Resettlement Action Plan Preparation Based on JICA Guidelines

As shown in Table 5.5-1, it is estimated that the total number of persons to-be-resettled for the Xuyen Tam Canal project would be over 8,600. According to the JICA Guidelines for Environmental and Social Considerations (April, 2010), the project that entails land acquisition or involuntary resettlement of more than 200 people will be categorized as "Category A" and a full scale resettlement action plan (RAP) has to be prepared.

Structure and content of the resettlement action plan required by JICA Guidelines are summarized in Table 5.5-2. It is also recommended that a local consultant with experience in preparing RAP for WB projects should be employed. The consultant should support developer or UCCI in conducting baseline survey (population census, socioeconomic survey and assets inventory, etc.) and preparing RAP by following Vietnamese laws and OP 4.12 of World Bank.

Table 5.5-2 Summary of Resettlement Action Plan (RAP) Required by JICA Guidelines

Item	Contents	Evaluation on Existing F/S Report
1. Introduction	1) Briefly describe the project. 2) List project components including associated facilities. 3) Describe project components requiring land acquisition and resettlement 4) Give overall estimates of land acquisition (area in m^2) and resettlement (number of displaced persons)	This part can be almost completed based on the existing F/S report. The number of persons to-be-resettled should be identified.
2. Legal Framework	1) Describe all relevant Vietnamese laws and customs that apply to resettlement. 2) Identify gaps between Vietnamese laws and World Bank policies, and describe or propose project-specific mechanisms to address conflicts. 3) Describe method of valuation used for affected structures, land, trees, and other assets, measures to restore livelihoods of displaced persons.	This part can be almost completed based on the existing information. Detailed analysis of the gaps between Vietnamese and World Bank polies should be conducted.
3. Necessity of Land Acquisition and Resettlement	1) Describe project components required land acquisition and involuntary resettlement, describe affected area. 2) Describe efforts made to avoid or minimize involuntary resettlement (such as alternatives study etc.). 3) Describe the results of these efforts. 4) Describe mechanisms used to minimize displacement during implementation.	Affected area is identified. However, no alternative study was shown in the existing F/S report. Alternative study to avoid or minimize involuntary resettlement should be shown in RAP in future.
4. Census and Socioeconomic Surveys	Results of census and socioeconomic surveys should include: 1) Current occupants of the affected area to establish a basis for the design of the RAP (cut-off date setting). 2) Assets inventories (land, structure, shops, public facilities, trees etc.). 3) Economic activity, living standard and income of each affected household.	Information of PAPs and asset inventories is shown in the existing F/S report. However, no information for economic activity, living standard and income of each affected household is shown in the F/S report.

Item	Contents	Evaluation on Existing F/S Report
5. Compensation Policies and Income Restoration	1) Definition of displaced persons and criteria for determining their eligibility for compensation and other resettlement assistance, including relevant cut-off dates. 2) The methodology to be used in valuing losses to determine their replacement cost; and a description of the proposed types and levels of compensation under Vietnamese law. 3) If some gaps between replacement cost and compensation policy specified by the PC of HCM are identified, measures to bridge such gaps should be proposed. 4) Describe measures (such as credit facilities, job training and creation etc.) to improve livelihoods and living standards of resettled persons or at least to restore them to pre-resettlement levels. 5) Prepare entitlement matrix (including type of loss, entitled persons, entitlement, implementation issues/guidelines and responsible organization)	No information for compensation policies and income restoration is shown in the F/S report.
6. Development Plan of Relocation Sites	1) Relocation sites should have locational advantages. 2) Describe the plan to provide housing, infrastructure (e.g., water supply, feeder roads), and social services (e.g., school, health services). 3) Describe the environmental impact assessment (EIA) of relocation site, measures to mitigate and manage these impacts.	No relevant information is presented in the F/S report. However, development of relocation sites is progressing and over 700 houses are ready for resettled households.
7. Grievance Redress Mechanism	Describe the step-by-step process for registering and addressing grievances considering ease, convenience, reliability (ward PC, district PC and HCM PC).	No relevant information is shown in the F/S report.
8. Implementation Structure	1) Identify agencies (implementation organization, location government, consultants, NGOs etc.) responsible for delivery of resettlement measures. 2) Clarify the responsibilities of each agency. 3) Evaluate the capacity of each implementing agency responsible for resettlement.	No relevant information is shown in the F/S report.
9. Resettlement Schedule	1) Prepare a month-by-month implementation schedule (using a bar chart, for example) of activities to be undertaken as part of resettlement implementation. 2) Describe the linkage between resettlement implementation and initiation of civil works for each of the project components.	No relevant information is shown in the F/S report.
10. Costs and Budgets	1) Prepare tables showing itemized cost estimates for all resettlement activities, including compensations for land, houses, trees and other assets; development of relocation sites; support for transportation; allowances for inflation and population growth; management and administration (personnel costs, training costs and monitoring costs etc.); income restoration; and other contingencies. 2) Prepare timetables for overall expenditures. 3) Clarify sources of funds.	All information for costs except income restoration is summarized in the F/S report. However, unit price of compensation for lands and houses should use the latest market price.
11. Monitoring and Evaluation	1) Describe the internal/performance monitoring process including monitoring form preparation. 2) Define key monitoring indicators derived from baseline survey. Provide a list of monitoring indicators that will be used for internal monitoring. 3) Define methodology and indicators for external monitoring. 4) Describe arrangements for final external evaluation.	No relevant information is presents in the F/S report. Examples for monitoring forms are proposed in Table 5.5-3 to Table 5.5-6.

Item	Contents	Evaluation on Existing F/S Report
12. Participation and Consultation	1） Describe the strategy for consultation with and participation of resettled persons and hosts (relocation sites) in the design and implementation of the resettlement activities. The strategy should include: a) Analysis of various stakeholders b) Outlines of preliminary design of the project and alternative study. c) Results of census and socioeconomic surveys. d) Resettlement action plan (RAP) including compensation policies for lost assets and eligibility for compensation. e) Focus group discussion with socially vulnerable people (such as women and children, the elderly, those below the poverty line, ethnic minorities, disabled people) f) Measures for income restoration g) Grievance redress mechanism and monitoring system 2） Relevant records for participation/consultation including a) Date and time b) Venue c) Consultation method (meeting or individual interview) d) Number and organization of participants e) Consultation contents and comments from participants f) Response of implementing organization g) Describe how the comments received were reflected to the RAP.	No relevant information is shown in the F/S report.
13. Annex	1） Copies of census and surveys 2） Affected households' inventory and asset inventory etc. 3） Information on all public consultation including announcements and schedules of public meetings, meeting minutes, and lists of attendees 4） Related maps, drawings and photos etc.	

Source: JICA Study Team

Related monitoring forms are shown in Table 5.5-3 to Table 5.5-6.

Table 5.5-3 Public Consultations Monitoring Form

No	Date / Time	Organizer	Venue	Consulted Issues / Comments / Response
1				
2				
3				

Public Consultations are held as needed.
Source: JICA Study Team.

Table 5.5-4 Monitoring Form for Resettlement Sites Preparation

No.	Explanation of the Site	Status	Details	Expected Date of Completion
1	(e.g. location, area, no. of resettlement household etc.)	(Completed (date)/not completed)	(e.g. site selection, identification of candidate sites, discussion with PAPs, development of the site etc.)	
2				
3				
4				

Source: JICA Study Team.

Table 5.5-5 Land Acquisition and Resettlement Action Plan Monitoring Form

Activity	Q'ty	Unit	Progress (figure / %)						Completed as of	Responsibility
			1qtr	2qtr	3qtr	4qtr	5qtr	6qtr		
Consultant procurement		MM								
Census survey (incl. household economic survey)										
RAP approval			Approved as of:							
PAPs list finalization										
Compensation Progress		HHs								
Line 1		HHs								
Line 2		HHs								
Line 3		HHs								
Line 4		HHs								
Land Acquisition Progress		ha								
Line 1		ha								
Line 2		ha								
Line 3		ha								
Line 4		ha								
Resettlement Progress	2,109	HHs								
Line 1	1,373	HHs								
Line 2	426	HHs								
Line 3	141	HHs								
Line 4	169	HHs								

HHs: Households
MM: Man-month
Source: JICA Study Team.

Table 5.5-6 Grievance Redress Monitoring Form

No.	Date & Time	Category	Contents	Mitigation / Result
1				
2				
3				
4				

Grievances are addressed as they are received. There is no set periodic schedule.
Source: JICA Study Team.

5.6 Issues for Attracting Foreign Investors

There were some projects implemented by BT scheme in Vietnam. As a result of studying the BT scheme, there are many incentives to attract investors. However, there is one big obstacle to attract foreign investors on the process of the BT scheme.

The issue is related to resettlement of existing residents at a project site. Article 49 of Decree 63 of public Private Partnership Investment Form indicates that the provincial People's Committee is responsible for site clearance and for completing procedures for allocation of lease of land to implement the project.

Article 49 of Decree 63 preparation of the construction site

1. the provincial people's committee is responsible for site clearance and for completing procedures for allocation of lease of land to implement the project in accordance with the law on land, the project contract and related contracts.

However, a cost for the resettlement and compensation shall be prepared by the investor. This condition is not mentioned in the decree, but it is a common way to implement BT project in Vietnam (result of interview to an investor and related organizations).

On the other hand, it is mentioned that formulation of compensation and ground clearance plans and carrying out of the compensation and ground clearance are local functional agencies and investor's responsibilities, on the article 5 of Decision No.23/2015/QD-TTg of Providing the Mechanism Whereby the State Uses Land to Make Payment to Investors Implementing Construction Investment Projects in the Form of Build –Transfer,

Article 5 of Decision 23 use of land to make payment for BT projects

1. For un-cleared land

On the basis of the location and area of the land fund to be paid by the provincial-level People's Committee, the request of the competent state agencies signing the BT contract and the request of the investor, provincial-level People's Committees shall make written commitments to investors on the use of land funds for payment of BT project; At the same time, assign local authorities and investors to:

a) Formulate detailed plans of a 1:500 scale and submit them to competent state agencies for approval.

b) Formulate compensation and ground clearance plans and submit them to competent state agencies for approval.

c) Pay in advance funds for compensation and ground clearance according to regulations.

d) Carry out the compensation and ground clearance according to approved plans.

Based on the results of compensation and ground clearance, provincial-level People's Committees shall issue decisions to allocate or lease land to investors. The valuation of land areas used to make payment and the payment for BT contracts must comply with Clause 2 of this Article.

The condition means that investor has to bear a delay risk of a resettlement. The risk of delay associated with resettlement of residents, regardless of the differences between Vietnamese investors and foreign investors, is at risk of investor. However, Vietnamese investors can be promoting projects with this risk by coordinating with regional People's Committee based on past experience. On the other hand regarding to resettlement problem which linked deeply to local condition, it is difficult to control risk of resettlement for foreign investors. Especially for Japanese investors, when using JICA's Private Sector Investment Finance loan (PSIF loan) and/or loans from Japanese bank, it is necessary to confirm whether appropriate resettlement and compensation has been implemented based on JICA guidelines for Environmental and Social Considerations. As such, Japanese investor cannot leave the resettlement and compensation to a Vietnamese partner company. This risk will be a reason why foreign investors have not joined projects conducted by BT scheme.

[Interceptor Pipe Plan]

CHAPTER 6 PLAN FRAMEWORK

6.1 Target Years

There is no clear information about target years in the Pre F/S report. JST, therefore, the proposed target year for WEIP III is shown below.

Sewerage systems should be constructed considering future population, wastewater volume and other factors. Generally, 20 to 30 years later is applied as the planned future. Therefore, in this survey, the target year is set on 2040 which almost 20 years after 2018.

6.2 Future Population of District 7

6.2.1 Current Population

Based on the year book 2016 issued by General Statistic Office, Ho Chi Minh City, the current population of District 7 is shown in the following table.

Table 6.2-1 Current Population of District 7

	2011	2012	2013	2014	2015	2016	2017
Population	268,438	266,330	280,743	296,757	310,178	317,488	327,223
Increase/Decrease		-2,108	14,413	16,014	3,421	17,310	9,735
Rate		-0.8 %	5.1 %	5.4 %	1.1 %	5.5 %	3.0 %

Source: The Year Book 2016 and General Statistic Office of HCMC

6.2.2 Population Projection

(1) Applying City Planning Growth Rate

In the case of applying the city planning growth rate, the future population will be projected in the table below:

Table 6.2-2 Population Projection by City Planning Growth Rate

	Growth Rate	Population	Remarks
2020	5.11 %	416,540	Growth rate of 2011 - 2020
2025	2.49 %	471,040	Growth rate of 2020 - 2030
2030	2.49 %	532,760	Ditto
2040	2.49 %	681,310	Assumed value as same growth rate

Source: HCMC Adjustment Plan
Note: value of the 2040 is calculated by JICA Study Team

(2) Applying Formula

From the current population of the years in the Table 6.2-1, the population is projected to apply an average annual growth rate. The following table shows population projection by use of the formula.

Table 6.2-3 Population Projection by Formula

Year	Current Population	Future Population		
		By Formula	Pre-F/S	By City Planning
2015	310,178			
2016	317,488	325,300		
2017	327,223			
2020		384,200		416,540
2025		457,800	400,000	471,040
2030		531,400		532,760
2040		678,500		681,310

Source: JICA Study Team
Note: City Planning Population of the 2040 is calculated by JICA Study Team.

(3) Expected Population

The population of District 7 calculated by the formula is relatively conservative with the city planning but larger than the data used in the Pre F/S report (in Pre F/S report the District 7 population is 400,000 by the year 2025).

Based on the above, the expected population data used in WEIP III for District 7 is concluded in Table 6.2-4.

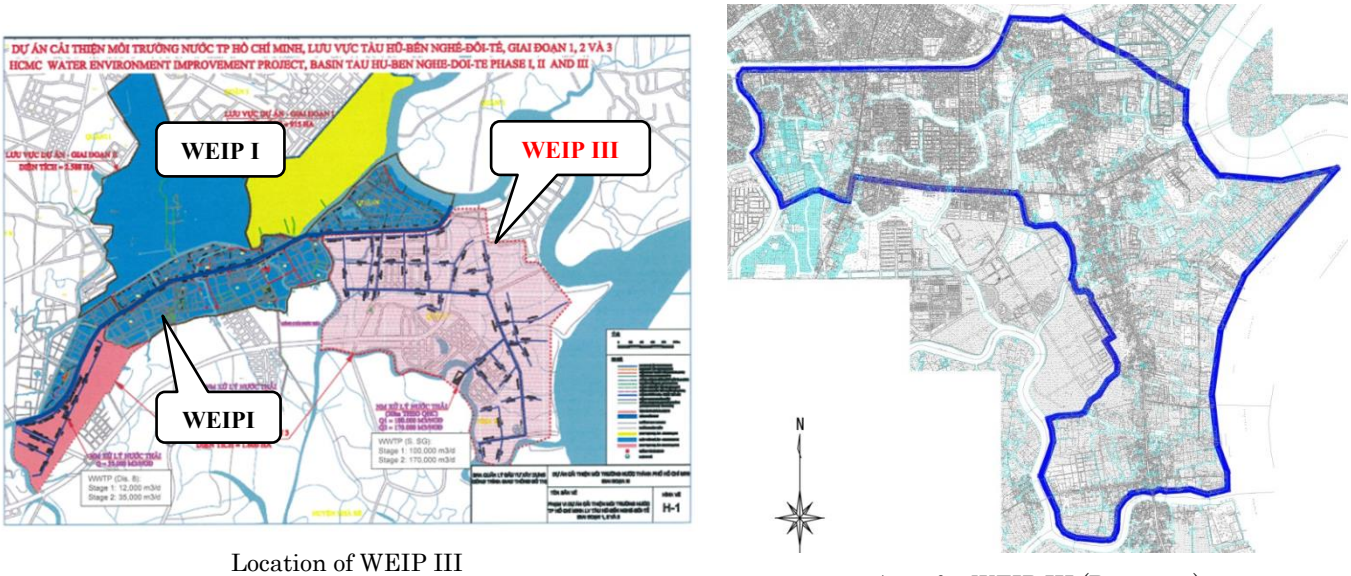
Table 6.2-4 Population Projection for District 7

Year	Population	Remarks
2020	384,200	
2025	457,800	
2030	531,400	
2040	678,500	

Source: JICA Study Team

6.3 Target Area

There are some areas which have already been covered by private sewerage systems in District 7 (as shown in Figure 6.3-2). Therefore, the sewerage target area is defined as in the figure below considering the existing sewerage systems. The proposed target area is 2,012ha.



Location of WEIP III

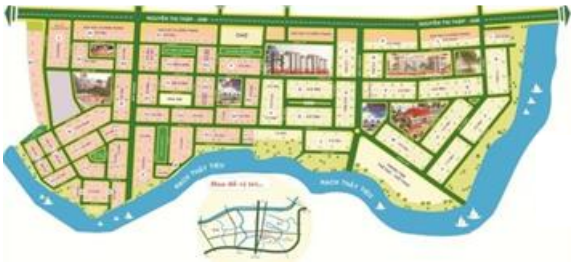
Area for WEIP III (District 7)

Source: JICA Study Team

Figure 6.3-1 Target Area for Sewer System

Phu My Hung Area

Tan Thuan Processing Area



Tan Quy Don Area

Riverside Urban of Tan Phu Ward

Source: Prepared by JICA Study Team based on General Adjustment Planning Report for Construction of District 7 to 2020

Figure 6.3-2 Areas Where Sewerage Systems are Constructed or Planned

6.4 Target Population

The population to be served by the sewerage system cannot be identified only using official population data because there is a difference between the administrative boundary and the sewerage target areas. So in this study, the target population is assumed and calculated by using district population density. The population to be served by sewerage system is shown in Table 6.4-1.

Table 6.4-1 Target Population

Item	Year of 2030	Year of 2040	Remarks
Area of District 7	3,546.8 ha	3,546.8 ha	
Population of District 7	531,400 people	678,500people	
Population Density	150 people/ha	191 people/ha	A
Target Area	2,012 ha	2,012 ha	B
Target Population	**302,000 people**	**385,000 people**	**C=A*B**

Source: JICA Study Team

6.5 Wastewater Volume Projection

6.5.1 Unit per Capita Wastewater Generation

Unit per capita wastewater generation is set as in table below.

Table 6.5-1 Unit per Capita Wastewater Generation

Item	Value	Remarks
Domestic	230 L/c/d	
Commercial (including public, small industry and others)	15%	
Daily Average Wastewater Generation	265 L/c/d	

Source: JICA Study Team

6.5.2 Wastewater Volume

Based on the projected population and unit per capita wastewater generation, wastewater volume is calculated as shown in Table 6.5-2

Table 6.5-2 Wastewater Volume

Item		Value	Remarks
Target Year		2040	
Population		385,000	
Daily Average	Unit per Capita	265 L/c/d	
	Wastewater Volume	**102,000 m^3/day**	= 265 L/c/d * 385,000
Daily Maximum	Peak Day Factor	1.20	
	Groundwater Infiltration	10%	102,000 m3/day *10%
	Wastewater Volume	**133,000 m^3/day**	= 122,400 + 10,200 122,400 ≒102,000 * 1.20
Hourly Maximum (for reference only)	Peak Hourly Factor	1.54	
	Groundwater Infiltration	10%	
	Wastewater Volume	167,500 m^3/day	= 157,080 + 10,200 157,080 ≒102,000 * 1.54

Source: JICA Study Team

6.6 Wastewater Quality (only for reference)

Wastewater quality was proposed as shown in Table 6.6-1 in the Pre F/S report. The quality is set based on Vietnamese standard of TCVN 7957-2008 and other projects which were carried out in the urban areas of Vietnam.

Table 6.6-1 Wastewater Quality of Pre F/S

Contents	Unit	Value
pH	-	5.5 - 8.0
BOD_5	mg/l	200
SS	mg/l	210
T-N	mg/l	40 - 45
T-P	mg/l	10 - 12

Source: Pre F/S report

On the other hand, actual wastewater qualities of inflow wastewater into Binh Chanh WWTP are shown in Table 6.6-2.

Table 6.6-2 Actual Wastewater Quality of Binh Chanh WWTP Inflow

Contents	Unit	Minimum	Average	Maximum	Remarks
BOD_5	mg/l	26	54.3	88	
SS	mg/l	29	52.6	98	
T-N	mg/l	15.7	19.9	24.6	
T-P	mg/l	1.30	1.60	1.90	

Source: ETM (Environmental Technology and Management) Center year 2018
Note: the data are results of January to July of 2018.

Value of the wastewater quality will be set on Feasibility Study or Detailed Design stage.

CHAPTER 7 SEWER SYSTEM DEVELOPMENT PLAN

7.1 Wastewater Collection System

There are several wastewater collection systems which have been used.

1) Separate System

This system consists of two separated sewers. One is a wastewater sewer system, this system collects and treats all kinds of wastewater from domestic, production, commercial and others, before being discharged to a receiving water source. The other is rainwater drainage system; this system collects rainwater from road surfaces, housing and others. Rainwater is discharged straight to a receiving water source without treatment.

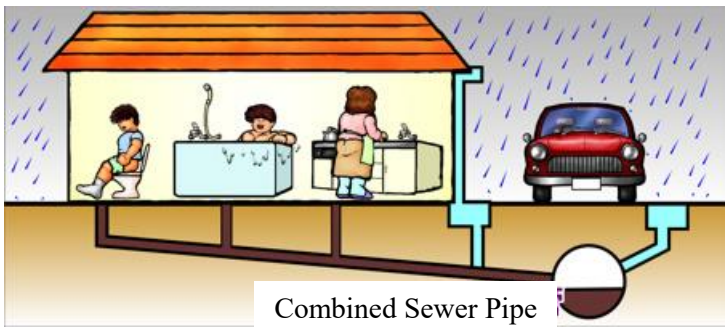
Source: Department of Environmental Creation, Yokohama City, Japan

Figure 7.1-1 Image of Separate System

2) Combined System

This system consists of one sewer. All kinds of wastewater and rainwater are collected, delivered in the same sewer system. Before flowing to a treatment plant, wastewater is separated by a diversion chamber. In this chamber, wastewater is separated into two parts and flow to two different types of sewers. One leads wastewater to a treatment plant, the other leads rainwater mixed with wastewater to receiving water sources.

When there is no rain, wastewater flows to a treatment plant. On the other hand, when there is rain, during an early period of a rain, there is low rain flow with high concentrated wastewater, then wastewater mixed with rainwater flows to a treatment plant. During a later period of rain, there is a larger volume of rainwater flowing into the drainage system. In this case, wastewater is diluted by being mixed with rainwater, and mixed water is discharged to a receiving water source without treatment.



Source: Department of Environmental Creation, Yokohama City, Japan

Figure 7.1-2 Image of Combined System

3) Interceptor System

This system consists of one sewer, and is almost the same as the combined system mentioned above.

The main difference between the interceptor system and the combined system is that the combined system is composed of buried drainage pipes or culverts, and the interceptor system is composed of

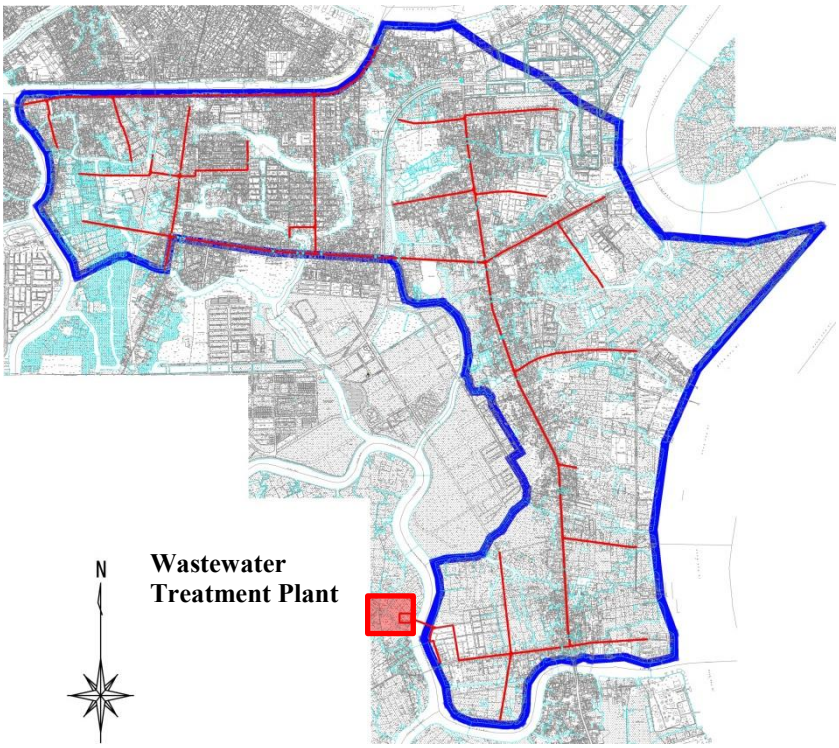
an existing general drainage system with a diversion chamber and interceptor pipe which connects to a treatment plant.

The combined system constructs drainage pipes on almost all roads in an area. On the other hand, the interceptor system constructs interceptor pipes before discharging receiving water sources.

Considering the features of that mentioned above, JST agrees with a plan which interceptor system is applied for the sewer system of District 7 proposed by Pre- F/S report. The area of District 7 has been already developed, so the interceptor collecting system is practical and ideal.

7.2 Location of Wastewater Treatment Plant

A WWTP for the sewer system of District 7 was planned at Nha Be District in Pre F/S, and proposed location is shown in Figure 7.2-1.



Source: JICA Study Team

Figure 7.2-1 Location of WWTP

Based on a confirmation to UCCI and Nha Be District PC, it is found that the location of the WWTP has been agreed on a meeting by each side, however an official agreement has not yet been signed.

Although the location of the WWTP has not yet fixed officially, JST conducts pipe line planning by the deemed locations of the WWTP, which is fixed on the locations shown in Figure 7.2-1.

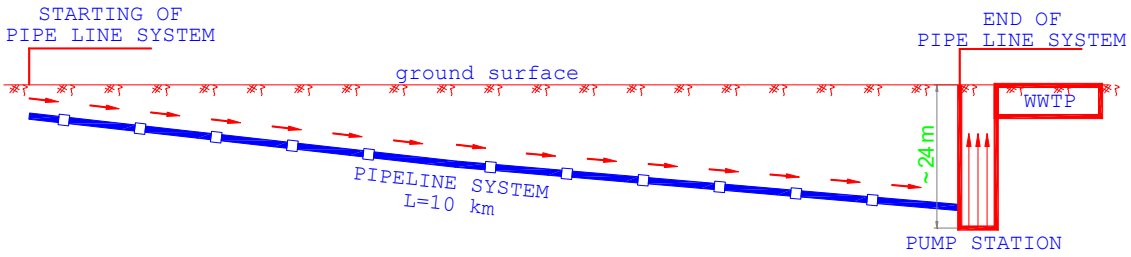
7.3 Study of Intermediate Pumping Station

7.3.1 Necessity of Intermediate Pumping Station

In the previous survey namely “Data Collection Survey on Matters relating to Efficient Execution of Ho Chi Minh City Water Environment Improvement Projects in Vietnam”, one intermediate pumping station was proposed around the junction of Nguyen Thi Thap Road and Huynh Tan Phat Road. The reasons why the pumping station was recommended are as follows.

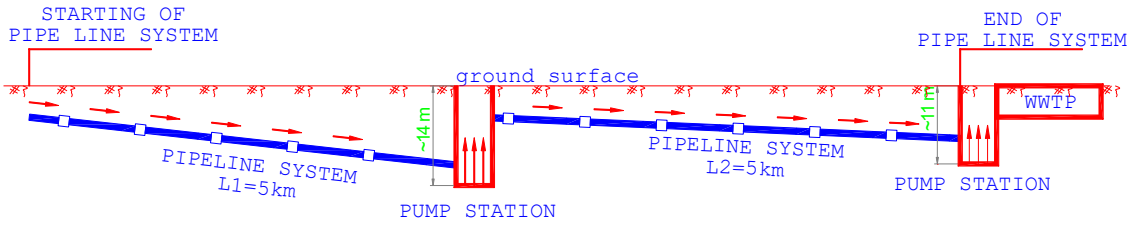
- Easiness of Construction

In case of no pumping station is constructed, sewer pipe depth exceeds more than 20m. On the other hand, the maximum depth is limited below 15m in case of with one intermediate pumping station. Images of the sewer pipe profiles are shown in the figures below.



Source: JICA Study Team

Figure 7.3-1 Image of Profile for Without PS plan



Source: JICA Study Team

Figure 7.3-2 Image of Profile for With PS plan

Although a shaft for the pipe jacking method is usually constructed by the steel sheet pile method, a shaft of more than 15m depth cannot be constructed by the steel sheet pile method. In such cases, a special construction method shall be applied.

Considering the above, construction of an intermediate pumping station was recommended by the view point of construction easiness of shafts on a road.

- Construction Cost

Construction cost for the intermediate pumping station at the junction of Nguyen Thi Thap road and Huynh Tan Phat road and construction cost for deep shaft are almost the same.

Considering cost efficiency, although O&M cost and land acquisition cost is necessary, construction of an intermediate pumping station was recommended.

- Social and Environmental Point of View

There is a very few differences between one pumping station plan and no pumping station plan by an environmental point of view.

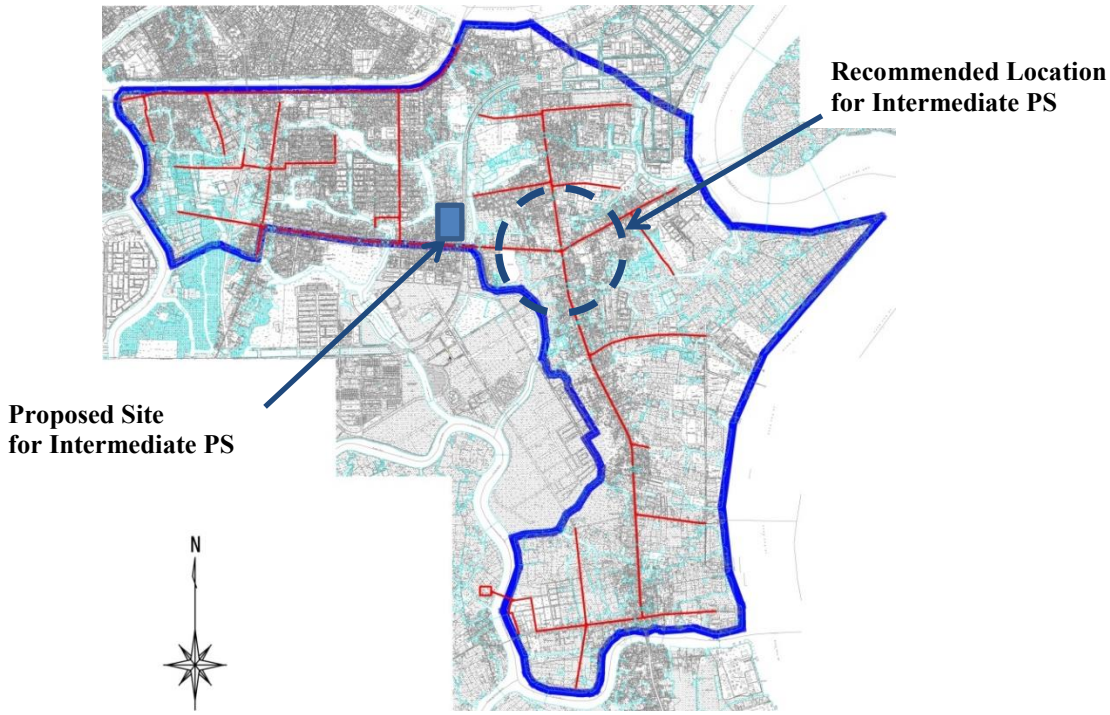
On the other hand, there is a big difference between these alternatives by a social point of view. The main difference is an impact to traffic control. In the case of one pumping station being constructed, the sewer depth is less than 15m and shaft can be constructed by ordinary steel sheet pile method. In this case 1 to 2 lanes will be occupied for shaft construction and pipe jacking site. However, in case of without pumping station, shaft depth exceeds 15m and special construction methods like underground continuous wall method, steel pipe sheet pile method and caisson method shall be applied and such construction method needs more than 2 lanes occupation to construct deep shafts on the road.

Due to this condition, the without pumping station case has disadvantage by social point of view.

7.3.2 Comparative Study for Alternatives

It is obvious that construction of the intermediate pumping station is a better solution for the construction of the sewer system of District 7, due to above mentioned features. However, there is no available space for the proposed pumping station around the junction of Nguyen Thi Thap road and Huynh Tan Phat road.

During detail discussion between UCCI, PC District 7 and the Study Team, there is one candidate site for the intermediate pumping station which proposed by PC District 7. Although the location of candidate site is a little far from the junction of Nguyen Thi Thap Road and Huynh Tan Phat Road, there is an available space for said pumping station.



Source: JICA Study Team

Figure 7.3-3 Proposed Location for PS

A comparative study for alternatives is studied on this report. Alternative 1 is "without PS" plan and alternative 2 is "with PS" plan.

(1) Conditions of Comparative Study

Some conditions and assumptions which set on the comparative study conducted on the previous study are not suite on actual conditions of the site as below.

- Construction method of deep shaft

  Soil mixing wall method and cast-in site diaphragm wall method were applied for construction of deep shaft which depth was more than 20m. However, such construction methods need 3 to 4 lanes occupation for construction, it means the road should be closed during construction.

  Therefore, in this comparative study, caisson method which can be implemented within 2 lanes of the road is applied for cost estimation, although the construction cost for the caisson method is expensive.

- Maximum length between manholes

  The maximum length between manholes is set by UCCI as 300m. However, if this maximum length applied for deep shaft spans a construction cost of the spans becomes too expensive due to construction cost of deep shafts by caisson method.

  Therefore in this comparative study, maximum length between manholes for deep spans is set

on 1000m as a special case. The maximum length shall be studied more detail on 8.6 of this report.

- Life cycle cost

  The pumping station needs continuous operation, so operation cost like electric cost is necessary. In addition, mechanical and electrical devices should be renewed on each 15 to 20 years. The "with PS plan" should include O&M cost for the comparative study.

  Therefore in this comparative study, converted costs by divided the construction cost by useful life time are used for.

(2) Result of Comparative Study

A comparison table is prepared to select the most applicable alternatives as shown in Table 7.3-1.

Table 7.3-1 Comparison of Intermediate PS Plan

	Alternative 1 : Without PS	Alternative 2 : With PS
Description	No intermediate pumping station	One intermediate pumping station
Maximum Depth of Sewer Pipe	More than 20m	About 15m
Construction Cost	Pipe Jacking : VND 658 bil. Shaft & Manhole : VND 797 bil. Pumping Station : VND 0 bil. Treatment Plant : VND 2,761 bil. **Total : VND 4,215 bil.**	Pipe Jacking : VND 658 bil. Shaft & Manhole : VND 227 bil. Pumping Station : VND 151 bil. Treatment Plant : VND 2,761 bil. **Total : VND 3,796 bil.**
O & M Cost		VND 3.0 bil. / year
Useful Life Time	Pipe, Shaft & MH : 50 years	Pipe , Shaft & MH : 50 years Pumping Station Civil & Architect : 50 years Mechanical & Electric : 15 years
Yearly Cost (Cost/Life Time)	Pipe Jacking : VND 13.2 bil./y Shaft & Manhole : VND 15.9 bil./y Pumping Station : VND 0 bil./y Total : VND 29.1 bil./y	Pipe Jacking : VND 13.2 bil./y Shaft & Manhole : VND 4.5 bil./y Pumping Station : VND 7.2 bil./y Total : VND 24.9 bil./y
	VND 29.1 bil./y + 0 bil./y **= VND 29.1 billion/year**	VND 24.9 bil./y + 3.0 bil./y **= VND 27.9 billion/year**
Advantages	- Unnecessity of O&M cost - Not required land acquisition for PS	- Shaft construction can be done by steel sheet pile method.
Disadvantages	- Required heavy equipment for shaft construction. - Road occupation area is large due to heavy equipment. - Daily life and traffic are affected by construction of deep shaft.	- O&M cost is necessary - Required land acquisition for PS
Evaluation	△	○

Source: JICA Study Team

As mentioned in the table, the result is summarized as below.

- The construction cost for deep shafts is very expensive than the construction cost for the PS.
- Due to the shafts construction cost, there is big difference of initial cost.
- O&M cost is necessary for the "with PS plan".
- Life cycle cost is almost same between two alternatives.
- Disadvantage for daily life and traffic by constructing deep shaft is not negligible.

7.3.3 Conclusion of the Study for Intermediate Pumping Station

Although the candidate site for the pumping station proposed by PC District 7 is far from an appropriate location, construction of a pumping station has advantages against the "without PS" plan. Construction of an intermediate pumping station on the proposed location is desirable solution for the sewerage system of District 7.

CHAPTER 8 BASIC PLAN FOR INTERCEPTOR PIPE

8.1 Application Criteria

Basic plan for interceptor pipe shall comply with "TCVN7957-2008 Drainage and Sewage External Networks and Facilities Design Standard" in principle.

8.1.1 Interceptor Ratio

In accordance with TCVN 7957-2008, it is stipulated that the target design volume of the interceptor pipe shall be 2 to 2.5 times larger than the daily average sewage volume.

This plan adopts the maximum value of the standard described value by 2.5 times based on the following reasons.

- Interceptor pipe development is effective in decreasing flood damage to some extent.
- District 7 targeted in this study has been damaged by heavy rain and high tide.
- Sewer works can decrease flood damage in District No. 7.

8.1.2 Formula for Flow Capacity

Manning formula is adopted for flow capacity of interceptor pipes. (TCVN 7957-2008 4.3.1)

$$Q=AV$$
$$V=1/n\times R^{2/3}\times I^{1/2}$$

Where,

Q: Flow quantity (m^3/s)
V: Velocity (m/s)
I : Gradient
R: Hydraulic radius (A/P)
A: Discharge section area (m^2)
P: Wetted perimeter (m)
n: Roughness coefficient (Refer to Table 8.1-1)

Table 8.1-1 Roughness Coefficient

Material of Pipe	Roughness Coefficient
Reinforced concrete pipe	0.013
Iron pipe	0.012
Polyvinyl chloride pipe	0.011

Source: TCVN7957-2008

8.1.3 Minimum Velocity

In accordance with TCVN 7957-2008 4.6.1, the minimum velocity is determined by the pipe diameter as shown in the table below.

Table 8.1-2 Minimum Velocity

Pipe Diameter (mm)	V min. (m/s)
200	0.7
300	0.8
400-500	0.9
600-800	1.0
900-1200	1.15
1300-1500	1.2
Over 1500	1.3

Source: TCVN7957-2008

8.1.4 Minimum Gradient

The minimum gradients that satisfy the minimum flow velocity (Source: TCVN 7957-2008) in "Chapter 8.1.3" is calculated in accordance with Manning Formula and are shown in Table 8.1-3.

Table 8.1-3 Minimum Gradient

Pipe Diameter (mm)	Minimum Gradient (‰)	
	RC	PVC, HDPE
200	3.9	2.8
300	3.0	2.1
400	2.4	1.7
500	1.7	1.2
600	1.7	1.2
700	1.3	-
800	1.1	-
900	1.3	-
1000	1.1	-
1100	1.0	-
1200	0.9	-
1300	0.9	-
1400	0.8	-
1500	0.7	-

Source: JICA Study Team

8.1.5 Design Water Depth (Water Depth in Sewer Pipe)

Design water depth in each sewer pipe is shown in the Table 8.1-4 below (based on TCVN 7957-2008 4.5.2).

Table 8.1-4 Maximum Water Depth

Pipe Diameter (mm)	Design Fullness
200-300	0.6 D
350-450	0.7 D
500-900	0.75 D
Over 900	0.8 D

Source: TCVN7957-2008

8.1.6 Maximum Distance between Manholes

Maximum distance between manholes in Vietnamese Standard and Japanese standard are shown in Table 8.1-5.

It is noted that these distances are provided for the drainage works constructed by the open-cut method and there is no standard for the pipe jacking method yet in Vietnam.

Table 8.1-5 Standard Maximum Distance between Manholes

Vietnam Standard : TCVN 7957-2008		Japanese Standard : Sewer Facility Planning and Design Guidelines and Commentary	
Pipe Diameter (mm)	Maximum Distance between Manholes	Pipe Diameter (mm)	Maximum Distance between Manholes
150 - 300	20 - 30m	-	-
400 - 600	40m	Up to 600	75m
700 - 900	60m	Up to 1,000	100m
Over 1,000	100m	Up to 1,500	150m

Source: JICA Study Team

In the design of "Package G of WEIP II", the maximum distance between manholes was stipulated for the pipe jacking method. Based on consultation among the Employer, the Engineer and the Contractor in the construction stage, it was provided for the interceptor pipe constructed by the pipe jacking method as shown in Table 8.1-6.

Table 8.1-6 Standard Maximum Distance between Manholes in WEIP II

Design of [WEIP II]		Fixed Value at Construction Stage	
Pipe Diameter (mm)	**Maximum Distance between Manholes**	**Pipe Diameter (mm)**	**Maximum Distance between Manholes**
Open Cut	60m	-	-
Up to 700	150m	Up to 700	150m
800 - 1,100	200m	Over 800	300m※2
Over 1,200	Permitted pipe jacking distance※1	-	-

Note : ※1 : Distance between manholes is allowed up to the limit distance that can be constructed without intermediate shaft by pipe jacking method.

※2 : When there are special circumstances such as traffic condition, river crossing, etc., They will be examined individually.

In Vietnam, there is no national design standard for maximum distance between manholes for the pipe jacking works, but it is possible to apply for foreign regulations and standards.

Therefore, in the future, further consideration will be given to the distance between manholes for the long distance pipe jacking method considering benefits in workability and cost reduction.

8.2 Status of Existing Drainage Pipe

8.2.1 Overview

In District 7, the drainage system is installed throughout the region. It collects sewage from not only rainwater but also wastewater from private houses and facilities, and discharges to the canals and small ponds scattered without any treatment. Their flows are very slow and therefore, hygiene problems such as turbidity and bad smell due to the sedimentation have been occurred.

Canal

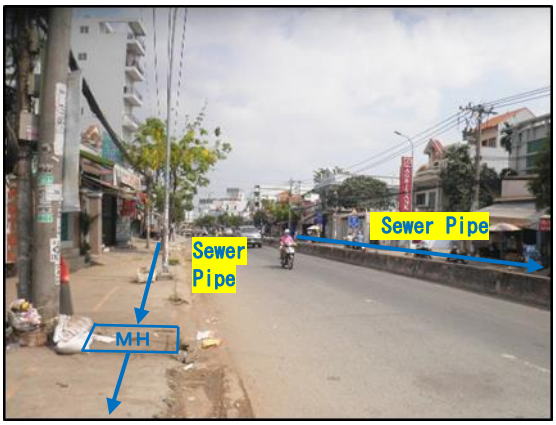
Pond

Source: JICA Study Team

Figure 8.2-1 Conditions of Discharge Points

8.2.2 Status of Installation of Sewer Pipes

Most of the existing sewer pipes are a circular shape, and the pipe diameters are 300mm to 1,200 mm diameter. The depth of the earth covering at the discharge point is various. The outlet with small diameter is generally shallow and the large diameter is deeper, and it is influenced by the topography condition such as the surface slope. Existing sewer pipes are installed in both edges of the road if it is wide, and the sewer pipe is in the center of the road if the road is narrow.



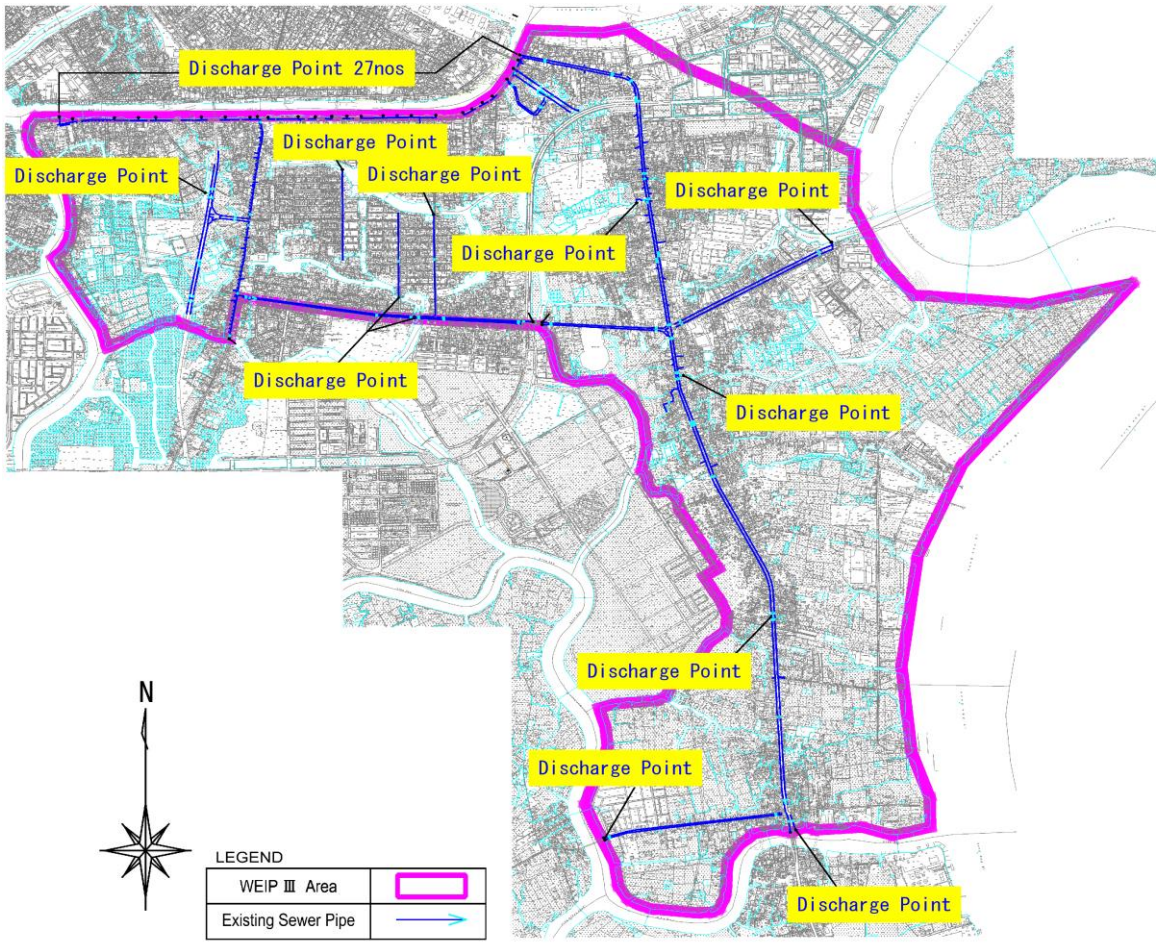
Wide Road [Hyu Ynh Tan Phat] Blanch Road

Source: JICA Study Team

Figure 8.2-2 General View of Existing Sewer Drainage Pipe

8.2.3 Existing Drainage System

The information obtained from the documents of the existing sewer pipes is incomplete. There is description for shape and diameter, but there is no detail of the depth of earth cover, and the extension of the scope is limited except the main street. Detailed surveys are required to understand the actual situation of the existing sewer pipes, since the data of sewer pipes in side streets that were reconfirmed during site investigation are insufficient. The plan of existing sewer pipelines drawn based on the existing documents is shown in Figure 8.2-3.



Source: JICA Study Team

Figure 8.2-3 Plan View of Existing Sewer Pipe

8.3 Examination for Construction Method of Pipe Installation

8.3.1 Outline and the Examination Policy of Pipeline Design in the "WEIP II"

For the selection method between the open-cut method and the pipe jacking method for pipeline design, the pipe jacking method was adopted in the aspect of safety in WEIP II for pipelines where the earth covering is 5.0 m and more or pipe diameter is 800 mm and more in accordance with the design policy of WEIP II. However, in the present construction stage, the following issues, which have not been concerned in design stage of WEIP II in 2010, appear along with the rapid urbanization progress in Ho Chi Minh City.

- Influence on Transportation: Increase in vehicular traffic volume and public transportation routes caused the adverse effects on construction.
  *Referring to Data Collection Survey, if emergency vehicles and buses can pass, it was confirmed that road occupation permit can generally be issued from the Department of Transportation of Ho Chi Minh City.
- Increase in underground utilities: An increase in underground utilities such as water supply pipes, gas mains and telephone cables cause the problems in excavation works.

In the project under this study, the reoccurrence of the similar problems experienced in WEIP II are concerned. The selection criteria shall be examined based on various conditions stated in Table 8.3-1 in order to select the pipeline installation method, the open-cut method or the pipe jacking method.

Table 8.3-1 Selection Criteria for Open-Cut Method and Pipe Jacking Method

Category	List	Selection Criteria
Basic Selection Criteria	1) Safety	・Safety in construction considering ground condition ・Influence on excavation depth and excavation to surrounding buildings such as houses
	2) Economic Efficiency	・Construction cost ・Required construction period
Individual Selection Criteria	3) Influence in Transportation	・Difficulty of traffic restriction and securing a bypass due to occupancy area during construction ・Existence of public transportation such as emergency vehicles and buses
	4) Workability	・Difficulty of road occupation for excavation of underground utility installations

Source: JICA Study Team

8.3.2 Selection Factors for Open-Cut Method and Pipe Jacking Method

(1) Safety

There is a high risk of ground collapse with its excavation depth becoming deep because the soil quality is the extremely loose cohesive soil and the groundwater level is around GL -1m in this target project area. Therefore, if the earth covering is 5m and more, the pipe jacking method shall be adopted based on WEIP II, which has extremely similar soil quality condition.

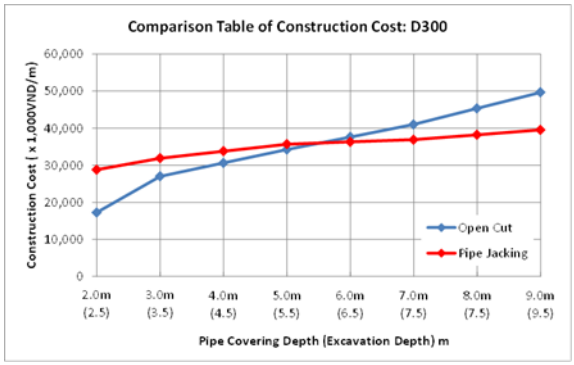
*Pipe jacking method is adopted if the excavation depth is 4m and more in Japan.

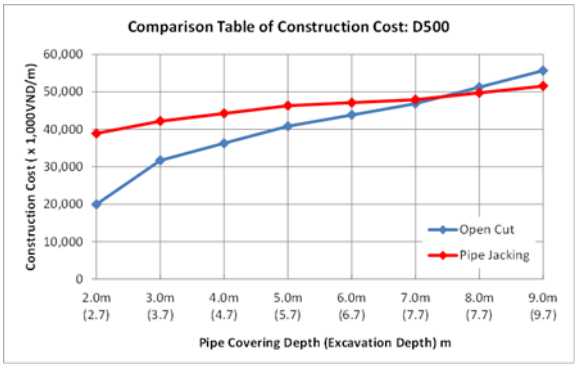
(2) Economic Efficiency

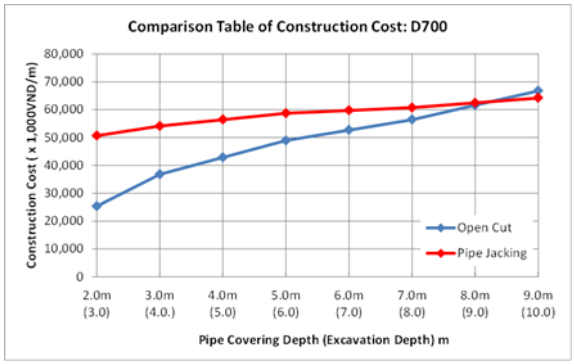
Figure 8.3-1 shows each pipeline construction (open-cut method and pipe jacking method) cost of small diameter pipe, and pipe diameter at 300mm, 500mm and 700mm.

If the earth covering is relatively shallow, the open-cut method is cheaper. On the other hand, if the earth covering is around from 5m to 7m and over, the pipe jacking method is cheaper.

*For large and medium diameter pipe (the diameter is 800mm and over), the adoption of the pipe jacking method shall be inevitably considered for the interceptor construction.







Source: JICA Study Team

Figure 8.3-1 Construction Cost for Open Cut Method and Pipe Jacking Method

(3) Impact on Traffic

Adequate consideration for traffic disturbance in this project area is required because the trend of recent vehicular traffic volume in Ho Chi Minh City is significantly increasing.

The pipe jacking method which needs a smaller area to construct a vertical shaft is recommended for wide roads with large traffic volume in all of the pipeline distribution area. The open-cut method shall be avoided because it needs traffic restrictions during excavation.

"Hyun Tan Phat" Street

"Hyun Tan Phat" and "Nguyen Thi Thap" Intersection

Source: JICA Study Team

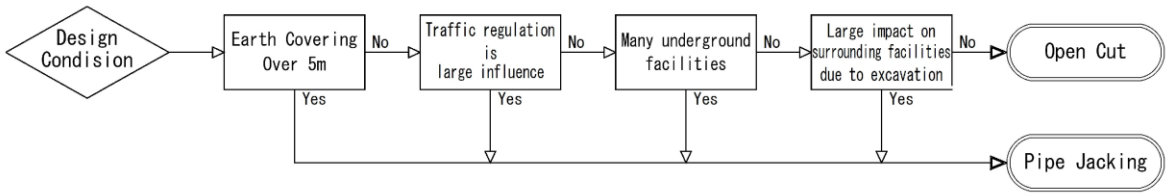
Figure 8.3-2 Vehicular Traffic Condition in Wide Roads

(4) Workability and Surrounding Environment

The pipe jacking method is more appropriate in the area with the concentration of underground utility installations or in areas where vibration and noise significantly influence the surrounding facilities, because the utility relocation cost is expensive in Ho Chi Minh City.

8.3.3 Selection Policy for Open-Cut Method and Pipe Jacking Method

Selection flow of construction method for pipeline installation is shown below based on the above 1), 2), 3) and 4) of "8.3.2".



Source: JICA Study Team

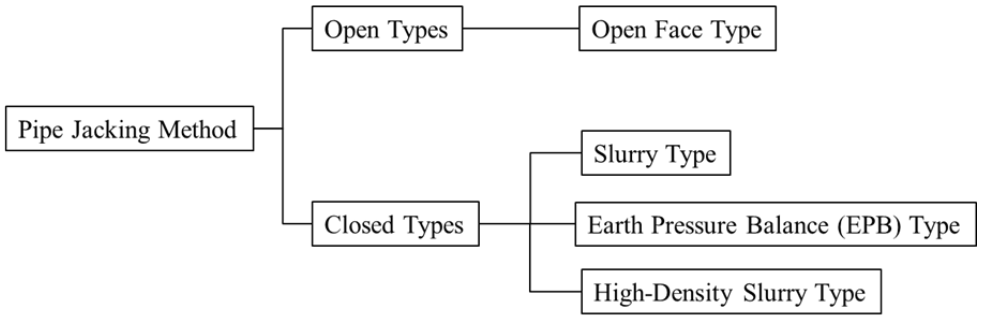
Figure 8.3-3 Selection Flow Chart for Open-Cut Method and Pipeline Jacking Method

8.4 Examination for Pipe Jacking Method

8.4.1 Classification of Pipe Jacking Method

Pipe jacking methods are classified by the nominal diameter of jacking pipes into large- and medium-diameter pipe jacking method, and small-diameter pipe jacking method. Moreover, they are also classified in detail by digging method and muck transportation method.

The classification of pipe jacking method except the special methods is shown in below.



Source: Japan Sewage Works Agency [Design and Construction Manual of Microtunneling Technology]

Figure 8.4-1 Classification of Pipe Jacking Methods

(1) Open Type Pipe Jacking Method (hereinafter "Open Face Type Pipe Jacking Method")

The open face type pipe jacking method is appropriate for short distance construction and the facilities are relatively simple. When facing obstacles on the way, the open face type pipe jacking method is adopted because the cutter head is open.

(2) Closed Type Pipe Jacking Method

The closed type pipe jacking method is appropriate for long distance pipe jacking because of its superior steering and wider targets for appropriate soils by the pipe jacking machines with its cutter face excavation and its cutter face stability.

8.4.2 Selection Policy of Pipe Jacking Methods

When selecting a pipe jacking method, safety, secured, and economic construction method should be selected based on the examination for pipe line route condition, the extension of construction section, soil condition, alignment, and other surrounding construction environment, necessary supplementary construction methods, and relocation of underground installations.

The following points are considered in order to select the construction methods.

① Nominal Diameter of Laying Down Pipes

② Pipe Jacking Extension per 1 Span

③ Relationship between Soil Quality and Underground Water

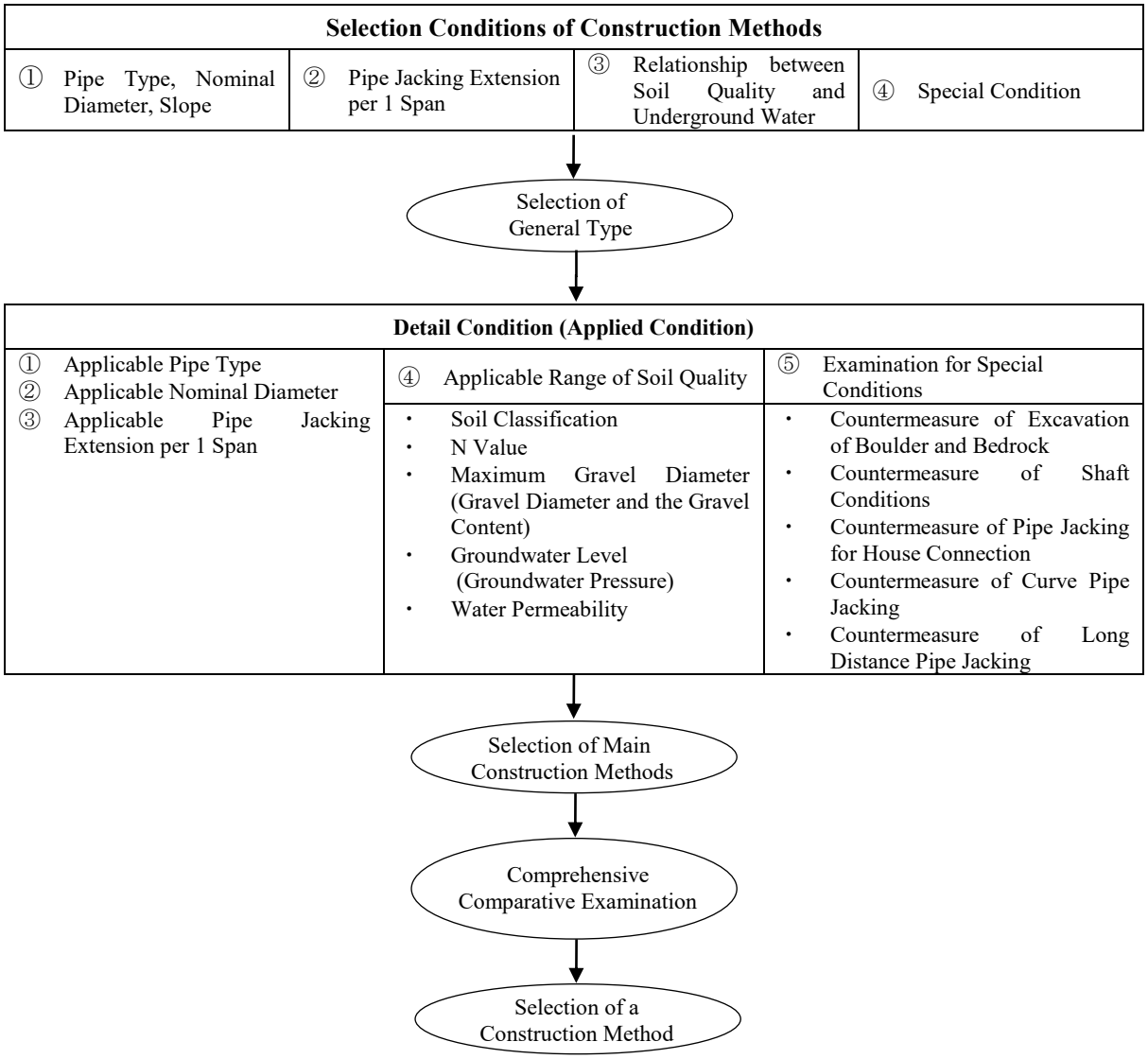
④ Alignment

⑤ Site Space Related to Muck Transportation from Shafts and Pipes

⑥ Transportation Condition and Surrounding Environment around the Shaft Location

⑦ Relationship between Underground Facilities and the Other Overhead Power Cables

The selection flow of pipe jacking method based on the above is shown below.



Source: Japan Sewage Works Agency [Design and Construction Manual of Microtunneling Technology]

Figure 8.4-2 Selection Flow of Pipe Jacking Methods

8.4.3 Selection of Pipe Jacking Method

The most appropriate pipe jacking method for the construction condition of this WEIP II shall be selected based on the above chapter. The comparative examination table is shown below.

Table 8.4-1 Table of Comparative Examination for Pipe Jacking Method

	Open Types	Closed Types		
	① Open Face Type	② Slurry Type	③ Earth Pressure Balance Type	④ High-Density Slurry Type
Outline	A cuter head on the front edge of the jacking pipe is used and jacking pipes are thrusted. The ground stabilization around the pipes is essential due to its open face and its manpower excavation.	The cutter chamber between the cutter head and partition with pressurized slurry which retains earth pressure and groundwater is filled. Combined muck and slurry are pumped outside of the drive shaft until outside treatment facilities.	The cutter chamber is filled with excavated soil and drilling fluid, which retain the earth pressure and groundwater pressure on the face. Muck is continuously extracted through screw conveyor in accordance with the jacking speed.	The cutter chamber between the cutter head and partition is filled with high-density slurry and excavated muck, which retain earth pressure and groundwater pressure on the face. Combined muck and slurry are intermittently extracted through the muck excavation valve.
Adaptability to Soil	Ground improvement for soft soil is required. △	○	○	○
Working Space	Small ○	Large △	Relatively Small ○	Relatively Small ○
Allowable Pipe Jacking Extension	Approximately 130m (For Intermediate Jacking Station) ×	Approximately 350m (Only Thrust Jack) ○	Approximately 350m (Only Thrust Jack) ○	Approximately 500m (Only Thrust Jack) ○
Daily Extension Volume	Small △	Large ○	Relatively large ○	Relatively large ○
Public Estimation Productivity	Exist (Japan Sewage Works Agency) ○	Exist (Japan Sewage Works Agency) ○	No Exist △	Exist (Japan Sewage Works Agency) ○
Evaluation	Inappropriate for Adopted Ground and Allowable Jacking Distance ×	Great Influence on Vehicular Traffic △	No Existence of Public Productivity and Small Variety of Boring Machine △	Most Suitable for Condition in Planned Area ○

Source: JICA Study Team

8.5 Examination for Earth Retaining Works for Shafts

8.5.1 Classification of Earth Retaining Works for Shafts

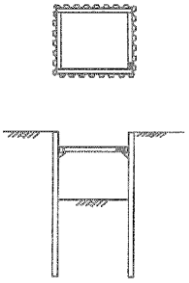
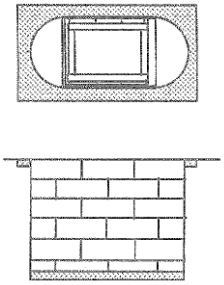
The steel sheet pile construction method and liner plate method are commonly used as earth retaining works when building shafts for pipe jacking.

8.5.2 Selection of Drive Shaft Construction Method

When selecting the drive shaft for pipe jacking, appropriate earth retaining works for excavation size, construction conditions, ground condition, and environmental condition should be carried out in order to prevent surrounding ground failure and large changes in the surrounding ground after the construction.

The comparative examination result of each shaft type is shown below.

Table 8.5-1 Comparative Examination Table for Shaft Construction Method

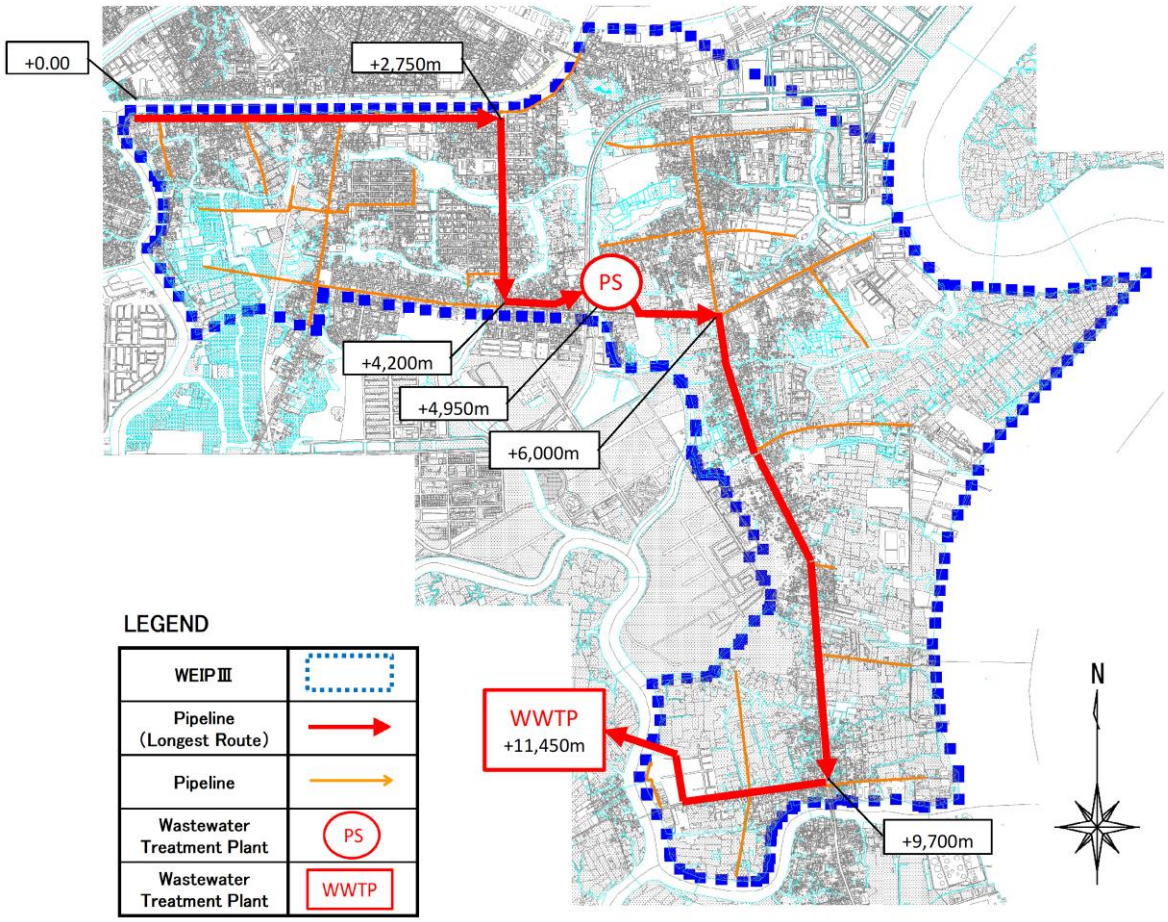
Construction Method		Steel Sheet Pile Shaft	Liner Plate Type Shaft
Schematic Diagram			
Outline		Steel sheet pile is built in series before excavation and falsework is carried out while excavating. The shaft is finaly built by continuing the above works.	Separated liner plates are constructed within the shaft in turn while excavating and then the shaft is built.
Targeted Ground	Soil	Sandy soil, Cohesive soil (Possible for soft soil)	Sandy soil, Cohesive soil (Self-supporting ground)
	N Value	Sandy soil N≦50, Cohesive soil N≦50 Gravel soil N≦50	Sandy soil N≦50、Cohesive soil N≦50 Gravel soil N≦50
	Evaluation	○	Soil improvement is required for soft soil△
Shape and Size	Shape	Rectangle	Circle/Ellipse/Rectangle
	Size	Almost no regulation	Almost no regulation
	Evaluation	○	○
Workability	Workability	It takes time to lay and remove the steel sheet piles, and to carry out earth retaining wall work and falsework.	It takes time in the end to work per 1 ring.
	Degree of groundwater sealing	Good	Bad
	Depth	Until approximately 20m	Until approximately 15m
	Evaluation	△	As for ground under the groundwater level, soil improvement is required. △
Environmental Pollution	Noise	Large Noise by Driving Small Noise by Pressing	Small
	Vibration	Large Vibration by driving No Vibration by pressing	No
	Evaluation	△	○
Construction Period	Construction Period	Long	Long
	Evaluation	△	△
Economy	Economic Efficiency	Cheap due to No Supplementary Construction Method	Expensive due to the Necessity of Supplementary Construction Method
	Evaluation	○	△
General Assessment		Long construction period is required but the construction is cheap.	Expensive supplementary construction method is necessary for planned ground.
		○	△

Source: JICA Study Team

8.6 Master Plan for Interceptor Pipeline

8.6.1 Planning Design

As this "WEIP III" is a plan for interceptor pipeline aimed at collecting existing sewage drain pipes. Therefore, the plan is based on the survey results on the discharge points of sewage pipe and field survey such as road conditions etc., the planning is as follows.



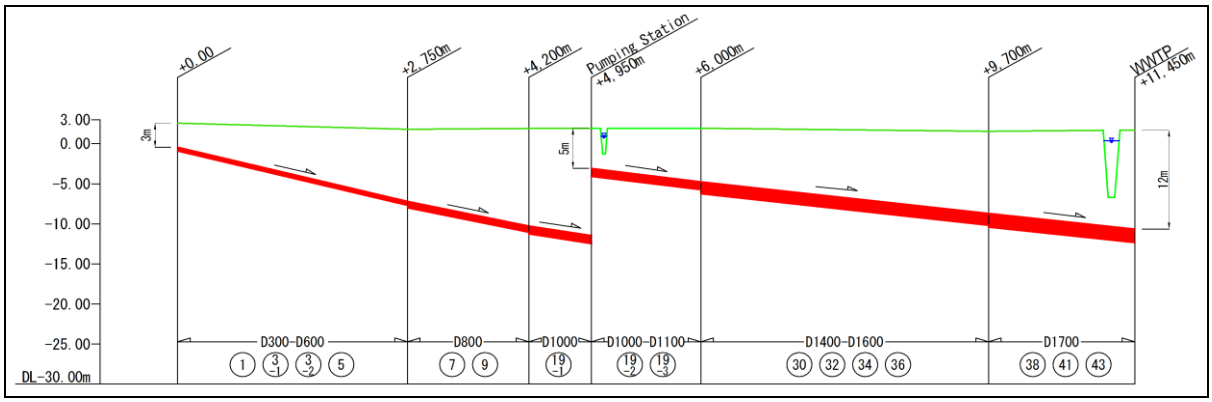
Source: JICA Study Team

Figure 8.6-1 Horizontal Plan of Interceptor Pipe

8.6.2 Vertical Pipe-line Planning

Minimum earth covering is set based on the buried depth of existing drainage pipes. Vertical pipe-line planning is based on Vietnamese design standard, called "TCVN 7957-2008". Earth covering of effluent pipes from the pump station is set by 5m considering the crossover of a river with its water depth by 3m and earth covering of effluent pipes from Northern side at the station (+6.000m) by approximately 6.5m.

Profile of the longest route of planned interceptor pipe is shown below.



Source: JICA Study Team

Figure 8.6-2 Profile of Interceptor Pipes

8.6.3 Flow Calculation

(1) Planed Flow Volume of Interceptor Pipe

Table 8.6-1 Planed Unit Flow Volume of Interceptor Pipe

Planned Targeted Area	Daily Average Flow Volume		Drainage Treatment Area	Interceptor Rate	Planned Flow Volume of Interceptor Pipe	Planned Unit Flow Volume of Interceptor Pipes
	(m^3/d)	(ℓ/s)	(ha)		(ℓ/s)	(m^3/s･ha)
No.7 District	102,000	1,180.56	2,012	2.5※	2,951.40	**0.001467**

Source: JICA Study Team
Note: Refer to Colum 5.1. (1)

(2) Flow Volume Calculation Sheet

Flow volume calculation sheet of the longest route of interceptor pipes is shown below.

Table 8.6-2 Flow Volume Calculation Sheet

District 7 Treatment Area

Unit V1:WW **0.0005868** m^3/s･ha
Unit V2:RW **0.0008802** m^3/s･ha

No	Inflow No	Treatment Area		Design Wastewater Flow				Section Characteristics					Remarks
		Unit Area	Total Area	Domestic: Flow per hectare	Domestic: WW Flow	Other	Total WW Flow	Diameter	Slope	Velocity	Capacity	Length	
		ha	ha	m^3/s･ha	m^3/s	m^3/s	m^3/s	mm	‰	m/s	m^3/s	m	
1		6.67	6.67		0.004	0.006	0.010	VU ◎ 300	2.5	0.81	0.057	200.00	
3-1	2	2.73	(17.12) 26.52		0.016	0.023	0.039	VU ◎ 300	2.5	0.81	0.057	150.00	
3-2		7.78	34.30		0.020	0.030	0.050	RC ◎ 300	3.5	0.81	0.057	500.00	
5	4	59.44	(35.65) 129.39		0.076	0.114	0.190	RC ◎ 600	2.2	1.02	0.288	1900.00	
7	6	89.73	(87.15) 306.27		0.180	0.270	0.450	RC ◎ 800	1.5	1.02	0.512	1200.00	
9	8	6.30	(15.42) 327.99		0.192	0.289	0.481	RC ◎ 800	1.5	1.02	0.512	250.00	
19-1	18	53.30	(245.47) 626.76		0.368	0.552	0.920	RC ◎ 1000	1.5	1.18	0.929	750.00	
19-2		0.00	626.76		0.368	0.552	0.920	RC ◎ 1000	1.5	1.18	0.929	150.00	Pumping Station
19-3		43.32	670.08		0.393	0.590	0.983	RC ◎ 1100	1.3	1.17	1.115	900.00	
30	26 29-2	86.28	(450.59) 1206.95		0.708	1.062	1.770	RC ◎ 1400	1.0	1.21	1.860	1050.00	
32	31-2	134.71	(218.44) 1560.1		0.915	1.373	2.288	RC ◎ 1600	1.0	1.32	2.655	950.00	
34	33	41.22	72.24 1673.56		0.982	1.473	2.455	RC ◎ 1600	1.0	1.32	2.655	700.00	
36	35	54.46	(38.26) 1766.28		1.036	1.555	2.591	RC ◎ 1600	1.0	1.32	2.655	1000.00	
38	37	17.66	(60.46) 1844.4		1.082	1.623	2.705	RC ◎ 1700	1.0	1.38	3.121	550.00	
41	39 40	40.45	(118.23) 2003.08		1.175	1.763	2.938	RC ◎ 1700	1.0	1.38	3.121	1000.00	
43	42	0.00	(8.92) 2012.00		1.181	1.771	2.952	RC ◎ 1700	1.0	1.38	3.121	200.00	
To WWTP													

Source: JICA Study Team

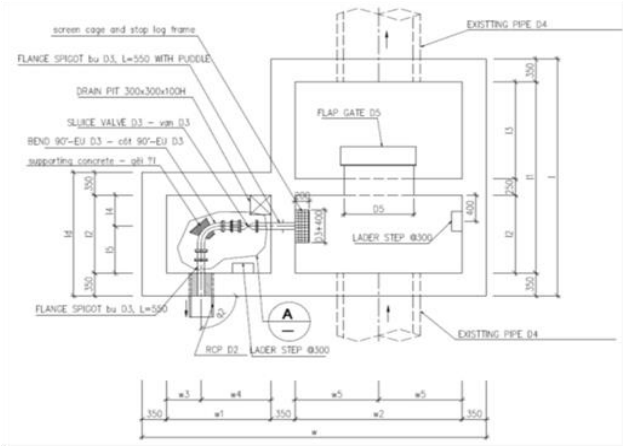
8.7 Necessary Considerations of Detailed Design based on the Condition of Second Phase Project

Working process is delayed in the construction stage called “WEIP II” due to various issues. Influence of the delay on the life of citizens is supposed to be significantly large considering present frequent traffic jams in Ho Chi Minh City. Therefore, previous countermeasures of shortening construction period and reducing the traffic obstacles for this WEIP III will be carried out based on the construction condition of WEIP II in order to smooth the construction.

8.7.1 Structure Plan of Diversion Chamber and Manhole

(1) Purpose

In Ho Chi Minh City, traffic congestion becomes chronic due to the increase of traffic volume accompanying rapid economic development in recent years.
A large structure integrating the functions of diversion chamber and manhole did not become a problem at the design stage of [WEIP II]. However, in the construction stage as of 2017, there was concern that such a large structure may cause traffic problems of vehicles. A road occupation permit has not been given by Department of Transportation of Ho Chi Minh City and it could not be constructed.



Source: WEIP II Package G

Figure 8.7-1 Diversion Chamber and Manhole Structure of WEIP II

(2) Problems and Countermeasures for WEIP II

Countermeasures based on the main theme in the second phase project is shown in the table below.

Table 8.7-1 Problems and Countermeasures for WEIP II

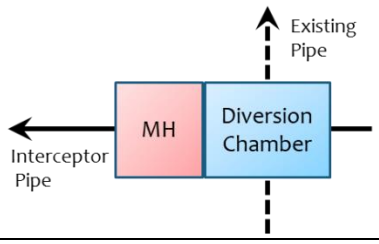
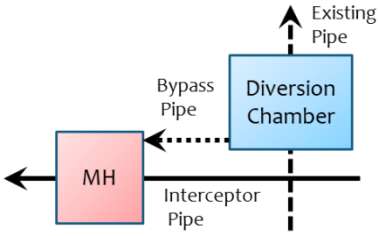
No.	Situation of Site	Problem	Countermeasure
1	Since the diversion chamber also serves to function as the manhole for maintenance of the interceptor pipe, the structural size becomes large.	Due to the large size (plan dimension, depth) of the structure, the occupied area during construction has expanded, and the adverse effect on traffic is a problem.	Separate the original manhole into a diversion chamber and a manhole for the interceptor pipe to reduce each structure size.
2	A diversion chamber has combined function as the shaft for the pipe jacking work.	The existing sewer pipes and underground utilities disturb the access when lifting down the pipe jacking device. Relocation of the existing outfall pipe or installation of temporary pipe outside of the vertical shaft is required, and the occupied area for construction is expanded further and the adverse effects to the surrounding area will be increased.	As described above, by separating an original manhole into two structures, it makes it flexible to set the vertical shaft position for the pipe jacking avoid relocation of the existing sewer pipe.
3	In several areas, concentrated existing sewer outfall pipes are found on site.	Due to the increased size of the diversion chamber, it may cause further traffic jams.	In order to decrease the number of diversion chambers, integrate existing rainwater pipes.

Source: JICA Study Team

(3) Comparison of Integral Structure and Separate Structure Plan of Diversion Chamber and Manhole

The comparison table (Table 8.7-2) is shown below for both the conventional integral structure plan adopted in the "WEIP II" and the separation structure plan separate it into the function as a diversion chamber and a manhole.

Table 8.7-2 Comparison Table of Structure Type of Diversion Chamber & Manhole

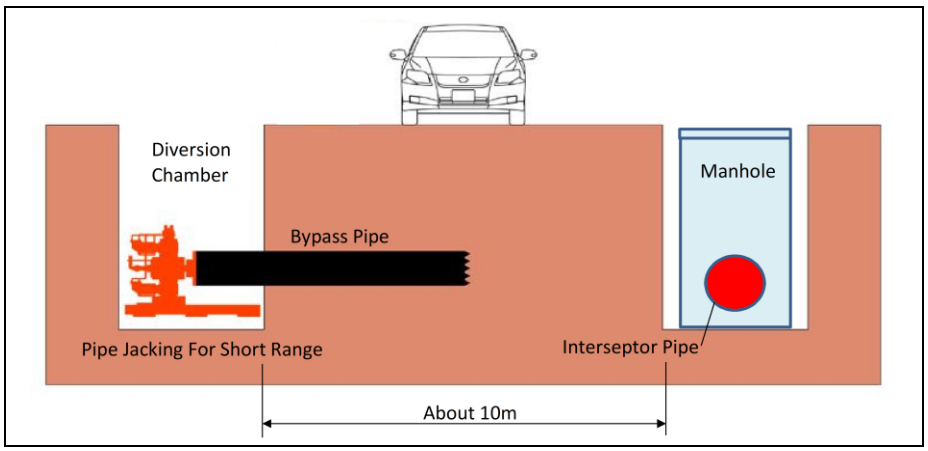
	Integral Structure	Separate Structure
Image Diagram		
Structure Size and Construction Area	Large Area ×	Middle Area △
Location of Installation	Fixed on intersection of existing outfall pipe and interceptor pipe ×	Flexible ○
Impact on Traffic	Big impact ×	Smaller than Integral Structure △
Evaluation	×	○

Source: JICA Study Team

- Each structure will be miniaturized by separating the original manhole into a diversion chamber and a manhole for each function.
- Number of structures will increase by the separated structure scheme, but each occupied area for construction will be smaller. Accordingly, adverse effects on traffic will be reduced.
- In case that the separated structure plan is applied, a manhole shall be constructed in the road area in accordance with the interceptor pipe alignment, but a location of a diversion chamber can be flexibly adjusted based on site conditions.
- In special cases where there are few obstructions (low traffic, few underground utilities, etc.) for construction, an integral-structure as the original is more appropriate than a separated structure plan. Therefore, the structure type should be determined by site situations for each plan in the detailed design stage.

8.7.2 Adoption of Short-Range Pipe Jacking Method

When laying down by-pass pipes from a storm overflow chamber to a manhole, the crossing road of the pipes causes vehicle traffic (Refer to Fig.8.7-2). Under this situation, the pipe jacking method is generally advisable but in the case of an ordinary pipe jacking method, the construction cost becomes expensive. Therefore, in the case of short construction distance having the concern about traffic obstacles, the short range pipe jacking method is recommended in the aspect of its smaller size and cheaper cost rather than ordinary pipe jacking method.



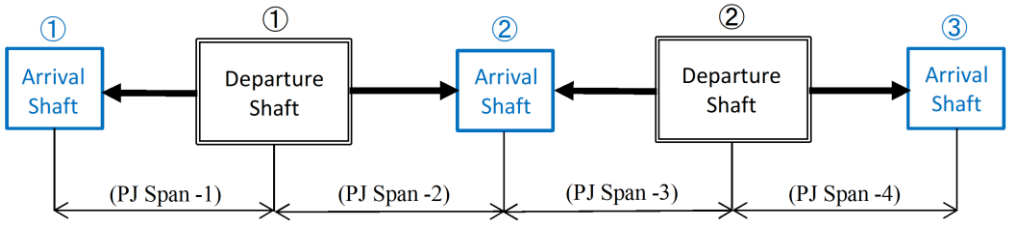
Source: JICA Study Team

Figure 8.7-2 Conceptual Drawing of Short-Range Pipe Jacking Method

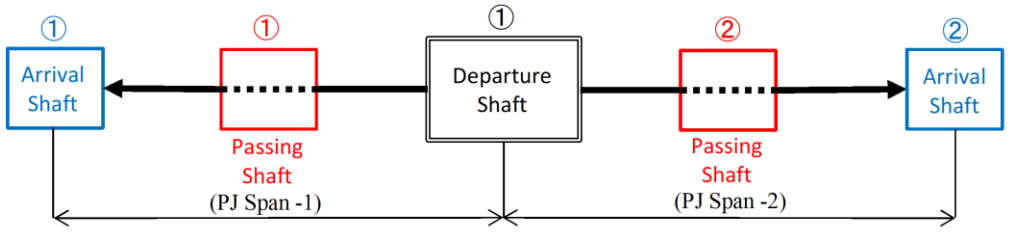
8.7.3 Adoption of Long-Range Pipe Jacking Method by Utilizing Passing Shaft

As for the departure base for the pipe jacking method, not only the departure shaft but also pipe jacking machines and heavy machines are arranged, which needs maximum working space. Therefore, in the sections with heavy vehicle traffic, minimizing the number of departure bases is desirable. As for large- and medium- diameter pipe jacking methods, pipe jacking (approximately 500 - 600m) is possible. However, constant distance (maximum 300m) for laying a manhole is required in order to maintain pipes and the facilities. Based on the above things, the passing shaft is adopted in the necessary location for manhole within the center of the pipe jacking range in order to decrease the number of departure bases. Each case between ordinary construction and the construction having passing shafts is shown in below schematic diagram.

＜CASE 1 : Normal＞



＜CASE 2 : Passing Shaft＞



Source: JICA Study Team

Figure 8.7-3 Schematic Diagram of the Arrangement of Pipe Jacking Shaft

The advantages by adopting the passing shaft of Case 2 are shown below.

- Minimizing traffic obstacles by decreasing the number of departure bases
- Smaller size and more economic, rather than drive shaft, due to not arranging the pipe jacking machines within a shaft
- No traffic regulation due to no construction work within a passing shaft except in the situation of building shafts and pipe jacking

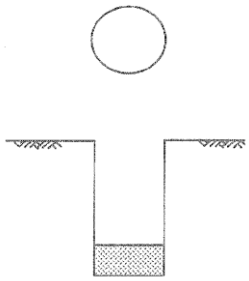
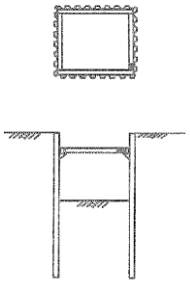
8.7.4 Adoption of Steel Casing Shaft for the Passing Shaft

Steel sheet pile construction method for shafts is commonly used for the pipe jacking construction method in Vietnam. However, it takes a long construction period, which affects vehicle traffic. In order to shorten the period, the steel casing construction method with its fast construction is examined.

The steel casing seems to be not appropriate as a departure shaft because the pipe jacking equipment and the thrust wall cannot fit into the circular shape of the casing. However, the casing can be used as a passing shaft or arrival shaft by not laying the equipment and thrust wall within the shaft. Therefore, the applicability of the steel casing as a passing shaft and arrival shaft is examined.

The characteristics of steel casing shaft and ordinary steel sheet pile shaft are shown in below.

Table 8.7-3 Comparative Table of Passing Shaft Construction Method

Construction Method	Steel Casing Shaft	Steel Sheet Pile Shaft
Schematic Diagram		
Outline	Press machines are used and the steel casing is thrusted underground. After excavation inside the casing by a clamshell, base plate concrete is poured and the shaft is built.	Steel sheet pile is built in series before excavation and falsework is carried out while excavating. The shaft is finaly built by continuing the above works.
Targeted Ground	Sandy soil, Cohesive soil, Gravel soil (The diameter of gravel soil≦200mm)	Sandy soil, Cohesive soil (Possible for soft soil)
	Sandy soil N≦50, Cohesive soil N≦30, Gravel soil N≦50	Sandy soil N≦50, Cohesive soil N≦50, Gravel soil N≦50
	○	○
Shape and Size	Circle	Rectangle
	○	○
Workability	Almost all works are machine works and workability is superior	It takes time to lay and remove the steel sheet piles, and to carry out earth retaining wall work and falsework.
	○	△
Safety	There is almost no human work until the end of building the shaft.	Caution to the ground collapse must be taken when working in shaft.
	○	△
Covering Plate	Opening and shutting is simple because of one circular plate or two semicircular plates.	Opening and shutting is complicated because of the use of multiple rectangle sheets.
	○	△
Construction Period	Short (3day/no.)※	Long (7day/no.)※
	3day/no×40nos = 120days	7day/no×40nos = 280days
	○	△
Economy	Expensive due to its special construction method	Cheap due to no supplementary construction method
	△	○
General Assessment	Economy is inferior but the construction period is shortened and the workability is superior.	Construction period is long and the workability is inferior.
	○	△

Source: JICA Study Team

※Note: Differ among size and excavation depth

Steel casing shaft is inferior in economy due to the use of special machines but superior in construction period, workability, and safety. Especially, in the aspect of construction period, it takes less than half the time compared to steel sheet pile shafts. As a result, in the aspect of all this planned area, the adoption of the steel casing shaft saves a couple of months' construction period in building shafts, which is supposed to be a large effect. In the project, called WEIPII, the steel casing shaft is examined and it is indeed used. The site photograph is shown below.

Steel Casing Shaft
(Passing Shaft/Covering Plate are installed)

Steel Sheet Pile Shaft
(Drive Shaft)

Source: JICA Study Team

Figure 8.7-4 Photography of the Installation of Pipe Jacking Shafts

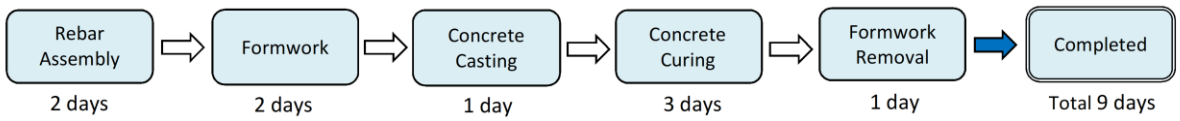
8.7.5 Adoption of Knockdown Manhole

Cast-in-place concrete is mainly used in building a manhole. However, the adoption of a knockdown manhole by using precast concrete can significantly decrease the construction period. Moreover, indeed, the knockdown manhole is adopted in a recent project in Vietnam. Therefore, the adoption of the knockdown manhole is examined.

(1) Working Process and Construction Period

Working process and construction period of cast-in-place manhole and knockdown manhole are compared. Work process of knockdown manhole is less rather than cast in place manhole, which can decrease construction period by 8 days per one place as shown in below flow.

＜Cast-in-Place Manhole: Per 1 Place＞



＜Knockdown Manhole: Per 1 Place＞

(2) Characteristic

There are various advantages of knockdown manhole including shortening the construction period. The comparative table is shown below.

Table 8.7-4 Comparative Table of Construction Method of the Manholes

	Knockdown Manhole	Cast-in-Place Manhole
Outline	Components are manufactured in a factory and only assembled and installed on site.	After assembling mold with reinforcing bars on site, concrete is poured in the mold.
Workability	Construction period is short due to only assembling	Plenty of working processes are required so that construction period is long.
	○	△
Quality	The quality is stable because it is managed in a factory.	The quality is not stable because it is manufactured on site.
	○	△
Construction Period	Short	Long
	○	△
General	・Occupation period is short.	・Flexible building is possible by adapting to the

Assessment	・The number of machines and the occupation area are small. ・The construction has not been affected by climate. ・Inadequate accuracy in assembling and installing can cause leak. ・Saving human work due to less work.	site specification. ・The construction has been easily affected by climate due to the long construction period and the necessity of curing. ・Plenty of machines are used and the occupation area is large. ・Occupation period is long and the care for surroundings must be taken.
	○	△

Source: JICA Study Team

8.7.6 Adoption of Pipe Jacking Method Coping with Underground Obstacles

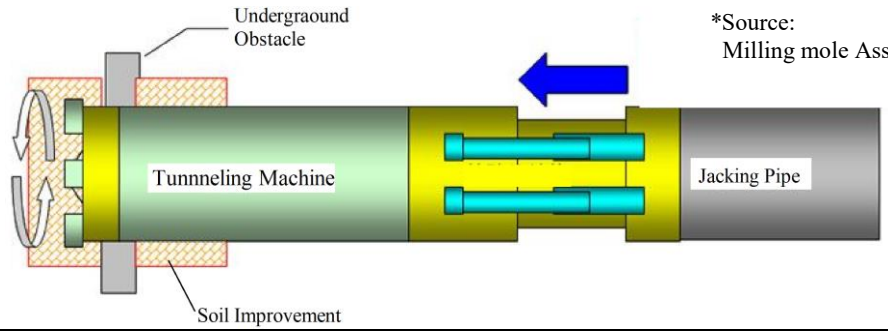
(1) Object

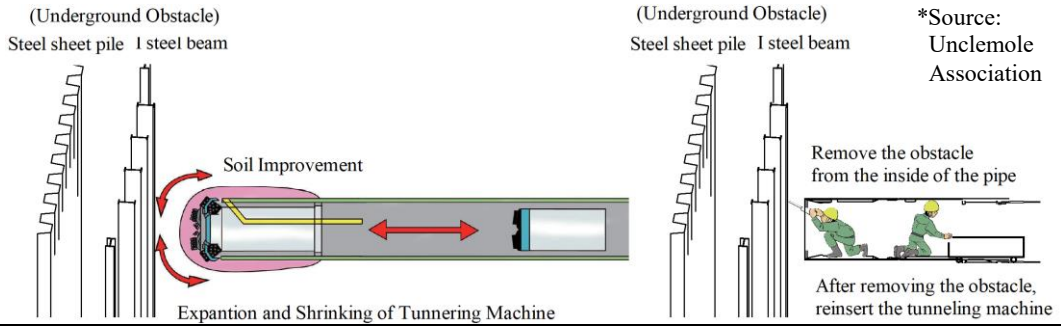
Pipe jacking is stagnant and delayed in some sections due to the existence of obstacles such as laid piles and temporary material beyond expectation. When facing the obstacles, the construction of ordinary pipe jacking method is difficult. Therefore, it is necessary to remove the obstacles from above the ground by laying earth retaining structures around obstacles and excavating, which requires enormous time and effort to deal with several conditions such as surrounding environment, vehicle traffic, and the condition of buried things. The pipe jacking method coping with underground obstacles is proposed in order to deal with the above situations. As for this method, the outline of the obstacles are detected by the front investigation and cutting and penetration to underground obstacles are possible by special cutter bit. However, the construction cost is expensive due to its high capability of pipe jacking and its specialty. Therefore, in the detailed design stage, the regulation of the usage only for the sections having obstacles (have no alternative routes) is examined.

(2) Main Example of Construction Method

Outline of pipe jacking method coping with underground obstacles is shown below.

Table 8.7-5 Outlines of Pipe Jacking Methods Coping with Underground Obstacles

Name	**Milling Mole Construction Method**
Outline	Milling mole construction method does not affect structures above the ground and safely cut and penetrate underground obstacles such as existing steel sheet pile and steel H beam. The method has the following 4 technologies, which are different from ordinary construction method. 1) Investigation Technology・・・Metallic obstacles is investigated in front during pipe jacking 2) Improvement Technology・・・Soil improvement from inside tunneling machine to the front and back of obstacles is carried out. 3) Cutting Technology・・・Metallic obstacles are cut in pieces and discharged. 4) Guidance Technology・・・Tunneling machine is guided into specific location of a shaft.
Schematic Diagram	 *Source: Milling mole Association

Name	Unclemole Shuttle Construction Method
Outline	Tunneling machine can be recovered within pipes and reclosed by expansion and shrinking of the cutter head. The machine is recovered in drive shaft. When facing obstacles, soil improvement from the machine will be carried out in order to deal with inflow sand and the obstacles will be removed. After the removal, the machine is reclosed and pipe jacking is restarted as usual.
Schematic Diagram	

Source: JICA Study Team

8.8 Examination for the Vertical Shaft Construction Method in Deep Excavation

8.8.1 Purpose

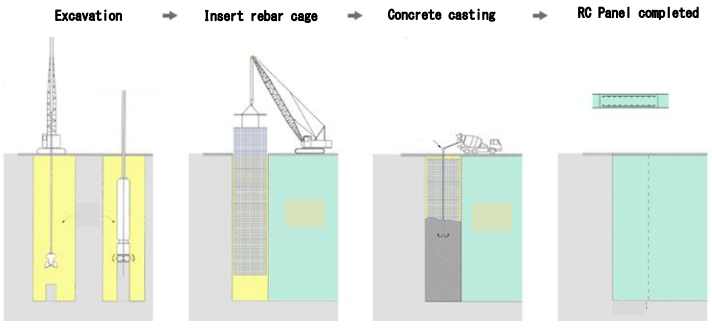
In the case of difficulty in securing sites for the pump station, the buried depth for pipes becomes significantly deep. Excavation depth adjacent to a wastewater treatment plant is supposed to reach approximately 25m. In order to construct a shaft with 15m or more depth in excavation, the steel sheet pile method generally adopted in Vietnam should not be adopted in the aspect of safety. Therefore, the examination is required for construction method for deep shaft with a depth 15m and more.

8.8.2 Outline of Construction Method for Deep Shaft

The outlined construction method is mentioned below for main construction methods of earth retaining walls for the shaft which is generally adopted in the case of deep excavation.

(1) Underground Continuous RC-Wall Method

Underground continuous wall construction method can be extensively used for earth retaining wall, underground external wall of buildings, and building foundation. Groove wall is excavated by using a special excavator (bucket type or horizontal multi-shaft type) with stabilized liquid, and a rebar cage which has already been produced on the ground is inserted, and concrete is poured while replacing the stabilized liquid, and then the wall is utilized as the main body.



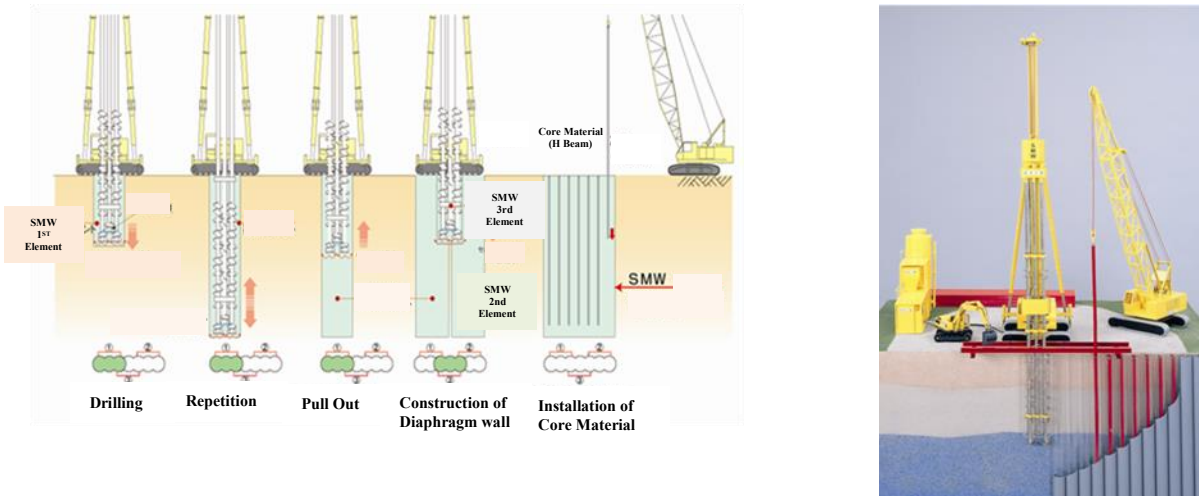
Source: JDC Corporation Home Page

Figure 8.8-1 Underground Continuous Wall Construction Method (Reference Drawing)

(2) Continuous Soil Cement Wall Method

Wall body is built underground by mixing and stirring soil and cement slurry in place. The natural ground is drilled by a specially developed multi-axis kneading auger machine, and then drilling and kneading of one element are carried out by emitting cement slurry from the tip of the

machine, and then the wall body of soil cement is built. This is the construction method by completely lapping the drilling kneading shaft of tip of the element over the next element.



Source: SMW Construction Method Technical Material

Figure 8.8-2 Soil Cement Construction Method (Reference Drawing)

(3) Steel Pipe Sheet Pile Method

For steel pipe sheet pile, joints are installed into the steel pipe pile. The Sectional function and the flexural rigidity of this pile are significantly large so that this method is widely adopted in various uses. Steel pipe sheet pile press – fit method is superior in the aspect of the press principle. This method can continuously press and construct steel pipe sheet pile without emitting environmental pollution during construction such as noise and vibration, which can build firm implant structure wall. Steel pipe sheet pile press machine (steel pipe piler) can build a high and stable quality continuous wall with its resistance to vertically and horizontally external force without disturbing ground and damaging pile material by static load press-fit method (oil pressure) due to the high accuracy construction with the confirmation of each pile's bearing capacity.

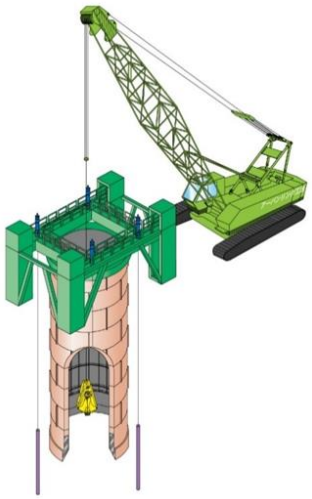
Source: Japanese Association for Steel Pipe Piles Home Page

Figure 8.8-3 Steel Pipe Piling Method (Reference Drawing)

(4) Press Caisson Method

For the press caisson method, opposing force is installed into th anchor for press-reaction force which is driven into ground, and the load is passed through rod into hydraulic jack, and the caisson withstands the cutting edge resistance and the peripheral surface friction force, and then the caisson is installed into the ground. Total loading power of hydraulic jacks located on the top

face of the caisson sums into from hundreds of tons to thousands of tons. High accuracy installation with securing attitude control by operating the jack alternately or altogether is possible. As for the construction method, there are the reinforced concrete method and the steel segment system (NS shaft) method.



Source: Kato Construction Co., Ltd Home page

Figure 8.8-4 Press Caisson Method (Reference Drawing)

8.8.3 The Selection of Deep Vertical Shaft Construction Method

From the construction methods mentioned above, an appropriate construction method for this project shall be selected.

(1) Selection Factors

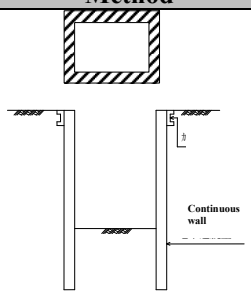
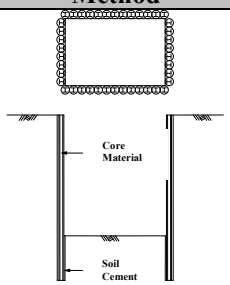
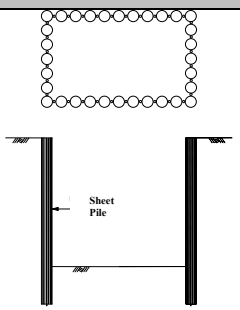
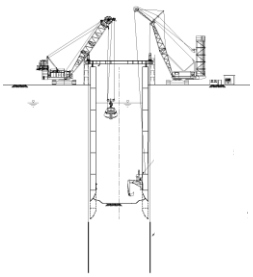
In selecting the shaft construction method, the design conditions assumed in this "WEIP III" plan are set as follows.

- Vertical shaft dimensions: W 4.0 m * L 8.0 m (Minimum dimension of departure shaft for RC φ 1,500 mm pipe jacking)
- Vertical shaft depth: H=25m
- Soil condition: Cohesive soil: N=0 - 2
- Width of occupied area: Within 10m (For one-side alternate passage traffic on full width 20m road)
- Others: Not considering obstacles of upper and underground.

(2) Examination with Comparison Table of Construction Method for Deep shaft

Based on the selection factors of (1) above, the comparative examination table is shown below.

Table 8.8-1 Examination comparison table of construction method for deep shaft

	1. Underground Continuous RC-Wall Method	2. Continuous Soil Cement Wall Method	3. Steel Pipe Sheet Pile Method	4. Press Caisson Method
Reference Drawing				
Allowable depth	○ Less than H=70m	○ Less than H=50m	○ Less than H=60m	○ Less than H=70m
Adaptability to soil condition	○	○	○	○
Construction Area	× W8.0m*L15.0m (A=120m^2) * Required additional space for plant	× W8.0m*L15.0m (A=120m^2) * Required additional space for plant	○ W8.0m*L15.0m (A=120m^2) *One-way passage traffic possible	○ W7.0m*L30.0m (A=210m^2) *One-way passage traffic possible
Retaining wall	○ Retaining wall also serves as the structural frame.	△ Remain in range deeper than 2m	△ Removal is impossible	○ Remain in range deeper than 2m
Construction Period	○ 3.5 month/no.	○ 3.0 month/no.	△ 4.5 month/no.	△ 4.5 month/no.
Cost	○ 20 billion VND/no.	○ 15 billion VND/no.	△ 70 billion VND/no.	△ 85 billion VND/no.
Comprehensive evaluation	× Need a large space for putting plant (1500m^2)	× Need a large space for putting plant (1500m^2)	○ Constructible and less expensive than 4method	△ Design conditions are satisfied but the most uneconomic

Source: JICA Study Team

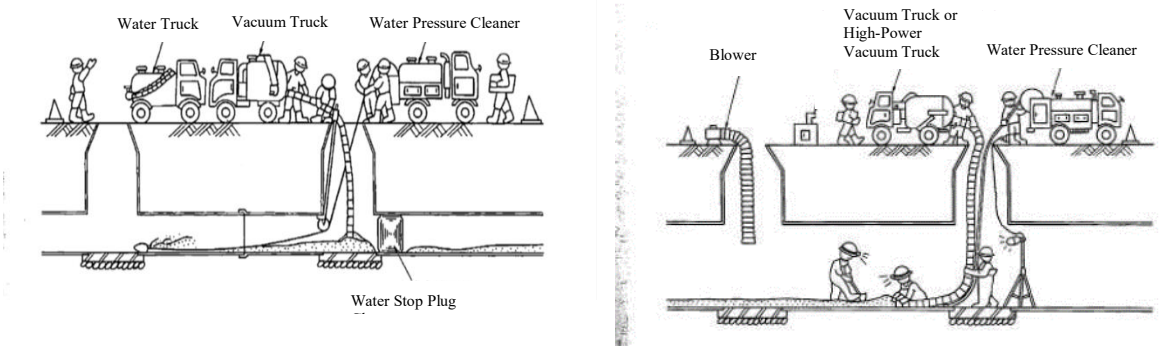
8.9 Propose for Pipe jacking method with Long Distance

8.9.1 Purpose

In a large diameter sewer system (pipe diameter of 1,000mm or more), generally the installation position tends to be deep, and in also this “WEIP III” area the excavation depth is 15m or more in the section where the pipe diameter is more 1000mm. As the installation level is deep, it will be installed by the pipe jacking method, but as mentioned in the previous section "5.5" above for the drilling depth of 15m, we cannot use the ordinary steel sheet pile method, so it is expensive: construction cost 70 ~ 90 billion VND. Also, when constructing a deep shaft, it may require a large working space, which impacts the traffic of vehicles. In this “WEIP III”, it is assumed that the installation section of pipelines where the earth covering is 15m or more with 1000mm dia. or more is expected to be about 6 km, most of which will be located in a boulevard. Based on the above contents, it is considered as “Special Case” to adopt the long distance pipe jacking method. The long distance pipe jacking method shall be examined since it may reduce the number of shafts and manholes that increase construction costs and traffic obstacles.

8.9.2 Studying on the Maximum Length between Manholes in “Special Case”

Manholes basically need to be installed at the starting point, confluence point and bending points, at those positions considered for maintenance. The distance between manholes are required within the range where the high pressure cleaning equipment with 80m hose can reach, in order to clean inside the pipe (Refer to figure 8.9-1 D<800mm). On the other hand, in the case of medium and large sized pipelines with pipe diameter of 800 mm or more, maintenance can be performed even if the span length between manholes exceeds 80m long pressure hose, because it is possible to clean inside of the pipe by human power (Refer to figure 8.9-1 D≧800mm). Therefore, in "Special Case" for a pipe diameter of 800mm or more, it is no problem in maintenance works that the distance between manholes is determined in accordance with the maximum distance constructed by the long distance pipe jacking method.



D<800mm　　D≧800mm

Source: Maintenance guidelines for sewers (Japan sewage works association)

Figure 8.9-1　Cleaning General View of Inside Pipe

8.9.3 Traffic Regulation for Deep Shaft Construction

Deep shaft construction requires an occupying space with 8m in width maintaining two ways transport. Accordingly, the position of the deep shaft is restricted to main streets with sufficient width. Since the influence on traffic congestion due to the road occupation for construction increases in proportion to number of shafts, the number of shafts will be reduced by adopting the long distance pipe jacking method, which is an effective means of reducing traffic problems.

8.9.4 Construction Cost for Deep Shaft

For the construction of a deep shaft which exceeds the excavation depth of 15m, the construction cost is about 70 billion VND/no. for the departure shaft, and the reduction in the number of shafts reduces construction cost substantially. In case of the long distance pipe jacking method for 800mm diameter or more, the number of shafts required can be greatly reduced.

In this “WEIP III”, Table 8.9-1 shows the deep shaft construction cost for each of the conventional criteria and the long distance pipe jacking method about the case of a pipeline length of about 6km with a pipe diameter of 1000mm or more. From the calculation result of Table 8.9-1, the construction cost reduction by adopting the long distance pipe jacking method is about 800 billon VND.

Therefore, in terms of economy, the adaption of the long distance pipe is effective.

Table 8.9-1　Construction Cost for Deep Shaft

Item	Unit Cost (VND)	Conventional Standard		Long Distance Pipe Jacking Method	
		Quantity	Amount (VND)	Quantity	Amount (VND)
Number of Span	-	20	-	6	-
Departure Shaft	70 billion	10	700 billion	3	210 billion
Arrival Shaft	50 billion	11	550 billion	4	200 billion
Total			**1,250 billion**		**410 billion**

Source: JICA Study Team

8.9.5 Construction Results of Long Distance Pipe Jacking Method

For reference, some of the result performances of the long-distance pipe jacking method in Japan (Pipe jacking distance of 800m or more) are shown below.

Table 8.9-2 Construction Results of Long Distance Pipe Jacking Method (In JAPAN)

No	Pie Diameter (mm)	Span Length (m)	Soil Condition	Construction Year
1	800	878.30	Sandy silt	2010
2	1000	1,069.40	Sandy gravel	2009
3	1000	1,274.63	Sandy silt	2004
4	1100	890.00	Sandy silt	2002
5	1200	1,298.90	Sandy soil	2010
6	1350	1,010.10	Sandy soil	2003

Source: Reinforced pipe Association Construction Results of Pipe Jacking Method with Long Distance

CHAPTER 9 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

9.1 Relevant Laws and Regulations

Main relevant laws and regulations in Vietnam relevant to environmental and social consideration are summarized in Table 9.1-1. The detailed relevant laws and regulations are shown in the Appendix.

Table 9.1-1 Main Laws and Regulations Related to Environmental and Social Consideration in Vietnam

No.	Date of Issue	Code/Number	Title
Environmental Impact Assessment (EIA)			
1	2014/06/03	Law No. 55/2014/QH13	Law on Environmental Protection (2nd revision)
2	2015/02/14	Decree No. 18/2015/ND-CP	Decree on environmental protection planning, strategic environmental assessment, environmental impact assessment, and environmental protection plans.
3	2015/02/14	Decree No. 19/2015/ND-CP	Detailing the implementation of a number of articles of the Law on Environmental Protection
4	2015/05/29	Circular No. 27/2015/ TT-BTNMT	Circular on strategic environmental assessment, environmental impact assessment and environmental protection plans.
Land Acquisition and Resettlement			
5	2013/11/29	Law No. 45/2013/QH13	Law on Land (revised)
6	2014/05/15	Decree No. 43/2014/ND-CP	Detailing a number of articles of the Law on Land
7	2014/05/15	Decree No. 47/2014/ND-CP	Regulations on compensation, support, resettlement when land is recovered by the state.

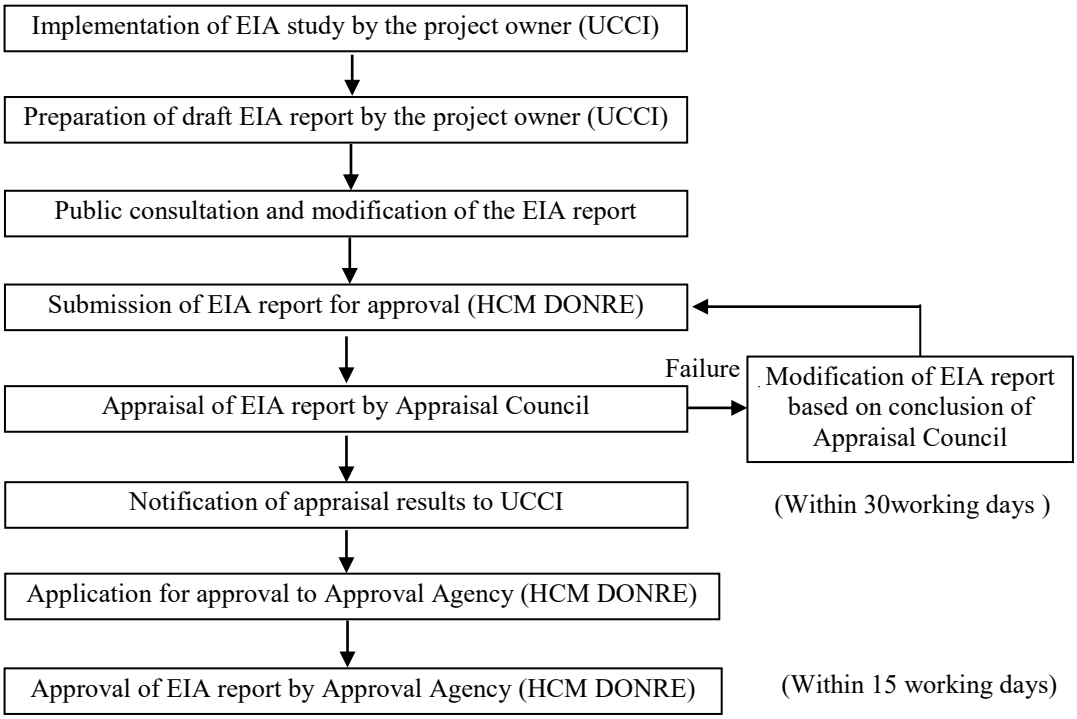
Source: JICA Study Team

9.2 Environmental Impact Assessment (EIA) Procedures in Vietnam

The EIA system in Vietnam is regulated by the Law on Environmental Protection (LEP) No. 55/2014/QH13, and detailed procedures are prescribed under Decree No. 18/2015/ND-CP and Circular No. 27/2015/TT-BTNMT. According to Decree No. 18/2015/ND-CP (Appendix II, List of entities subject to environmental impact assessment), a full scale EIA study must be conducted for the projects to construct or upgrade drainage systems in urban areas or residential areas with a length more than 10km.

The total length of interceptor collecting system planning in the project is about 30km, therefore an EIA study shall be carried out and the EIA report for the project shall be approved by Ho Chi Minh City's People Committee.

The procedure for appraisal and approval of EIA report for the project is shown in Figure 9.2-1.



Source: JICA Study Team based on relevant Vietnamese regulations.

Figure 9.2-1 Procedure for Appraisal and Approval of EIA Report

9.3 Comparison of JICA Guidelines and Vietnamese Regulations

Table 9.3-1 presents a comparison of JICA Guidelines for Environmental and Social Consideration (April, 2010) and Vietnamese regulations. There is no significant difference between the JICA guidelines and Vietnamese regulations for environmental and social considerations.

Table 9.3-1 Comparison of JICA Guidelines for Environmental and Social Considerations and Vietnamese Regulations

Item	JICA Guidelines	Vietnamese Regulations
EIA		
Policy	• To encourage and support the responsible organization to take appropriate considerations of environmental and social aspects. • To minimize and mitigate the negative impacts generated from the projects in order to achieve sustainable development.	Basically same as JICA guidelines.
Screening	Screening by classifying proposed projects into four categories: A, B, C, and FI. Category A: EIA level study and advice of the Advisory Committee is necessary. Category B: IEE (Initial Environmental Examination) level study is necessary. Category C: no more further activities. Category FI: to be determined	Screening by classifying proposed projects into two categories: the projects which need full EIA study, and the projects which only need EPP (Environmental Protection Plan) rather than full EIA study.
Scoping	Scoping such as choosing alternatives for analysis, deciding a range of significant and potentially significant impacts, and study methods is required.	Basically same as JICA guidelines.

Item	JICA Guidelines	Vietnamese Regulations
EIA report	• Executive summary • Policy, legal, and administrative framework • Project description • Baseline data • Environmental impacts • Analysis of alternatives • Environmental Management Plan (EMP) • Public consultation (stakeholder meetings with local stakeholders including affected individuals or groups are required.)	• Summary of the project (including project description) • Natural, socio-economic conditions • Assessment, predict the environmental impacts caused by the project • Mitigation measures of negative impacts • EMP • Public consultation (but only consultation with local PC and representatives of relevant organizations) • Conclusion, recommendation and commitment Basically same as JICA guidelines.
Information disclosure	JICA discloses information on its website in Japanese, English, and/or local languages, and provides related reports for public reading at its library and at JICA Vietnam office.	Not mentioned.
Land Acquisition and Resettlement		
Compensation rates	Compensation for lost land and other assets should be paid at full replacement costs.	Compensation is based on the land and other assets prices specified by PPC periodically. There are some cases that the gaps between actual market price and compensated ones are identified, and even the compensation rates can be adjusted to reduce the gaps.
Compensation for loss of income sources or means of livelihood	Loss of income sources should be compensated whether or not the project-affected-households (PAHs) must move to another location.	Support in respect of income loss is given only for registered businesses (Article 88, Law No. 45/2013/QH13). However, some supporting measures to restore income sources are provided (Article 19 to 21, Decree No. 47/2014/ND-CP)
Vulnerable Groups	Particular attention should be paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples, ethnic minorities, or other displaced persons who may not be protected through national land compensation legislation.	Not emphasized. The target of job training is those whose lands are recovered only. Landless people are not covered. In general, no compensation shall be paid to those who do not have legal rights to land, however, there are some cases that part of full compensation may be paid to them based on Provincial People Committee's decision.

Source: JICA Study Team based on relevant Vietnamese regulations.

9.4 Risk Analysis of Environmental and Social Impacts

The JICA Survey Team conducted risk analysis based on existing information and field survey. The results are summarized in Table 9.4-1.

Table 9.4-1 Risk Analysis of Environmental and Social Considerations

No.	Issues	Risk Evaluation		Comments
		P & C	Operation	
Social Environment				
1	Resettlement	D	D	Interceptors will be constructed along existing roads. No resettlement is expected.
2	Local economy (employment and livelihood etc.)	B-	B+	During construction stage, it is estimated that about 4,700 shops/business entities would be temporarily affected by the cut-and-cover construction works. But the impacts are temporary and mitigable by applying the non-open-cut method. In the operation stage, the project will create positive impacts on the local economy due to flood/inundation control.
3	Land use and utilization of local resources	C-	D	Some changes of land use may occur in case of the construction of an intermittent pump station. However, the area affected will be very limited.
4	Treated wastewater usage right	D	D	Although wastewater and rainwater will be collected and intercepted into wastewater treatment plant which is located at District Nha Be, no usage right of treated wastewater and rainwater within District 7 is identified.
5	Social institutions	D	D	Sewerage system construction normally has very limited negative impact on social institutions.
6	Existing social infrastructures and services (such as traffic etc.)	B-	B+	During construction stage, traffic disruption may occur during construction. The impacts of traffic congestion should be examined especially on electric power system, water supply system, telecommunication system, school, hospital, temple etc. During operation stage, flood and inundation in the area will be controlled, consequently, social infrastructures and services will be improved.
7	Poor households	C-	C	Appropriate wastewater tariff with consideration for low income users should be studied in the next stage.
8	Indigenous, or ethnic people	D	D	No group of ethnic people or indigenous people living in the project area.
9	Misdistribution of benefit and damage	B-	D	During construction stage, the residents living along the construction sites would be affected more than residents living in other places. In operation stage, the project will provide 100% service coverage to the area.
10	Local conflict of interests	B-	D	During construction stage, there may be conflicts of interest between the shops obstructed by the construction sites and the shops which are not obstructed by the construction sites. The project will provide 100% service coverage to the area during operation stage.
11	Gender	D	D	Impact caused by the project on gender is not expected.
12	Children's rights	D	D	Health of children will be improved after the project completion.
13	Cultural heritage	C-	D	The impacts of interceptor construction on cultural heritage should be considered during construction stage.
14	Infectious diseases such as HIV/AIDS	B-	D	Potential but mitigable risk of infectious diseases such as HIV/AIDS due to influx of construction workers during construction stage.
15	Accidents	B-	D	During construction stage, the impacts of accidents in open-cut construction sites or deep shaft for micro-tunneling method should be considered especially during heavy rains.
Natural Environment				
16	Geographical features	D	D	No change of topography and geology will be expected.
17	Ground	D	D	No large-scale structure will be constructed and no

No.	Issues	Risk Evaluation		Comments
		P & C	Operation	
	subsidence			groundwater will be withdrawn, consequently, no ground subsidence is expected.
18	Bottom sediment	D	D	No construction works along existing canals.
19	Biota and ecosystem	D	D	The project area is located in a developed urban area where there is no specific eco-system.
20	Meteorology (global warming)	D	D	Greenhouse Gas (GHG, such as CH_4, CO_2 etc.) emission will be very limited during both construction stage and operation stage.
21	Landscape	D	B+	During construction stage, landscape would be temporarily affected due to the fences installed around the construction sites, and construction machines during the construction stage. However, the impact is limited and mitigable. In operation stage, landscape will be improved due to flood/inundation control.
22	Protected areas	D	D	There is no protected area in the project area.
Pollution				
23	Air pollution	C-	D	During construction stage, limited dust and exhaust gas may be generated by construction equipment, vehicles, and excavation activities. No SO_2, NO_2, CO, or dust, will be discharged during operation stage.
24	Water pollution	C-	A+	During construction stage, water pollution may occur due to run-off water and discharge of wastewater from construction sites. During operation stage, however, wastewater and drainage will be collected and treated at wastewater treatment plant. Therefore, surface water quality will be greatly improved.
25	Soil pollution	D	D	During construction stage, surplus wastes from construction site will be disposed of at a landfill site.
26	Waste	B-	B+	During construction, domestic wastes and construction wastes would be generated. Proper measures are needed. During operation stage, wastewater and drainage containing solid wastes will be collected and treated at wastewater treatment plant. The waste discharged into surrounding water bodies will be reduced.
27	Noise and vibration	B-	D	There are hospitals, schools and residence along the planned interceptor route. During construction stage, impact of noise generated by construction equipment and vehicles is expected. During operation stage, no noise and vibration sources are expected.
28	Offensive odor	D	B+	No odor will be produced during construction stage. During operation stage, wastewater and drainage will be collected and treated as wastewater treatment plant, which will reduce offensive odors from the surrounding water bodies now receiving wastewater and drainage without proper treatment.

Source: JICA Study Team.

Note; P & C: Pre-construction and construction

A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of impact is unexpected, further study is needed

D: Limited/negligible impact, further study is not needed.

In addition, at the present stage no land acquisition and involuntary resettlement is expected in this project. Nevertheless, minor impacts on the environment and society are possible as described in

Table 9.4-1. This project probably falls under Category B, according to the JICA Guidelines.

9.5 Recommendations for Environmental and Social Considerations of Next Stage

9.5.1 JICA's Preparatory Survey

Considering the fact that the wastewater treatment plant (WWTP) for District 7 will be included into the scope of next Preparatory Survey, some recommendations for environmental and social considerations in Preparatory Survey are summarized in Table 9.5-1.

Table 9.5-1 Recommendations for Environmental and Social Considerations in Next Preparatory Survey

Item	Contents	Remarks
EIA	1. Reconfirmation of Category according to the JICA guidelines. 2. Confirmation of base line conditions (land use, natural environment, economic and social conditions etc.). 3. Confirmation of update laws and regulation for EIA etc. 4. IEE (Initial Environmental Examination) level study for predicting environmental impacts, studying alternatives and mitigation measures, preparing monitoring plan etc. 5. Implementation stakeholder meeting (residents around the WWTP and along planned sewer pipe route etc.). 6. Preparation of checklist according to the JICA guidelines. 7. Support the EIA study conducting by local qualified consultant hired by UCCI.	No involuntary resettlement and large-scale land acquisition is expected.
Land Acquisition and Resettlement	1. Reconfirmation of the necessity and scale of land acquisition and resettlement for the WWTP and intermittent pump station. 2. Confirmation of procedures and main compensation issues for land acquisition and resettlement of existing projects. 3. If needed, preparation of an Abbreviated Resettlement Action Plan (ARAP) based on the JICA Guidelines and the World Bank's OP 4.12. 4. Support UCCI, District 7 and District Nha Be People's Committee for implementation of the ARAP.	The land acquisition for the WWTP will be needed. In addition, alternative study of intermittent pump station is on-going. In some cases, land acquisition for the intermittent pump station may be necessary.

Source: JICA Study Team

9.5.2 UCCI

According to Decree No. 18/2015/ND-CP (Appendix II, List of entities subject to environmental impact assessment), a full scale EIA study must be conducted for all projects to construct an urban or industrial wastewater treatment system. Moreover, according the Appendix III (List of projects under assessment and approval for environmental impact assessment reports of the Ministry of Natural Resources and Environment), the EIA report must be approved by Ministry of Natural Resources and Environment (MONRE) for all projects to construct concentrated sewage treatment systems with capacity of 50,000 m^3/d or more.

It is recommended that UCCI should hire a qualified consultant to conduct the EIA study in collaboration with JICA's Preparatory Survey Team. Terms of reference (TOR) for the EIA have been proposed by the JICA Survey Team as shown in the Appendix. An action plan for the preparation and approval of the EIA report is proposed in Figure 9.5-1.

Main Tasks of Approval Procedure		Year 1				Year 1			
		Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1	**JICA Preparatory Survey (Assumption)**								
2	**EIA Study**								
2.1	Modification of TOR for the EIA study								
2.2	Selection of EIA consultant								
2.3	Implementation of the EIA study								
2.4	Preparation of draft EIA report and public consultation								
2.5	Submission of the final EIA report to MONRE								
2.6	Appraisal of the EIA report by Appraisal Council								
2.7	Approval of the additional EIA report by MONRE								
3	**JICA Appraisal Mission (Assumption)**								

Source: JICA Study Team.

Figure 9.5-1 Proposed Action Plan for the EIA Study

CHAPTER 10 CONSTRUCTION COST ESTIMATION AND CONSTRUCTION SCHEDULE

10.1 Basic Condition of Construction Cost Estimation

10.1.1 Base Year

The base year for cost estimation is 2018.

10.1.2 Exchange Rate

Exchange rates are shown as follows.

- 1 USD = 113.0 JPY
- 1 USD = 22,720 VND
- 1 VND = 0.00497 JPY

10.2 Direct Cost

10.2.1 Direct Construction Cost

The direct costs include the following three items.

- Labor Cost
- Material Cost (Including the materials provided by the investor)
- Machine Cost

10.2.2 Preparatory Cost

It is necessary to estimate preparatory cost by each item, however on this report, a preparatory cost was set as the total of the direct cost multiplied by 25%.

10.3 Indirect Cost

10.3.1 General Cost

According to Circular No. 06/2016 TT-BXD, a general cost is determined by the cost of construction before tax in the project. The total construction investment cost is as shown in the table below.

Table 10.3-1 Rate for General Cost Percentage

Unit: %

No	Type of Works under Project	Cost of construction before tax in the project total approved construction investment cost (billion dong)				
		≦15	≦100	≦500	≦1000	＞1000
1	Civil woks	6.5	6.0	5.6	5.4	5.2
	As for works renovating or restoring the historical and cultural relics	10.9	9.0	8.6	8.4	8.2
2	Industrial Works	5.5	5.0	4.6	4.4	4.2
	As for construction works of hydropower tunnel, pit	6.5	6.3	6.0	5.8	5.7
3	Traffic works	5.5	5.0	4.6	4.4	4.2
	As for works of traffic tunnel	6.5	6.3	6.0	5.8	5.7
4	Agricultural and rural development works	5.5	5.0	4.6	4.4	4.2
	Technical infrastructure works	5.0	5.0	4.1	3.9	3.7

Source: Circular no. 06/2016 TT-BXD by Ministry of Construction

10.3.2 Taxable Income Advance

According to Circular No. 06/2016 TT-BXD, a predetermined taxable income is calculated by the percentage (%) over the direct cost and general cost in the construction cost estimate.

Table 10.3-2 Rate for Pre-Determined Taxable Income

Unit: %

No	Item	Taxable Income
1	Civil Works	5.5
2	Industrial works	6.0
3	Traffic works	6.0
4	Agricultural and rural development works	5.5
5	Technical infrastructure works	5.5
6	Installation of technological equipment in construction works, building and installation of line, testing and calibration, electricity line and substation, testing of materials, structure and constructional structure.	6.0

Source: Circular no. 06/2016 TT-BXD by Ministry of Construction

10.4 Estimated Construction Cost for the Package

Estimated construction cost is shown as the table below.

Table 10.4-1 Construction Cost for District 7

No	Item	Specification	Amount		Remarks
			JPY (Million)	VND (Billion)	
I	Direct Cost				
	1. Preparatory Cost		4,865	979	25%
	2. Interceptor Pipe	D300-1,700 L=30,700 m	6,442	1,296	Refer to Table 10.4-2
	3. Pumping Station	1 no.	650	131	Reference price
	4. WWTP	102,000 m^3/d	12,369	2,489	Reference price
	Total Cost of Direct Cost	I	24,326	4,895	
II	General Cost		900	181	3.7%
III	Taxable Income Advance		1,387	279	5.5%
	Construction Cost before TAX	I+II+III	26,613	5,355	
IV	Value added TAX		2,661	535	10.0%
	Construction Cost after TAX	I+II+III+IV	**29,275**	**5,890**	

Source: JICA Study Team

Table 10.4-2 Direct Cost of Interceptor Pipe

Item		Quantity	Unit	Unit Price (VND)	Amount (VND)	Remarks
Open Cut	D300	5,900	m	23,073,000	136,130,700,000	
	D400	5,400	m	25,101,000	135,545,400,000	
	D500	2,650	m	26,761,000	70,916,650,000	
	D600	200	m	31,609,000	6,321,800,000	
	D700	1,500	set	30,389,000	45,583,500,000	
	Manhole	272	m	174,296,000	47,408,512,000	
Pipe Jacking	D300	500	m	23,553,000	11,776,500,000	
	D400	400	m	25,167,000	10,066,800,000	
	D600	3,000	m	31,844,000	95,532,000,000	
	D700	1,800	m	34,778,000	62,600,400,000	
	D800	2,100	m	42,497,000	89,243,700,000	
	D1,000	900	m	46,735,000	42,061,500,000	
	D1,100	900	m	50,216,000	45,194,400,000	
	D1,400	1,050	m	64,473,000	67,696,650,000	
	D1,600	2,650	m	75,074,000	198,946,100,000	

Item		Quantity	Unit	Unit Price (VND)	Amount (VND)	Remarks
Pipe Jacking	D1,700	1,750	set	81,935,000	143,386,250,000	
	Shaft	78	set	422,000,000	32,916,000,000	
	Manhole	78	set	478,247,000	37,303,266,000	
Total					**1,278,630,128,000**	

Source: JICA Study Team

10.5 Construction Period

10.5.1 Daily quantity of work

Construction period is calculated by unit which refers to the volume of work and a track record for construction period in Vietnam.

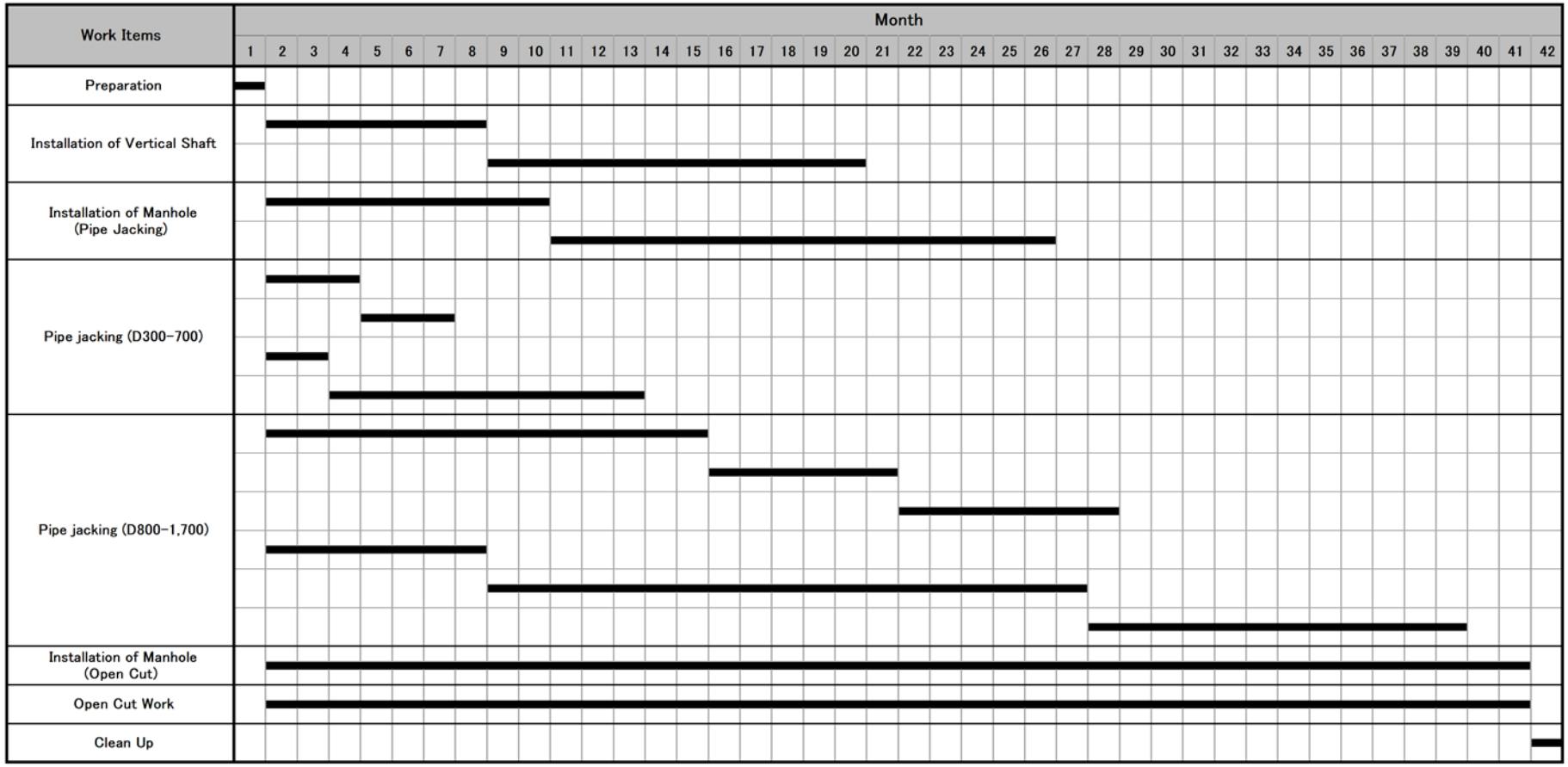
Table 10.5-1 Daily Quantity of Work

Work Item	Daily Quantity of Work (Per Service Day)	Remarks
Open-Cut Work	2.5 m/d	
Installation of Manhole (Open-Cut)	0.1 no./d	10 day/no.
Pipe jacking (D300-700)	5.5 m/d*[1]	6.5-7.4 m/d
Pipe jacking (D800-1,700)	5.0 m/d*[1]	5.8-7.0 m/d
Installation of Vertical Shaft	0.14 no./m	7 day/no.
Installation of Manhole (Pipe jacking)	0.1 no/d	

Source: JICA Study Team

*Note*1: Include preparation works and equipment removal upon completion.*

Table 10.5-2 Construction Schedule for Interceptor of District 7



CHAPTER 11 PRIVATE FINANCE VIABILITY

11.1 Private Finance Viability to Sewer Pipe Construction

PPP scheme is a one of the main measures of applying private finance to construction of sewer system. However, in case of this study which target is only for interceptor sewer pipes, sewage usage charge cannot be collected as an income of the investor, due not to perform as a sewer system.

On the other hand, BT scheme which applying to Xuyen Tam Canal Project has a possibility to construct interceptor sewer pipes by private finance.

11.2 Possibility of Applying BT Scheme to Sewer Pipe Construction

(1) Similar Scheme with the F/S (Xuyen Tam Canal Project)

In order to apply similar BT scheme as Xuyen Tam Canal project for the sewer pipe construction of District 7, the site shall meet conditions as set below.

a) Living conditions of a project site should be improved by upgrading a natural canal, reducing flooding and constructing infrastructure by the project,

b) The site has to be attractive for developers, and

   For example,

   - ✓ Land has good transportation access as located near main road,
   - ✓ Land which infrastructure such as water supply, sewerage and electricity has been improved or are to be developed,
   - ✓ Land where social infrastructure such as schools, hospitals, police stations exist nearby,
   - ✓ Land that is resistant against flood in HCMC

c) The site should be located upstream of the sewer system, in order not to affect the sewerage system even if the construction is delayed.

Considering these conditions, there is no appropriate site for applying similar BT scheme with the Xuyen Tam Canal Project on the sewer system of District 7. Because District 7 has been developed by both public and private sectors, and there is less land to develop near existing canals. In addition, there are middle income resident houses around the existing canals and ponds, resettlement and compensation cost will be high and the requirement of development is less around canals and ponds in District 7.

(2) Other Scheme

According to the concerned law and decree to BT project, land to be used for payment can be located away from the project site. It means if HCMC has available land which can be used for payment for construction of sewer pipes in District 7 and meets b) of the above conditions as to be attractive for developers, the candidate land can be used for payment against construction of sewer pipes in District 7.

Regarding this scheme, JST conducted hearing interview to HCMC through UCCI and got a reply that HCMC does not have any appropriate land to be used for payment as of now.

(3) Conclusion

Based on the study results mentioned above, it is better not to apply BT scheme for the sewer system construction project in District 7, nevertheless the BT scheme is considered to have many advantages for construction of infrastructure. HCMC has studied and considered utilization of BT scheme for construction of sewer pipes. However, they cannot find an appropriate piece of land for development to be used for payment for public works. HCMC is unlikely to apply BT scheme to construction of

sewer pipes of District 7 as of now. This conclusion is drawn by considering the policy of the Vietnamese government regarding application of BT scheme to infrastructure development projects as mentioned on "(4) additional information" as well.

However, it becomes possibility to apply a BT scheme to construction of sewer pipes in District 7 if the following conditions can be met, 1) transparency for bidding and evaluation of land value is secured by enacting the new decree and 2) HCMC can secures piece of land appropriate for payment. In order to implement the sewer pipe construction project by BT scheme, it is necessary to continue to learn contents and enacting schedule of the new decree and for HCMC to secure an appropriate land for payment.

In addition, a Japanese developer replied to our interview that they cannot consider participation without confirmation of the location of land for payment by the BT scheme.

If HCMC wants to implement infrastructure construction, not limited to the construction of sewer pipe construction in District 7, using BT scheme, HCMC has to designate the land to be used for payment. In addition, the land should be cleared and resettlement should be finished by HCMC before starting construction. These conditions are a first step of applying BT scheme and involving Japanese developers.

(4) Additional Information

MOF decided that from Jan, 2018, the use of public property (land) for payment to Build-Transfer investors should be stopped until the Vietnamese government's new decree related to this aspect takes effect. The MOF submitted a draft decree regulating the use of public property for payment to investors of projects in the form of BT to the government in Oct, 2017. Up to January of 2019, this document has not been issued and the exchange of land for infrastructure will be stopped in the meantime. It is expected that halting of BT scheme of exchanging land against infrastructure construction will be removed even though some restrictions are imposed and BT projects will be implemented once the new decree takes effect.

One of the reasons of MOFs proposal is the lack of fairness in the evaluation of land values and process of tender bid in the previous BT projects.

Considering the above circumstances, it is unlikely that BT schemes area applied to new projects until the new decree proposed by MOF has taken effect.