Chapter 28 Recommendation on Institutional Arrangement

28.1 Administration, management and operation of ports

28.1.1 Classification of ports

A port is a base of physical distribution, passenger traffic and industry of not only its direct hinterland but also a much broader area. Therefore planning and investment for ports should be done efficiently from a long-term outlook. Ports should be classified and disposed according to their importance and function. As for public ports, priority of investment must be identified to allocate limited budget effectively. From the reasons mentioned above, inland waterway ports in Vietnam should be classified as shown below, regardless of whether the owner or operator is public or private.

- Major Port

A Major Port has a large hinterland with vibrant socio-economic activities. Several kinds of cargo are handled at relatively large volume. Infrastructure is built in permanent structures. In the Hanoi segment, Hanoi Port, Khuyen Luong Port, New North Port and New East Port are classified as Major Ports. In addition Chem Berth is also exceptionally classified as Major Port despite being a Berth, a temporary facility, because it is expected to play a very important role in the urban development of west area.

- Minor Port

The hinterland of Minor Ports is limited. Few types of cargo are handled and cargo volume is small. This includes Berths which are temporary facilities established by making use of favorable natural conditions. In the Hanoi segment, all ports excluding Major Ports identified above are classified as Minor Ports.

- Specialized Port

Specific cargo is handled at specialized ports. It functions as a dedicated port of large-scale plants such as power plants. There are no specialized ports in the Hanoi segment.

28.1.2 Role sharing for port management and operation

Generally port management and operation systems are classified into 4 types as follows.

- Service Port
- Landlord Port
- Government Initiative Company Port
- Company Port

Table 28.1.1 shows role sharing for port management and operation of each type. However, as land held in demesne is not permitted in Vietnam, land is owned by the Government even if it is a company port.

Table 28.1.1 Type of Port Management and Operation

Type		Service Port	Landlord Port		Government Initiative Company Port	Company Port
		A	B	C	D	E
Port Planning		○	○	○	○	●
Construction						
	Infrastructure (berthing facilities, yard, etc.)	○	○	○	●	●
	Superstructure (crane, warehouse, etc.)	○	○	●	●	●
Ownership						
	Land	○	○	○	○	○
	Infrastructure	○	○	○	●	●
	Superstructure	○	○	●	●	●
Port Operation		○	●	●	●	●

Notes) ○:Government ●:Company

Source) JICA Study Team

Table 28.1.2 shows merits and demerits of each type from the viewpoint of the Government.

Table 28.1.2 Merits and Demerits of Each Type from the Viewpoint of the Government

Type	Merits	Demerits
Service Port	-Since the Government constructs, owns and operates all facilities, it is easy to improve facilities in case of need according to port planning.	-Generally cargo handling efficiency of the Government operated port is lower than that of company port due to the absence of competition in the market
Landlord Port	(Both patterns) In the case of need for the port planning in the future, the Government can improve facilities since it owns the infrastructure (pattern C) Since the superstructure is built by a company, financial burden of the Government is reduced.	Financial burden of the Government is large because it has to invest in all infrastructure.
Government Initiative Company Port	-Though port is constructed and operated by a company, the Government can control port planning. -Since all facilities are constructed by a company, there is no need for the Government to invest.	- Since it is not the owner, the Government can not participate in its planning during the contract period.
Company Port	- There is no financial burden to the Government	- The Government can not participate in port planning.

Source) JICA Study Team

Table 28.1.3 depicts the Government's degree of participation and financial burden by each port management and operation type.

Table 28.1.3 Participation and Financial Burden of the Government by Port Management and Operation Type

	Service Port	Landlord Port	Government Initiative Company Port	Company Port
Participation in port planning and operation by the Government	Strong			Weak
Financial burden of the Government	Big			Small

Source) JICA Study Team

Based on the above, the Study Team proposes the role sharing for inland waterway ports in Vietnam as follows. However this form is not applied to Chem Berth because it is an exception.

Table 28.1.4 Desirable Type of Port Management and Operation

Port Classification	Desirable Type
Major Port	Landlord Port (B, C)
Minor Port (1) (Port)	Landlord Port (B, C), Government Initiative Company Port (D)
Minor Port (2) (Berth)	Government Initiative Company Port (D), Company Port (E)

Source) JICA Study Team

- Major Port

Since Major Ports have a great impact on both regional and national interests, planning has to be done from a long term and national perspective. Therefore the state (MOT) should participate in the management. In other words, the state should plan, invest and own port infrastructure such as berthing facilities and road. Superstructure, however, such as cargo handling equipment and warehouse can be installed either by the state or a company. The state does not need to participate in operation. In fact, it is preferable that operation be left to companies which are generally much more efficient in this area. Port operator leases the infrastructure from the state.

- Minor Port

As the role of a Minor Port is smaller than that of a Major Port, the degree of state participation in management and operation should be decreased. This will reduce the state's financial burden. Public sector in this case should be local government rather than the central government because local government has a better grasp of the actual circumstances. Berths, however, should be managed and operated by completely a company to enhance competition and increase efficiency.

28.1.3 Proper port management

At present VIWA, a competent authority for IW port management, does not fully grasp the present situation of ports (i.e. location, scale, facilities, owners and operators) under its jurisdiction. In addition, there are ports being operated without permission. To have a solid understanding of ports in its jurisdiction is a basic and minimum duty of a competent authority. This is the basis for port management activities such as port statistics and dues collection. A competent authority must grasp the present situation of ports in its jurisdiction by establishing an adequate financial and personnel framework.

Moreover, technical standards for port facilities should be established for appropriate construction, improvement and maintenance of port and berth.

28.1.4 Restriction of new berth construction

At present many small Berths are scattered throughout the Hanoi segment. Existence of so many scattered Berths is undesirable from the viewpoints of not only efficient distribution network and city environment but also safety. Hence new construction or extension of existing ports/Berths other than Major Ports and satellite passenger berths should be prohibited. Temporary cargo Berths located between Thang long and Thanh Tri Bridges shall be removed and transferred to the outside by 2020.

28.1.5 Strengthening competitiveness of state operated ports

At present in the Hanoi segment there are many public and private Berths as well as state operated ports such as Hanoi Port and Khuyen Luong Port. Almost all ports and Berths are handling bulk cargo such as construction materials and coal. It can be observed that the state operated ports are less efficient and lack competitiveness. Because new Berth construction should be controlled as mentioned above, the role of state operated ports becomes more and more important. Therefore the state operated ports should be able to successfully compete with Berths. The Study Team proposes the following measures.

(1) Extension of operating hours

In the Hanoi segment, operating hours of state operated ports are shorter than that of private Berths. For example, while the operating hours of Hanoi Port is 14 hours(net 12 hours) ; 7 hours / shift(6hours for handling and 1 hour for maintenance) × 2 shifts, that of Chem berth is 24 hours. State operated ports need to expand their operating hours to the same level of private Berths.

(2) Reduction of idle time

Idle time (=berthing time – cargo handling time) of state operated ports is longer than that of private Berths. For example, it is 6～12hours / vessel in Hanoi Port and 3 ～ 6 hours / vessel in Chem berth. To reduce this difference in idle time it will be necessary to introduce 24hour operation and streamline documentation procedures at state operated ports. Accordingly IWPA which is manages arriving and leaving vessels and collects tonnage dues and port operators which manage and operate cargo handling equipment, etc., will have to assign personnel properly and make use of MIS.

(3) Improvement of cargo handling efficiency

Compared with private Berths, cargo handling efficiency is lower as shown in the table below.

Table 28.1.5 Comparison of Cargo Handling Efficiency

Unit : ton/hour•crane

	Bulk Cargo	Other Cargo
Hanoi Port	55	25
Chem Berth	70	30

Source) JICA Study Team

One of the reasons for the difference in efficiency is that all cargoes are loaded at the yard and then loaded onto trucks at Berth, but at Hanoi Port it is loaded directly to trucks. Since it is difficult to secure sufficient space at the detached piers in Hanoi Port, it is proposed to carry out reconstruct to transform them into standard type piers.

28.1.6 Introduction of Management Information System (MIS)

(1) General

Management Information System is a comprehensive system using computers which allows information to be accumulated and circulated to relevant personnel in a timely manner. Since there is a limit to the amount of information that can be managed by human power, information is generally distributed to a certain section and then filtered down to other sections. In other words, information is not immediately distributed. In MIS, however, information is dispersed from a central organization to all sections simultaneously.

Since information in port management and operation such as arrival and departure of vessels, use of port facilities, charge and due collection and port statistics is mutually related, the introduction of MIS will bring the following benefits.

1) Faster and more efficient operation

The integrated on-line network system allows advance processing of information related to the use of port facilities, thus enhancing the speed and accuracy of business transactions.

2) Efficient management of port facilities

A wide range of data on the use of port facilities can be obtained anytime on-line, which allows efficient management of the facilities.

3) More efficient handling of charges

By computerizing the calculation of charges, billing, settlement, and issuance of receipts, the efficiency and accuracy of the charge-management are improved.

4) Utilization of advanced data

Policy-making and planning of port development are improved because users of the system can retrieve the necessary data and process it into diverse formats in a speedy and accurate manner.

(2) Object ports to introduce MIS

While it is hoped that MIS will eventually be introduced to all ports in the Hanoi segment, the Study Team proposes that MIS should be introduced to the 4 Major Ports as a first phase, namely Hanoi Port, Khuyen Luong Port, New North Port, New East Port.

MIS should be prepared by MOT as a part of port facilities and managed by users, namely IWPA and port operators.

(3) Utilization of MIS

IWPA and port operators can use MIS for variety of purposes, from the management of entering and departing vessels to the preparation of various reference materials. (See **Table 28.1.6**).

Table 28.1.6 Areas covered by MIS

Item	Users	
	IWPA	Operator
1) Management of arriving / leaving vessels	○	○
2) Management of cargo handling equipment	-	○
3) Management of warehouse and yard	-	○
4) Collection of charges	○	○
5) Preparation of statistical data	○	○
6) Preparation of various reference materials	○	○

Source) JICA Study Team

(4) Outline of each system

Outline of each system is as follows.

1) Management of arriving / leaving vessels (Arriving / leaving vessel management system)

Based on documents submitted by vessels or their agents (for example, schedule of ship arrivals and departures, applications for the use of berthing facilities and notices of vessel-movements), berths are assigned to arriving vessels and schedules of operation are decided for arriving / leaving vessels at the port. In addition, information about the vessel movements is collected to determine quay utilization / tonnage dues and for administrative purposes.

2) Management of cargo handling equipment (Cargo handling equipment management system)

Use of facilities is permitted with receipt of an application for the use of berth, cargo handling equipment and other equipment. Data collected from such applications is used in calculation charges for use and for administrative document preparation.

3) Management of warehouse and yard (Warehouse and yard management system)

Use of facilities is permitted upon receiving an application for the use of warehouse and yard, and based on the notices of the completion of use submitted by forwarders and agents. Cargo inventories are checked based on reports of cargo movements and other data. Charges for the use of warehouse and yard are calculated based on this information, and the appropriate administrative documents drawn up.

4) Collection of charges (Charge management system)

Invoices and receipts for the tonnage dues and port charges such as cargo handling and storage are created using information collected from applications.

5) Preparation of statistical data (Statistical management system)

Statistical data is compiled monthly and annually, according to the regulations.

6) Preparation of various reference materials (Information retrieval system)

Information on each operation is classified and analyzed to allow the creation of a number of unconventional documents.

28.1.7 Improvement of port statistics

(1) Importance of Port Statistics

Effective and foresighted port management and operation must be based on accurate and updated information of every aspect of port traffic and activities, which entirely relies on exact and prompt statistics.

Apart from being important to planning, management and operation of individual ports, port statistics are useful for analysis of physical distribution in a wider regional setting.

(2) Establishment of legal framework for port statistics

Therefore port statistics must be continuously maintained at all ports and Berths in the same format. This means the compilation of port statistics must be mandatory not only at Major Ports such as Hanoi Port but also at scattering Berths.

Presently there is no standard for IW port statistics in Vietnam. A new law or regulation should be established to oblige every ports and Berths to keep statistics.

(3) Unification of format

Port statistics should be kept by all ports according to a set standard, that is to say, the same items should be surveyed, the same method of classification should be used etc..

Regarding standard, if there was a international standard or Vietnamese sea port standard, it would be desirable to be based on them for data compatibility. But there is neither an international nor an appropriate Vietnamese sea port standard. Port Authorities are keeping statistics according to the standard set by VINAMARINE. But the standard lacks the classification of cargo. And VINAMARINE is now considering a more comprehensive one.

Therefore in IW sector it is proposed to establish a law and standard in line with the sea port sector. In the standard the following should be mentioned: concrete contents, procedures, deadline of submission, etc.

(4) Competent Authority

It is proposed that port statistics be implemented under the supervision of IWPA, a branch of VIWA. Each port should report using a given format every month. IWPA puts these reports together and submits them to VIWA.

(5) Contents of port statistics

Port statistics should consist of the following items.

About vessel : date of arrival, name of vessel, DWT, nationality, type of vessel, place of berthing, arrival time, departure time

About cargo : import/export, domestic import/export, from/to, commodity, cargo volume, type of packing, type of container, number of container

About passenger : number of passengers getting on and off, from/to

Regarding article classification, although at present the commodities are limited to several cargo types, it is proposed to set a detailed classification in the light of future necessity. **Table 28.1.7** shows example of article classification as a reference, which is applied for 819 sea ports in Japan.

Table 28.1.7 Example of article classification

Aguricultural and Aquatic Products		42	Other Machinery
01	Wheat	**Chemical Industrial Products**	
02	Rice	43	Ceramic Ware
03	Maize	44	Cement
04	Beans	45	Glass Products
05	Other Cereals	46	Ceramic Products
06	Vegetables, Fruits	47	Heavy Oil
07	Raw Cotton	48	Petroleum Products
08	Other Agricultural Produce	49	Liquefied Natural Gas
09	Wool	50	Liquefied Petroleum Gas
10	Other Livestock	51	Other Petroleum Products
11	Aquatic Produce	52	Coke
Forest Products		53	Coal Products
12	Logs	54	Chemicals
13	Lumber	55	Chemical Fertilizers
14	Resin	56	Dyestuff, Paints, Synthetic Resin, Other Industrial Chemicals
15	Woodchips	**Light Industrial Products**	
16	Other Forestry Products	57	Paper and Woodpulp

17	Firewood, Charcoal	58	Yarn and Semi-Spun Textiles
Mineral Products		59	Other Industrial Textile Products
18	Coal	60	Sugar
19	Iron Ore	61	Processed Foodstuffs
20	Ore	62	Beverages
21	Gravel, Sand	63	Water
22	Stone	64	Tobacco Products
23	Crude Oil	65	Other Foodstuffs
24	Phosphate Rocks	**Miscellaneous Industrial Priducts**	
25	Limestone	66	Toys
26	Raw Salt	67	Clothing, Footwear
27	Nonmetallic Minerals	68	Stationery, Exercise Equipment, Leisure Goods
Metal Working and Machine Industrial Products		69	Household Furniture and Fittings
28	Iron and Steel	70	Other Commodities
29	Steel Materials	71	Rubber Goods
30	Nonferrous Metal	72	Wooden Goods
31	Metal Products	73	Other Processed Goods
32	Railway carriage	**Special Items**	
33	Assembled Vehicles	74	Scrap Metal
34	Other transport Vehicles	75	Recycled Materials
35	Motorcycles	76	Fertilizer and Animal Feed
36	Auto Parts	77	Waste
37	Other Transportation Machinery	78	Landfill
38	Industrial Machinery	79	Container for Transportation Use
39	Electrical Machinery	80	Mixed Lots
40	Surveying, Optical and Medical Equipment	**Unclassifiable Goods**	
41	Office Equipment	81	Unclassified Goods

28.1.8 Setting appropriate port dues/charges

There are many kinds of dues/charges related to IWT as shown in **Table 10.4.1.** In general, it is desirable to set dues/charges as low as possible in order for IWT to compete with other modes of transport. However, a moderate increase in tonnage dues should be considered according to the need for proper channel maintenance. A moderate increase in the cargo handling charge should also be considered when new equipment is introduced to secure efficient and safe handling.

28.1.9 Organization chart of Major Port operators

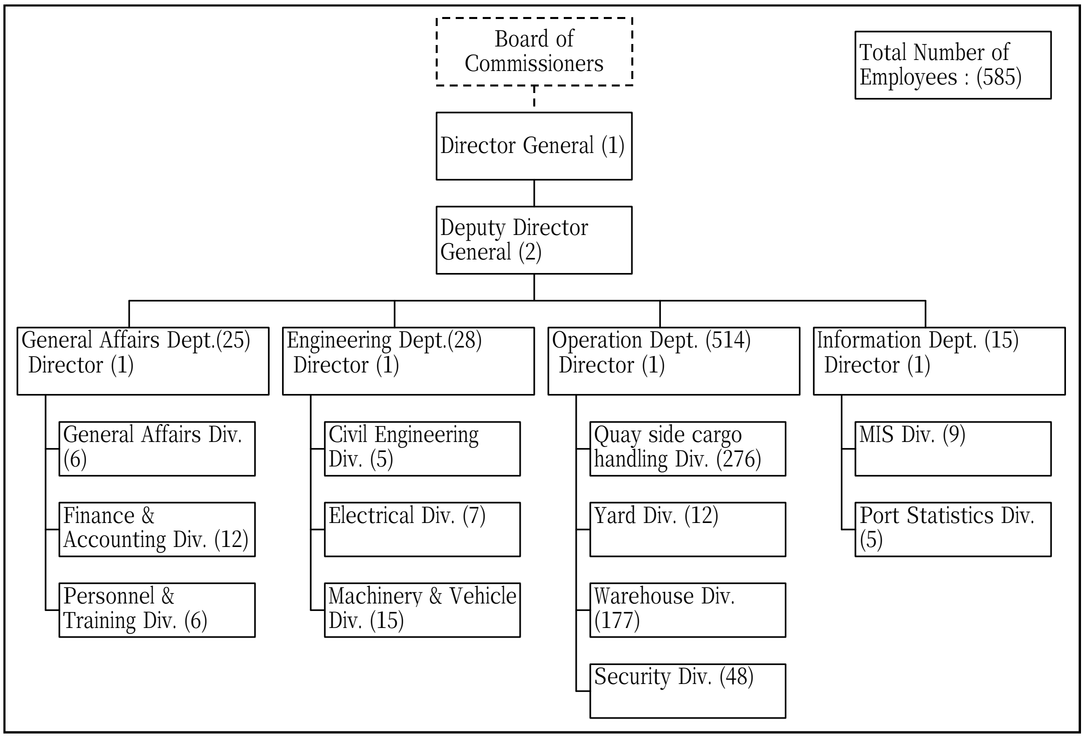
Proposed 4 Major Ports except Chem Berth are invested and owned by MOT and leased to port operators.

MOT(VIWA) will manage ports as an investor and an owner. Concretely, VIWA should supervise the usage of facilities. Therefore it is recommended that VIWA strengthen personnel of related unit to manage ports adequately.

Although these ports will not be operated by MOT, the Study Team proposes appropriate organization structures and scales of the 4 Major Ports for reference.

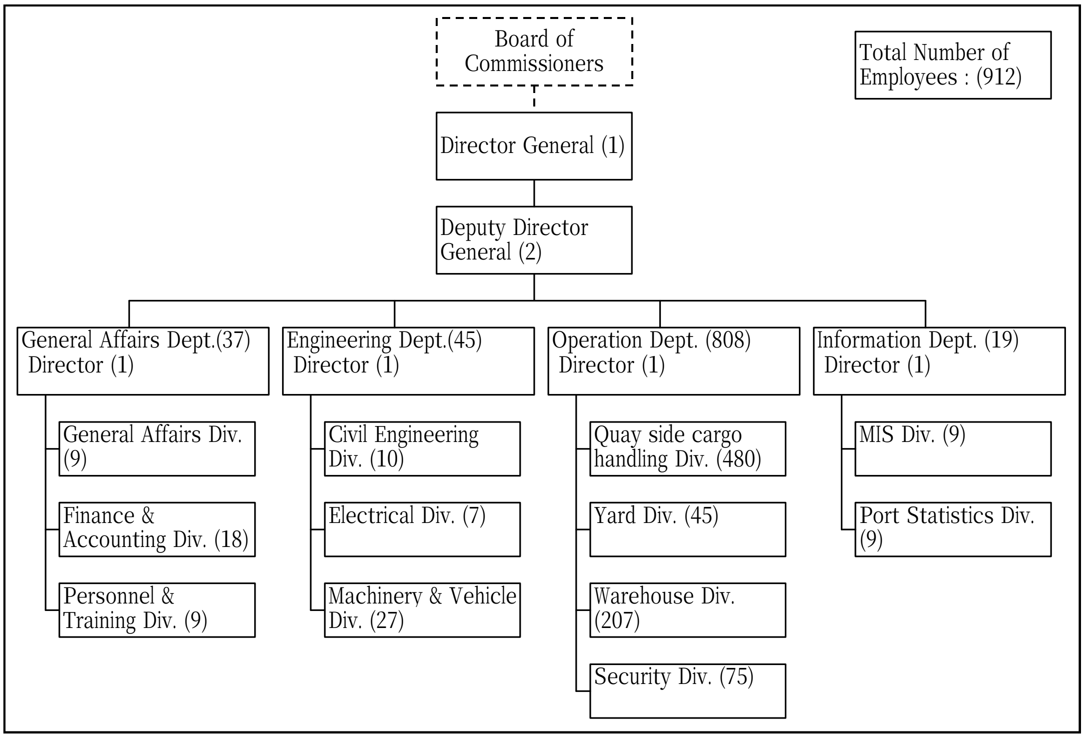
Organization should be as clear and simple as possible and based on the principle of delegation of authority.

Figure 28.1.1 – 28.1.4 shows proposed organization chart of Hanoi Port, Khuyen Luong Port, New North Port and New East Port for the year 2020. Figures in parentheses indicate the number of employees. The number of employees of Operation Department , the largest department, is estimated based on the number of cargo handling equipment and on a 3-shift system. It should be noted that staff for passenger terminal in Hanoi port is not estimated here because it might not be operated by Hanoi Port operator but by HNPC.



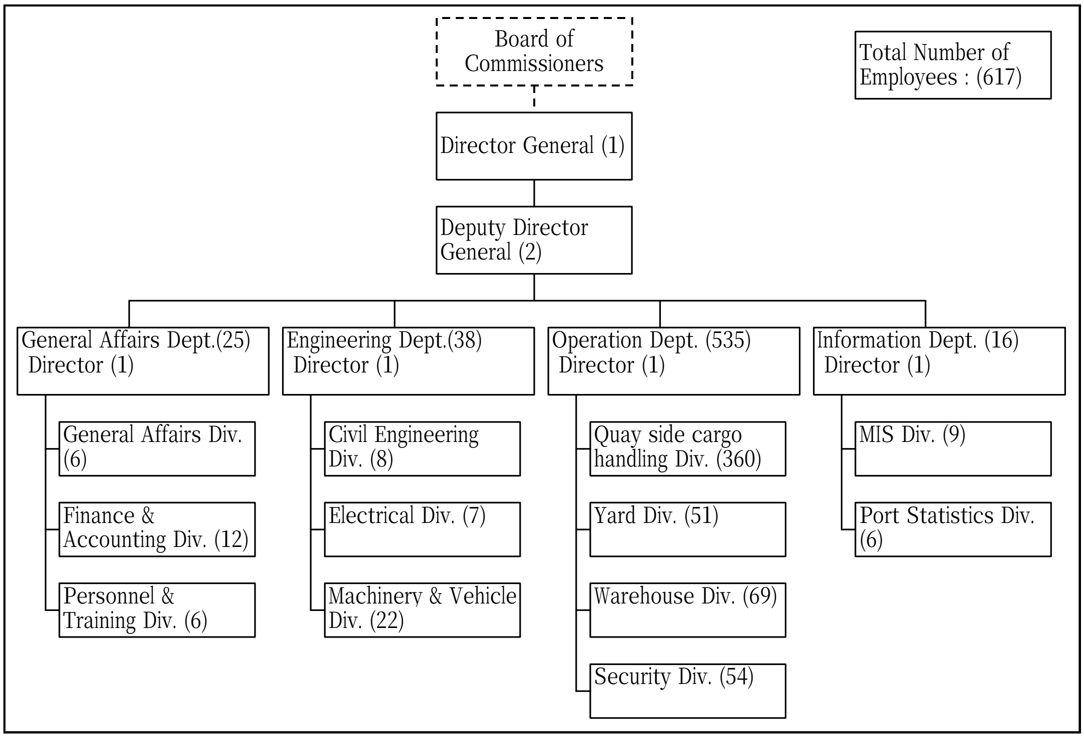
Source) JICA Study Team

Figure 28.1.1 Organization Chart of Hanoi Port Operator



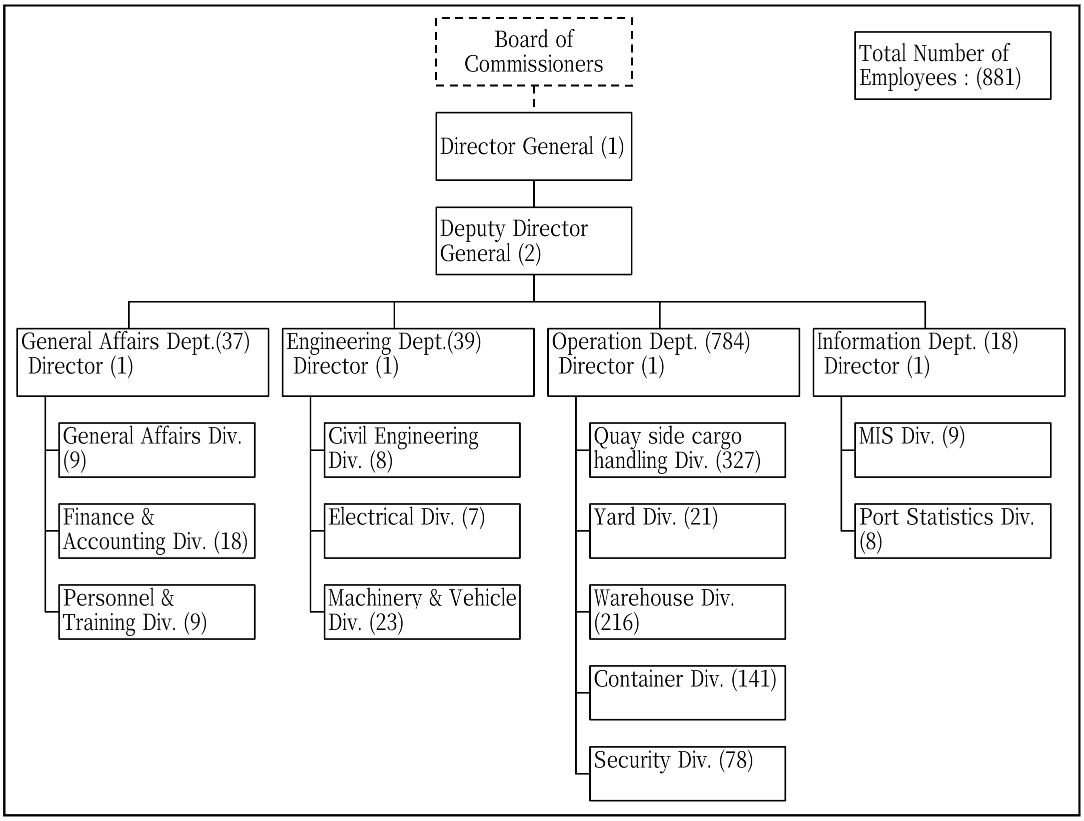
Source) JICA Study Team

Figure 28.1.2 Organization Chart of Khuyen Luong Port Operator



Source) JICA Study Team

Figure 28.1.3 Organization Chart of New North Port Operator

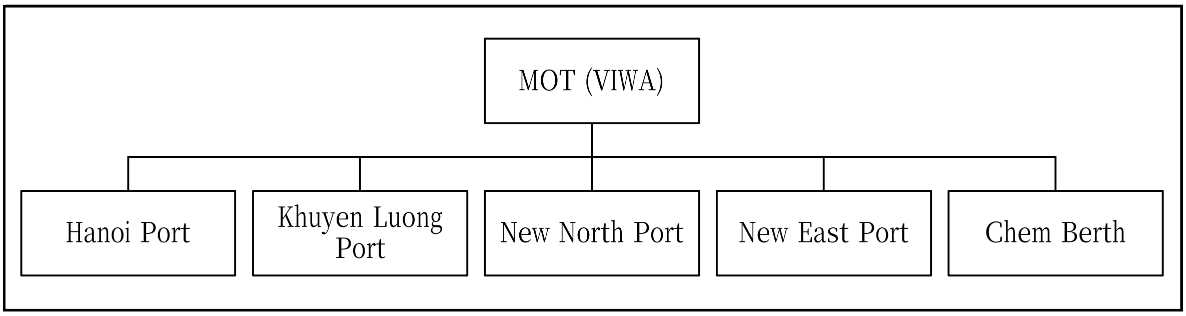


Source) JICA Study Team

Figure 28.1.4 Organization Chart of New East Port Operator

28.1.10 Council Meeting of 5 Major Ports

It is proposed to establish 5 Major Ports in the Hanoi Segment in the master plan ; Hanoi Port, Khuyen Luong Port, New North Port, New East Port and Chem Berth. In the Hanoi segment more than 70% of the total cargo will be handled at these 5 ports. Therefore, though these 5 ports will be rivals they should cooperate with each other to form an efficient distribution network in the Hanoi segment. For the reasons mentioned above, the Study Team proposes that a council meeting consisting of MOT(VIWA) and the 5 Major Ports be established. In the meeting proper distribution of cargo for each Major Port in the Hanoi Segment should be discussed and decided under the supervision of MOT(VIWA). In addition, navigation matter should be also discussed in the meeting to secure safety and smooth navigation in the Hanoi segment.



Source) JICA Study Team

Figure 28.1.5 Organization Chart of Council Meeting

28.1.11 Introduction of support system for private company participation in IW sector

In future it is expected that private sector invests in IW port. **Table 28.1.8** shows expected investment for Ports/Berths by private sector.

Table 28.1.8 Investment for Ports/Berths by Private Sector

Investor	Objective of Investment
Operators of the 4 Major Ports	Small scale investment for superstructure
Operators of Chem Berths	Improvement in terms of safe and environmental aspects
Operators of Other Berths[(1)]	

Note) (1)located outside the area between Thang Long and Thanh Tri Bridges

Source) JICA Study Team

Regarding Major Ports except Chem Berths, MOT will invest not only in infrastructure but also in main superstructure and operators will invest in small superstructure. As for Chem Berths and other Berths located outside the area between Thang Long and Thanh Tri Bridges, improvement in terms of safety and environmental aspects will be allowed. However generally speaking, improvement of port facilities requires large-scale investment.

Concerning vessels, difference between IW transport and Sea transport should be taken into account. As for sea transport, since it covers a much wider area compared with IWT, there is slight relation between development of ports and provision of vessels. On the other hand, as for IW transport, the area of activity is much smaller, or it is limited. Therefore vessels should be deployed in line with the development of ports to realize IWT sector development. But like ports, it requires a large investment to participate in the IW shipping business.

By enabling easy investment or participation of motivated and qualified private companies in IWT business, competition will be promoted. Consequently better services can be provided to users.

Therefore the Study Team proposes that certain initiatives to support the private sector such as low interest loans and tax incentives be studied.

28.2 Administration and management of Inland Waterway

28.2.1 Classification of IW

Since Inland Waterway is a infrastructure of Inland Waterway Transport, it is very important to develop and maintain IW to bring efficiency, stability and safety of IWT. As IW comprises a network, the cost for development and maintenance is high. Therefore IW should be classified and disposed according to their importance and function to allocate limited budget effectively. For the reasons mentioned above, IW in Vietnam should be classified as follows. Here this classification is purely decided by the importance of IW and has no relation to technical classification.

- Major Inland Waterways

IW which are important to national and regional interests. Passing cargo volume is generally more than 500,000 tons / year. They mainly consist of class I, II, III. In the Hanoi segment all the Inland Waterways are classified as Major IW.

- Other Inland Waterways

IW which are not classified in Major IW mainly consist of class IV, V, VI.

28.2.2 Role sharing for IW management

According to the classification mentioned above, competent authorities for IW planning, investment and management are proposed in **Table 28.2.1**. Based on this, waterways in the Hanoi segment should be invested in by PMU-Waterways and managed by VIWA. Management by district or commune, which is sometimes used in the case of roads, is not suited to Inland Waterway management because jurisdiction areas would become too small.

Table 28.2.1 Competent Authority by IW classification

Classification of IW	Competent Authorities		
	Planning	Investment	Management
Major IW	MOT	MOT (PMU-W)	MOT (VIWA)
Other IW	Province(1)	Province(2)	Province(2)

Note) (1)Under approval of MOT

(2)Subsidy from MOT should be considered

Source) JICA Study Team

28.2.3 Introduction of appropriate management equipment

Management of IW consists of various duties, such as installation and maintenance of navaids, survey of navigation channel, dredging, patrol, rescue, observation of passing vessels and removal of obstacles.

To conduct those duties efficiently and safely, it is indispensable for VIWA to introduce appropriate management equipment as well as to place personnel properly.

Management equipment to be improved or introduced is as follows.

1. Vessel
Vessel is basic equipment in installation and management of naviaids, survey of navigation channel, dredging, aid, etc. It is necessary to work out appropriate sets of vessels by purposes. Particularly regarding dredger, so far it has not been introduced at IWMS No. 6. Therefore when dredging is needed, each IWM

Sub-station has to make request to VIWA HQ through IWMS No.6 and when approved, the dredging is done by enterprises. The time-consuming procedure involved prevents dredging from being done in a timely manner.

2. Survey equipment
At present VIWA surveys IW using pole. It is not efficient and the data needs to be processed by hand. By introducing GPS and depth sounder, it will become possible to identify position of vessel and survey depth of channel as the vessel is running.

3. Data processing equipment
A huge volume of data regarding channel survey, water depth and management information of naviaids and ports is gathered and processed for IW management. By introducing computer system, it will become more efficient to process information, especially numerical data. Computer system enables not only rapid data processing but also easy archiving and usage.

At present IWMS No. 6, VIWA is managing the Hanoi Segment, the target area of the master plan. And 3 Sub-stations, Chem, Hanoi and Khuyen Luong, are doing daily activities in the field and this demarcation seems to be reasonable from the viewpoint of the scale of each area.

Table 28.2.2 shows number of vessels to be introduced in 2020 by Sub-stations. Here dredging fleet consists of dredger, 2 barges and tugboat.

Table 28.2.2 Vessels Required to be Introduced in 2020 by Sub-stations

Vessel type	Chem	Hanoi	Khuyen Luong	total
Dredging fleet	-	1	-	1
Buoy lifting	2	2	1	5
First Aid	-	1	-	1
High-speed(patrol&survey)	1	3	1	5

Source) JICA Study Team

Moreover depth sounder and GPS shall be installed on high-speed boats and computer system shall be installed at Sub-stations to increase the efficiency of survey activities.

Table 28.2.3 shows management equipment required to be introduced in the Hanoi Segment in 2020.

Table 28.2.3 Management Equipment Required to be Introduced in the Hanoi Segment in 2020

Item	Spec	Unit	Number
Dredging fleet		unit	1
Dredger	150m3/h	vessel	1
Barge	400DWT	vessel	2
Tugboat	150CV	vessel	1
Buoy lifting vessel	150CV, crane-5ton	vessel	5
First Aid vessel	600CV	vessel	1
High-speed boat	50CV	vessel	5
Depth sounder		Unit	5
GPS		Unit	5
Computer system		unit	3

Source) JICA Study Team

In addition, in line with the introduction of equipment, personnel of IWMS (including Sub-station) should also be placed properly. **Table 28.2.4-28.2.6** shows proposed number of staff by Sub-stations.

Table 28.2.4 Proposed Number of Staff of Chem Sub-station

	Position	Number of Staff		
		General Staff	Vessel Staff	Engineer
Office	Director	1		
	Vice Director	1		
	Staff	4		4
Ves -sel	Buoy Lifting Vessel×2	-	5×2=10	
	High-speed Vessel×1	-	2	1
Total		6	12	5

Source) JICA Study Team

Table 28.2.5 Proposed Number of Staff of Hanoi Sub-station

	Position	Number of Staff		
		General Staff	Vessel Staff	Engineer
Office	Director	1		
	Vice Director	1		
	Staff	5		4
Vessel	Dredging Fleet×1			
	Dredger×1		9	1
	Barge×2		2×2=4	
	Tugboat×1		4	
	Buoy Lifting Vessel×2		5×2=10	
	First Aid Vessel×1	-	5	
	High-speed Vessel×3	-	2×3=6	1×3=3
Total		7	38	8

Source) JICA Study Team

Table 28.2.6 Proposed Number of Staff of Khuyen Luong Sub-station

	Position	Number of Staff		
		General Staff	Vessel Staff	Engineer
Office	Director	1		
	Vice Director	1		
	Staff	4		4
Ves -sel	Buoy Lifting Vessel×2	-	5	
	High-speed Vessel	-	2	1
Total		6	7	5

Source) JICA Study Team

28.2.4 Introduction of Management Information System (MIS)

As mentioned in 28.1.3, integrated data management system by introducing MIS is very helpful for efficient and accurate management. The system should also be introduced to IW management. As introduction of the computer system for IWMS has been already mentioned in 28.2.3, here the Study Team will discuss the area covered by MIS.

Management items for which MIS can be introduced are as follows.

1) Management of IW maintenance information

As the volume of data for IW maintenance is huge, to compile the data by hand is very hard work. Introduction of computer makes it easier to use, archive and access the data. Moreover computerized data is very easy to process and analyze. It can be used for estimating future change of IW. To date, IW surveys has been conducted using a pole. By introducing a depth sounder, survey data can be transferred to computer directly.

2) Information on passing vessels

By introducing data analysis using computer, IWMS will be able to archive, access and use data of passing vessels easily.

3) Information on administrative management of ports

IWMS and IWPA has to grasp the present situation (location, size, facility, owner and operator) of ports in its jurisdiction. By putting the data into database and sharing it, duties of them such as inspection of ports and collection of charges can be done more efficiently.

4) Facility (buoy etc.) management information

It is very important to properly maintain navigation aids after installation. For that purpose it goes without saying that daily inspection is indispensable. In addition by keeping maintenance information (record of repair etc.) in computerized data, facilities will be able to be managed systematically.

5) Information service for users

MIS makes it easier to inform users of IW information because computerized data is easy to process and send. Moreover by disclosing a part of data to outside, user will be able to access and get IW information from the internet.

Basically this system and the system we proposed to introduce into port management and operation are independent of each other. But in the future there may be a possibility to realize more sophisticated IWT system by integrating parts of both systems and sharing information.

28.2.5 Information Service System

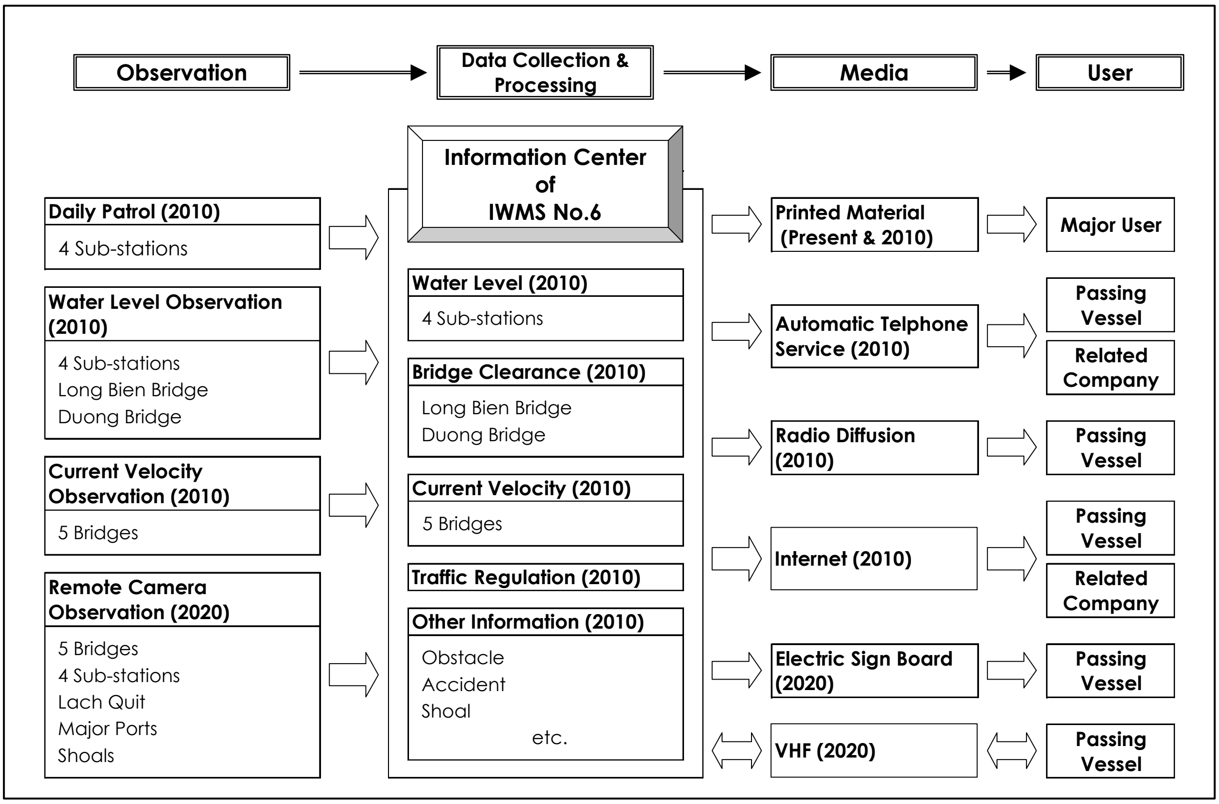
Condition of IW is changing day by day and season by season. Therefore it is indispensable to know the latest information about IW for safe and efficient navigation. Thus the Study Team proposes an Information Service System here.

This system should be invested by MOT as a part of navigation channel improvement project and managed and operated by VIWA.

The data flow is as follows: (1) observe necessary data such as water level, (2) collect and process data and provide users with latest information, (3) through media.

Observation ⇒ Data collection & processing ⇒ Through media ⇒ Users

Figure 28.2.1 shows the structure of the Information Service System.



Source) JICA Study Team

Figure 28.2.1 Structure of Information Service System in Hanoi Segment

(1) Contents of information

Contents of information which should be provided to users is shown below. Figures in parentheses are target years.

1. Water level (2010)
Needless to say, information about water level is the most basic one for vessel navigation. Especially at Red river it is very important in the dry season.

2. Bridge clearance
In the Hanoi Segment and adjacent areas there are two bridges which don't have sufficient vertical clearance, namely Long Bien Bridge and Duong Bridge. Especially in the rainy season, the bridges are obstacles to navigation due to their low clearance. Therefore to provide users with clearance information is really important and helpful for vessel navigation planning.

3. Current velocity (2010)
The current velocity is a factor which directly influences navigation speed of vessels. Therefore to know it is useful for transport planning.

4. Traffic regulations (2010)
Information about traffic regulations due to accident, shortage of bridge clearance, etc. is provided.

5. Others (2010)
Urgent and temporary information such as obstacles, accidents, shoals, etc. is provided.

(2) Observation

Monitoring works to provide users with the information mentioned above is shown below. Figures in parentheses are target years.

1. Daily Patrol (Present & 2010)
Daily patrol is a basic activity of IW management. Even if the latest equipment is installed, the most reliable way is observing by eyes. It should be done by 4 Sub-stations, Chem, Hanoi, Khuyen Luong and Duong Ha, which take responsibility for the Hanoi Segment.

2. Water level observation (2010)
It should be done at 4 Sub-stations, Long Bien Bridge and Duong Bridge.

3. Current velocity observation (2010)
It should be done at 5 bridges, namely Thang Long, Long Bien, Chuong Duong, Duong and Phu Dong.

4. Remote camera observation (2020)
Dangerous places for navigation and Major Ports should be observed to ascertain the traffic situation. Cameras should be installed at 5 bridges, 4 Sub-stations, Lach Quit channel, Major Ports and shoals.

Data concentrating and processing (establishment of information service center)

The Study Team proposes the establishment of an Information Service Center, where observed data is concentrated and processed to provide for users. The Study Team proposes the location of the information service center to be at Duong bifurcation, specifically at the tip of the land, Soi village.

(3) Media

Media is a means to provide information for users. It needs accuracy, simultaneity and economical efficiency from the users point of view, and easiness of management and operation and economical efficiency from the providers point of view. **Table 28.2.7** shows a comparison of media for IW information service from the viewpoint mentioned above.

Table 28.2.7 Comparison of Media for IW Information Service

Media	Items of evaluation					Overall evaluation
	From users point of view			From providers point of view		
	Accuracy	Realtime	Investment	Management/ operation	investment	
Radio	B	A	A	A	A	A
Answering telephone	B	A	A	A	A	A
VHF	C	B	C	B	B	C
Printed material	A	C	A	B	A	B
Electric sign board	B	A	A	A	C	B
Internet	A	B	B	B	A	B

Source) JICA Study Team

Judging from the comparison, the Study Team proposes following media to provide users with the information. Figures in parentheses are target years.

1. Printed material (present&2010)
2. Automatic telephone service (2010)
3. Radio diffusion (2010)
4. Internet (2010)
5. Electric sign board (2020)
6. VHF (2020)

28.2.6 Revision of IW cargo transport tariff

At present charge of IW transport is calculated by converted transport distance which is set according to the IW classification. Therefore there are big differences in cost between each IW class. For example, cost for IW class II is 1.5 times and cost for IW class III is 3 times higher than that of IW class I even if the real distance is the same. Since such drastic conversion of distance would hinder effective use of the IW network, it is recommended that such a conversion system be revised (or abolished if necessary) .

28.2.7 Strict control for illegal sand exploitation

At present illegal sand exploitation is frequently observed at various places. This can lead to changes in the navigation channel, erosion of river banks and accidents of vessels. Therefore it is strongly recommended for VIWA to strictly control illegal sand exploitation through close cooperation with relevant authorities.

28.2.8 Enactment of legal framework to regulate newly-built bridge clearances

There are many bridges crossing IW. Some of them does not have enough clearance. Shortage of vertical clearance causes restriction of vessel navigation. For example, vessels are forced to make a detour in flood season due to shortage of vertical clearance of Duong Bridge. Ultimately these restrictions will bring economic loss to the country. A Bridge is a semipermanent structure and it is very difficult to improve once it is constructed.

From the reasons mentioned above, it is very important to secure necessary vertical and horizontal clearance when a bridge is newly constructed. It is strongly recommended to enact new laws (or rules) that guarantee consultation with MOT when bridge is newly constructed or improved.

Regarding improvement of Duong Bridge, which is a bottleneck of IWT due to its low vertical clearance, it would be financially unfeasible for IW sector to undertake such a project solely by itself. Hence it should be prepared as a comprehensive transport project through close consultation with VRA (Vietnam Road Administration) and VR (Vietnam Railway).

Chapter 29 Preliminary Structural Design and Cost Estimate

At the master planning stage of the Study, surveys on natural conditions are still underway, information of which is indispensable to conduct structural design. In this chapter, the structures in the primary ports, which were selected in the Master Plan, are designed conceptually, and their costs are roughly estimated as a preliminary estimate.

29.1 Conceptual structural design

The objective structures are:

1. Hanoi Port
    - Passenger Berth and Cargo Handling Berth

3. Khuyen Luong Port
    - Cargo Handling Berth

2. New North Port
    - Cargo Handling Berth

4. New East Port
    - Cargo Handling Berth

29.1.1 Design conditions

In order to ensure required functions of the structures to be designed, several conditions shall be studied and evaluated carefully. Primary design conditions are described in the following sections:

(1) Design vessels

The dimensions of design vessels are summarized in the table below.

Table 29.1.1 Dimensions of Design Vessels

Port and Berth Type		DWT (ton)	LOA (m)	Beam (m)	Draft (m)
Hanoi	Passenger[1)]	NA	35.0	8.6	1.5
	Cargo	1.000	81.0	11.0	3.2
Kyuyen Luong	Cargo	1.000	81.0	11.0	3.2
New North / East	Cargo	600	50.0	10.0	2.1

Note) 1) Technical Report on Construction Investment Project of Ha Noi Passenger Port, TEDIport, 2002
Source) JICA Study Team

(2) Load conditions

1) Unit weights

The values of unit weights of construction materials in the table below are applied for calculation of dead weight of structures.

Table 29.1.2 Unit Weight of Primary Construction Materials

Material	Unit Weight (kN/m^3)	Material	Unit Weight (kN/m^3)
Steel	77.0	Reinforced Concrete	24.0
Asphalt Concrete	22.6	Plain Concrete	22.5
Stone	26.0	Sand (wet condition)	18.0

Source) JICA Study Team

2) Surcharges

In case of the cargo handling berths, surcharge on the deck of pier structure is designed to be 30 kN/m^2, which is sustainable for wheel load of possible cargo handling equipment.

In case of the berthing structures for the passenger berth, the surcharge load on the deck of pier structure is assumed to be 20 kN/m^2, which is sustainable for wheel load of expected vehicles for passenger transport and small trucks for maintenance works.

3) Cargo handling equipment

It is assumed that, on the cargo handling berths, cargos are handled with quayside mobile cranes, which has lifting capacity of 44 ton within 10m working circle.

They could have a traveling system either tires or caterpillar.

4) Berthing force

In general, berthing force is the most critical design load specifically for pier structures. It varies widely depending on the combination of calling vessel's dimensions, berthing speed, and material and layout of pier's fender system.

A berthing force of 20.0 tf on a unit of the fender system is applied for pier structures, referring to design records of similar existing facilities in Vietnam.

5) Mooring force

Mooring force is produced by the combination of wind, wave and river flow, which are affecting the mooring vessels. A mooring force of 10.0 tf on a bollard is applied for pier structures, referring to the design precedents of similar existing facilities.

6) Seismic force

Based on the Vietnamese Technical Standard for Port Construction, 1985, the Study Area is located in the zone where the seismic force is Level 7, or the horizontal seismic coefficient is about 0.05.

(3) Design natural conditions

In the previous phase of the Study, the natural conditions survey during the dry season was conducted. Evaluating the results of the survey, the important conditions for structural design are summarized in the following sections:

1) Water levels

In the Study Area, one of the essential design condition is the design water level. As described in previous **Chapter 14**, the difference in water levels between rainy-season and dry-season is considerably large.

According to the records at Hanoi observatory, it reaches 8.76m between Mean Annual Highest Water Level (LSD+10.96m) and Mean Annual Lowest Water Level (LSD+2.20m), where LSD stands for Land Survey Datum.

For the design purpose, the 95% water level (not less than 95% occurrence), which is calculated by the Study Team based on that at Hanoi Gauging Station from 1995 to 2000 and the results of water level observation during the dry season in January

2002, is defined as Low Water Level (LWL) at each port as shown in **Table 29.1.3**.

High Water Level (HWL) is also defined as the 5% water level (not exceed more than 5% occurrence) based on the 5% water level at Hanoi Gauging Station, LSD +9.50m, and the records of water level measurement during the dry season. It will be reviewed later, however, when the water level observation during the rainy season will be carried out by the Study Team.

HWL and LWL are basic levels for setting the crown height of the berths and the depth of the basin in front of the berthing structures, respectively. The LWL is summarized in **Table 29.1.3** below.

Table 29.1.3 LWLs at in the Red River Hanoi Segment

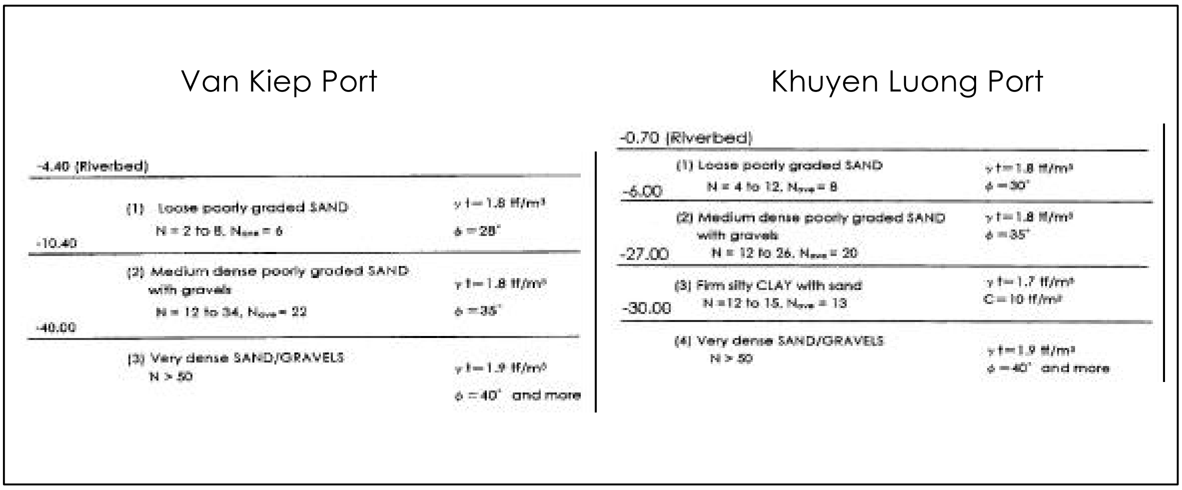
Unit: m

Port	LWL
Hanoi Port	LSD +1.93
Khuyen Luong Port	LSD + 1.77
New North Port	LSD + 3.19
New East Port	LSD + 2.45

Source) JICA Study Team

2) Soil condition

Based on the results of soil investigation conducted by the Study Team, primary characteristics of soil conditions at Van Kiep and Khuyen Luong Port are shown in **Figure 29.1.1.**



Source) JICA Study Team

Figure 29.1.1 Soil Conditions at Van Kiep and Khuyen Luong Ports

29.1.2 Preliminary design of possible structures

Based on the available data at this moment, preliminary structural design is conducted. It is noted that all the structures presented here as possible structures may be reviewed in the later stage of this Study, referring to the results of the additional natural condition survey, which will be conducted during the rainy season.

(1) Passenger berth

At a passenger berth, safety of passengers should be considered at first priority. For this reason and to overcome the large change of water level, slope-plus-sliding boarding deck structure is proposed as the first option, a general section of which is shown in **Figure 29.1.2 (1) and (2)**. Pontoon-plus-pier structure might be another alternative.

From river training point of view, a high wall structure with reclamation, which might cause river flow deviation, is not preferable.

(2) Cargo handling berth

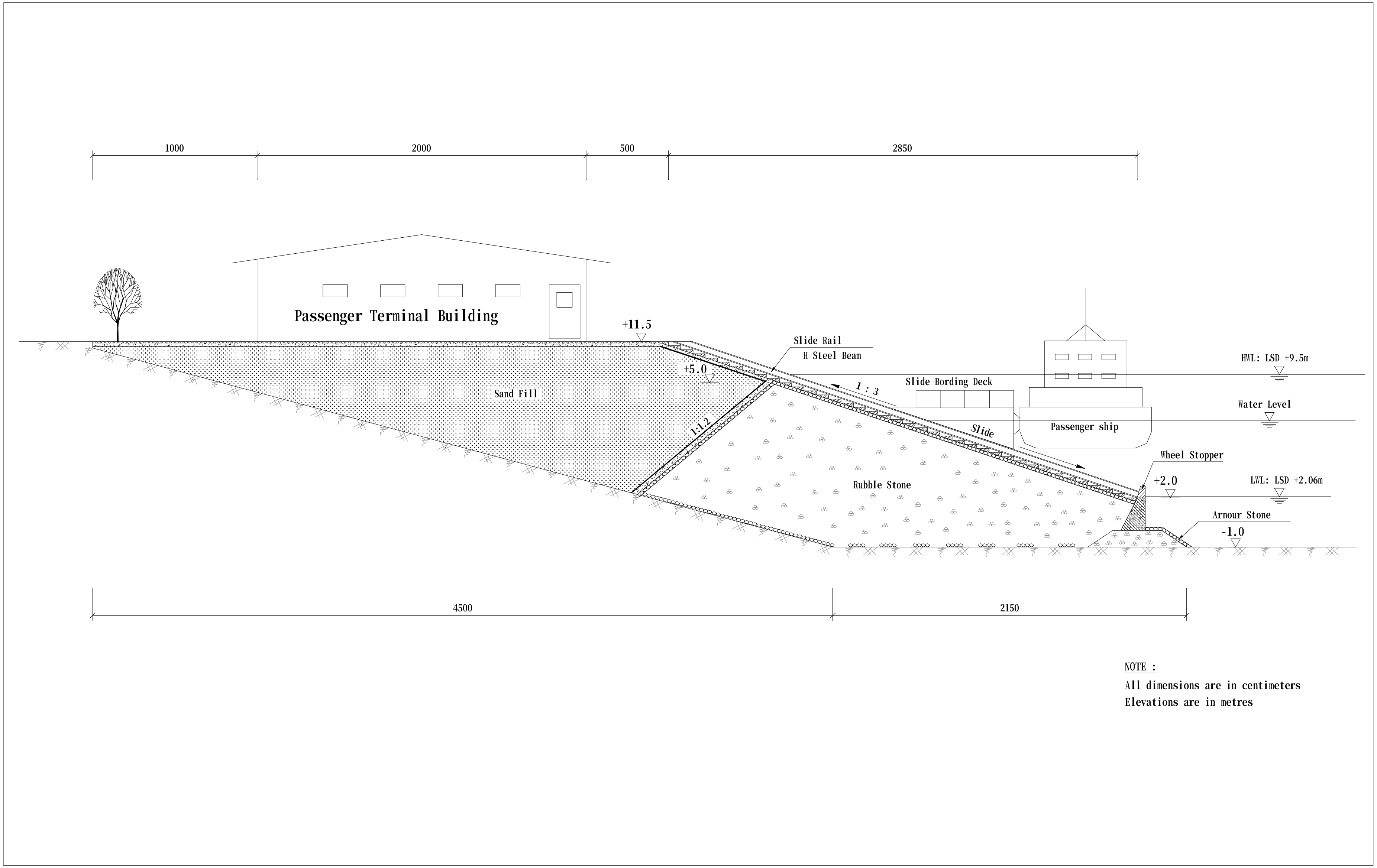
Filling and flattening of the area between the parallel pier and the riverbank have been demanded In order to improve cargo-handling efficiency at the existing berths. Considering the stiffness of the existing piers, however, construction of new berth can be considered as a sound option.

Based on the results of soil investigation conducted, concrete pier structure is proposed as the first option, a general cross-section of which is shown in **Figure 29.1.3**. Depending on the result of additional soil investigations during rainy season, steel pile pier structures might be an alternative.

(3) Other structures

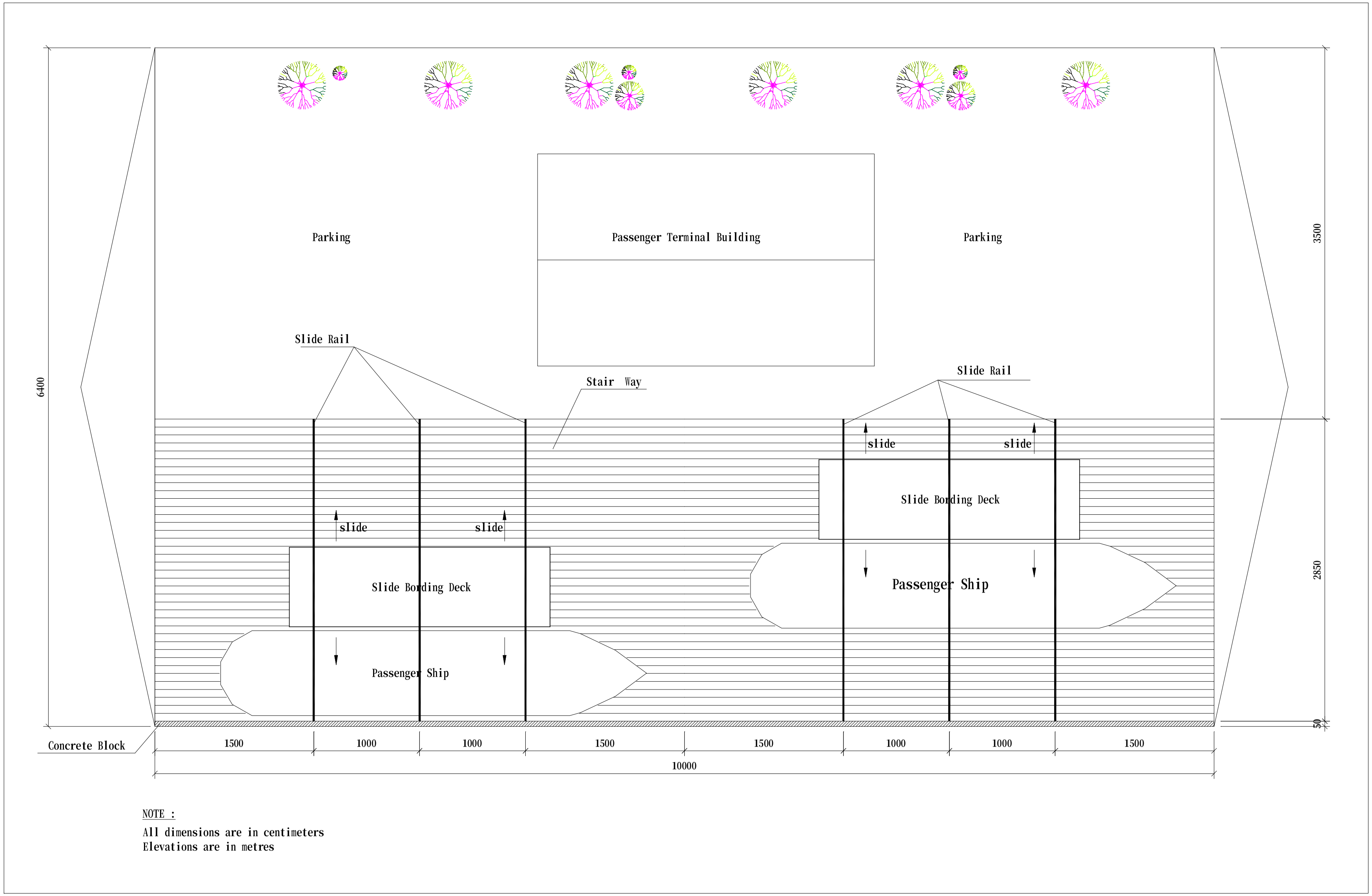
Referring to the existing structures in the Red River Hanoi segment, general cross sections of river and channel stabilization structures are proposed as shown in **Figure 29.1.4**.

In order to reflect the result of numerical simulations on river flow and bed stability in the flood season, which are going to be carried out soon in the Study, other alternatives might be proposed.



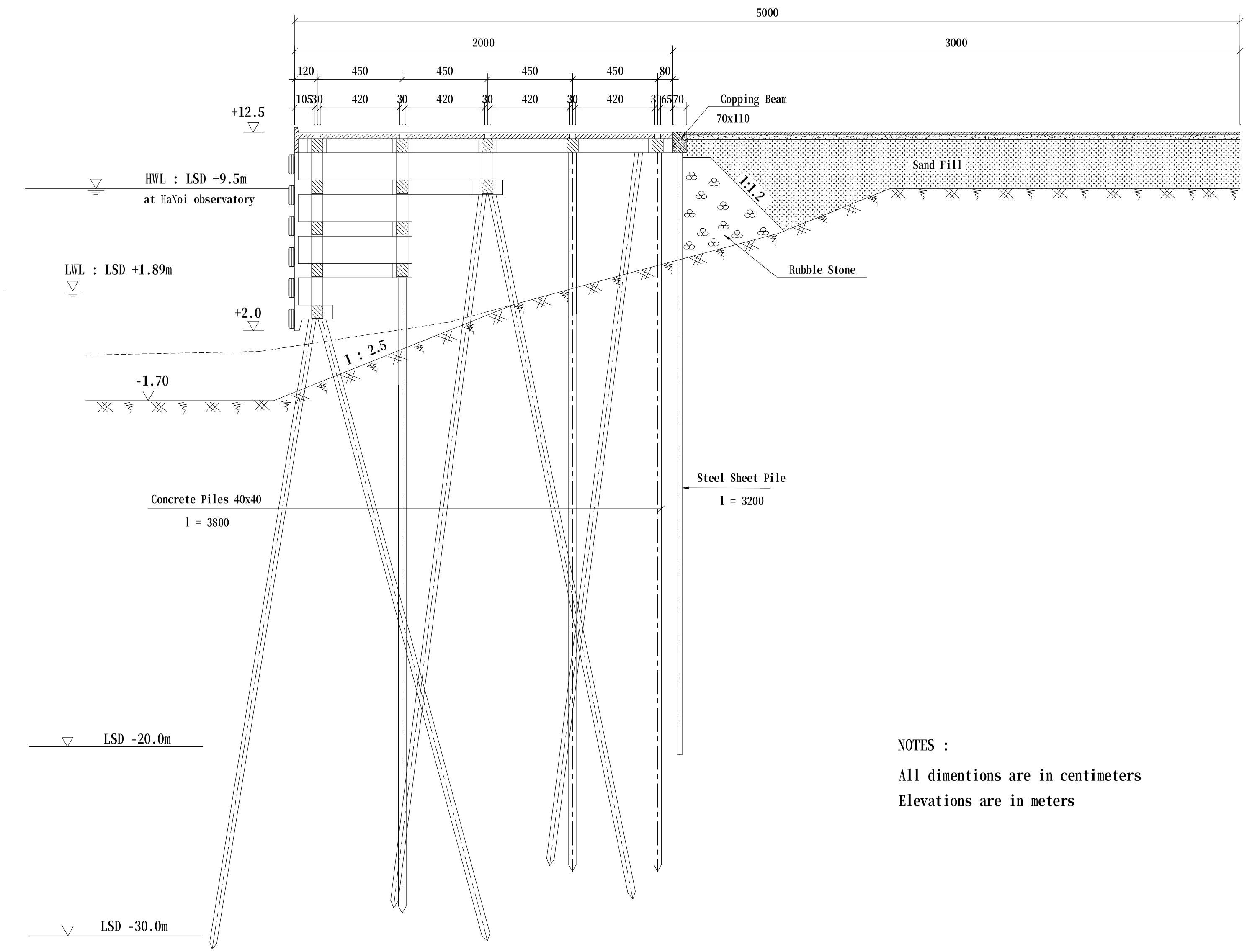
Source) JICA Study Team

Figure 29.1.2 (1) Possible Structure of Passenger Berth in Hanoi Port



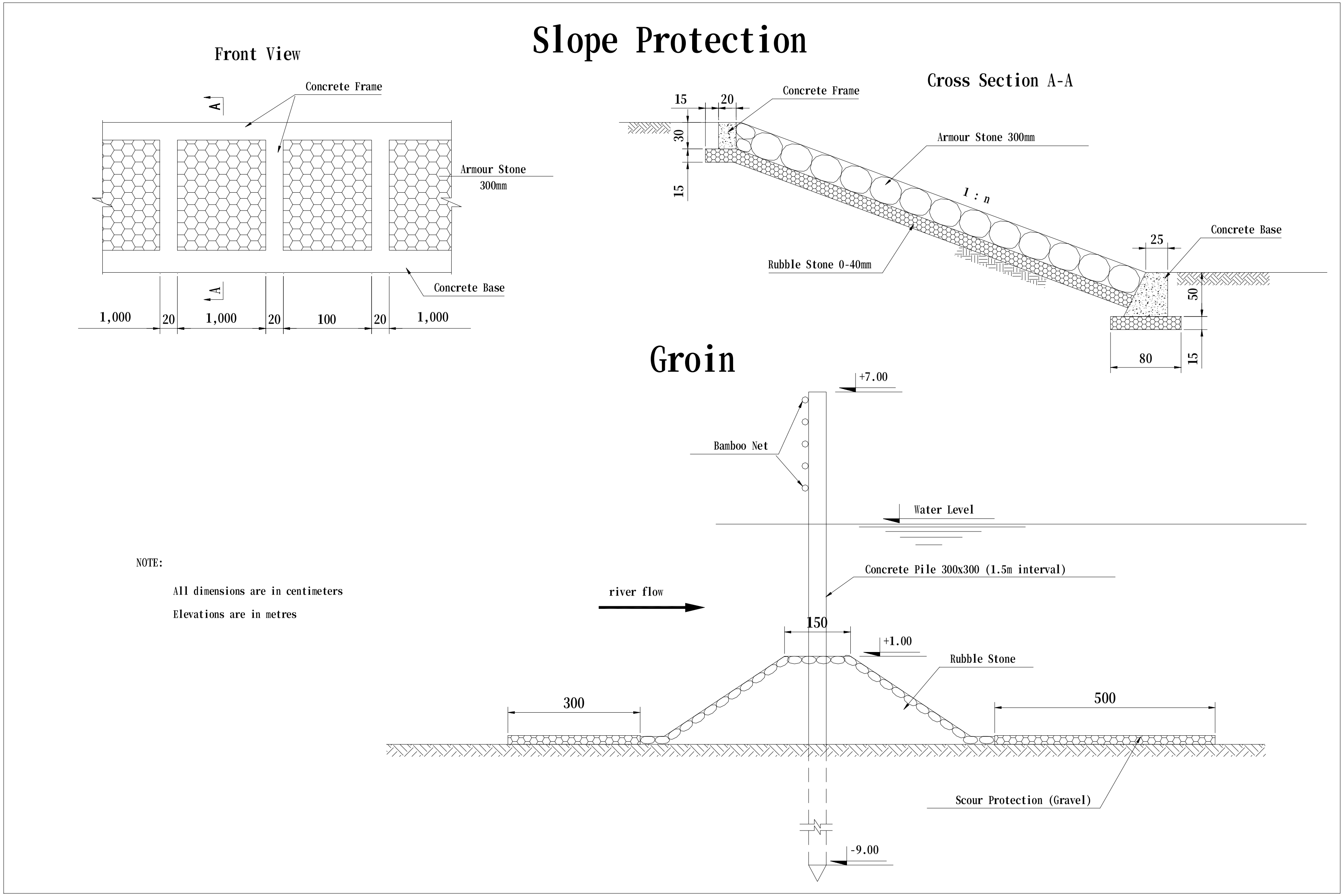
Source) JICA Study Team

Figure 29.1.2 (2) Possible Structure of Passenger Berth in Hanoi Port



Source: JICA Study Team

Figure 29.1.3 Possible Structure of Cargo Berth



Source) JICA Study Team

Figure 29.1.6 General Plan of River Training Structures

29.2 Preliminary cost estimate

Based on the results of the preliminary structural design, construction costs for the Master Plan (2020) were roughly estimated as shown in **Table 29.2.1**.

Table 29.2.1 Summary of Cost Estimation for Master Plan Project (2020)

Item	2020	
	Million US$	Share
A. Port	**108.4**	**45%**
1. Hanoi Port	13.4	6%
2. Khuyen Luong Port	30.2	13%
3. New North Port	26.7	11%
4. New East Port	38.1	16%
B. Channel Stabilization	**101.5**	**42%**
C. Navigation Channel	**13.8**	**6%**
D. Duong Bridge Improvement	**17.7**	**7%**
Direct Cost (A+B+C+D)	241.4	100%
Contingency (10% of Direct Cost)	24.1	
Engineering Service (7% of Direct Cost)	16.9	
Survey and Analysis	2.0	
VAT (5% of D.C+Cont.+Eng.+S.&A.)	14.2	
Ground Total	**298.6**	

Note) Excluding operation & maintenance costs
Source) JICA Study Team

The cost estimation has been made by means of Unit Rate Method as shown in **Table 29.2.2**.

Table 29.2.2 Cost Estimation Sheet (1)

Master Plan Project (2020) Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	Unit	Unit Cost (USD)	Quantity	Cost (Thou. USD)	Remarks
A. Port				**108,372**	
1. Hanoi Port				**13,418**	
(1) New Passenger Terminal				**3,522**	
1) Main Passenger Berth				**2,560**	
a) Pier	m	10,182	100.0	1,018	
b) Sheet Pile Wall	m	2,855	100.0	286	
c) Back Filling	m	546	100.0	55	
d) Slope Protection	m	1,601	100.0	160	
e) Pontoon	unit	520,693	2.0	1,041	
2) Passenger House	m^2	120	1,000.0	**120**	
3) Utilities	set	41,937	1.0	**42**	Fence, Lighting, etc.
(2) New Cargo Terminal				**8,087**	
1) Cargo Berth	m	20,000	80.0	**1,600**	
2) Cargo Terminal				**1,708**	
a) Warehouse	ha	1,200,000	1.40	1,680	
b) Utilities	set	28,000	1.0	28	
3) Cargo handling equipment				**4,779**	
a) Quay-side crane	unit	984,000	0	0	30t
b) Quay-side crane	unit	380,000	9	3,420	8t
c) Grab Bucket	unit	17,000	2	34	
d) Forklift	unit	380,000	0	0	37t
e) Forklift	unit	20,000	23	460	3t
f) Shovel Loader	unit	47,000	1	47	
g) Bulldozer	unit	150,000	1	150	
h) Dump Truck	unit	50,000	3	150	
I) Truck	unit	30,000	15	450	
j) Tractor+Trailer	unit	76,000	0	0	
k) Pallet	unit	25	2,700	68	
(3) Bank Protection 7-2	m	1,392	800.0	**1,114**	
(4) Road Elevation Improvement	ha	250,000	2.6	**650**	Asphalt Pavement
(5) New Satellite Passenger Berth	m	10,000	80.0	**800**	20m x 4 locations
(6) Management Information System	set	45,000	1.0	**45**	
2. Khuyen Luong Port				**30,160**	
(1) New Cargo Terminal				**28,382**	
1) Cargo Berth				**13,463**	
a) Pier	m	13,183	760.0	10,019	
b) Sheet Pile Wall	m	2,872	760.0	2,183	
c) Back Filling	m	425	760.0	323	
d) Slope Protection	m	1,234	760.0	938	
2) Cargo Terminal				**5,067**	
a) Revetment	m	151	700.0	106	
b) Land Reclamation	m^3	2	299,000.0	598	
c) Storage Yard	ha	250,000	3.4	850	Asphalt Pavement
d) Warehouse	ha	1,200,000	1.89	2,268	
e) Utilities	set	239,800	1.0	240	
f) Terminal Pavement	ha	150,000	6.7	1,005	Asphalt Pavement
3) Cargo handling equipment				**9,852**	
a) Quay-side crane	unit	984,000	0	0	30t
b) Quay-side crane	unit	380,000	18	6,840	8t
c) Grab Bucket	unit	17,000	10	170	
d) Forklift	unit	380,000	0	0	37t

Source) JICA Study Team

Table 29.2.2 Cost Estimation Sheet (2)

Master Plan Project (2020) Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	Unit	Unit Cost (USD)	Quantity	Cost (Thou. USD)	Remarks
e) Forklift	unit	20,000	27	540	3t
f) Shovel Loader	unit	47,000	7	329	
g) Bulldozer	unit	150,000	3	450	
h) Dump Truck	unit	50,000	18	900	
I) Truck	unit	30,000	18	540	
j) Tractor+Trailer	unit	76,000	0	0	
k) Pallet	unit	25	3,300	83	
(2) Access Road				**1,733**	
1) 2 lanes	m	642	2,700.0	1,733	
2) 3 lanes	m	797	0.0	0	
(3) Management Information System	set	45,000	1.0	**45**	
3. New North Port				**26,703**	
(1) New Cargo Terminal				**24,861**	
1) Cargo Berth				**12,979**	
a) Pier	m	12,837	760.0	9,756	
b) Sheet Pile Wall	m	2,872	760.0	2,183	
c) Back Filling	m	226	760.0	172	
d) Slope Protection	m	1,142	760.0	868	
2) Cargo Terminal				**3,517**	
a) Revetment	m	151	450.0	68	
b) Land Reclamation	m^3	2	263,000.0	526	
c) Storage Yard	ha	250,000	4.3	1,075	Asphalt Pavement
d) Warehouse	ha	1,200,000	0.65	780	
e) Utilities	set	213,000	1.0	213	
f) Terminal Pavement	ha	150,000	5.7	855	Asphalt Pavement
3) Cargo handling equipment				**8,365**	
a) Quay-side crane	unit	984,000	0	0	30t
b) Quay-side crane	unit	380,000	15	5,700	8t
c) Grab Bucket	unit	17,000	12	204	
d) Forklift	unit	380,000	0	0	37t
e) Forklift	unit	20,000	9	180	3t
f) Shovel Loader	unit	47,000	9	423	
g) Bulldozer	unit	150,000	3	450	
h) Dump Truck	unit	50,000	24	1,200	
I) Truck	unit	30,000	6	180	
j) Tractor+Trailer	unit	76,000	0	0	
k) Pallet	unit	25	1,100	28	
(2) Access Road				**1,477**	
1) 2 lanes	m	642	2,300.0	1,477	
2) 3 lanes	m	797	0.0	0	
(3) Management Information System	set	45,000	1.0	45	
(4) Capital Dredging	m3	2	160,000.0	320	Basin
4. New East Port				**38,091**	
(1) New Cargo Terminal				**36,620**	
1) Cargo Berth				**11,741**	
a) Pier	m	12,867	720.0	9,264	
b) Sheet Pile Wall	m	2,399	720.0	1,727	
c) Back Filling	m	123	720.0	89	
d) Slope Protection	m	918	720.0	661	

Source) JICA Study Team

Table 29.2.2 Cost Estimation Sheet (3)

Master Plan Project (2020) Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	Unit	Unit Cost (USD)	Quantity	Cost (Thou. USD)	Remarks
2) Cargo Terminal				**13,804**	
a) Revetment	m	151	900.0	136	
b) Land Reclamation	m^3	2	512,000.0	1,024	
c) Storage Yard	ha	250,000	1.8	450	Asphalt Pavement
d) Warehouse	ha	1,200,000	1.95	2,340	
e) Distribution Center / CFS	ha	1,300,000	6.70	8,710	
f) Utilities	set	319,000	1.0	319	
g) Terminal Pavement	ha	150,000	5.5	825	Asphalt Pavement
3) Cargo handling equipment				**11,075**	
a) Quay-side crane	unit	984,000	2	1,968	30t
b) Quay-side crane	unit	380,000	13	4,940	8t
c) Grab Bucket	unit	17,000	5	85	
d) Forklift	unit	380,000	4	1,520	37t
e) Forklift	unit	20,000	28	560	3t
f) Shovel Loader	unit	47,000	3	141	
g) Bulldozer	unit	150,000	2	300	
h) Dump Truck	unit	50,000	9	450	
I) Truck	unit	30,000	19	570	
j) Tractor+Trailer	unit	76,000	6	456	
k) Pallet	unit	25	3,400	85	
(2) Access Road				**1,426**	
1) 2 lanes	m	642	1,600.0	1,027	
2) 3 lanes	m	797	500.0	399	
(3) Management Information System	set	45,000	1.0	**45**	
B. Channel Stabilization				**101,481**	
(1) Groin				**7,234**	
1) Groin 1	m	2,794	1,500	4,191	
2) Groin 2	m	2,372	600	1,423	
3) Groin 3	m	1,800	900	1,620	
(2) Training Wall				**32,528**	
1) Training Wall 1	m	3,000	4,300	12,900	
2) Training Wall 2-1	m	2,816	4,500	12,672	
3) Training Wall 2-2	m	4,016	1,000	4,016	
4) Earth Work	m^3	3	980,000	2,940	$100m^3$ / m
(3) Bank Protection				**58,763**	
1) Bank Protection 1	m	2,300	5,200	11,960	
2) Bank Protection 2	m	1,349	800	1,079	
3) Bank Protection 3	m	1,349	500	675	
4) Bank Protection 4	m	2,000	4,300	8,600	
5) Bank Protection 5	m	1,992	1,000	1,992	
6) Bank Protection 6	m	3,034	5,500	16,687	
7) Bank Protection 7-1	m	3,082	2,500	7,705	
8) Bank Protection 8	m	2,000	3,300	6,600	
9) Earth Work	m^3	3	1,155,000	3,465	$50m^3$ / m
(4) Structural Maintenance	set	2,956	1.0	**2,956**	3% of (1),(2),(3)

Source) JICA Study Team

Table 29.2.2 Cost Estimation Sheet (4)

Master Plan Project (2020) Exchange Rate: USD 1.0=VND 15,000=JPY 125

Item	Unit	Unit Cost (USD)	Quantity	Cost (Thou. USD)	Remarks
C. Navigation Channel				**13,838**	
(1) Capital Dredging	m^3	2	4,200,000.0	8,400	
(2) Main Navigation Aids	set	976,000	1.0	976	
(3) Management Equipment	set	1,130,000	1.0	1,130	
(4) Information Service System				**3,332**	
1) Observation Equipment	set	647,000	1.0	647	
2) Information Service Center	set	2,685,000	1.0	2,685	
D. Duong Bridge Improvement				**17,700**	
	set	17,700,000	1.0	17,700	
Direct Cost	A+B+C+D			241,391	
Contingency	10% of Total			24,139	
Engineering	7% of Total			16,897	
Survey and Analysis				2,000	
VAT	5% of (D+C+E+S)			14,221	
Grand-total	D + C + E + S + V			**298,600**	

Source) JICA Study Team

Chapter 30 Preliminary Economic Analysis

30.1 Principle of economic analysis

This chapter presents the framework of the economic analysis for the evaluation of the economic viability of the inland waterway transport system improvement project in the Red River Delta (This is referred to as the Project hereinafter in this chapter) at a master plan level and the improvement program specifically designed for its Hanoi Segment.

(1) Project framework

The project framework provides a conceptual framework for analyzing the Project and is appraisal tool and a means by which the Project can be monitored for implementation efficiency or testing the input-output linkage. The project framework provides for the identification, quantification and valuation of project objectives or target for input, outputs, project effects, and sector impact.

(2) Difference between financial and economic analysis

The economic analysis of projects is similar in form to financial analysis: both appraise the profit of an investment. The concept of financial profit is not the same as economic profit. The financial analysis of a project estimates the profit accruing to the project-operating entity or to the project participants, whereas economic analysis measures the effect of the project on the national economy.

For the project economically viable, it must be financially sustainable, as well as economically efficient. If a project is not financially sustainable, economic benefits will not be realized. Financial analysis and economic analysis are therefore two sides of the same coin and complementary.

Both types of analysis are conducted in monetary terms, the difference lying in the definition of costs and benefits. In financial analysis all expenditures incurred under the project and revenues resulting from it are taken into account. This form of analysis is necessary to assess the degree to which a project will generate revenue sufficient to meet its financial obligations and ensure demand on which the economic analysis is based are consistent with financial charges or available budget resources.

Economic analysis attempts to assess the overall impact of a project on improving the economic welfare of the citizens of the country concerned. It assesses a project in the context of the national economy, rather than for the project participants or the project entity that implement the project.

The economic analysis differs from financial analysis in terms of both (i) the breadth of the identification and evaluation of inputs and outputs, and (ii) the measures of benefits and costs. Economic analysis includes all members of society, and measures the project's positive and negative impacts in terms of willingness to pay for units of increased services.

Willingness to pay is used rather than prices actually paid or received because many project impacts that are marketed or offered and accepted in market where prices are distorted by various government interventions, by macroeconomic policies, or by imperfect competition.

Therefore, shadow prices may be used in estimating the willingness to pay of service provider (seller) and willingness to accept of service users (buyer) in the face of these market absences and market imperfection. Shadow prices are used to take into account the major impacts of a project where economic values differ from financial values.

In many developing countries, many prices paid and received in the project accounts may come from relatively incomplete markets where the major impacts are captured in the transaction between service provider and service user (seller and buyer), and are reflected by the prices paid and received.

(3) Identification and quantification of costs and benefits

1) General

The basic steps to analyzing the economic viability of a project are;

- Identify the economic costs and benefits;
- Quantify the costs and benefits;
- Value the costs and benefits; and
- Compare the benefits with the costs.

To identify project costs and benefits, the situation without the project should be compared with the situation with the project. The comparison of without-project and with-project situations is at the heart of the estimation of net benefits for any project. The without-project situation is that which would prevail without the project. In comparing project alternatives, the without-project situation follows the same scenario assumed under with-project situation, and provides the basis for comparing with-project net benefit flows for each project alternative.

2) Identification and quantification of benefits

The need for services from indirectly productive projects such as transport development project will depend on underlying factors, such as the rate of economic growth for freight transport. A key feature of a sector or project analysis will be the phasing of investments to match the demand of services. The type and extent of expected benefits can be quantified through such factors as time and cost savings, increased access, and so on, which have a productive effect, as well as a direct effect on welfare.

3) Identification and quantification of costs

While several types of cost need to be included in the economic analysis of a project, some types of financial cost must be excluded. The underlying principle is that project costs comprise the difference in costs between the without and with project situation, that is, the extra use of resources necessary to achieve the corresponding benefits.

(a) System cost

The project boundary must include the total system investment required to achieve the benefits, and correspondingly, the total system benefits. If the total system of investments is viable, then the project can also be considered viable.

(b) Sunk cost

A project may require a use of facilities already in existence. The costs of such facilities are sunk costs and should not be included in the project cost. The sunk costs are those costs that would exist both without and with the project situation, and thus are not additional costs for achieving project benefits.

(c) Contingency

Contingency allowances, which are determined by engineering and financial considerations, also have implications for economic appraisal. When estimating project costs for financial planning purpose, both physical and price contingencies are included. Since economic returns are measured in constant prices, general price contingencies should be excluded from the economic cost of the project.

Physical contingencies represent the monetary value of additional real resources that may be required beyond the base cost to complete the project, and should be treated as part of the economic cost of a project. Costs and benefits should be valued in constant prices, that is, in terms of the price level prevailing in the year in which the project is appraised. Any expected change in the general price level can be ignored.

(d) Transfer payment

Some of the items included in the financial costs of a project are not economic costs, as they do not increase or decrease the availability of real resources to the rest of the economy. These items will, however, affect the distribution of financial costs and benefits between the project entity and other entities, and among project beneficiaries. They are thus referred to as transfer payments, as they transfer command over resources from one party to another without reducing or increasing the amount of resources available as a whole. Taxes, duties and subsidies are examples of items that may be considered to be transfer payment.

(e) Depreciation

The financial accounts of agencies implementing a project will include provision for depreciation and amortization on the basis of prevailing accounting practice. However, project economic analysis, the stream of real investment required to realize and maintain project benefits is included in the resource flow, together with a residual value for these assets at the time they are released from project use at the end of the project's life. The stream of investment assets includes initial investment and replacement during the project's life. This stream of expenditures generally will not coincide exactly with the time profile of depreciation and amortization in the financial accounts.

4) Valuation of economic costs

Once the costs of a project have been identified and quantified, they should be valued according to a common criterion. Decisions by service providers and users of project output will be based on financial prices. However, to evaluate the consequences of their decisions for the national economy costs and benefits need to be valued at economic prices that represent their value from the national economic perspective.

In an economic analysis, market prices are adjusted to account for the effects of government intervention and market structure. The result is shadow price. For project outputs, the shadow price is based on the prevailing supply price, the demand price, or a weighted average of the two.

5) Economic price of labor

Labor is an important component of any project. The demands for labor for the project should be broken into two basic categories: types of labor that are scarce and types that are in surplus supply. Scarce labor consists of those workers who would be able to find alternative employment in a short time, that is, where supply is more or less in fixed supply in the short term. This generally includes vocational and technical occupations; it also generally includes managerial and professional occupations.

For most labor that is scarce, the cost of labor inclusive of benefits can be taken, as it demand price. This provides an estimate of its opportunity or economic cost. Surplus labor consists of categories for which there would, in general, be a long search time between jobs. For these types of labor, the project wage is usually at or above the supply price. Often the effect of a project may be to draw surplus labor from rural areas or from agricultural production.

The economic price of different categories of labor can be expressed in relation to the full wage of the same category of labor to form the shadow wage rate factor (SWRF). The SWRF for surplus labor is the ratio of the opportunity cost of rural labor plus the economic costs of immigration to the project wage for surplus labor.

6) Economic price to a common base

The aggregation of costs and benefits requires a unit of account to be established in terms of currency and the price level in which the analysis is to be conducted. Economic analysis can be undertaken in the currency of the borrowing country or a foreign currency. An aggregate conversion factor composed of various conversion factors can be calculated and used when testing the economic viability of a project. Such an aggregate conversion factor is the ratio between the economic price value and the financial value for a project output and input. This ratio can be applied to the constant price of financial value in project analysis to derive the corresponding economic value.

7) Economic viability

The preceding sections outlined the principles for identification, quantification, and valuation of project costs and benefits. The resulting streams of costs and benefits are used to make project choices. Essentially, there are three types of project decisions for which criteria are needed.

- Choice of the least-cost option for achieving the same benefits
- Choice of the best among project alternatives; and
- Testing the economic viability of the best option.

The first type of decision occurs when benefits cannot be valued for comparison with project cost. The purpose is to achieve the same benefit effect at the lowest cost. The second type of decision occurs when choices are being made about project location, scale, size and other features of project design.

Costs and, to some extent, benefits may differ between alternatives. The purpose is to choose the best alternative from the point of view of the national economy. The third type of decision is the basis for agreeing to fund a project or not. It should be noted that the best project alternative might not be economically viable.

A test is needed of the economic viability of the best alternative for a project, in short, whether a proposed project is acceptable for investment or not. To make these decisions, all cost and benefit streams are discounted to present value.

Present costs and benefits are accorded a larger weight than those in future. The weights on future costs and benefits are treated as decreasing at a constant rate each year. Such a discount rate is known as the discount rate.

8) Choosing the discount rate

A discount rate for economic analysis can be estimated in different ways.

- The economic rate of return on alternative marginal project or the economic opportunity cost of capital, so that investments can be selected that show a minimum rate of return that is not exceeded by other possible investments;
- The real cost of foreign borrowing, which ensures that investment funds are committed to projects that will be able to meet the country's debt obligations,

especially where investment is highly dependent on inflows of foreign capital;

- The real rate of return in the capital market, which will indicate the return of a project must earn before investors will forego more liquid types of investment to invest in physical assets; and

In the absence of specific data on foreign loans, a world rate, such as the London inter-bank offer rate (LIBOR) adjusted for administration fees and a risk premium, can be used. Rates of interest or return on different sources of capital such as insurance, pension funds, investment and commercial banks, bond and stock market can be deflated to real terms and converted to economic prices.

Whatever the sources are, the project should provide a return greater than the sources of funds that finance them. However, capital markets and, especially interest rates, are frequently regulated, controlled, or small, and may not provide and appropriate measure of economic return on financial investment. Normally, a discount rate used for testing economic viability in the developing countries or in Asia is between 10 to 12 percent. In this report, the discount rate to is determined at 10 % as appropriate to apply for the economic analysis and 15 % for selection of project among other alternative project.

9) Testing the economic viability

Where the benefits of a project and project alternatives can be valued, they can be aggregated and compared with the costs of the project or project alternatives. Three criteria are commonly used to aggregate and compare costs and benefits, such as NPV, B/C and IRR.

(a) Net Present Value (NPV)

The net present value compares the present value of the cost streams with the present value of the benefit streams. However, it does so not as a ratio but by taking the cost steam away from the benefit stream to obtain the net benefit stream, which can then be discounted.

In choosing between project alternatives, the alternatives can be ranked according to their NPVs, which at economic prices represent the present value of net output that will be generated in he economy over the life of the project. The discounted value of economic benefits should be positive. All independent project and subproject, for which the NPV is greater than zero (0) is acceptable.

Net Present Value = $\sum_{t=0}^{n}(B_t/(1+d)^t) - \sum_{t=0}^{n}(C_t/(1+d)^t)$

Where;

B_t is incremental economic benefit in year t
C_t is incremental investment and operation cost in year t
n is the project life years
d is the discount rate

(b) Benefit-cost ratio (B/C)

The benefit-cost ratio compares the present value of the cost streams with the present value of the benefit streams, each discounted at the same discount rate. The comparison is made by forming the ratio of the present value of benefits to the present value of costs. All independent project and subproject for which the B/C ratio is greater than one (1.0) is acceptable.

B/C ratio = $\sum_{t=0}^{n}(B_t/(1+d)^t) / \sum_{t=0}^{n}(C_t/(1+d)^t)$

Where;

B_t is incremental economic benefit in year t
C_t is incremental investment and operation cost in year t
n is the project life years
d is the discount rate

(c) Internal Rate of Return (IRR)

The third criterion for summarizing the benefit and cost effects of a project alternative is the internal rate of return (IRR). The IRR represents the rate of return in economic prices that would be achieved on all expenditures of the project. The EIRR is calculated using the net benefit stream obtained by subtracting year by year all costs from all benefits.

The EIRR is the rate of discount for which the present value of the net benefit stream becomes zero. Put another way, it is the rate of discount at which the present value of the cost stream is equal to the present value of the benefit stream. The economic internal rate of return on resources should exceed that on the next best alternative project. All independent projects and subprojects for which the EIRR is greater than the chosen discount rate is acceptable.

The formula to obtain IRR is as follow: $\sum_{t=0}^{n} = \frac{B_t - C_t}{(1+d)^t} = 0$

Where;

B_t is incremental economic benefit in year t
C_t is incremental investment and operation cost in year t
n is the project life years
d is the discount rate

30.2 Valuation of economic costs and benefits

(1) Economic costs

The cost of the Project was estimated firstly on the basis of the market price as financial cost and it is converted to the economic cost for the economic analysis. As for the economic analysis, it is assumed that the Project is owned and operated fully by the public entity. Therefore, the cost estimated therein covers fully the requirement to operate whole cargo handling activity in the project ports and the inland waterway transport.

The monetary unit shown therein, therefore, is based on prevailing market prices of required goods and services as of February 2002. Taxes composed of the current tax and import duties are subtracted as transfer payment from the total financial cost estimated. The combined tax rates applied for this subtraction were 10 % on all prices estimated for local components and 8 % as import duties on all prices estimated for foreign components. However, it is to be noted that the estimated project cost are of preliminary nature at the time this report is prepared.

The economic cost used for the analysis of economic viability of the Project are obtained by means of converting the market or financial price to the economic price using the following standard conversion factors for each type of works after deducting transfer payment such as import duties, taxes and adjusted labor cost taking into account the seasonal fluctuation of labor cost. These standard conversion factors are determined by following process.

(a) Shadow exchange rate (SER)

Shadow exchange rate is applied to the foreign currency portion of the price being converted to the economic price. This rate is obtained by the following formula.

Shadow Exchange Rate (SER) = $(Imp_t + Exp_t)/(Imp_t + Exp_t + ImpD_t + ExpS_t)$

Where;

SER is the shadow exchange rate
Imp_t is the total amount of imports in year t
Exp_t is the total amount of exports in year t
$ImpD_t$ is the total amount of import duties in year t
$ExpS_t$ is the total amount of export subsidies in year t, if any

The average shadow exchange rate of the past 5 years (1996 – 2000) obtained by computation of these data available from the Statistic Year Book 2001 of Vietnam is **0.95**.

(b) Shadow wage rate (SWR)

Shadow wage rate is applied to the cost of unskilled labor in the local labor cost component in order to adjust the fluctuation of seasonal labor cost into an average labor cost. The seasonal fluctuation of labor cost is chiefly caused by the seasonal condition of unskilled labor available from the agricultural labor sector.

This rate is obtained through dividing the average annual income of agricultural labor by the average annual income of total labor. The average shadow rate of labor cost computed based on the data mentioned in the preceding paragraph in the past 5 years is **0.75**.

(c) Proportion of costs by currency

The financial cost is divided into foreign currency portion and local currency portion. The major cost items of foreign currency portion are deemed to be the cost related to imported materials, equipment, and construction plant, supervisory services conducted by the foreign experts, fuel, machine oil, etc. The local currency portion is deemed to be the cost related to locally available labor for related works and installation of electro-mechanical works as well as locally available materials for the construction or fabrication works.

In order to proceed to arrive the standard conversion factor, the proportion of foreign currency portion and local currency portion for different works in percentage in total cost of each type of works are computed.

The standard conversion factors (SCF) for direct body cost by type of works are obtained based on the cost demarcation between foreign and local currency portion and with the application of the shadow exchange rate for foreign currency portion as well as the shadow wage rate for labor cost of unskilled labor as shown in **Table 30.1** below.

Table 30.1 Standard Conversion Factors and Cost Demarcation

Type of Works	SCF	Foreign	Local
Marine Engineering Works	0.85	75%	25%
Civil Engineering Woks	0.80	25%	75%
Electro-mechanical Works	0.85	75%	25%
Machinery & Equipment	0.85	90%	10%

Source: JICA Study Team

An aggregate conversion factor applicable to the conversion of financial price to economic price for the required works and estimation of capital investment is obtained as **0.85** through the above exercises.

2) Economic benefits

The benefits are estimated based on the comparison of With and Without Project situations in various cases. The quantifiable benefits applied for the economic analysis are as follows:

(A) Benefit from saving of transport cost derived from two different types of vessels used for transporting cargos such as between small size barge pushed by tugboat and large size of self-propelled barge, etc;
(B) Benefits from saving of transport cost derived from two different transport mode for transporting cargoes such as between IWT and road transport; and
(C) Benefits from avoiding vessel waiting time at relevant ports;

The economic cost of inland waterway transport and road transport were analyzed as follows:

The majority of present vessel fleet for the inland waterway transport in the Red River Delta is steel barges of 2 x 400 tons pulled or pushed by tug driven by 90 – 200 hp diesel engine or self-propelled steel barge having capacity of 200 – 800 tons. Most of vessel fleets were built from 13 – 15 years ago and have not been upgraded to date except some self-propelled steel barges.

The economic transport cost of inland waterway vessel (SOC) is obtained by similar method used to obtain the standard vehicle operation cost (VOC) in Vietnam as shown in **Appendix 30.1, 30.2, 30.3 and 30.4**. The transport cost estimated on the basis of prevailing market price differs from its cost estimated in terms of national economy. The latter tends to be lower than that of the former at around 80 %.

Table 30.2 summarizes the standard economic transport cost for different size and type of inland waterway vessel in terms of ton-km for transporting cargoes. The estimated transport costs therein were verified with the same analyzed and applied for the national transport sector study such as VITRANSS in 1999.

Table 30.2 Summary of Economic Transport Cost

Mode and Type	Cargo Load (ton)	Cost (ton-km in VND)	Cost (ton-km in US$)	Cruise Speed (km/hour)	Load Factor	Vessel Cost per Day
Tug + Barge Type IWT	400	149	0.00993	8	0.5	261
	800	110	0.00671	8	0.5	353
Self-propelled Type IWT	200	174	0.01158	10	0.5	293
	400	93	0.00618	12	0.5	439
	600	71	0.00476	14	0.5	592
	800	58	0.00387	16	0.5	732
Sea-cum-River Vessel	1000	87	0.00580	16	0.5	1,373
Large Size Truck	10	365	0.02430	50	1.0	
40’ Container Trailer	20	271	0.01860	50	1.0	

Source) JICA Study Team

3) Estimation of saved transport cost

(A) Saved transport cost due to introduction of larger and faster vessel for same distance

The transportation cost saved or lost because of using the larger size and speeder vessels, which become available to use due to deepening of LAD, improved navigation aid system, improved port facilities, etc.

Annual saved transport cost in year t = V_t*(SOC_1 – SOC_2)

Where;

V_t is annual total volume of cargo to be transported in ton-km in year t
SOC_1 is the ship operation cost of smaller and slower vessel per ton-km
SOC_2 is the ship operation cost of larger and faster vessel per ton-km

(B) Saved transport cost due to use of IWT

The transportation cost saved or lost because of using the inland waterway transport system instead of other alternative transport mode is to be estimated under with project situation and without situation so as to obtain economic benefit of the project. The formula for such economic benefit estimation is as follow:

Annual saved transport cost in year t = V_t * (SOC – VOC)

Where;

V_t is annual total volume of cargo to be transported in ton-km in year *t*
SOC is the ship operation cost per ton-km
VOC is the vehicle operation cost per ton-km

30.3 Prerequisite of the economic analysis

The relevant economic feasibility criterion is derived from a procedure aimed at maximizing the overall objectives of the national economy. Economic feasibility is measured by comparing the Economic Internal Rate of Return (EIRR) of the project, which is assumed to be minimum EIRR of ten (10 %) percent for infrastructure project in Vietnam. (ADB 1998) This 10 percent discount rate is used as the economic opportunity cost of capital and this rate is used to calculate B/C, NPV and EIRR.

Before the economic evaluation is carried out and various inputs factors determined, the framework has to be established and defined. The data framework consists of the following components.

- Investment plan period
- Design and construction period
- Project commissioning year
- Currency

(1) Investment plan period

The investment plan period is defined as the total time period between the starting of the cost stream and the end of benefit stream. The cost stream is assumed to start with the detailed design of the Project. The investment plan period for a project normally extends over a period of 20 – 30 years. In the evaluation of the Project, thirty-years is adopted taking into account of the life of machinery provided for the project, which does not need to consider the residual value of the asset. During the investment plan period, the cost and benefit are recorded annually over the whole period separately for each cost and benefit components.

(2) Design and construction period

After the completion of financial arrangement and detailed design of the Project, the tender is called and contract will be awarded to the selected contractors to execute required works. The necessary period of detailed design is estimated as one (1) year and the construction period counted from the date of awarding contractors to the completion of each project component (except channel dredging work) is estimated as three (3) years. Thus, the total period for design and construction is assumed as four (4) years for each port planned to be developed. The required period to complete the necessary dredging works for waterway is preliminary estimated as discussed in the relevant section of this report.

(3) Project commissioning year

The project's or subproject's commissioning year is assumed as 2005 - 2008 so as to meet with the cargo demand forecast projected for year 2010.

It is assumed that the construction works of the selected port to be completed at latest by the beginning of 2010, and the cargo handling operations will commence immediately. The strategic planning relative to the commencement of port operation at each port has not been determined yet for the Hanoi segment at the time this report is prepared, however, the development schedule including the timing, location, capacity of each port planned, etc. will be determined in the mean time to proceed to the feasibility study of such prioritized ports.

(4) Currency

The currency used in the economic evaluation is US Dollar. The exchange rate of Vietnam Dong to one United States Dollar is VND 15,000 as of July 2002.

(5) Construction cost

The economic construction cost estimated for the Project in July 2002 based on the market price is converted to the economic cost using the conversion factors discussed in preceding section. The total capital outlay of the Project is estimated for over twenty (20) years development period excluding the replacement cost of equipment and machinery needed for cargo handling operation.

(6) Schedule for replacement of machinery

The cost of major machinery for cargo handling operation shall be estimated taking into account their replacement costs in the future at an appropriate interval for each type of machine. The residual value of relevant machinery, if life of machine remains, shall be estimated and presented in the terminal year. However, these are not considered in this study as the project life is assumed to be 30 years including the construction period, which is the same period of the life of machinery furnished to the project.

(7) Engineering cost

The engineering cost including detailed design, consultancy services, construction supervisory services, etc. is estimated at eight (8 %) percent of total capital investment cost for respective port construction works and included in the construction cost estimated as above.

(8) Physical and price contingency

Price contingency is added on top of the direct body costs including the above mentioned engineering cost estimated at the rate of five (5 %) on both foreign and local portion taking into account the cost inflation in the future. The ratio applied for the physical contingency, which is added on top of the cost including price contingency is ten (10 %) percent on both foreign and local currency portion of the cost. However, these are included in the construction cost estimated as above.

(9) Operation cost of the port

The data and information concerned to the operation cost of the existing port obtained from the organization operating the inland waterway transport. The record of operation cost relating to the cargo handling in this report is based on the actual performance of various ports in the year 2000.

However, these data do not clearly indicate the operation cost of the port especially for cargo handling charges. In accordance with the data and information available from other source is thought to be rather applicable for the analysis of the port operation cost.

According to this data, the average cargo handling and port operation cost per metric ton of cargo handled in Vietnam is obtained as US$2.00 as appeared in **Table 30.3** below. Then, it is converted to the economic price (conversion factor: 0.85) as US$ 1.70, which is used for the economic analysis in this report.

(10) Maintenance cost

The annual maintenance cost for port facilities are assumed at two (2 %) percent of the capital investment amount for the port facilities of civil engineering work and four (4 %) percent for the machinery furnished to the port for cargo handling operation for the same.

The annual cost of maintenance dredging is estimated in the relevant section of this report.

Table 30.3 Average Cost of Cargo Handling and Port Operation

Article	Data
Cargo Throughput (MT)	2,659,000
Revenue (Million VND)	89,641
Contribution (Million VND)	10,183
Expenditure (Million VND)	79,458
Expenditure converted in US$	5,300,000
Cost per Ton in US$	1.99
Cost per Ton in US$ in Economic Price	1.70

Source) Ministry of Transport, Vietnam Maritime Bureau, February 2001

30.4 Economic viability test for whole IWT System in the RRD

The economic viability of the project and several subprojects are analyzed as follows:

(1) Improvement of IWT's infrastructure as a whole

The total project for the improvement of IWT in the Red River Delta was tested based on the cost estimates prepared by ADB in 1999. The capital investment amount and maintenance cost of major improvement works for the inland waterway system depends on data and estimation available from ADB report. The cargo volume is projected as 23.1 million tons (3.1 billion ton-km) in 2010 and 36.7 million (4.9 billion ton-km) in 2020, respectively. The economic benefit applied for this study is the saved transport cost derived from the difference of two different types and size of IWT vessels. The change of fleet mix for IWT was envisaged as the share of larger size vessel will increase year by year to the future. The saved IWT transport cost because of this change of the fleet mix is summarized in **Table 30.4.** This analysis computed the maximum capital investment amount for the improvement of IWT infrastructure consisted with improvement of port, navigation aid, capital dredging where necessary, deepening of LAD, etc. Various economic viability indicators indicate the result of economic analysis as shown in **Table 30.5**. (See details **Appendix Table 30.5**)

Table 30.4 Change of Fleet Mix and Saved SOC

Size of Vessel in DWT	<50	50-100	100-300	>300	Difference
2001	8%	25%	41%	26%	
2010	7%	20%	41%	32%	0.00105
2020	5%	15%	40%	40%	
SOC per ton-km (US$)	0.0266	0.0216	0.0116	0.0049	0.00239

Table 30.5 Result of Economic Analysis (Whole System)

	Investment (US$ Million)	EIRR	NPV (US$ Million)	B/C
	616	10.00		
Discount Rate 10 %			1.63	1.00

As shown in the above table, the result of computation clear the minimum criteria of all economic viability indicators as EIRR exceed 10 %, NPV is affirmative, and B/C exceed 1.0. Thus, the project is considered as feasible and competitive to the opportunity cost in view of national economy. Accordingly the maximum capital investment amount in financial price can be obtained at US$ 725 million based on the total economic benefit derived from the saving of transportation cost alone.

(2) Introduction of Sea-cum-River Vessel to Corridor 4B

The economic analysis on the introduction of the Sea-cum-River Vessel (SRV) to Corridor 4B (Ho Chi Minh – Hanoi/Khuyen Luong) was conducted to test its economic viability. The cargo volume projected for Corridor 4B or Ho Chi Minh – Hanoi/Khuyen Luong via Hai Phong is 0.65 million tons in 2010 and 0.96 million in 2020. If the estuary of the Duong River is sufficiently dredged to accept SRV of 1,000 DWT, the transport efficiency is expected to increase. The comparison between the one case (Case-A) that transport the cargo between the southern part of Vietnam and Hanoi/Khuyen Luong by a combination of coastal vessel of 10,000 DWT, 5,000 DWT and 3,000 DWT and IWT via Hai Phong; and the other case (Case-B) that transport the cargo without transfer at Hai Phong by SRV of 1,000 DWT. The transport cost for each transport means is summarized as shown in **Table 30.6.** Various economic viability indicators indicate the result of economic analysis as shown in **Table 30.7**. (See **Appendix Table 30.6, 30.7 and 30.8** for details).

Table 30.6 Transport Cost Comparison for Corridor 4B

	10,000 DWT + IWT	5,000 DWT + IWT	3,000 DWT + IWT
CASE-A (US$ per ton-km)	13.83	14.34	15.84
CASE-B (US$ per ton-km)	6.71	6.71	6.71

Table 30.7 Result of Economic Analysis (Corridor 4B for SRV)

	Capital Investment (US$ Million)	EIRR	NPV (US$ Million)	B/C
	17.7			
10,000 DWT+IWT		25.9	34.1	2.85
5,000 DWT+IWT		27.4	37.8	3.06
3,000 DWT+IWT		30.8	46.2	3.52

As shown in the above table, the result of computation clears the minimum criteria of all economic viability indicators as EIRR exceed 10 %, NPV is affirmative, and B/C exceed 1.0. Thus, the project is considered as feasible and competitive to the opportunity cost in view of national economy. However, the cost of maintenance dredging at the estuary of the Duong River is thought to be quite sensitive to the economic viability. It is recommendable to conduct to ascertain the needed dredging volume to maintain the LAD properly to meet with the requirement of SRV throughout the year.

(3) Introduction of Sea-cum-River Vessel to Corridor 3NB for coal transport

The economic analysis on the introduction of the Sea-cum-River Vessel (SRV) to Corridor 3NB (Quang Ninh – Ninh Bin) specifically to transport coal by the SRV was conducted to test its economic viability.

The volume of coal projected for Corridor 3NB or Quang Ninh – Ninh Bin via the river mouth of the Duong River is 0.40 million tons in 2010 and 0.90 million in 2020. If the estuary of the Duong River is sufficiently dredged to accept SRV of 1,000 DWT, the transport efficiency is expected to increase. The comparison between the one case (Case-A) that transport coal from Quang Ninh to Ninh Bin by a conventional configuration of a number of 200 DWT barge with pusher boat (tugboat) through inland waterway (distance 318 km); and the other case (Case-B) that transport coal from Quang Ninh along the coast and via the river mouth of the Duong River through Corridor 3NB (distance 266 km) to Ninh Bin. The transport cost for each transport means and route is summarized as shown in **Table 30.8**. Various economic viability indicators indicate the result of economic analysis as shown in **Table 30.9**.(See **Appendix Table 30.9 and 30.10** for details)

Table 30.8 Transport Cost Comparison for Corridor 3NB

	200 DWT x 2 units	200 DWT x 4 units
CASE-A (US$ per ton-km)	0.00993	0.00671
CASE-B (US$ per ton-km)	0.00580	0.00580

Table 30.9 Result of Economic Analysis (Corridor 3NB for SRV)

	Capital Investment (US$ Million)	EIRR	NPV (US$ Million)	B/C
	1.22			
200 DWT x 4 + pusher		10.2	0.02	1.01
200 DWT x 2 + pusher		67.7	3.50	2.75

As shown in the above table, the result of computation clears the minimum criteria of all economic viability indicators as EIRR exceed 10 %, NPV is affirmative, and B/C exceed 1.0. Thus, the project is considered as feasible and competitive to the opportunity cost in view of national economy.

(4) Improvement of the Duong Bridge

The air clearance of the Duong Bridge is not sufficient for both current and projected IWT traffic especially in flood period in the year. The project envisages to raise or to furnish a vertical movable bridge a like to make this stretch navigable throughout the year. When this section of river stretch is closed when the water level increased due to flood, the IWT fleet is obliged to take a detour of around 60 km. The cargo volume passing through this bridge is projected at 3.90 million tons in 2010 and 5.0 million tons in 2020. The number of days, which will become available for IWT traffic due to this bridge improvement project and the basis of economic benefit estimation is summarized in **Table 30.10**.

The economic analysis for this project is conducted to calculate back the maximum amount of capital investment, which can attain the minimum acceptable feasibility level. The project's EIRR is set as close as possible to 10 % (10.60%), positive NPV and over 1.0 in B/C (1.01) as shown in **Appendix Table 30.11**. As a result of this analysis, the maximum capital investment for this project arrived at US$ 4.2 million in financial price.

Table 30.10 Benefit due to Improvement of the Duong Bridge

	<50 DWT	50-100 DWT	100-300DWT	>300 DWT	Average
Average Size in 2001 (DWT)	30	80	150	460	
Fleet Mix in 2010	7%	20%	41%	32%	
Mast Height (m)	2.0	2.5	3.0	3.5	
Required Air Clearance (m)	3.5	4.0	4.5	5.0	
Current Regulated Water Elevation (+m)	8.3	7.8	7.3	6.8	
Current No. of Regulated Days (Day)	14	20	31	48	
Future Regulated Water Elevation (+m)	10.7	10.2	9.7	9.2	
Future Number of Regulated Days (Day)	1	3	5	8	
Difference of No. Of Regulated Days (Day)	13	17	26	40	
Average SOC (US$/ton-km)	0.0266	0.0216	0.0116	0.0049	
Saved SOC (US$/ton-km)	0.1328	0.1410	0.1155	0.0948	0.1088

Note:
1. Current elevation of girder bottom of the Duong Bridge: 11.78 m
2. Future elevation of girder bottom of the Duong Bridge: 14.18 m
3. Distance shortened due to the improvement project: 60.0 km
Source: JICA Study Team

30.5 Preliminary economic viability test for Hanoi Section

The economic viability test for the Hanoi Section was conducted assuming that the cargo handling capacity of the existing ports will become insufficient to handle incremental cargo volume from 2005 and beyond and the excessive volume is totally transported by road transport. The maximum capital investment for the Hanoi Section is computed backwardly keeping its EIRR at 10 % as US$ 242 million.

Chapter 31 Initial Environmental Examination for Master Plan

The particulars on the environmental aspects with respect to natural conditions and social conditions are to be referred to Appendix 31.

31.1 Environmental conditions

31.1.1 Location of work sites

(1) Measurement of sediment materials quality

The sites for monitoring of sedimentation levels are described in **Table 31.1.1**.

Table 31.1.1 Sites for Monitoring of Sedimentation Levels

Symbol	Description	N	E
S-1	Thuong Cat Port	21○06'37.9"	105○43'53.0"
S-2	Hoang Xa Commune	21○05'30.2"	105○46'01.5"
S-3	Thang Long Bridge	21○05'42.7"	105○47'15.0"
S-4	Van Phuc Island (the South side)	21○05'06.9"	105○49'49.5"
S-5	Van Phuc Island (the North side)	21○05'14.7"	105○49'58.1"
S-6	Dau Mouth (the Duong River)	21○04'56.1"	105○49'58.0"
S-7	Thuong Cat Hydrological Station	21○04'15.4"	105○52'46.5"
S-8	Location between the Long Bien and Chuong Duong Bridges (the North side)	21○02'30.1"	105○51'41.3"
S-9	Location between the Long Bien and Chuong Duong Bridges (the South side)	21○02'24.4"	105○51'41.3"
S-10	Hanoi Port	21○00'14.6"	105○52'37.0"
S-11	Bat Trang Ceramic Traditional Village	20○58'32.0"	105○54'27.8"
S-12	Thanh Tri Bridge	20○59'28.7"	105○54'04.1"
S-13	Khuyen Luong Port	20○57'18.4"	105○53'38.3"

Source) JICA

The sedimentation monitoring sites are indicated on the attached map.

(2) Measurement of water quality

The sites for water sampling and in-situ measurement are described in **Table 31.1.2**.

Table 31.1.2 Sites for Water Sampling and In Situ Measurement

Symbol	Description	N	E
W-1-x	Thuong Cat Port	21°06'37.9"	105°43'53.0"
W-2-x	Hoang Xa Commune	21°05'30.2"	105°46'01.5"
W-3-x	Thang Long Bridge	21°05'42.7"	105°47'15.0"
W-4-x	Van Phuc Island (the South side)	21°05'06.9"	105°49'49.5"
W-5-x	Van Phuc Island (the North side)	21°05'14.7"	105°49'58.1"
W-6-x	Dau Mouth (the Duong River)	21°04'56.1"	105°49'58.0"
W-7-x	Thuong Cat Hydrological Station	21°04'15.4"	105°52'46.5"
W-8-x	Location between the Long Bien and Chuong Duong Bridges (the North side)	21°02'30.1"	105°51'41.3"
W-9-x	Location between the Long Bien and Chuong Duong Bridges (the South side)	21°02'24.4"	105°51'41.3"
W-10-x	Hanoi Port	21°00'14.6"	105°52'37.0"
W-11-x	Bat Trang Ceramic Traditional Village	20°58'32.0"	105°54'27.8"
W-12-x	Thanh Tri Bridge	20°59'28.7"	105°54'04.1"
W-13-x	Khuyen Luong Port	20°57'18.4"	105°53'38.3"

Note) x =1 – the water sample collected at the depth of 0.5 m from the water surface;
x =2 – the water sample collected at the middle depth;
x =3 – the water sample collected at the depth of 0.25 m from the bottom
Source) JICA

The water sampling sites are indicated on the attached map.

(3) Measurement of benthos in riverbed

The sites for monitoring of benthos in riverbed are described in **Table 31.1.3.**

Table 31.1.3 Sites for Monitoring of Benthos in Riverbed

Symbol	Description	N	E
B-1	Thuong Cat Port	21°06'37.9"	105°43'53.0"
B-2	Hoang Xa Commune	21°05'30.2"	105°46'01.5"
B-3	Thang Long Bridge	21°05'42.7"	105°47'15.0"
B-4	Van Phuc Island (the South side)	21°05'06.9"	105°49'49.5"
B-5	Van Phuc Island (the North side)	21°05'14.7"	105°49'58.1"
B-6	Dau Mouth (the Duong River)	21°04'56.1"	105°49'58.0"
B-7	Thuong Cat Hydrological Station	21°04'15.4"	105°52'46.5"
B-8	Location between the Long Bien and Chuong Duong Bridges (the North side)	21°02'30.1"	105°51'41.3"
B-9	Location between the Long Bien and Chuong Duong Bridges (the South side)	21°02'24.4"	105°51'41.3"
B-10	Hanoi Port	21°00'14.6"	105°52'37.0"
B-11	Bat Trang Ceramic Traditional Village	20°58'32.0"	105°54'27.8"
B-12	Thanh Tri Bridge	20°59'28.7"	105°54'04.1"
B-13	Khuyen Luong Port	20°57'18.4"	105°53'38.3"

Source) JICA

The sites for monitoring of benthos in riverbed are indicated on the attached map.

(4) Measurement of air quality

The sites for Air Sampling are described in **Table 31.1.4.**

Table 31.1.4 Sites for Air Sampling

Symbol	Description	N	E
A-1-t	Thuong Cat Port	21°06'32.0"	105°43'38.0"
A-2-t	Van Kiep Port	21°00'58.0"	105°51'55.1"
A-3-t	Hanoi Port	21°00'20.0"	105°52'18.7"
A-4-t	Khuyen Luong Port	20°57'14.6"	105°53'20.6"

Note) t =1 – the air sample collected from 7:00-9:00
t =2 – the air sample collected from 12:00- 14:00
t =3 – the air sample collected from 17:00- 19:00
Source) JICA

The air sampling sites are indicated on the attached map.

31.1.2 Sampling and analysis methods

(1) Methods for measurement of sediment materials quality

Sampling equipment was used to collect adequate volume of bed materials from the surface of riverbed for laboratory tests.

(2) Methods for measurement of water quality

1) Water sampling

Water temperature was measured on the boat immediately after recovering the samples to avoid the effect of air temperature.

Samples were collected from three (3) depths (approximately 0.5m from surface, middle and 0.25 m from bottom).

Samples were sealed in plastic containers and kept cool with much care. Necessary information including date, location and depth was indicated on the containers of each sample.

2) In situ measurement

- Temperature, pH measured by temperature meter, TOA (Japan)
- Salinity measured by conductivity meter HANNA (Italy)
- DO measured by DO-meter, WTW (Germany)

3) Laboratory analysis

- Suspended solid (SS) : TCVN 4560-88
- Chemical Oxygen Demand (COD) : Colorimetric method
- Biological Oxygen Demand (BOD5) : determined by measuring instrument BOD-YSI, USA (incubation in five days with the temperature 20± 0.5 °C) (similar TCVN 6001-95)
- Heavy metals : AAS method (GBC, Australia)
- N-hexan : GC method (HP-5980, USA)
- Particle size : Sieving on the shaker and weighting (METLER TOLLEDO Balance, 0.001 mg).

Laboratory tests were performed by experienced engineers and well treated testing equipment.

(3) Methods for measurement of benthos in riverbed

Sampling equipment was used to collect adequate volume of benthos from riverbed for laboratory tests.

(4) Methods for measurement of air quality

1) Method of sampling

Samples were collected two (2) days and taken three (3) times per day at intervals of three (3) hours.

2) Method of analysis

- Suspended Particulate Matter (SPM) : TCVN 5057-95
- Sulfur Dioxide (SO2) : TCVN 5971-95
- Nitrogen Dioxide (NO2) : Colorimetric method
- Carbon Monoxide (CO) : Colorimetric method
- Volatile Organic Compound (VOC) : Gas Chromatography

31.1.3 Results of measurements/surveys and activities performed

(1) Results of measurement of sediment materials quality

The results of measurement of sediment materials quality are presented in **Table 31.1.5**.

Table 31.1.5 Results of Measurement of Sediment Materials Quality

No	Parameter	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7
01	Pesticide	μg/kg	1.89	2.37	2.69	1.41	0.55	1.47	1.09
02	N-hexan	mg/kg	6.8	4.2	5.7	6.2	4.8	10.4	8.1
03	Cadmium	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
04	Lead	mg/kg	52.86	35.33	14.08	13.41	20.92	22.51	11.24
05	Chromium	mg/k	12.8	7.7	6.4	8.2	6.9	5.9	9.1
06	Arsenic	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
07	Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
08	Ignition of lose	%	4.99	5.83	1.57	1.45	1.61	1.30	1.11

Source) ENTEC, Feb. 2002

Table 31.1.5 (continued)

No	Parameter	Unit	S-8	S-9	S-10	S-11	S-12	S-13	Note
01	Pesticide	μg/kg	0.82	1.29	0.02	2.52	1.58	1.20	
02	N-hexan	mg/kg	7.2	4.4	3.8	4.2	3.4	6.2	
03	Cadmium	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
04	Lead	mg/kg	10.73	22.53	21.33	47.05	38.76	27.51	
05	Chromium	mg/k	8.4	7.6	7.8	8.1	7.0	11.0	
06	Arsenic	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
07	Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
08	Ignition of lose	%	2.38	1.53	2.88	3.98	2.60	1.70	

Source) ENTEC, Feb. 2002

(2) Results of measurement of water quality

The results of measurement of water quality are presented in **Table 31.1.6.**

Table 31.1.6. Results of Measurement of Water Quality

No	Parameter	Unit	Point W-1			Point W-2		
			W-1-1	W-1-2	W-1-3	W-2-1	W-2-2	W-2-3
01	Temperature	°C	21.6	21.2	20.5	25.3	24.8	24.1
02	Salinity	mg/l	5.1	5.1	4.7	5.2	5.2	5.2
03	pH	-	8.1	8.2	8.2	8.2	8.3	8.3
04	SS	mg/l	154	156	150	135	132	136
05	DO	mg/l	8.5	5.6	5.6	7.2	6.3	6.4
06	BOD_5	mg/l	1.5	1.7	1.4	1.6	1.2	1.1
07	Nitrogen	mg/l	0.60	0.54	0.48	0.70	0.72	0.62
08	Phosphorus	mg/l	0.92	0.90	0.59	2.03	1.71	0.94
09	Coliform	MPN/100ml	2,100	2,800	7,500	240	1,500	1,500
10	N-hexan	mg/l	0.01	0.01	<0.01	0.06	0.03	0.03
12	Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
13	Lead	mg/l	0.005	0.008	0.001	0.002	0.002	0.002
14	Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
15	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.02
16	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Source) ENTEC, Feb. 2002

Table 31.1.6 (Continued)

No	Parameter	Unit	Point W-3			Point W-4		
			W-3-1	W-3-2	W-3-3	W-4-1	W-4-2	W-4-3
01	Temperature	°C	26.0	24.6	23.8	18.9	18.6	18.7
02	Salinity	mg/l	5.6	5.2	5.1	4.7	4.3	4.2
03	pH	-	8.3	8.3	8.3	8.2	8.2	8.2
04	SS	mg/l	142	147	138	145	140	139
05	DO	mg/l	6.8	6.6	6.7	7.6	7.6	7.2
06	BOD_5	mg/l	1.7	2.0	1.4	1.4	1.7	1.4
07	Nitrogen	mg/l	0.34	0.32	0.32	0.46	0.46	0.32
08	Phosphorus	mg/l	0.56	0.67	0.80	0.60	0.98	0.50
09	Coliform	MPN/100ml	2,000	920	150	210	430	230
10	N-hexan	mg/l	0.08	0.09	0.02	0.15	0.13	0.09
12	Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
13	Lead	mg/l	0.002	0.004	0.028	0.002	0.003	0.009
14	Chromium	mg/l	<0.01	<0.01	<0.01	0.01	<0.01	0.01
15	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16	Mercury	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Source) ENTEC, Feb. 2002

Table 31.1.6 (Continued)

No	Parameter	Unit	Point W-5			Point W-6		
			W-5-1	W-5-2	W-5-3	W-6-1	W-6-2	W-6-3
01	Temperature	°C	18.8	18.8	18.7	19.2	18.6	18.8
02	Salinity	mg/l	5.1	4.7	4.7	5.2	5.1	4.7
03	pH	-	8.3	8.2	8.3	8.2	8.2	8.2
04	SS	mg/l	138	136	102	131	114	103
05	DO	mg/l	7.4	7.1	6.9	7.9	7.3	7.3
06	BOD_5	mg/l	1.1	1.7	1.9	1.5	1.2	1.7
07	Nitrogen	mg/l	0.44	0.42	0.42	0.38	0.40	0.44
08	Phosphorus	mg/l	1.84	0.91	1.27	0.58	0.80	0.76
09	Coliform	MPN/100ml	360	150	750	200	93	1,100
10	N-hexan	mg/l	0.39	0.25	0.08	0.32	0.24	0.11
12	Cadmium	mg/l	<0.001	<0.001	<0.001	0.007	<0.001	<0.001
13	Lead	mg/l	0.009	0.016	0.023	0.003	0.004	0.008
14	Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
15	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16	Mercury	mg/l	0.001	<0.001	0.001	0.001	<0.001	<0.001

Source) ENTEC, Feb. 2002

Table 31.1.6 (Continued)

No	Parameter	Unit	Point W-7			Point W-8		
			W-7-1	W-7-2	W-7-3	W-8-1	W-8-2	W-8-3
01	Temperature	°C	19.8	18.7	18.7	19.6	19.1	18.8
02	Salinity	mg/l	4.7	4.3	4.3	3.6	3.6	3.3
03	pH	-	8.2	8.2	8.3	8.1	8.3	8.3
04	SS	mg/l	108	106	104	126	124	130
05	DO	mg/l	7.8	7.4	7.2	7.1	6.4	6.8
06	BOD_5	mg/l	1.6	1.2	1.5	1.3	1.4	1.5
07	Nitrogen	mg/l	0.34	0.32	0.40	0.48	0.52	0.54
08	Phosphorus	mg/l	1.52	0.85	0.80	0.61	0.44	0.40
09	Coliform	MPN/100ml	430	93	9	93	210	150
10	N-hexan	mg/l	0.63	0.14	0.12	0.23	0.13	0.11
12	Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
13	Lead	mg/l	0.010	0.008	0.028	0.002	0.001	0.007
14	Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
15	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16	Mercury	mg/l	<0.001	<0.001	<0.001	0.001	<0.001	<0.001

Source) ENTEC, Feb. 2002

Table 31.1.6 (Continued)

No	Parameter	Unit	Point W-9			Point W-10		
			W-9-1	W-9-2	W-9-3	W-10-1	W-10-2	W-10-3
01	Temperature	°C	18.7	18.8	18.8	16.5	17.4	17.9
02	Salinity	mg/l	4.7	4.7	4.3	4.7	4.7	4.7
03	pH	-	8.3	8.3	8.3	8.3	8.3	8.3
04	SS	mg/l	155	161	149	160	155	125
05	DO	mg/l	6.7	6.7	6.9	7.5	7.5	7.2
06	BOD_5	mg/l	2.0	1.9	2.0	1.9	1.9	1.8
07	Nitrogen	mg/l	0.62	0.54	0.60	0.42	0.42	0.44
08	Phosphorus	mg/l	0.90	0.79	0.55	0.92	0.51	0.46
09	Coliform	MPN/100ml	150	92	4,600	240	74	36
10	N-hexan	mg/l	0.14	0.12	0.11	0.76	0.06	0.04
12	Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
13	Lead	mg/l	<0.01	0.013	0.016	0.001	0.007	0.009
14	Chromium	mg/l	<0.01	<0.01	<0.01	0.013	<0.01	<0.01
15	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16	Mercury	mg/l	0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Source) ENTEC, Feb. 2002

Table 31.1.6 (Continued)

No	Parameter	Unit	Point W-11			Point W-12		
			W-11-1	W-11-2	W-11-3	W-12-1	W-12-2	W-12-3
01	Temperature	°C	16.5	17.4	17.8	16.7	17.6	17.4
02	Salinity	mg/l	6.0	5.1	5.2	5.6	4.3	4.7
03	pH	-	8.3	8.3	8.4	8.3	8.3	8.3
04	SS	mg/l	155	150	150	145	159	147
05	DO	mg/l	7.2	6.8	6.8	7.1	6.7	7.0
06	BOD_5	mg/l	1.9	1.9	1.7	1.2	1.3	1.3
07	Nitrogen	mg/l	0.58	0.62	0.44	0.44	0.70	0.42
08	Phosphorus	mg/l	0.51	0.50	0.46	0.44	0.39	0.40
09	Coliform	MPN/100ml	1,500	430	1,500	2,100	930	11,000
10	N-hexan	mg/l	0.25	0.13	0.09	0.41	0.08	0.06
12	Cadmium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
13	Lead	mg/l	0.002	0.025	0.002	0.005	0.013	0.007
14	Chromium	mg/l	<0.01	<0.01	0.01	<0.01	<0.01	0.011
15	Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16	Mercury	mg/l	0.001	<0.001	<0.001	0.002	<0.001	<0.001

Source) ENTEC, Feb. 2002

Table 31.1.6 (Continued)

No	Parameter	Unit	Point W-13		
			W-13-1	W-13-2	W-13-3
01	Temperature	°C	16.9	17.3	17.3
02	Salinity	mg/l	5.1	4.7	4.7
03	pH	-	8.3	8.3	8.4
04	SS	mg/l	167	164	153
05	DO	mg/l	7.2	7.2	7.0
06	BOD_5	mg/l	1.4	1.5	1.5
07	Nitrogen	mg/l	0.62	0.44	0.40
08	Phosphorus	mg/l	0.75	0.80	0.66
09	Coliform	MPN/100ml	15,000	7,500	9,300
10	N-hexan	mg/l	0.17	0.14	0.11
12	Cadmium	mg/l	<0.001	<0.001	<0.001
13	Lead	mg/l	0.008	0.009	0.017
14	Chromium	mg/l	0.01	0.014	<0.01
15	Arsenic	mg/l	<0.01	<0.01	<0.01
16	Mercury	mg/l	<0.001	<0.001	<0.001

Source) ENTEC, Feb. 2002

The results of distribution of particle size of suspended solid are presented in **Table 31.1.7.**

Table 31.1.7 Results of Distribution of Particle Size of Suspended Solid

No	Sample	Portions (%) of the particle sizes (mm)					
		>0.1	0.1-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001
01	W-1-1	1.50	11.52	35.04	18.63	29.50	3.05
02	W-1-2	2.16	12.10	34.06	17.83	28.77	3.15
03	W-1-3	5.51	15.11	34.77	16.01	24.80	2.51
04	W-2-1	2.02	13.53	37.42	17.01	25.02	3.24
05	W-2-2	6.50	14.33	38.14	14.43	20.9	4.50
06	W-2-3	10.61	16.10	35.76	11.52	20.09	5.01
07	W-3-1	0.00	8.71	35.01	19.10	28.54	6.50
08	W-3-2	0.00	9.08	35.18	19.71	29.09	5.81
09	W-3-3	2.01	10.69	36.51	20.03	24.80	4.62
10	W-4-1	3.19	12.89	37.43	17.43	22.59	5.29
11	W-4-2	4.46	14.85	36.51	15.14	23.01	4.31
12	W-4-3	9.19	15.09	38.05	12.51	18.01	5.01
13	W-5-1	4.37	13.74	34.86	13.54	26.51	5.00
14	W-5-2	8.26	16.94	31.07	12.01	23.43	6.49
15	W-5-3	12.09	18.31	27.55	12.41	21.51	6.47
16	W-6-1	0.00	8.35	38.43	18.25	29.11	4.10
17	W-6-2	2.01	14.33	37.17	13.41	25.79	5.59
18	W-6-3	3.68	16.51	32.79	15.13	27.14	3.25
19	W-7-1	0.00	9.62	36.43	21.55	28.04	4.16
20	W-7-2	5.25	15.83	34.14	14.00	25.09	3.79
21	W-7-3	7.81	18.11	28.52	16.81	23.24	4.00
22	W-8-1	1.50	13.62	31.41	21.02	29.53	2.00
23	W-8-2	2.00	11.80	35.00	20.47	26.60	2.54
24	W-8-3	3.81	12.61	34.41	19.24	26.38	2.29
25	W-9-1	4.02	14.64	30.37	22.49	22.59	3.89
26	W-9-2	4.50	13.62	27.81	25.62	23.57	3.53
27	W-9-3	5.22	17.01	29.67	21.42	22.09	2.59
28	W-10-1	0.00	5.52	35.85	19.62	29.59	7.61
29	W-10-2	4.05	16.33	30.16	15.02	27.81	4.61
30	W-10-3	4.95	14.45	36.76	14.07	26.64	2.13
31	W-11-1	5.54	14.80	32.06	13.74	28.68	3.52
32	W-11-2	6.04	15.36	31.72	14.93	24.17	5.87
33	W-11-3	9.07	16.93	30.36	15.20	20.04	6.39
34	W-12-1	0.00	4.62	37.16	20.06	28.76	7.53
35	W-12-2	0.00	6.44	36.78	19.55	29.57	6.50
36	W-12-3	2.00	11.84	38.51	14.01	26.09	5.65
37	W-13-1	0.00	8.70	35.94	18.06	29.75	5.82
38	W-13-2	2.55	12.97	37.53	14.00	27.67	4.21
39	W-13-3	4.37	13.74	34.87	13.54	26.50	5.00

Source) ENTEC, Feb. 2002

(3) Results of measurement of benthos in riverbed

The results of measurement of benthos in riverbed are presented in **Table 31.1.8.**

Table 31.1.8. Results of Measurement of Benthos in Riverbed

(Unit : piece)

No	Species	Family	B-1	B-2	B-3	B-4	B-5	B-6	B-7
01	Corbicula	Corbiculidae	03	01	01	03	05	-	0
02	Littorina	Littorinidae	03	-	-	-	-	-	0
03	Spirontocaris	-	50	09	11	47	52	65	0
04	Marcromia	Macromidae	02	14	01	04	03	27	0
05	Tarebia	Thiaeidae	01		-	-	-	-	0
06	Tagelus	Psammobiidae	-	01	-	-	-	-	0
07	Campeloma	Viviparidae	-	-	09	-	-	-	0
08	Notonecta	Notonectidae	-	-	-	-	-	-	-

Source) ENTEC, Feb., 2002

Table 31.1.8 (Continued)

(Unit: piece)

No	Species	Family	B-8	B-9	B-10	B-11	B-12	B-13	Note
01	Corbicula	Corbiculidae	-	-	02	-	08	06	
02	Littorina	Littorinidae	-	-	-	-	-		
03	Spirontocaris	-	42	-	18	33	26	41	
04	Marcromia	Macromidae	01	12	05	11	07	11	
05	Tarebia	Thiaeidae	-	243	-	03	-	05	
06	Tagelus	Psammobiidae	-	-	-	-	-	-	
07	Campeloma	Viviparidae	-	-	-	-	-	-	
08	Notonecta	Notonectidae	-	-	01	-	-	-	

Source) ENTEC, Feb. 2002

(4) Results of measurement of air quality

The results of measurement of air quality are presented in **Tables 31.1.9.**

Table 31.1.9 Results of Measurement of Air Quality (in the first day)

No	Parameter	Unit	Point A-1			Point A-2		
			A-1-1	A-1-2	A-1-3	A-2-1	A-2-2	A-2-3
01	SPM	mg/m^3	0.28	0.24	0.41	0.38	0.24	0.28
02	SO2	mg/m^3	0.073	0.071	0.076	0.071	0.065	0.055
03	CO	mg/m^3	1.95	1.21	2.24	1.39	1.85	2.14
04	NO2	mg/m^3	0.044	0.038	0.055	0.038	0.055	0.047
05	VOC	mg/m^3	0.46	0.17	0.27	0.75	0.17	9.46

Source) ENTEC, Feb., 2002

Table 31.1.9 (Continued)

No	Parameter	Unit	Point A-3			Point A-4		
			A-3-1	A-3-2	A-3-3	A-4-1	A-4-2	A-4-3
01	SPM	mg/m^3	0.36	0.21	0.28	**<0.01**	**<0.01**	0.13
02	SO_2	mg/m^3	0.065	0.079	0.060	0.076	0.079	0.060
03	CO	mg/m^3	2.14	2.04	2.04	1.21	1.57	1.39
04	NO_2	mg/m^3	0.038	0.055	0.049	0.060	0.072	0.055
05	VOC	mg/m^3	0.27	3.44	0.75	0.36	0.17	0.65

Note) Bold figures : The samples collected at the raining time.

Source) ENTEC, Feb., 2002

Table 31.1.10 Results of Measurement of Air Quality (in the second day)

No	Parameter	Unit	Point A-1			Point A-2		
			A-1-1	A-1-2	A-1-3	A-2-1	A-2-2	A-2-3
01	SPM	mg/m^3	0.38	0.31	0.36	0.36	0.41	0.31
02	SO_2	mg/m^3	0.063	0.068	0.079	0.097	0.085	0.079
03	CO	mg/m^3	1.76	1.57	1.57	2.14	1.39	1.48
04	NO_2	mg/m^3	0.028	0.028	0.055	0.089	0.083	0.072
05	VOC	mg/m^3	0.36	0.17	0.27	3.87	3.04	3.58

Source) ENTEC, Feb., 2002

Table 31.1.10 (Continued)

No	Parameter	Unit	Point A-3			Point A-4		
			A-3-1	A-3-2	A-3-3	A-4-1	A-4-2	A-4-3
01	SPM	mg/m^3	0.26	0.32	0.28	**<0.01**	0.17	0.23
02	SO_2	mg/m^3	0.060	0.071	0.068	0.076	0.079	0.085
03	CO	mg/m^3	1.57	2.14	1.85	1.85	2.04	1.85
04	NO_2	mg/m^3	0.055	0.049	0.038	0.072	0.038	0.066
05	VOC	mg/m^3	3.58	2.28	3.17	3.58	1.93	3.44

Note) Bold figures : The samples collected at the raining time.

Source) ENTEC, Feb., 2002

31.1.4 Evaluation of results of the measurements/surveys and activities performed

(1) Environmental guidelines and standards

The methods of sampling, measurement and analysis have been followed the guidelines of the Ministry of Science Technology and Environment (MOSTE).

The results of the environmental monitoring have been compared with Vietnam Environmental Standards.

TCVN 5937-1995 : Ambient air quality standards

TCVN 5938-1995 : Maximum allowable concentration of some hazardous substances in ambient air

TCVN-5942-1995 : Parameter limits and maximum allowable concentration of pollutants in surface water

(2) Evaluation of results of measurement of sediment materials quality

Analyzing results given at **Table 31.1.5** shows that the Ignition of lose in the sediments ranged from 1.11% to 4.99%. The concentrations of chemical characteristics in the sediments range from 0.02 to 2.69 µg/kg for pesticides, from 3.4 to 10.4 mg/kg for N-Hexan.

Table 31.1.5 shows the range of heavy metals found in the Red river sediments. The table shows that the level of heavy metals in sediments ranged from 10.73 to 52.86 mg/kg for Pb, from 6.4 to 12.8 mg/kg for Cr, less than 0.1 mg/kg for As, less than 0.01 mg/kg for Cd and Hg.

(3) Evaluation of results of measurement of water quality

Comparing the analyzed results with the surface water quality standard (TCVN 5942-1995) (category A) shows that:

- pH value of the Red river's water meets the standard .
- Concentration of BOD of the Red river's water is lower than the standard, but concentration of SS is higher than the standard from 5 to 8 times.
- Oil and grease concentration of all samples is higher than the standard.
- Total Coliform value of samples collected at some points exceeds the standard.
- All parameters of chemical tests on health items meet the Vietnamese Standard.

(4) Evaluation of results of measurement of benthos in riverbed

Some benthos species *(i.e. Corbicula, Littorina, Spirontocaris, Marcromia, Tarebia, Tagelus, Campeloma, Notonecta)* were identified in the riverbed, among those *Spirontocaris sp.* are the most abundant.

However, there were not the benthos species subjected to the laws or regulations of protection.

(5) Evaluation of results of measurement of air quality

Comparing the analyzed results with the ambient air quality standards (TCVN 5937-1995) shows that concentrations of NO_2, SO_2, CO, VOC at 4 sampling points are lower than the ambient air quality standards (TCVN 5937-1995), while concentrations of SPM at some sampling points (i.e. A-1-1, A-1-2, A-1-3, A-2-1, A-2-2, A-2-3, A-3-1, A-3-2) are higher than the standard from 1.1 to 1.4 times.

(6) Conclusion

1) Sedimentation monitoring

- Ignition of lose in the sediments ranged from 1.11% to 4.99%. The concentrations of chemical characteristics in the sediments range from 0.02 to 2.69 µg/kg for pesticides, from 3.4 to 10.4 mg/kg for N-Hexan.
- The level of heavy metal in sediments ranged from 10.73 to 52.86 mg/kg for Pb, from 6.4 to 12.8 mg/kg for Cr, less than 0.1 mg/kg for As, less than 0.01 mg/kg for Cd and Hg.

2) Water quality

- pH value of the Red river's water meets the standard .
- Concentration of BOD of the Red river's water is lower than the standard, but concentration of SS is higher than the standard from 5 to 8 times.
- Oil & Grease concentration of all samples is higher than the standard.
- Total Coliform value of samples collected at some points exceeds the standard.
- All parameters of chemical tests on health items meet the Vietnamese Standard.

3) Measurement of benthos in riverbed

Some benthos species *(i.e. Corbicula, Littorina, Spirontocaris, Marcromia, Tarebia, Tagelus, Campeloma, Notonecta)* were identified in the riverbed, among those *Spirontocaris sp.* are the most abundant. However, there were not the benthos species subjected to the laws or regulations of protection.

4) Air quality

Concentrations of NO_2, SO_2, CO, VOC at 4 sampling points are lower than the ambient air quality standards (TCVN 5937-1995), while concentrations of SPM at some sampling points are higher than the standard from 1.1 to 1.4 times.

31.2 Identification of the environmental issues to be examined in EIA report

The project's activities, potential environmental impacts and levels are summarized in **Table 31.2.1.**

Table 31.2.1 Initial Environmental Examination Check List

Project Activities	Potential Environmental Impacts	Impact Levels
A. PRE-CONSTRUCTION PHASE		
Taking space		
Resettlement of the local people to the appropriate land	Reduction of incomes of removed households	+
	Disturbance of life of the relocated households	+++
	Reduction of agricultural and aquatic products in the project area	++
Violation of historical and customs places	Influence to historical and customs places	+
	People has allergic reaction to the project	+
Violation of ecosystems	Influence to wild animal life	+
	Reduction of biodiversity	++
	Reduction of aquatic product	++
	Increasing erosion	+++
	Lose ecological tourist places	+
B. CONSTRUCTION PHASE		
Dredging		
Change in tidal flows	Increasing saline intrusion	+
	Increasing erosion	+++
Water Pollution	Dredging will mix bottom mud/sand into water. This will cause water pollution at the project area and around. Turbidity and solid substances will be increased, sunlight penetration will be decreased, those lead to temporarily decreasing dissolved oxygen in water, some of the local benthos will be smothered and removed.	++
Change in benthos community	Dredging will change the benthos community locally and may result in loss of fishery in the project area.	++
	Reduction of bottom habitat will decrease self-cleaning ability of the river	+

Project Activities	Potential Environmental Impacts	Impact Levels
Oil pollution generated by dredging equipments	This will cause temporarily water pollution.	++
Constructing port		
Air pollution	Dust, noise, vibration generated from constructing facilities.	+++
Water pollution	Rain water will be contaminated by construction materials, sand, stone,…	++
	Sewage wastewater will cause water pollution	++
Land pollution	Land is polluted by solid wastes such as domestic wastes, construction materials, sand, stone,…	+
C. OPERATION PHASE		
Increasing transportation		
Increasing ship density	Increasing potential accident about hitting, lead to increasing oil spilling incident	++
	Increasing spilling incidents such as lubricants, hydraulic oils, fuels, liquid and solid chemicals	++
	Increasing oily ballast, bilge water, sewage water discharged from ship	+
	Hot water discharging from electricity generation facilities.	0
	Increasing solid wastes	+
	These wastes will cause water and land pollution. Especially, oil pollution will affect to mangrove forests and may be damage them; finally, those will affect to ability of erosion protect as well as microclimate harmony.	+
	Waves from ship will increase erosion, influence to fisheries	+
	Influence to water habitat and may be removed. This will reduce aquatic products	+
Oil store	This is source that can cause oil spilling incident due to supply oil for ship, combustion,…	++
Increasing traffic load	Increasing air pollution, traffic accidents	++
Consequential development		
Increasing trade and services	Increasing wastes such as air emissions, wastewater, solid wastes	+
Impact to socio-economic condition	Changing socio-economic conditions	0
	Tribal, cultural, ethnic, historical, religious aspects likely impacted by changes, including consequences of modernization and industrialization	++

Note)

0: Unclear effect

+: Light negative effect

++: Moderate negative effect

+++: Strong negative effect

31.3 Conclusion and recommendation

31.3.1 Necessity of Environmental Impact Assessment (EIA)

The Law on Environmental Protection was passed by the National Assembly of Vietnam in December 1993 and came into force in 1994. Consequently, most of large projects are subject to EIA studies. The Law requires the investors, project managers or directors of the offices to conduct the assessment of environmental impact (Article 9). Article 11 of the Law defines that the EIA shall be conducted in two phases, namely preliminary and detailed. Appraising power is given to the Ministry of Science, Technology and Environment (MOSTE) for large projects and to the provincial Department of Science, Technology and Environment for others. In case of the development of ports, all projects which may handle more than 500,000 m^3/year need to be appraised by MOSTE.

Advantages of EIA include:

- Perfecting design and choosing position of project
- Supplying exact information in order to decide
- Strengthening responsibility of related parts during developing process
- Taking project into right socio-economic situation
- Decreasing environmental damages
- Increasing socio-economic effectiveness of project
- Contributing on stable development positively

31.3.2 Contents of EIA

Environmental Impact Assessment (EIA) for a Short-term Development Plan for the IWT System in the Red River Segment through Hanoi, including the priority feasibility projects shall comprise the following:

(1) Introduction

1) Purpose of the EIA report setting up

2) List of legal documents, technical data and references for reporting

Legal documents include :

– The Law of Environmental Protection (LEP) adopted by the National Assembly of the S.R. Vietnam on 27 December, 1993

– The Government Decree No 175/CP of 18 October 1994 on the guidance for implementing LEP.
– Relevant legal instruments relating to EIA requirement issued by MOSTE.
– The Vietnamese environmental standards issued by MOSTE.
– Technical data and references for EIA reports including publications, survey and inventory documents and other references

3) EIA methods

The following methods will be used for EIA investigation: checklists, matrices, networks, comparison, expert judgment, rapid assessment, field survey, modeling, cost-benefit analysis, remote sensing, GIS application.

4) EIA organization and schedule

(2) Preliminary description of the Project

1) Description of the Project

- Project title
- Project owner(s)
- Proposed project site
- Socio-economic objectives of the project
- Project contents or activities
- Socio-economic benefits of the project
- Investment form and source of funds
- Project activity schedule
- Project budgets and expense schedule

2) Preliminary description of the Project technologies and equipment

3) Preliminary description of environmental technologies and equipment intended to be applied

(3) Current state of the environment at the proposed Project area

1) Baseline environmental data

– National conditions including geographic location, topographic and geomorphologic features, climate and meteo-hydrological features.

- Socio-economic conditions including population/labor, socio-economic conditions, culture and history.
- Natural resources including land, surface water, ground water, founa, flora.
- Transportation infrastructure and services.
- State of the physical environment including soil quality, surface and ground water quality, air quality, noise and vibration.

2) Analysis of baseline environmental data

It shall include land use, surface and ground water quality, air quality, noise and vibration, socio-economic conditions.

3) Assessment of baseline environmental data

- Physical environment including surface and ground water quality, air quality, climate, noise and vibration, soil quality, floods etc.
- Biological resources including fauna, flora, endangered species etc.
- Natural resources including land use, land clearance for the project.
- Cultural and historical heritage sites including religious works, graves, archaeological sites, landscape and tourism destinations.
- Socio-economic conditions: population, employment, living standards, sanitary conditions, community health etc.

(4) Environmental impact prediction and assessment of the Project

1) Description of potential sources of environmental pollution and degradation

- Activities in the preparation phase.
- Activities in the construction phase.
- Activities in the operation phase.

2) Assessment of possible changes in the environmental quality during the implementation of the project

- Impacts of the project in the preparation phase on hydraulic regimes, soil erosion and sedimentation, biological resources, land use, human life, aesthetics and landscape, historical and archaeological sites etc.
- Impacts of the project in construction phase on land use, water quality, air quality, soil quality etc.

- Impacts of the project in operation phase on air quality, water quality, soil quality, human life etc.

3) Risk assessment

- Identification of project implementation risk
- Potential institutional bottlenecks

4) General assessment

5) Recommendations and project implementation alternatives

(5) Negative impact mitigation measures

- Negative impact mitigation measures for the preparation phase.
- Negative impact mitigation measures for the construction phase.-
- Negative impact mitigation measures for the operation phase.
- Developing needed regulatory and institutional frameworks
- Building capacity of the project-executing agencies

(6) Follow-up environmental monitoring and management

1) Environmental management programs

- Institutional arrangement and manpower for environmental management.
- Environmental management and protection plans.
- Environmental awareness rising, education and training

2) Environmental monitoring programs

- Monitoring parameters
- Monitoring frequency and duration
- Monitoring equipments
- Monitoring manpower
- Monitoring funding

(7) Conclusions and recommendations

(8) List of references

(9) Annexes

- Survey and measurement data
- Relevant legal documents relating to the project.
- Pictures and maps.

31.3.3 Recommendation

According to environmental protection overview, although the port development project at the Survey area is essential, it also has to ensure the following items:

- Port development in harmony with the environment
- Promotion of public involvement measures
- Strict application of regulation against discharge from land area
- Preparation of funds required for urgent rehabilitation of unexpected damage to environment

Explanation of Cover Design

Future images of the Inland Waterway Transport System in the Red River Delta, the projects on channel stabilization and the major ports in the segment through Hanoi in particular, are drawn in this Study. This project is expected to contribute to the 1000 year anniversary of Thang Long - Hanoi - in 2010. In the cover page of this final report, pink band and light blue band express the Red River and the blue sky above Hanoi respectively. Both Dao (peach flowers) and Quat (a kind of citrus fruits) in the colored bands are cultivated along the river bank and adorned at the entrance of each house to celebrate Tet (a new year) in Hanoi. The JICA Study Team and relevant organizations of Vietnam hope the project will be carried out as early as possible.


THE STUDY ON THE RED RIVER IWT SYSTEM
LANDSAT-7 16th November 2001
MOT (PMU-Waterways)
JICA Study Team (OCDI & JPC)