PART V

FEASIBILITY STUDY ON THE PRIORITY PROJECTS

Chapter 40 Economic Analysis of the Project

40.1 Method of economic analysis

The subject project for the economic analysis carried out and discussed in this section is the project referred to as the proposed Short-term Development Plan (up to 2010) in the Hanoi segment, which is composed of 4 major ports, namely Hanoi, Khuyen Luong, New North and New East Port and the navigation channel.

The methodology applied for the economic analysis of the project is as discussed in **Chapter 30**. The project life is assumed to be 30 years from the commencement of operation. The hurdle rates established to judge the economic viability of the project are as follows:

Internal Rate of Return (IRR): More than 10% (discount rate used for computation)
Net Present Value (NPV): More than zero (0)
Benefit Cost Ratio (BCR): More than one (1)

40.2 Economic cost

The initial capital investment costs estimated in market price and in economic price are as shown in **Table 40.2.1**. The cost in market price is converted to the economic cost using the Standard Conversion Factor (SCF) determined at 0.85, which includes the Shadow Wage Rate (SWR). Annual maintenance cost is assumed to be one percent (1%) for the civil engineering portion and three percent (3%) for the machinery portion.

Table 40.2.1 Initial Capital Investment Amount (2010)

(Unit: US$ million)

Project	Hanoi Port*3	Khuyen Luong Port	New North Port	New East Port	4 Ports Total	Channel*4	4 Ports and Channel
In Market Price*1	9.88	10.93	12.02	23.50	56.33	92.67	149.00
In Market Price*2	9.88	10.93	12.02	15.56	48.39	92.67	141.06
In Economic Price	8.40	9.29	10.22	13.23	41.14	78.77	119.90

Note) 1. Estimated cost in market price include net cost, VAT, physical and price contingencies.
2. Estimated cost of New East Port in market price does not include the cost for the construction of the Distribution Center (DC) and the Container Freight Station (CFS).
3. Estimated cost of Hanoi Port includes the cost of satellite passenger berths.
4. The channel project includes channel stabilization works, channel dredging, provision of navigation aids, etc.

Source) JICA Study Team

40.3 Economic benefit

The economic benefit of the project is quantified based on the saved transport cost between "Without Project Situation" and "With Project Situation". The transport cost of each situation is analyzed based on the unit cost on ton-kilometer as the Ship Operation Cost (SOC) of vessel and the Vehicle Operation Cost (VOC) of truck as discussed in **Chapter 30**.

Under the Without Project Situation, it is assumed that the IWT system in the Hanoi segment can no longer handle or transport the cargo volume more than that handled or transported at the year 2003; and the truck will transport such excessive cargoes substituted for the IWT. Under the With Project Situation, the IWT system will be able to handle or transport all forecasted cargoes in the Hanoi segment.

The cargo handling cost applied for IWT is estimated for each commodity based on the current cargo handling charges at ports but in economic price. The cargo handling cost applied for road transport by truck is assumed to be the half of that applied for IWT. The loading factor of cargo is assumed to be 0.5 for both modes. Further, the hauling distances of truck and IWT for each commodity in one-way are assumed as shown in **Table 40.3.1**.

Table 40.3.1 Hauling Distance of Commodity by IWT and by Truck

Commodity	By IWT	By Truck	Remarks
Construction Material	100 km	100 km	Phu Tho – Hanoi
Cement	150 km	120 km	Hai Phong – Hanoi, etc.
Coal	210 km	190 km	Quang Ninh - Hanoi
Others	150 km	120 km	Hai Phong – Hanoi, etc.
Container	150 km	120 km	Hai Phong - Hanoi

Source) JICA Study Team

In quantifying economic benefit of the project, the average size of vessel deployed in the Hanoi segment is assumed to increase from the present size to the projected size and the average size of truck substituted for IWT under the Without Project Situation is assumed as shown in **Table 40.3.2**. The difference between SOC of vessel and VOC of truck is deemed as the economic benefit. The typical SOC and VOC are as shown in **Table 40.3.3**.

Table 40.3.2 Average Size of Vessel and Truck by Commodity

Commodity	Average Size of Vessel (DWT)*1			Average Lord of Truck
	Present	2010	2020	
Construction Material	200	250	300	6 tons
Cement	200	250	300	10 tons
Coal	200	250	300	10 tons
Others	200	250	300	6 tons
Container	-	600	800	40' Trailer*2

Note) 1) Average size of vessel which call the major ports in the Hanoi Segment.
2) LCL (less than container load) cargo is assumed to use 6-ton truck.
Source) JICA Study Team

Table 40.3.3 Difference of Transport Cost in SOC and VOC

(Unit: US$ per ton-km)

SOC of Vessel		VOC of Truck		Difference
250 DWT	0.0088	6 ton truck	0.0348	0.0260
600 DWT	0.0048	6 ton truck	0.0348	0.0300
250 DWT	0.0088	10 ton truck	0.0243	0.0155
600 DWT	0.0048	40' Trailer Truck	0.0180	0.0132

Note) Cargo handling cost is not included in the above transport cost per ton-km.

Source) JICA Study Team

The cargo volume of each kind of cargo is projected as shown in **Table 40.3.4**. The average economic benefit estimated for each commodity per ton for the project life of 30 years starting from 2010 in the Hanoi segment is summarized as shown in **Table 40.3.5** (see details in **Appendix Table 40.1 – 40.5**).

Table 40.3.4 Cargo Volume Projection by Commodity in Hanoi Segment

(Unit: million tons per year)

Commodity	Year 2001	Year 2010	Year 2020
Construction Material	3.77	6.57	11.03
Cement	1.18	2.21	3.41
Coal	0.50	0.70	0.86
Others	0.55	0.74	1.13
Container	0.00	0.32	0.67
Fertilizer	0.00	0.00	0.18
Rice	0.00	0.00	0.61
Total	6.00	10.54	17.89

Source) JICA Study Team

Table 40.3.5 Economic Benefit by Commodity per Ton

Commodity	Economic Benefit per Ton
Construction Material	US$ 1.94
Cement	US$ 1.51
Coal	US$ 1.97
Others	US$ 1.71
Container	US$ 1.57

Source) JICA Study Team

The economic benefit derived from the passenger transport is analyzed in the same method applied for that derived from the cargo transport by replacing vessel and truck with passenger boat and bus. This economic benefit is exclusively associated with Hanoi Port where the passenger terminal is planned. According to the analysis the estimated economic benefit per year in 2010 and 2020 are US$ 0.11 million and US$ 0.16 million respectively (see **Appendix 40.6** for details).

40.4 Economic viability

The result of the economic analysis of the project for the target year 2010 is tabulated in **Table 40.4.1** (see **Appendix 40.7 – 40.12** for details). The economic viability indicators of all projects in 2010 clear the predetermined hurdle rates. Therefore, the project is considered as viable from the national economic point of view.

Table 40.4.1 Results of Economic Viability

Target Year Project	EIRR	NPV (US$ million)	BCR
Hanoi Port	13.6%	3.14	1.32
Khuyen Luong Port	16.3%	6.70	1.61
New North Port	15.6%	6.51	1.54
New East Port	22.1%	19.21	2.21
4 Ports Total	16.3%	26.43	1.54
All Ports plus Channel	12.8%	34.56	1.24

Source) JICA Study Team

Further, the economic viability of each port is tested by means of sensitivity analysis assuming the changes of conditions and the results are shown in **Table 40.4.2**. As shown therein, the economic viability of each port is ascertained. However, the economic viability of the project composing all ports and the channel in the Hanoi segment is evaluated as delicate in Case-3. The computation of viability indicators for the project composing all ports and the channel is based on various assumptions such as the investment amounts estimated for the other ports/berths than 4 project ports in the Hanoi segment, which is estimated in proportion to the 4 major port's cargo handling volume.

Table 40.4.2 Results of Economic Sensitivity Analysis

	Hanoi Port	Khuyen Luong	New North	New East	4-Ports Total	All Ports & Channel
Base Case	13.6%	16.3%	15.6%	22.1%	16.3%	12.8%
Case-1 EIRR	12.4%	15.1%	14.4%	20.5%	14.3%	11.6%
Case-2 EIRR	12.2%	14.8%	14.1%	20.2%	14.0%	11.4%
Case-3 EIRR	11.1%	13.6%	13.0%	18.7%	12.8%	10.3%

Note) Assumed conditions

Assumed Conditions	Case-1	Case-2	Case-3
Investment Amount Increased at	10%	-	10%
Economic Benefit Decreased at	-	10%	10%

Source) JICA Study Team

The economic benefit expected from the channel project alone cannot be estimated quantitatively in precise way due to the following reasons; therefore, the economic benefit is analyzed qualitatively.

The economic benefit expected from the channel project is not limited to the benefit related to the cargoes handled at ports in the Hanoi segment alone but; 1) whole IWT transport passing through this segment; 2) the effective land use of Hanoi city; and 3) the protection of riverbanks. Assuming that the channel project is not implemented, the indirect economic benefits from the channel project are thought to be as follows:

1) The least available depth (LAD) of ports in the Hanoi segment may decrease then the ports will not be able to handle the forecasted cargo or no longer function as the ports thereafter;
2) The passage at the Duong Bifurcation will not be able to accommodate increased volume of IWT traffic; and
3) The enlargement of IWT vessel size will no longer available due to shallow water depth in the dry season.

Duet to these reasons the channel project is justified qualitatively as well in view of indirect economic benefits.

Chapter 41 Financial Analysis of the Project

41.1 Method of financial analysis

The subject project for the financial analysis carried out and discussed in this section is the project referred to as the proposed Short-term Development Plan (up to 2010) in the Hanoi segment, which is composed of 4 major ports, namely Hanoi, Khuyen Luong, New North and New East Port as well as the navigation channel. The channel project is considered as an independent project from the port project.

The methodology applied for the financial analysis of the project is similar to that applied for the economic analysis. However, NPV and BCR are not used. The project life is assumed to be 30 years from the commencement of operation. It is assumed that the project will be funded totally by loan. The loan conditions for the project and the hurdle rate applied to judge the financial viability of the project are assumed as follows:

	Loan Period	Grace Period	Interest Rate
80% of total investment amount	30 years	10 years	1.8%
20% of total investment amount	15 years	none	10.0%
Weighted Average Interest Rate			3.4%

Internal Rate of Return (IRR): More than 3.4%

41.2 Financial costs

The initial capital investment costs estimated in market price are the same as shown in **Table 40.2.1** of former chapter. Annual maintenance cost is assumed at one percent (1%) for the civil engineering portion and three percent (3%) for the machinery portion. Annual operation cost of each port is estimated as tabulated in **Table 41.2.1** in accordance with the operation scheme discussed in **Chapter 37** (see **Appendix Table 41.1** for details).

Table 41.2.1 Estimated Operation Cost (2010)

(Unit: US$ million)

Port	Hanoi	Khuyen Luong	New North	New East
Cargo Handling Cost	0.24	0.27	0.21	0.43
Administration Cost	0.10	0.05	0.05	0.07
Total Operation Cost	0.35	0.32	0.26	0.50

Source) JICA Study Team

41.3 Projected revenue

The source of revenue of each port is assumed solely from the cargo handling operation except Hanoi Port. As to Hanoi Port, the revenue from the operation of passenger terminal is estimated in addition to the revenue from the cargo handling operation. Cargo handling charge is assumed to be unchanged in principle as tabulated in **Table 41.3.1**. (See **Appendix Table 41.2** for details)

Table 41.3.1 Cargo Handling Charge by Commodity

(Unit: VND per ton)

Charge / Commodity	Handling Charge	Storage Charge	Total in VND/ton	Total in US$/ton
Construction Material	11,800	600	12,400	0.83
Cement	20,300	600	20,900	1.39
Fertilizer	23,900	1,200	25,100	1.67
Coal	14,200	600	14,800	0.99
Rice	20,300	1,200	21,500	1.43
Others	30,250	1,200	31,450	2.10
Container	-	-	65,000	4.33

Note: The cargo handling charges used for the computation of financial analysis are according to the current tariff except for container. Container handling charge is estimated as an all inclusive amount in weight ton based on the current tariff applied in Hai Phong Port.

Source) JICA Study Team

The forecasted cargo volume of each port by commodity are tabulated in **Table 36.1.1** of former chapter. The revenue of each port is projected based on the foregoing charge and cargo volume by commodity as shown in **Table 41.3.2**.

Table 41.3.2 Projected Revenue of Each Port

(Unit: US$ million)

Port	Hanoi*1	Khuyen Luong	New North	New East	4 Ports Total
2010*2	1.07	1.14	1.02	2.64	5.87

Note: 1) The annual revenue of Hanoi Port is composed of revenue from cargo handling and passenger terminal operation at US$0.90 and US$0.17, respectively.
2) It is assumed that the maximum cargo handling capacity of each port covers 120 % of the cargo forecast of 2010 for the computation of financial viability indicators.

Source) JICA Study Team

The annual revenue derived from the operation of passenger terminal in Hanoi Port and the assumed charges to be collected from the passengers of different kind are shown in **Table 41.3.3**.

Table 41.3.3 Projected Revenue of Passenger Terminal Charge in Hanoi Port

	Local Ordinary Pax	Local Tourist Pax	Foreign Tourist Pax*2	Total per Year
Charge per Departing PAX in VND*1	1,000	6,000	30,000	
Charge per Departing PAX in UDS$	US$0.07	US$0.40	US$2.00	
Passenger Demand in 2010 ('000)	605	80	49	734
Annual Revenue (US$ million)	US$0.040	US$0.032	US$0.098	US$0.170
Passenger Demand in 2020 ('000)	863	201	114	1,178
Annual Revenue (US$ million)	US$0.058	US$0.080	US$0.228	US$0.366

Note: 1) These charges are planned to cover the cost relative to the passenger terminal operation but not for the operation of the river passenger transport services as a whole.
2) The charges to the foreign tourist is assumed to be collected by the travel agent as a part of tour package fee and paid to the port management entity as the charge to use the passenger terminal.

Source) JICA Study Team

The average charges for the river cruise in Bangkok and other places in the world is more than US$ 20 per person per trip for foreign tourist. Therefore, it can be guessed that the foreign tourist can afford to pay US$ 2.00 per person or 10% of above-mentioned cruise charge for the service provided by the passenger terminal.

The New East Port is planned to handle containerized cargo by IWT between Hai Phong/Cai Lan and Hanoi. Therefore, ICD (inland container/clearance depot) consisting of CY (container yard), CFS (container freight station) and DC (distribution center) is planned in this port. Container handling charge is determined as an all-inclusive amount based on the current tariff applied in Hai Phong Port. The container cargo handling charge is estimated at VND 65,000 or US$4.33/weight ton (see **Appendix Table 41.3** for details).

41.4 Financial viability

Two types of the financial analysis are carried out by source of revenue i.e. cargo handling charge and lease amount. The type of port operation in the former case is referred to as the Service Port Case for the sake of convenience. The later case is referred to as the Landlord Port Case.

The financial internal rate of return of each port is calculated to check whether these projects are financially viable or their IRR exceed the predetermined hurdle rate set at 2.8% as discussed in the foregoing paragraph assuming that the ports are operated by respective entity as the service port. As for the landlord port case, the expected annual lease amount of each port is calculated assuming that the terminal operator as the lessee of landlord port provides only the necessary labors and management staffs for the cargo handling operation.

This exercise is done for two cases to find out the maximum annual lease amount, which makes the margin of the terminal operator at zero (0) as Case-A, and to find out minimum annual lease amount, which makes the FIRR of landlord port at 3.4%. The result of this financial analysis is summarized in **Table 41.4.1** (see **Appendix Table 41.5 – 41.9** for details).

Table 41.4.1 Results of Financial Viability (2010)

Port	Service Port	Landlord Port					
		Case-A			Case-B		
	FIRR	Lease	FIRR	Margin	Lease	FIRR	Margin
Hanoi Port	7.2%	1.03	7.2%	0	0.87	3.4%	11.9%
Khuyen Luong Port	6.2%	0.96	6.2%	0	0.71	3.4%	18.2%
New North Port	8.1%	1.34	8.1%	0	0.79	3.4%	33.4%
New East Port	7.8%	2.40	7.8%	0	1.52	3.4%	29.2%
4 Ports Total	7.5%	5.73	7.5%	0	3.71	3.4%	8.9%

Note) 1) Lease amount is annual lease amount in US$ million
2) Margin means the profit margin of terminal operator and the difference between operation cost and revenue derived from cargo handling operation.
Source) JICA Study Team

The annual lease amount should be negotiated between the owner of the port and port facilities as the Lesser and the terminal operator as the Lessee. Under this landlord port scheme, MOT is assumed as the port owner or the Lessee. According to the result of financial viability analysis, all the port project is considered as feasible in both form of operation; i.e. service port and landlord port.

The financial viability of each port is tested by means of sensitivity analysis assuming the changes of conditions and the results are shown in **Table 41.4.2**.

Table 41.4.2 Result of Sensitivity Analysis

Project Port	Base Case	Case-1	Case-2	Case-3
Hanoi Port	7.2%	6.3%	5.7%	4.9%
Khuyen Luong Port	6.2%	5.4%	4.7%	3.9%
New North Port	8.1%	7.3%	6.8%	6.0%
New East Port	7.8%	7.0%	6.5%	5.6%
4 Port Combined	7.5%	6.6%	6.1%	5.3%

Note) Assumed conditions:

Assumed Conditions	Case-1	Case-2	Case-3
Investment amount increased at	10%		10%
Revenue decreased at		10%	10%

Source) JICA Study Team

As shown in **Table 41.4.1** and **Table 41.4.2**, the FIRRs of each port and 4 ports combined are more than the hurdle rate predetermined, then the port project is considered financially feasible.

As to the channel project, the minimum revenue directly related to the channel project in the Hanoi segment is obtained backwardly by presetting its FIRR at 3.4% as minimum FIRR. According to this exercise, the revenue to be collected from all IWT vessels using the all ports/Berths in the Hanoi segment should be at VND 5,700/DWT or US$0.38/DWT as minimum if such revenue is collected solely from IWT vessels (see **Appendix Table 41.4** for details).

However, VND 5,700/DWT is equivalent to about 19 times of current tonnage dues of VND 300/DWT or 25% of average cargo handling charge per ton and such additional charge is considered to have an adverse effect on the promotion of IWT. Therefore, the other means to cover the investment cost, which may not limit but include the following measures, should be studied with all concerned parties relating to the project.

1) Initial capital investment cost borrowed through loan will be repaid from the general account of either the National Treasury or Hanoi City.
2) A part of every possible revenues relating to the land created or value added as by-product of the project will be allocated for the repayment.
3) Acceptable charges to IWT operator as the tonnage dues will be collected in order to cover the maintenance cost.

Chapter 42 Comprehensive Environmental Evaluation

42.1 Introduction

The comprehensive environmental evaluation covers the priority port development projects in the Red River and Duong River Segments through Hanoi, including construction of 2 new ports (i.e. New North port, New East port) and expansion of 2 existing ports (i.e. Hanoi port, Khuyen Luong port).

The measures for waste pollution control and risk response as well as rough cost estimation are presented in this Chapter.

42.2 Waste pollution

42.2.1 Waste pollution loads

42.2.1.1 Estimation of dust Loads

The critical pollution is dust caused by the processes of transporting, unloading, loading, storing in the terminals. Pollution loads of dust from different sources can estimated on the base of the emission factors, which established by WHO (See **Table 42.2.1**).

Table 42.2.1 Dust Emission Factors

No	Activities	Pollution factor (kg/ton)
1	Bulk cargo unloading/loading	0.10
2	Non-bulk cargo unloading/loading	0.01

Source) WHO, 1999

The dust pollution loads emitted from loading/unloading the bulk or non-bulk cargos are estimated in **Tables 42.2.2, 42.2.3, 42.2.4.**

Table 42.2.2 Estimation of Dust Loads Emitted from Loading/Unloading the Bulk Cargo at the Planned Ports

No	Name of port	Bulk Cargo Throughput (x1,000 ton)			Dust load (ton/year)		
		2001 (*)	2010	2020	2001	2010	2020
01	New North Port	0	1,002	2,877	0	100.20	287.70
02	Hanoi Port	717	599	333	71.7	59.90	33.30
03	Khuyen Luong Port	195	903	2,170	19.5	90.30	217.00
04	New East Port	0	353	1,078	0	35.30	107.80
05	Chem Berth	1,680	1,729	2,128	168.0	172.90	212.80
06	Other Berths	3,401	2,686	3,305	340.1	268.60	330.50
	Total	**5,993**	**7,272**	**11,891**	**599.3**	**727.20**	**1,189.10**

Source) JICA Study Team, 2002

(*) – Almost of present cargo throughput (2001) is bulk

Table 42.2.3 Estimation of Dust Loads Emitted from Loading/Unloading the Non-Bulk Cargo at the Planned Ports

No	Name of port	Non- Bulk Cargo Throughput (x1,000 ton)			Dust load (kg/year)		
		2001 (*)	2010	2020	2001	2010	2020
01	New North Port	0	122	373	0	1.22	3.73
02	Hanoi Port	0	245	905	0	2.45	9.05
03	Khuyen Luong Port	0	245	1,087	0	2.45	10.87
04	New East Port	0	612	1,119	0	6.12	11.19
05	Chem Berth	0	386	421	0	3.86	4.21
06	Other Berths	0	1,341	1,433	0	13.41	14.33
	Total	**0**	**2,951**	**5,338**	**0**	**29.51**	**53.38**

Source) JICA Study Team, 2002

(*) – Almost of present cargo throughput (2001) is bulk

Table 42.2.4 Estimation of Total Dust Loads Emitted from Loading/Unloading theCargo at The Planned Ports

No	Name of port	Total dust load (ton/year)		
		2001	2010	2020
01	New North Port	0.00	101.42	291.43
02	Hanoi Port	71.70	62.35	42.35
03	Khuyen Luong Port	19.50	92.75	227.87
04	New East Port	0.00	41.42	118.99
05	Chem Berth	168.00	176.76	217.01
06	Other Berths	340.10	282.01	344.83
	Total	**599.30**	**756.71**	**1,242.48**

Source) JICA Study Team, 2002

42.2.1.2 Estimation of domestic waste water loads

Domestic wastewater of the staff members working at the planned ports contains high concentrations of suspended solids (SS), organic matters (BOD_5), nutrients (N, P) and bacteria.

(1) Water Pollution loads

According to the statistic of many developing countries, pollution factors of each person per day discharging into the environment (if untreated) are presented in **Table 42.2.5.**

Table 42.2.5 Waste Water Pollution Factors

Pollutants	Pollution load(g/capita/day)
BOD_5	45-54
COD	72-102
SS	70-145
Total N	6-12
Ammonia	2.4-4.8

Source) WHO, 1999

The annual pollution loads are estimated in **Table 42.2.6.**

Table 42.2.6 Waste Water Pollution Loads (2010)

No	Name of port	Effluent (m^3/year)	Water pollution loads (ton/year) (2010)				
			BOD_5	COD	SS	Total N	Ammonia
01	New North Port	7,154	4.43	7.78	9.61	0.80	0.32
02	Hanoi Port	8,118	5.00	8.79	10.85	0.90	0.36
03	Khuyen Luong Port	8,848	5.48	9.62	11.88	0.99	0.40
04	New East Port	12,848	7.96	13.97	17.26	1.44	0.57

Source) JICA Study Team, 2002

(2) Waste water concentrations

Concentration of pollutants are calculated base on pollution load and wastewater flow. Pollutant's concentrations in domestic wastewaters are presented in **Table 42.2.7.**

Table 42.2.7 Waste Water Pollution Concentration

Pollutants	Pollution concentration(mg/l)	TCVN 6984 :2001 (Q>200 m^3/s, Column F1)
BOD_5	619	50
COD	1,075	100
SS	1,344	100
Total N	11	60 (*)
Ammonia	45	1 (*)

Note) (*) TCVN 5945-1995 (Grade B)

Source) JICA Study Team, 2002

Comparing the main pollutant's concentration in the wastewater with the permissible values of the standard (TCVN 6984 :2001, Q> 200 m^3/s, Column F1 and TCVN 5945:1995, class B), it is obvious that BOD_5 concentration exceeds the permissible standard 12.4 times, that same for COD: 10.8 times, SS: 13.4 times. In this cases, it is necessary to treat the domestic wastewater to meet the Vietnam Standards before discharging into the Red and Duong Rivers.

42.2.1.3 Solid wastes

Solid waste loads those will be originated from the planned ports are estimated in **Table 42.2.8.**

Table 42.2.8 Solid Waste Quantity (2010)

No	Name of port	Solid waste quantity (2010)	
		Domestic waste (*)	Service waste (**)
01	New North Port	62,6	610.0
02	Hanoi Port	71.0	1,225.0
03	Khuyen Luong Port	77.4	1,225.0
04	New East Port	112.4	3,060.0

Note) (*) -Domestic waste is 0.7 kg/person/day

(**)- Service waste is 0.5% of packaged cargo

Source) JICA Study Team, 2002

42.2.2 Waste pollution control

42.2.2.1 Air pollution control

(1) Dust pollution control in the construction stage

To prevent dust in the construction stage, the following measures will be applied:

- To use a truck with water sprinkler in the sunny days for reduction of dust from scattering at the construction site.
- To cover the trucks by sheet during transportation of the construction materials .

(2) Pollution control in the operation stage

- To use a truck with water sprinkler in the sunny days for reduction of dust from scattering at the floor and roads.
- To cover the trucks by sheet during transportation of the bulk cargo.
- To use bag filters at appropriate points (for example: at the ends of conveyers for the bulk material's loading/unloading) for dust collection.
- To use an air slide and a bucket elevator for the bulk material's loading/unloading
- To use a mobile sweeper with suction type for cleaning up floor and roads.
- To use diesel oil with low sulphur content for stand-by electricity generators.
- To be adjusted the engine of the trucks, ships to fit the best condition of combustion.

42.2.2.2 Noise pollution control

- To minimize the noise pollution originated from the construction site, the mechanical construction means should not be operated in the night time.
- To minimize noise down to required level, silencers shall be attached to outlets of fans.
- Insulators will be installed at stands of air blowers, fans and compressors.
- Places causing high noise should be enclosed tightly.
- To avoid the noise, ships should not be to whistle at night time.
- Trees will be planted around the port to hamper the noise.

42.2.2.3 Water pollution control

(1) Construction stage

In construction stage, the run-off rain water will accompany soil, sand and spilled cement, which will be collected into the sedimentation pond to remove the solid residues before discharging into the Red river.

(2) Operation stage

1) Waste water from ships

- Ships should not be allowed to discharge wastewater, neither oil polluted water nor garbage into the river.
- All ships have to equip the oil separator to remove oil and dregs before being pumped into the river. An oil separator should be set up on board. The separated oil and dregs will have to be transferred to inland for recycling and / or further treatment.
- All ships should be equipped with appropriate means to prevent incidents such as fire, explosion and oil spill.

2) Domestic waste water discharging from ports

- Wastewater from the kitchen, canteen, washing rooms and toilets will be collected and led to septic tanks before discharging to the river.
- Waste water originated from floor and road cleaning, which is collected into sedimentation pond to remove sediments, suspended solids before discharging into the river.

3) Run-off rain water

- Run-off rain water will be collected and led into screen to remove big size garbage, then to sedimentation pond to remove sediments, suspended solids before discharging into the river.

42.2.2.4 Solid waste disposal

(1) Construction stage

Construction activities may produce solid wastes, which consist of broken bricks, woods, papers, plastics, iron and steel, garbage and so on . The measures for treatment and disposal are as follows:

- Sanitary landfill method can be used for broken bricks, concrete , garbage etc.
- Waste papers, iron and steel, wood can be reused as production materials.
- Waste papers, wood, nylon and so on can be incinerated.

(2) Operation stage

- Hazardous wastes (i.e. waste oil, oily sludge, chemical packages etc.) will be managed in accordance with the Government Decree No 155/CP on the hazardous waste management regulation.
- The domestic garbage will be collected and disposed by the Urban Environmental Company (URENCO).

42.3 Oil spill control

- Ships and barges, anchored at ports, have to be equipped with all necessary means to prevent oil spill. The means may be an oil isolating float system, oil pumps, oil separators and/or centrifuges, etc.
- All ports have to be equipped with all necessary means to prevent oil spill, including boom, skimmer, oil pumps etc.
- Develop spill prevention and clean-up plans. Train a team to handle spills.

42.4 Fire and exploitation control

The fire and exploitation control measures at the port and terminals are summarized as follows:

- All the equipment working under high temperature and pressure should be registered and checked periodically the state authorities. The equipment should have thermometers, pressure gauges and so on to monitor the technical parameters.
- Fire and explosion sensors as well as communication and alarm systems should be installed in the ships' holds and ports. Besides appropriate fireproof equipment should always be there to take precautions against fire.
- Sailors should always be on their shifts, follow all operating instructions and check the technical parameters periodically. If anything unusual happens with the ship, they have to report right away to the duty officers.

- In the inflammable places, it should not be allowed to smoke, to carry things which can easily cause fire, nor wear nail sole shoes.
- Develop fire fighting plan. Train a response team.

42.5 Cost estimation

42.5.1 Cost estimation for waste pollution control

The pollution control facilities s including air emission, noise, waste waters, domestic solid wastes and hazardous wastes will be installed in each port.

The cost estimation for pollution control in each port is described in **Table 42.5.1.**

Table 42.5.1 Cost Estimation for Pollution Control

Pollution control facilities	Estimation cost (USD)			
	New North Port	Hanoi Port	Khuyen Luong Port	New East Port
Air pollution control facilities (including bag filters, noise reduction equipment etc.) at each port	152,130	93,525	139,125	62,130
Waste water collection and treatment system (including sewer pipes, septic tanks, drainage rain water pipes, central waste water treatment system etc.) at each port	715,400	811,800	884,800	1,284,800
Domestic solid waste and hazardous waste collection and storage system at each port	67,260	129,600	129,940	317,240
Tree's plantation	13,950	29,550	41,700	28,800
Total	**948,740**	**1,064,475**	**1,195,565**	**1,692,370**

Source) JICA Study Team, 2002

Total cost for pollution control facilities at the planned ports is estimated about 4,901,150 USD.

42.5.2 Cost estimation for oil spill control

The main facilities for oil spill control will be installed in each port.

The cost estimation for oil spill control in each port is described in **Table 42.5.2.**

Table 42.5.2 Cost Estimation for Oil Spill Control at Each Port

Equipment/facilities	Unit	Quantity	Unit cost (Million VND)	Total cost (Million VND)
Boom	m	400	1.5	600
Skimmer	unit	2	1,500	3,000
Oil storage tank	unit	1	150	150
Boat	unit	2	750	1,500
GPS	unit	2	50	100
Communication system	system	1	300	300
Air Compressor	unit	2	350	350
Boom carrier	unit	2	250	250
			Total	**6,250**

Source) JICA Study Team, 2002

Total cost for oil spill control facilities at each port is 6,250 million VND, equivalent to 416,000 USD.

Total cost for oil spill control facilities at for ports is as follows:

	Planned ports (year of 2010)
Number of port	4
Cost estimation for each ports (Million VND)	6,250
Investment (Million VND)	**25,000**
or Investment (USD)	**1,664,000**

Total cost for oil spill control facilities is 25,000 million VND, equivalent to 1,664,000 USD.

42.5.3 Cost estimation for fire and exploitation fighting

The main fire prevention and fighting equipment will be installed in each port.

The cost estimation for fire prevention and fighting in each port is described in **Table 42.5.3.**

Table 42.5.3 Installation of Main Fire Prevention and

Fighting Equipment at Each Port

Equipment/Facilities	Unit	Quantity	Unit cost (Million VND)	Total cost (VND)
Fire Fighting Tanker	unit	1	700	700
Bubble making system	system	1	400	400
Water storage tank	Unit	1	200	200
Automatic Fire Alarms	Unit	5	20	100
Communication system	system	1	100	100
CO_2 vessels (10 kg)	unit	20	0,3	6
CO_2 vessels (50 kg)	unit	10	1	10
Masks	unit	20	0.5	10
			Total	**1,626**

Source) JICA Study Team, 2002

Total cost for fire and exploitation fighting facilities at each port is 1,625 million VND, equivalent to 108,400 USD.
Total cost for fire and exploitation fighting facilities at four ports is as follows:

	Planned ports (year of 2010)
Number of port	4
Cost estimation for each ports (Million VND)	1,626
Investment (Million VND)	**6,504**
or Investment (USD)	**433,600**

Total cost for fire and exploitation fighting is 6,054 million VND, equivalent to 433,600 USD.

42.5.4 Total cost for pollution control and risk response

Total cost for pollution control and risk response is summarized in **Table 42.5.4.**

Table 42.5.4 Total Cost for Pollution Control and Risk Response

No	Equipment/Facilities	Estimated cost (USD) (2010)
01	Total cost for pollution control facilities	4,901,150
02	Total cost for oil spill control facilities	1,664,000
03	Total cost for fire and exploitation fighting facilities	433,600
04	Monitoring cost (*)	283,200
05	Training and management (10%)	265,760
	Total	**8,010,145**

Note) 1- year monitoring in preparation phase , 3 -year monitoring in construction phase, 5-year monitoring in operation phase .

Source) JICA Study Team, 2002

Total cost for pollution control and risk response is 8,010,145 USD.

42.6 Positive environmental effect of the project

A certain degree of modal shift is expected from the land transport of port cargos to river transport after the completion of the Project, which will reduce the quantity of CO_2 discharge as shown in the **Table 42.6.1** below.

Table 42.6.1 Effect of Project on Decrease in CO_2 Discharge

(2020, unit: 1000 tons)

	Investment to IWT Sector		Decrease
	Without	Width	
Northern region by IWT (overflow: Truck)	807	404	404
Share to whole country by all sectors	0.30%	0.15%	0.15%
Share to Red river Delta by transport sector	6.73%	3.36%	3.36%
Hanoi segment by IWT (overlow: Truck)	477	239	239
Share to whole country by all sectors	0.18%	0.09%	0.09%
Share to Red river Delta by transport sector	3.98%	1.99%	1.99%

Note) CO_2 Discharge (million tons) estimated by JICA Study Team

Whole Vietnam by all sectors: 266

Red River Delta by transport sector: 12

Source) JICA Study Team

Furthermore, it is considered desirable to maintain environment-friendly dual channel system, minimizing man-made structures as much as possible for channel development. This leads not only to preserve the biodiversity but also to the continuation of people's life who are living on the water with more than 100 boats.

This subject needs to be considered not only from natural environmental aspect but also from social aspect.

42.7 Conclusions and recommendations

- The environmental impact on the Red River and Hanoi metropolitan area by the implementation of this development project is considered to be comparatively little, and main impacts can be mitigated by way of appropriate measures.
- After the completion of development, improvement of air quality and reduction of CO_2 in the area in question can be expectable according as the modal shift will be realized.

- After the completion of development, consequential economical effects besides direct business effects will be generated on the outside business area, which will contribute to a great extent to the economical development and social stability of riverside Hanoi metropolitan area.
- The resettlement of inhabitants with the development of river ports and access roads will be minimum, but reasonable indemnity will have to be considered for purchasing the land under cultivation.
- During the construction stage, attention should be paid to avoid traffic accidents due to transportation vehicles, and noises and vibrations generated by construction machinery and equipment, thereby taking adequate mitigation measures.
- It is desirable to effect plantation of small trees on the riverbank to enhance the scenery of the riverside in Hanoi metropolitan area.

PART VI

OVERALL EVALUATION AND RECOMMENDATIONS

Chapter 43 Overall Evaluation and Recommendations

43.1 Importance and urgency of the project in the Hanoi segment

43.1.1 Development of ports and waterways

The IWT system in the Red River Delta plays an important role in carrying construction materials, cement, coal, etc., as well as bettering the lives of 15 million people living there. One of the most active areas in terms of IWT is the Hanoi segment where the IWT system supports the development and activities of the capital Hanoi of which population exceeds 2.7 million.

In Hanoi, west suburban area development is under way. Urban and industrial development projects of east and north suburban areas are also planned and some portions have commenced. Most of the suburban areas of Hanoi consist of paddy field or marsh peculiar to the delta area. Reclamation of at least 2 to 3 meters is required to develop the residential or industrial zone in these lower elevation areas. This would involve a large volume of construction materials in addition to their demand for buildings, houses and various infrastructures. It is also anticipated that other cargoes will increase together with the industrial and urban development.

At present, about six million tons of cargo are handled at Hanoi and Khuyen Luong Ports as well as the temporary facilities called Berth/Landing Stage which are operated by companies in the Hanoi segment. This cargo volume is equivalent to about two thousand 8-ton trucks per day.

According to the demand forecast in this Study, cargo throughput in the Hanoi segment will increase about threefold in 2020. Development of new ports as well as increasing the capacity of existing ports is urgently needed to meet the rapid increase of the IWT.

Temporary cargo Berths have been increasing randomly here and there along the Red River in order mainly to handle increasing construction materials. If this situation is allowed to continue, many disorderly heaps of sand and gravel will be seen along the Red River and this will have an adverse effect on the city planning.

Therefore, it is vital to restrict the increase of these temporary cargo Berths and instead to concentrate the investment into major ports. Improvement in terms of safe and environmental aspects should only be allowed for existing temporary cargo Berths. In addition, temporary cargo Berths located between Thang Long Bridge and Thanh Tri Bridge should be removed and transferred to the outside by 2010 in principle.

It is also important that dirty cargo such as coal and construction materials should be handled at the suburban ports, while Hanoi Port located near city center should be changed its characteristics to a clean cargo port as well as a passenger port.

As a result, the Study Team proposes to construct 2.4km (0.9km) of berth, 4 satellite passenger berths and related port facilities such as handling equipment, storage facilities, ICD with distribution center, passenger terminal and access roads in addition to navigation channel plan in the Hanoi segment by 2020 (2010) after formulating the Long-term Strategy for the IWT System in the Red River Delta.

Table 43.1.1 Summary of Port Development in Hanoi Segment

	Existing Berth	Newly Planned Berth			
		2010		2020	
	Cargo	Cargo	Passenger	Cargo	Passenger
Hanoi Port	568m		100m	80m	100m
Khuyen Luong Port	166m	160m		760m	
New North Port		280m		760m	
New East Port		360m		720m	
Sub-total	734m	800m	100m	2,320m	100m
Satellite Berth			4 sites		4 sites

Note) Existing berth of Khuyen Luong Port includes 60m to be completed before 2010.
Source) JICA Study Team

In Vietnam, especially in urban area, traffic condition has been worsening and the number of traffic accidents have been increasing. More than 10 thousand people were killed in traffic accidents at present. If the cargo which is expected to be transported by the IWT in the future were to be transported by road, it is easy to imagine that traffic congestion would be more serious and that traffic accidents would also increase.

In addition, existing roads have many restrictions such as vertical clearance under the pedestrian bridges and the minimum radius of roads where it is difficult for tall containers or ultra large cargo to pass.

Hence, it is clear that economic and social development in Hanoi will be restricted and road transportation will have to undertake a big burden if the IWT system is not developed. It is necessary to develop the IWT system as proposed in this Study as early as possible.

On the other hand, the IWT can carry a large volume of cargo at one time, and discharged carbon dioxide (CO2) per unit load of cargo is quite low. This means that the IWT is a environment-friendly transport mode. There is a growing movement to prevent environmental deterioration caused by transportation all over the world. This project must be materialized urgently from the viewpoint of not only increasing the capacity of IWT system but also improving the environment.

43.1.2 Channel stabilization

The IWT channels in the Red River Delta, specifically in the Hanoi segment, have had problems of instability of the routes, variable shallow depth, limitation of bridge clearance, etc., causing troubles of stranded ships and other hindrances. Construction of countermeasure facilities for stabilization and development of the channel in the Hanoi segment has been the most basic potential demands in the Red River Delta. It has not always been undertaken in the past mostly due to lack of funds. Thus, the IWT system in the Red River Delta is far behind that in the Mekong Delta.

On the other hand, the hydrological, hydraulic and morphological phenomena in the Red River Hanoi segment have been studied and researched since long time ago from various standpoints of flood control, irrigation, land utilization, etc. Related organizations, including MOT, MARD, HNPC, the Hanoi University of Civil Engineering and some of their subordinate corporations, have been undertaken and/or proposed several projects for stabilization of the riverbed. The channel stabilization program proposed in this study is the latest and most comprehensive one in the field of IWT, having employed state-of-the-art technology in surveys and analyses, and covering the whole segment until 2020.

During the execution of this Study, several new facts are revealed including hydraulic characteristics in the river, dynamic mechanism of the sedimentation/ erosion and effects of proposed channel stabilization facilities. Very recently, after several years of maintaining the same flow route, the main stream showed a tendency to change the direction at Thang Long Bridge, which may cause drastic changes in the alignment of the channels. This is to be re-trained urgently to retrieve the original alignment so as not to affect the present infrastructure.

Under the above circumstances, the proposed Project could be considered essential and urgent for the development of not only the IWT but also other socio-economic activities in the Hanoi segment.

Besides the necessity and urgency of the channel stabilization under this Project, the channel stabilization could affect the formation of other related projects for different purposes in the Hanoi segment such as the "Project of Building Rigid Embankment of the Red River Segment through Hanoi and Road on the Embankment, Phase I" by HNPC and "Training Plan for Improvement of Flood Drainage Capacity and Riverbed Stabilization in Hanoi" by MARD. These projects have already been proposed to the government and now under review of the State Appraisal Committee, MPI. Urgent formation of the channel stabilization could help incorporate with those projects to be affected by this channel stabilization, which is the common understanding and basic policy in the government.

In this context, this channel stabilization can be considered as the kernel measure to motivate and enhance the development of the river environment and the capital city.

43.2 Project risks and recommendation on project implementation

43.2.1 Channel stabilization

The discussions and analysis on channel stabilization made in this Study are mostly based on survey results from 1999 to 2002. It is observed, however, that, after the flood season in 2002, there is a trend where **change of the main channel** into the secondary channel is going to occur, which shall be avoided, stopped, and trained to flow to the planned direction. Hence, the proposed channel stabilization measures should be undertaken as soon as possible.

The major tool employed in this Study to analyze and predict hydraulic and morphological phenomena is a 2-D **numerical simulation model** with cylindrical axis system. Although the model is proved to have enough accuracy as far as flow is concerned, it is not practical to apply it to forecast of long-term change in riverbed bathymetry. In this context, detailed analysis should be carried out by means of physical hydraulic models on the behavior of movable bed in the Detailed Design Stage.

The proposed facilities for channel stabilization should be constructed step by step with careful monitoring on the effects of the facilities by **follow-up surveys**, at least twice a year in the dry and the flood seasons, including bathymetric, topographic, hydraulic, and geotechnical surveys, and review of the plan taking account of the expected and realized effects, priority, timing, and scale of the facilities.

In addition to construction of hard facilities, flexible and mobile operations of **dredging** should be incorporated in the execution of the Project. An amount of capital dredging with an order of 3million m^3 and a certain amount of annual maintenance dredging should be taken into consideration.

The effects of proposed channel stabilization facilities on the expected **floods** are discussed in terms of water level, velocity, and discharge. It is concluded that the effects are negligibly small. It is also judged that the effects on flood discharge capacity are minimal compared with the conditions without the facilities. On the other hand, construction of Son La Dam and others **reservoirs** in the near future will further ameliorate the flood conditions in the Hanoi Segment. Therefore, the proposed channel stabilization measures should be positively promoted even in consideration of flood control.

43.2.2 Ports and waterways

(1) Reliability of statistics and necessity of monitoring

Effective and foresighted management and operation of ports and waterways including planning activity must be based on accurate and updated information of every aspect of port traffic and activities. However, there is no reliable and comprehensive statistics of ports and waterways at present.

Therefore, master plans and short-term development plans for ports and waterways in this Study are formulated based on information from surveys and estimations conducted by the Study Team in addition to existing statistics. In addition, Vietnam is undergoing major economic changes and transport activities are rapidly increasing.

Hence, it is recommended to keep reliable statistics on ports and waterways as well as to continuously monitor the availability of premises used for planning in this Study. It is also crucial to confirm how the urban and industrial development in the hinterland is progressing when deciding the investment, especially for the project which will be implemented at later stage.

(2) Restriction of the increase of temporally cargo Berths

Temporary cargo Berths have been increasing randomly here and there along the

Red River In order mainly to handle increasing construction materials. If this situation is allowed to continue, many disorderly heaps of sand and gravel will be seen along the Red River and this will have an adverse effect on the city planning.

Therefore, it is vital to restrict the increase of these temporary cargo Berths and instead to concentrate the investment into major ports. Improvement in terms of safe and environmental aspects should only be allowed for existing temporary cargo Berths. In addition, temporary cargo Berths located between Thang Long Bridge and Thanh Tri Bridge should be removed and transferred to the outside by 2010 in principle. It should be noted that this policy is one of basic premises of planning for the 4 major ports.

(3) Promotion of passenger/tourist transport

As to passenger transport, new service routes from Hanoi for Hung Yen - Thai Binh and for Viet Tri - Phu Tho have potential to be realized. In order to attract passengers on these service routes, it is indispensable to provide a service almost the same as that of bus in terms of transit time and fare. Before starting operation of passenger boat service, promotion activity of a large scale in order to make passengers shift from bus transport to IWT is recommended.

In addition to normal passenger traffic, it is also important to promote the river cruse for international and domestic tourists. In promoting the river cruise, discovering tourist attractions in and around the Hanoi segment as well as providing various types of cruise service are recommended.

(4) Development of waterways for SRV

The feasibility of linking coastal transport to inland waterway transport could prove to be economically important to Vietnam when one considers that such a link could enable the centers of two important economic zones, namely Mekong Delta and the Red River Delta, to trade directly with each other.

The Coasters, however, have always been difficult to pass the river mouths and some other parts of major rivers connecting the sea to the ports in Ninh Binh and Hanoi due to draught limitations. As a result the Coasters had to call at Hai Phong Port. Hence, formulating a master plan of waterways for Coasters/SRVs with careful feasibility study is recommended as early as possible.

43.3 Recommendation on management and operation system

43.3.1 Ports

(1) Planning, investment and operation of major ports

Four major ports of Hanoi, Khuyen Luong, New North and New East should be managed and operated as "Landlord Port". Namely, MOT should plan and invest in these ports and port operation companies should operate them. Management of Ports/Berths should be conducted by VIWA. Improvement of Chem Berths in terms of safe and environmental aspects will be needed and should be undertaken by port operation companies. In this case, support system for the companies such as low interest loan or tax incentive should be studied.

(2) Proper port management

VIWA must grasp the situation of ports in its jurisdiction properly by establishing an adequate financial and personnel framework. Technical standards for port facilities should be established. A council meeting consisting of MOT (VIWA) and 5 major port operators should be established in order to form an efficient distribution network as well as to secure safe and smooth navigation.

(3) Restriction of new berth construction

New berth construction or extension of existing Berths other than 5 major ports and satellite passenger berths should be prohibited. Temporary cargo Berths located between Thang Long Bridge and Thanh Tri Bridge shall be removed and transferred to the outside by 2010 in principle.

(4) Setting appropriate port dues/charges

It is desirable to set port dues/charges as low as possible in order for IWT to compete with other transport modes. However, a moderate raising of tonnage dues should be considered according to the need for channel maintenance. A moderate raising of cargo handling charge should also be considered when new equipment is introduced to secure efficient and safe handling.

(5) Providing efficient and competitive port services

Round-the-clock operation should be realized and idle time including time for formalities/procedures should be reduced in order to provide efficient and competitive port services. In this context, it is recommended that VIWA (IWPA) and port operators assign personnel properly and make use of MIS. Reliable statistics on port activities should be kept properly.

(6) Introduction of support system for private sector

It is proposed to study support system for private sector such as low interest loan and tax incentive for improving port facilities in terms of safe and environmental aspects and building vessel fleet.

43.3.2 Inland waterways

(1) Planning, investment and management of waterways

Waterways in the Hanoi segment should be planned, invested and managed by MOT as it is major IW.

(2) Introduction of appropriate management equipment

Introduction of an appropriate management equipment (vessel, survey equipment, etc.) is proposed in order to conduct IW management efficiently and safely. Personnel of IWMS (including Sub-station) should be also placed properly.

(3) Introduction of information service system

Introduction of a new information service system is proposed in order to provide the latest information about IW for safe and efficient navigation.

(4) Revision of IW cargo transport tariff

Current IW cargo transport tariff, which is calculated by converted transport distance depending upon IW class, should be revised since the current drastic conversion of distance would hinder an effective use of the IW network.

(5) Strict control for illegal sand exploitation

It is strongly recommended for VIWA to strictly control illegal sand exploitation through close cooperation with relevant authorities.

(6) Enactment of legal framework to regulate bridge clearances

It is very important for IWT to secure necessary vertical and horizontal clearances when a bridge is newly constructed. It is strongly recommended to enact legal framework to regulate bridge clearances.

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)

JICA