Chapter 28 Construction Plan and Cost Estimate

28.1 Construction Plan

28.1.1 Construction Company Capable of the Priority Project

In order to implement the Priority Project we shall execute large-scale marine works that need large floating cranes, pile driving vessels, platforms in the water or high efficient dredgers. As for land works we will need soil improvement works economically and efficiently or a great amount of soil works as well.

As investigated and discussed in the Chapter 19, there are local construction companies, which have some experiences and are capable of marine works in the Study Area. They can contribute to the execution of the Project by raising capacity and supplying equipment through joint operation with foreign contractors. We can list up such major local companies as VINAWACO(Vietnam Waterway Construction Corporation) which has been mostly executing dredging works, CIENCO No.6 (Civil Engineering Corporation No.6) which is a major company in the South Viet Nam, and PVECC (Petrovietnam Engineering & Construction Company) which is specializing in fabricating or installing platform jackets or jetties for exploiting crude oil or constructing LPG bases including earth leveling or vertical plastic board drain (VPBD) works. These companies seem to be candidates of actual contractors for the Project.

28.1.2 Equipment Needed for the Project

Through the interviews or documents supplied by the above-mentioned construction companies, typical or rather high capacity equipments available in case of the implementation of our projects become clear. (cf. Table 19.1.11).

However, it is assumed that not many but some equipment should be procured for the Project because of shortage in number or capacity to carry out works till the decided time schedule. Table 28.1.1 shows considerable equipments necessary to procure when the work will start.

Table 28.1.1 Typical Equipment Necessary to Procure for the Priority Project

Kind of Equipment	Capacity	Remarks
Truck Crane	Lifting Capacity over 100t	At present maximum 70t
VPBD Pile Driver	Vertical Plastic Board drain works over 35m deep	PVECC has 4sets till 24m deep. They are short to reach bottom levels.
Diesel Pile Hammer	Hammer Weight 7.5t(D75)	Existing number is limited.
Pile Driving Vessel	100t Fat Barge+D75 P&H	Existing number is limited.
Hopper Dredger	Hopper capacity over 3500 m^3	MADRECONo.2 has one 3500m^3 hopper dredger. Capacity is short.

We can use rather large scale of existing equipment or work vessels listed in Table 19.1.11. However, it is supposed that deep vertical plastic board drain works up to –36m or steel pipe piles driven up to –50m need more large-size equipment for execution. As for channel dredging works, excavating

volume amounts to nearly 10.6 million cubic meters. Problems might happen such as shortage of dredgers or work vessels for implementation. When we need large-size hopper dredgers, we shall procure them from foreign countries.

28.1.3 Procurement of Construction Material

Construction materials for earth or concrete-works are available in the nearby hinterland. In the areas upstream of the Dong Nai River we can obtain fine sand for filling material in land or concrete mixing fine aggregate. As for rubble stones there are some quarries located in the east mountainside of Baria City about 20km from the Project site. Near Cai Mep LPG Base there is also a large-scale supply base for rubble stones, sand or aggregate. We can easily transport these materials to the Project site by barges or trucks from that base.

As for cement there are some cement factories in SEFA for example Sao Mai Cement and Ha Tien Cement factories. In Heip Phuoc there is Nghi Son cement distribution base, where is a pier to be able to berth 20,000DWT cement carriers and a cement silo with a storing capacity of 8,000 tons. There are also bagging facilities to supply 800,000ton cement per year.

As described in Chapter 19.1.4 we have a ready mixed concrete plant in My Xuan Industrial Zone near Cat Lo fishing port in Vung Tau City. That concrete batching plant can supply 80~100m^3 ready mixed concrete per hour. As a conclusion there is no problem to supply local construction materials such as sand, rubble stone and cement for the Project.

As for steel materials, steel bars for reinforced concrete can be supplied from local factories in general. In Phu My there is a steel iron factory named VINAKYOEI (Japanese-Vietnam Joint Company) which has 200,000~250,000 ton producing capacity mostly of steel bars and liner steel materials. That factory can provide steel bars with Japanese Industrial Standard (JIS) and British Standard as well. However, steel sheet or pipe piles and rather large structural steel materials should be imported from foreign countries.

In Vietnam, 40×40cm square concrete piles (normal reinforced or pre-stressed concrete) are prevailing to use for pier structures or foundations for buildings or other use. There is no factory which can produce large diameter circular concrete piles so far. If it is needed to use circular PC concrete piles over 600mm, we shall import from Malaysia or Singapore.

Major construction materials for the Priority Project are shown in the Table 28.1.2. Among the necessary materials, the largest quantity required is sand which amounts to more than 5.7 million cubic meters. Barges or dump trucks will transport them.

28.1.4 Dredging and Disposal of Dredged Material

Base on the data provided by MPMU navigation channel maintenance dredging volume counted 350,000 to 600,000 cubic meters mostly originated in Long Tau navigation channel. They are dumped in Ganh Lai Bay or partially used for reclamation works. The dredging quantity calculated becomes rather large volume. Furthermore, those materials to be dredged from the channels, mooring basins or excavating foundation for other facilities are, according to the result of soil investigation, mostly not

suitable materials for reclamation of wharfs or filling as structural foundation. So that dredged materials should be dumped in the offshore.

Table 28.1.2 Major Construction Materials for the Priority Project

Item	Unit	TVG-1&TVG-2	LCC-3&LCC-4	Total
Reclamation (sand and soil)	m^3	2,160,000	3,598,000	5,758,000
Rubble Stone	m^3	58,000	59,200	117,200
Concrete	m^3	19,190	26,800	45,990
Steel Material	ton	15,992	15,394	31,386
Steel Pipe Pile	ton	11,248	13,150	24,395
Steel Sheet Pile	ton	2,037	0	2,037
Other Steel	ton	1,092	0	1,092
Reinforced bar	ton	1,615	2,244	3,859

If these dredged materials dumped into near water areas from Project Sites where there are no surrounding embankments, dense muddy water flow must affect severe damages to fauna and flora. It should be avoided to make water environment getting worse.

We can choose offshore dumping site about 10km from Vung Tau Peninsula where the depth is more than –20m and rather high-speed sea current exists (Figure 25.2.2.6). It easily disperses dense muddy water to allowable suspended solid level, for example, lower than 100 ppm and it also prevent dumped soils from returning to the channels.

A trailing suction hopper dredger (we can call it a drag suction dredger or a hopper dredger), capable of dredging without being much swayed and to allow ships navigating coming and outgoing Thi Vai – Cai Mep or Long Tau Channels, will carry out dredging work for channels. A grab dredger will carry out a small amount of excavation for foundation. Almost of all channels dredging works will be executed by trailing suction hopper dredgers. Approximate volumes of dredged materials are tabulated below.

Table 28.1.3 Volume to be Dredged

Source	Initial Dredging Volume (m^3)
Offshore to Lower Cai Mep (-14.0m)	9,918,000
Cai Mep to Thi Vai International Port (-12m)	663,000
Total	10,581,000

If a side trailing suction hopper dredger to be employed for dredging the access channel and mooring basin is of self-propeller type, it is capable of dredging while navigating along predetermined courses. The dredged materials are pumped into the strong hold through the drag heads and arms and they are dumped through the bottom doors over a specified area of the sea.

The outline of a trial-dredging plan of the channel and basin by a side trailing suction hopper dredger is as follows:

- Volume of soils: 3,000,000 m^3
  Capacity of dredger: 3,240 m^3
  Dredging capacity: 3,000 m^3/hr
  Dredging depth: 9~15m

- Service speed: 8 km/hour
- Distance to the dumping site: 15 km (from the site)
- Time required with load: 1.0 hr
  without load: 40 min
- Volume of spoiled soil per day: 5,200 m^3/day
- Number of workable days: 320 days/year
- Dredging capacity 3,000,000/5,200 = 577 days

This trial calculation means that we need two or more trailing suction hopper dredgers, if we would complete dredging works within two years. (cf. Chapter 25.2.2)

28.1.5 Construction Time Scheduling

In order to prepare a proper construction schedule, local natural conditions, such as wave and wind records should be thoroughly examined and taken into account. Statistics show that the occurrence of wave height over 1.25m in Ganh Lai Bay is 5 percent (19 days per year). (cf. Table A3.29). Rainfall and wind velocity as well as the wave height affect the progress of construction work on the sea and on the land. Therefore, in the execution stage these natural phenomena should be taken into consideration and the result of examinations should be reflected in the detailed construction schedule. However, we can work over 330 days as usual.

Particularly, it is to be noted that the dredging and soil improvement works should be carefully scheduled so as to avoid possible delay of the completion and the start of the container and general cargo handling terminals.

In order to complete the project within five years from the commencement of construction work, an integrated long-range program should be prepared to carry out all types of construction works, mobilize and demobilize construction plants, procure necessary machines and equipments, and timely supply of various construction materials.

The proposed construction schedule is shown in Figure 28.1.1 (1). In this time schedule, it is supposed that various procedures will be done smoothly and quickly, for example, fund arrangement, selection of the consultant, execution of engineering services and conclusion of tender contracts. The schedule in general should be understood to be rather tight specifically in the case of reclamation for soil improvement and filling works is critical pass because of 2 years settlement of soft soil layers to reach 70～80% consolidation level. Dredging works should be done near the final stage to avoid increasing of dredging volume by sedimentation.

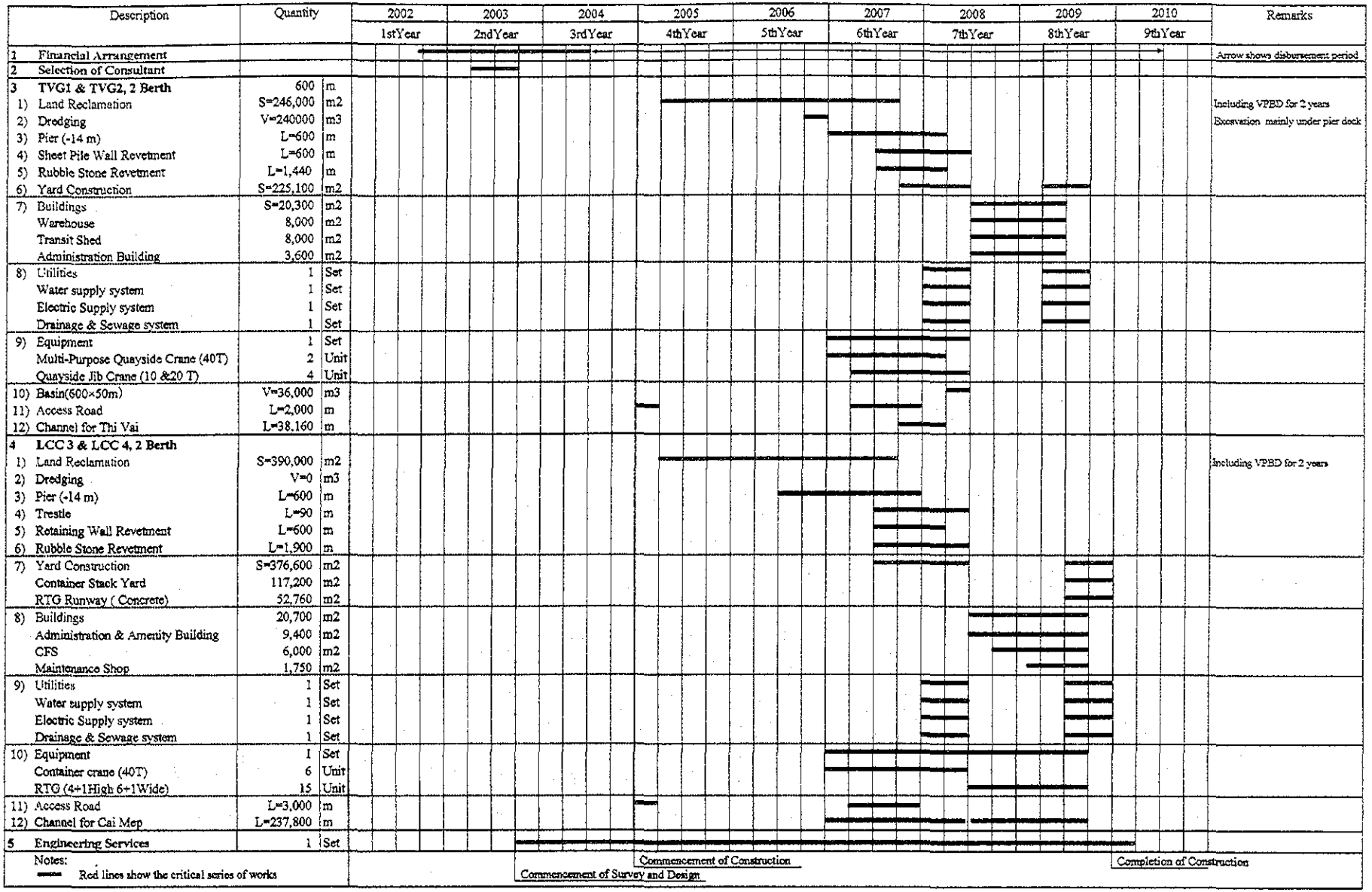
The works can be started in each berth site simultaneously, so that we need four construction working units in principal.

At first we should construct access roads temporally so as to transport construction materials and equipment. Sand volume for filling and surcharging becomes extraordinarily large. We should transport sand by both barges and trucks. After laying sand mats for V.P.B.D. (Vertical Plastic Board Drain) we should immediately drive VPBD to progress consolidation of foundation as soon as possible.

Alternative construction schedules are discussed, one of which is presented in Figure 28.1.1 (2). This alternative schedule is characterized by a shorter construction period of about four years. It is supposed, however, that the foundation soil improvement is expedited by introducing VPBD with triangular drain pitches of 1.1m, instead of 1.5m for the proposed schedule, which enables a saving of consolidation time of about six months. It also assumes three-month earlier start of construction of the temporary access road and the Administration & Amenity Building at LCC. In other words, the temporary access road should be contracted as soon as possible after effectuation of the fund, possibly by means of its local portion.

One of the important disadvantages of the alternative schedule is an increase in drain length by about 1.6 times, which results in an increase of construction cost of about 800 million Yen, compared with the proposed schedule.

Thus, the Study Team would like to recommend the proposed construction schedule, taking account of the target year of the Project, cost reduction, time allowance for procedures and construction works, and others.



Description	Quantity		2002 1stYear	2003 2ndYear	2004 3rdYear	2005 4thYear	2006 5thYear	2007 6thYear	2008 7thYear	2009 8thYear	2010 9thYear	Remarks
1 Financial Arrangement												Arrow shows disbursement period
2 Selection of Consultant												
3 **TVG1 & TVG2, 2 Berth**	600	m										
1) Land Reclamation	S=246,000	m2										Including VPBD for 2 years
2) Dredging	V=240000	m3										Excavation mainly under pier dock
3) Pier (-14 m)	L=600	m										
4) Sheet Pile Wall Revetment	L=600	m										
5) Rubble Stone Revetment	L=1,440	m										
6) Yard Construction	S=225,100	m2										
7) Buildings	S=20,300	m2										
Warehouse	8,000	m2										
Transit Shed	8,000	m2										
Administration Building	3,600	m2										
8) Utilities	1	Set										
Water supply system	1	Set										
Electric Supply system	1	Set										
Drainage & Sewage system	1	Set										
9) Equipment	1	Set										
Multi-Purpose Quayside Crane (40T)	2	Unit										
Quayside Jib Crane (10 &20 T)	4	Unit										
10) Basin(600×50m)	V=36,000	m3										
11) Access Road	L=2,000	m										
12) Channel for Thi Vai	L=38.160	m										
4 **LCC 3 & LCC 4, 2 Berth**												
1) Land Reclamation	S=390,000	m2										Including VPBD for 2 years
2) Dredging	V=0	m3										
3) Pier (-14 m)	L=600	m										
4) Trestle	L=90	m										
5) Retaining Wall Revetment	L=600	m										
6) Rubble Stone Revetment	L=1,900	m										
7) Yard Construction	S=376,600	m2										
Container Stack Yard	117,200	m2										
RTG Runway (Concrete)	52,760	m2										
8) Buildings	20,700	m2										
Administration & Amenity Building	9,400	m2										
CFS	6,000	m2										
Maintenance Shop	1,750	m2										
9) Utilities	1	Set										
Water supply system	1	Set										
Electric Supply system	1	Set										
Drainage & Sewage system	1	Set										
10) Equipment	1	Set										
Container crane (40T)	6	Unit										
RTG (4+1High 6+1Wide)	15	Unit										
11) Access Road	L=3,000	m										
12) Channel for Cai Mep	L=237,800	m										
5 Engineering Services	1	Set										

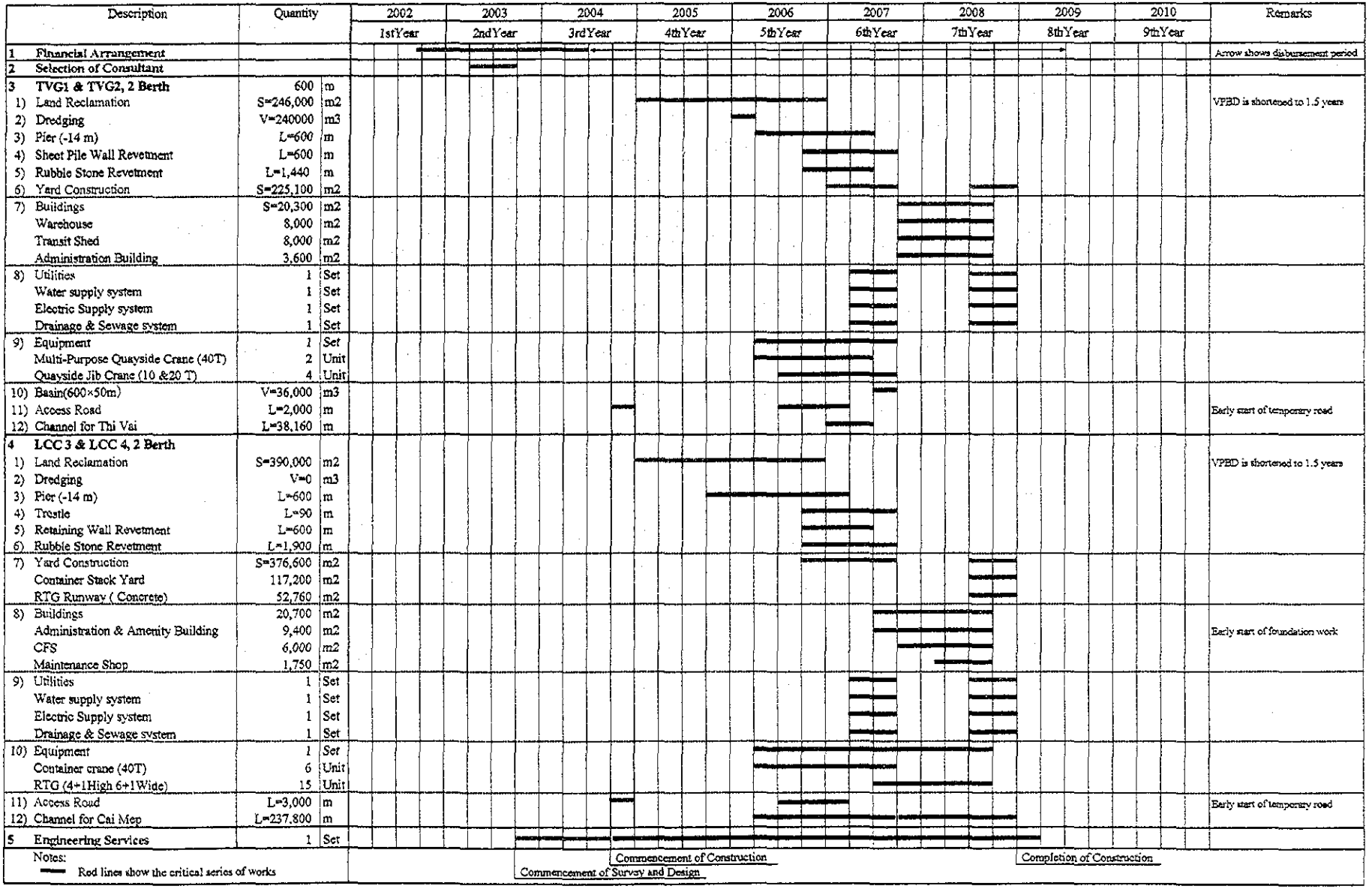
Notes:
Red lines show the critical series of works

Commencement of Survey and Design

Commencement of Construction

Completion of Construction

Figure 28.1.1 (1) Proposed Construction Schedule



	Description	Quantity		Remarks
1	Financial Arrangement			Arrow shows disbursement period
2	Selection of Consultant			
3	**TVG1 & TVG2, 2 Berth**	600	m	
1)	Land Reclamation	S=246,000	m2	VPED is shortened to 1.5 years
2)	Dredging	V=240000	m3	
3)	Pier (-14 m)	L=600	m	
4)	Sheet Pile Wall Revetment	L=600	m	
5)	Rubble Stone Revetment	L=1,440	m	
6)	Yard Construction	S=225,100	m2	
7)	Buildings	S=20,300	m2	
	Warehouse	8,000	m2	
	Transit Shed	8,000	m2	
	Administration Building	3,600	m2	
8)	Utilities	1	Set	
	Water supply system	1	Set	
	Electric Supply system	1	Set	
	Drainage & Sewage system	1	Set	
9)	Equipment	1	Set	
	Multi-Purpose Quayside Crane (40T)	2	Unit	
	Quayside Jib Crane (10 &20 T)	4	Unit	
10)	Basin(600×50m)	V=36,000	m3	
11)	Access Road	L=2,000	m	Early start of temporary road
12)	Channel for Thi Vai	L=38,160	m	
4	**LCC 3 & LCC 4, 2 Berth**			
1)	Land Reclamation	S=390,000	m2	VPED is shortened to 1.5 years
2)	Dredging	V=0	m3	
3)	Pier (-14 m)	L=600	m	
4)	Trestle	L=90	m	
5)	Retaining Wall Revetment	L=600	m	
6)	Rubble Stone Revetment	L=1,900	m	
7)	Yard Construction	S=376,600	m2	
	Container Stack Yard	117,200	m2	
	RTG Runway (Concrete)	52,760	m2	
8)	Buildings	20,700	m2	
	Administration & Amenity Building	9,400	m2	Early start of foundation work
	CFS	6,000	m2	
	Maintenance Shop	1,750	m2	
9)	Utilities	1	Set	
	Water supply system	1	Set	
	Electric Supply system	1	Set	
	Drainage & Sewage system	1	Set	
10)	Equipment	1	Set	
	Container crane (40T)	6	Unit	
	RTG (4+1High 6+1Wide)	15	Unit	
11)	Access Road	L=3,000	m	Early start of temporary road
12)	Channel for Cai Mep	L=237,800	m	
5	Engineering Services	1	Set	

Notes:
Red lines show the critical series of works

Figure 28.1.1 (2) Alternative Construction Schedule

28.2 Cost Estimate for the Priority Project

28.2.1 Premises of Cost Estimate

Based on the layout plans for the Priority Project discussed in the Chapter 26 and the preliminary structural designs made out in the Chapter 27, cost estimate has been carried out. The detailed quantities, which are shown in the cost estimate Table A28.2.1 and A28.2.2, have been calculated according to the preliminarily designed sections or the layout plans.

These quantities contain allowances necessary in actual works and are summarized as follows:

Table 28.2.1 Allowance Rate for Quantity

Item	Allowance Rate
Sand Filling	30% calculated Volume
Surcharge Soil	30% calculated Volume
Rubble Stone	30% calculated Volume
Concrete	1% calculated Volume
Reinforced Bar (deformed)	2% calculated Volume
Geo-textile	5% calculated Volume

The amount of the cost has been figured out using these quantities and unit costs. Dredging volume is calculated adding tolerance volume for works. (cf. Chapter 25.2.2)

Unit costs are fixed by referring with the average and prevailing costs shown in the Table 19.2.2 (Chapter19.2), data from Japanese trading companies that have the experiences of foreign trade, or cost estimate documents in the similar projects in south Vietnam.

According to the regulation, all construction projects must pay 5 % value added tax. We prepare total construction cost by adding an amount equivalent to 5% to the direct construction costs, corresponding to this tax.

As for engineering fee, there is a rate stipulated relative to the direct construction cost by the Construction Code in Vietnam, that is, to designing, cost estimate, preparing for necessary documents and supervision etc. Actual total rates vary 4 % to 5%, therefore the engineering fee has been calculated using the same rate as stipulated or actual one, and adding necessary survey fee such as topographic and bathymetric surveys, soil boring and laboratory tests, and environmental surveys as well.

The rate of contingency to the direct cost is adopted as 10%, as in similar projects in Vietnam.

Land acquisition and compensation cost are not summed up, considering that the execution organization will prepare it.

28.2.2 Result of Cost Estimate

The result of the cost estimate is summarized as shown in the Table 28.2.2. The grand total for four berths is approximately VND 3,600 billion, which is equal to USD 240 or JY 28.8 billion.

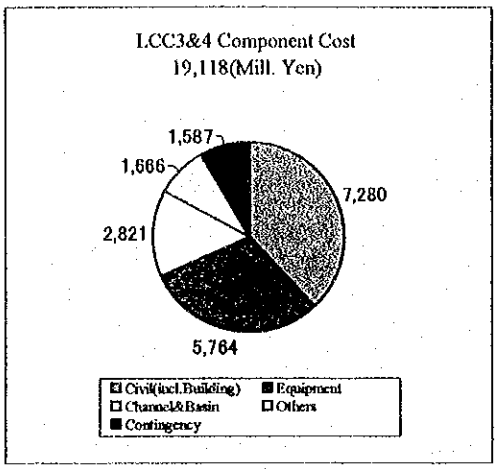
Table 28.2.2 Summary of Construction Cost for the Priority Project

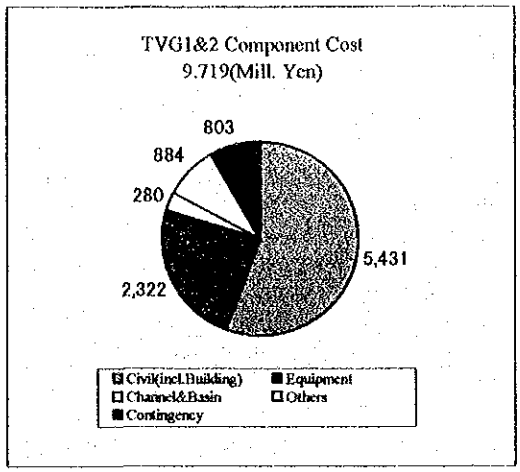
Port	Description.	No.	Cargo	Length (m)	Depth(m)	Billion VND	Million USD	Million Yen
LCC3&LCC4								
1.Container Wharf	50,000DWT	2	Container	300×2=600m	-14.0m	1,543.5	102.90	12,348
2.Access Road	W=20m	1		3,000m		87.0	5.80	696
3.Basin	600m × 50m				-14.0m	1.4	0.09	11
4.Channel	9.9 Mill. m^3			26,160m		351.3	23.42	2,810
T.V. Channel	8.1 Mill. m^3			5,600m	-14.0m	315.4	21.03	2,523
V.T. Channel	1.8 Mill. m^3			3,900m	-14.0m	35.9	2.40	287
5.Valule Added Tax	(1+2+3+4) × 5%	1				99.2	6.61	793
6.Engineering	(1+2+3+4) × 5%+Survey	1				109.2	7.28	873
7.Contingency	(1+2+3+4) × 10%	1				198.3	13.22	1,587
Total						**2,389.8**	**159.32**	**19,118**
TVG1&TVG2								
1.General Wharf	50,000DWT	2	General	300×2=600m	-14.0m	926.7	61.78	7,413
2.Access Road	W=20m			2,000m		42.3	2.82	339
3.Basin	600m × 50m				-14.0m	1.2	0.08	10
4.Channel	0.7 Mill. m^3			4,700m	-12.0m	33.8	2.26	271
5.Value Added Tax	(1+2+3+4) × 5%	1				50.2	3.35	402
6.Engineering	(1+2+3+4) × 5%+Survey	1				60.2	4.01	482
7.Contingency	(1+2+3+4) × 10%	1				100.4	6.69	803
Total						**1,214.9**	**81.00**	**9,719**
Grand Total						**3,604.7**	**240.31**	**28,837**

Note: 1) Exchange rate: VND15,000 = USD 1 = JY 120. 2) Maintenance dredging is not included.

Table 28.2.3 and Table 28.2.4 show each project cost by items such as civil works, building, utilities (water or electric power supply etc.) and equipment. Comparing with No.3&4 container 50,000DWT berths in Lower Cai Mep (LCC3&LCC4) and general 50,000DWT berths in Thi Vai (TVG1&TVG2), there is not significant difference between the costs in each item in Wharf except that of equipment. Equipment cost for two 50,000DWT general berths is about 2.3 billion yen. While those cost for two 50,000DWT container berths becomes 5.8 billion yen that is nearly triple as of general berth equipment.

The portion of equipment cost for the container berth is very high to occupy 47% of the total direct cost. While the portion of equipment cost for the general berth is rather high to indicate 31% to the direct cost. Figure 28.2.1 shows the component of the cost including the indirect cost.
The each cost breaking down in detail is shown in the Table 28.2.3 and Table 28.2.4.





Note: Indirect cost= Value Added Tax, Engineering, and Contingency

Figure 28.2.1 Components of Cost

Table 28.2.3 Cost Estimate of Lower Cai Mep International Container Terminal

A. Wharf (LCC&LCC4) 15,000VND=1USD=120Yen

No	Item	Description	Unit	Quantity	Amount of Construction Cost		
					Mill. VND	Thou. USD	Mil. Yen
1	Land Reclamation	600 × 650m	m^2	39,000	309,693	20,646	2,478
2	Dredging	Inside Quay Line	m^3	0	0	0	0
3	Pier	L=600m, B=50m	m	600	302,369	20,158	2,419
4	Trestle	20m x 90m x 2	m	360	26,691	1,779	213
5	Retaining Wall Revetment	L=600m	m	600	4,735	316	38
6	Rubble Stone Revetment	L=1,900m	m	1,900	8,981	599	72
7	Yard Construction	For 2 Berth	m^2	428,690	115,086	7,672	921
8	Buildings	For 2 Berth	m^2	20,300	33,035	2,202	264
9	Utilities	For 2 Berth	set	1	22,468	1,498	180
10	Equipment	For 2 Berth	unit	100	720,450	48,030	5,764
11	Basin	L=600m, B=50m	m^2	31,200	1,373	92	11
A	Total				1,544,881	102,992	12,360

B. Access Road for Lower Cai Mep (L=3,000m W= 20m)

No	Item	Description	Unit	Quantity	Amount of Construction Cost		
					Mill. VND	Thou. USD	Mil. Yen
1	Access Road	L=3,000m W=20	m	3,000	86,950	5,797	696
B	Total			3,000	86,950	5,797	696

C. Channel for Lower Cai Mep (L=9,500m B=310m -14.0m)

No	Item	Description	Unit	Quantity	Amount of Construction Cost		
					Mill. VND	Thou. USD	Mil. Yen
1	Channel (s15.2—s20.8)	L=5,600mB=310m-140m	Thou. m^3	8,122	315,385	21,026	2,523
2	Channel (S3.9---Vung Tau)	L=3,900mB=3150m-140m	Thou. m^3	1,796	35,920	2,395	287
C	Total	Incl. Buoy 7 sets		9,918	351,305	23,421	2,810

D. Direct Cost Total

D	(A+B+C)				1,983,135	132,209	15,865

E. Value Added Tax

E	(D×5%)				99,157	6,610	793

F. Engineering Cost

F	(D×5%+ Survey Cost)				109,157	7,277	873

G. Contingency

G	(D×10%)				198,314	13,221	1,587

H	**Grand Total**	LCC3&4			**2,389,763**	**159,318**	**19,118**

Table 28.2.4 Cost Estimate on Thi Vai International General Cargo Terminal

A. Wharf (TGV1&TVG2) 15,000VND=1USD=120Yen

No	Item	Description	Unit	Quantity	Amount of Construction Cost		
					Mill. VND	Thou. USD	Mill. Yen
1	Reclamation	600m x410m	m^2	246,000	143,038	9,536	1,144
2	Dredging	Inside Quay Line	m^3	240,000	12,720	848	102
3	Pier	L=600m, B=40m	m	600	281,834	18,789	2,255
4	Sheet Pile Wall Revetment	L=600m	m	600	72,109	4,807	577
5	Rubble Stone Revetment	L=1,440m	m	1,440	6,960	464	56
6	Yard Construction	For 2 Berth	m^2	223,250	64,730	4,315	518
7	Buildings	For 2 Berth	m^2	25,750	38,675	2,578	309
8	Utilities	For 2 Berth	set	1	16,378	1,092	131
9	Equipment	For 2 Berth	unit	112	290,250	19,350	2,322
10	Basin (-14.0m)	Within 600×50m	m^2	11,200	1,230	82	10
A	Total				927,924	61,861	7,424

B. Access Road for Thi Vai General Cargo Terminal (L=2,000m W= 20m)

No	Item	Description	Unit	Quantity	Amount of Construction Cost		
					Mill. VND	Thou. USD	Mill. Yen
1	Access Road	L=2,000m W=20	m	2,000	42,347	2,823	339
B	Total			2,000	42,347	2,823	339

C. Channel for Thi Vai (L=4,700m, B=310m, -12.0m)

No	Item	Description	Unit	Quantity	Amount of Construction Cost		
					Mill. VND	Thou. USD	Mill. Yen
1	Channel (S.00~S.7.2)	L=4,700 B=310m -12.0m	Thm m^3	663	33,828	2,255	271
C	Total	Incl. Buoy 3 sets		663	33,828	2,255	271

D. Direct Cost Total

D	(A+B+C)				1,004,100	66,940	8,033

E. Value Added Tax

E	(D×5%)				50,205	3,347	402

F. Engineering Cost

F	(D×5%+ Survey Cost)				60,205	4,014	482

G. Contingency

G	(D×10%)				100,410	6,694	803
H	**Grand Total**	TVG1&2			**1,214,920**	**80,995**	**9,719**
I	**Project Total**	LCC3&4+TVG1&2			**3,604,683**	**240,313**	**28,837**

28.2.3 Cost in Each Year

Cost for each year can be calculated according to the construction time schedule discussed in the previous section 28.1.5. For example the first year at the beginning we should need various survey and consultant fees for preparing designing of necessary facilities. As for construction works the first step is to make the temporary access roads and filling sand to the planned reclamation areas and driving VPBDs into the soft foundation. Then we can sum up these costs for the first year of our Project. As same as the first year the amount of each year can be calculated.

Table 28.2.5 and Table 28.2.6 show the amount of cost needed in each year. It can be said that these amounts regard disbursement money in each year.

As for necessary amount of fund in Thi Vai International General Cargo Berths (TVG1&TVG2) and Lower Cai Mep International Container Berths (LCC3&LCC4), they are nearly same except cost for equipment. In 2005, the cost is mainly for soil improvement works, In 2007, we need the maximum amount because we should start construction of piers and procuring cargo-handling equipments.

Table 28.2.5 Estimate of Yearly Cost for LCC3&LCC4

Unit: Billion VND

No.	Item	2003	2004	2005	2006	2007	2008	2009	2010	Total
1	Land Reclamation			176.97	44.24	88.48				309.69
2	Dredging									-
3	Pier				100.79	201.58				302.37
4	Trestle					13.35	13.35			26.69
5	Retaining Wall Revetment					3.16	1.58			4.74
6	Rubble Stone Revetment					4.49	4.49			8.98
7	Yard Construction					28.77	28.77	57.54		115.09
8	Buildings						13.21	19.82		33.04
9	Utilities						14.98	7.49		22.47
10	*Equipment*					324.20	198.12	198.12		720.45
A	Sub-total (Nos.1 to 10)			176.97	145.03	664.03	274.50	282.98		1,543.51
B	Basin							1.37		1.37
C	Access Road			14.49		72.46				86.95
D_1	Channel (Thi Vai)					114.69	114.69	86.01		315.39
D_2	Channel (Vung Tau)							35.92		35.92
E	Total Direct Cost (A to D_2)			191.46	145.03	851.17	389.19	406.28		1,983.14
F	Value Added Tax (E x 5%)			9.57	7.25	42.56	19.46	20.31		99.16
G	Engineering (incl. Surveys)	17.47	19.65	19.65	1.96	16.37	16.37	16.37	1.31	109.16
H	Contingency (E x 10%)			19.15	14.50	85.12	38.92	40.63		198.31
I	Total (Bill. VND)	17.5	19.6	239.8	168.8	995.2	463.9	483.6	1.3	2,389.8
	Total (Mill. USD)	*1.16*	*1.31*	*15.99*	*11.25*	*66.35*	*30.93*	*32.24*	*0.09*	*159.32*
	Total (Mill. Yen)	140	157	1,919	1,350	7,962	3,712	3,869	10	19,118
	Composition (%)	0.7	0.8	10.0	7.1	41.6	19.4	20.2	0.1	100

Note: Maintenance dredging cost for channels is not included.

Exchange rate : VND 15,000 = USD 1 = JY 120

Table 28.2.6 Estimate of Yearly Cost for TVG1&TVG2

Unit: Billion VND

No.	Item	2003	2004	2005	2006	2007	2008	2009	2010	Total
1	Land Reclamation			81.74	20.43	40.87				143.04
2	Dredging				12.72					12.72
3	Pier					225.47	56.37			281.83
4	Sheet Pile Wall Revetment					36.05	36.05			72.11
5	Rubble Stone Revetment					4.64	2.32			6.96
6	Yard Construction					12.95	25.89	25.89		64.73
7	Buildings						19.34	19.34		38.68
8	Utilities						10.92	5.46		16.38
9	Equipment					130.61	159.64			290.25
A	*Sub-total (Nos.1 to 10)*			81.74	33.15	450.59	310.53	50.69		926.69
B	Basin						1.23			1.23
C	Access Road			7.06		35.29				42.35
D	Channel (Thi Vai)					16.91	16.91			33.83
E	Total Direct Cost (A to D)			88.79	33.15	502.79	328.67	50.69		1,004.10
F	Value Added Tax (E x 5%)			4.44	1.66	25.14	16.43	2.53		50.20
G	Engineering (incl. Surveys)	9.63	10.84	10.84	1.08	9.03	9.03	9.03	0.72	60.20
H	*Contingency (E x 10%)*			8.88	3.32	50.28	32.87	5.07		100.41
I	Total (Bill. VND)	9.6	10.8	112.9	39.2	587.2	387.0	67.3	0.7	1,214.9
	Total (Mill. USD)	0.64	0.72	7.53	2.61	39.15	25.80	4.49	0.05	81.00
	Total (Mill. Yen)	77	87	904	314	4,698	3,096	539	6	9,719
	Composition (%)	0.8	0.9	9.3	3.2	48.3	31.9	5.5	0.1	100

Project Total

	Grand Total (Bill. VND)	27.1	30.5	352.8	208.0	1,582.5	850.9	550.9	2.0	3,604.7
	Grand Total (Mill. US$)	1.81	2.03	23.52	13.86	105.50	56.73	36.73	0.14	240.31
	Grand Total (Mill. Yen)	217	244	2,822	1,664	12,660	6,808	4,407	16	28,837
	Composition (%)	0.8	0.8	9.8	5.8	43.9	23.6	15.3	0.1	100

Note: Maintenance dredging cost for channels is not included.
Exchange rate : VND 15,000 = USD 1 = JY 120

Exactly saying, actual disbursement money is different from the figures shown in the above Tables. However, we can use the figures as preparation for disbursement money. As for container cranes, adopted unite price is referring to Panamax type cranes so that, if we need container cranes for Post-Panamax type, we might use the allocation in the contingency.

28.2.4 Maintenance Dredging Cost

According to the study in the Chapter 25.2.2, maintenance dredging cost is calculated. Unit cost for maintenance dredging is as same as that for the initial capital dredging because supposing dredgers and dumping sites are as same as those of the initial capital dredging.

Maintenance dredging works will execute once 4 years for the Thi Vai Channel (-14.0m) and once 3 years for the Vung Tau Channel (-14.0m) because of filling time by sedimentation up to –14.0m. As for the Channel for Thi Vai International General Cargo Terminal, maintenance dredging works will execute once 4 years considering filling time up to –12.0m.

The results are summarized as in the Tables 28.2.7 and 28.2.8.

Table 28.2.7 Maintenance Dredging Cost for LCC3&4

LCC3&LCC4 (-14m)

No	Item	Description	Unit	Quantity	Amount of Cost		
					Million VND	Thou. USD	Thou. Yen
A	Maintenance Dredging	1+2	m3	2,790,000	55,800	3,720	446.400
1	Thi Vai Total	**Thi Vai, Once 4years**	m3	2,420,000	48,400	3,227	387,200
	Dredging		m3	2,420,000	36,300	2,420	290,400
	Dumping		m3	2,420,000	12,100	807	96,800
2	Vung Tau Total	**Vung Tau, Once 3 yrs**	m3	370,000	7,400	493	59,200
	Dredging		m3	370,000	5,550	370	44,400
	Dumping		m3	370,000	1,850	123	14,800
B	Value Added Tax	(A)×0.05			2,790	186	22,320
C	Engineering (incl. Survey)	(A)×0.05+Survey			2,790	186	22,320
D	Contingency	(A)×0.1			5,580	372	44,640
	Total				**66,960**	**4,464**	**535,680**

Table 28.2.8 Maintenance Dredging Cost for TVG1&2

TVG1&TVG2 (-12.0m)

No	Item	Description	Unit	Quantity	Amount of Cost		
					Million VND	Thou. USD	Thou. Yen
A	Maintenance Dredging	**Once 4 years**	m3	584,000	29,200	1,947	233,600
	Dredging		m3	584,000	8,760	584	70,080
	Dumping		m3	584,000	20,440	1,363	163,520
B	Value Added Tax	(A)×0.05			1,460	97	11,680
C	Engineering (incl. Survey)	(A)×0.05+Survey			1,460	97	11,680
D	Contingency	(A)×0.1			2920	195	23,360
	Total				**35,040**	**2,336**	**280,320**

28.2.5 Currency Portions

Considering the expected source of fund, it will be needed to divide investment cost to foreign currency and local currency. These portions are calculated as the following premises:

Table 28.2.9 Rate of Foreign and Currency Portions

Item	Foreign Currency Rate (%)	Local Currency Rate (%)	Remarks
Local material			Vietnam is importing oil product because of no oil refinery so far. When producing local material oil products (almost all is fuel) are consumed.
sand, gravel, rubble stone,	5	95	
bricks concrete,	5	95	
reinforced bar	5	95	
Imported material			We need foreign currency when importing, Transportation needs local currency but portion is negligibly small comparing material cost
steel pipe or sheet pile	100	0	
anchor pile, other steel	100	0	
rubber fender	100	0	
Equipment			Equipment is imported. When transporting and installing these equipment, local currency is needed
container crane	99.8	0.2	
tractor or others	99.8	0.2	
Works			All works need fuel for construction machines and equipments and work vessels. These construction machines, equipments and dredgers were imported from foreign countries. Usually these costs can be counted as leasing or rental fees. However foreign currency shall be reflected. As for pavement asphalt or local material are needed. Gate houses include foreign made weigh bridges.
soil improvement(VPBD)	80	20	
pile Driving	15	85	
dredging	15	85	
pavement	10	90	
building	20	80	
gate house	5	95	
others			
utilities			
water & power supply	10	90	Water or power supply facilities, need some parts imported.
drainage and sewage	5	95	
Engineering	80	20	Man months for expatriate engineers are foreign currency.

Using each detail currency portion rate above mentioned, amount of foreign and local currency by items are calculated then summed up.

Large items of foreign and local currency or average currency rates are calculated as in the Table 28.2.10 and 28.2.11.

These tables show necessary amounts of cost by foreign currency and local currency for the Feasibility Study Project.

Table 28.2.10 Currency Portions for LCC3&LCC4

No.	Item	Unit	Quantity	F. Currency	L. Currency	Total	F. Currency Rate(%)	L. Currency Rate(%)
				1,000 Yen	Million VND	Million VND		
1	Land Reclamation	m2	390,000	1,106,677	171,358	309,693	44.7	55.3
2	Dredging	m3	0	0	0	0	15.0	85.0
3	Pier	m	600	1,896,390	65,321	302,369	78.4	21.6
4	Trestle	m	90	143,231	8,787	26,691	67.1	32.9
5	Retaining Wall Revetment	m	600	2,852	4,379	4,735	7.5	92.5
6	Rubble Stone Revetment	m	1,900	7,838	8,001	8,981	10.9	89.1
7	Yard Construction	m2	428,690	92,069	103,577	115,086	10.0	90.0
8	Buildings	m2	20,300	17,804	30,810	33,035	6.7	93.3
9	Utilities	Set	1	15,553	20,524	22,468	8.7	91.3
10	Equipment	Unit	100	5,752,073	1,441	720,450	99.8	0.2
A	Total			9,034,486	414,197	1,543,508	26.8	73.2
B	Basin	m3	31,200	1,647	1,167	1,373	15.0	85.0
C	Access Road	m	2,000	213,379	60,277	86,950	30.7	69.3
D_1	Channel (Thi Vai)	m3	8,122,000	378,462	268,075	315,385	15.0	85.0
D_2	Channel (Vung Tau)	m3	1,796,000	43,104	30,532	35,920	15.0	85.0
E	Direct Cost $(A+B+C+D_1+D_2)$			9,671,078	774,248	1,983,135	39.0	61.0
F	Value Added Tax(E×0.05)			483,554	38,712	99,157	39.0	61.0
G	Engineering (incl. Survey)			699	17,465	109,157	80.0	20.0
H	Contingency (Ex0.1)			967,108	77,425	198,315	39.0	61.0
I	Grand Total			11,122,438	907,850	2,389,763	38.0	62.0

Note : VND 15,000 = JY 120

Table 28.2.11 Currency Portions for TVG1&TVG2

No.	Item	Unit	Quantity	F. Currency	L. Currency	Total	F. Currency Rate(%)	L. Currency Rate(%)
				1,000 Yen	Million VND	Million VND		
1	Land Reclamation	m2	246,000	381,935	95,296	143,038	33.4	66.6
2	Dredging	m3	240,000	15,264	10,812	12,720	15.0	85.0
3	Pier	m	600	1,783,687	58,873	281,834	79.1	20.9
4	Sheet Pile Wall Revetment	m	600	402,460	21,802	72,109	69.8	30.2
5	Rubble Stone Revetment	m	1,440	5,961	6,215	6,960	10.7	89.3
6	Yard Construction	m2	223,250	51,784	58,257	64,730	10.0	90.0
7	Buildings	m2	25,750	20,024	36,172	38,675	6.5	93.5
8	Utilities	L.S	1	11,114	14,989	16,378	8.5	91.5
9	Equipment	Unit	112	2,317,356	581	290,250	99.8	0.2
A	Total			4,989,585	302,996	926,694	32.7	67.3
B	Basin	m3	23,200	1,476	1,046	1,230	15.0	85.0
C	Access Road	m	2,000	20,149	39,828	42,347	5.9	94.1
D	Channel (Thi Vai)	m3	663,000	40,594	28,754	33,828	15.0	85.0
E	Direct Cost (A+B+C+D)			5,051,804	372,624	1,004,100	37.1	62.9
F	Value Added Tax(E×0.05)			252,590	18,631	50,205	37.1	62.9
G	Engineering (incl.Survey)			385	9,633	60,205	80.0	20.0
H	Contingency (Ex0.1)			505,180	37,262	100,410	37.1	62.9
I	Grand Total			5,809,960	438,151	1,214,920	36.1	63.9

Note: VND 15,000 =JY 120

Chapter 29 Investment Plan

29.1 Stage-wise Development

The scale of development affects the viability of a port development project, in particular at the first stage of the development. Special attention should therefore be paid to the scale of economy. An industrial port usually has a base cargo and can invite regular ship calls. Industrial development projects in the hinterland may bear part of the port construction cost. However, a commercial port has no guarantee of regular ship calls. The initial stage development plan should therefore be carefully designed from the viewpoint of the scale of initial investment and the timing of completion of the project.

From the short term development plan components, the Study Team and the MOT and VINAMARINE selected certain projects in order of necessity. Two container terminals in Cai Mep and two general cargo terminals in Thi Vai were selected for a priority project package in the year 2010.

Stage-wise development plan of Cai Mep - Thi Vai International Port is shown in Figure30.1, in which the construction works start from the berth LCC-3 in Cai Mep International Container Terminal. The construction works for the other three berths (LCC-4, TVG-1, and TVG-2) also start consecutively. Dredging of channel up to the berth LCC-3 will be carried out up to -12m and be deepened to -14m at the next stage. The channel between the berth LCC-3 and TVG-1 will be dredged t o -12m.

Investment schedule of each berth is planned to cover the cargo throughput demand as shown in Figure 31.2. Since Cai Mep is a new international container terminal, there is no basic cargo for the terminal and consequently the development of the terminal should be carefully examined. The selected project package should be further studied.

29.2 *Investment Plans*

The investment plans for the Cai Mep-Thi Vai International Port are as follows

(1) Cai Mep International Container Terminal

After evaluating various development and management systems, a lease system is recommended for the development of the new container terminal. VINAMARINE will invest in infrastructure and quay gantry cranes. Investment in superstructure, such as cargo handling equipment and buildings, should be done by the private sector.

(2) Thi Vai International General Cargo Terminal

Multi purpose berth is public infrastructure for various users and should be constructed by VINAMARINE. It should be examined whether it is feasible to construct two general cargo terminals by 2010 from the aspect of the available loan scale and the results of the financial analysis

(3) Navigation Channel

Navigation channel is basic public infrastructure for various users and should be constructed by VINAMARINE.

(4) Access Road

Access road is essential infrastructure for port activities and should be constructed by VINAMARINE. But it is highly possible that this access road will become a toll road.

Figure 29.1 Investment Plan

Area	Vessel	Terminal		-2010			-2020
Cai Mep	50,000DWT	LCC3	LCC4	160			
	50,000DWT	LCC5	LCC6		130		
	50,000DWT	UCC2	UCC1			130	
	80,000DWT	LCC2	LCC1				200
Thi Vai	50,000DWT	TVG1	TVG2	80			
	50,000DWT	TVG3	TVG4		40	40	
	50,000DWT	TVG5	TVG6				80
Total				240	170	170	280

Mill. USD

Figure 29.2(1) Cai Mep Int. Container Terminal

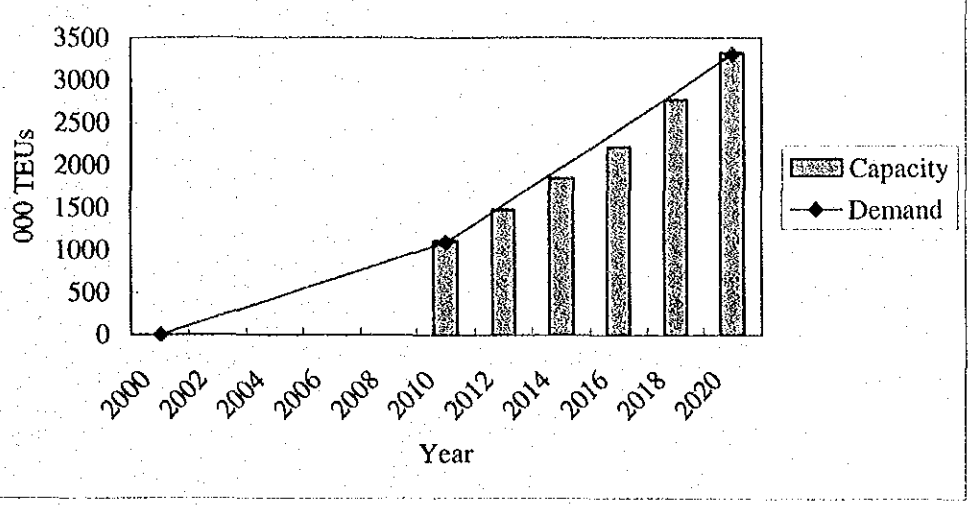
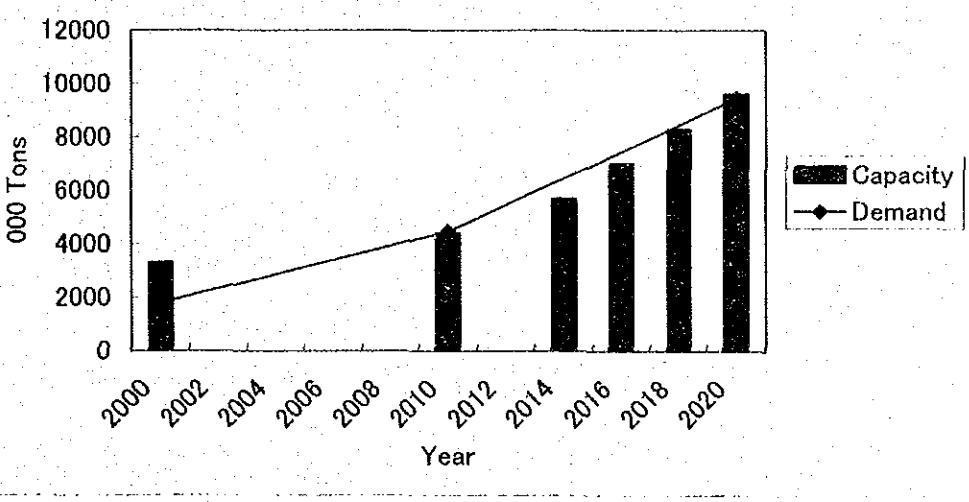


Figure 29.2(2) Thi Vai Int. General Terminal



Chapter 30 *Economic Analysis*

30.1 Introduction

This chapter presents the results of evaluation of the economic viability of Vietnam's major port development project in the south, which has been selected and determined as the priority project package through relevant master plan study and the results of a series of dialogues with executing agencies and the concerned organizations.

(1) Physical Outline

The Project involves the construction of container berths at Lower Cai Mep and the general cargo berths at Thi Vai area including the provision of all necessary equipment for cargo handling, port operation and maintenance of all project components. The brief composition of the Project is tabulated in Table 30.1 below.

Table 30.1 Outline of the Project

Project Name	Cargo	Maximum Size of Vessel per Berth	Number of Berth	Reference Number	Development Schedule
Lower Cai Mep	Container	50,000 DWT	2 berths	LCC-3, 4	2006-10
Thi Vai International	General	50,000 DWT	2 berths	TVG-1, 2	2006-10

(2) Operational Outline

The Project's construction work is planned to commence in 2006 and complete in 2010. The cargo volume projected by cargo type for each project site is assumed as shown in Table 30.2 below:

Table 30.2 Cargo Volume

Type of Cargo	Year 2010	Year 2020
Container Cargo	6.0 million tons	7.4 million tons
General Cargo	1.1 million tons	1.9 million tons

30.2 Prerequisite

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 and NPV. Various conditions are determined to arrive these indices of economic analysis as follows:

(1) General

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

a. Investment plan period
b. Design and construction period
c. Project commissioning year
d. Currency
e. Standard conversion factor

1) Investment Plan Period

The investment plan period is defined as the total period from the start of the cost stream to the end of the benefit stream. The cost stream is assumed to start with the Project's detailed design. The investment plan period for a project is determined to be 40 years. During this period, the cost and benefit are recorded annually over the whole period separately for each project component.

2) Design and Construction Period

After the completion of financial arrangement and detailed design of the Project, the tender is called and the contract is awarded to the selected contractors for execution of the required works. The necessary period of detailed design is estimated at one (1) year. The construction period, which will start from the contract is awarded to the completion of each project component (except channel dredging work) is estimated at five (5) years. Thus, the total period for design and construction is assumed at six (6) years for each planned port. The required period to complete the channel dredging works is estimated at two (2) years.

3) Project Commissioning Year

It is assumed that the construction works of the selected berths will commence in 2004 and finish by the end of 2009. After the berths are completed cargo-handling operations will commence immediately.

4) Currency

The currency used in the economic evaluation is US Dollar. One US Dollar is equivalent to 15,000 Vietnam Dong as of June 2002.

5) Standard Conversion Factors

The standard conversion factor applied in this study is 0.85 based on an analysis conducted as part of the master plan study.

(2) Economic Cost

1) Cost Estimation

The details of the cost estimate in financial (market) price are to be referred with the relevant chapter of this report. The estimated economic costs of the Project are summarized as shown in Table 30.3.

2) Engineering Cost

The engineering cost, which includes that of detailed design, consultancy services, construction supervisory services, etc. is estimated at five (5) percent of the total net capital investment cost and included in the construction cost.

3) Physical Contingency

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.

30.3 Assumptions

(1) Capital Investment Amount

The estimated capital investment amount in financial price is to be referred with Chapter 29 of the report for its details. These are converted into economic price using the standard conversion factor of 0.85. Table 30.3 below summarizes the capital investment amount by each project port, which is capable to berth either 50,000 DWT container vessels or 50,000 DWT general cargo vessels.

The capital investment amount for the capital dredging of the channel is divided proportionately in indicated percentage for each channel, which are equal to the share of cargo volume planned to be handled by the Project in the total cargo volume planned to be handled in the area of the Cai Mep – Thi Vai International Port group by year 2020 in total. (Refer Table 13.5.1 of the Master Plan Study).

(2) Annual Operation Cost

The average cargo handling and port operation cost per metric ton of general cargo handled is determined at US$1.88 at market price. Then, it is converted to the economic price (conversion factor: 0.85) as US$ 1.60 per ton. Then, the annual operation cost to handle the general cargo is obtained by applying this unit rate to the projected cargo volume in subject year.

The average cargo handling and port operation cost per metric ton of container cargo is assumed as US$ 4.23 at market price. Then, it is converted to the economic price as US$ 3.60 per ton (or US$ 36 per TEU). Then, the annual operation cost to handle the general cargo is obtained by applying this unit rate to the projected cargo volume in subject year, as well.

Table 30.3 Project Cost

Unit: US$ Million

Project Port	In Financial Price	In Economic Price	Remarks
A. Cai Mep International Container Terminal (Priority Package)			
Container Berth	83.7	71.1	2 x 50000 DWT
Equipment	68.4	58.1	
Access Road	7.0	6.0	
Sub-total (A)	159.1	135.2	
B. Thi Vai International General Cargo Terminal (Priority Package)			
General Cargo Berth	51.3	43.6	2 x 50000 DWT
Equipment	23.5	20.0	
Access Road	3.4	2.9	
Basin	0.2	0.2	
Sub-total (B)	78.5	66.7	
C. Channel Dredging			
Thi Vai Channel	2.7	2.3	40%[1]
Cai Mep Channel	28.5	24.2	44%
Gan Rai Bay Channel	2.9	2.5	54%
Sub-total (C)	34.1	29.0	
Grand Total	271.7	230.9	

Note: See details Chapter 29 of this report.

(3) Annual Maintenance Cost

1) Berth and Equipment

The annual maintenance cost of the different project components is assumed to be a percentage of relevant capital investment cost as shown in Table 30.4. The percentage of maintenance cost of berth and equipment is based on standard rates commonly applied in evaluating similar projects.

Table 30.4 Annual Maintenance Cost for Berth and Equipment

Component	*Percentage in Total Capital Investment Amount*
Berth	1 %
Equipment	4 %

Source: JICA Study Team

2) Maintenance Dredging

The annual cost of maintenance dredging is based on the detailed analysis of the design and cost estimate for the channel as discussed in Chapter 29 of this report. The percentage of the maintenance dredging is obtained by dividing the volume of capital dredging by the volume

estimated for the maintenance dredging for each channel. The percentage of volume or cost for the maintenance dredging for each channel are estimated and divided in four (4) as the maintenance dredging is planned to be carried out each four (4) years after the completion of the channel dredging for such cost is estimated on constant basis for each year in this economic analysis. Their percentage of volume or cost in capital dredging volume or cost for each channel are tabulated in Table 30.5 below:

Table 30.5 Annual Maintenance Cost for Channel

Terminal	Name of Channel	Share	Cost (US$ Million)
LCC	Thi Vai River Approach Channel	6.4 %	0.930
TVG	Thi Vai Channel	4.0 %	0.639
LCC+TVG	Combination of both channel	5.9 %	0.969

Source: JICA Study Team, Chapter 20 of this report.

(3) Economic Benefit

The benefits are estimated based on a comparison of the Project's "With Case" and "Without Case". The quantifiable benefits applied for the economic analysis are as follows:

A. Reduction in vessel's waiting time due to the increased port capacity;
B. Net saving in land transport (trucking or hauling) cost
C. Net saving of vessel's time cost by eliminating channel navigation;
D. Reduction of material loss and expenditure associated with maritime accidents;

1) Method to Obtain Economic Benefit

The Project's economic benefits are analyzed and obtained per ton of cargo so as to facilitate the economic analysis of specific port development plan within Thi Vai – Cai Mep area. All the data used for the preparation of the Master Plan were reviewed and the benefit stream of the Project was analyzed by each factor, which derives the economic benefit of the Project as follows.

A. Reduction of Vessel Waiting Time

The probable cost of vessel waiting time in existing port group in Ho Chi Minh City was estimated up to year 2010 assuming that no expansion of cargo handling capacity of those port. As no vessel waiting time is expected in the project port to handle the same volume of cargo, such cost is totally regarded as the economic benefit of the project. The cargo volume projected for 2010 – 2020 by type of cargo (See Appendix-30.1) was allocated to each major port in Ho Chi Minh City in proportionate to the cargo handling capacity of each port so as to obtain the waiting time and relevant value of ship cost at each port. The annual waiting time at each port is estimated based on the projected berth utilization ratio and standard conversion rate (See Appendix 30.2 Average Waiting Time of Ship in Queues). The value of waiting time is obtained by multiplication of ship value per day on annual waiting time of ships at each port. (See Appendix 30.3 for details).

The formula used for this analysis is as follow:

$$ASVWT_{t1} = (VWTO_{t1} - VWTW_{t1}) \times DVC$$

Where;

$ASVWT_{t1}$	= annual saving cost from reduction in vessel's waiting time in year t1
$VWTO_{t1}$	= waiting time of vessel in days under Without Project Case
$VWTW_{t1}$	= waiting time of vessel in days under With Project Case
DVC	= daily vessel cost

B. Saving of Land Transport Cost of Trucking for 2010 – 2020

The cargo handled at the port is transported to and from the inland container depot or major location where such cargo is generated or destined or collected for further haulage. The land transport cost associated with the port cargo is projected for 2010 – 2020 in two assumed cases. The one assumption is that the cargo will be transported to and from the center of Ho Chi Minh City to Long Thanh along National Road 51 (Distance 110 km per round trip). The other assumption is that the cargo will be transported to and from Cai Mep project site to the nearest junction of National Road 51 (Distance 6.5 km). The economic cost of land transport is obtained based on the Vehicle Operation Cost (VOC) estimated per each type of truck used for container and general cargo transport (See Appendix 30.4). The difference of cost between two assumed cases is considered as the economic benefit to the Project (See Appendix 30.5)

The formula used for this analysis is as follow:

$$ASTC_{t1} = (V_{t1}*(TDCO - TDCP)*(DO-DP)+V_{t1}*((TTCO*DO/SO)-(TTCP)*DP/SP))*D$$

Where;

$ASTC_t$	= saving in land transport cost in year t
V_t	= cargo volume for land transport in year t
TTCO	= trucking time cost to and from Ho Chi Min Port Group in minute
TDCO	= trucking distance cost to and from Ho Chi Min Port Group in minute
TTCP	= trucking time cost to and from the project port group
TDCP	= trucking distance cost to and from the project port group
DO	= distance between Ho Chi Min Port Group and ICD in km
DP	= distance between Ho Chi Minh Port Group and ICD in km
SO	= speed per hour in km for DO
SP	= speed per hour in km for DP
D	= working days per year

C. Saving from Reduction of Ship Time for Channel Navigation

The distance of channel navigation and average vessel size differs between the existing port and the Project port. The difference of channel navigation cost is estimated carefully taking into

account of such factors as distance and necessary navigation time (See Appendix 30.6).

The formula used for this analysis is as follow:

ASC_{t1} =
$(VCt/LOc*TOc*SCOc+VGt/LOg*TOg_1*SCOc_1)-(Vgt/LPc*TPc*SCPc+Vgt/LPg*TPg_2*SCPg)$

Where;

ASC_t	= annual saving channel navigation in year t
VC_t	= container cargo volume for channel navigation in year t
VGt	= general cargo volume for channel navigation in year t
LOc	= cargo lot per container vessel for existing channel
LOg	= cargo lot per general cargo vessel for project channel
TOc	= time required by container vessel for existing channel in hour
TOg	= time required by general cargo vessel for existing channel in hour
TPc	= time required by container vessel for project channel in hour
TPg	= time required by general cargo vessel for project channel in hour
SCOc	= current container vessel's ship cost per hour
SCOg	= current general cargo vessel's ship cost per hour
SCPc	= projected container vessel's ship cost per hour
SCOg	= projected general cargo vessel's ship cost per hour

D. Average Annual Damage of Maritime Accident

It is expected that the Project will eliminate the maritime accident. The average annual damage or cost of maritime accident is estimated based on the past record of the maritime accident occurred in the existing channel (See Appendix 30.7). The saved annual damage in average per year is estimated as US$ 2.5 million.

2) Economic Benefit of the Project per Ton of Cargo

The economic benefits derived from the Project are based on analysis conducted for the master plan study. The economic benefit by factor is estimated for each year for 2010-2020 by type of cargo. The estimated economic benefit for each year by factor is divided by the cargo volume of respective year to obtain the economic benefit per ton of cargo by type for each year. These benefits are summarized in terms of its value per ton by type of cargo in 2010, 2015 and 2020 as shown in Table 30.6 (See details in Appendix 30.8).

As shown Table 30.6, the economic benefit relative to non-containerized cargo or general cargo is substantially higher than that of containerized cargo in terms per ton of cargo handled. The reason why the economic benefit per ton of non-containerized cargo is larger than that of containerized cargo is discussed in subsequent section.

Table 30.6 Economic Benefit per Ton of Cargo

Year	Combined Benefit (US$/ton)		
	Container	Non-cont.	Combined
2010	2.30	16.57	18.87
2015	7.92	19.50	27.42
2020	10.22	17.20	27.42

Source: JICA Study Team

3) Composition of Economic Benefit

The share of the total economic benefit derived from the saving of vessel's waiting time through the period 2010 - 2020 is approximately 84.7 % of the total combined economic benefit of the same. The share of the total economic benefit derived from the channel navigation, the maritime accident and trucking (haulage) are 3.3 %, 0.9 % and 11.1 %, respectively. This implies that the economic benefit derived from the vessel's waiting time is a dominant factor of the result of economic analysis.

The share of the economic benefit relative to non-containerized cargo in the total economic benefit derived from the vessel's waiting time accounts for 44 % and the same of containerized cargo accounts for 40 %. However, the share of non-containerized cargo in terms of cumulative volume through the period 2010 - 2020 accounts for 25 %, however, the same of containerized cargo accounts 75 % of the cumulative cargo volume. This is the reason why the economic benefit relative to non-containerized cargo is much higher than that of containerized cargo.

The berth occupancy ratio of container terminal should not exceed 1.0, however, that of general cargo berth would exceed or very close to 1.0 unless a substantial expansion of berth is executed. This is the reason why; the cost associated with the vessel's waiting time of general cargo is larger than that of containerized cargo. In this study, a substantial expansion of the existing berth both for containerized and non-containerized cargo are considered taking into account of the existing future expansion plans but not sufficiently to meet with a growing cargo volume to be handled, therefore, the vessel's waiting time increases year by year from 2005 and beyond especially in the general cargo berth. If such expansion is to be considered perfectly, then, the capital investment for such expansion should be counted equal to the direct economic benefit of the project as whole.

30.3 Result of Economic Analysis

(1) Economic Viability Indicators

The economic viability evaluation of the Project was carried out for each project port, namely Lower Cai Mep International Container Terminal (LCC) and Thi Vai International General Cargo Terminal (TVG), using the economic benefit per ton as mentioned in the previous section, separately and in combination as shown below in Table 30.7. (See Appendix 30.9 for details)

Table 30.7 Economic Viability Indicators

	LCC+TVG	LCC Alone	TVG Alone
EIRR	15.2 %	11.8 %	20.5 %
NPV at 10 % D.R. (US$ Million)	136.9	34.4	88.2
B/C at 10 % D.R.	1.40	0.82	1.44

Source: JICA Study Team

(3) Conclusion

As shown in the above table, both cases of a combination of LCC and TVG terminal exceeds the minimum EIRR rate of 10% and B/C rate of 1.0. Therefore, the project of the Lower Cai Mep International Container Terminal combined with the Thi Vai International General Cargo Terminal is considered competitive and feasible from the national economic viewpoint. However, if LCC is developed independently without TVG's general cargo terminal, B/C shows less than 1.0 therefore it can be evaluated as negative.

Judging from the preceding results, it is evident that increased handling capacity of general cargo improves the Project's economic viability. The reason of this result is clear because the economic benefit relative to general cargo is higher than that of container cargo as shown in Table 30.5. This result implies that the development of the general cargo terminal is quite important and indispensable to make the project envisaged in the Master Plan more feasible and meaningful in view of national economy.

Chapter 31 Financial Analysis

31.1 Objective and Methodology of Financial Analysis

(1) Objective

The purpose of the financial analysis is to evaluate the financial feasibility of the project (The project means the priority project at Cai Mep-Thi Vai in this chapter.). When evaluating the financial viability of the project, financial soundness of the executing agency, which is a New Port Management Body is also assessed.

(2) Methodology

(a) Viability of the project

The viability of the project is analyzed using the Discount Cash Flow Method and appraised by the Financial Internal Rate of Return (FIRR). The FIRR is the discount rate that makes the discounted costs and revenues over the project life equal, i.e., the rate "r" that satisfies the following formula:

$$\sum_{i=1}^{n} = \frac{Bi - Ci}{(1+r)^{i-1}} = 0$$

Where, n : Project life,
Bi : Revenue in the i-th year : the first year is the base year,
Ci : Cost in the i-th year
r : Discount rate.

The revenues and costs which are taken into account for the FIRR calculation are summarized in Table 31.1.1. The revenue and cost items excluded from the FIRR calculation are also summarized in Table 31.1.2. When the calculated FIRR exceeds the weighted average interest rate of the total funds for the investments of the project, that project is regarded as financially feasible.

Table 31.1.1 Revenues and Costs Employed in the FIRR Calculation

Revenues	Costs
1) Operating revenues by the project	Investments for the project. (Including re-investment for the project, installation of handling equipment and replacement/overhaul of Equipment) 2) Operating expenses such as maintenance, repair, rental, personnel and *administration costs*

Table 31.1.2 The Revenues and Costs Exempted from the FIRR Calculation

Revenues	Costs
1) Fund management income	1) Depreciation cost 2) Repayment of the loan principal 3) Interest on loans

(b) Financial soundness of the executing agency of the project

The financial soundness of the executing agency of the project is appraised based on its projected financial statements (Profit and Loss Statement, Cash Flow Statement and Balance Sheet). The appraisal is generally made from the viewpoint of profitability, loan repayment capacity and operational efficiency, using the following formula:

1) Profitability

Rate of Return on Net Fixed Asset :

$$\frac{\textit{Net Operating Income}}{\textit{Total Fixed Assets}}$$

This indicator shows the profitability of the investments in terms of Net Fixed Assets. It is necessary to keep the rate higher than the average interest rate of various funds for investments, which have different interest rates.

2) Loan repayment capacity

Debt Service Coverage Ratio :

$$\frac{\textit{Net Operating Income + Depreciation Cost}}{\textit{Repayment and Interest on Long-term Loans}}$$

This indicator shows whether the operating income can cover the repayment of both the principal and the interest on long-term loans. The ratio should be higher than 1.0 and is desirable to be higher than 1.75 (World Bank recommendation).

3) Operating Efficiency

(i) Operating Ratio :

$$\frac{\textit{Operating Expenses}}{\textit{Operating revenues}}$$

(ii) Working Ratio :

$$\frac{\textit{Operating Expenses} - \textit{Depreciation Expenses}}{\textit{Operating Revenues}}$$

The Operating Ratio shows the operational efficiency of the organization as an enterprise, while the Working Ratio shows the efficiency of the routine operations. When the Operating Ratio is less than 70~75% and the Working Ratio is less than 50~60%, the operation of the organization is assessed to be efficient.

31.2 Assumption for Financial Analysis

(1) Scope of Analysis

The viability of the project is assessed using the revenues and costs related to the project. It is also assumed that a New Port Management Body will construct the new container terminal at Cai Mep-Thi Vai, and that it will lease out the new container terminal to private organizations based on the PSP policy. Thus, the investment by the New Port Management Body will be confined to the following :

- All infrastructure construction work of the new container terminal at the Cai Mep-Thi Vai International Port, including capital dredging of the access channel.
- Procurement of quayside gantry cranes for the new container terminal.
- Construction of port access roads to the new terminal.
- Maintenance dredging of the access channel.

(2) Base Year

Price as of year 2001 is used in this financial analysis. Price escalation due to inflation for the future is not considered.

(3) Project Life

Taking account of conditions of the long-term loans and service lives of port facilities, the project life for the financial analysis is determined as 30 years after the completion of the project.

(4) Cargo Handling Volume

To estimate revenues to be generated from both Cai Mep and Thi Vai new port, volumes of cargo shown below (Table 31.2.1) are used in the financial analysis.

Table 31.2.1 Future Cargo Volume to be used in Financial Analysis

Year	Container Cargo at Priority Project Port (1,000 TEU)	General Cargo at Priority Project Port (1,000 ton)	Remarks
2010	550	1,100	
2011	600	1,200	Container cargo demand at Priority Project Port in 2011 has reached to the cargo handling capacity, and cannot surpass it.
2012	600	1,300	General cargo demand at Priority Project Port in 2012 has reached to cargo handling capacity, and cannot surpass it.
2013 to 2039	600	1,300	

(5) Fund Raising

It is assumed that 85 % of the total project cost is financed by foreign funds. The remaining 15 % of the total cost is assumed to be raised by domestic funds. The following conditions are employed for each fund in this financial analysis.

1) Foreign Fund

The foreign loan conditions are assumed as follows :

- Loan period : 30 years
- Grace period : 10 years
- Interest rate : 1.8 % per annum
- Repayment : Fixed amount repayment of principal
- Ratio of investment : Less than 85 % of the project cost

2) Domestic Fund

The domestic loan conditions are assumed as follows :

- Loan period : 10 years
- Interest rate : 15.0 % per annum
  (The real interest rate excluding inflation rate)
- Repayment : Fixed amount repayment of principal

3) Weighted Average Interest Rate of New Port Authority

The weighted average interest rate of the funds for investments is 3.78 % per annum under the loan conditions stated above. (1.8 * 0.85 + 15.0 * 0.15 = 3.78)

4) *Interest rate of Private Sector (Terminal Operator)*

- 20 % (It is assumed with reference to the Manila Port's interest rate of the private sector.)

(6) Port Tariff

Revenues for the project will be generated from receiving vessels and handling cargoes charged based on the port tariff. The Study Team will take the following assumptions for determining the future container port charge at Cai Mep-Thi Vai.

1) The existing Ho Chi Minh Port Group will continue to keep the present port tariff during the loan period. .
2) Containers handled at Cai Mep New Container Terminal will be shared equally between 40 feet and 20 feet containers. It is also assumed that both 40 feet and 20 feet containers will include 25 % empty containers.
3) The Cai Mep New Container Terminal will adopt the same tariff as that of the Ho Chi Minh Port Group. (Table 31.2.2 to Table 31.2.7)

Table 31.2.2 Maritaime Charges at the existing Ho Chi Minh Port Group

(Unit : US Dollars / GRT)

	Rate
Tonnage Dues	0.085
Maritime Safety Charges	0.24

Table 31.2.3 Wharfage Dues

	Rate
Wharfage for vessel	0.0035 / US Dollars / GRT- hour
Wharfage for cargo	0.30 US Dollars / ton

Table 31.2.4 Container Cargo Stevedoring Charge at the existing Ho Chi Minh Port Group

(Unit : US Dollars / box)

Container Type	20 feet or smaller	40 feet	Over 40 feet
With cargo (Holds, barge - warehouse, yard or contrary.)	57	85	127
Empty (Holds, barge - warehouse, yard or contrary.)	34	50	80
With cargo (Warehouse, yard – wagon, truck, barge or contrary.)	23	35	53
Empty (Warehouse, yard – wagon, truck, barge or contrary.)	15	23	34

Table 312.5 General Cargo Stevedoring Charge at the existing Ho Chi Minh Port Group

(Unit : US Dollars / ton)

Handling	Bulk Cargo	Bagged Cargo	Goods in Case	Machines, equipment, steel and metal
Holds, barge – store, yard or contrary	2.90	3.66	4.74	5.14
Store, yard – wagon, truck or contrary	0.73	0.90	1.27	1.32

Table 31.2.6 Container Cargo Storage Charge at Ho Chi Minh Port Group

(Unit : US Dollars / box / day)

Container Type	20 feet or smaller	40 feet	Over 40 feet
With cargo	2.0	3.0	4.5
Empty	1.0	1.5	2.3

Table 31.2.7 General Cargo Storage Charge at Ho Chi Minh Port Group

(Unit : US Dollars / ton / day)

	Warehouse	Yard
All Types of General Cargo	0.2	0.1

(7) Leasing Policy

1) Lease Contract

There are several types of a lease contract. The Lease contract basically consists of 6 terms, which include a) Duration, b) Leased facilities, c) Land concessions, d) Lease fee, e) Tariff adjustment and f) Specific conditions.

a) Duration.

Long-term contract will enable a port management body to be financially stable. However, long-term contract will not assure the flexibility of financial fluctuation. When cargo handling volume is predicted to steadily grow toward a long-term future, the lease contract should be concluded in the long run. In order to avoid the inability of response to changing international shipping market, lease contract is reviewed at regular intervals even if the long-term contract is concluded.

b) Leased facilities

When a lease type Private Sector Participation (PSP) is adopted, wharves and yards are basically leased to a terminal operator. It depends on the PMB's leasing policy whether quayside container cranes are also leased or not. In general, leased quayside cranes will make a terminal operator bear the less business risk. However, leased quayside cranes will not provide a terminal operator with no chance to choose the best quayside crane system for loading/unloading activities of containers.

c) Land concessions

In many cases, land concessions are not given to a terminal operator when a lease contract is concluded. In case that land concessions are the prerequisite of PSP contract, the lease contract should be transformed into a concession contract. In general, a terminal operator will gain much more benefit from land concessions, which enable the terminal operator to develop the land there to seek another business chance. At the same time, the more rent by PMB will be imposed than in case of the simple lease contract.

d) Lease fee

Lease fee is to be agreed by both parties in the same manner as other contract items, based on both side's financial viability. In other words, lease fee has a trade-off relation between PMB and a terminal operator. The more the lease fee is, the more prosperous a lessor is, but the higher a lessee's financial risk becomes. In many cases, the baseline lease fee is determined as the same amount as all investment and maintenance cost plus related managerial expenditures divided by duration years.

e) Tariff adjustment

Tariff adjustment should be appropriately carried out at regular intervals to catch up with the changing container market's trend. In this sense, tariff adjustment should be defined within the overall lease contract. On the other hand, tariff must be maintained in accordance with the nationwide port tariff structure. Therefore, PMB plays an important role to determine the level of tariff at port, being assisted by the central government.

2) Case Study on Typical Container Ports in Southeast Asia

The Study Team studied the actual lease contract at typical container ports in the Southeast Asia. As shown in Table 31.2.8, lease contract differs at each port. But, the difference lies within a certain extent.

Table 31.2.8 Lease Contract at Typical Container Port in Southeast Asia

Terms of Contract	*A Port of the Philippines*	*A Port of Indonesia*	*A Port of Thailand*
Duration of Lease	10 Years, then 10 Year Extension	20 Years	25 years, but rearranged in every 5-6 years.
Leased facilities and Equipments at Port	Wharf, Paved Yard and Quay side Cranes.	Wharf, Paved Yard and Quay side Cranes.	Wharf, Paved Yard and Quay side Cranes
Land Concessions	Nothing.	Nothing.	Nothing.
Lease Fee	A certain amount of fixed lease charge.	10% of Preceding Month Port Revenue	A certain amount of fixed lease charge.
Monetary Contract Other Than Lease Fee	No.	No.	If cargo volume is greater than a certain amount, some percent of revenues should be paid for PMB.
Tariff Adjustment	Negotiable.	Every 2 Years	Negotiable, but not always agreed between the lessor and the lessee.
Main Agreement Bodies		IPC2 and Grosbeak PT.Hong Kong Ltd.	Joint Venture (Nihon Yusen Included)
Other Specific Conditions, in particular.			There is a penalty, if cargo handling volume is decreased below a certain amount.

Cf.. Lease fee tends to go up when the time passes away. Because, the early time of the operation has a fewer customers, thus the port revenue is less.

Based on the above case study, the following five points are summarized regarding a lease contract of container terminals in the Southeast Asia.

a) Duration ranges from 10 to 25 years. The short-term contract always contains the opportunity for the lessee to extend the contract.

b) Land concessions are not granted at each port.

c) Lease fee is determined by two kinds of way. Some port has the fixed lease fee, another port has the lease fee equal to the percentage share of port revenue. In case of the fixed lease fee, some percentage share of port revenue is charged in addition, if the container throughput reaches more than the projected target. This implies the enhancement of entrepreneurship, or cooperation of efficient port operation and joint distribution of profits.

d) Tariff adjustment is negotiable, or carried out at regular intervals.

3) Assumption of Lease Contract for New International Container and General Cargo Terminals

The above all being taken into account, the Study Team assumes the following lease contract for the planned international container and general cargo terminals, which is shown in Table 31.2.9.

Table 31.2.9 Lease Contract for Planned Container and General Cargo Terminals

Terms of Contract	In case of New International Container and General Cargo Terminals	Remarks
Duration of Lease	30 Years	The same duration of a foreign soft loan period.
Leased facilities and Equipments at Port	Container wharves, container yards and quayside container cranes.	A terminal operator is further relieved from the financial risk, at the same time, there is still a plenty of opportunity to take advantage of a leased terminal as efficiently as possible.
Land Concessions	No.	The same as other container terminals in the Southeast Asia.
Lease Fee	12 million US Dollars.	12 million US dollars is smaller than all investment and maintenance cost plus related managerial expenditures divided by duration years. Because, the lessor gains a certain portion of profits return, in addition to the fixed lease fee. This implies the enhancement of entrepreneurship. In other words, profits and losses derived from terminal operation, should be shared by both parties.
Monetary Contract Other Than Lease Fee	20 % of cargo handling revenue for a lessor, and 80 % for a lessee.	As stated above, another monetary contract should be introduced. If only fixed royalty, all revenue surplus belongs to a terminal operator, and all revenue loss also falls into the operator. In order to rectify this one-sided financial risk, joint distribution of profits should be introduced. The actual percentage of revenue share must be decided to form a fair and well-balanced risk

		management system on both parties.
Tariff Adjustment	The same tariff during the contract.	The reduced tariff has been applied based on the Vietnamese tariff adjustment policy. However, the present tariff should be reviewed and evaluated in order to catch up with the competition in the world shipping market.
Main Agreement Bodies	New PMB and Terminal Operator	-
Other Specific Conditions		-

(8) Revenues and Expenditures

1) Revenues and Expenditures of New Port Management Body

(a) Revenues

All revenues are calculated on the basis of the leasing policy and the present tariff structure adopted by the Ho Chi Minh Port Group.

Items of port revenues shouldered by the New Port Authority are as follows.

- Maritime Charges (Tonnage Dues, Maritime Safety Charges)
- Wharfage Dues (Wharfage for Vessels, Wharfage for Cargo)
- 20 % of Cargo Stevedoring Charge
- 20 % of Cargo Storage Charge
- Lease Charge from Private Sector (It is fixed at 12.0 million UD Dollars.)

Fixed lease charge from private sector is determined as follows. Total investment, maintenance and managerial cost during project life by a new port management body, including civil works, maintenance dredging and quayside cranes amounts to 514 million UD Dollars. The new port management body must recover its investment, maintenance and managerial cost by the last year of loan period, namely, 30 years. If the new port management body is released from a loan interest, and also waives any profits from the terminal business, the fixed lease fee must be equal to 17.0 million US Dollars per year, which is derived from 514 million US Dollars divided by 30. However, based on the policy of entrepreneurship for a terminal business between a lessor and a lessee, the new port management body gains 20 % of cargo handling revenue. Accordingly, 17.0 million US Dollars fixed lease fee must be reduced to the appropriate amount. The actual percentage of revenue share must be decided to form a fair and well-balanced risk management system on both sides. The Study Team assumes that the fixed lease charge should be 12.0 million US Dollars, after reiterating a number of calculations to find out the most appropriate amount of a fixed lease charge.

(b) Expenditures

Capital cost and annual cost for the 5 year construction (2005-2009) project are summarized in Table 31.2.10. Maintenance dredging cost is included in the annual cost of the project. On the

other hand, capital cost for the 4 year construction project (2005-2008) is slightly higher than the 5 year construction project by 6.6 million USD.

Table 31.2.10 Initial Construction and Procurement Costs for Cai Mep-Thi Vai International Port

(Unit : Million US Dollars)

	Year 2004	Year 2005	Year 2006	Year 2007	Year 2008	Year 2009	Total
Cai Mep Container Terminal	17.94	12.60	13.46	21.05	50.67	43.59	159.32
Thi Vai General Cargo Terminal	8.59	8.85	13.20	13.34	17.85	19.17	80.99
Total	26.53	21.45	26.66	34.39	68.52	62.76	240.31

i) Investment costs

Initial investment cost for the infrastructure and superstructure developed by a New Port Management Body (PMB) are estimated. Since the durable years of infrastructure facilities are longer than the project life, re-investment costs for these facilities are not counted in this analysis.

ii) Personnel Costs

The new PMB leases the container and general cargo berths to private sector, and then stevedoring and storage are carried out by private sector. Thus, the new PMB's personnel cost is for port administration, management and security only. Personnel cost for stevedoring and storage is excluded from this calculation.

Required annual personnel costs are estimated by multiplying the number of core businessmen and staff by average wages according to personnel level. The number of staff is derived from the organization chart of a new PMB in Chapter 34, and the average wage is estimated with reference to that of the Sai Gon Port in Ho Chi Minh Port Group. The number of personnel and average wage are shown in Table 31.2.11.

Table 31.2.11 Average Wage of Personnel at New Port Management Body

(Unit : US Dollars / month)

Organizational Position		Number of Personnel	Average Wage
Board Members		7	350
Core Businessmen	Director General	1	300
	Deputy Director General	4	250
	Manager	5	200
Staff	Office of Director General	3	130
	Administration	90	130
	Business	90	150
	Engineering and Technology	40	150
	International Business	30	150
	Information Technology	30	150
Total		300	151.1

iii) Administration Costs

Administration costs are assumed to be equal to 60 % of total personnel costs.

vi) Maintenance cost

Annual maintenance cost for infrastructure facilities are calculated as 1.0% of the initial construction cost. Annual maintenance cost for superstructure facilities are calculated as 5.0% of the original procurement cost. In addition, the replacement cost of large cranes is counted in the year 2025, and the replacement cost of other smaller equipments are counted in the year 2015, 2020, 2025, 2030 and 2035.

v) Depreciation cost

Annual depreciation cost for both infrastructure and superstructure facilities is calculated by the straight line method, based on their durable years. Residual value after all depreciation is estimated as being zero.

2) Revenues and Expenditures of Private Sector (Terminal operator)

(a) Revenues

All revenues are calculated on the basis of the present tariff at Ho Chi Minh Port Group. The item of port revenues shouldered by private sector are as follows.

- 80 % of Cargo Stevedoring Charge
- 80 % of Cargo Storage Charge

(b) Expenditures

i) Investment cost

Initial investment cost for the infrastructure and superstructure developed by private sector are estimated. Since the durable years of infrastructure facilities are longer than the project life, re-investment costs for these facilities are not counted in this analysis.

ii) Personnel Costs

While it is assumed that the new terminals are leased to private sector, the personnel costs of a terminal operator is estimated including stevedoring and storage.

Required annual personnel costs are estimated by multiplying the number of administration officers and stevedores by average wages. The number of stevedores is derived from the organization charts of a container and general cargo terminal in Chapter 34. The number and average wage are shown in Table 31.2.12 and Table 31.2.13.

Table 31.2.12 Number and Average Wage at Cai Mep Container Terminal (2 Berths)

(Unit : US Dollars / month)

Organizational Section		Number of Stevedores	Average Wage
Administration		15	120
Yard Operation	Quay Side Crane Driver	27	160
	Transfer Crane Driver	68	160
	Tractor/Chassis Driver	110	140
Yard Control		15	140
Ship Operation		216	140
CFS Operation		16	140
Documentation		20	120
Maintenance		17	120
Gate Operation		30	120
Total		534	140.5

Table 31.2.13 Number and Average Wage at Thi Vai General Cargo Terminal (2 berths)

(Unit : US Dollars / month)

Organizational Section		Number of Stevedores	Average Wage
Administration		15	120
Yard Operation	Crane Driver	27	160
	Tractor/Chassis Driver	45	140
	Forklift Driver	150	140
	Ship Operation Gang	600	140
Yard Control		12	140
Documentation		24	120
Maintenance		12	120
Gate Operation		27	120
Total		912	138.9

iii) Administration Costs

Administration costs are assumed to be equal to 60 % of total personnel costs.

vi) Lease Fee for Port Management Body

Lease fee from Private Sector is fixed at 12.0 million UD Dollars.

Fixed lease charge from private sector is determined as follows. Total investment cost during project life by a new port management body, including civil works, maintenance dredging and quay side cranes amounts to 240million US Dollars. The new port management body must recover its initial investment cost for about 30 years. Based on the finance policy, the fixed lease fee is equal to 12.0 million US Dollars per year for private sector.

v) Maintenance costs

Annual maintenance cost for infrastructure facilities are calculated as 1.0% of the initial construction cost. Annual maintenance cost for superstructure facilities are calculated as 5.0% of

the original procurement cost. In addition, the replacement cost of large cranes is counted in the year 2025, and the replacement cost of other smaller equipments are counted in the year 2015, 2020, 2025, 2030 and 2035.

iv) Depreciation cost

Annual depreciation cost for both infrastructure and superstructure facilities is calculated by the straight line method, based on their durable years. Residual value after all depreciation is estimated as being zero.

32.3 Evaluation of Project

(1) Evaluation of 5 Year Construction Project

1) Viability

The result of FIRR calculation is shown in Table 31.3.1, Table 31.3.2 and Table 31.3.3. FIRR for the New Port Management Body is 5.7 %, which is exceeding the weighted average interest rate of loan (3.78 %). FIRR for the terminal operator is 23.8 %, which is also exceeding the assumed private bank's interest rate (15.0 %).

Table 31.3.1 Result of FIRR Calculation

	New Port Authority	Private Sector
FIRR	5.7 %	23.8 %

The result of FIRR calculation under the condition that the share of cargo handling charge at the Cai Mep-Thi Vai International Port is variable between 10 % and 25 %, is shown in Table 31.3.4. Judging from the following result of FIRR calculation, 20 % variable share of cargo handling charge is financially viable to both the New Port Authority and the private sector.

Table 31.3.4 Result of FIRR Calculation assuming the variable rent of the terminal

Variable Share of Cargo Handling Charge (%) for PMB	FIRR of New Port authority	FIRR of Private Sector
10 %	3.9 %	33.0 %
15 %	4.8 %	28.5 %
20 %	5.7 %	23.8 %
25 %	6.5 %	18.8 %

2) Sensitivity Analysis

Sensitivity analysis is carried out to examine the impact of unexpected future changes such as cargo volume, construction cost, inflation or exchange rate. The following cases are envisioned.

- Case 1 : Investment costs increase by 10 %.
- Case 2 : Revenues decrease by 10 %.
- Case 3 : Investment costs increase by 10 %, and revenues decrease by 10 %.

Table 31.3.2 Financial Internal Rate of Return at New Pt Management Body

(Unit:Thousand USD)

	Year	Revenue (1)	Cost(2)			Difference (1)-(2)	Net Present Value		
			Investment	Expenses	Total		Revenue	Cost	Difference
1	2,004	0	26,530	0	26,530	-26,530	0	26,530	-26,530
2	2,005	0	21,450	0	21,450	-21,450	0	20,300	-20,300
3	2,006	0	26,660	0	26,660	-26,660	0	23,877	-23,877
4	2,007	0	34,390	0	34,390	-34,390	0	29,149	-29,149
5	2,008	0	59,410	0	59,410	-59,410	0	47,655	-47,655
6	2,009	0	41,700	0	41,700	-41,700	0	31,656	-31,656
7	2,010	25,247	0	6,416	6,416	18,831	18,138	4,609	13,529
8	2,011	26,425	0	6,416	6,416	20,009	17,966	4,362	13,604
9	2,012	26,425	740	6,416	7,156	19,269	17,003	4,604	12,398
10	2,013	26,425	7,410	6,416	13,826	12,599	16,091	8,419	7,672
11	2,014	26,425	0	6,416	6,416	20,009	15,228	3,697	11,531
12	2,015	26,425	740	6,416	7,156	19,269	14,412	3,903	10,509
13	2,016	26,425	0	6,416	6,416	20,009	13,639	3,311	10,327
14	2,017	26,425	7,410	6,416	13,826	12,599	12,907	6,753	6,154
15	2,018	26,425	740	6,416	7,156	19,269	12,215	3,308	8,907
16	2,019	26,425	0	6,416	6,416	20,009	11,560	2,807	8,753
17	2,020	26,425	0	6,416	6,416	20,009	10,940	2,656	8,284
18	2,021	26,425	8,150	6,416	14,566	11,859	10,354	5,707	4,646
19	2,022	26,425	0	6,416	6,416	20,009	9,798	2,379	7,419
20	2,023	26,425	0	6,416	6,416	20,009	9,273	2,251	7,021
21	2,024	26,425	740	6,416	7,156	19,269	8,776	2,376	6,399
22	2,025	26,425	59,240	6,416	65,656	-39,231	8,305	20,635	-12,330
23	2,026	26,425	0	6,416	6,416	20,009	7,860	1,908	5,951
24	2,027	26,425	740	6,416	7,156	19,269	7,438	2,014	5,424
25	2,028	26,425	0	6,416	6,416	20,009	7,039	1,709	5,330
26	2,029	26,425	7,410	6,416	13,826	12,599	6,662	3,486	3,176
27	2,030	26,425	740	6,416	7,156	19,269	6,305	1,707	4,597
28	2,031	26,425	0	6,416	6,416	20,009	5,967	1,449	4,518
29	2,032	26,425	0	6,416	6,416	20,009	5,647	1,371	4,276
30	2,033	26,425	8,150	6,416	14,566	11,859	5,344	2,946	2,398
31	2,034	26,425	0	6,416	6,416	20,009	5,057	1,228	3,829
32	2,035	26,425	0	6,416	6,416	20,009	4,786	1,162	3,624
33	2,036	26,425	740	6,416	7,156	19,269	4,529	1,227	3,303
34	2,037	26,425	7,410	6,416	13,826	12,599	4,287	2,243	2,044
35	2,038	26,425	0	6,416	6,416	20,009	4,057	985	3,072
36	2,039	26,425	740	6,416	7,156	19,269	3,839	1,040	2,799
	Total	791,572	321,240	192,480	513,720	277,852	285,422	285,422	0

Table 31.3.3 Financial Internal Rate of Return at Terminal Operator

(Unit:Thousand USD)

	Year	Revenue (1)	Cost(2)			Difference (1)-(2)	Net Present Value		
			Investment	Expenses	Total		Revenue	Cost	Difference
1	2,004	0	0	0	0	0	0	0	0
2	2,005	0	0	0	0	0	0	0	0
3	2,006	0	0	0	0	0	0	0	0
4	2,007	0	0	0	0	0	0	0	0
5	2,008	0	9,110	0	9,110	-9,110	0	3,877	-3,877
6	2,009	0	26,060	0	26,060	-26,060	0	8,959	-8,959
7	2,010	25,873	0	17,430	17,430	8,443	7,184	4,840	2,344
8	2,011	28,226	0	17,430	17,430	10,796	6,331	3,909	2,421
9	2,012	28,226	0	17,430	17,430	10,796	5,113	3,158	1,956
10	2,013	28,226	0	17,430	17,430	10,796	4,130	2,550	1,580
11	2,014	28,226	0	17,430	17,430	10,796	3,336	2,060	1,276
12	2,015	28,226	12,647	17,430	30,077	-1,851	2,695	2,871	-177
13	2,016	28,226	0	17,430	17,430	10,796	2,176	1,344	832
14	2,017	28,226	0	17,430	17,430	10,796	1,758	1,086	672
15	2,018	28,226	0	17,430	17,430	10,796	1,420	877	543
16	2,019	28,226	0	17,430	17,430	10,796	1,147	708	439
17	2,020	28,226	12,647	17,430	30,077	-1,851	926	987	-61
18	2,021	28,226	0	17,430	17,430	10,796	748	462	286
19	2,022	28,226	0	17,430	17,430	10,796	604	373	231
20	2,023	28,226	0	17,430	17,430	10,796	488	301	187
21	2,024	28,226	0	17,430	17,430	10,796	394	243	151
22	2,025	28,226	34,267	17,430	51,697	-23,471	318	583	-265
23	2,026	28,226	0	17,430	17,430	10,796	257	159	98
24	2,027	28,226	0	17,430	17,430	10,796	208	128	79
25	2,028	28,226	0	17,430	17,430	10,796	168	104	64
26	2,029	28,226	0	17,430	17,430	10,796	136	84	52
27	2,030	28,226	12,647	17,430	30,077	-1,851	109	117	-7
28	2,031	28,226	0	17,430	17,430	10,796	88	55	34
29	2,032	28,226	0	17,430	17,430	10,796	71	44	27
30	2,033	28,226	0	17,430	17,430	10,796	58	36	22
31	2,034	28,226	0	17,430	17,430	10,796	47	29	18
32	2,035	28,226	12,647	17,430	30,077	-1,851	38	40	-2
33	2,036	28,226	0	17,430	17,430	10,796	30	19	12
34	2,037	28,226	0	17,430	17,430	10,796	25	15	9
35	2,038	28,226	0	17,430	17,430	10,796	20	12	8
36	2,039	28,226	0	17,430	17,430	10,796	16	10	6
	Total	844,427	120,025	522,900	642,925	201,502	40,041	40,041	0

The result of the sensitivity analysis is shown in Table 31.3.5. In all cases, FIRR exceeds, or is almost the same as the target interest rate of loan (3.78 % per annum for PMB and 15.0 % per annum for a private sector).

Table 31.3.5 Results of Sensitivity Analysis

Case	New Port Authority	Private Sector
Original Case	5.7 %	23.8 %
Case 1	4.8 %	21.1 %
Case 2	4.3 %	15.6 %
Case 3	3.5 %	13.2 %

3) Financial Soundness of Executing Agency

Together with the above-mentioned financial analysis, overall financial soundness of the New Port Management Body was assessed to confirm the feasibility of the project. In the assessment, current financial assessment, loan repayment programs and income prospects for the future were evaluated. Projected financial statements and financial indicators for the New Port Management Body are shown in Table 31.3.6.

1) Profitability

The rate of return on net fixed assets exceeds the weighted average interest rate of the funds in each case.

2) Loan Repayment Capacity

The debt service coverage ratio exceeds 1.0 during the project life.

3) Operational Efficiency

The operation ratio keeps below 60 % and working ratio keeps below 50 %. This means that the operation at port will be efficient.

As mentioned above, the financial condition of the New PMB will be satisfactory, regarding the Priority Project. But, in particular, the operator of the Cai Mep-Thi Vai International Port should make continuous efforts to secure forecast cargo volume, to improve cargo handling efficiency, and to reduce operating expenses.

(2) Evaluation of 4 Year Construction Project

1) Viability

The result of FIRR calculation is shown in Table 31.3.7, Table 31.3.8 and Table 31.3.9. FIRR for the New Port Management Body is 5.8%, which is exceeding the weighted average interest rate of loan (3.78 %). FIRR for the terminal operator is 22.5%, which is also exceeding the assumed private bank's interest rate (15.0%). Therefore, the project is financially viable to both the New Port Management Body and the private sector.

Table 31.3.6 Financial Statement for Feasibility Study (1/2)

Income Statement (Unit:USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Operating Revenue	0	0	0	0	0	0	25,247	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425
Operating Expenses	0	0	0	0	0	0	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306
Personnel & Administration	0	0	0	0	0	0	871	871	871	871	871	871	871	871	871	871	871	871	871
Maintenance	0	0	0	0	0	0	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550
Depreciation	0	0	0	0	0	0	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885
Net Operating Income	0	0	0	0	0	0	12,941	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119
Interest on Long-term Loans	0	0	637	1,080	1,592	2,218	3,353	3,904	3,344	2,784	2,224	1,664	1,631	1,544	1,598	1,853	2,666	3,232	3,041
Net Surplus	0	0	-637	-1,080	-1,592	-2,218	9,588	10,215	10,775	11,335	11,895	12,455	12,488	12,575	12,520	12,265	11,452	10,887	11,077
Corporation Income Tax	0	0	0	0	0	0	2,397	2,554	2,694	2,834	2,974	3,114	3,122	3,144	3,130	3,066	2,863	2,722	2,769
Accumulated Earnings	0	0	-637	-1,717	-3,309	-5,527	1,664	9,325	17,406	25,907	34,828	44,170	53,536	62,967	72,357	81,557	90,146	98,311	106,619

Cash Flow

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Cash Beginning	0	0	-472	-1,961	-4,368	-7,897	-13,108	-3,766	6,045	16,277	26,929	38,001	48,629	58,583	67,733	75,722	81,585	85,479	88,948
Cash Inflow	31,430	25,411	31,584	40,741	70,383	49,405	18,826	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004
Net Operating Income	0	0	0	0	0	0	12,941	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119
Depreciation	0	0	0	0	0	0	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885
Long-term Loans	31,430	25,411	31,584	40,741	70,383	49,405	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Outflow	31,430	25,883	33,073	43,148	73,913	54,616	7,087	7,638	7,078	6,518	5,958	6,262	6,928	7,710	8,885	11,075	13,247	13,812	13,622
Investment	31,430	25,411	31,584	40,741	70,383	49,405	0	0	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	0	472	853	1,326	1,938	2,993	3,734	3,734	3,734	3,734	3,734	4,599	5,297	6,166	7,286	9,222	10,581	10,581	10,581
Interest on Long-term Loans	0	0	637	1,080	1,592	2,218	3,353	3,904	3,344	2,784	2,224	1,664	1,631	1,544	1,598	1,853	2,666	3,232	3,041
Corporation Income Tax	0	0	0	0	0	0	2,397	2,554	2,694	2,834	2,974	3,114	3,122	3,144	3,130	3,066	2,863	2,722	2,769
Cash Balance	0	-472	-1,489	-2,407	-3,530	-5,211	9,342	9,812	10,232	10,652	11,072	10,628	9,954	9,150	7,989	5,863	3,894	3,470	3,613
Cash Ending	0	-472	-1,961	-4,368	-7,897	-13,108	-3,766	6,045	16,277	26,929	38,001	48,629	58,583	67,733	75,722	81,585	85,479	88,948	92,561

Balance Sheet

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Current Assets	0	0	0	0	0	0	0	6,045	16,277	26,929	38,001	48,629	58,583	67,733	75,722	81,585	85,479	88,948	92,561
Cash & Deposit	0	0	0	0	0	0	0	6,045	16,277	26,929	38,001	48,629	58,583	67,733	75,722	81,585	85,479	88,948	92,561
Fixed Assets	31,430	56,841	88,425	129,166	199,549	248,954	243,069	237,184	231,299	225,414	219,529	213,643	207,758	201,873	195,988	190,103	184,218	178,333	172,448
Total Assets	31,430	56,841	88,425	129,166	199,549	248,954	243,069	243,229	247,576	252,343	257,530	262,272	266,341	269,606	271,710	271,688	269,697	267,281	265,009
Liabilities	31,430	56,841	89,062	130,883	202,858	254,481	241,405	233,904	230,170	226,436	222,701	218,103	212,805	206,639	199,353	190,131	179,551	168,970	158,389
Short-term Loans	0	472	1,961	4,368	7,897	13,108	3,766	0	0	0	0	0	0	0	0	0	0	0	0
Long-term Loans	31,430	56,370	87,101	126,515	194,961	241,373	237,638	233,904	230,170	226,436	222,701	218,103	212,805	206,639	199,353	190,131	179,551	168,970	158,389
Net Worth	0	0	-637	-1,717	-3,309	-5,527	1,664	9,325	17,406	25,907	34,828	44,170	53,536	62,967	72,357	81,557	90,146	98,311	106,619
Total Liabilities & Net Worth	31,430	56,841	88,425	129,166	199,549	248,954	243,069	243,229	247,576	252,343	257,530	262,272	266,341	269,606	271,710	271,688	269,697	267,281	265,009
check	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Financial Indicators

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Rate of Return Fixed Assets							5.3%	6.0%	6.1%	6.3%	6.4%	6.6%	6.8%	7.0%	7.2%	7.4%	7.7%	7.9%	8.2%
Debt Service Coverage Ratio							2.66	2.62	2.83	3.07	3.36	3.19	2.89	2.59	2.25	1.81	1.51	1.45	1.47
Operating Ratio							48.7%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%
Working Ratio							25.4%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%

Table 31.3.6 Financial Statement for Feasibility Study (2/2)

Income Statement (Unit:USD)

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Operating Revenue	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425	26,425
Operating Expenses	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306	12,306
Personnel & Administration	871	871	871	871	871	871	871	871	871	871	871	871	871	871	871	871	871
Maintenance	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550	5,550
Depreciation	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885
Net Operating Income	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119
Interest on Long-term Loans	2,851	2,661	2,470	2,280	2,089	1,899	1,708	1,518	1,327	1,137	947	756	566	399	252	129	38
Net Surplus	11,268	11,458	11,649	11,839	12,030	12,220	12,411	12,601	12,791	12,982	13,172	13,363	13,553	13,720	13,867	13,989	14,081
Corporation Income Tax	2,817	2,865	2,912	2,960	3,007	3,055	3,103	3,150	3,198	3,245	3,293	3,341	3,388	3,430	3,467	3,497	3,520
Accumulated Earnings	115,070	123,664	132,400	141,280	150,302	159,467	168,775	178,226	187,820	197,557	207,436	217,458	227,623	237,913	248,312	258,805	269,366

Cash Flow

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Cash Beginning	92,561	96,317	100,214	104,256	108,440	112,767	91,337	70,049	74,804	79,702	84,744	89,928	95,254	102,060	110,070	119,532	130,818
Cash Inflow	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004	20,004
Net Operating Income	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119	14,119
Depreciation	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885	5,885
Long-term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Outflow	13,432	13,241	13,051	12,860	12,670	38,379	38,189	12,098	11,908	11,718	11,527	11,337	9,810	8,564	7,075	5,220	2,137
Investment	0	0	0	0	0	25,900	25,900	0	0	0	0	0	0	0	0	0	0
Repayment of principal	10,581	10,581	10,581	10,581	10,581	10,581	10,581	10,581	10,581	10,581	10,581	10,581	9,245	8,165	6,823	5,091	2,100
Interest on Long-term Loans	2,851	2,661	2,470	2,280	2,089	1,899	1,708	1,518	1,327	1,137	947	756	566	399	252	129	38
Corporation Income Tax	2,817	2,865	2,912	2,960	3,007	3,055	3,103	3,150	3,198	3,245	3,293	3,341	3,388	3,430	3,467	3,497	3,520
Cash Balance	3,755	3,898	4,041	4,184	4,327	-21,430	-21,288	4,756	4,898	5,041	5,184	5,326	6,806	8,010	9,462	11,287	14,347
Cash Ending	96,317	100,214	104,256	108,440	112,767	91,337	70,049	74,804	79,702	84,744	89,928	95,254	102,060	110,070	119,532	130,818	145,165

Balance Sheet 20,015

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Current Assets	96,317	100,214	104,256	108,440	112,767	91,337	70,049	74,804	79,702	84,744	89,928	95,254	102,060	110,070	119,532	130,818	145,165
Cash & Deposit	96,317	100,214	104,256	108,440	112,767	91,337	70,049	74,804	79,702	84,744	89,928	95,254	102,060	110,070	119,532	130,818	145,165
Fixed Assets	166,563	160,678	154,792	148,907	143,022	163,037	183,052	177,167	171,282	165,397	159,512	153,627	147,741	141,856	135,971	130,086	124,201
Total Assets	262,879	260,892	259,048	257,347	255,789	254,374	253,101	251,971	250,984	250,140	249,439	248,881	249,801	251,926	255,503	260,905	269,366
Liabilities	147,809	137,228	126,648	116,067	105,487	94,906	84,326	73,745	63,165	52,584	42,003	31,423	22,178	14,013	7,191	2,100	0
Short-term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-term Loans	147,809	137,228	126,648	116,067	105,487	94,906	84,326	73,745	63,165	52,584	42,003	31,423	22,178	14,013	7,191	2,100	0
Net Worth	115,070	123,664	132,400	141,280	150,302	159,467	168,775	178,226	187,820	197,557	207,436	217,458	227,623	237,913	248,312	258,805	269,366
Total Liabilities & Net Worth	262,879	260,892	259,048	257,347	255,789	254,374	253,101	251,971	250,984	250,140	249,439	248,881	249,801	251,926	255,503	260,905	269,366
check	0	0	0	0	0	0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	-0	0

Financial Indicators

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Rate of Return Fixed Assets	8.5%	8.8%	9.1%	9.5%	9.9%	8.7%	7.7%	8.0%	8.2%	8.5%	8.9%	9.2%	9.6%	10.0%	10.4%	10.9%	11.4%
Debt Service Coverage Ratio	1.49	1.51	1.53	1.56	1.58	1.60	1.63	1.65	1.68	1.71	1.74	1.76	2.04	2.34	2.83	3.83	9.36
Operating Ratio	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%	46.6%
Working Ratio	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%	24.3%

Table 31.3.7 Result of FIRR Calculation

	New Port Management Body (PMB)	Private Sector
FIRR	5.8 %	22.5 %

2) Sensitivity Analysis

Sensitivity analysis is carried out to examine the impact of unexpected future changes such as cargo volume, construction cost, inflation or exchange rate. The following cases are envisioned.

- Case 1 : Investment costs increase by 10 %.
- Case 2 : Revenues decrease by 10 %.
- Case 3 : Investment costs increase by 10 %, and revenues decrease by 10 %.

The result of the sensitivity analysis is shown in Table 31.3.10. In case 1 and case 2, FIRR for the project exceeds, or is almost the same as the target interest rate of loan (3.78% per annum for PMB and 15.0% per annum for a private sector). However, in case 3 (investment costs 10% up and revenue 10% down), FIRR for the New PMB and a terminal operator does not exceed the target interest rate. Therefore, if there were a drastic change in the financial environment, this project would not be feasible.

Table 31.3.10 Results of Sensitivity Analysis

Case	New Port Management Body (PMB)	Private Sector
Original Case	5.8 %	22.5 %
Case 1	4.8 %	20.1 %
Case 2	4.4 %	14.8 %
Case 3	3.4 %	12.7 %

31.4 Conclusion

Judging from the above analysis, the project is regarded as financially feasible. And the financial soundness of executing agency, which is the New Port Management Body, is considered to be sound. However, the project should be reviewed and reevaluated from time to time, in particular when the financial environment is expected to drastically change. It is also recommendable that the New Port Management Body and a terminal operator should make continuous efforts to heighten the quality of the service, to improve cargo handling efficiency, to secure the predicted cargo volume, and to seduce operating expenses.

Table 31.3.8 Financial Internal Rate of Return at New Port Management Body (4 Year Construction Project)

(Unit:Thousand USD)

	Year	Revenue (1)	Cost(2)			Difference (1)-(2)	Net Present Value		
			Investment	Expenses	Total		Revenue	Cost	Difference
1	2,004	0	26,530	0	26,530	-26,530	0	26,530	-26,530
2	2,005	0	28,050	0	28,050	-28,050	0	26,516	-26,516
3	2,006	0	26,660	0	26,660	-26,660	0	23,824	-23,824
4	2,007	0	34,390	0	34,390	-34,390	0	29,052	-29,052
5	2,008	0	101,110	0	101,110	-101,110	0	80,744	-80,744
6	2,009	24,121	0	6,416	6,416	17,705	18,209	4,844	13,366
7	2,010	25,247	0	6,416	6,416	18,831	18,017	4,579	13,438
8	2,011	26,425	0	6,416	6,416	20,009	17,827	4,328	13,498
9	2,012	26,425	740	6,416	7,156	19,269	16,852	4,564	12,288
10	2,013	26,425	7,410	6,416	13,826	12,599	15,930	8,335	7,595
11	2,014	26,425	0	6,416	6,416	20,009	15,059	3,656	11,403
12	2,015	26,425	740	6,416	7,156	19,269	14,236	3,855	10,381
13	2,016	26,425	0	6,416	6,416	20,009	13,457	3,267	10,190
14	2,017	26,425	7,410	6,416	13,826	12,599	12,722	6,656	6,065
15	2,018	26,425	740	6,416	7,156	19,269	12,026	3,257	8,769
16	2,019	26,425	0	6,416	6,416	20,009	11,368	2,760	8,608
17	2,020	26,425	0	6,416	6,416	20,009	10,747	2,609	8,137
18	2,021	26,425	8,150	6,416	14,566	11,859	10,159	5,600	4,559
19	2,022	26,425	0	6,416	6,416	20,009	9,604	2,332	7,272
20	2,023	26,425	0	6,416	6,416	20,009	9,079	2,204	6,874
21	2,024	26,425	740	6,416	7,156	19,269	8,582	2,324	6,258
22	2,025	26,425	59,240	6,416	65,656	-39,231	8,113	20,157	-12,045
23	2,026	26,425	0	6,416	6,416	20,009	7,669	1,862	5,807
24	2,027	26,425	740	6,416	7,156	19,269	7,250	1,963	5,287
25	2,028	26,425	0	6,416	6,416	20,009	6,854	1,664	5,189
26	2,029	26,425	7,410	6,416	13,826	12,599	6,479	3,390	3,089
27	2,030	26,425	740	6,416	7,156	19,269	6,125	1,659	4,466
28	2,031	26,425	0	6,416	6,416	20,009	5,790	1,406	4,384
29	2,032	26,425	0	6,416	6,416	20,009	5,473	1,329	4,144
30	2,033	26,425	8,150	6,416	14,566	11,859	5,174	2,852	2,322
31	2,034	26,425	0	6,416	6,416	20,009	4,891	1,188	3,703
32	2,035	26,425	0	6,416	6,416	20,009	4,623	1,123	3,501
33	2,036	26,425	740	6,416	7,156	19,269	4,371	1,184	3,187
34	2,037	26,425	7,410	6,416	13,826	12,599	4,132	2,162	1,970
35	2,038	26,425	0	6,416	6,416	20,009	3,906	948	2,957
	Total	789,268	327,100	192,480	519,580	269,688	294,722	294,722	0

FIRR= 5.78%

Table 31.3.9 Financial Internal Rate of Return at Terminal Operator (4 Year Construction Project)

(Unit:Thousand USD)

	Year	Revenue (1)	Cost(2)			Difference (1)-(2)	Net Present Value		
			Investment	Expenses	Total		Revenue	Cost	Difference
1	2,004	0	0	0	0	0	0	0	0
2	2,005	0	0	0	0	0	0	0	0
3	2,006	0	0	0	0	0	0	0	0
4	2,007	0	9,110	0	9,110	-9,110	0	4,959	-4,959
5	2,008	0	26,060	0	26,060	-26,060	0	11,583	-11,583
6	2,009	23,716	0	17,430	17,430	6,286	8,607	6,325	2,281
7	2,010	25,873	0	17,430	17,430	8,443	7,667	5,165	2,502
8	2,011	28,226	0	17,430	17,430	10,796	6,829	4,217	2,612
9	2,012	28,226	0	17,430	17,430	10,796	5,576	3,443	2,133
10	2,013	28,226	0	17,430	17,430	10,796	4,553	2,811	1,741
11	2,014	28,226	0	17,430	17,430	10,796	3,717	2,296	1,422
12	2,015	28,226	12,647	17,430	30,077	-1,851	3,035	3,234	-199
13	2,016	28,226	0	17,430	17,430	10,796	2,478	1,530	948
14	2,017	28,226	0	17,430	17,430	10,796	2,024	1,250	774
15	2,018	28,226	0	17,430	17,430	10,796	1,652	1,020	632
16	2,019	28,226	0	17,430	17,430	10,796	1,349	833	516
17	2,020	28,226	12,647	17,430	30,077	-1,851	1,102	1,174	-72
18	2,021	28,226	0	17,430	17,430	10,796	899	555	344
19	2,022	28,226	0	17,430	17,430	10,796	734	453	281
20	2,023	28,226	0	17,430	17,430	10,796	600	370	229
21	2,024	28,226	0	17,430	17,430	10,796	490	302	187
22	2,025	28,226	34,267	17,430	51,697	-23,471	400	732	-332
23	2,026	28,226	0	17,430	17,430	10,796	326	202	125
24	2,027	28,226	0	17,430	17,430	10,796	267	165	102
25	2,028	28,226	0	17,430	17,430	10,796	218	134	83
26	2,029	28,226	0	17,430	17,430	10,796	178	110	68
27	2,030	28,226	12,647	17,430	30,077	-1,851	145	155	-10
28	2,031	28,226	0	17,430	17,430	10,796	118	73	45
29	2,032	28,226	0	17,430	17,430	10,796	97	60	37
30	2,033	28,226	0	17,430	17,430	10,796	79	49	30
31	2,034	28,226	0	17,430	17,430	10,796	64	40	25
32	2,035	28,226	12,647	17,430	30,077	-1,851	53	56	-3
33	2,036	28,226	0	17,430	17,430	10,796	43	27	16
34	2,037	28,226	0	17,430	17,430	10,796	35	22	13
35	2,038	28,226	0	17,430	17,430	10,796	29	18	11
	Total	839,917	120,025	522,900	642,925	196,992	53,363	53,363	0

FIRR= 22.47%

Chapter 32 Preliminary Environmental Impact Assessment (Pre-EIA)

32.1 Purpose and Flow of Pre-EIA

The purpose of Pre-EIA consists of the following primary parts:

- To predict and assess the potentials of the environmental impacts, which are likely to be caused by the implementation of the project.
- To propose proper mitigation measures for the negative environmental impacts.

General flow of pre-EIA is shown in Figure 32.1.1.

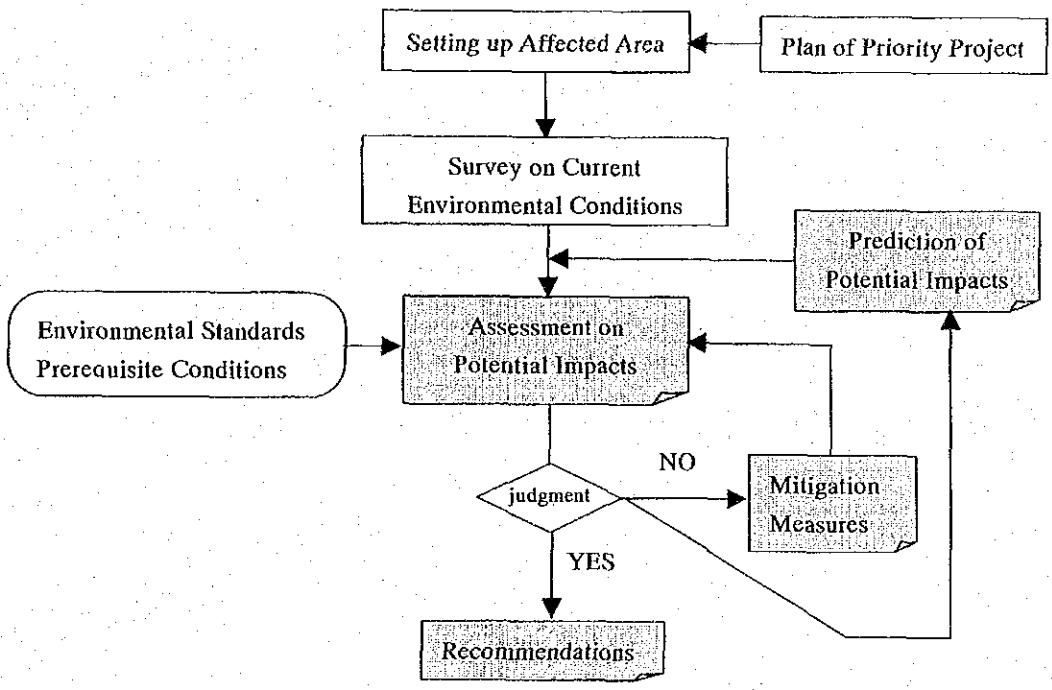


Figure 32.1.1 General Flow of pre-EIA

The Pre-EIA discussed in this chapter was conducted with due regard for the following Vietnamese guideline and standard.

- *Guidelines for Setting Up of Environmental Impact Assessment Report of Transport Project*, Ministry of Science, Technology and Environment (MOSTE), 1999

- Branch Standard No.22TCN242-98, Standard on Environmental Impact Assessment in Preparing Feasibility Study and Designing of Transport Constructions, Ministry of Transport & Communication, 1998

32.2 Description of the Project

From the environmental considerations point of view, the outline of the project is presented as follows.

This project envisaging the construction of Thi Vai International General Cargo Terminal No. 1 and 2 (TVG 1 and 2), Lower Cai Mep International Container Terminal No. 3 and 4 (LCC 3 and 4) and Navigation Channel, has selected from the Master Plan as the Priority Project aiming at completion in the year of 2010.

The preliminary features of the project are summarized in Table 32.2.1.

Table 32.2.1 (1) Preliminary Descriptions of Port Construction

Item	TVG 1 and 2	LCC 3 and 4
1. Site location	Phu My Town	Phuoc Hoa Commune
2. Site area	27 ha	39 ha
3. Site level	CDL + 5.0 m	CDL + 5.0 m
4. Time in operation	24 hours	24 hours
5. Kind of handling cargo	Bulk cargo	Container cargo
6. Structure of berth	Pier structure	Detached pier structure
7. Structure of yard surface	Asphalt pavement	Concrete pavement
8. Required reclamation	1,200,000 m^3	2,077,000 m^3
9. Access road (Width / Length)	20 m / 2 km	20 m / 3 km
10. Procurement of materials		
Concrete	In site	In site
Asphalt	In site	In site
Filling soil	In Province	In Province
Rock	In province	In province

Table 32.2.1 (2) Preliminary Description of Navigation Channel Construction

Item	Thi Vai River	Ganh Rai Bay
1. Depth / Width	From mouth to LCC 3 & 4 CDL – 14.0 m / 310.0 m From LCC 3 and 4 to TVG 1 & 2 CDL – 12.0 m / 310.0 m	CDL – 14.0 m / 310.0 m
2. Time in operation	24 hours	24 hours
3. Required capital dredging	663,000 m^3	7,336,000 m^3
4. Dumping site location	5 km offshore of Vung Tau cape	

32.3 Current State of Environment in the Project Sites

In the previous phase of this study, wide range information on the current state of environment in the study area has been collected and evaluated in Chapter 4.

In order to propose effective mitigation measures for negative environmental impacts, following additional surveys, which have been considered to be necessary for further understanding on the current state of environment in the project sites are conducted.

- Water Current Survey in Mangrove Swamp area
  To avoid an interruption of complex surface water exchange system in the mangrove swamp due to the partial reclamation work in Cai Mep site, the local water current conditions in spring tide including direction, speed, temperature, salinity and phenyl, were measured and evaluated.

- Benthos Survey in Mangrove Swamp and Coastal Mud-land area
  To prepare a baseline data on diversity of aquatic eco-system in Cai Mep and Ben Dinh-Sao Mai site, benthos sampling was conducted.

The results of surveys are presented in Appendix 32.

32.4 Potential Negative Impacts and Mitigation Measures

Based on the available information at this moment, the short and long term as well as direct and indirect negative environmental impacts, which are likely to be caused by the implementation of the priority projects, are predicted and assessed objectively.

Corresponding to the prediction and assessment above, mitigation measures are proposed so that negative impacts may be minimized.

According to the Guidelines for Setting Up of Environmental Impact Assessment Report of Transport Projects, MOSTE, 1999, proposed mitigation measures must ensure following principles:

- Mitigation measures must be appropriate to the project scales and available financial sources.

- Environmental protection measures must be taken through all the stages of the project, from preparatory, construction and operation phases.

- Appropriate options should be developed to cope with unrecoverable environmental impacts.

Potential negative impacts and its mitigation measures throughout the stages of the project are summarized in Table 32.4.1.

Table 32.4.1 (1) Negative Environmental Impacts and Mitigation Measures

Factors	Impacts	Mitigation Measures
A. Preparatory Phase		
1. Site clearing		
(1) Relocation of residents	Since the sites of new port construction (Thi Vai and Lower Cai Mep) are located in the current Industrial Zones, a few cases of resettlement may be necessary along the planned access roads between national road No.51 and the Industrial Zones. Possible impacts of resettlement on the local residents are changing job, decreasing income, changing lifestyle, isolation in the new settlement area, etc.	Advance notices and discussions on the implementation of the project must be made in order to avoid arising allergic reactions from the affected local residents. Appropriate compensation must be provided for not only damages to their land, house and garden, but also their changes in lifestyle and new employment in long rum.
(2) Encounter with dangerous object	Death or injury of human being and destruction of natural resources may occur due to the explosion of duds and spillage of toxic substances.	Historical survey on the land, especially during the war period, must be made prior to the site clearing.
B. Construction Phase		
1. Dredging work		
(1) Increase of turbidity	As shown in Table 32.5.1, soil dumping at the proposed location (about 5 km offshore the Vung Tau Cape) hardly has significant negative impact on local environment. However, short term increase of turbidity at the dredging and dumping sites may cause decline of bio-diversity due to decrease of light penetration and associated photosynthetic activity, and local depletion of dissolved oxygen level.	Even though the potential impact of dredging and soil dumping are expected to be small, appropriate dredging methods and less intrusive dredging equipment must be selected. Monitoring of turbidity around the dredging and dumping site is necessary to abstain operations in case unacceptable condition arises. Uncontaminated sediments can be use for land reclamation, however, mud land reclamation is no longer considered as sound option from protection of mud land eco-system viewpoint.
(2) Change in water current character	Large scale of change in bathymetry by dredging and dumping may alter local water current characters (direction, speed, period), which may cause dead-water puddle or erosion of land along coastline.	In case of channel dredging, the layout, which is laid parallel to the natural water current directions, may be able to avoid the alteration of its characters.
(3) Oil spillage or leakage from equipment	Human health may hardly be affected by oil contaminant directly, however, sea products and aquatic leisure activity will suffer from oily smell.	Well-maintained equipment must be used to avoid accidental oil spillage due to mechanical troubles.

Table 32.4.1 (2) Negative Environmental Impacts and Mitigation Measures

Factors	Impacts	Mitigation Measures
2. Reclamation work		
(1) Increase of turbidity	Increase of turbidity around the reclamation area is likely to cause decline of aquatic bio-diversity due to the decrease of light penetration into the water, associated photosynthetic activity and short-term depletions of dissolved oxygen level. Excessive increase of turbidity due to soil discharge from reclamation area may cause accumulation of new soil layer on natural eco-system.	In order to avoid the increase of turbidity due to the discharge of filling material from the reclamation area, temporary revetments must be constructed at perimeter of the area to be reclaimed. Monitoring of turbidity around the reclamation area is necessary to abstain operations in case unacceptable condition arises.
(2) Hindrance of natural water exchange	Decline of water exchange function of estuary is likely to cause organic pollution, which is induced by eutrophication process. As a result, eco-balance in the mangrove swamp will be destroyed. As the complexity of water exchange network in mangrove swamp, adverse impact on eco-system may appear in wider area more than expected.	According to the result of water current and benthos survey in mangrove swamp, it could be considered that water exchange function of Nga Tu and Ong canals are not high. Therefore, to keep their function, structure of access roads at intersection over those canals must consider wide spanned bridge structure.
3. Structural work		
(1) Change in water current character	High plane wall structures along riverbank may cause alteration of natural river flow characteristics. River bank in downstream on opposite side to such structures is likely to be eroded due to the reflected flow by the structures.	It is preferable that berth structure is constructed by pier structure, not continues wall structure, and/or gentle slope structure covered by natural stone.
(2) Solid waste disposal	Disposal of solid waste, which is contaminated by chemical solvent, remover, etc., may result in water pollution by heavy metal substance. Leaving massive sold waste such as broken concrete, removed steal structure, etc. under public sight may cause neighbors complaint.	Appropriate area for solid waste disposal on land must be designated in accordance with the regulations of local authority concerned. Prior to disposal, all adherent substances, which are likely to be source of pollution, have to be removed.

Table 32.4.1 (3) Negative Environmental Impacts and Mitigation Measures

Factors	Impacts	Mitigation Measures
4. Others		
(1) Increase of construction related traffic	Increase of heavy traffic volume may cause hindrance on local traffic and negative impact on neighbor's health. Especially, dump trucks carrying bulky construction materials such as soil, sand, graded stone, etc. are primary source of noise, dust, vibration and exhaust substances. Besides, deterioration of road surface conditions dye to heavy traffic means may cause traffic accidents.	Traffic flow at the cross point of access road and No.51 road must be controlled by light signal and/or trained person in order to avoid traffic congestion and accident. Waiting space for transport vehicles must be allocated within the construction site so as not to hinder local traffic. Dust pollution caused by dump trucks can be minimized by the sheet covering of transporting materials and watering on the ground. In order to minimize the interference with local community, access from waterside must be selected as much as possible.
(2) Processing construction material	In case that huge volume exploitation of raw construction materials such as soil, sand, stone, etc. is required, negative environmental impacts may arise in remote source and on its transportation route. Besides, operation of concrete and asphalt plants in and around the construction sites is a source of dust pollution, which is likely to cause adverse impacts on neighbor's health.	Transportation route of raw construction material must not go through nearby sensitive area such as residential area, schools and hospitals. Location of mixing plants of concrete and asphalt must be selected carefully taking landform, wind characters, etc. into account.
(3) Placing worker's camp	Worker's camps are provisional accommodation for the workers in the construction site. They are potential sources of domestic wastewater discharge, solid waste discharge and social crimes.	Available manpower in local community must be used as much as possible in order to reduce the size of camps. Sanitary facilities including latrines, bathrooms and solid waste disposal sites must be adequately provided. Besides, living rules in the camps must be developed to manage workers daily life.

Table 32.4.1 (4) Negative Environmental Impacts and Mitigation Measures

Factors	Impacts	Mitigation Measures
C. Operation Stage		
1. Increase of port related traffic		
(1) Land traffic	Increase of land traffic is likely to cause adverse effects on neighbor's human health, such as dust, exhaust, noise and vibration. Besides, deterioration of road surface conditions by heavy traffic may cause traffic accidents.	Comprehensive restriction on operation speed, over-loaded transportation, obsolete vehicle usage may be effective directly or indirectly. In addition, periodical maintenance works of neighboring roads, such as watering, repairing and monitoring must be performed.
(2) Water traffic	Increase of water traffic volume is a primary reason of ship collision. Large amount of oil leakage due to ship collision may cause serious environmental impacts on local eco-system. In the end, water front eco-system may be fully destroyed due to emergency recovery works. In the Thi Vai river, as the water traffic increases, erosion of mangrove forest along the riverbank due to the wave, which is generated by ships, may be accelerated.	Adequate operation space, such as turning basins in front of ports and navigation aids must be installed along the channel to prevent ship collision. Erosion of mangrove forest may be minimized by keeping distance between the forest and ships, slowing down of ship speed and installation of wave dissipating net
2. Port operation		
(1) Dust discharge	Large amount of bulky yard stock without cover may be discharged by wind and rain. Such discharges may degrade air and water quality around the port.	Bulky stock in the yard must be kept with cover and/or surrounding trench. Especially, toxic stock must be kept in house appropriately.
(2) Oil spillage	Even small amount, oil spillage in long-term from equipment maintenance shop and oil fueling facility may deteriorate soil and water qualities. Especially, quality of aquatic cultivation products is likely to be degraded due to oily smell.	In order to prevent accidental spillage, oil trap trench or fence must be placed surrounding the oil handling facilities.
(3) Lighting	Strong lighting during night operation may alter neighboring eco-system.	Layout, strength and operation time of lighting system must be planned so that the impact on neighbor eco-system may be minimized.

32.5 Dispersion of Dumped Soil

A study on dumping by barges reports that the expected Suspended Solid (SS) at a dumping site in Japan is about 8,310 mg/l. In assessing impacts on marine biology in Japan, however, a "unit turbidity rate, w_0" at the dumping site is commonly introduced as 37.7 kg/m^3 for sandy soil and 41.6 kg/m^3 for clayey soil, which are dumped by drag suction hopper dredgers and barges. The guideline density for fisheries is considered to be less than 10 ppm in Japan.

The most severe conditions are the case of high-efficiency large-size drag suction hopper dredger. Assuming a hopper capacity, V, of 4,000 m^3 and a concentration, C, of 30% for silt and clay (w_0= 40 kg/ m^3), the instantaneous load at the dumping site, M (kg/once), becomes:

$$M = w_0 VC = 40 \times 4{,}000 \times 0.3 = 48 \text{ ton} = 48{,}000 \text{ kg}$$

The density of suspended solids, SS (g/cm^3), at a distance of r (cm) from the dumping site after a lapse of time, t (sec), under an average current speed of u (cm/sec) can be calculated by the Fick's formula for each dumping work as shown in Table 32.5.1.

Characteristics of this equation is that it make possible to take account of:

1) Diffusion from an origin of turbidity by an average current,
2) Turbidity in terms distance from the origin or time for one dumping operation, and
3) Other parameters, which include turbidity coefficient and density of dumped soils.

Table 32.5.1 Assessed Distribution of SS due to Dumping of Soft Soils

Unit: ppm

Time	Distance, r (m)					Maximum
t (hour)	0	250	500	1,000	2,000	reach
0.5	10.6	4.5	-	-	-	360 m
1	5.3	3.4	0.9	-	-	720 m
3	1.8	1.5	1.0	0.2	0.0	2,160 m

(Notes) Water depth: 20m, Average current velocity: 20cm/sec, Load=48 ton/once

Source: Study Team

It is apparent that diffusion of SS in the dumping area is expected to be minimal, complying the requirement of fisheries to be less than 10 ppm, except at the exact dumping point and within 30 minutes after dumping.

There is ocean current at offshore of Vung Tau Cape, the direction of which is parallel to the coastline. Dumped soils at a depth of, for example, 20 m can disperse, by a maximum current of 1 knot, to a distance of about 4 km in case of silt, and about 400 m in case of fine sand, following the Ruby's Theory.

Judging from these facts, we may consider that dumping of dredged soils at offshore areas with a depth of 20 m will not cause serious impacts on water quality and marine biology.