4.8 Implementation and Financial Programs for the Short Term Plan

4.8.1 Production Payments

It is possible to trace back the origin of Project Financing to a series of Production Payments in the 1930s through 1960s for oil mining projects in the United States. Oil field in the US , different from that of Middle and Near East, were comparatively small in scale and there were many minor oil companies. During the great financial panic of 1929, many oil companies went bankrupt and subsequently few were willing to risk investing in the oil industry.

As a result, fund raising for the oil industry became difficult. In this social and financial background, Production Payments emerged as an important source of funds for the oil industry.

Production Payment is " the right to receive of oil or money sold that will be produced from a well or oil field in the future". Under the Production Payment System, an owner of an oil field (seller) can sell a part or whole of his right of it to a buyer as a Production Payment. The buyer can arrange a loan with a bank mortgaging the right of Production Payment.

From the side of a bank who supplies money, it is not the buyer but a mortgage of the right of Production Payment or cash flow which will be produced by sales of oil that can be trusted. This is just the origin of Project Financing.

In the early days, it was usual to take the oil product itself as a mortgage rather than the oil field. It started as a short term inventory finance with a mortgage of merchandise (oil), however, Production Payment gradually grew to a long term finance method mortgaging oil deposits. It is now an established way of long term financing.

This prototype Production Payment was renewed and applied to more large scale oil field development such as the North Sea Oil Field Development Project in the 1970s.

4.8.2 Production Payments and Container Terminal Project Financing

If the word " container " is substituted for " oil " and " future container throughput " for " oil deposits ", it is possible to introduce the Production Payment System to a container terminal construction project.

The Short Term Development Plan of SBMA is just like The North Sea Oil Field Development Project in terms of project financing. Both Projects are predicated on the assumption that resources (oil) or services (container handling) will yield future returns. Banks will finance a project by mortgaging these huge deposits.

In the case of the North Sea Project, one large oilfield has an oil deposit of more than a billion barrels requiring more than US $ 1 billion for development. In this circumstance, the banks concerned introduced the Production Payment method for financing.

In the case of the SBMA Short Term Plan, the projected throughput (the deposit) is enormous: 237,300 TEU in 2006 and 456,000 TEU in 2011. However, because there is currently no container terminal in Subic, the numbers of containers handled in 1998 is less than 30,000 TEU.

For instance, if two terminal operators equally can charge US $ 100 per TEU in the year 2011, the total gross earning of the two operators will be US $ 45,600,000. Assuming that SBMA can share 50 % of the gross amount, the figure is US $ 22,800,000, it should be possible for SBMA to produce a sizable loan.

The overall project cost for the Short Term Plan is estimated as US $ 184.6 million and it is not an easy job to plan the financial programs for the Short Term Plan. It is necessary for SBMA to introduce the concept of " Handling Payment " as a nucleus of the financial programs.

The assumed composition of the funding is a mixture of a low interest rate loan from an international finance group(s) and a higher rate loan from commercial banks. It is assumed that the lower rate is 8 % and the higher rate is 15 %.

Needless to say, it is desirable that the lower rate portion be as large as possible, and in order to make banking groups willing to finance the project, it is necessary to show them how big the future throughput (again it can be compared to an oil deposit) is and how sure it is as a mortgage.

4.8.3 The Scenario of the Handling Payment

The Handling Payment as a project financing method is simple and clear. This method totally depends on the demand forecast for the container throughput and the container handling ability of terminal operators.

The demand forecast is based on the assumption that SBMA as a port management body has responsibility of port sales and that terminal operators offer to users better service than their competitors. Regarding container handling ability, it is assumed that each of the two operators of the new terminals can handle 25 boxes per gantry crane per hour, which is the world standard.

Container terminal operators handle containers in much the same way that oil is pumped from an oilfield. That is why a container terminal is called a container processing factory. In this regard, both oil industry and container terminals are process industries.

If international banking organization groups believe in the mortgage power of the forecasted container throughput, it would be easy for them to make a decision to go ahead in arranging a loan contract for this project. At the same time, it is indispensable for SBMA to minimize administration costs by making its organization slim and compact; by so doing commercial banks will agree to the loan program. The detailed composition model of the loan will be elaborated in The chapter 6.

In this project, the throughput which has been likened to an oil deposit, is the key for financing. It is widely known that some of the leading financing banks in the US employ a group of oil rig specialists to evaluate oil field development projects. Similarly, it is important to verify the forecasted container throughput to evaluate the whole project.

In summing up, Production Payment is not an outdated method, especially these days when many international projects come with a price-tag that exceeds the level of ordinary mortgage and financial capacity of project proponents.

4.8.4 Outline of the Investment

(Some figures in this sub-chapter are derived from a calculation model, thus subject to change)

(1) Total Project Cost of SBMA for Short Term Development Plan (in Million US$)

Phase 1 96.2

Phase 2 74.8

Total Investment 171.0 (excluding price escalation and replacement investment)

Total Interest Sum for Project Period 59.5

G. Total 130.5

(2) Phase-wise Annual Administration and Depreciation Cost

The outline of the yearly cost for the investment according to the phases of the Short Term Plan is shown below:

	Administration Cost	Depreciation	Total
Phase 1	US$ 112,000	US$ 2,622,000	US$ 2,734,000
(280m wharf with 2 Gantries)			
Phase 2	US$ 112,000	US$ 2,139,000	US$ 2,251,000
(280m wharf with 2 Gantries)			
Short Term Total 560m wharves with four Gantries	US$ 224,000	US$ 4,761,000	US$ 4,985,000

(Average per annum per berth cost from the year 2008 is assumed about US$ 7,700,000 per berth per year which is calculated from the above US$ 5million/2 plus 3.78% average interest rate and necessary buffer)

The cost versus earning detail by year is elaborated in Chapter 6 of this report. SBMA's break even level to pay off US$7,700,000 at US$ 25.00 is 308,000 and at US$ 30.00 is 257,000 TEU.

(3) Gantry Crane Leasing Fee and Land Leasing Fee

As is elaborated in the previous sub-chapter 4.6 Improvement Plan and Schedule for Short Term Development Plan, it is proposed to let private enterprises operate the new terminals. As is also already proposed, it is assumed that SBMA will purchase Gantry Cranes and lease them to the terminal operators at the appropriate lease fee, one that is beneficial to both parties.

SBMA calculate the land usage to recover the sum invested and prepare the concession tender paper showing the conditions which must be satisfied by the bidders. It is so called house rent of a container terminal.

The Depreciation figures shown in (2) include both of the above. The break-down of Depreciation is as follows:

Phase 1	US$ 2,622,000	Gantry x 2	US$ 1,212,000
		Civil	US$ 1,410,000
Phase 2	US$ 2,139,000	Gantry x 2	US$ 1,212,000
		Civil	US$ 927,000

Assuming all necessary invested cost is to be recovered through land usage, the following calculation is possible:

Phase 1 (280m Terminal)

Land Area including wharf = 13.16 ha (280m x 470m)
US$ 199,200 per ha per year (US$ 2,622,000/13.16 ha)

Phase 2 (280m Terminal)

Land Area including wharf = 13.16 ha (280m x 470m)
US$ 162,500 per ha per year (US$ 2,139,000/13.16 ha)

Assuming that the civil cost excluding gantry cost is to be recovered through land usage, the following calculation is possible:

Phase 1 (280m First Terminal)

Land Area including wharf = 13.16 ha
US$ 102,660 per ha per year (US$ 1,410,000/13.16 ha)

Phase 2 (280m Second Terminal)

Land Area including wharf = 13.16 ha
US$ 107,100per ha per year (US$ 1,240,000/13.16)

There is no definite world wide market rate for a container terminal site. However, it is a common method to recover the invested sum through the formula of cost plus administration/maintenance. In Subic, there is no standard market to judge the right land usage rate.

For instance, SBMA Seaport Department is using a standard lease rate of US$ 3.00 per square meter per month for a parcel of land with a warehouse in the NSD area. This is US$ 30,000 per ha per month, on US$ 360,000 per ha per year.

It is considered reasonable that about two thirds of the land usage for a land with building such as warehouse in waterfront should be kept bare. According to this way of thinking, the above figure becomes US$ 240,000/ha/year.

There is another model calculation of land value using an actual civil figures of the Short Term Plan as follows:

Civil Construction Investment	US$ 93,482,000
Total Interest for Project Period	US$ 41,000,000
Total Sum to recover	US$ 134,482,000
30 Years Equivalence	US$ 4,483,000
Total 26.32 ha (13.16 x 2)	US$ 170,000/ha

4.8.2 Financial Program for Short Term Plan

(1) Variable Lease Fee (So-called All Throughput Calculation Lease Fee)

For the preparation of the concession, it is important to analyze and decide how to recover the investment and related cost. There are three major ways to recover the cost when the facilities are leased out for use to the public sector.

The Variable Lease Fee is the most simple and popular calculation system for container terminal leasing. The key is how to foresee the throughput for the particular container facility in this system. For instance, the Phase 1 Terminal, which will be completed at the end of 2005, is expected to handle 237,301 TEU, while the all inclusive invested amount for the particular year of 2007 is US$ 33,550,000. However, after the completion of the construction works of the two terminals, this settles down to the yearly sum of around US$ 7,700,000 per berth from 2008 and the projected throughput is 364,601 TEU.(see Table 6.2.3-3 for the throughput forecast)

Assuming per TEU income in 2008 of US$ 30.00, the gross income of SBMA will be US$ 10,938,060 (US$ 30.00 x 364,601 TEU) which is about US$ 4,000,000 short of the necessary revenue of SBMA to recover the due invested cost for the two terminals.

The break-even level of these two terminals for SBMA by US$ 30.00 in the year 2008 is 513,300 TEU (US$ 15,400,000/US$ 30.00). This means that if the throughput of both terminals in the year 2008 exceeds the line of 513,3000 TEU for the two terminals, every marginal TEU will produce an income of US$ 30.00 to SBMA. However, if the throughput does not reach the level, then SBMA will suffer a marginal loss of the same amount per TEU.

The throughput level of 513,300 TEU will be realized in the year of 2015 when the throughput of 588,113 TEU is forecast.

Assuming the handling numbers of containers by each terminal become equal by 2008 through competition and each terminal handle about 300,000 TEU (about 180,000 boxes) every year after the year 2016, the annual cost and throughput of the year of 2016 and after can be calculated as follows:

1) The First Terminal (280m wharf with two gantries)

Throughput 300,000 TEU

Annual Cost US$ 7,700,000

Required TEU US$ 7,700,000/US$ 25.00 = 308,000 TEU
/US$ 30.00 = 256,600 TEU

2) The Second Terminal (280m wharf with two gantries)

Throughput 300,000 TEU

Annual Cost US$ 7,700,000

Required TEU is the same as The First Terminal.

SBMA can calculate easily by this lease system whether the necessary amount is recoverable by the throughput every year, thus making it easy to negotiate with potential terminal operators. On the other hand, the terminal operator who wants to lease either of these terminals must foresee how many boxes can be handled at the terminal.

The prospective operator must grasp the total earning per TEU together with the throughput. For instance, the per box earning power is assumed to be US$ 60.00* (US$ 60.00 is derived based on SBMA 's share being as 10 % for Other Charges as per the Seaport Department Tariff, plus some miscellaneous earnings.

In case of the First Terminal, assuming the annual lease fee is US$7,700,000 and per TEU earning is US$ 60.00, throughput 300,000 TEU, their gross profit will be US$ 18,000,000 minus US$ 7,700,000 and operation cost. It is seemingly rather well balanced but will be elaborated in Chapter 6. Financial Analysis.

(2) <u>Fixed and Variable Lease Fee (So called Combined Lease Fee of Land/Gantry Usage and Throughput Rate)</u>

The above " Variable Lease Fee " totally depends on the throughput, and it is sometimes too risky for SBMA as well as terminal operators. This Fixed and Variable mixed lease fee system can be employed to reduce that risk.

For instance, what will happen if the throughput of First Terminal in 2006 is only 200,000 TEU, less than the SBMA's break-even TEU of 256,600TEU. SBMA's income is reduced by US$ 1,698,000 (56,600 TEU x US$ 30.00). On the other hand, the operator also suffers a loss of US$ 3,396,000 (56,600 TEU x US$ 60.00). To avoid this risk, all or some portions of the total sum can be fixed as a land and gantry usage and the remaining portion can be linked to throughput. An example is as follows:

Fixed Fee (Land and Gantry Usage)   90 % of US$ 7,700,000 = US$ 6,930,000
Variable Fee (Throughput Linked Fee)   US$ XX   to fill the balance of about US$ 7.7m

The meaning of this lease fee system is that the scale of the variable portion is smaller, lightening the burden of risk for both sides, especially for the lessee. In this system, a terminal operator can calculate the profit and loss more easily according to forecast throughput, and even if throughput is less than projected, the loss will be smaller.

From the view point of securing the income of SBMA, it is needless to say that the Fixed Lease Fee (So called All Inclusive Lump-sum Lease Fee) which is to be explained next is far better. However, if the lessees are reluctant to enter such a contract, then some other lease fee must be negotiated. In this regard, this combined system has broader room to adjust for both lessor (SBMA) and lessees (terminal operators).

In this system, the parity of the fixed portion versus throughput portion can be changed: 80/20, 70/30, 60/40 etc. according to container cargo forecast.

(3) <u>Fixed Lease Fee (So called All Inclusive Lump-sum Lease Fee)</u>

It is possible to depend totally on the investment cost to compute a container terminal leasing fee. This computing method is historically the oldest one and even today it is still popular among many terminal operators in the world.

In a negotiation in this system, SBMA's position is rather easy because the total cost plus some percent of net profit is easily calculated as Fixed Lease Fee. On the other hand, for the terminal operator, projected throughput is naturally very important. As is already shown, if the projected figure of 182,300 TUE for each terminal is realized in 2008 , it is enough to clear the breakeven point of 128,300 TEU (US$ 7,700,000/ US$ 60.00) and every terminal operator will be happy. However, it is difficult to tell how many TEUs are really coming in/out of the Port of Subic.

Generally speaking, if the co-relation of the break-even point and the projected throughput is strong, it is possible to introduce this Lease Fee System.

Just for reference, a model calculation using aforementioned figures according to this system for the year 2008 is as follows:

<u>Both Terminals (280m wharf terminal with two gantries)</u>

100 % of the cost of US$7,700,000 per annum to be agreed upon as Fixed Lease Fee

Throughput of the Terminal (half of 364,602 TEU) 182,300 TEU

Minimum Required TEU to cover the lease fee assuming a half of revenue is paid for the lease fee (US$ 3,850,000/US$ 30.00) 128,300 TEU

SBMA is not affected by the change in the throughput and the terminal operator too is not affected either if the throughput is exceeding the line of 128,300 TEU.

The above two cases show that the projected throughput is far higher than the necessary minimum numbers of TEU, and the introduction of this Fixed Lease Fee (so called All Inclusive Lump-sum Lease Fee) is possible and desirable. However, in case the projected TEU or more TEU become reality, it is the terminal operator who enjoys large benefits.

For example, if the projected TEU is handled at the both terminals, the figure for SBMA and the terminal operators based on a simple model will be as follows:

1) SBMA income	US$ 7,700,000 x 2 berth = US$ 15,400,000	
Necessary Investment Recovery per year		US$ 15,4000,000
Gross Profit/Loss		0
2) Operator's income	182,300 TEU x US$ 60.00 = US$ 10,938,000	
Lease Fee		US$ 7,700,000
Gross Profit		US$ 3,238,000

The above shows that once the throughput of a container terminal exceeds a certain point, the revenue of the operator rapidly increases, while that of the land owner remains at a fixed level in this Fixed Lease Fee System.

(4)Proposed Financial Scheme for Lease Fee

Taking all of the strong points and weak points into consideration, Combined Lease Fee of Fixed Fee and Variable Fee (so called Profit and Loss Sharing System) is proposed.

The main framework of this system is as follows:

1) An appropriate % of the investment cost per year to be covered by Fixed Fee
2) Royalty charge per TEU or actual box numbers shall be subject to retroactive adjustment when the throughput of the period becomes finally confirmed by both parties.
3) The way to adjust the royalty charge shall be 50/50 of the profit or loss of the terminal operator.

It is possible to vary the percentage of the investment cost from 100 % to lessor levels such as 50, 40 and 30 %. However, because a container yard with a wharf is like a stage for an actor (terminal operator in this case), its fee should be born by the player substantial percent.

The royalty adjustment is also changeable to 40/60 to 30/70, but 50/50 is believed the fairest way, unless either party paid a considerable part of the starting capital. The profit and loss sharing system, when the out-look throughput is large enough, tends to be a profit sharing system.

As is explained in 4.7.2 (6) Rationalization of the Seaport Tariff, a tariff issuing right concerning container handling must be transferred to the terminal operator, because kind of charges by what level is their business as far as they pay the full amount of the lease fee agreed upon in the lease contract.

SBMA, on the other hand, should try hard to establish an ideal port tariff specialized to " SBMA Seaport Charges " which entirely belong to SBMA. It is necessary to establish the independence of SBMA as a port management body and to attain financial independence. To that end, it is necessary to establish a financial basement founded on the port tariff and facility lease contracts structure.

In a container terminal leasing contract negotiation, the Seaport Department will be mainly responsible in collaboration with the Land & Estate Management Department. SBMA must recover 100 % of its investments.

In this sub-chapter, the focus has been on container handling and container terminal construction and every financial analysis and study is based on and limited to the earnings and cost of the container handling operation. However, the current revenue largely depends on the conventional cargoes and conventional type vessels. The detailed financial analysis including both container cargo/vessels and conventional cargo/vessels will be elaborated in Chapter six.

For reference, the item-wise container/non-container contribution ratios of the Seaport Department's earnings are as follows:

Charge Particular	1998 (US$)	Contribution % (Container)	Contribution % (Non-container)
1. Vessel Charges	37,752,572	35	65
2. Cargo Charges	22,402,578	44	56
3. Storage Charges	8,141,577	44	56
4. Reefer Charges	418,458	100	0
5. Other Charges	9,526,943	44	56
6. Processing Fee	4,269,900	20	80
Total	82,512,028	36	64

Source: SBMA Seaport Dept.

5. Economic Analysis

5.1 Objective and Methodology of the Economic Analysis

5.1.1 Objective

The objective of the economic analysis is to appraise the economic feasibility of the Short-term plan for Subic Port in the target year 2005 from the viewpoint of the national economy. Therefore, the objectives of this section are to investigate the economic benefits as well as the economic costs that will arise from the Short-term plan, and to evaluate whether the net benefits of the project exceed those that could be obtained from other investment opportunities in the Philippines.

5.1.2 Methodology

Economic analysis will be carried out according to the following method. Short-term plan will be defined and it will be compared to the "Without" case. All benefits and costs of it in market price for the difference from the "With" case will be calculated and it will be converted to economic price. All benefits and costs are evaluated using economic prices in the economic analysis based on the border price concept.

There are various methods to evaluate the feasibility of this type of development project. Here, the economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the feasibility of the project.

The EIRR is a discount rate which makes the costs and benefits of the project during the project life equal. The procedure used for this economic analysis is shown in Fig. 5.1.2-1.

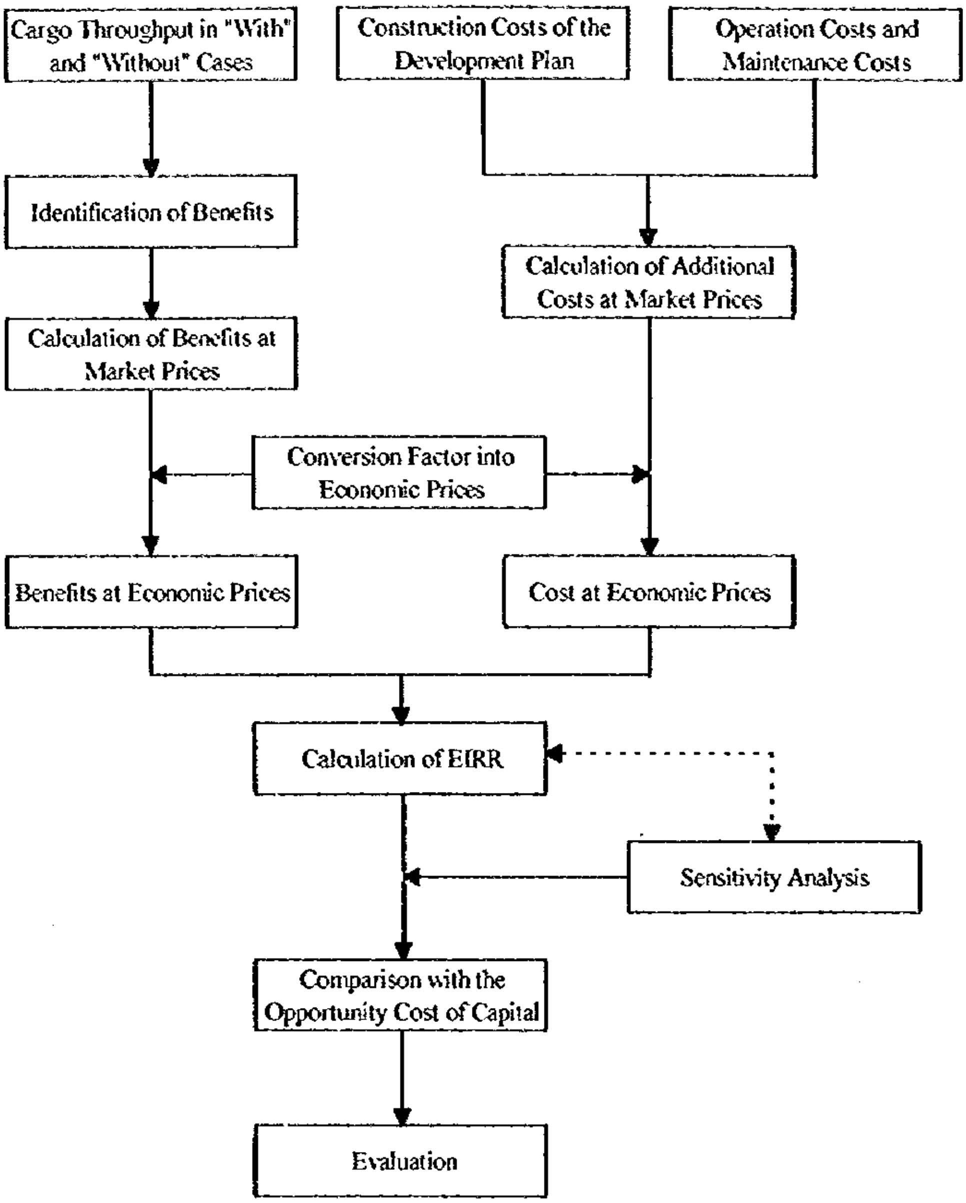


Fig. 5.1.2-1 Procedure of the Economic Analysis

5.2 Economic Analysis

5.2.1 "With" Case and "Without" Case

In the cost-benefit analysis, the benefits and the costs of the project are defined as the difference between the "Without" case and "With" case of the project. Therefore, it is very important to define the difference between the "Without" case and "With" case in the economic analysis in order to evaluate the feasibility of the Short-term plan. The following conditions are assumed for this study.

(1) "With" Case

In an economic analysis, benefits are mainly brought about by improvements and expansions in handling capacity. Therefore, the "With" case scenario includes all improvements in productivity and all expansion of port facilities in the Short-term plan.

(2) "Without" Case

A cost-benefit analysis is conducted on the difference between the "With" and "Without" investment cases. In this study, the following conditions are adopted as the "Without" case:

1) No investment is made for the port.
2) When handling volume reaches the maximum volume of handling capacity of the port, the cargoes imported which can not be handled in the port are assumed to be handled in adjacent ports and then transported to SBFZ and its hinterland through adjacent ports by trucks. In the same way, the cargoes exported which can not be handled in the port are assumed to be handled at adjacent ports and then have to be transported to adjacent ports by trucks.
3) Industrial estates (Industrial Park phase I & II, Technopark phase I) which are already operating or being developed are located in SBFZ. However, future planning industrial estates (Industrial Park III and Technopark II) will not be developed as investors will lose interest for investment because of the inconvenience to their operation. This could be detrimental to the national economy.
4) A lot of economic special zones which are already operating, being developed or planned are located in Region III. But, the development plans of these industrial estates will not be coordinated with the Short-term plan. However, the transportation cost by truck from aforesaid economic special zones to SBF is clearly cheaper than the transportation cost to Manila ports. This could be detrimental to the national economy.

5.2.2 Prerequisites of the Economic Analysis

In order to estimate the costs and benefits, the following requisites are assumed for the analysis.

(1) Base Year

The "base year" here means the standard year in the estimation of costs and benefits. Taking into consideration the base year in the cost estimation of construction, 2003 is set as the "Base Year" for this study.

(2) Project Life

Taking into consideration the depreciation period of the main facilities of 30 years and the construction period for phase-1 of two years (in the middle of 2005, new facilities can begin to be utilized) and the construction of phase-2 of two years continuously, the period of the calculation (project life) for the economic analysis is assumed to be thirty two years from the beginning of construction work.

(3) Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = 127.8 yen = 40.45 Peso (February,1998), the same rate as used in the cost estimation.

5.2.3 Economic Prices

(1) Method of Converting to Economic Prices from Market Prices

For the economic analysis, prices are expressed in economic prices rather than prices based on the border price concept. There are various methods to convert the market prices into border prices. Here, the border prices (economic prices) are calculated by eliminating transfer items, such as taxes, subsidies, etc.

In general, all the costs and benefits are divided into three categories : labor, tradable goods and non-tradable goods. And labor is further classified into skilled labor and unskilled labor. As for skilled labor, the economic price is determined by multiplying the market wage by the conversion factor for consumption. On the other hand, the economic price of unskilled labor is determined by multiplying the nominal wage by the shadow wage rate and the conversion factor for consumption. The prices of tradable goods are expressed in CIF and FOB value for import goods and export goods respectively.

These values show the actual border prices. However, as the border price of non-tradable goods cannot be converted directly, the border price of the inputs needed to produce the non-tradable goods is considered. After some classification of the non-tradable goods, the economic price of a small amount of the non-tradable goods is calculated by multiplying the market prices by the standard conversion factor directly.

(2) Transfer Items

Import / export duties, other taxes and subsidies are merely transfer items which do not actually reflect any consumption of national resources. Therefore, these transfer items should be excluded in the calculation of the costs and benefits of the project for the economic analysis.

(3) Conversion Factors

Conversion factors for goods and labor are determined as follows:

1) Standard conversion factor (SCF)

The standard conversion factor is used to determine the economic prices of certain goods which cannot be directly revalued at border prices. These goods include most non-tradable goods and services. The standard conversion factor is expressed by the following equation:

$$SCF = \frac{(X+M)}{\{(X-Tx)+(M+Tm)\}}$$

where,
X : Value of exports
M : Value of Imports
Tx : Value of taxes on export
Tm : Value of taxes on import

The calculated result of SCF is as shown in Table 5.2.3-1. The SCF of 0.947 in 1997 is adopted according to the past records of trade and customs.

Table 5.2.3-1 Estimation of Standard Conversion Factor in 1997

Items	Unit	Tradable goods
Total amount of Imports (CIF)	Million US$	42,242
Total amount of Exports (FOB)	Million US$	25,228
Total taxes on Imports	Million US$	3,750
Total taxes on Exports	Million US$	0
Conversion Factor : SCF		0.947

Source; Economic Indicators, National Statistical Coordination Board, 1997

2) Conversion factor for consumption (CFC)

This conversion factor is used to convert the market prices of consumption goods into the border prices. The conversion factor for consumption is usually calculated in the same manner as the SCF, replacing total imports and exports by those of consumption goods only.

However, value for the abovementioned consumption goods has not been announced officially. So hereinafter, foreign exchange premium (1.2) based on NEDA guide-line will be adopted to determine the conversion factor for consumption goods.

Conversion factor for consumption is expressed by the following equation:

$$CFC = 1 / 1.2 = 0.833$$

3) Conversion factor for skilled labor

The cost of skilled labor is calculated based on actual market wages, assuming that the market mechanism is functioning properly. However, as these are domestic costs or market costs, they are converted into border prices by multiplying the market wage by the CFC.

$$\text{The Conversion Factor for Skilled Labor} = (\text{Market wage rate}) \times (\text{CFC}) = 1 \times 0.833 = 0.833$$

4) Conversion factor for unskilled labor

As the wages paid to unskilled labor by a project are usually far the above opportunity cost, these market wages should not be used for calculation of the economic value of the unskilled labor. Considering the labor market, the labor is usually provided from the agriculture sector. Therefore, in this study, the economic cost of unskilled labor is estimated based on a simplified measure of the opportunity cost considering the productivity of the agriculture sector.

The conversion factor for unskilled labor is calculated by the following formula.

$$\begin{array}{c}\text{Conversion Factor}\\ \text{for Unskilled Labor}\end{array} = \frac{\text{Opportunity Cost}}{\text{Worker's Cost of Construction}} \times \text{CFC}$$

$$= (140.0 / 190.0) \times 0.833 = 0.614$$

5.2.4 Costs of the Projects

The items that should be considered as costs of the projects(difference between "With" case and "Without" case) are construction costs, re-investment costs and operation costs. The project costs must be converted from market prices into economic prices for the economic analysis.

(1) Construction Costs

Construction costs are divided into such categories as foreign currency portion and local currency portion.

The costs of local currency portion are divided into such categories as non-tradable goods, skilled labor, unskilled labor and transfer items.

The cost of non-tradable goods are converted to economic prices by multiplying by the SCF.

The costs of skilled labor and unskilled labor at market prices are converted to economic prices by multiplying by the CFC for skilled labor and the conversion factor for unskilled labor respectively.

Table 5.2.4-1 shows estimation of construction cost to convert to economic prices by multiplying by the SCF and CFC. Aggregated conversion factor is 0.930 which is only adopted for the initial investment.

Table 5.2.4-1 Estimation of Construction Cost (Initial Investment)

Unit: 1000 US$

	Foreign Currency Total	Local Currency Total					Total
			Non-tradable	Skilled Labor	Unskilled labor	Transfer Item	
Financial Price	138,811	59,877	38,920	8,383	3,593	8,982	198,688
			(SCF)	(CFC)			Aggregated C.F.
	1.000		0.947	0.833	0.614	0	0.930
Economic Price	138,811	46,062	36,871	6,986	2,206	0	184,873

(2) Re-investment Costs

The re-investment costs for equipment after their useful lifetimes are considered.

(3) Operation Costs

1) Maintenance costs

The costs of maintaining the port facilities are estimated as a fixed proportion (1% for structures, 4% for cargo handling equipment) of the original construction costs excluding the costs of dredging and reclamation costs.

2) Personnel costs

Personnel costs are based on the estimation in the following section "Financial Analysis", and the costs are converted to economic prices by the CFC for skilled labor.

3) Others

Other costs are based on the estimation in the following section "Financial Analysis", and the costs are estimated as 40% of the personnel costs.

(4) Summary of Costs

Table 5.2.4-2 shows the economic prices of the construction costs, re-investment costs and operation costs by years.

Table 5.2.4-2 Cost in Economic Prices by Year

Unit: US$ 1,000

	Calender Year	Construction Costs	Re-investment Costs	Operation Costs			Total Costs
				Maintenace	Personnel	Others	
1	2003	14,587	0	0	0		14,587
2	2004	29,174	0	0	0		29,174
3	2005	64,201	0	912	892	310	66,315
4	2006	34,365	0	1,852	1,413	565	38,196
5	2007	42,547	0	2,724	1,842	737	47,850
6	2008	0	0	3,568	2,271	908	6,747
7	2009	0	0	3,568	2,271	908	6,747
8	2010	0	0	3,568	2,271	908	6,747
9	2011	0	0	3,568	2,271	908	6,747
10	2012	0	0	3,568	2,271	908	6,747
11	2013	0	10,544	3,568	2,271	908	17,291
12	2014	0	0	3,568	2,271	908	6,747
13	2015	0	9,095	3,568	2,271	908	15,842
14	2016	0	0	3,568	2,271	908	6,747
15	2017	0	0	3,568	2,271	908	6,747
16	2018	0	0	3,568	2,271	908	6,747
17	2019	0	0	3,568	2,271	908	6,747
18	2020	0	12,500	3,568	2,271	908	19,247
19	2021	0	10,544	3,568	2,271	908	17,291
20	2022	0	12,500	3,568	2,271	908	19,247
21	2023	0	9,095	3,568	2,271	908	15,842
22	2024	0	0	3,568	2,271	908	6,747
23	2025	0	0	3,568	2,271	908	6,747
24	2026	0	0	3,568	2,271	908	6,747
25	2027	0	0	3,568	2,271	908	6,747
26	2028	0	0	3,568	2,271	908	6,747
27	2029	0	10,544	3,568	2,271	908	17,291
28	2030	0	0	3,568	2,271	908	6,747
29	2031	0	9,095	3,568	2,271	908	15,842
30	2032	0	0	3,568	2,271	908	6,747
31	2033	0	0	3,568	2,271	908	6,747
32	2034	0	0	3,568	2,271	908	6,747
Total		184,873	83,917	101,822	65,465	26,140	462,216

5.2.5 Benefits of the Projects

(1) Benefit Items

As the benefits brought about by the short-term plan of the study port, the following items are identified.

1) Saving in land transportation costs
2) Saving in water transportation cost by enlargement of ship size
3) Saving of costs in cargo handling
4) Saving in interest of cargo costs
5) Reduction of cargo damage and accidents at the port
6) Promotion of regional economic development
7) Increase in employment opportunities and income

Item 1), 2), 3), 4) and 6) are considered countable and in this study the monetary benefits of item 1), 3) and 6) are calculated.

(2) Calculation of Benefits

1) Saving in land transportation costs

a) Container cargo for industrial estate at SBFZ

In the "without" case , investment activities for industrial park located in SBFZ might be delayed or canceled. In this study, only the on-going projects of Industrial Park phase I & II and Technopark phase I will be developed. Other projects such as Industrial Park phase III and Technopark phase II will not be developed.

Based on above assumption, in the "Without" case, 70% of the export containerized cargo generated at factories located in SBFZ is transported to Manila and 20% of import containerized cargo needed at factories located in SBFZ is transported to SBFZ from Manila as at present (see Table 4.3.1-6, chapter 4.3.1, volume 2).

In the "With" case, all of the export and import container cargo will be loaded/unloaded at SBF.

Therefore, savings in land transportation costs can be considered as a benefit of the project. The benefit that will accrue to the national economy from the projects can be calculated by the following formula.

Savings in land transportation costs

= 70% of the export and 20% of import container cargo volume

× Pesos 8,280/TEU (transportation cost from SBF to Manila port)

b) Container cargo for industrial estate outside of SBFZ

In the "Without" case , containerized cargoes for industrial estates located in Region III will be transported to/from Metro Manila in the same manner as at present. However containerized cargo volume through SBF will be decreased year by year from 2001 due to the limitation of container handling capacity of SBF.

The development of these industrial estates will continue but there will be no coordination with the development of SBF. Therefore, the containerized cargo volumes at industrial estates will gradually increase as the national economy grows. And then these cargoes will be transported to/from Manila Port for export/import in the same manner as at present.

However, in the "With" case, considering the transportation cost from each industrial estate to Subic/Metro Manila, all of these cargoes will move through SBF instead of Manila port. Hereinafter, the transportation cost from each industrial estate to SBF/Manila port will be determined by considering the development plan of each industrial estate.

In the "Without" case, containerized cargo demand from industrial estates located in Region III to Manila ports in each year is shown in the following Table 5.2.5-1.

Table 5.2.5-1 Forecasted Containerized Cargo Volume through Manila Port

Unit: TEU

Industrial Estate	Year				
	2000	2005	2010	2015	2020
Bataan EPZ	3,056	7,255	27,960	42,154	41,323
C. S. E. Z	18,909	35,359	119,246	159,803	140,989
A. Industrial. P.	6,546	8,160	18,346	18,439	16,268
Luisita I. P.	5,501	13,055	47,698	66,379	65,072
B. C. E. Z.	175	345	913	918	810
Hermosa	0	19,039	85,612	137,676	151,835
Total	34,188	83,213	299,776	425,369	416,297

Based on above cargo volume, calculation method for differential cost of land transportation between SBF to each industrial estate and Manila port to each industrial estate in 2005 is shown in the following Table 5.2.5-2.

Table 5.2.5-2 Comparison of Land Transportation Cost

2005 year

Destination	Rate	Transportation Cost	Industrial Estate	Cargo Volume	Rate	Transportation Cost	Destination
	Peso	Peso		(TEU)	Peso	Peso	
Subic	4,600	33,370,718	Bataan EPZ	7,255	9,000	65,290,535	Manila
Subic	5,100	180,330,530	C. S. E. Z	35,359	5,720	202,253,065	Manila
Subic	5,100	41,614,606	A. Indust. P.	8,160	5,720	46,673,637	Manila
Subic	5,900	77,027,030	Luisita I. P.	13,055	7,480	97,654,608	Manila
Subic	12,279	4,238,190	B. C. E. Z.	345	13,760	4,749,260	Manila
Subic	3,000	57,118,422	Hermosa	19,039	6,600	125,660,528	Manila
		393,699,497		83,213		542,281,634	
Average	4,731				6,517		

Source; Trucking Rate for Containerized Cargo

Confederation of Truckers' Association of the Philippines, Inc.

As a result, difference of transportation cost in 2005 year is 1,786 pesos.

Based on above calculation method with demand forecast in each year, the difference in land transportation cost is shown in the following Table 5.2.5-3.

Table 5.2.5-3 Difference of Transportation Rate (per TEU)

Year	Transportation Rate (Peso/TEU)		Difference (Peso)
	Subic to Industrial Estates	Manila to Industrial Estates	
2005	4,731	6,517	1,786
2010	4,603	6,582	1,979
2015	4,511	6,622	2,111
2020	4,423	6,657	2,234

Based on the above, there are significant differences in transportation cost between SBF and Manila ports to industrial estates. This difference can be considered as a benefit of the project in the "With" case and "Without" case.

The benefit at each year that will accrue to the national economy from the projects can be calculated by the following formula.

Savings in land transportation costs

= Difference of transportation cost

× (Cargo volume through Manila port in the "Without case"

- Cargo volume through Manila port in the "With" case)

c) Non-container cargo through SBFZ

In the "Without" case, import and export non-containerized cargo volume for Region III through SBF will decrease year by year from 2005 because the deterioration of existing facilities will result in a reduced cargo handling capacity.

Cargo volume forecasted in the "With" and "Without" case is given in chapter 2, volume 3. (see Table 2.2.2-6)

Generally, non-containerized cargo can be considered as consumable goods. There is a correlation between population of each province of Region III and non-containerized cargo volume consumed at each province. Also SBF and Manila port share a common hinterland in Region III.

The result of calculation for transportation distance and cost to the each province from SBF or Manila port is determined more or less same. However, certain provinces like Zambales and Bataan are clearly located closer to SBF than Manila port. Therefore, differential transportation cost of non-containerized cargoes for aforesaid provinces will be determined hereafter.

Population ratio of Zambales and Bataan in Region III is 14.8% in 1995. Non-containerized cargo volume through SBF in the "With" and "Without" case will be assumed an object for benefit due to difference transportation cost by multiplying by the population ratio.

Table 5.2.5-4 shows the difference of transportation cost per one truck from SBF and Manila port to above two provinces, respectively.

Table 5.2.5-4 Difference of Transportation Cost

Transportation Cost (Peso / Truck)		Difference (Peso)
SBF to Two Provinces	Manila port to Two Provinces	
4,971	10,740	5,769

Source: Estimated by Trucking Rate for Containerized Cargo
Confederation of Truckers' Association of the Philippines, Inc.

Based on the above, difference of land transportation cost can be considered as a benefit of the project.

The benefit at each year that will accrue to the national economy from the projects can be calculated by the following formula.

Savings in land transportation costs
= Difference of transportation cost (10 tons/truck)
× { (Cargo volume in the "With" case - Cargo volume in the "Without" case)
× 14.8% population ratio }

The benefits obtained at item a), b) and c) are including some expenses such as labor costs and equipment costs. Therefore, to obtain actual benefits which will accrue to the national economy, a conversion factor of 0.6 is used in this study.

2) Saving of costs in cargo handling

At present, an arbitrary charge (outport surcharge) of more than US$ 200 per one TEU is levied on container handling cargo by the shipping companies because the arrival of container ships is troublesome to SBF due to the small container cargo volume. However, as long as this charge is levied at SBF, remarkable development of SBF can not be expected.

In the "With" case, once port facilities have been developed sufficiently in 2005, and then container cargo volume is to be increased, this arbitrary charge will no longer be levied. In the "Without" case, this arbitrary charge for import/export container cargo will continue.

Amount of this arbitrary charge can be considered more less the same as the inland transportation cost from SBF to Manila ports. If arbitrary charge is much higher than inland transportation cost, all shippers located in SBFZ will transport container cargo to Manila ports. At present, about 80% of import container cargoes are handled at SBF. This is because the inland transportation cost from Manila to SBF is higher than the arbitrary charge. On the other hand, only 30% of export container cargoes are handled at SBF. This is because export cargoes are mostly valuable goods and delivery time is more important to the shipper. Therefore, shippers are sending container cargoes to Manila ports unwillingly in spite of the high cost.

Based on the above assumption, arbitrary charge and inland transportation cost are considered to be at the same level.

As for calculation of benefit, arbitrary charge is conservatively set up according to the following idea.

Arbitrary charge (per TEU) = Transportation cost (9,200 pesos) × 0.8
= 7,360 Pesos/TEU

The whole benefit due to the abolishment of arbitrary charge that will accrue to the national economy from the projects can be calculated by the following formula.

Savings of arbitrary charge costs
= Import and export containerized cargo (110,000 TEU) in the "Without" case
× US$182 per one TEU

3) Promotion of regional economic development

In the preceding section, it was noted that Industrial Park phase III and Technopark phase II would not be developed in future in the "Without" case.

In this study, amount of value added created from the factories located in Industrial Park phase III and Technopark phase II in future will be estimated. And then, benefits of the "With" case will be determined.

Amount of value added at each type of industry varies. Industry in the aforesaid industrial estates is classified into three types as mentioned in Chapter 7.3.4 volume 2. Amount of value added per square meter is obtained from a Japanese report (Investigation of Unit Rate for Conditions of location of industry). In this study, located factories at SBFZ are mostly foreign and materials and products in these factories are imported/exported abroad. Therefore, unit rate of amount of value added in Japan can be used to exchange to local currency. However, amount of value added per square meter includes the cost of labor. Therefore, converting the labor cost to local currency is necessary.

The whole benefit that will accrue to the national economy from the projects can be calculated by the following formula.

Benefit = Unit Rate of Amount of value added (US$/ m2)
× Factory area (m2) × Contribution rate to port (%)

Hereinafter, two methods will be applied to determine contribution rate to port.

a) Based on examples in port cities such as Yokohama, Kobe and Kitakyushu City, the port will accrue about 20% of direct effect value in the value added borne by the local economic zone. However, the electricity, water service, road and port in SBFZ is considered to be public property. Therefore, one quarter of public property is 5%. This is applied as the amount of value added borne by the project.
b) In the "Without" case, the factories which were planning to locate in Industrial Park phase Ⅲ and Technopark phase Ⅱ will look elsewhere. But if such factories go to other industrial estates located in Batangas, Cavite, Bataan etc., they would still be contributing to the national economy of the Philippines. However, among the factories which are planning to locate in Industrial Park phase Ⅲ and Technopark phase Ⅱ, some have been attracted by the close proximity of the airport.

Based on questionnaire survey of present locators, it can be assumed that about 20% of the factories are investing here principally because of the airport. In the preceding paragraph, the value added to port is one quarter of public property. Based on this theory, actual value added to port will be 5%.

Based on the above, the value added to port is 5% of the amount of value added borne by the project.

(3) Summary of Benefits

Table 5.2.5-5 shows the results of the benefits by above method.

Table 5.2.5-5 Benefits of the Project

Unit: US$ 1,000

	Calender Year	Factories Development Profit	Transportation Cost			Arbitrary Charge	Total Benefits
			Container SBFZ	Container Outside SBFZ	Non-container		
1	2003	0	0	0	0	0	0
2	2004	0	0	0	0	0	0
3	2005	4,400	2,436	774	0	10,008	17,619
4	2006	12,266	4,926	3,164	31	20,017	40,404
5	2007	15,733	4,986	4,847	62	20,017	45,644
6	2008	19,200	5,052	6,597	93	20,017	50,959
7	2009	22,666	5,127	7,427	125	20,017	55,362
8	2010	26,133	5,209	8,288	158	20,017	59,804
9	2011	27,840	5,284	9,195	180	20,017	62,515
10	2012	29,546	5,368	10,128	202	20,017	65,261
11	2013	31,253	5,462	11,086	225	20,017	68,043
12	2014	32,960	5,565	12,071	249	20,017	70,861
13	2015	34,666	5,678	13,083	273	20,017	73,718
14	2016	34,666	5,811	13,422	298	20,017	74,214
15	2017	34,666	5,955	13,577	324	20,017	74,539
16	2018	34,666	6,080	13,706	350	20,017	74,819
17	2019	34,666	6,080	13,755	377	20,017	74,896
18	2020	34,666	6,080	13,795	405	20,017	74,964
19	2021	34,666	6,080	13,795	405	20,017	74,964
20	2022	34,666	6,080	13,795	405	20,017	74,964
21	2023	34,666	6,080	13,795	405	20,017	74,964
22	2024	34,666	6,080	13,795	405	20,017	74,964
23	2025	34,666	6,080	13,795	405	20,017	74,964
24	2026	34,666	6,080	13,795	405	20,017	74,964
25	2027	34,666	6,080	13,795	405	20,017	74,964
26	2028	34,666	6,080	13,795	405	20,017	74,964
27	2029	34,666	6,080	13,795	405	20,017	74,964
28	2030	34,666	6,080	13,795	405	20,017	74,964
29	2031	34,666	6,080	13,795	405	20,017	74,964
30	2032	34,666	6,080	13,795	405	20,017	74,964
31	2033	34,666	6,080	13,795	405	20,017	74,964
32	2034	34,666	6,080	13,795	405	20,017	74,964
Total		915,320	170,221	348,050	9,024	590,499	2,033,115

5.2.6 Economic Internal Rate of Return (EIRR)

(1) Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the economic feasibility of the project. The EIRR is the discount rate which makes the costs and benefits of a project during the project life equal. It is calculated by using the following formula.

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

Where,
- n : Period of economic calculation (project life)
- Bi : Benefits in i-th year
- Ci : Costs in i-th year
- r : Discount rate

(2) Sensitivity Analysis

In order to determine whether the project is feasible when certain conditions change, a sensitivity analysis is made for the following three alternatives.

Case A: The costs increase by 10%
Case B: The benefits decrease by 10%
Case C: The costs increase by 10% and the benefits decrease by 10%

The sensitivity analysis for the three alternatives is calculated by using above formula as the base case and the results are shown in Table 5.2.6-1 (refer to Table 5.2.6-2(a) - (d)).

Table 5.2.6-1 Results of Sensitivity Analysis

Case	EIRR (%)
Base Case	29.0
Case A	26.1
Case B	25.8
Case C	23.2

5.3 Evaluation

There are various views concerning the critical percentage of EIRR to judge whether a project is feasible or not. The leading view is that the project is feasible if the EIRR exceeds the opportunity cost of capital (OCC).

In general, the opportunity cost of capital is considered to range from 10% to 15% based on the interest rate of a city bank in the Philippines.

It is generally considered that a project with an EIRR of more than 15% is economically feasible for infrastructure or social service projects.

As for this project, even though the economic calculation only takes into account the items which can be quantified, the EIRR (29.0%) exceeds 15%.

Therefore, this short-term plan development project is feasible from the viewpoint of the national economy.

Table 5.2.6-2 (a) Cost / Benefit Analysis of Short-term Plan (Base Case)

EIRR= 29.0%

Unit: US$ 1000

	Calender Year	Cost Total	Benefit Total	Benefit - Cost	Net Present Value (NPV) Benefit	Cost	Benefit - Cost
1	2003	14,587	0	-14,587	0	14,587	-14,587
2	2004	29,174	0	-29,174	0	22,620	-22,620
3	2005	66,315	17,619	-48,696	10,592	39,866	-29,275
4	2006	38,196	40,404	2,208	18,833	17,804	1,029
5	2007	47,850	45,644	-2,206	16,496	17,293	-797
6	2008	6,747	50,959	44,212	14,279	1,891	12,389
7	2009	6,747	55,362	48,614	12,028	1,466	10,562
8	2010	6,747	59,804	53,057	10,074	1,137	8,938
9	2011	6,747	62,515	55,768	8,165	881	7,284
10	2012	6,747	65,261	58,514	6,609	683	5,926
11	2013	17,291	68,043	50,751	5,343	1,358	3,985
12	2014	6,747	70,861	64,114	4,314	411	3,903
13	2015	15,842	73,718	57,875	3,480	748	2,732
14	2016	6,747	74,214	67,467	2,716	247	2,469
15	2017	6,747	74,539	67,791	2,115	191	1,924
16	2018	6,747	74,819	68,072	1,646	148	1,498
17	2019	6,747	74,896	68,149	1,278	115	1,163
18	2020	19,247	74,964	55,717	992	255	737
19	2021	17,291	74,964	57,673	769	177	591
20	2022	19,247	74,964	55,717	596	153	443
21	2023	15,842	74,964	59,122	462	98	365
22	2024	6,747	74,964	68,217	358	32	326
23	2025	6,747	74,964	68,217	278	25	253
24	2026	6,747	74,964	68,217	215	19	196
25	2027	6,747	74,964	68,217	167	15	152
26	2028	6,747	74,964	68,217	130	12	118
27	2029	17,291	74,964	57,673	100	23	77
28	2030	6,747	74,964	68,217	78	7	71
29	2031	15,842	74,964	59,122	60	13	48
30	2032	6,747	74,964	68,217	47	4	43
31	2033	6,747	74,964	68,217	36	3	33
32	2034	6,747	74,964	68,217	28	3	26
Total		462,216	2,033,115	1,570,899	122,285	122,285	0

Table 5.2.6-2 (b) Cost / Benefit Analysis of Short-term Plan (Case A)

EIRR= 26.1%

Unit: US$ 1000

	Calender Year	Cost Total	Benefit Total	Benefit - Cost	Net Present Value (NPV) Benefit	Cost	Benefit - Cost
1	2003	16,045	0	-16,045	0	16,045	-16,045
2	2004	32,091	0	-32,091	0	25,445	-25,445
3	2005	72,947	17,619	-55,328	11,077	45,861	-34,784
4	2006	42,016	40,404	-1,612	20,141	20,944	-804
5	2007	52,635	45,644		18,041	20,804	-2,763
6	2008	7,422	50,959	43,537	15,970	2,326	13,644
7	2009	7,422	55,362	47,940	13,757	1,844	11,912
8	2010	7,422	59,804	52,382	11,783	1,462	10,321
9	2011	7,422	62,515	55,093	9,766	1,159	8,607
10	2012	7,422	65,261	57,839	8,084	919	7,164
11	2013	19,020	68,043	49,022	6,683	1,868	4,815
12	2014	7,422	70,861	63,439	5,518	578	4,940
13	2015	17,427	73,718	56,291	4,552	1,076	3,476
14	2016	7,422	74,214	66,792	3,633	363	3,270
15	2017	7,422	74,539	67,117	2,893	288	2,605
16	2018	7,422	74,819	67,397	2,303	228	2,074
17	2019	7,422	74,896	67,474	1,828	181	1,647
18	2020	21,172	74,964	53,792	1,451	410	1,041
19	2021	19,020	74,964	55,943	1,150	292	858
20	2022	21,172	74,964	53,792	912	258	654
21	2023	17,427	74,964	57,537	723	168	555
22	2024	7,422	74,964	67,542	573	57	517
23	2025	7,422	74,964	67,542	455	45	410
24	2026	7,422	74,964	67,542	360	36	325
25	2027	7,422	74,964	67,542	286	28	258
26	2028	7,422	74,964	67,542	227	22	204
27	2029	19,020	74,964	55,943	180	46	134
28	2030	7,422	74,964	67,542	142	14	128
29	2031	17,427	74,964	57,537	113	26	87
30	2032	7,422	74,964	67,542	90	9	81
31	2033	7,422	74,964	67,542	71	7	64
32	2034	7,422	74,964	67,542	56	6	51
Total		508,437	2,033,115	1,524,677	142,816	142,816	0

Table 5.2.6-2 (c) Cost / Benefit Analysis of Short-term Plan (Case B)

EIRR= 25.8%

Unit: US$ 1000

	Calender Year	Cost Total	Benefit Total	Benefit - Cost	Net Present Value (NPV) Benefit	Cost	Benefit - Cost
1	2003	14,587	0	-14,587	0	14,587	-14,587
2	2004	29,174	0	-29,174	0	23,184	-23,184
3	2005	66,315	15,857	-50,458	10,014	41,882	-31,867
4	2006	38,196	36,363	-1,833	18,251	19,171	-920
5	2007	47,850	41,080		16,385	19,086	-2,700
6	2008	6,747	45,863	39,116	14,538	2,139	12,399
7	2009	6,747	49,826	43,078	12,551	1,700	10,852
8	2010	6,747	53,824	47,077	10,775	1,351	9,424
9	2011	6,747	56,264	49,516	8,951	1,073	7,878
10	2012	6,747	58,735	51,987	7,426	853	6,573
11	2013	17,291	61,238	43,947	6,153	1,737	4,416
12	2014	6,747	63,775	57,028	5,092	539	4,554
13	2015	15,842	66,346	50,504	4,210	1,005	3,205
14	2016	6,747	66,793	60,045	3,368	340	3,028
15	2017	6,747	67,085	60,337	2,689	270	2,418
16	2018	6,747	67,337	60,590	2,145	215	1,930
17	2019	6,747	67,406	60,659	1,706	171	1,535
18	2020	19,247	67,467	48,220	1,357	387	970
19	2021	17,291	67,467	50,176	1,078	276	802
20	2022	19,247	67,467	48,220	857	245	613
21	2023	15,842	67,467	51,625	681	160	521
22	2024	6,747	67,467	60,720	541	54	487
23	2025	6,747	67,467	60,720	430	43	387
24	2026	6,747	67,467	60,720	342	34	308
25	2027	6,747	67,467	60,720	272	27	245
26	2028	6,747	67,467	60,720	216	22	194
27	2029	17,291	67,467	50,176	172	44	128
28	2030	6,747	67,467	60,720	136	14	123
29	2031	15,842	67,467	51,625	108	25	83
30	2032	6,747	67,467	60,720	86	9	78
31	2033	6,747	67,467	60,720	68	7	62
32	2034	6,747	67,467	60,720	54	5	49
Total		462,216	1,829,803	1,367,587	130,655	130,655	0

Table 5.2.6-2 (d) Cost / Benefit Analysis of Short-term Plan (Case C)

EIRR= 23.2%

Unit: US$ 1000

	Calender Year	Cost Total	Benefit Total	Benefit - Cost	Net Present Value (NPV) Benefit	Cost	Benefit - Cost
1	2003	16,045	0	-16,045	0	16,045	-16,045
2	2004	32,091	0	-32,091	0	26,041	-26,041
3	2005	72,947	15,857	-57,090	10,441	48,034	-37,592
4	2006	42,016	36,363	-5,652	19,430	22,450	-3,020
5	2007	52,635	41,080	-11,555	17,812	22,822	-5,010
6	2008	7,422	45,863	38,441	16,137	2,611	13,526
7	2009	7,422	49,826	42,403	14,226	2,119	12,107
8	2010	7,422	53,824	46,402	12,470	1,720	10,751
9	2011	7,422	56,264	48,842	10,578	1,395	9,182
10	2012	7,422	58,735	51,313	8,961	1,132	7,828
11	2013	19,020	61,238	42,218	7,581	2,355	5,226
12	2014	7,422	63,775	56,353	6,407	746	5,661
13	2015	17,427	66,346	48,919	5,408	1,421	3,988
14	2016	7,422	66,793	59,371	4,418	491	3,927
15	2017	7,422	67,085	59,663	3,601	398	3,203
16	2018	7,422	67,337	59,915	2,933	323	2,610
17	2019	7,422	67,406	59,984	2,383	262	2,120
18	2020	21,172	67,467	46,295	1,935	607	1,328
19	2021	19,020	67,467	48,447	1,570	443	1,128
20	2022	21,172	67,467	46,295	1,274	400	874
21	2023	17,427	67,467	50,041	1,034	267	767
22	2024	7,422	67,467	60,045	839	92	747
23	2025	7,422	67,467	60,045	681	75	606
24	2026	7,422	67,467	60,045	553	61	492
25	2027	7,422	67,467	60,045	448	49	399
26	2028	7,422	67,467	60,045	364	40	324
27	2029	19,020	67,467	48,447	295	83	212
28	2030	7,422	67,467	60,045	240	26	213
29	2031	17,427	67,467	50,041	194	50	144
30	2032	7,422	67,467	60,045	158	17	140
31	2033	7,422	67,467	60,045	128	14	114
32	2034	7,422	67,467	60,045	104	11	92
Total		508,437	1,829,803	1,321,366	152,603	152,603	0

6. Financial Analysis

6.1 Objective and Methodology of the Financial Analysis

6.1.1 Objective

The purpose of the financial analysis is to evaluate the financial feasibility of the project. The analysis focuses on the viability of the project itself and the financial soundness of the port management body (SBMA) during the project life.

6.1.2 Methodology

(1) 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 revenue over the project life equal, i.e. the rate "r" that satisfies the following formula:

$$\sum_{i=1}^{n} = \frac{Bi - Ci}{(1+r)^{i-1}} = 0 \qquad \cdots (6.1)$$

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 elements of revenue and cost which are taken into account for the FIRR calculation are summarized in Table 6.1.2-1.

Table 6.1.2-1 The Revenue and Cost Elements Employed in the FIRR Calculation

Revenues	Costs
1) Port operating revenues	1) Investments for the project (initial investments for the project and replacement/overhaul of Equipment) 2) Operating expenses such as maintenance, repair, personnel and other costs

The revenue and cost items excluded from the FIRR calculation are summarized in Table 6.1.2-2.

Table 6.1.2-2 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

When the FIRR exceeds a certain threshold, the project is assessed to be financially feasible: the weighted average of the interest rates of various funds generated for the project is used as the threshold.

(2) Financial soundness of the port management body

The financial soundness of the port management body 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:

a. Profitability

Rate of Return on Net Fixed Asset

$$= \frac{\textbf{Net Operating Income}}{\textbf{Total Fixed Assets}} \times 100\,\%$$

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.

b. Loan repayment capacity

Debt Service Coverage Ratio

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

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).

c. Operational efficiency

Operating Ratio

$$= \frac{\text{Operating Expenses}}{\text{Operating revenues}} \times 100\ \%$$

Working Ratio

$$= \frac{\text{Operating Expenses} - \text{Depreciation Expenses}}{\text{Operating Revenues}} \times 100\ \%$$

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.

6.2 General Prerequisites of Financial Analysis

6.2.1 Scope of the Analysis

SBMA is assumed to be responsible for the investment in such items as the construction of a new wharf at Cubi Point having a length of 585m (two berths), repair of NSD marine terminal, installation of four container gantry cranes and the construction of access road between the new Cubi wharf and Boton wharf and utilities.

SBMA is assumed to be the owner of the port facilities which are to be leased to container terminal operators. It is further assumed that the new container wharf is leased to two separate operators, namely Operator A and Operator B. Both operators lease 280m long berthes, container yard and two container gantry cranes. The non-container wharves are assumed to be public wharves and shall be rented to the stevedoring companies on a per day or per hour base.

The financial analysis considers the project of the short-term plan. There are three entities: the port management body (SBMA), Operator A and Operator B. It is assumed that Operator A starts its operation at the middle of 2005, and Operator B starts at the middle of 2007.

The costs Ci and revenues Bi in Formula (6.1) are defined as the difference of costs and revenues between "the With Case" and "the Without Case".

With Case	: Short-term plan is implemented
Without Case	: Short-term plan is not implemented

6.2.2 Project Life and Base Year

Taking account of the conditions of the long-term loans and the service lives of various elements of the port facilities, the project life for the financial analysis is determined as 32 years after the first investment is made: the construction period of two years and the operating period of 30 years. It is also assumed that construction starts in 2003, i.e. the Base year.

6.2.3 Revenue and Expenditure

In principal, all costs and revenues are indicated in prices as of February 1998 (US$1.00=127.8yen=40.45 Peso). Neither price inflation nor increases in nominal wage are considered during the project life.

(1) Cargo handling volume and calling vessels

The cargo handling volume and calling vessels are estimated based on the cargo traffic forecast. The volume and number of vessels estimated are shown in Table 6.2.3-1(With Case) and Table 6.2.3-2 (Without Case). The volume to be handled by each operator is Table 6.2.3-3 and Figure 6.2.3-1. The handling capacity at the container cargo berths will reach its limit in 2016. There cargo volume and the ship calls are used for the calculation of the revenues.

(2) Revenue and Cost Items

The SBMA has announced that it will revise its port tariff. The financial analysis employs the revised tariff, and all the revenues are calculated on the basis of the revised tariff.

The items of the cost shouldered and the revenue obtained by the SBMA and those by the operators are assumed to be as listed in Table 6.2.3-4.

The revenues during the project life are shown in Table 6.2.3-1 and Table 6.2.3-2.

Table 6.2.3-4 Cost and Revenue Items Allocated to SBMA and Operators

	SBMA	Operator A and Operator B
Cost	1. Construction cost (excluding operator's building) 2. Installation of gantry cranes 3. Administration cost	1. Construction cost of operator's building 2. Installation of handling equipment other than gantry cranes 3. Lease fee (container terminal) 4. Daily maintenance cost 5. Administration and operation cost
Revenue	1. Pilotage Fee 2. Harbor Fee 3. Berthing Fee for non-container ships (excluding Berthing Fee for container ships) 4. Wharfage & storage Fee (non-container wharf) 5. Lease fee (container terminal)	1. Berthing Fee for container ships 2. Cargo handling charge (container cargoes)

Table 6.2.3-1 Revenue in With Case

```
pilotage  (5000-10000)                                             U00= 53.468
pilotage(10001-15000)                                               U0= 72.668   (US$/vessel)
Navigation Revenues(container )                                     U1= 0.06     (US$/GT)
Navigation Revenues( Non-Container )                                U2= 0.20     (US$/GT)

Handling  Revenues(Container Cargo)                  Import         U3= 72.64    (US$/TEU)
                                                     Export         U4= 60.6     (US$/TEU)
Handling Revenues(Non-Container)                     Import         U5= 0.972    (US$/tons)
                                                     Export         U6= 0.521    (US$/tons)
```

(unit : US$.)

Year	Cargo Volume				Calling Vessels										Revenue								
	Container		Non-Container		Container		Non-Container								Container Cargo				Non-Container				
	Import (1-1) (TEU)	Export (1-2) (TEU)	Import (2-1) (ton)	Export (2-2) (ton)	Number of calling Vessels (3)	Av.GT of Vessels (4)	Number of calling Vessels Import (5)	Av.GT of Vessels Import (6)	Number of calling Vessels Export (7)	Av.GT of Vessels Export (8)	Number of calling Vessels heavy Equ & others (9)	Av.GT of Vessels heavy Equ & others (10)	Number of calling Vessels cigarettes (11)	Av.GT of Vessels cigarettes (12)	Handling Operator A & Operator B	Navigation (3)*(4)*U1	pilotage (3)*U0	Sub Total	Handling (2-1)*U5+(2-2)*U6	Navigation {(5)*(6)+(7)*(8)+(9)*(10)+(11)*(12)}*U2	pilotage {(5)+(7)+(9)}*U00,U0	Sub Total	Grand Total (unit:1000US$)
2003	55,000	55,000	331,478	21,810	440	10,120	114	8,844			7	9,000	334	210	2,033,450	445,280	31,974	2,510,704	333,559	227,955	6,460	567,974	3,079
2004	55,000	55,000	346,113	23,031	440	10,120	99	9,609			7	9,000	334	210	2,033,450	445,280	31,974	2,510,704	348,421	216,568	7,559	572,548	3,083
2005	86,825	86,825	361,439	24,321	232	13,000	83	10,408	1	12,030	7	11,069	333	210	7,975,873	180,960	16,859	8,173,692	363,990	204,659	6,459	575,108	8,749
2006	118,651	118,651	373,006	25,683	283	13,000	86	10,399	1	12,030	8	11,077	362	210	15,937,531	220,740	20,565	16,178,836	375,943	214,200	6,903	597,046	16,776
2007	150,476	150,476	384,747	28,527	358	13,000	89	10,391	1	12,030	8	11,084	391	210	20,212,371	279,240	26,015	20,517,626	388,837	221,525	7,121	617,483	21,135
2008	182,301	182,301	396,677	30,124	434	13,000	92	10,384	1	12,030	9	11,091	420	210	24,487,278	338,520	31,538	24,857,336	401,265	231,069	7,412	639,746	25,497
2009	196,970	196,970	408,795	30,243	469	13,000	96	10,269	2	12,030	9	11,097	449	210	26,457,801	365,820	34,081	26,857,703	413,105	240,800	7,775	661,681	27,519
2010	211,707	211,707	421,111	31,937	504	13,000	99	10,265	2	12,030	10	11,102	478	210	28,437,190	393,120	36,625	28,866,935	425,959	250,344	8,066	684,369	29,551
2011	228,016	228,016	433,624	33,726	543	13,000	102	10,262	2	12,030	10	11,106	507	210	30,627,869	423,540	39,459	31,090,868	439,054	257,666	8,284	705,004	31,796
2012	244,401	244,401	446,340	35,614	582	13,000	105	10,259	2	12,030	11	11,110	536	210	32,828,757	453,960	42,293	33,325,010	452,397	267,211	8,575	728,183	34,053
2013	260,868	260,868	459,268	37,609	621	13,000	109	10,288	2	12,030	11	11,114	564	210	35,040,659	484,380	45,127	35,570,166	466,003	277,232	8,865	752,100	36,322
2014	277,417	277,417	472,399	39,714	661	13,000	112	10,285	2	12,030	12	11,117	593	210	37,263,576	515,580	48,034	37,827,190	479,863	286,776	9,156	775,795	38,603
2015	294,056	294,056	485,745	41,939	700	13,000	115	10,281	2	12,030	12	11,121	622	210	39,498,716	546,000	50,868	40,095,584	493,994	294,100	9,374	797,469	40,893
2016	297,000	297,000	499,298	44,288	707	13,000	118	10,278	2	12,030	13	11,123	651	210	39,894,030	551,460	51,376	40,496,866	508,392	303,644	9,665	821,701	41,319
2017	297,000	297,000	513,059	46,768	707	13,000	122	10,191	3	12,030	13	11,126	680	210	39,894,030	551,460	51,376	40,496,866	523,059	313,372	10,028	846,460	41,343
2018	297,000	297,000	527,036	49,386	707	13,000	125	10,191	3	12,030	14	11,131	709	210	39,894,030	551,460	51,376	40,496,866	538,009	322,926	10,319	871,254	41,368
2019	297,000	297,000	541,220	52,152	707	13,000	128	10,190	3	12,030	14	11,133	738	210	39,894,030	551,460	51,376	40,496,866	553,237	330,246	10,537	894,020	41,391
2020	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,787	10,828	919,363	41,416
2021	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2022	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2023	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2024	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2025	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2026	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2027	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2028	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2029	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2030	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2031	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2032	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2033	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
2034	297,000	297,000	555,613	55,073	707	13,000	131	10,189	3	12,030	15	11,133	767	210	39,894,030	551,460	51,376	40,496,866	568,749	339,783	10,828	919,359	41,416
Total	8,004,688	8,004,688	15,735,550	1,422,967	19,700	410,240	3,759	325,630	74	360,900	400	351,596	20,206	6,720	1,060,821,092	15,570,160	1,431,560	1,077,822,811	16,036,320	9,557,040	304,973	25,898,334	1,103,721

Table 6.2.3-2 Revenue in Without Case

pilotage (5000-10000)		U00= 53.468	
pilotage(10001-15000)		U0= 72.668	(US$/vessel)
Navigation Revenues(container)		U1! = 0.10	(US$/GT)
Navigation Revenues(Non-Container ExIm)		U2= 0.20	(US$/GT)
Handling Revenues(Container Cargo)	Import	U3! = 21.80	(US$/TEU)
	Export	U4! = 15.37	(US$/TEU)
Handling Revenues(Non-Container Cargo)	Import	U5= 0.972	(US$/tons)
	Export	U6= 0.521	(US$/tons)

(unit : US$.)

Year	Cargo Volume: Container Import (1-1) (TEU)	Cargo Volume: Container Export (1-2) (TEU)	Cargo Volume: Non-Container Import (2-1) (ton)	Cargo Volume: Non-Container Export (2-2) (ton)	Calling Vessels: Container Number of calling Vessels (3)	Calling Vessels: Container Av.GT of Vessels (4)	Calling Vessels: Non-Container Number of calling Vessels Import (5)	Av.GT of Vessels Import (6)	Number of calling Vessels Export (7)	Av.GT of Vessels Export (8)	Number of calling Vessels heavy Equ & others (9)	Av.GT of Vessels heavy Equ & others (10)	Number of calling Vessels cigarettes (11)	Av.GT of Vessels cigarettes (12)
2003	55,000	55,000	331,478	21,810	440	10,120	114	8,844			7	9,000	334	210
2004	55,000	55,000	346,113	23,031	440	10,120	99	9,609			7	9,000	334	210
2005	55,000	55,000	351,439	24,321	440	10,120	82	10,618	2	10,618	7	9,000	333	210
2006	55,000	55,000	352,654	24,281	440	10,120	80	11,510	2	11,510	7	9,000	339	210
2007	55,000	55,000	343,876	24,240	440	10,120	78	11,117	2	11,117	7	9,000	345	210
2008	55,000	55,000	335,108	24,195	440	10,120	77	10,724	2	10,724	7	9,000	350	210
2009	55,000	55,000	326,352	24,144	440	10,120	74	10,715	2	10,715	7	9,000	356	210
2010	55,000	55,000	317,612	24,083	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2011	55,000	55,000	316,286	24,600	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2012	55,000	55,000	314,918	25,128	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2013	55,000	55,000	313,507	25,673	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2014	55,000	55,000	312,052	26,234	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2015	55,000	55,000	310,554	26,813	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2016	55,000	55,000	309,010	27,409	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2017	55,000	55,000	307,420	28,023	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2018	55,000	55,000	305,785	28,654	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2019	55,000	55,000	304,103	29,304	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2020	55,000	55,000	302,373	29,971	440	10,120	74	10,611	2	10,611	7	9,000	361	210
2021	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2022	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2023	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2024	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2025	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2026	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2027	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2028	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2029	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2030	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2031	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2032	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2033	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
2034	55,000	55,000	302,373	29,971	440	10,120	51	10,608	1	10,608	5	9,000	250	210
Total	1,760,000	1,760,000	10,043,864	881,513	14,080	323,840	2,128	338,374	39	319,921	200	288,000	9,858	6,720

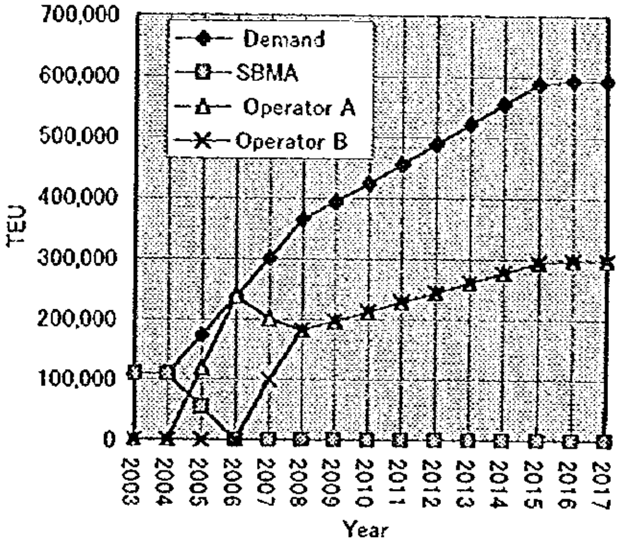
Year	Revenue: Container Cargo Handling (1-1)*U3!+(1-2)*U4!	Container Cargo Navigation (3)*(4)*U1!	Container Cargo pilotage (3)*U0	Container Cargo Sub Total	Non-Container Handling (2-1)*U5+(2-2)*U6	Non-Container Navigation {(5)*(6)+(7)*(8)+(9)*(10)+(11)*(12)}*U2	Non-Container pilotage {(5)+(7)+(9)}*U00,U0	Non-Container Sub Total	Grand Total (unit:1000US$)
2003	2,033,450	445,280	31,974	2,510,704	333,559	227,955	6,460	567,974	3,079
2004	2,033,450	445,280	31,974	2,510,704	348,421	216,568	7,559	572,548	3,083
2005	2,033,450	445,280	31,974	2,510,704	363,990	204,622	6,468	575,030	3,086
2006	2,033,450	445,280	31,974	2,510,704	355,431	215,455	6,329	577,215	3,088
2007	2,033,450	445,280	31,974	2,510,704	346,876	205,027	6,190	558,093	3,069
2008	2,033,450	445,280	31,974	2,510,704	338,330	196,985	6,123	541,438	3,052
2009	2,033,450	445,280	31,974	2,510,704	329,793	190,877	5,911	526,581	3,037
2010	2,033,450	445,280	31,974	2,510,704	321,269	187,566	5,844	514,678	3,025
2011	2,033,450	445,280	31,974	2,510,704	320,247	187,566	5,844	513,657	3,024
2012	2,033,450	445,280	31,974	2,510,704	319,192	187,566	5,844	512,602	3,023
2013	2,033,450	445,280	31,974	2,510,704	318,105	187,566	5,844	511,514	3,022
2014	2,033,450	445,280	31,974	2,510,704	316,983	187,566	5,844	510,392	3,021
2015	2,033,450	445,280	31,974	2,510,704	315,828	187,566	5,844	509,238	3,020
2016	2,033,450	445,280	31,974	2,510,704	314,638	187,566	5,844	508,047	3,019
2017	2,033,450	445,280	31,974	2,510,704	313,413	187,566	5,844	506,822	3,018
2018	2,033,450	445,280	31,974	2,510,704	312,152	187,566	5,844	505,562	3,016
2019	2,033,450	445,280	31,974	2,510,704	310,856	187,566	5,844	504,265	3,015
2020	2,033,450	445,280	31,974	2,510,704	309,522	187,566	5,844	502,931	3,014
2021	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2022	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2023	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2024	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2025	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2026	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2027	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2028	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2029	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2030	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2031	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2032	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2033	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
2034	2,033,450	445,280	31,974	2,510,704	309,522	129,823	4,046	443,391	2,954
Total	65,070,407	14,248,960	1,023,165	80,342,533	10,221,904	5,338,243	165,964	15,726,111	96,069

Table 6.2.3-3 Handling Volume Share of Operators

(TEU)

Year	Demand	SBMA	Operator A	Operator B
2003	110,000	110,000	0	0
2004	110,000	110,000	0	0
2005	173,650	55,000	118,650	0
2006	237,301	0	237,301	0
2007	300,951	0	200,634	100,317
2008	364,601	0	182,301	182,301
2009	393,941	0	196,971	196,971
2010	423,413	0	211,707	211,707
2011	456,032	0	228,016	228,016
2012	488,802	0	244,401	244,401
2013	521,735	0	260,868	260,868
2014	554,834	0	277,417	277,417
2015	588,113	0	294,057	294,057
2016	594,000	0	297,000	297,000
2017	594,000	0	297,000	297,000

Figure 6.2.3-1 Handling Volume Share of Operators



(3) Investment cost

Initial investment costs are summarized in Table 6.2.3-5

Table 6.2.3-5 Project Cost of SBMA and Operators Unit:US$1,000

	SBMA	Container Terminal		Non-container	Total
		Operator A	Operator B		
Civil works	122,993	-	-	-	
Building (CFS etc.) Phase1	-	3,047	-	-	
Phase2	-	-	3,047	-	129,087
Equipment Phase1 :2Gantry cranes	18,176	-	-	-	
Others (Transfer Crane etc.)	-	9,998	-	-	
Marine Terminal (Forklift etc)	-	-	-	1,593	
Phase2 :2Gantry crane	18,176	-	-	-	
Others (Transfer Crane etc.)	-	-	9,998	-	57,941
Rehabilitation of Marine Terminal	11,660	-	-	-	11,660
Total	171,005	13,045	13,045	1,593	198,688

(4) Operation Expenses

The annual operation expenses are calculated in following manner.

a. Personnel cost

The annual personnel costs are estimated based on the number of personnel required to manage and operate the port facilities to handle cargo volumes estimated. Personnel cost for SBMA and Operator A begins in 2005 while that for Operator B begins in 2007.

Table 6.2.3-6 Personnel Cost

	Number of Person	Personnel Cost per person per month (peso)	Months per year	Exchange rate $/peso	Personnel cost (US$)
SBMA	54	9,200	13	1$=40.45	159,664
Operator A	290	9,200	13	1$=40.45	857,454
Operator B	290	9,200	13	1$=40.45	857,454
Total	634				1,874,572

b. Administration and other costs

Administration and other costs are assumed as 40% of the total personnel cost. This ratio is the one observed at SBMA in recent years.

c. Maintenance and repair cost

The annual maintenance and repair costs for port facilities are calculated as follows:

Infrastructure :1.0% of the original construction cost
Cargo handling equipment :4.0% of the original procurement cost

d. Depreciation cost

The annual depreciation costs for port facilities and equipment are calculated by the straight line method based on their service lives. Residual values after all depreciation are estimated as zero. Depreciation cost is exempted from calculation of the analysis of the viability of the project. In the analysis of the influence on the financial soundness, depreciation cost is caluculated on the existing and planned facilities.

6.2.4 Fund Raising

Eighty-five percent of the initial investment by SBMA is assumed to be raised by foreign funds. The remaining 15% is assumed to be raised by domestic funds.

The following conditions are employed for the foreign funds.

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

The following conditions are employed for the domestic fund

Loan period	:10 years
Interest rate	:6% per annum (the real interest rate excluding inflation rate)
Repayment	:Fixed amount repayment of principal

The weighted average interest rate of the funds for investments by SBMA is 2.43% under the conditions stated above.

6.3 Financial Analysis

6.3.1 Analyzed Pattern

The FIRR of the project of the Short Term Plan is analyzed to clarify the viability of the project. The following lease schemes are considered.

1) Variable Fee

The amount that private container terminal operators pay is proportional to the traffic volume handled on the basis of a fixed amount per TEU.

2) Fixed Fee

The private container terminal operators pay a fixed amount annually, in accordance with the initial investment cost of SBMA, regardless of the actual number of containers handled by the operators.

3) Combinations of the variable fee and fixed fee

The private container terminal operators pay both the variable fee and fixed fee.

The first scheme is the most advantageous for the operators because they pay in accordance with the traffic volume; in other words, they pay as they earn. The second scheme is the most advantageous for SBMA. Because the annual income through the container terminal lease is fixed regardless of the container traffic volume. The third scheme takes a middle position between the variable fee and fixed fee is advantageous for both the operators and SBMA.

On the assumption that operators can charge US$67 per TEU, combinations of the variable fee and fixed fee lease plans have been employed. Under the variable fee plan, SBMA would receive US$3.5 per TEU handled, while in the fixed fee plan, SBMA recovers its initial investment cost multiplied by 3.5%. The fixed fee is equal to US$5.986 million/year for both operators.

6.3.2 Sensitivity Analysis

Sensitivity analysis is conducted to examine the impact of unexpected future changes (for example, decrease of the estimated cargo volume, increase of the construction cost).

The following three cases are envisioned: (1) the revenue decreases by 10% (2) the project cost increases by 10% and (3) the revenue decreases by 10% and the project cost increases by 10%.

6.4. Evaluation

6.4.1 Viability of the Project

The results of the FIRR calculation are shown in Table 6.4.1-1.

Under such condition that 85% of initial cost of SBMA is covered by a soft loan with interest rate of 1.8 % and the remaining 15% is covered by a loan with interest rate of 6%, while that of the Operators is covered by a loan with an interest rate of 6%, the weighted average interest rate is 2.9%.

In all cases, FIRR exceeds this rate. Judging from this analysis, this project is assessed to be financially viable.

Table 6.4.1-1 Result of the FIRR

Base Case	10% decrease in revenue	10% increase in cost	10% decrease in revenue & 10% increase in cost
11.1	9.3	9.7	8.0

6.4.2 Financial Soundness of SBMA

The financial statements and financial indicators, the rate of return fixed assets, debt service coverage ratio, operating ratio and working ratio of SBMA are shown in Table 6.4.2-1.

1) Profitability

The rate of return on net fixed assets exceeds 2.43%(weighted average interest rate of

SBMA) after 2006, the beginning of the operation.

2) Loan repayment capacity

The debt service coverage ratio exceeds 1.0 after 2005, the beginning of the operation.

3)Operational efficiency

The operating ratios keep below 70% (World Bank Standard) and the working ratios keeps below 50% (World Bank Standard) during the project life. This shows that the operation will be efficient.

4) Appraisal

Based on the above indicators, it can be judged that the financial status of SBMA can be easily secured.

6.4. 3 Conclusion

Judging from the above analysis, this project can be regarded as financially feasible. However, SBMA and Operators should make efforts to heighten the quality of the service, to improve cargo handling efficiency, to secure the forecast cargo volume, and to reduce operating expenses.

Table 6.4.2-1 Financial statements (SBMA)

Income Statement

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Operating Revenue	0	0	2,093	4,567	8,834	11,206	11,375	11,543	11,712	11,884	12,057	12,232	12,405	12,457	12,483	12,509	12,533
Operating Expenses	0	0	353	3,078	3,252	5,392	5,392	5,392	5,392	5,392	5,392	5,392	5,392	5,392	5,392	5,392	5,392
Personnel & Administration	0	0	324	223	223	223	223	223	223	223	223	223	223	223	223	223	223
Maintenance	0	0	29	87	117	117	117	117	117	117	117	117	117	117	117	117	117
Depreciation	0	0	0	2,767	2,913	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052
Net Operating Income	0	0	1,740	1,489	5,632	5,814	5,983	6,151	6,320	6,492	6,666	6,841	7,013	7,065	7,091	7,117	7,141
Interest on Long-term Loans	0	374	1,107	2,396	3,194	3,885	3,732	3,578	3,424	3,270	3,116	2,950	2,775	2,585	2,417	2,256	2,125
Net Surplus	0	-374	633	-906	2,438	1,929	2,252	2,573	2,896	3,222	3,550	3,890	4,238	4,480	4,674	4,861	5,016
Accumulated Earnings	0	-374	259	-647	1,790	3,719	5,971	8,544	11,440	14,663	18,213	22,103	26,341	30,821	35,495	40,356	45,372

Cash Flow

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cash Beginning	0	0	-604	-663	-316	2,973	7,389	12,127	17,188	22,571	28,280	33,664	38,311	41,441	44,079	46,034	48,679
Cash Inflow	15,374	30,748	56,494	40,835	42,094	10,866	11,035	11,203	11,372	11,544	11,718	11,893	12,065	12,117	12,143	12,169	12,193
Net Operating Income	0	0	1,740	1,489	5,632	5,814	5,983	6,151	6,320	6,492	6,666	6,841	7,013	7,065	7,091	7,117	7,141
Depreciation	0	0	0	2,767	2,913	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052	5,052
Long-term Loans	15,374	30,748	54,754	36,578	33,550	0	0	0	0	0	0	0	0	0	0	0	0
Cash Outflow	15,374	31,352	56,553	40,487	38,806	6,451	6,297	6,143	5,989	5,835	6,334	7,245	8,935	9,479	10,188	9,524	9,393
Investment	15,374	30,748	54,754	36,578	33,550	0	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	0	231	692	1,513	2,062	2,565	2,565	2,565	2,565	2,565	3,218	4,295	6,160	6,894	7,771	7,268	7,268
Interest on Long-term Loans	0	374	1,107	2,396	3,194	3,886	3,732	3,578	3,424	3,270	3,116	2,950	2,775	2,585	2,417	2,256	2,125
Cash Balance	0	-604	-59	347	3,289	4,416	4,739	5,060	5,383	5,709	5,383	4,648	3,130	2,638	1,955	2,645	2,800
Cash Ending	0	-604	-663	-316	2,973	7,389	12,127	17,188	22,571	28,280	33,664	38,311	41,441	44,079	46,034	48,679	51,480

Balance Sheet

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Current Assets	0	0	0	0	2,973	7,389	12,127	17,188	22,571	28,280	33,664	38,311	41,441	44,079	46,034	48,679	51,480
Cash & Deposit	0	0	0	0	2,973	7,389	12,127	17,188	22,571	28,280	33,664	38,311	41,441	44,079	46,034	48,679	51,480
Fixed Assets	15,374	46,122	100,876	134,687	165,324	160,272	155,220	150,168	145,116	140,064	135,012	129,960	124,908	119,856	114,804	109,752	104,700
Total Assets	15,374	46,122	100,876	134,687	168,297	167,661	167,347	167,356	167,687	168,344	168,676	168,271	166,349	163,935	160,838	158,431	156,179
Liabilities	15,374	46,496	100,617	135,334	166,507	163,942	161,376	158,811	156,246	153,681	150,463	146,168	140,008	133,114	125,343	118,075	110,808
Short-term Loans	0	604	663	316	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-term Loans	15,374	45,891	99,954	135,018	166,507	163,942	161,376	158,811	156,246	153,681	150,463	146,168	140,008	133,114	125,343	118,075	110,808
Net Worth	0	-374	259	-647	1,790	3,719	5,971	8,544	11,440	14,663	18,213	22,103	26,341	30,821	35,495	40,356	45,372
Total Liabilities & Net Worth	15,374	46,122	100,876	134,687	168,297	167,661	167,347	167,356	167,687	168,344	168,676	168,271	166,349	163,935	160,838	158,431	156,179

Financial Indicators	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Rate of Return Fixed Assets			1.7%	1.1%	3.4%	3.6%	3.9%	4.1%	4.4%	4.6%	4.9%	5.3%	5.6%	5.9%	6.2%	6.5%	6.8%
Debt Service Coverage Ratio			0.97	1.09	1.63	1.68	1.75	1.82	1.90	1.98	1.85	1.64	1.35	1.28	1.19	1.28	1.30
Operating Ratio			16.9%	67.4%	35.6%	48.1%	47.4%	46.7%	45.0%	45.4%	44.7%	44.1%	43.5%	43.3%	43.2%	43.1%	43.0%
Working Ratio			16.9%	6.8%	3.8%	3.0%	3.0%	2.9%	2.9%	2.9%	2.8%	2.8%	2.7%	2.7%	2.7%	2.7%	2.7%

Income Statement

(Unit US$ 1,000)

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Operating Revenue	12,560	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619	12,619
Operating Expenses	5,013	5,013	4,635	4,635	4,635	4,635	4,635	4,635	4,635	4,635	4,635	4,635	4,635	4,635	4,635
Personnel & Administration	223	223	223	223	223	223	223	223	223	223	223	223	223	223	223
Maintenance	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117
Depreciation	4,674	4,674	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295
Net Operating Income	7,546	7,606	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984
Interest on Long-term Loans	1,995	1,864	1,733	1,602	1,471	1,340	1,210	1,079	948	817	686	556	425	294	175
Net Surplus	5,552	5,742	6,251	6,382	6,513	6,644	6,775	6,905	7,036	7,167	7,298	7,429	7,560	7,690	7,809
Accumulated Earnings	50,923	56,666	62,917	69,299	75,812	82,456	89,231	96,136	103,172	110,340	117,638	125,066	132,626	140,316	148,126

Cash Flow

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Cash Beginning	51,480	41,937	45,085	35,864	39,274	42,815	46,486	50,288	54,221	58,285	62,480	66,805	71,262	75,849	81,220
Cash Inflow	12,220	12,280	12,280	12,280	12,280	12,280	12,280	12,280	12,280	12,280	12,280	12,280	12,280	12,280	12,280
Net Operating Income	7,546	7,606	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984	7,984
Depreciation	4,674	4,674	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295	4,295
Long-term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Outflow	21,762	9,131	21,501	8,870	8,739	8,608	8,477	8,346	8,216	8,085	7,954	7,823	7,692	6,908	5,482
Investment	12,500	0	12,500	0	0	0	0	0	0	0	0	0	0	0	0
Repayment of principal	7,268	7,268	7,268	7,268	7,268	7,268	7,268	7,268	7,268	7,268	7,268	7,268	7,268	6,614	5,307
Interest on Long-term Loans	1,995	1,864	1,733	1,602	1,471	1,340	1,210	1,079	948	817	686	556	425	294	175
Cash Balance	-9,542	3,148	-9,221	3,410	3,541	3,671	3,802	3,933	4,064	4,195	4,325	4,456	4,587	5,371	6,797
Cash Ending	41,937	45,085	35,864	39,274	42,815	46,486	50,288	54,221	58,285	62,480	66,805	71,262	75,849	81,220	88,017

Balance Sheet

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Current Assets	41,937	45,085	35,864	39,274	42,815	46,486	50,288	54,221	58,285	62,480	66,805	71,262	75,849	81,220	88,017
Cash & Deposit	41,937	45,085	35,864	39,274	42,815	46,486	50,288	54,221	58,285	62,480	66,805	71,262	75,849	81,220	88,017
Fixed Assets	112,526	107,853	116,057	111,762	107,467	103,172	98,877	94,581	90,286	85,991	81,695	77,400	73,105	68,810	64,515
Total Assets	154,464	152,938	151,922	151,036	150,282	149,658	149,165	148,803	148,571	148,471	148,501	148,662	148,954	150,030	152,532
Liabilities	103,540	96,272	89,005	81,737	74,469	67,202	59,934	52,666	45,399	38,131	30,863	23,596	16,328	9,714	4,406
Short-term Loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-term Loans	103,540	96,272	89,005	81,737	74,469	67,202	59,934	52,666	45,399	38,131	30,863	23,596	16,328	9,714	4,406
Net Worth	50,923	56,666	62,917	69,299	75,812	82,456	89,231	96,136	103,172	110,340	117,638	125,066	132,626	140,316	148,126
Total Liabilities & Net Worth	154,464	152,938	151,922	151,036	150,282	149,658	149,165	148,803	148,571	148,471	148,501	148,662	148,954	150,030	152,532

Financial Indicators	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Rate of Return Fixed Assets	6.7%	7.1%	6.9%	7.1%	7.4%	7.7%	8.1%	8.4%	8.8%	9.3%	9.8%	10.3%	10.9%	11.6%	12.4%
Debt Service Coverage Ratio	1.32	1.34	1.36	1.38	1.41	1.43	1.45	1.47	1.49	1.52	1.54	1.57	1.60	1.78	2.24
Operating Ratio	-39.9%	39.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%	36.7%
Working Ratio	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%

7. Environmental Impact Assessment (EIA)

7.1 Objective of the Environmental Impact Assessment

The potential EIA items which need to be examined during the stage of the feasibility study were identified through the Initial Environmental Examination (IEE) for the master plan (the Long Term Plan) of the port, which is described in the Volume two of this Report. This chapter describes the EIA which was conducted on the basis of the result of the field surveys and analyses regarding respective items. The EIA is conducted for the Short Term Plan prepared for the cargo forecast in accordance with the Middle growth scenario.

The EIA focused on the following items:

① Change in coastal currents by reclamation
② Water pollution due to dispersion of suspended solid caused by reclamation and dredging works
③ Natural resource utilization including possible collision between calling ships and fishing boat traffic
④ Socioeconomic environment consisting of beach recreation, activities in Redondo Peninsula and port labor conditions
⑤ Environmental monitoring

The following field surveys and analyses with numerical simulation were conducted:

① Simulation of current change after reclamation
② Simulation of suspended solid dispersion during the reclamation and dredging works
③ Interviews with tourists visiting the beaches of Cubi Point
④ Interviews with port workers and stevedores
⑤ Interviews with employees working at Cubi Point
⑥ Interviews with residents along the eastern coast of Redondo Peninsula
⑦ Interviews with fishermen operating fishing boats

7.2 EIA for Change in Coastal Currents

7.2.1 Methodology

(1) General

Reclamation and dredging have the most potentially adverse effects. Particularly, the new container terminal at Cubi Point is designed in a reclaim land scale of 30 ha in the short term plan and 44 ha in the long term plan adjacent to the Leyte Wharf. Landfill in the north-west side of the Subic International Airport might influence the coastal currents in Subic Bay.

To assess the impact of the port development in the short term plan and the long term plan, tidal currents are identified by means of computer simulation. The simulation area encompasses 104 km^2 of surface water, having the simulation boundary delineated from Buiong Point at Port Binanga and Sueste Point at Redondo Peninsula.

(2) Methodology

A single layer differential model is adopted for the simulation. Equations of the model are shown in Equation 7.2.1-1. Grid size of the simulation is 100 m in Olongapo Bay and the project site and 300 m in Subic Bay (see Figure 7.2.1-1). The observed tide was diurnal constituent with the range of 70 cm. Location and volume of freshwater discharge are shown in Figure 7.2.1-2 and Table 7.2.1-1.

Simulation was carried out over a period of 504 hours (21 tides×24 hours) until the current flow reached a steady state. Simulation cases are as follows:

Case 1: Present Topography
Case 2: Long Term Plan
Case 3: Short Term Plan

Calibration of the model was carried out in line with the current data observed at four points (one point at the mouth of the bay, two points in Olongapo Bay, one point at the inner part of the Subic Bay: see Figures 7.2.1-3 and 7.2.1-4). The component of tidal portion (K1, m1) is less than 5 cm/s and the current pattern in the present topography is as follows (see Figures 7.2.1- 5,6,7):

① The anti-clockwise current pattern appears at the inner part of the bay not only in the rising tide but also in the falling tide.

② Current flow toward south direction appears along the off-shore of the airport and the east side of the mouth of the bay not only in the rising tide but also in the falling tide.

③ The residual inflow through the mouth of Subic Bay is seen in the west side of the bay mouth and the residual out flow is seen in the east side.

Equation 7.2.1-1

Continuity equation;

$$\frac{\partial \zeta}{\partial t}+\frac{\partial}{\partial x}\left[(\zeta+D)u\right]+\frac{\partial}{\partial y}\left[(\zeta+D)v\right]=0$$

Momentum equations ;

$$\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}=fv-g\frac{\partial \zeta}{\partial x}+A_h\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}\right)-\gamma_b^2\frac{u\sqrt{u^2+v^2}}{(\zeta+D)}$$

$$\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}=-fu-g\frac{\partial \zeta}{\partial y}+A_h\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}\right)-\gamma_b^2\frac{v\sqrt{u^2+v^2}}{(\zeta+D)}$$

where,

x, y	:A rectangular coordinate system is x-eastward, y-northward
u, v	:Depth-averaged velocity components in the x- and y-directions, respectively
t	:Time
ζ	:Elevation of water surface measured from mean sea level positive upward
D	:Water depth below the mean sea level
f	:Coliolis parameter
g	:Gravitational acceleration
γ_b^2	:Bottom friction coefficient
A_h	:Lateral eddy viscosity coefficient

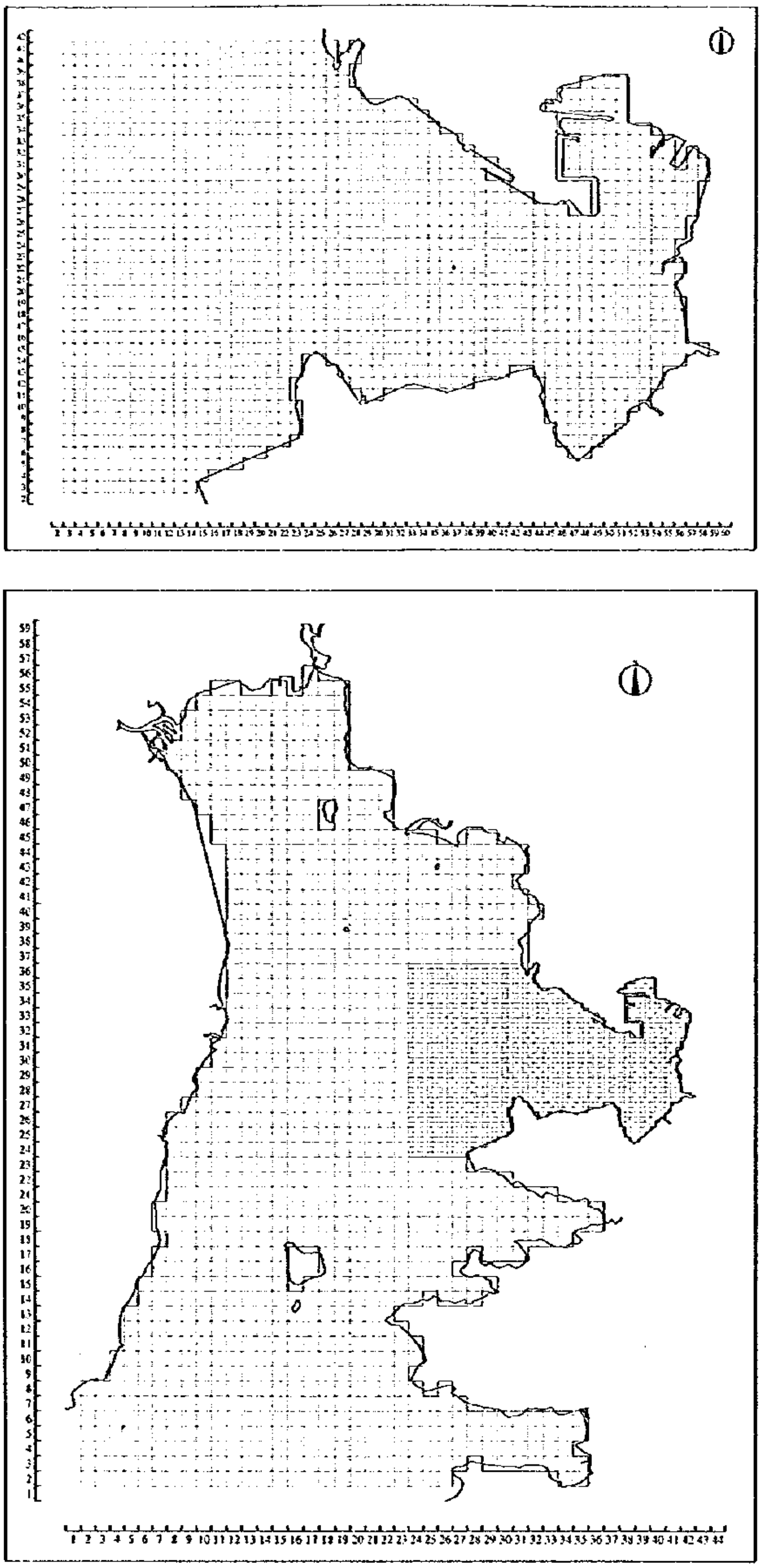


Figure 7.2.1-1 Simulation Domains of Grid Size
(upper panel: 100 m grid, lower panel: 300 m grid)

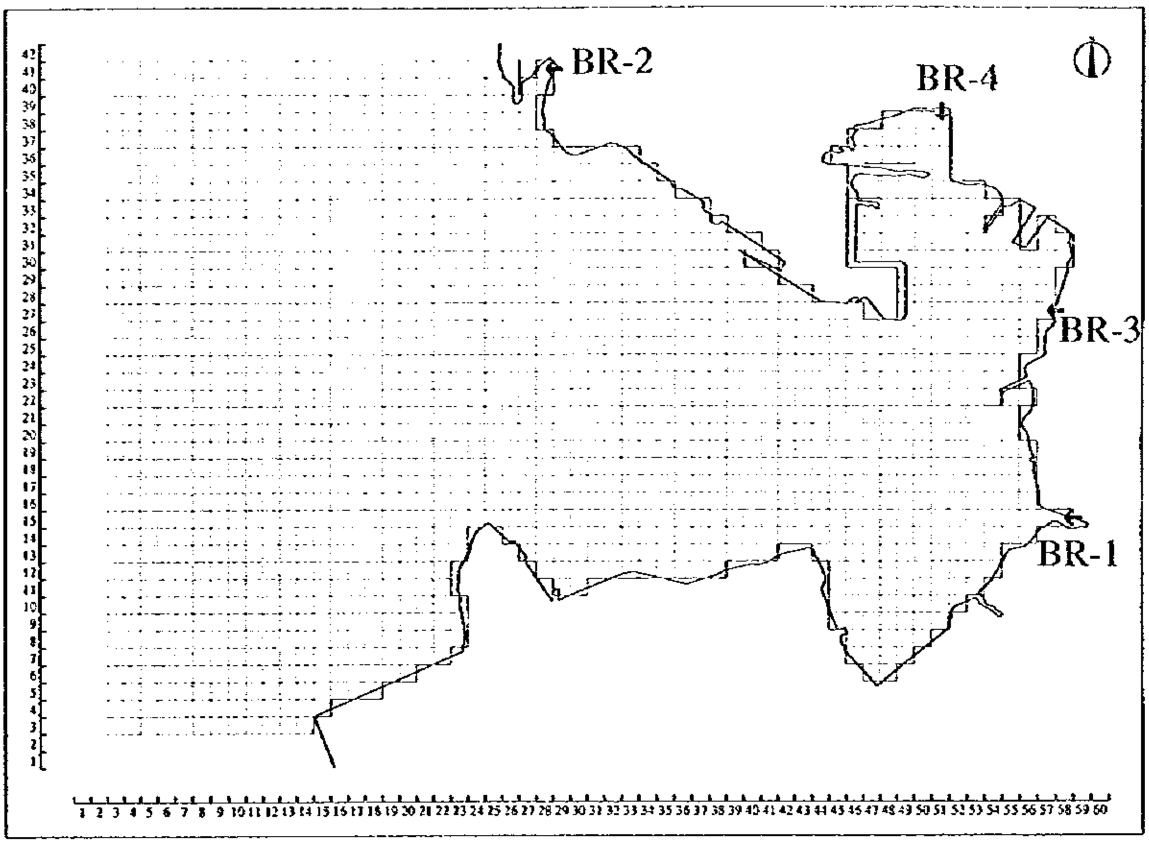
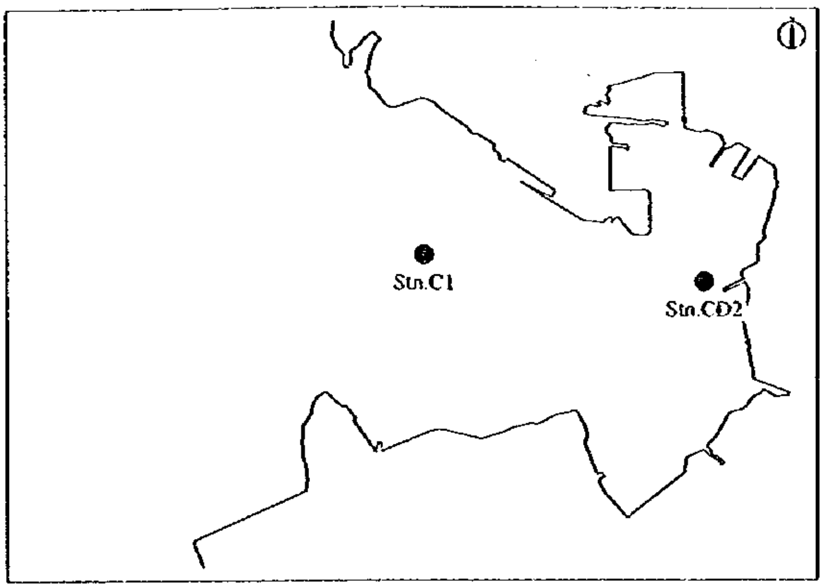


Figure 7.2.1-2 Location of Fresh Water Discharge from Four Rivers

Table 7.2.1-1 Fresh Water Discharge from Four Rivers

Station	River	Fresh Water Discharge (m^3/sec)
BR-1	Boton River	3.6
BR-2	Kalaklan River	31.8
BR-3	Malawaan River	5.1
BR-4	Kalalake River	8.0

Source) JICA field observations carried out in July,1998



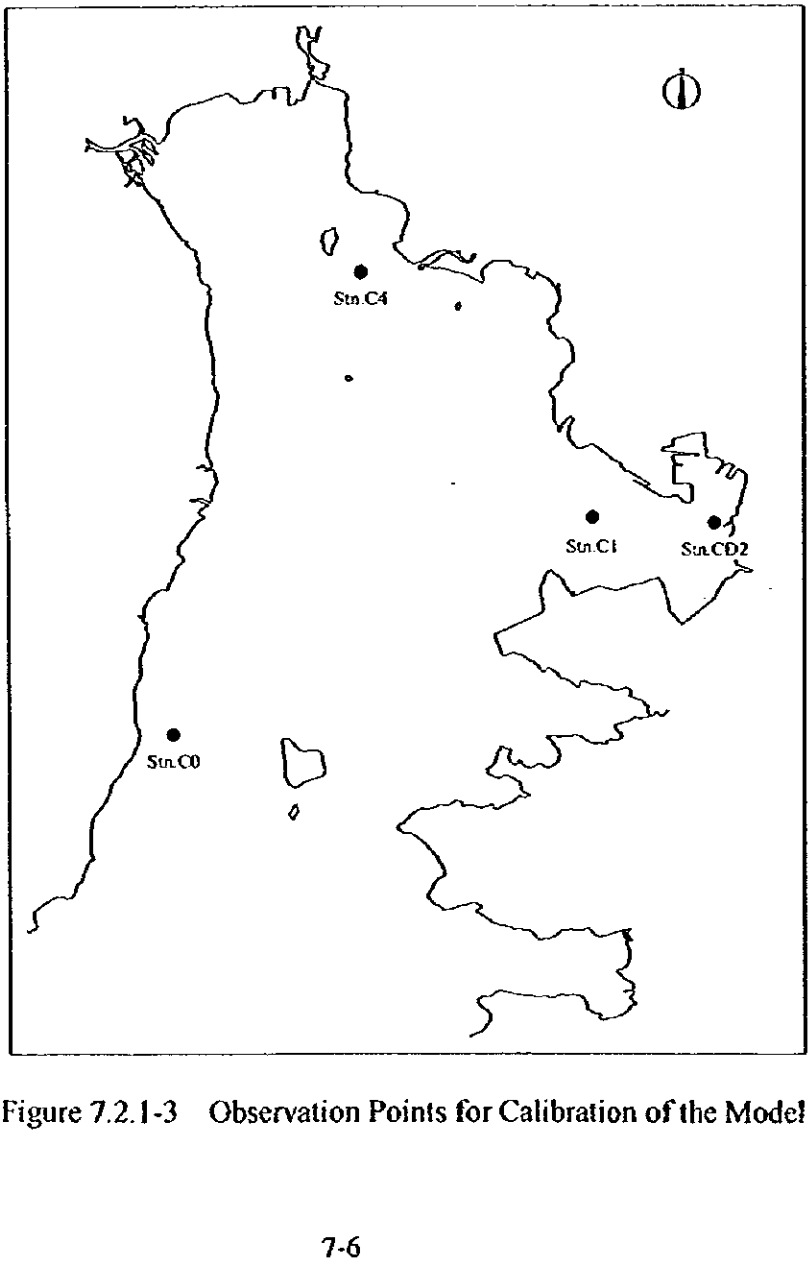


Figure 7.2.1-3 Observation Points for Calibration of the Model

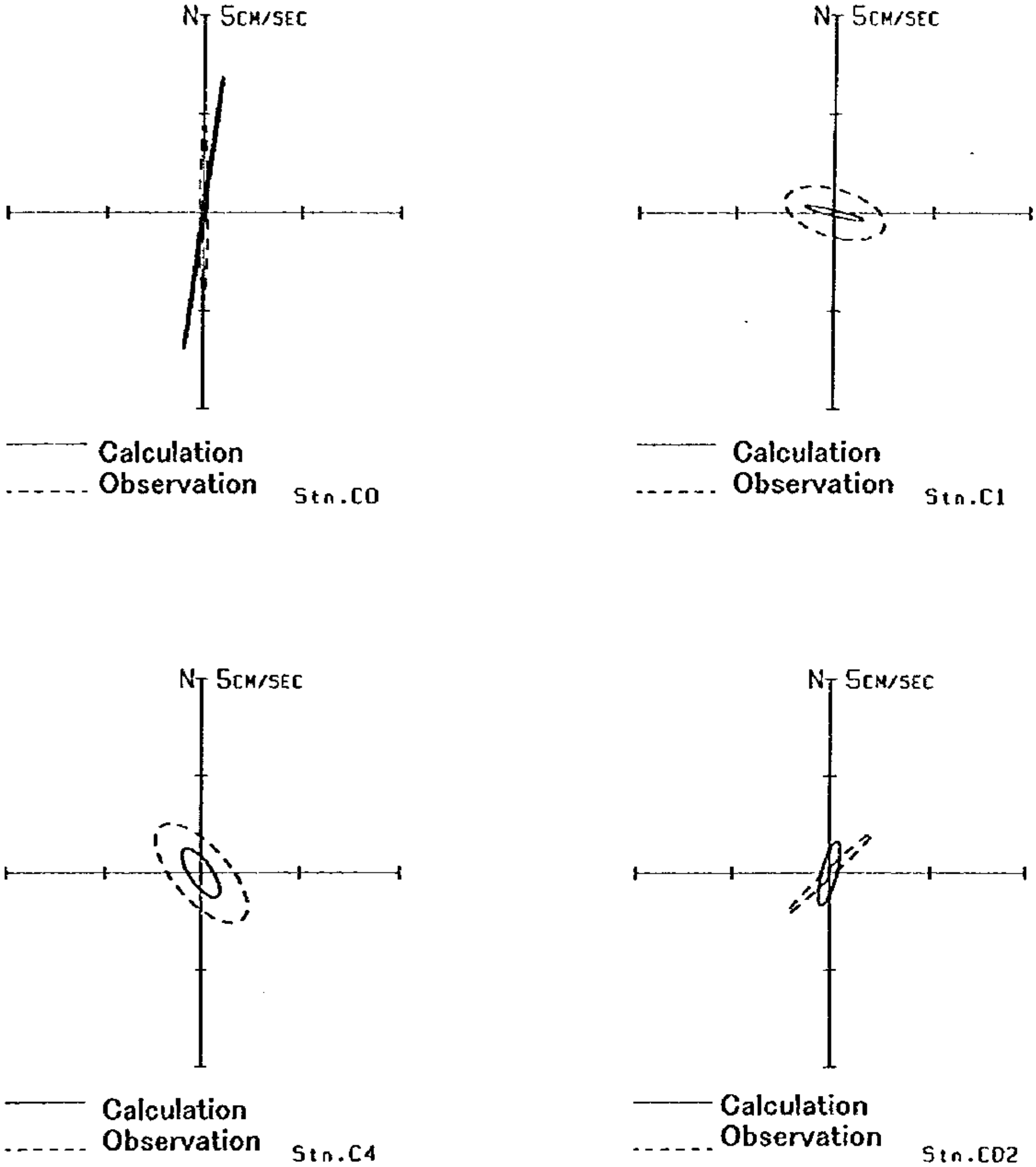
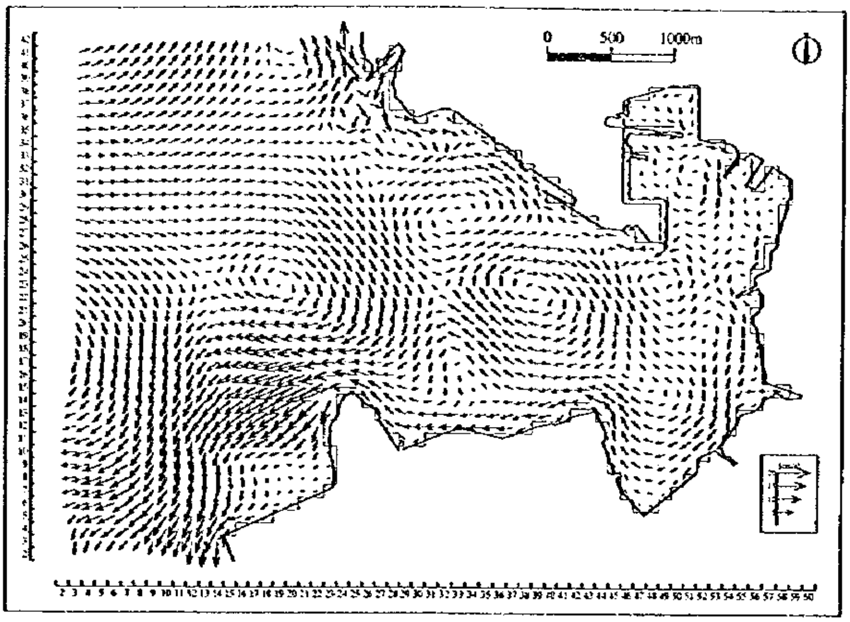


Figure 7.2.1-4 Tidal Current Ellipse



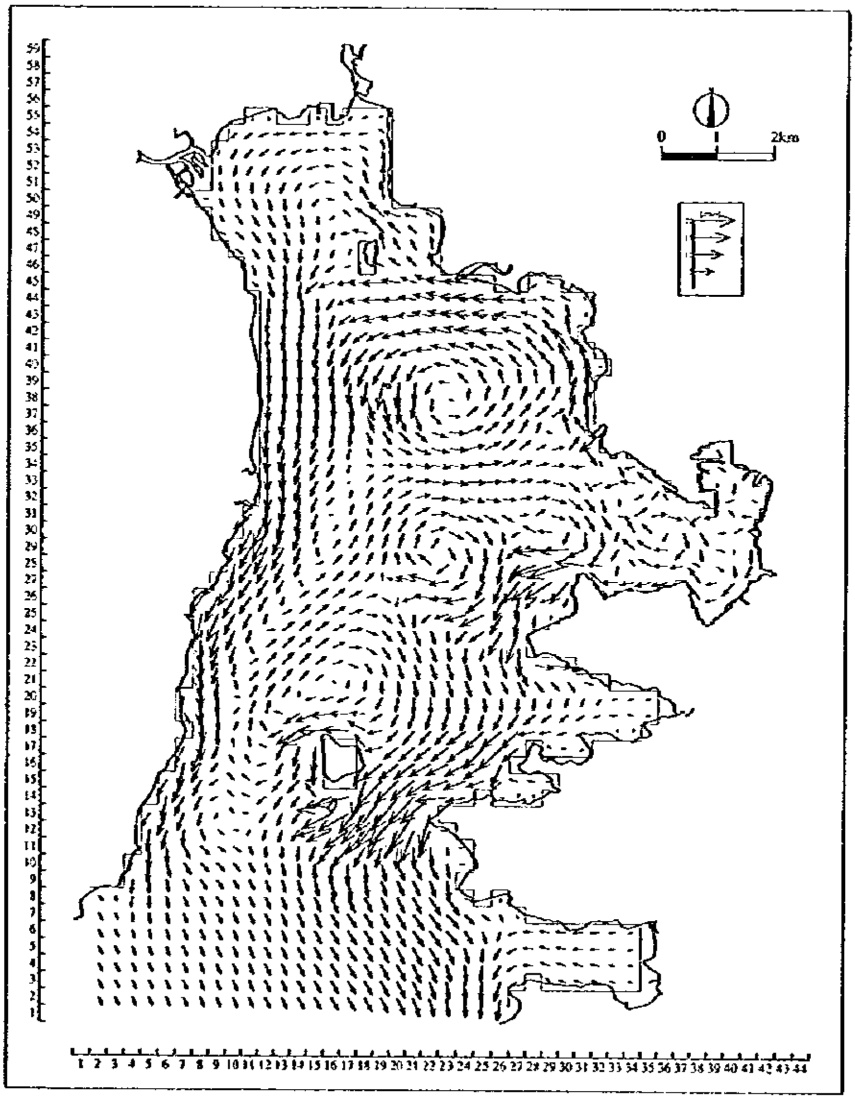


Figure 7.2.1-5 Tidal Current Pattern (falling tide, present topography)

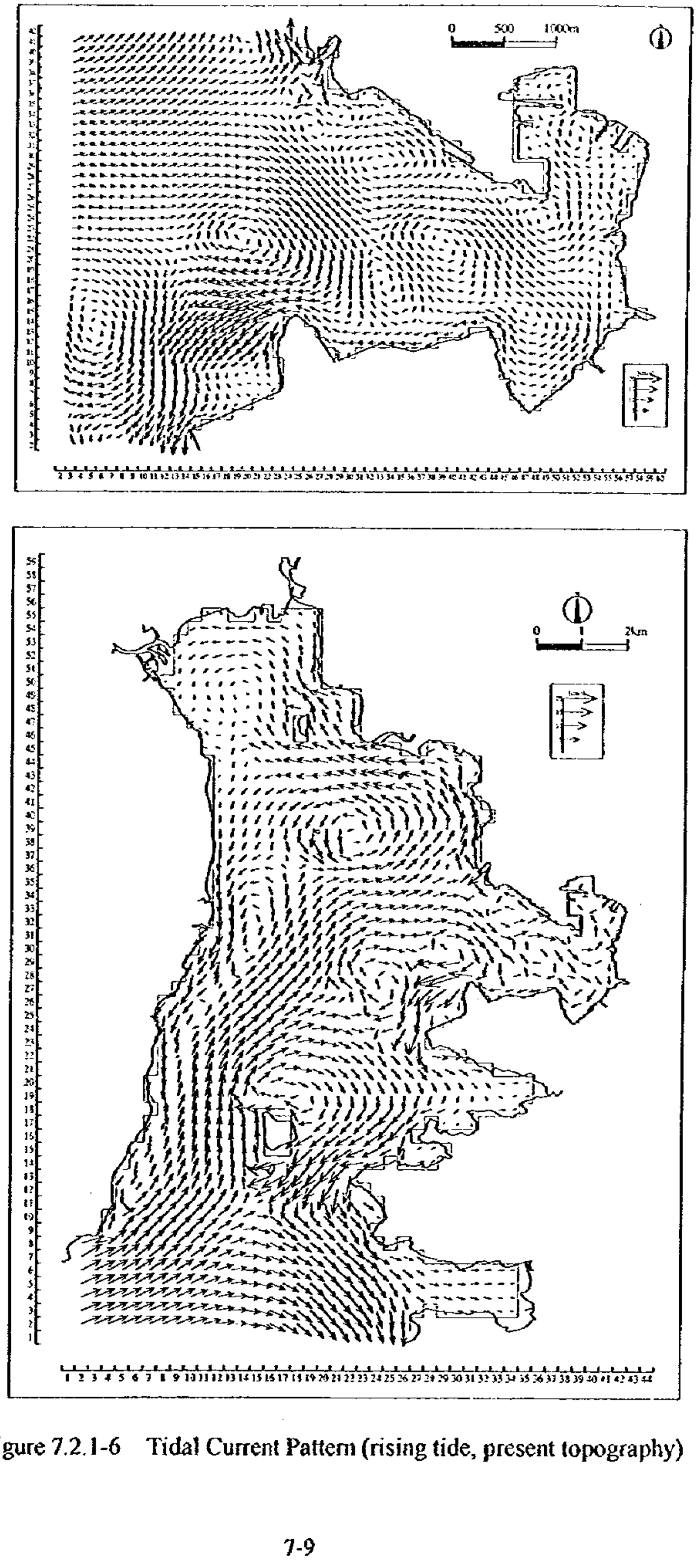


Figure 7.2.1-6 Tidal Current Pattern (rising tide, present topography)

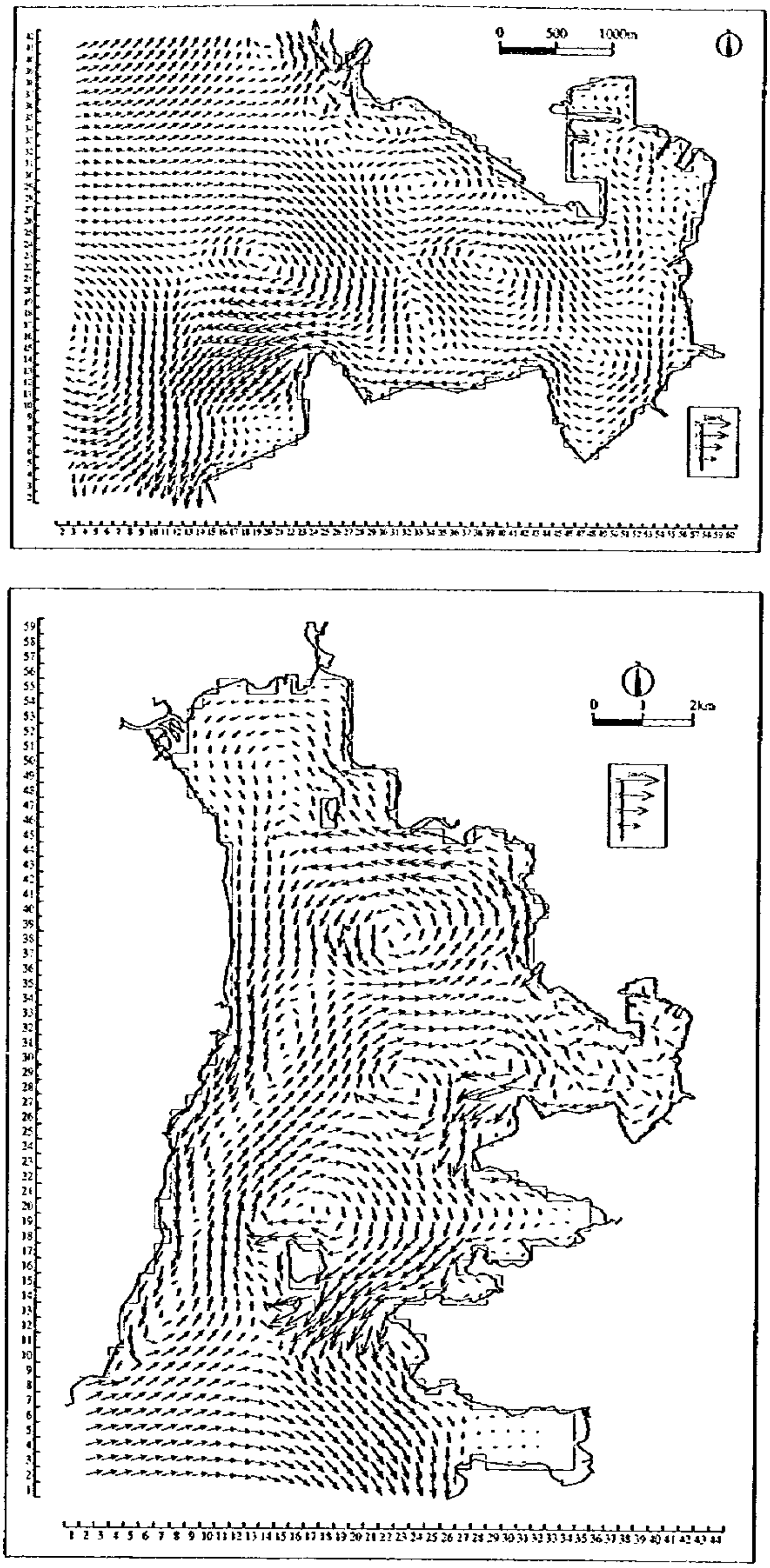


Figure 7.2.1-7 Tidal Current Pattern (residual current, present topography)

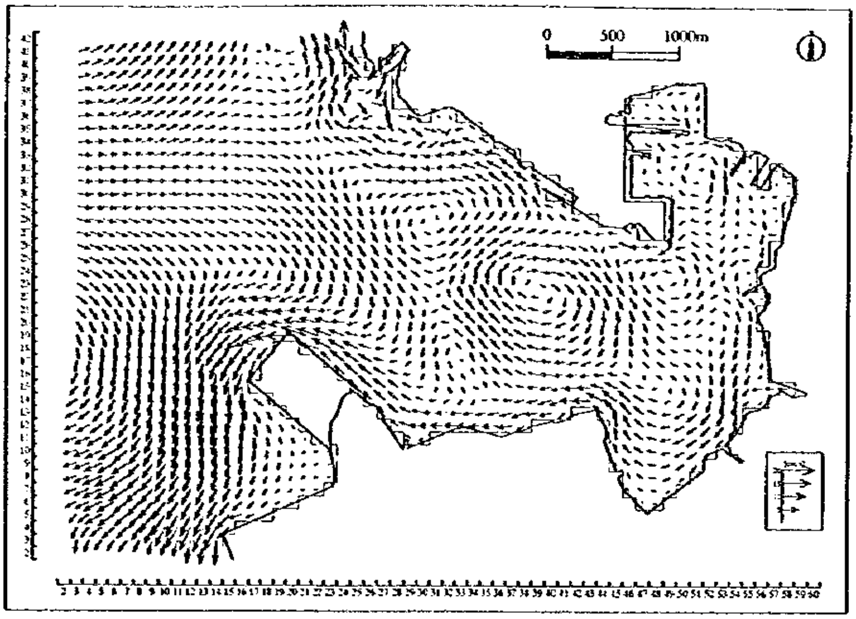
7.2.2 Results of the Calculation

Results of the calculation in the long term plan are shown in Figures 7.2.2-1, 7.2.2-2 and 7.2.2-3, and in the short term plan are shown in Figures 7.2.2-4, 7.2.2-5 and 7.2.2-6, in which current direction and velocity are indicated with vector array.

Differences in current velocity between the present topography and the future are presented in Figures 7.2.2-7 and 7.2.2-8.

The conclusions are as follows:

①In both future cases (long term plan, short term plan), changes in current velocity of more than 2 cm/s are limited to the area adjacent to the project site; the influenced area is 600 m in distance in the long term plan and 400 m in the short term plan from the reclaimed land.



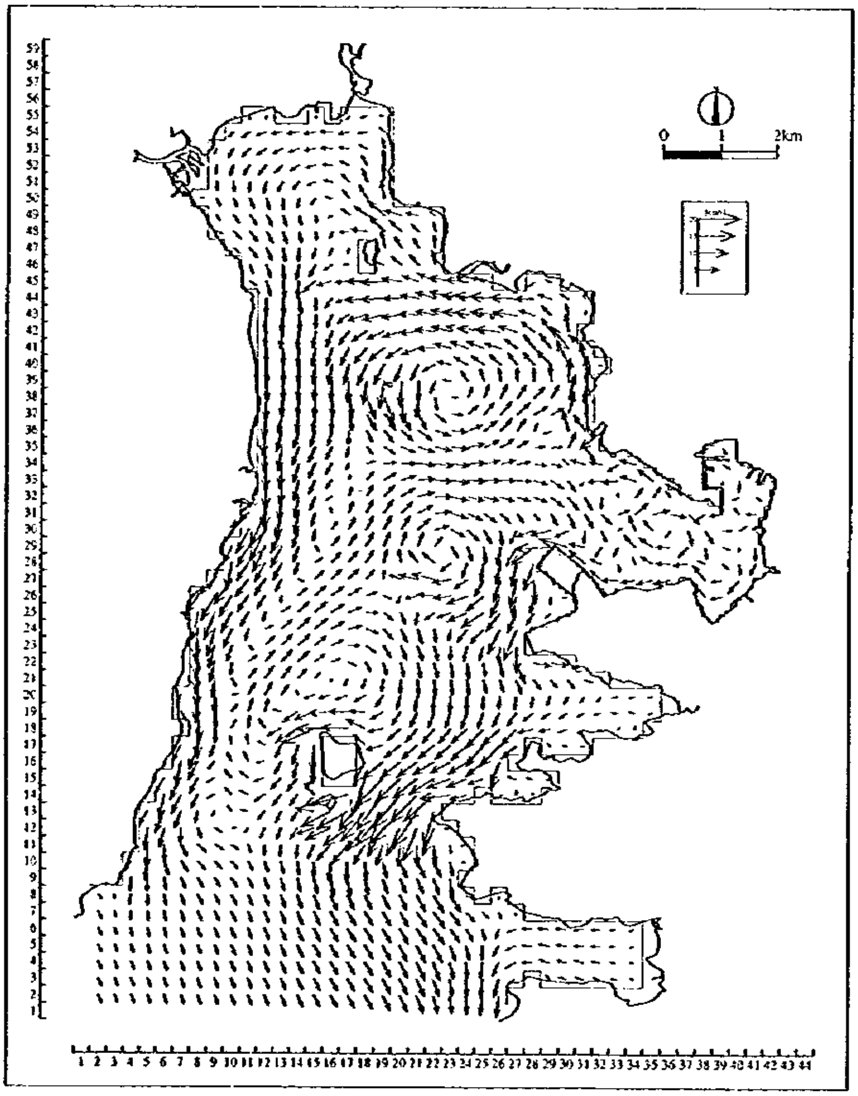
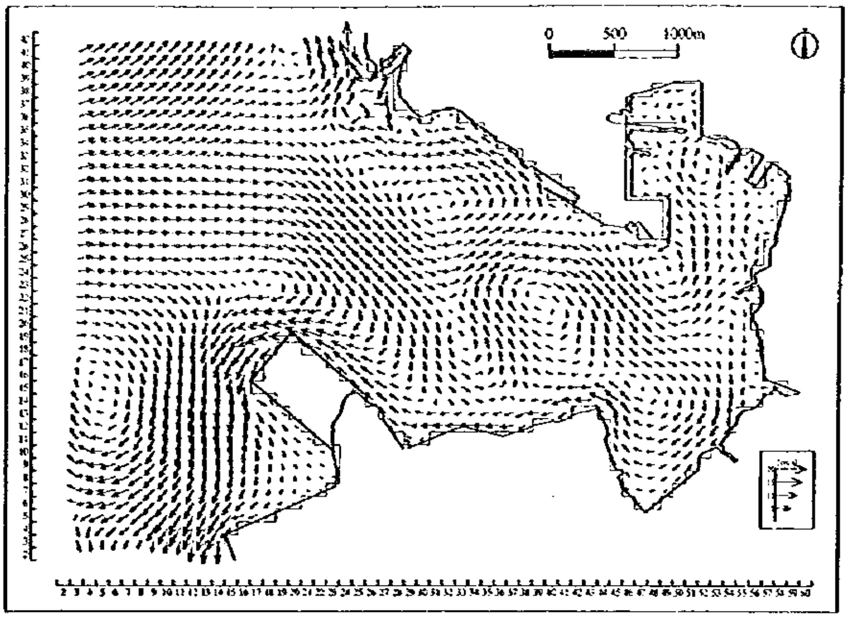


Figure 7.2.2-1 Tidal Current Pattern (falling tide, long term plan)



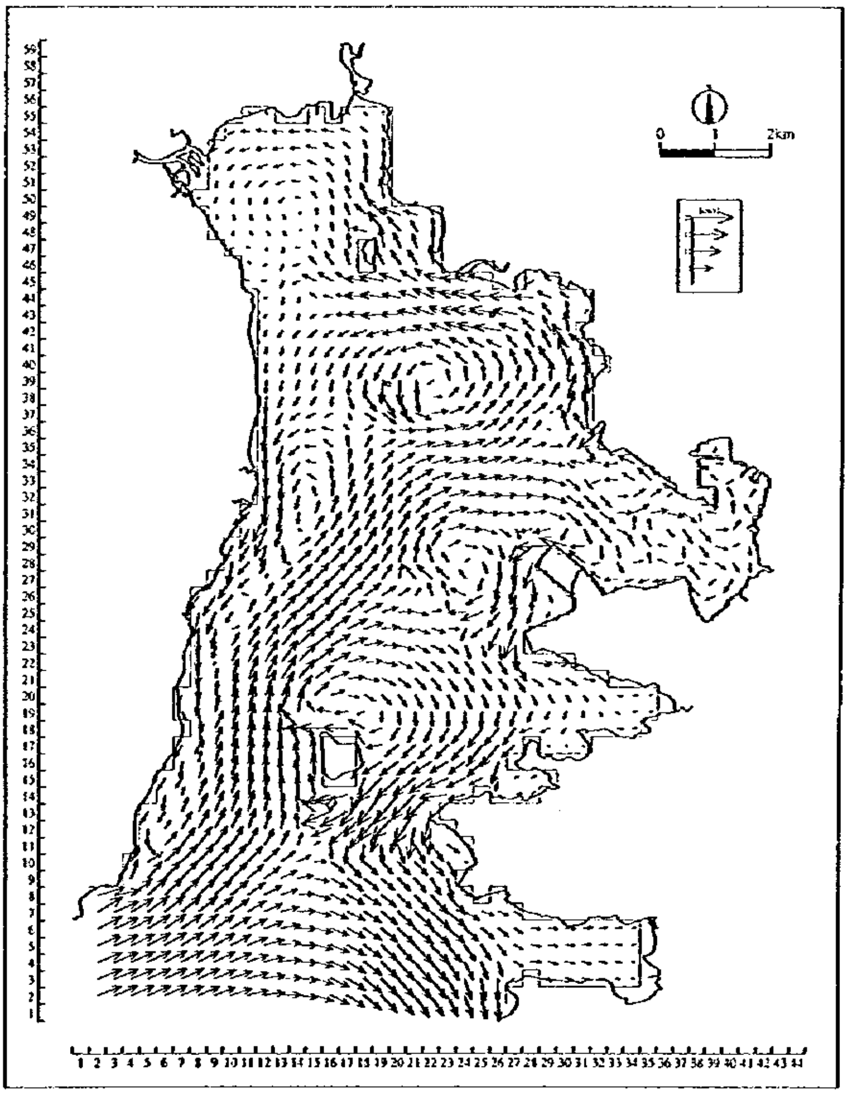
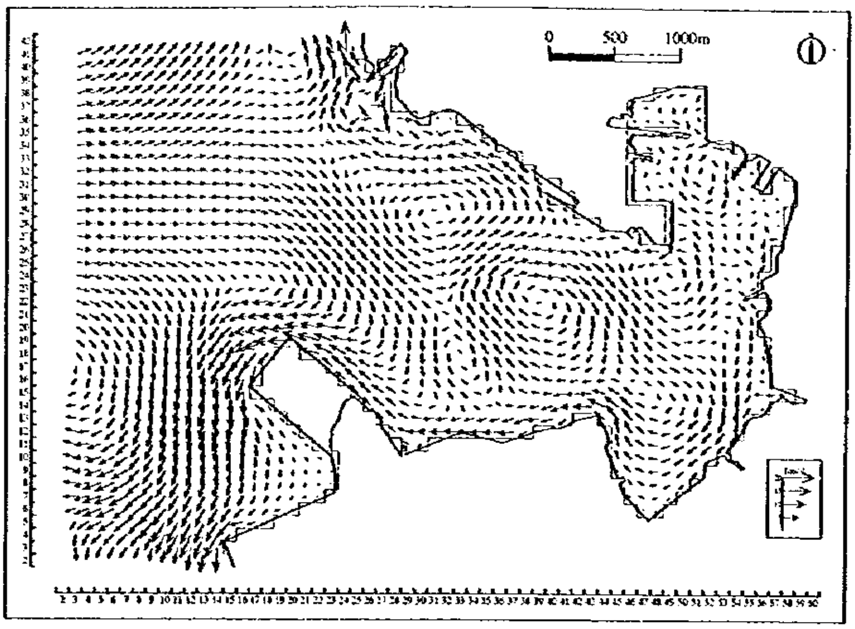


Figure 7.2.2-2 Tidal Current Pattern (rising tide, long term plan)



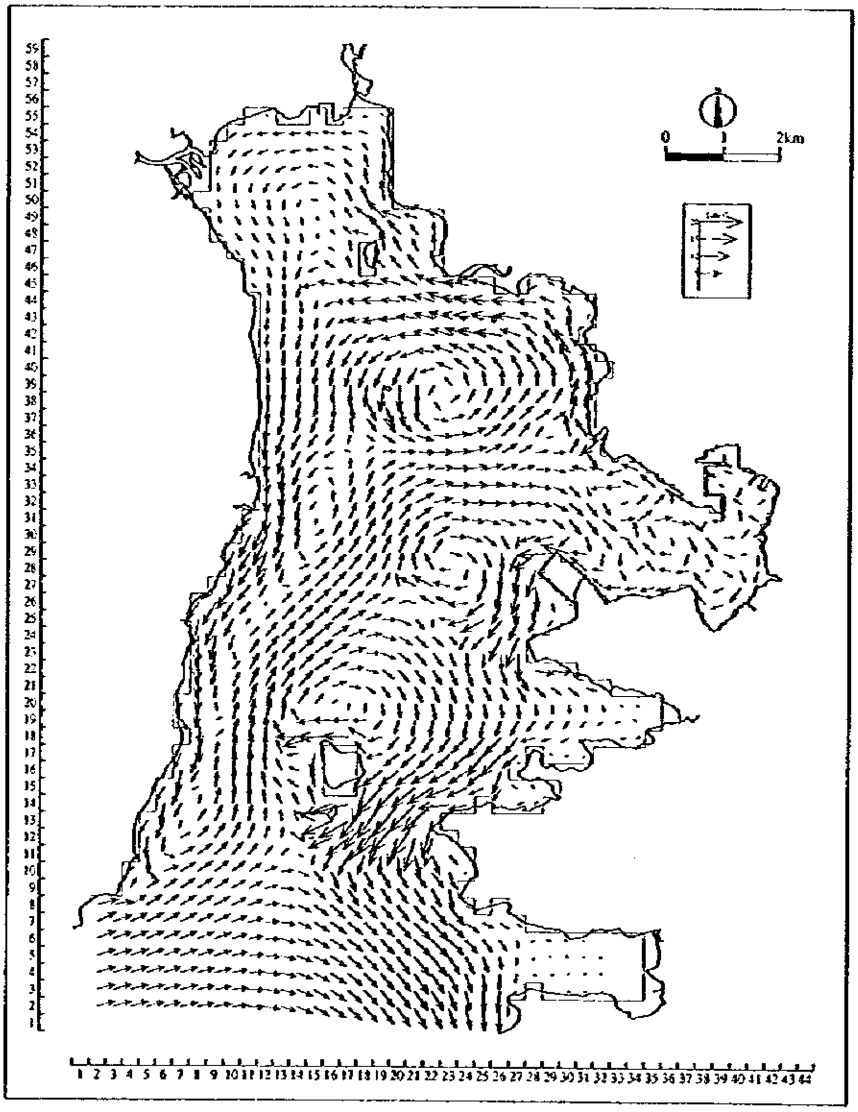
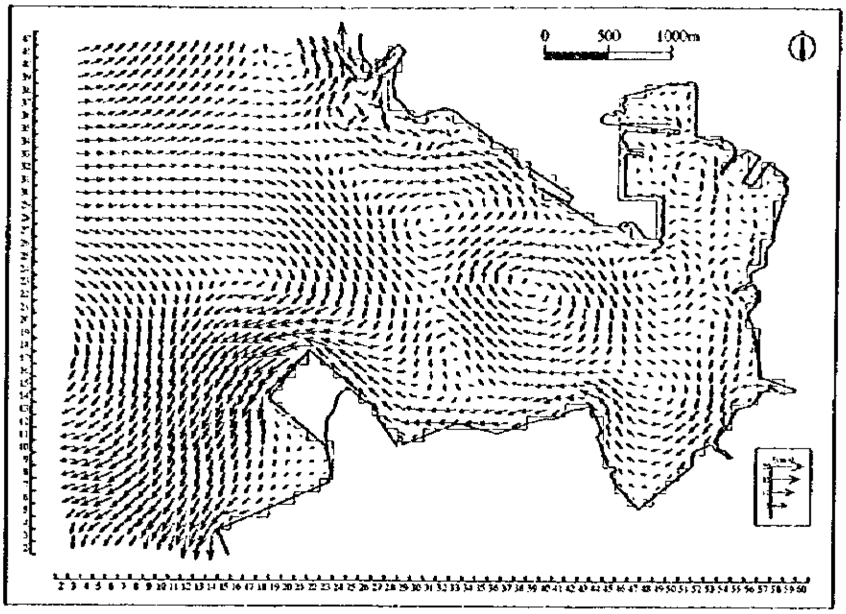


Figure 7.2.2-3 Tidal Current Pattern (residual current, long term plan)



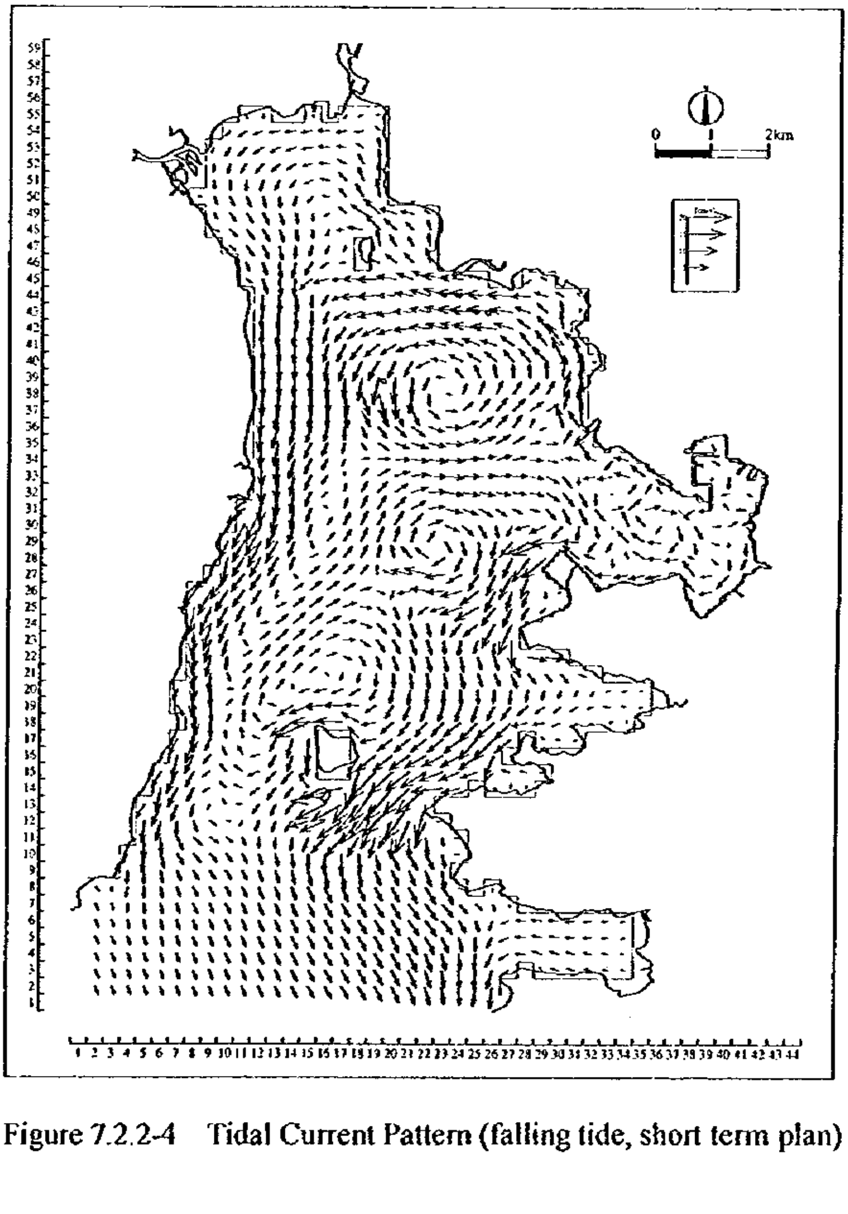
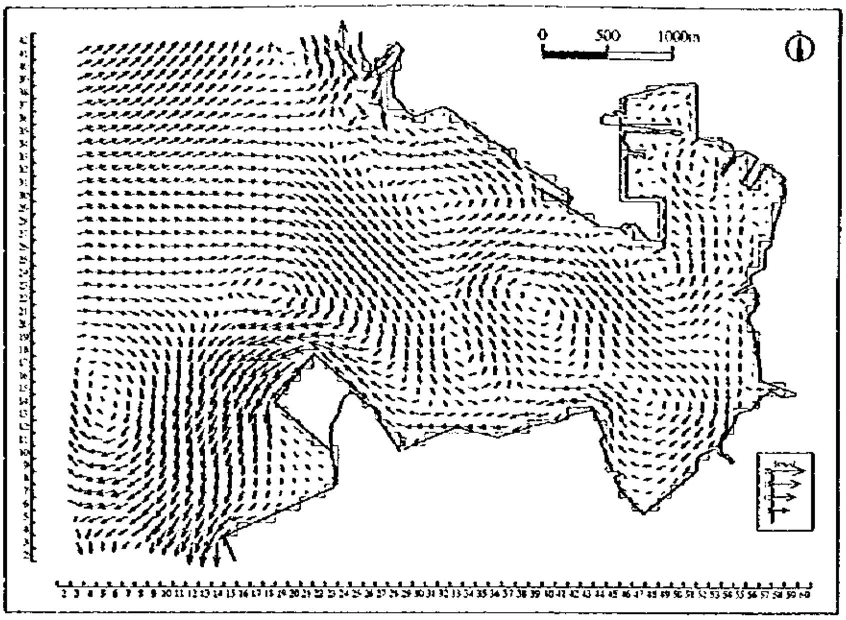


Figure 7.2.2-4 Tidal Current Pattern (falling tide, short term plan)



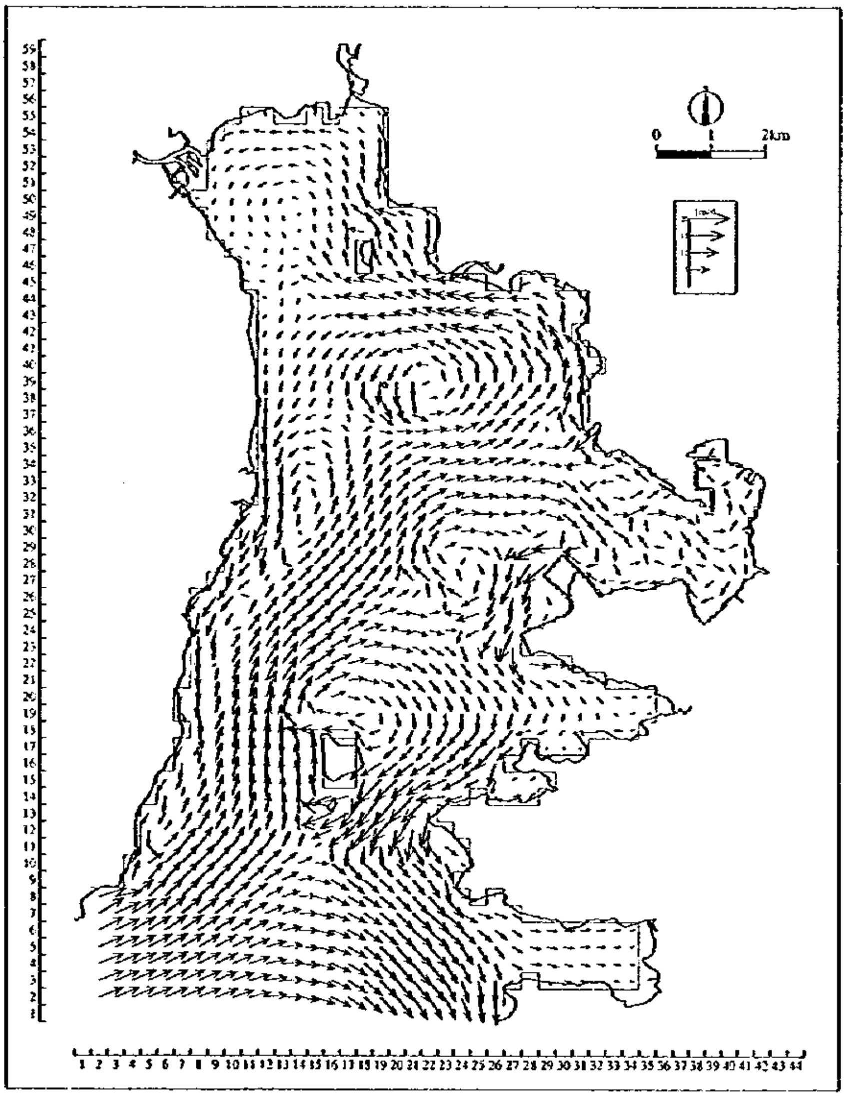


Figure 7.2.2-5 Tidal Current Pattern (rising tide, short term plan)

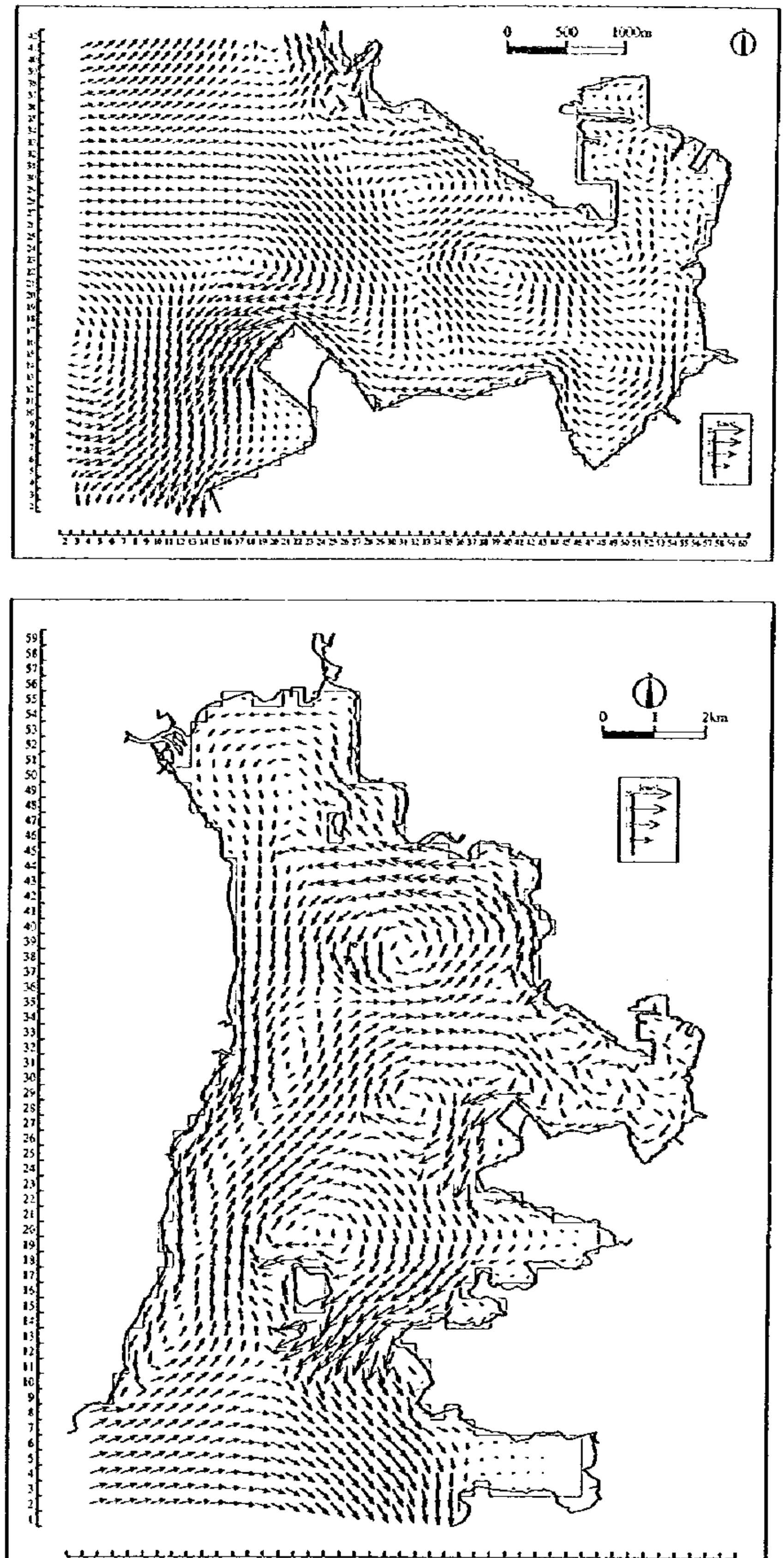


Figure 7.2.2-6 Tidal Current Pattern (residual current, short term plan)

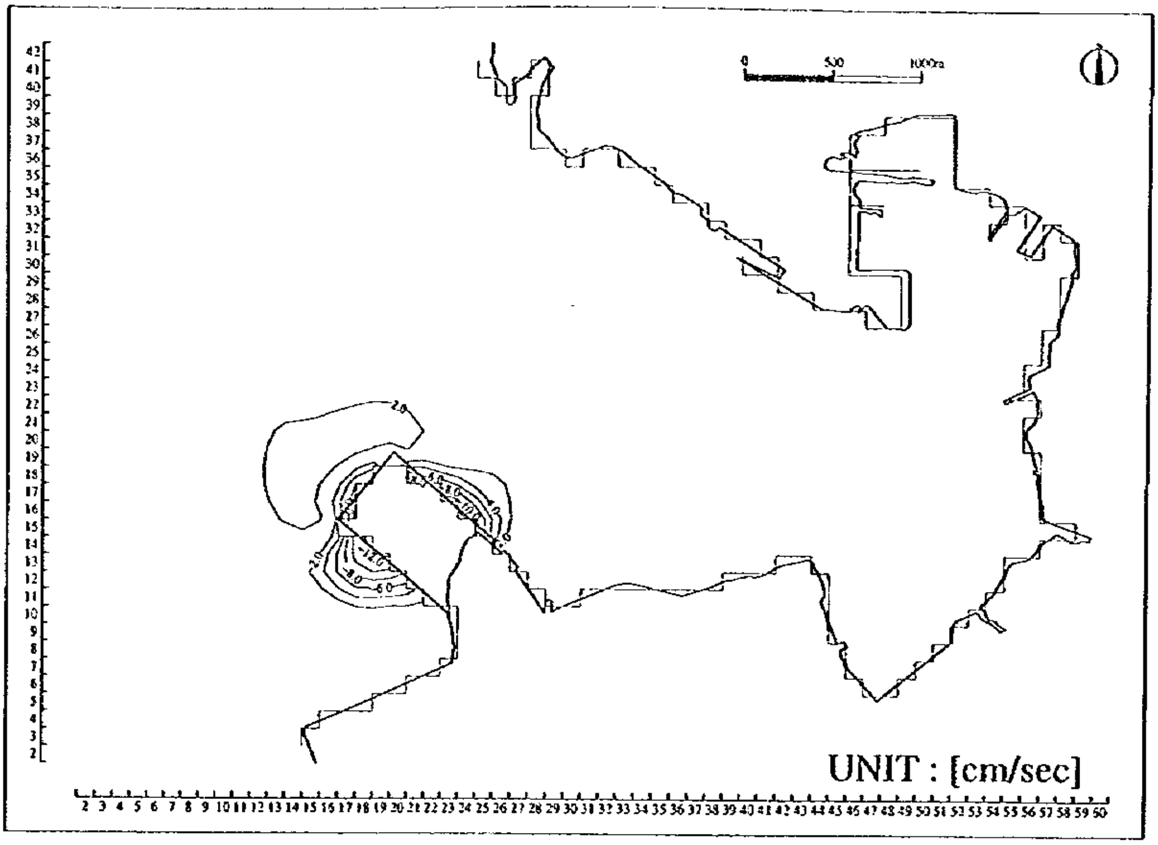


Figure 7.2.2-7 Difference of Current Velocity (residual current, long term plan)

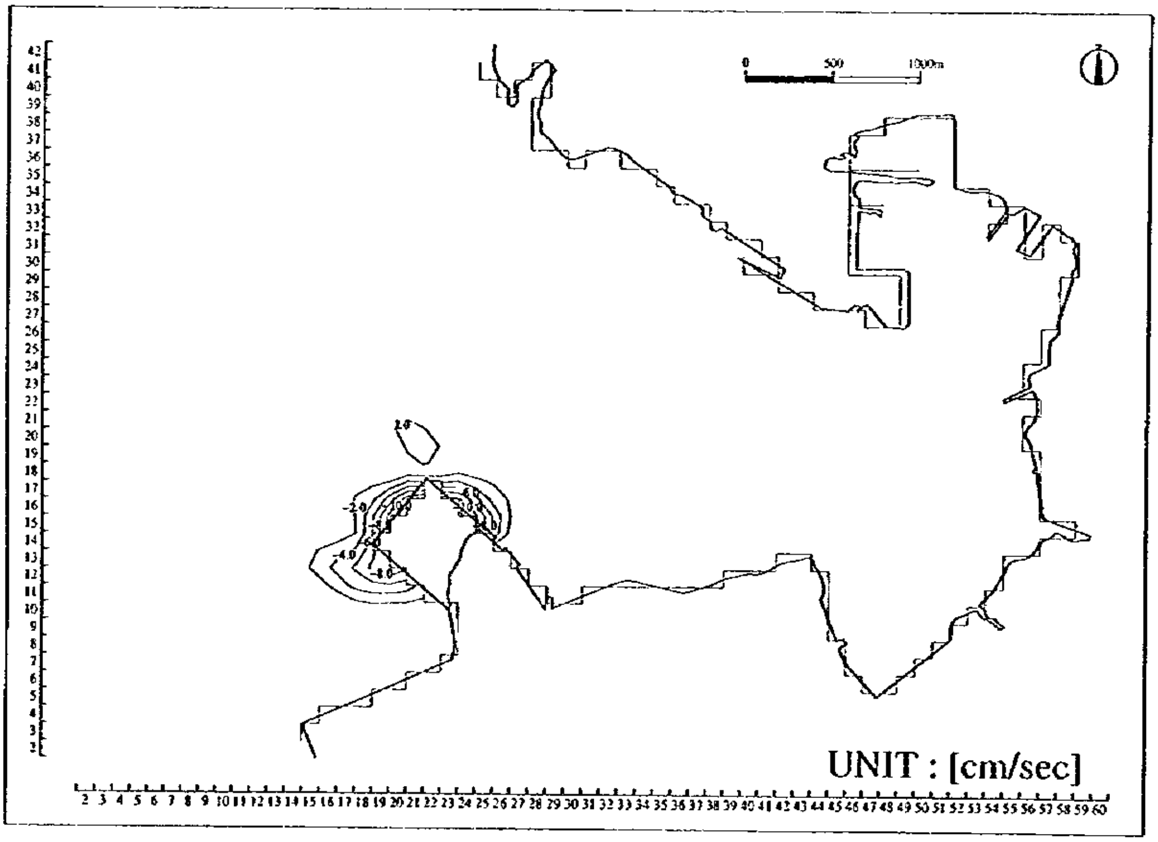


Figure 7.2.2-8 Difference of Current Velocity (residual current, short term plan)

7.3 EIA for Dispersal of Dredging and Reclamation Material

7.3.1 Suspended Solid

(1) Methodology

1) General

Deposition of rubble, dredging and other construction works in water cause resuspension of sediments and turbid water. Resuspension of sediments in water leads to an increase in the level of suspended solids (SS) and in the concentration of organic matter, possibly to toxic or harmful levels. It also reduces sunlight penetration.

Reclamation has also potential adverse effects on the level of SS. The short term plan proposed in this report involves a large volume of reclamation, the material for which will be taken mainly from dredging of sea bottom. Therefore, dredging and reclamation works will be conducted at the same time.

2) Methodology

While the adverse effects of dredging and reclamation are limited to working hours, a possible area of turbid water dispersion is assessed by computer simulation using SS as an indicator. A diffusion model for suspended solid is solved separately after the calculation of current by a hydrodynamic model. The depth-averaged 2-dimensional diffusion model for suspended solid has the sinking term. It can be obtained by vertical integration similar to a hydrodynamic model. The equation is as follows;

$$\frac{\partial S(\zeta + D)}{\partial t} = -\frac{\partial}{\partial x}[Su(\zeta + D)] - \frac{\partial}{\partial y}[Sv(\zeta + D)] + \frac{\partial}{\partial x}[K(\zeta + D)\frac{\partial S}{\partial x}] + \frac{\partial}{\partial y}[K(\zeta + D)\frac{\partial S}{\partial y}] + L_S - W_0 S$$

where,

S	:	Depth-averaged concentration for suspended solids
x,y	:	A rectangular coordinate system with x-eastward, y-northward
u,v	:	Depth-averaged velocity components in the x- and y- directions, respectively
t	:	time
ζ	:	Elevation of water surface measured from the mean sea level positive upward

D	:	Water depth below the mean sea level
K	:	Lateral eddy diffusivity coefficient
W_0	:	Settling velocity
I_s	:	Input load of suspended solids

3) Simulation Cases

Dredging and reclamation works can generally divided into two stages; Stage 1 and Stage 2. Stage 1 will start after construction of the south revetment (685 m in length) and this work will be carried out by one grab dredger (8 m^3 class) and one hopper barge (500 m^3 class). Stage 2 will start after construction of all revetments (1,210 m in length) and quay wall (560 m in length) and this work will be carried out by one cutter suction dredger (8,000 H.P. class).

Simulation cases are as follows:

Case 1: Simulation Case for Construction Stage 1

Topographical features

South revetment (685 m) is completed.

Dredging work

One grab dredger (8 m^3 class) with one hopper barge (500 m^3 class)

Reclamation work

Deposit site of reclamation material is the east side of the south revetment with the hopper barge.

Case 2: Simulation Case for Construction Stage 2

Topographical features

All revetments and quay wall (1,770 m in total length) except a waste way are completed.

Dredging work

one cutter suction dredger (8,000 H.P. class)

Reclamation work

Deposit site is inside of the revetments/quay wall and sea water is drained off from the waste way.

The control value of SS at the waste way is 250 mg/L.

Topographical features and SS loads of construction sites in each simulation case are shown in Figures 7.3.1-1 and 7.3.1-2. It is assumed that the concentration of SS from outlet of the waste way is 250 mg/L (water discharge volume: 180,000 m^3/day) according to the discharge standards of the SBMA.

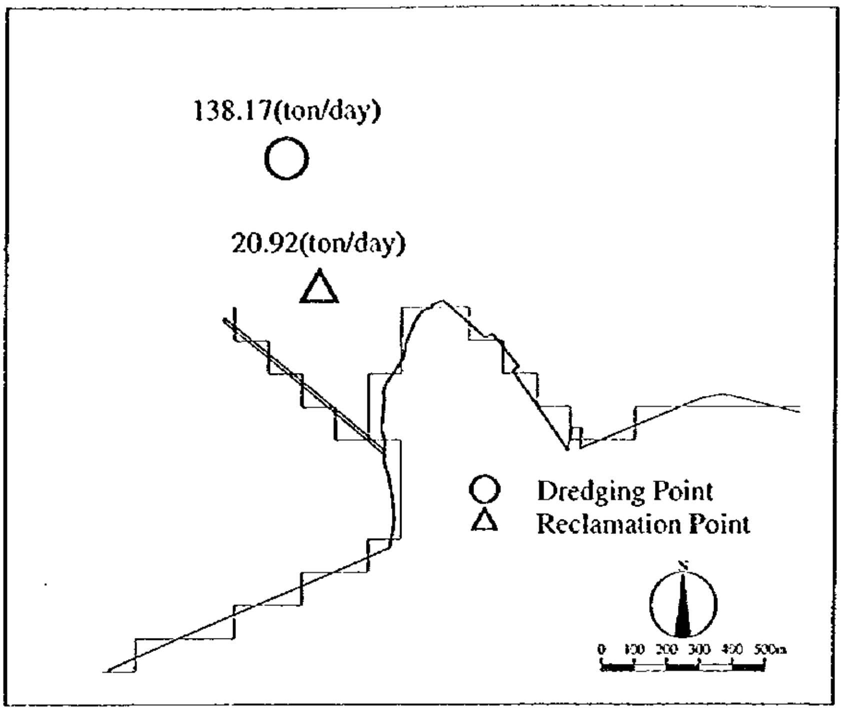


Figure 7.3.1-1 Topographic Features and SS Loads in Construction Stage 1

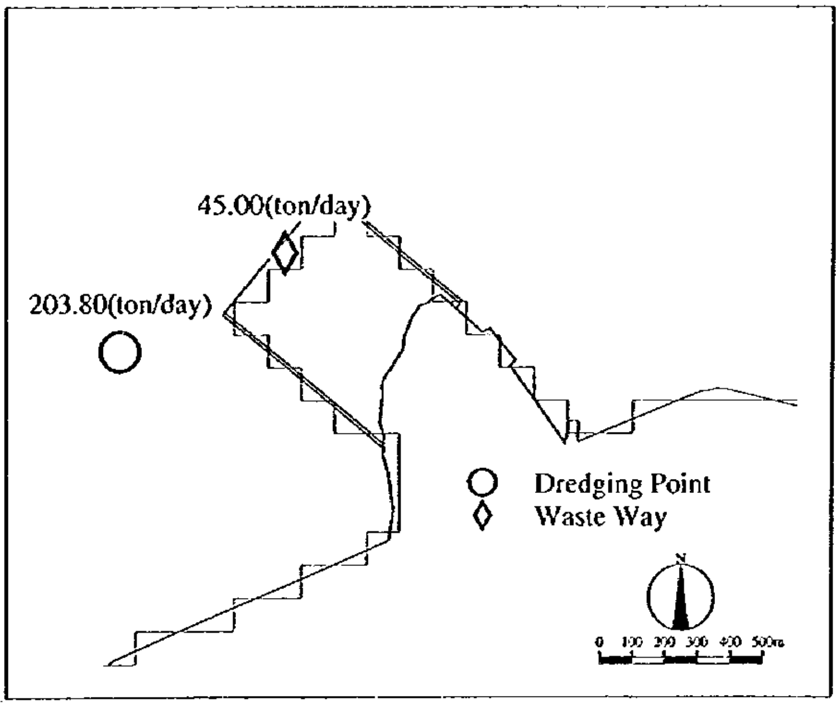


Figure 7.3.1-2 Topographic Features and SS Loads in Construction Stage 2

4) Settling velocity

Settling velocity of suspended solid is an important parameter in the simulation. The settling velocity of suspended solid depends on its diameter. This parameter is set by using the Stokes equation from the medium diameter of the sediment. The Stokes equation is as follows;

$$V = \frac{1}{18} g \frac{(\rho_S - \rho) d^2}{\mu}$$

V	:settling velocity (cm/s)
ρ_S	:sediment density(2.5g/cm^3)
ρ	:water density(1.024g/cm^3)
g	:acceleration of gravity(980cm/s^2)
d	:diameter of sediment(cm)
μ	:viscosity of water(0.01145 gram/cm/s)

Since we selected two types of suspended solid, which differ in diameter, we have to estimate two settling velocities for the case of the construction stage 2. The settling velocity for each construction stage is shown in Table-7.3.1-1

Table-7.3.1-1 Characteristics of each suspended solid

Case Name		Settling Velocity (m/hour)
Stage1	Dredging Works	0.374
	Reclamation Works	0.374
Stage2	Dredging Works	0.374
	Waste Way	0.005

(2) Results of the Calculation

Results of the simulation are shown in Figure 7.3.1-3 (Daily Average of SS Concentration) and Figure 7.3.1-4 (Daily Maximum SS Concentration) for the Construction Stage 1, and Figure 7.3.1-5 (Daily Average of SS Concentration) and Figure 7.3.1-6 (Daily Maximum SS Concentration) for the Construction Stage 2.

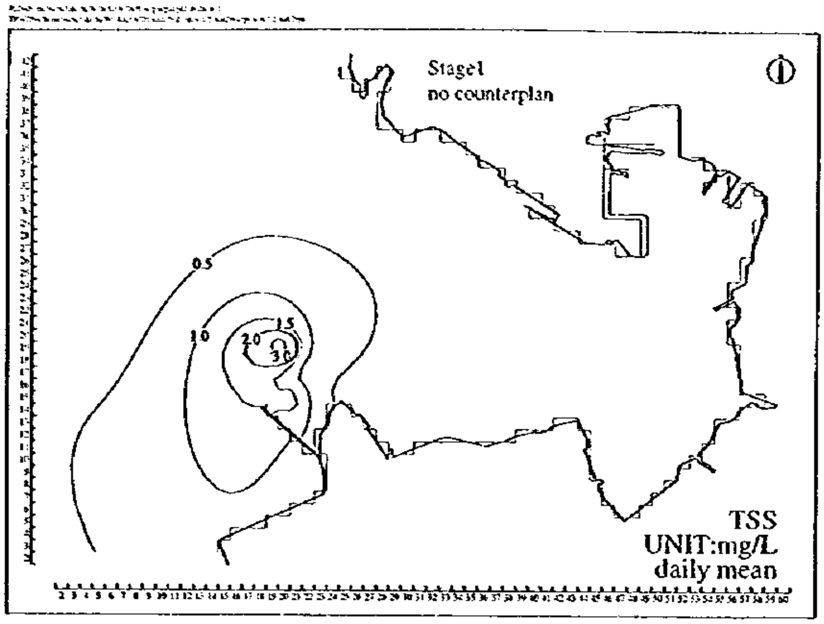
The water quality classification in Subic Bay is shown in Table 7.3.1-2 based on the SBMA Guide Line.

Table 7.3.1-2 The Standard Values of SS for each Classification in Subic Bay

Classification of Marine Waters	Place	Standard Values of SS
Class SA	Triboa Bay, Ilanin Bay	Not more than 30 % increase
Class SB	Whole Subic Bay except Class SA and SC	Not more than 30 mg/L increase
Class SC	Olongapo Bay	Not more than 30 mg/L increase

According to the World Bank Baseline Ecological Study Final Report prepared by Woodward-Clyde(1997), the TSS background levels in Triboa Bay are from 6.0 mg/L to 20.0 mg/L. Therefore, "Not more than 30 % increase" equals "Not more than 2 mg/L" in the minimum SS level for Class SA marine water.

The calculation results indicate that SS dispersion is limited to the area adjacent to work site in the Construction Stage 1. Taking into account that the ambient water quality criteria in SBMA defines the limit of SS from the effluent discharge quality as not more than 2 mg/L increase in Class SA and, 30 mg/L increase in Class SB/SC marine waters, estimated level of SS will not have significant impacts on the sea water area in the project site in Construction Stage 1 and 2.



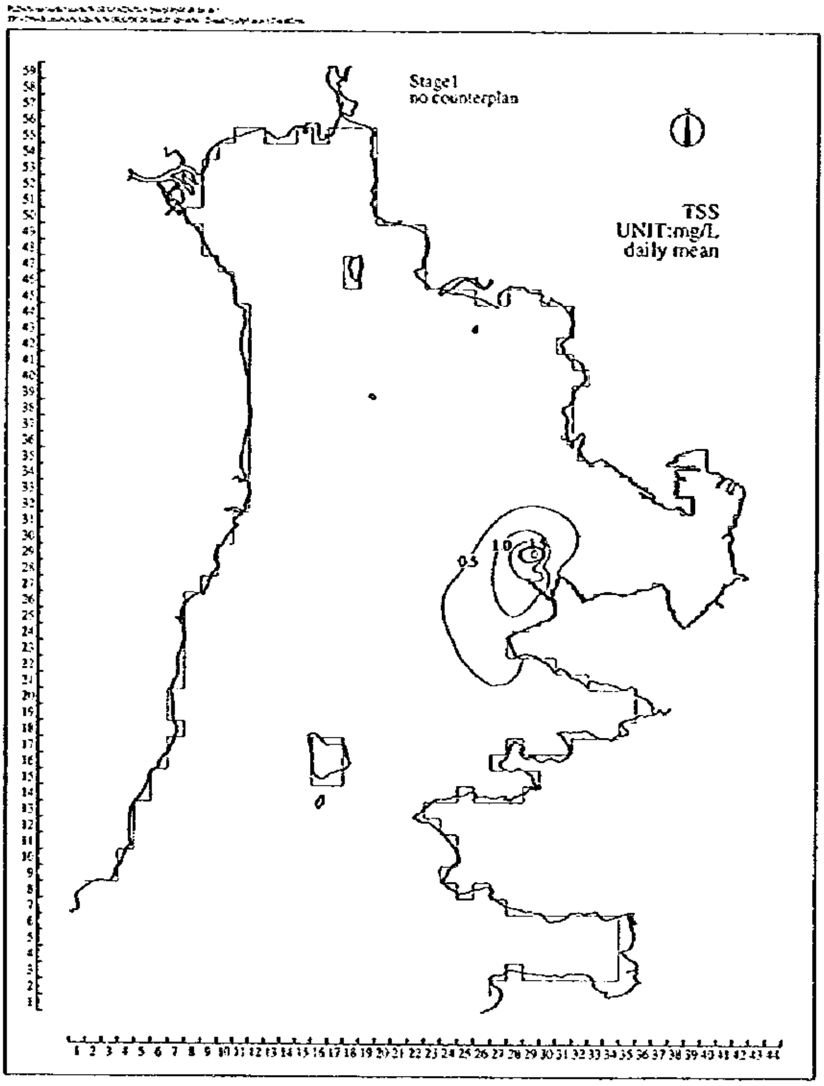
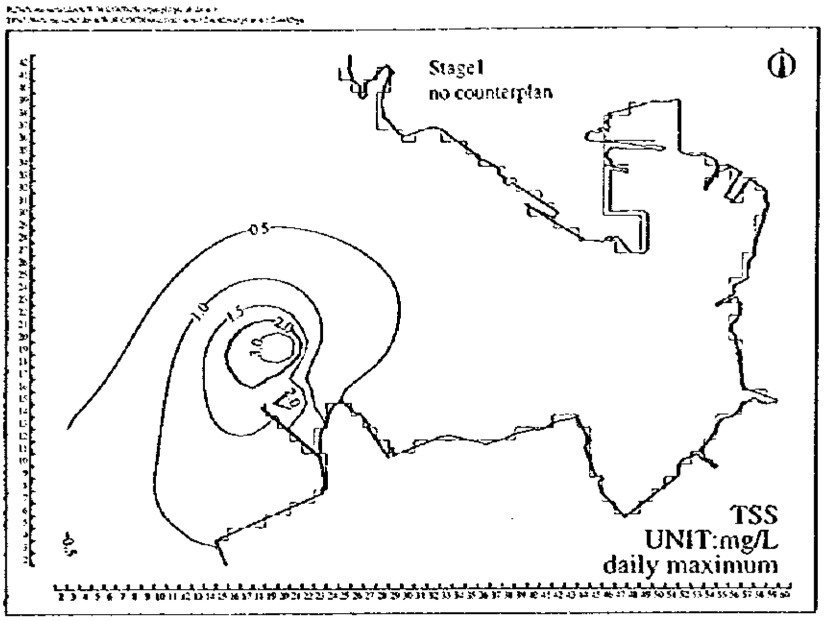


Figure 7.3.1-3 Daily Average of SS Concentration in Construction Stage 1



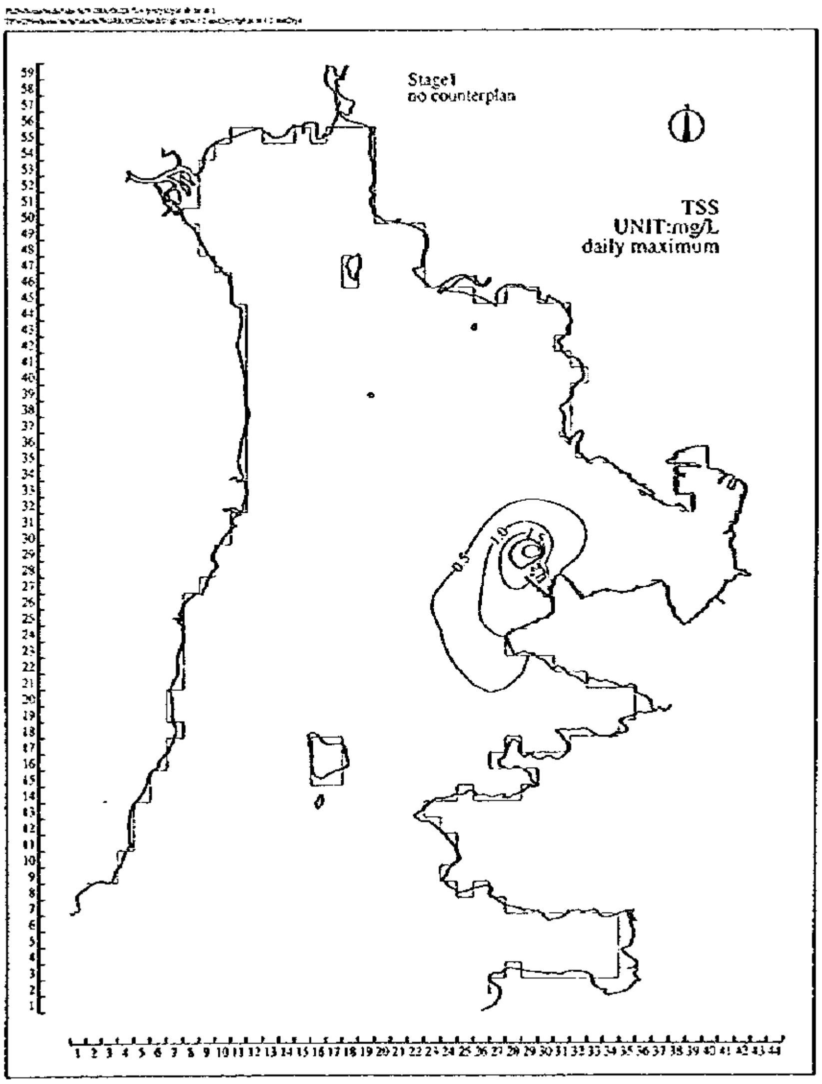
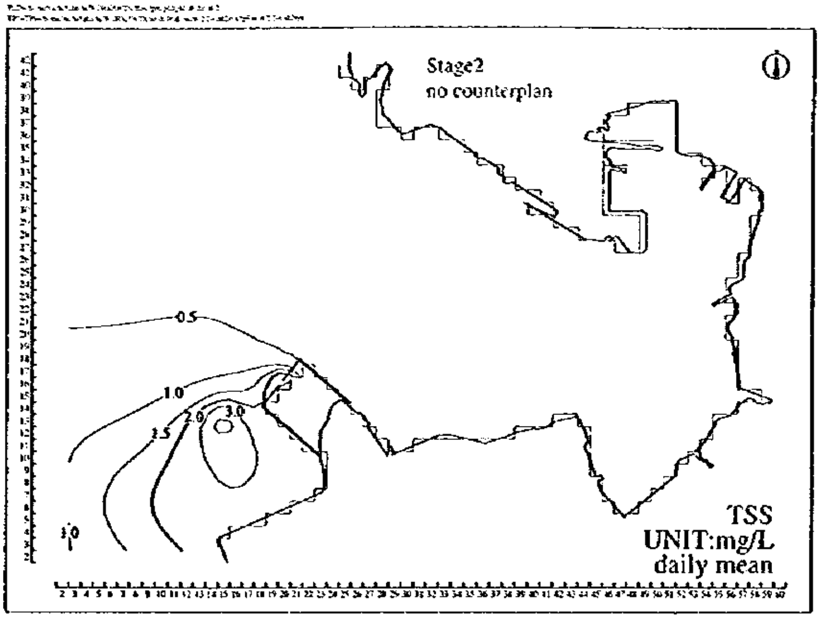


Figure 7.3.1-4 Daily Maximum of SS Concentration in Construction Stage 1



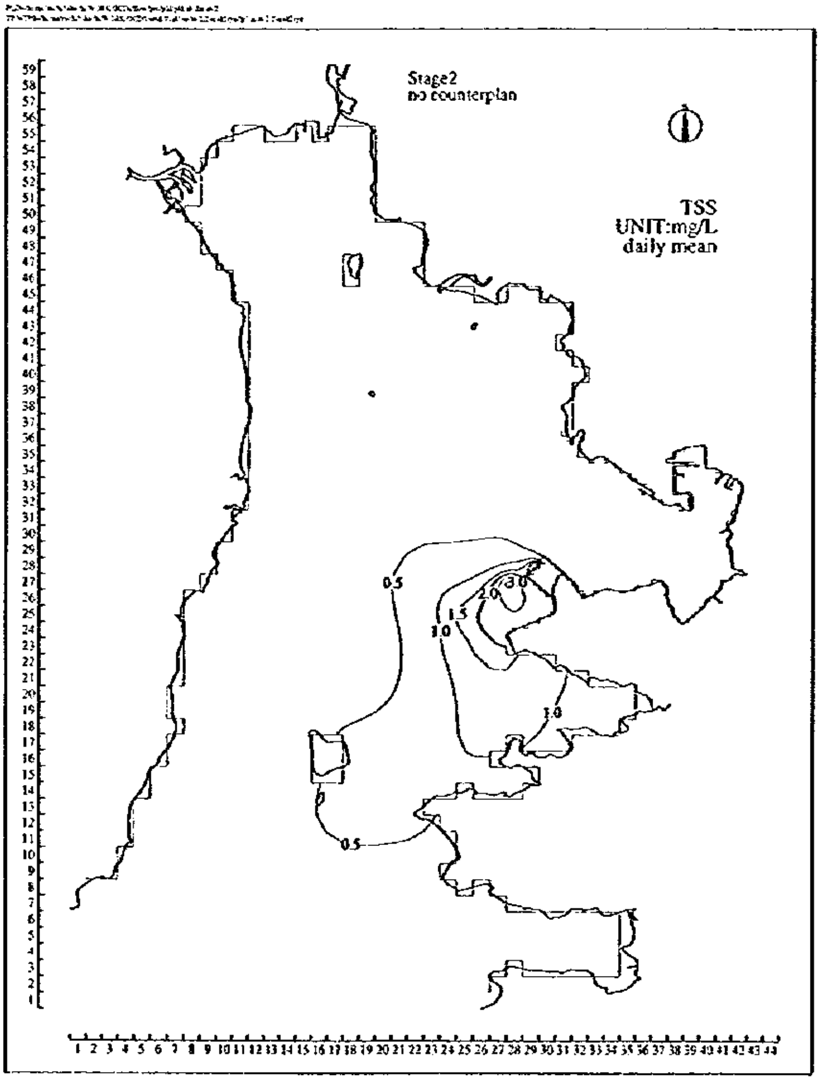
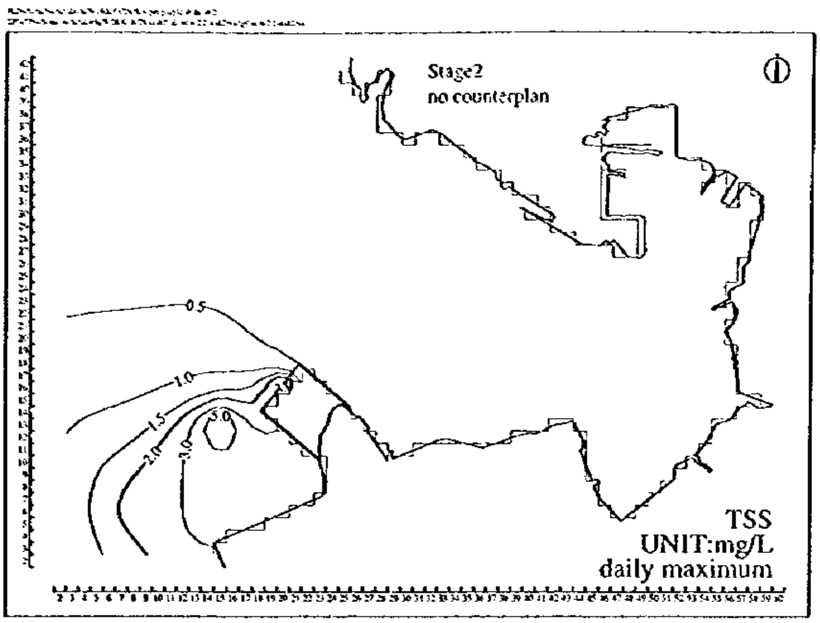


Figure 7.3.1-5 Daily Average of SS Concentration in Construction Stage 2



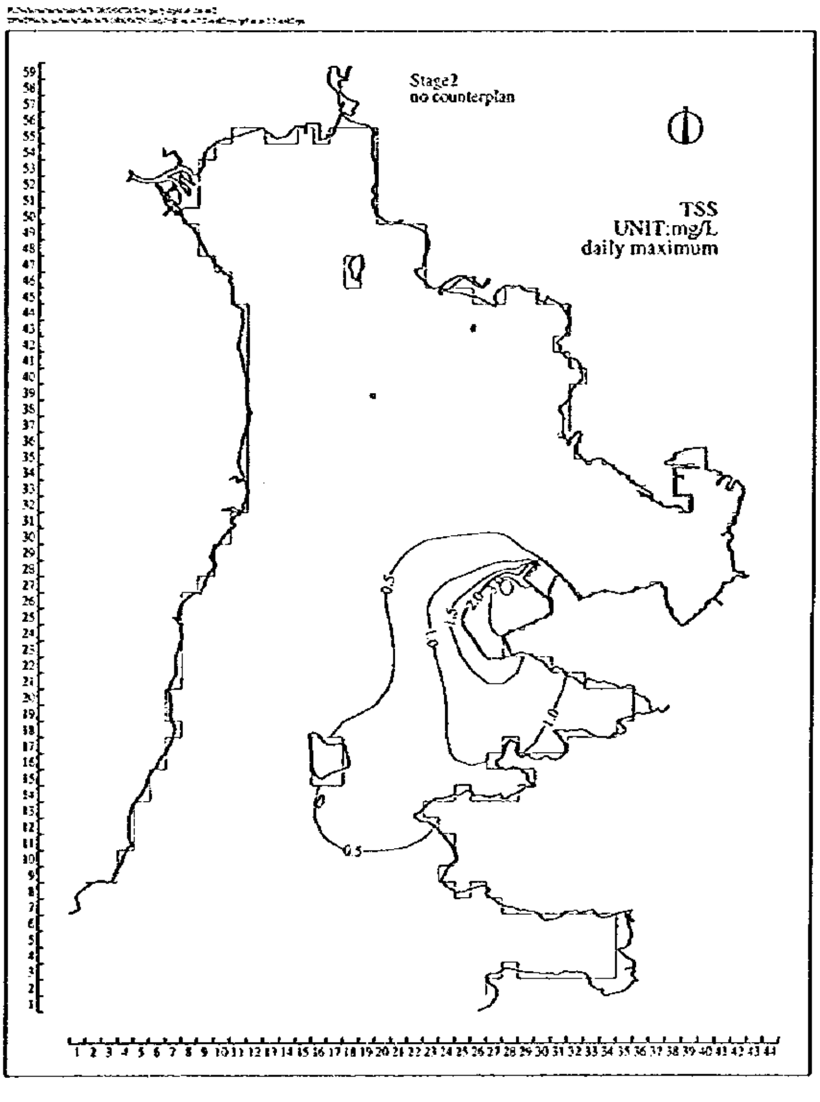


Figure 7.3.1-6 Daily Maximum of SS Concentration in Construction Stage 2

7.3.2 Sea Bottom Quality (Cadmium, Chromium)

According to the laboratory test of sea bottom quality conducted by the JICA Study Team in 1999, the cadmium (Cd) and the chromium (Cr) concentrations in the sediments at the Cubi Point were higher than the sediment screening values for metals (developed by U.S.NOAA) given in the World Bank Study Final Report (cadmium: 0.6 mg/kg, chromium: 81 mg/kg). The cadmium concentrations ranged from 1.37 mg/kg to 2.05 mg/kg and the chromium concentrations ranged from105 mg/kg to 230 mg/kg.

The chromium concentrations differ greatly from the other heavy metals (arsenic, cadmium, lead, mercury) in sediments; other heavy metals were detected in particular sites but chromium was detected in whole area of Subic Bay, and the maximum concentration (329 mg/kg) was found at the mouth of Cayuag River, which is far from the former base area. This indicates that the chromium concentration is caused by natural mineral resources.

Since there are no environmental standards in the Philippines concerning sea bottom quality containing heavy metals, it is recommended to select one of the following countermeasures.

① During the detailed design stage, leaching tests of sea bottom concerning cadmium and chromium must be conducted, and if the solution shows more than 0.1 ppm for Cd and/or 2 ppm for Cr (based on the standard of the Japanese Government), the sediments that percolate out Cd more than 0.1 ppm and/or Cr more than 2 ppm must be dredged prudently in order not to influence the sea water quality. It is also necessary to deposit the sediments within revetments that have sufficient waterproof function. The required dredging and reclamation methods are as follows;

a. the dredging work must be conducted with silt screen.

b. Cd and/or Cr of sea water quality around the dredging and reclamation sites and a waste way point must be monitored (control value for the works is defined as 0.01 mg/L for Cd and 2 mg/L for Cr).

② If the volume of the sediments at the sea bottom containing high cadmium and/or chromium concentration is large, entailing expensive dredging and reclamation works, the reclamation material must be taken from land in stead of sea bottom material.