

Since there are no large scale industrial factories around this area, the major sources of contamination of sea water are oil spilled from vessels and discharge of domestic sewage water from residential areas, mainly Colon City. In addition there is the drainage from swamps along the west coast line. The sewage water from Colon City is discharged on the sea bottom 500 meters off Colon northward via submerged pipe. There is no recent data on the quality of the sewage water.

The bay is also connected with the French Canal inlet and Manzanillo Bay. The French Canal inlet receives sanitary discharges from the Mount Hope shipyard, via three small out falls, and the bordering Manzanillo waters receive the effluent from the Colon City out fall.

The Panama Canal Company carried out a large scale systematic survey on the water quality of the Limon Bay Area for the years 1972-1975 in the course of the "Canal Zone Water Quality Study". They collected and analyzed samples from 34 sampling stations which were distributed throughout the area effectively. After this study, no notable survey on the water quality of the whole Limon Bay area has ever been carried out either by PCC or the Government of Panama.

The overall water quality can be said to be well maintained considering the great number of ships that enter the area.

The Atlantic waters near the coast of Panama have lower levels of nutrients and therefore less plankton to serve as food for the fish and other marine life. Consequently the Atlantic waters do not support a commercial fishery along the coast of Panama. Although the number and amount of fish is less than on the Pacific side, it seems that there is a greater species diversity in the Atlantic.

#### 11.2.2 Socioeconomic Cultural Environment

According to the national census carried out every ten years, the population of the Colon District which includes Colon City and 12 other corregimientos increased by 28 thousand from 113 thousand in 1980 to 141 thousand in 1990. (Corregimiento which is composed of several neighborhoods is a sub-area of a district.)

The population is concentrated in Colon City and its surroundings as shown Figure 11-2-3.

The population of Colon City decreased approximately 10% during these 10 years. On the contrary, the population of corregimientos surrounding Colon City has increased by approximately 60%. However, the population in areas other than Colon and its vicinity is negligible from the environmental impact point of view.



Figure 11-2-2 Gatun Road and Fort Sherman

Employment conditions have generally become worse in this area. The unemployment rate has increased to 14.9% in 1990, and Colon City has the highest rate (16.3%) in the district.

Within the area, there is no heavy industry which would have a great impact on the environment, however, a great deal of commercial activity is extensively carried on in the Colon Free Zone. Transportation and distribution based on the ports are also some other major industries in this area. Fishery is not carried out as an industry in Limon Bay as mentioned before.

The traffic conditions of this area are not good. The road network around the port of Cristobal lacks sufficient capacity and it is constantly congested with large vehicles related to port activities.

Domestic and industrial waste in this area is gathered and disposed mainly in Telfers Island basically without incineration. The total amount of the waste is 3,000 tons per month on average. Many kinds of wastes are involved, though the percentage of paper waste is higher than in other areas. The Free Zone has its own incinerator and takes responsibility for the treatment of waste on its own.

Boating, fishing and diving are popular recreation along the Atlantic coast, and there are a few yacht clubs and boat ramps in the area. Diving is especially popular since the coral reefs thrive in the Atlantic Ocean where the water is clear, warm, and the tidal range is not great. Such activities are not possibly not feasible in Limon Bay due to the heavy marine traffic, but there are two marinas presently operating in the French Canal and in Manzanillo Bay respectively.

### 11.3 Initial Environmental Examination

The impact of the project on each environmental aspect was evaluated using the check-list shown in Table 11-3-1. This check-list was prepared based on the international standard type often used by international financial organizations with slight modification to adjust to this project.

Since the result of the evaluation of each item differs by its project site, the four areas shown below were assumed as possible project sites for the future port development. (See Figure 11-3-1)

- Site-CS : Coco Solo and its surrounding area
- Site-C : West coast of Colon City
- Site-F : French Canal area
- Site-T : Northern part of Telfers Island

DENSIDAD DE POBLACION EN EL DISTRITO DE COLON,  
 POR CORREGIMIENTO: CENSO DE 1990

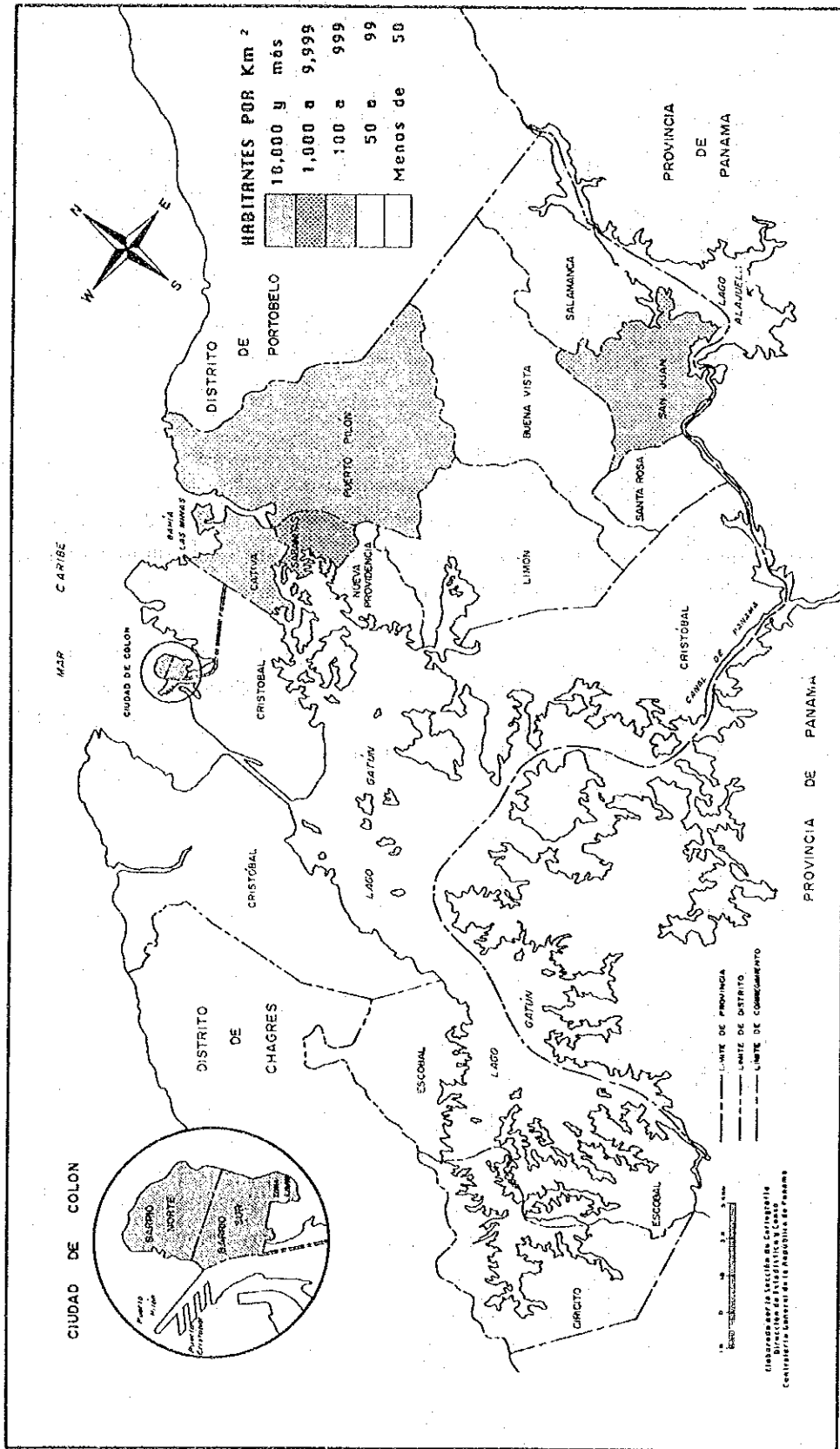


Figure 11-2-3 Population Density of the Colon District

Each item on this list was evaluated for all these alternative sites. In case that an item is evaluated as "Significant Effect", the corresponding site is shown in "Remarks" columns.

Taking this check list into consideration, a brief explanation of the evaluation of major environmental aspects is shown below:

(1) Air, Noise and Smell

A container terminal doesn't essentially affect air pollution, noise and smell by itself. However, port oriented road traffic tends to cause such adverse impact as mentioned above. In order to avoid it, port highways are desirable to be built away from residential areas.

(2) Current

Since Limon Bay is almost enclosed by breakwaters, a west bound offshore current dominant at outer sea does not affect current in the bay area. Tidal current is very weak in the bay due to small tidal range which is less than 30 cm on average. There is no need to investigate effect on current in detail.

(3) Water Quality

The water quality will be generally affected to a certain extent by the construction of port and related facilities in the coastal areas at any of the candidate sites in such a closed water area as Limon Bay. Surrounding water area of Site-CS and F, in particular, are recognized as sensitive to the increase of load of pollutant. It seems necessary to investigate impact on water quality in more detail.

(4) Terrestrial Ecology

1) Sites-CS and C

These areas have already been developed and the ecological importance of the land area is not great.

2) Site-F

There might exist fisheries and wildlife in the estuary zone.

If the water area is closed, it may bring about considerable changes in the environment.

3) Sites-F and T

There remain natural rain forests and mangrove in Telfers Island, but a considerable area has already been used as a dredging spoil dump and domestic waste disposal area. The additional impact on the terrestrial ecology will not be significant considering the total ecological capacity of the

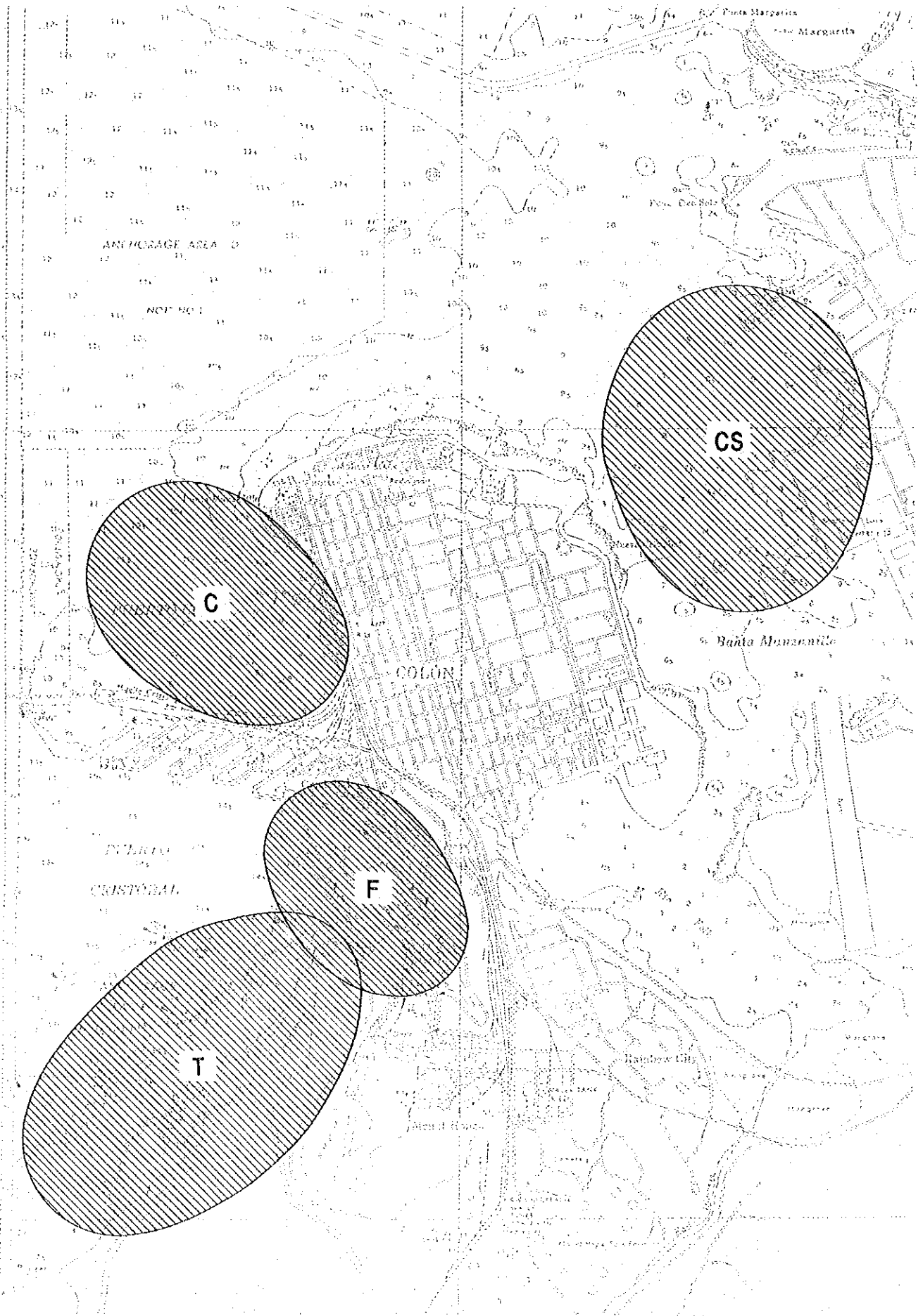


Figure 11-3-1 Location of Possible Project Sites

Table 11-3-1 Check List for IEE

CHECKLIST OF ENVIRONMENTAL PARAMETERS FOR PORT AND HARBOR PROJECTS  
FOR THE STUDY ON THE DEVELOPMENT PLAN AT THE PORT OF CRISTOBAL IN PANAMA.

Actions affecting environmental resources and values. (A)	Damages to Environment (B)	Recommended feasible protection measures (C)	No significant effect (D1)	IEE Significant effect			RE MARKS
				Small (D2)	Moderate (D3)	Major (D4)	
<b>A. Actions affecting coastal marine ecology</b>							
1. Location on harbors in fisheries reproduction zones	Loss of fisheries reproduction	Consider relocation of harbor site	x				
2. Location of harbor in fisheries capture zones	Displacement of fisherman families	Relocation of fishing zones	x				
3. Disposal of dredging spoils into fisheries reproduction zones.	Loss of fisheries reproduction	Proper spoils disposal	x				
4. Disposal of dredging spoils into coral beds.	Loss of fragile marine ecology	Proper spoils disposal	x				
5. Oil spill/leakage within harbor which escapes harbor area.	Damage to marine ecology (fishes/corals)	Improved routine and emergency control of oil leakage/spills	x				
6. Oil spill from tankers on way to and from harbor	Damage to marine ecology (fishes/corals)	Improved routine and emergency control of oil leakage/spills	x				
<b>B. Actions affecting Recreational/Resort/Beach areas along Coastal Zone.</b>							
1. Location of harbor too close to recreational areas.	Visible turbidity or discoloring of beach waters	Consider relocation of port or resort	x				
2. Escape of liquid and solid wastes from harbor area, especially floatables	Silt depositions along shoreline	Extraordinary attention to liquid solid waste management.	x				
3. Air pollutant emissions from harbor ship/facilities	Visible floating wastes	Extraordinary attention to air pollution control	x				
4. Disposal of dredging spoils which reach along shoreline.	Waste deposition along shoreline	Proper spoils disposal	x	x			COCO SOLO
5. Oil spill/leakage within harbor which escapes harbor area.	Oil films on beach waters and shoreline	Improved spill/leakage control and improved emergency oil spill cleanup	x				
6. Oil spill from tankers on way to and from harbor.	Contamination of beach waters	Improved emergency oil spill cleanup	x				
<b>C. Actions causing unacceptable sanitation conditions in harbor area.</b>							
<b>C. Unsanitary Harbor Environment including:</b>							
1. Inadequate provision of water supply to port facilities.	unacceptable environmental activities	Extraordinary attention to water supply	x				
2. Inadequate management of waste emissions from port facilities.	health hazards to port and ship workers	Extraordinary attention to waste management from shore facilities	x				
a. liquid sanitary and industrial wastes.	destruction of harbor ecology		x				
b. solid sanitary and industrial wastes.	hazards for pollution of coastal areas by escape of wastes from harbor		x				
c. gaseous emissions from shore industries.			x				
3. Inadequate management of wastes from ships.	Similar to A 1,2,3,4, above	Extraordinary attention to management from ships	x				
(a) liquid wastes, especially floatables, including bilge waters			x				
(b) solid wastes, especially floatables, including garbage			x				
4. Escape of oils within harbor	Similar to A 1,3,4 above	Improved routine and emergency controls of oil leakage and spills					
<b>D. Handling of hazardous cargoes within harbor especially:</b>							
1. Dust emissions (for example, handling of coal and cassava dusts)	Air pollution and explosion hazards	Proper air pollution control					
2. Hazardous materials (inflammables, explosives, toxic substances)	Health and safety of workers and nearby residents	Proper control of hazardous materials	x				
<b>E. Handling of materials to and from harbor</b>							
1. Traffic congestion	Air pollution and explosion hazards	Proper air pollution control		x			All
2. Hazardous material spills (inflammables, explosives, toxics)	Health and safety of workers and nearby residents	Proper control of hazardous materials	x				
<b>F. Actions affecting local socioeconomics</b>							
1. Inadequate housing for new population	Hazards for creating slums	Planning to prevent slum problems	x				
2. Inadequate health precautions during construction (especially malaria)	Communicable disease hazards	Proper planning of construction worker facilities	x				
a. communicable disease hazards from imported workers/carriers	Proper precautions during construction	Spraying of workers camp for erophefene mosquito control	x				
b. inadequate water supply and sanitation for workers	Provision for adequate facilities	Provision for adequate facilities					
3. Changes in land use patterns:							
a. displacement of agriculture	loss of agricultural values	appropriate resettlement	x	x			Colon west
b. displacement of villages	displacement of villages	appropriate resettlement		x			Teller
c. displacement of waste disposal area	loss of waste disposal area	provision of adequate site		x			Colon west Coco solo
d. displacement of water discharge	loss of water discharge	provision of adequate site		x			
4. Excessive noise from harbor operations	Health of harbor workers and nearby residents	Adequate noise control					
5. Increased employment	increase social stability			x			All
<b>G. Actions affecting terrestrial ecology</b>							
1. Adverse impact on local forest	Similar to A 1 to A 6 above	Similar to A1 to A6 above	x				
2. Adverse effects on wildlife from loss in forest habitat			x				
3. Adverse effects on estuarine lagoons (fisheries, wildlife)				x			French Canal Coco Solo
<b>H. Actions caused by changes in coastal hydrology</b>							
<b>Damage to coastal facilities/ecology</b>							
1. Deposition along nearby coastal areas	Damage to shoreline properties	Careful project design with respect to hydrology plus protection facilities.					
2. Erosion along nearby coastal areas	Damage to shoreline properties	Proper engineering to avoid problem	x				
3. Adverse effect on marine water quality	Damage to living conditions		x				
<b>I. Actions affecting precious Historical/Cultural/Religious Monuments/Sites</b>							
<b>Loss or damage to resources</b>							
1. By displacement or submergence		Relocation or protection measures	x				
2. By alterations in coastal zone hydrology/shoreline			x				
<b>J. Hazards from access roads/trails/ living harbor</b>							
	Collision/Spill Hazards to ships	Proper design for harbor access	x				
<b>K. Navigation Hazards from ship entering or leaving harbor</b>							
				x			All

CONCLUSIONS: NO SIGNIFICANT ADVERSE ENVIRONMENTAL EFFECT TO BE CAUSED BY PROJECT. NO EIA NEEDED.

X SIGNIFICANT ENVIRONMENTAL IMPACT AS SHOWN IN COLUMNS D2/D3/D4.  
FOLLOW-UP IEA NEEDED AS DESCRIBED IN ATTACHMENT 1

surrounding area.

(5) Coastal Marine Ecology

Since an inshore fishery does not exist in the Limon Bay area, there is no need to evaluate the effect on the fishery. There might be some fishery reproduction zone in the French Canal or in Manzanillo Bay, however, they are not important reproduction areas compared to many other similar areas in the Limon Bay.

(6) Displacement of Villages and Facilities

1) Site-C

The possibility of displacing the squatter area on the west shore of Colon City will be examined carefully in the case of reclamation of the coastal area.

2) Site-F

There are bunkering facilities, a navigation channel to the ship repair facilities, a marina and other facilities related to the Canal and port operation. It will be necessary to prepare substitutive area or facilities if the development of new port facilities obstruct these existing functions.

3) Site-T

A substitute area for dredged spoil dumping and domestic waste disposal might be required in the case that this area is utilized as a new port construction site.

(7) Disposal of Dredging Spoil

1) Site-CS

Since the water depth around Coco Solo is not sufficient for a deep sea port, a great amount of dredging will be needed. The place and method for dumping dredging spoils will be examined to avoid environmental damage.

(8) Effect on Navigation Control

There is an access channel of the Panama Canal in front of the Cristobal Basin. Many ships traverse this channel. An increase in the number of ship calls to the ports will make the navigation control more complicated and especially busy on the site alternatives inside the Cristobal Basin; Site-F and T.

The Cristobal Basin is not very wide. The turning basin for a large size ship can barely be secured inside the Cristobal Basin. It is necessary to examine the possibility of serving all ships calling at the port without inducing adverse effects on Canal navigation.



#### 11.4 Base Line of EIA

Main purpose of Environmental Impact Assessment (EIA) of the Study is to evaluate environment impact of the Short term plan. Many of the items which were evaluated as "Significant Effects" in the check list for IEE will be settled during the course of site selection or physical planning and will not necessarily be examined in detail on EIA.

In spite of that, further investigation of the impact on water quality appears to be necessary for any alternative site so long as large scale port facilities are to be constructed in the water area.

Since Site-T is recommended as the most appropriate development site for new container terminals, necessary items for this site were examined further in the following sections.

#### 11.5 Impact on Water Quality

##### 11.5.1 Evaluation Method of Impact on Water Quality

Impact on water quality is evaluated in terms of Chemical Oxygen Demand (COD). A numerical simulation model called the Box Mixing Model is applied. Total area of Limon Bay is the object of the simulation study, which is then divided into several areas or "boxes". Impact of the development project on water quality for each box is examined by simulation. In order to assess impact of the project plainly, background condition such as inflow of pollutant from other areas including Colon City is assumed to be unchanged. Major process of examination is as follows.

- 1) Collection and analysis of existing data and information
- 2) Dividing Limon Bay area into several areas (boxes)
- 3 Setting inflow volume of pollutant
- 4) Setting water quality of present situation as a target of calibration
- 5) Calibration of the simulation model by simulating present condition
- 6) Simulation of future water quality in "With the Project Case"
- 7) Evaluation of impact on water quality of the project by comparing 5) and 6)

Future condition at Short Term Plan stage is the major object of the simulation study, however, future conditions for Master Plan stage and Post Master Plan stage taking future land use plan at each stage into consideration are also examined as references. Cases for simulation are shown as follows.

Case	Loading Condition	Remarks
Present	Present Condition	Condition of existing data
Case-1	Short Term	One new container terminal
Case-2	Master Plan	Three new container terminals and corresponding land use plan
Case-3	Post Master Plan	Five new container terminals and corresponding land use plan

Container terminals essentially have no significant pollution source and little impact on water quality of surrounding area.

The objective of this simulation is not to predict the local change of water quality in detail but to ascertain that the project will not affect general situation of water quality of Limon Bay.

#### 11.5.2 Outline of simulation model

General explanation of Box Mixing Model is provided in this section.

The box mixing model is suitable for a closed bay or port with an entrance from the sea and a width of up to 5 km. This model assumes that pollutants are poured in at some sections of the bay, water in each section is mixed in one tidal period (usually 12 hours), and pollutants in one section are conveyed to the next section by tidal flow. Inward flow conveys outer seawater and outward flow carries away pollutants. Some pollutants are carried back on the next inward flow. The model calculates the balance of pollutants in each section and seeks a concentration level where inflow and outflow of pollutants are equal. Usually COD or BOD is used as an indicator of pollutants.

The idea of the box mixing model is shown in Figure 11-5-1 and its equation is below the figure. Concentration level of each section ( $S_i$ ) is changed by the number of tides calculated but  $S_i$  converges to a certain level after a number of tides, which is likely an average of the concentration levels in each section.

Theoretically, it is possible to calculate  $S_i$  by assuming that the difference between  $S_i^m$  and  $S_i^{m-1}$  becomes Zero where inflow and outflow of pollutants are balanced. The equation can be solved by a method coalition linear equations.

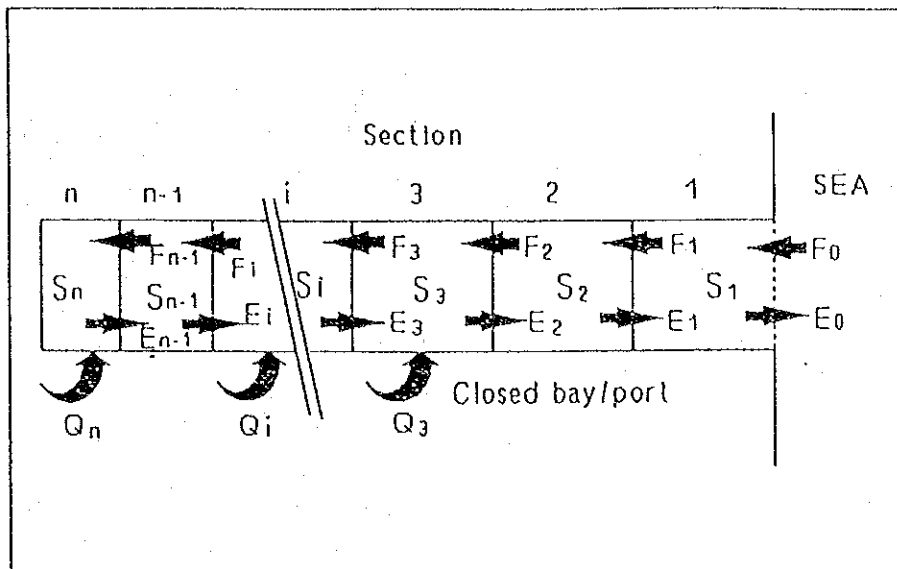


Figure 11-5-1 Box Mixing Model

Balance of inflow and outflow of pollutants

$$\text{Section 1 : } (F_1 + E_0)S_1 = F_0S_0 + E_1S_2 + Q_1$$

$$\text{Section 2 : } (F_2 + E_1)S_2 = F_1S_1 + E_2S_3 + Q_2$$

$$\text{Section i : } (F_i + E_{i-1})S_i = F_{i-1}S_{i-1} + E_iS_{i+1} + Q_i$$

$$\text{Section n : } E_{n-1}S_n = F_{n-1}S_{n-1} + Q_n$$

where,

$S_0$ : concentration level in outer sea water (mg/l)

$S_i$ : concentration level at section i (mg/l)

$Q_i$ : pollutants discharged into section i during a tidal period (about 12 hours)

$F_i$ : volume passing through the boundary between section i and 1 during inflow

$E_i$ : volume passing through the boundary between section i and i+1 during outflow

A simple way to estimate  $F_i$  is to calculate a volume of tidal amplitude from sections i to n.  $E_i$  equals the sum of  $F_i$  and the amount of discharge into sections from i to n.

### 11.5.3 Data and Information Available for Simulation

Data and information available is extremely limited. Main data used for simulation is shown below.

(1) Present Situation of Water Quality

Present situation of water quality of surrounding area is assumed on the basis of the water quality survey by the Study Team. Other sole survey result available is Canal Zone Water Quality Study by Panama Canal Company in 1975, which was used as a supplement.

(2) Inflow of Fresh Water to Limon Bay

The largest inflow of fresh water which affect the current in the Bay is discharged water from Gatun Lock operation. Each time a ship enters or leaves Gatun Locks, 26 million gallons (approx. 100 thousand cub. m) of water from the lake are discharged into the channel that leads to Limon Bay and the ocean. According to PCC's data, 4.7 million cub.m of water will be discharged in a day on average. Other major inflow is from sewage systems around the Limon Bay, however, it is less than 40 thousand cub.m a day. The quantity of fresh water inflow from natural rivers is negligible.

(3) Loading of Pollutants

The major pollutants are from river and sewage. Since no recent data and information is available, they are mainly assumed from the survey result by Panama Canal Company in 1974.

(4) Tide and Tidal Current

Tidal data observed by PCC for more than 50 years is available. Tidal current is very weak based on the survey result by the Study Team. The change of coast line is small and negligible due to lack of breakwater or jetty. Therefore, tidal current can be ignored.

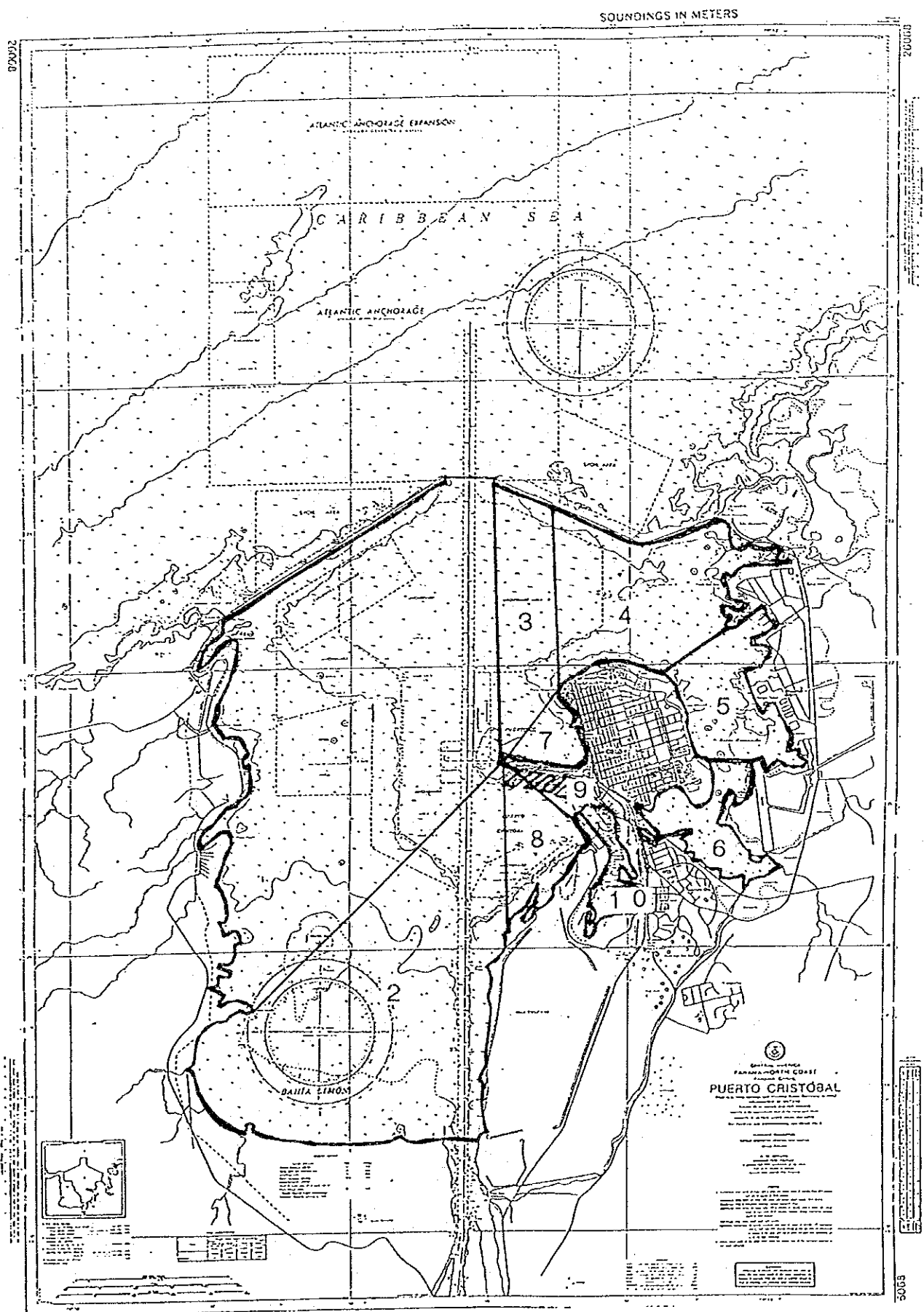


Figure 11-5-2 Division of Limon By Area

#### 11.5.4 Condition of Calculation

##### (1) Dividing Condition of Limon Bay Area

For formulating Box Mixing Model, the Limon Bay Area is divided into 10 boxes as shown in Figure 11-5-2. The area and characteristics of each box are shown below.

Box No.	Area (sq.km)	Remarks
1	12.510	Main anchorage area for Panama Canal
2	15.087	Entrance area of Panama Canal
3	2.570	
4	3.650	Entrance of Manzanillo Bay
5	2.487	Inner area of Manzanillo Bay
6	0.908	Folks River area
7	0.587	West side of Colon City
8	*) 1.369 1.296 1.173 0.963	Surrounding area of new container terminals (Present condition) (Short Term Plan) (Master Plan) (Post Master Plan)
9	0.377	Surrounding area of existing Piers
10	0.372	Inner area of French Canal

\*) Area differs by reclamation for construction of new container terminals.

##### (2) Inflow of Fresh Water and Pollutant

Based on the existing data and information and future port development plan, inflow of fresh water and pollutant are estimated as shown below.

No. of Box	Inflow of Fresh Water(cu.m/day)	Load of Pollutant (kg/day)	Remarks
1	-	-	
2	4,733,365	36,620	from Gatun Lock of Panama Canal and others
3	-	-	
4	27,787	13,490	from Colon City area
5	482	141	from Coco Solo area
6	8,410	1,584	from Rainbow City area
7	-	-	-
8	- 65 915 2,899	- 33 460 1,463	Present condition Short Term Plan Master Plan Post Master Plan
9	197 150 150 150	99 75 75 75	Present condition Short Term Plan Master Plan Post Master Plan
10	66	131	from Mount Hope Area

Inflow of fresh water and pollutant to Box 8 and 9 are assumed to be from port and relating facilities. These value are calculated by multiplying specific productivity (for fresh water and pollutant) with population. Specific productivity is acquired from the data of inflow of fresh water and pollutant from Colon City area surveyed by Panama Canal Company in 1974 divided by the population of Colon City in 1980 as shown below.

Fresh Water	0.436 m <sup>3</sup> /person/day
Pollutant (COD)	219 g/person/day

Since there is no residential area, people are assumed to work 8 hours out of their total 16 waking ours. Accordingly specific productivity can be reduced to half of the figures shown above.

Expected number of worker at port and surrounding area in each time stage is estimated as shown below.

CASE	Box 9 (Existing Port)	Box 8 (New Port)	Remarks
Present	902	-	Year 1992
Case 1	785	255	Short Term Plan
Case 2	785	4,197 *) 765 2,477 826	Master Plan Container Terminals Bonded Warehouse Business Center
Case 3	785	13,047 1,275 4,953 1,651 4,953	Post Master Plan Container Terminals Bonded Warehouse Business Center Export Process Zone

\*) In master plan stage, half of bonded warehouse and business center expected at Post Master Plan stage is assumed to be operated.

(3) Tidal Range

Tidal range for calculation of water volume inflows into Limon Bay during one tidal cycle is assumed as 26 cm based on the difference between M.H.W. and M.L.W..

(4) Water Quality of Outer Sea

Mean concentration of COD at outer sea is assumed as 8,61 mg/l converted from the survey result in BOD outside of East Breakwater by Panama Canal Company.

11.5.5 Calibration

(1) Target Value for Calibration

Present condition of COD as the target of calibration is converted from observed data in BOD. Conversion formula is estimated as below utilizing survey result by the Study Team.

$$\text{COD} = 5.86 \times \text{BOD} + 5.09$$

(2) Result of Calibration

Distribution of COD in calculated result is shown in Figure 11-5-3. Relation between calculated result and target value is shown in Figure 11-5-4 with the regression line. Regression coefficient is calculated as R=0.88. Reproductivity of simulation model can be recognized as reliable.



### 11.5.6 Result of Simulation

Based on the data described above, a series of numerical simulation have been conducted for each future time stage. The table below shows the results of the simulations in terms of the difference between the present and future time stages.

(mg/l)

Box No.	Present	Case-1 Short Term	Case -2 Master Plan	Case-3 Post Master Plan
1	9.20	0.00	0.02	0.06
2	8.71	0.00	0.03	0.13
3	11.99	0.00	0.02	0.05
4	15.98	0.00	0.02	0.06
5	16.87	0.00	0.02	0.06
6	19.87	0.00	0.02	0.06
7	11.99	0.00	0.02	0.05
8	8.85	0.02	0.57	1.78
9	9.27	-0.05	0.50	1.71
10	9.60	-0.04	0.51	1.71

### 11.5.7 Evaluation of Impact on Water Quality

In Case-1 (Short Term Plan Stage), concentration of COD increases by 0.01 mg/l in Box No.8 and decreases in Box No.9 and No.10. This is indicative of the change in the number of workers at each port area. However, expected change of water quality by the Short Term Plan is negligible. On the other hand, concentration in Box No.8 to 10 will fairly increase in Master Plan stage and Post Master Plan Stage. It may affect water quality in Limon Bay. Figure 11-5-5 shows relation between load and water quantity in Box No.8. The relation is almost linear.

To evaluate total effect on Limon Bay, average water quality with weight of surface area is compared with total load in Figure 11-5-6.

Sensitivity of concentration of COD is evaluated. Increase of load of pollutant of around 80 kg/day induce increase of 0.1 mg/l of COD in local and increase of 0.01 mg/l of COD in total bay area.

As a conclusion, effect on water quality by short term plan is totally negligible. In the master plan stage or post master plan stage, the effect should be carefully examined and appropriate countermeasures such as introducing sewage processing system should be considered.

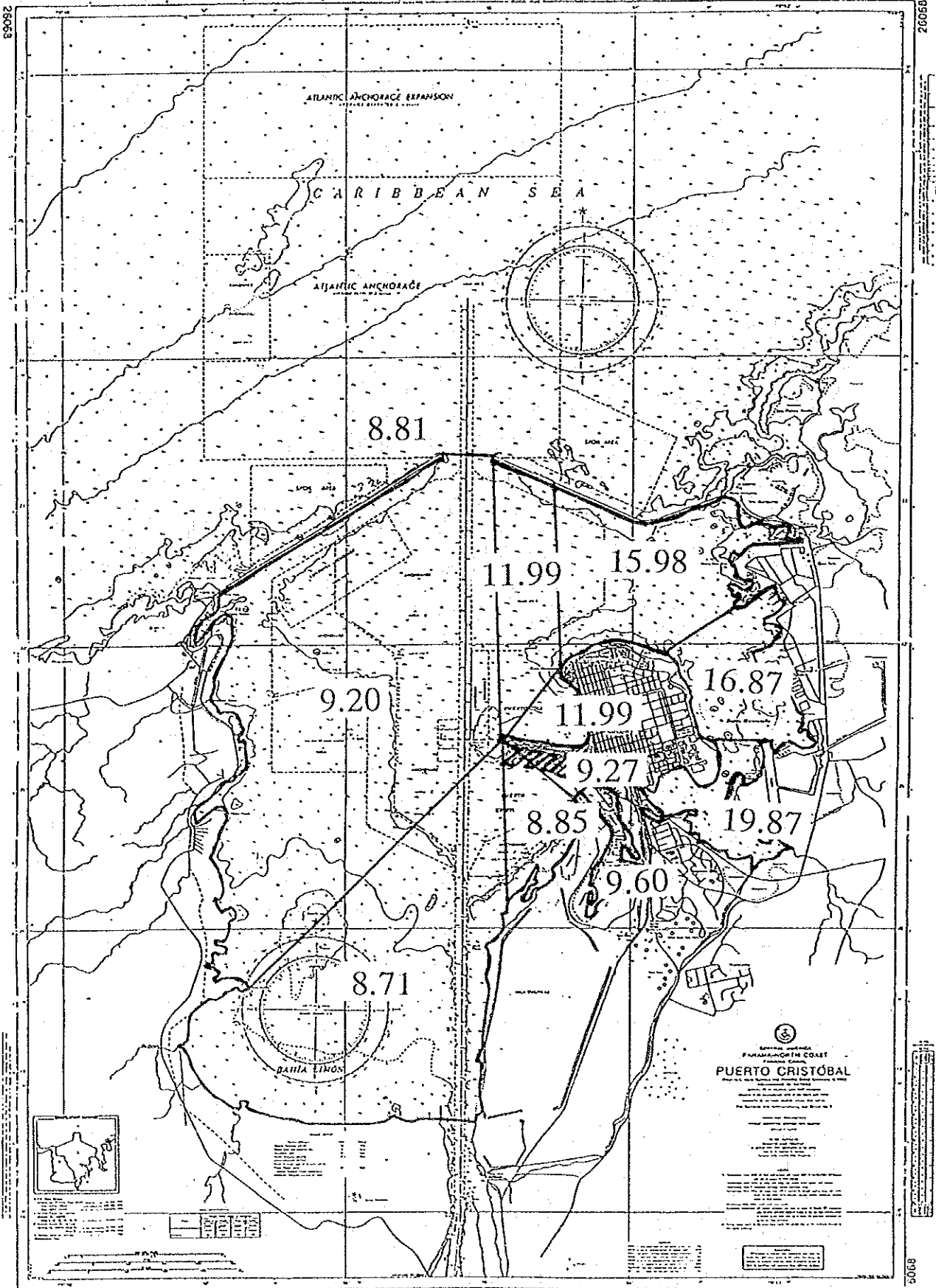


Figure 11-5-3 Calculated Result of Concentration of COD at Present Condition (mg/l)

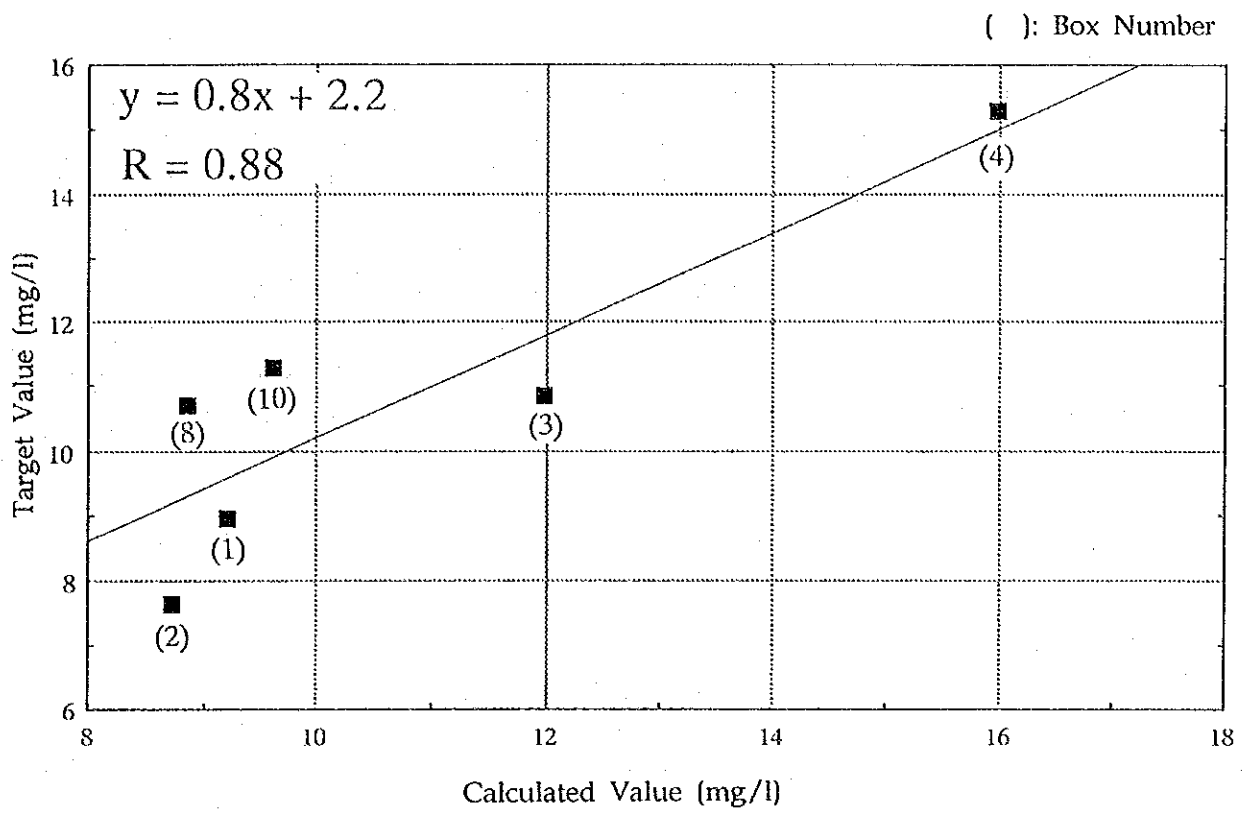


Figure 11-5-4 Result of Calibration

## 11.6 Impact on Inland Traffic Condition

Port oriented traffic volume will increase mainly by development of a new container terminal in 2000 as estimated in Part II Chapter 8. Since expected cargo volume at existing Cristobal Port area is not so different from the present condition, the impact on traffic condition by modernization of existing port facilities is negligible.

On the other hand, traffic to and from Telfers container terminal will largely affect the traffic conditions of existing road network around the port of Cristobal, especially at the entrance of Colon city. In order to alleviate this impact, short cut route shall be prepared so that vehicles can take a roundabout way to avoid it as shown in Part II Chapter 8.

## 11.7 Impact on Navigation Safety

### 11.7.1 Capacity of Navigation Channel

Vessels calling at the port of Cristobal inevitably use navigation channel of the Panama Canal in Limon Bay. It is necessary to examine the impact on navigation safety for Canal transit vessels caused by the project through increase of vessels calling at the port of Cristobal.

Number of vessels calling at the port of Cristobal is estimated as follows.

	1991	2000	2010
Cargo Handling	745	1,027	1,237
Bunkering	383	663	1,166
Others	25	49	183
Total	1,153	1,739	2,586
Increase from 1991	-	586	1,433

Total number of vessels which transit the Panama Canal was 14,108 in 1991. Transit volume of the Canal is limited by the capacity of locks and Gaillard Cut, and is said to be around 15,000 vessels.

On the other hand, navigation channel in Limon Bay itself has for more capacity and transit volume will not increase in future.

The number of vessels calling at the port of Cristobal is far less than the capacity of channel and majority of calling vessels are also canal transit vessels. The impact of the project on congestion of navigation channel of Panama canal is negligible.

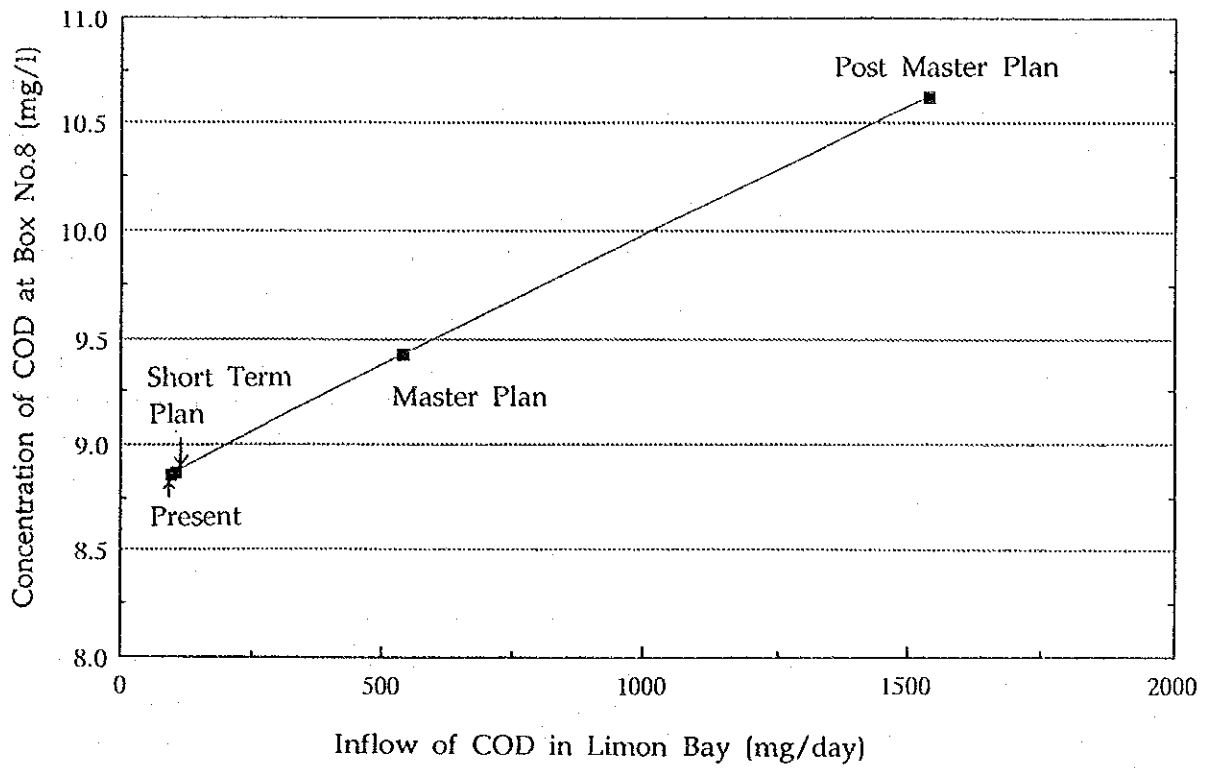


Figure 11-5-5 Relation between Concentration of COD at Box No.8 and Inflow of COD into Box No.8 and 9

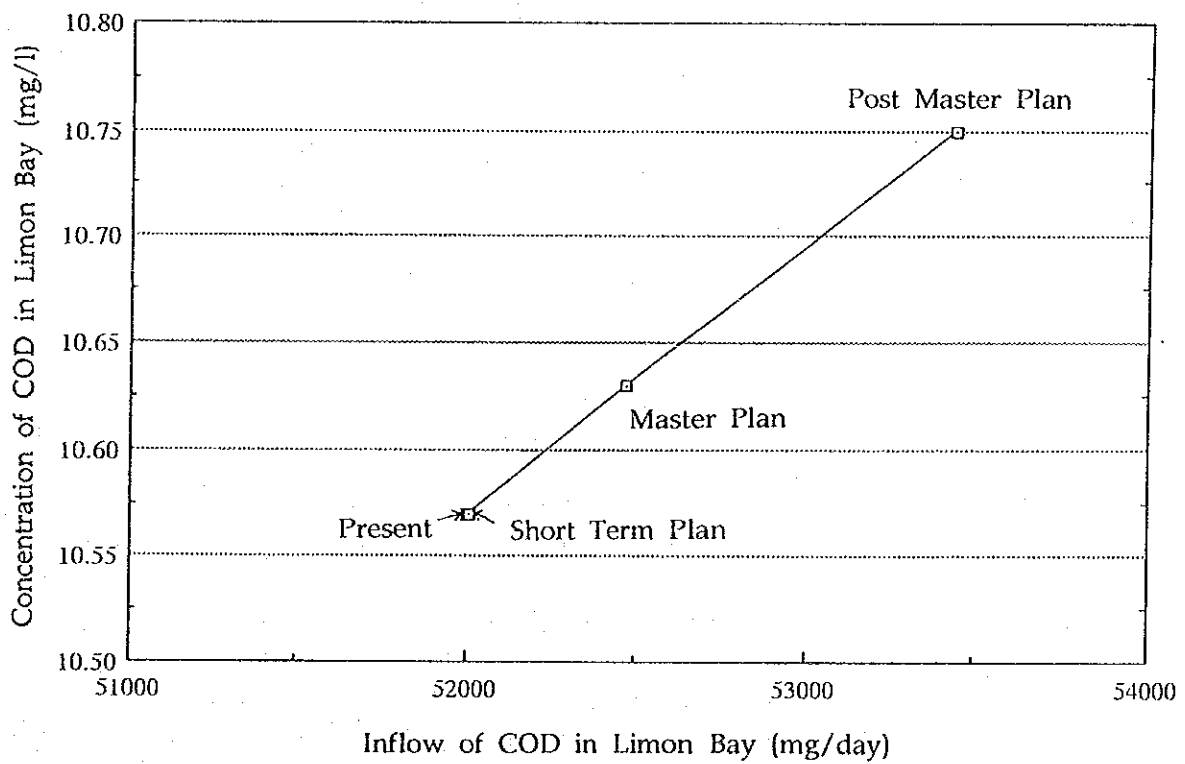


Figure 11-5-6 Relation between Concentration and Inflow of COD in Limon Bay

### 11.7.2 Water Area Use

It is important to examine whether port facilities will affect navigation safety of Canal transit.

Up to the master plan stage, channel and basin for Telfers container terminal can be secured sufficiently apart from the navigation channel and no significant effect is anticipated.

In case two other new container terminals are developed at Telfers Island in the post master plan stage, detailed investigation on the effect and countermeasures will be necessary because these container terminals would be close to the navigation channel.

### 11.7.3 Ship Wave

New container berths at Telfers Island is sufficiently apart from navigation channel ( 650 m at the nearest point). Ship wave in front of container berth induced by Canal transit vessel in the navigation channel has negligible effect on container cargo handling at the container berth. Impact on navigation safety for Canal transit by ship wave reflected at Telfers new container berth is also negligible.

## 11.8 Impact on Employment

The project will largely increase employment. This impact is examined from three different aspects.

### 11.8.1 Employment during Construction Term

According to the National Census in 1990, total labor force was 19,365 while the unemployed totaled 3,151 in Colon City Area. Unemployment rate is 16.3 % accordingly.

The construction work of the project will produce significant amount of jobs in Colon City area. Expected construction period for Short Term Plan is about two years. During the construction period, approximately 500 workers are roughly estimated to be employed on average. At the peak time, around 1,500 workers will be employed.

If these jobs are provided in Colon City Area, simple calculation shows that unemployment rate in Colon City will decrease to 13.6 % on average and 8.5 % in peak time. Indeed, all of the employment opportunities will not necessarily be created in Colon City, but construction work will produce a large amount of indirect employment in related industries. The effect of construction work on employment condition is definitely significant. Since this rise in employment will take place at the beginning of the project, it will be very effective in improving social stability which has suffered due to recent decrease in employment in the Colon City area.

### 11.8.2 Direct Employment of Terminal Operation

In the short term plan stage, facilities and activities at the port of Cristobal will significantly increase, however, direct employment will not increase so much in total due to rationalization and improvement of efficiency of management and operation of existing container terminal.

On the other hand, effect on related industries such as shipping agents, inland transportation, insurance and bank will be large and a large amount of new employment opportunities are expected.

### 11.8.3 New Employment Supported by Port Activity

As explained in the chapter of economic analysis, the Colon Free Zone has a large scale future expansion plan. This plan cannot be realized without increase of container cargo handling capacity. In other words, a new container terminal is indispensable for future expansion of the Colon Free Zone. The expected increase of employment ( approximately 9,400 person ) of free zone is supported by the port development project. The total amount of income for the in new employees will be 52 million Balboa annually. Since this employment is not temporary but permanent, the project will largely contribute to the social stability of the Colon City area.

## 11.9 Impact on Other Environmental Aspect

### 11.9.1 Displacement of Domestic Waste Disposal Area

Domestic waste from Colon City and surrounding area is disposed at PCC administrating area in Telfers Island, however, it has already been decided to remove the disposal area by the year 1997. Thus, there is no relation between the port development project and removal of waste disposal area. In addition, as an alternative site for removal of existing disposal area has not been examined or selected at all, there is no way to evaluate the impact of removal.

### 11.9.2 Oil Spills and Leakage

One of the major adverse effect on surrounding environment induced through port activities is oil spills and leakage. Disposal of bilge from vessel is strictly prohibited by international treaty and necessary facilities and countermeasures are established. On the other hand, oil spills and leakage sometimes take place accidentally during bunkering operation. Total volume of oil leakage reported in recent years is as follows;

Year	Volume of Oil Leakage at the Port of Cristobal (m <sup>3</sup> )
1991	11.3
1992	3.3
1993 (up to June)	21.7

These leakages of oil are neither unavoidable consequence of bunkering activities nor will they necessarily increase along with flourishing port activities. It can be prevented or decreased through effort of rehabilitation of bunkering facilities and of safe and efficient operation. Accordingly, the port development project will not increase the spill or leakage of oil.

In order to keep water quality in good condition, APN should take necessary measures such as inspection on calling vessels to prevent illegal disposal of bilge.

#### 11.10 Overall Evaluation of Environmental Impact

The result of EIA is summarized as follows.

Item	Result of Evaluation
Water Quality	No significant impact by Short Term Plan. Further investigation will be needed for future land use of Telfers Island.
Inland Traffic	Possible to be settled by making port oriented traffic to avoid congested area
Navigation Safety	No significant impact by Short Term Plan. Further investigation will be necessary for Post Master Plan.
Employment	Remarkable effect is expected.
Others	No specific problem is anticipated.

Impact of the project in the Short Term Plan on surrounding natural environment is small and negligible. On the other hand, its economic effect will largely contribute to the social stability of this area.



## CHAPTER 12 OVERALL EVALUATION

Viability of the Short Term Plan was evaluated from various points of view which mentioned in the preceding chapters.

### 12.1 Engineering Soundness

(1) Basic structure of existing piers is in sound condition in spite of long term use of more than 70 years. They can be continuously used further with only minor rehabilitation works.

(2) Proposed construction site for new container terminals in Telfers Island is endowed with favorable conditions. Topographic condition is suitable for constructing container berth. There is no serious current or sedimentation which affects maintenance of channel and basin. It is not necessary to construct anti-sedimentation facilities.

(3) Water area in front of the construction site is well sheltered from strong waves by breakwaters and a mole deployed on the north side. There is no need to construct breakwater or jetty to protect container berth from waves in order to secure smooth operation.

### 12.2 Economic Feasibility

Container terminals, in general, treat commodities of high price. It has a great effect for advancing cargo flow. The port of Cristobal has the Colon Free Zone which greatly supports the Panamanian economy in its hinterland.

Economic analysis in Chapter 8 indicates that EIRR is 18.8 % in the base case. Based on the sensitivity analysis, EIRR is 13.9 % even in the worst case with 10 % increase of cost and 10 % decrease of economic benefit. This value is recognized as sufficiently high compared to similar projects. Accordingly, the Short Term Plan is economically feasible.

### 12.3 Financial Viability

Operation of container terminal has, in general, good profitability and contributes greatly to the national budget.

With the great increase of cargo and rationalization of terminal operation, the Short Term Plan has a good FIRR of 16.3 % in the base case. Even in the case of 10 % increase of cost and 10 % decrease of income, it has a good FIRR of 9.6 %.

Based on the financial statement analysis, good profitability is expected from the beginning of the operation. By introducing a long term loan, it is possible to avoid raising a high interest rate "stopgap" fund which tends to worsen the financial condition.

The Short Term Plan is financially viable.

#### 12.4 Environmental Impact

Telfers Island, where a new container terminal is planned, is an undeveloped flat area presently under the administration of PCC. There are no activities in this area which will be affected by the construction of container terminal. There is no specific valuable natural asset which should be preserved.

Concerning the water quality of surrounding area, activity of container terminal itself will not generate much pollutant, thus the impact of the Short Term Plan on the water quality is small and negligible. However, expected gradual progress of land use of Telfers Island at the back of container terminals might cause considerable impact on the water quality in future through increase of inflows of pollutant. It will be appropriate to investigate said impact further at some stage in the future.

The Short Term Plan creates direct or indirect employment and will increase income through its construction and operation.

#### 12.5 Overall Evaluation

Based on the comprehensive judgement from various points of view including items mentioned above, the Short Term Plan is the best choice for improving the function of the port of Cristobal. The result of overall evaluation is summarized in Table 12-5-1.

Table 12-5-1 Result of Overall Evaluation

Item	Result	Remarks
Engineering Soundness	Good	Existing major structures are sound. Project site is in good condition for construction.
Economic Feasibility	Good	Project greatly contributes to expansion of Free Zone.
Financial Viability	Good	Project has high profitability. APN can greatly contribute to National Budget.
Environmental Impact	Good	Project has no significant environmental impact and contributes to local economy and social stability.

**CONCLUSION  
AND  
RECOMMENDATION**



## CONCLUSION

### 1 General

#### 1.1 General Understanding on Current Situation of the Ports of Cristobal

The Republic of Panama is a country which is blessed with excellent marine transport capability, facing both the Atlantic and Pacific Ocean which are connected by the Panama Canal.

Under the circumstances, the Ports of Cristobal and Balboa are playing the most important roles, among 13 APN ports, in contributing to the national economy thanks to their advantageous location at the Atlantic and Pacific entrance of the Canal.

The Ports of Cristobal, which consist of three major port areas including Cristobal, Coco Solo and Bahia Las Minas, is considered as a so-called port complex functioning as one port in handling cargoes for the hinterland covering the entire country and Free Zone in particular. While the Ports may have the potential to become the predominant cargo distribution center in Central/South America and Caribbean Sea, its current facilities and operation are not really efficient in handling the increasing cargo traffic, mainly due to the relatively short experience of APN in this field compounded by severe budget constraints. Regardless of the continuous efforts by APN, severe congestion and constant delay of container handling have had for many years a very negative impact on the economic activities of the country; for example, the lack of valuable incentives has discouraged business entities from investing in the hinterland of the Ports.

Those in industrial and marine transport business circles both in and out of Panama who know the situation very well, are now strongly expecting the Ports to realize its potential capability in serving a substantial amount of cargo flow which is no doubt vital in stimulating economic development of the country.

Considering the various factors surrounding the Ports, such as the possible expansion of the Canal capacity, active development of competing Caribbean ports, prevailing wave of commercialization policy under the severe financial position of the country, substantial amount of potential cargo traffic, and so on, we believe it is exactly the right time for the Government to take confident action for the effective improvement of the Panamanian port function under carefully examined port plans with proper financial arrangement.

#### 1.2 Present Situation of the Port of Cristobal

##### (1) Port Facilities

The port of Cristobal has six piers divided into 23 berths with a total length of 3,200 meters. Pier Nos. 6, 7, 8 and 16 are finger type piers. Piers No. 9 and 10

are marginal. These piers have an approximate 12 m depth and 300 m length, so Panamax type vessels can generally berth at all these piers.

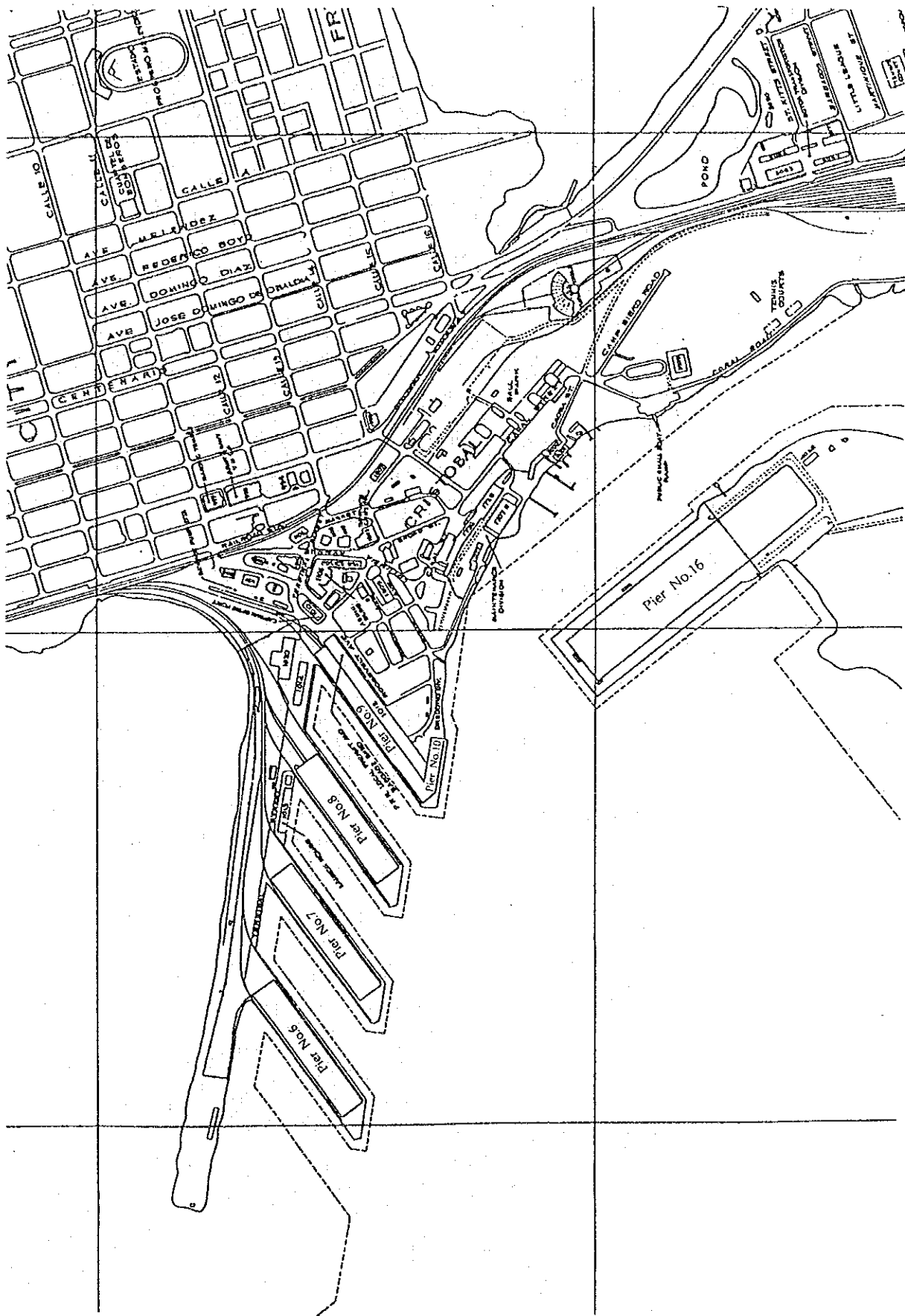
Piers No. 9 and 10 share the same container yard with 7.5 hectares just behind the piers. Pier No. 9 is used exclusively for containers equipped with two 40-ton container cranes. Pier No. 10 has no wharf crane.

Bunkering service is one of the major functions of the port of Cristobal due to its location near the Panama Canal. Pier No. 16 was originally constructed for the purpose of supplying coal and fuel oil to the Canal transit vessels.

The following figure illustrates the facilities layout of the port of Cristobal. The major dimensions of the berths at the port are shown below.

Major Dimensions of Berths at the Port of Cristobal

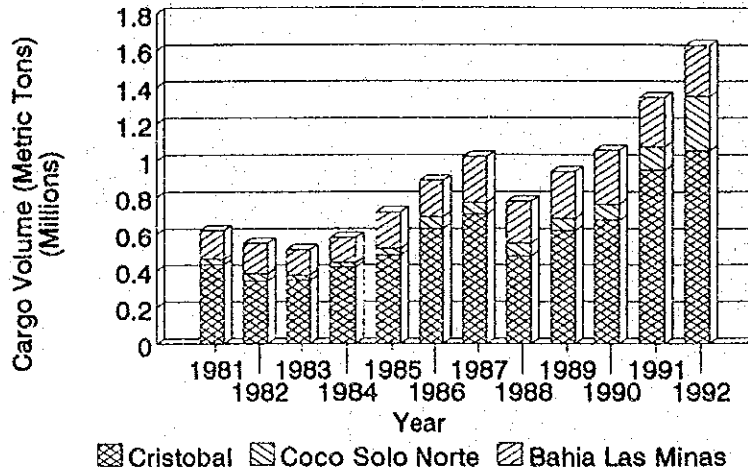
Pier No.	Berth No.	Length (m)	Draft (m)	Major Cargo
6	A-B	291.0	11.4	General Cargo
	C-D	309.0	12.0	Container
	E	72.0	12.0	Vehicle
7	A-B	276.0	10.8	General Cargo
	C-D	300.0	12.0	Container
	E	72.0	12.0	
8	A-B	283.0	11.4	General Cargo
	C-D	303.0	12.0	Container
	E	75.0	12.0	
9	A-B	311.0	11.1	Container
10		127.0	12.0	Container
16	A-B	321.0	12.6	Fuel Oil
	C-D	321.0	12.0	Vehicle
	E	137.0	8.7	



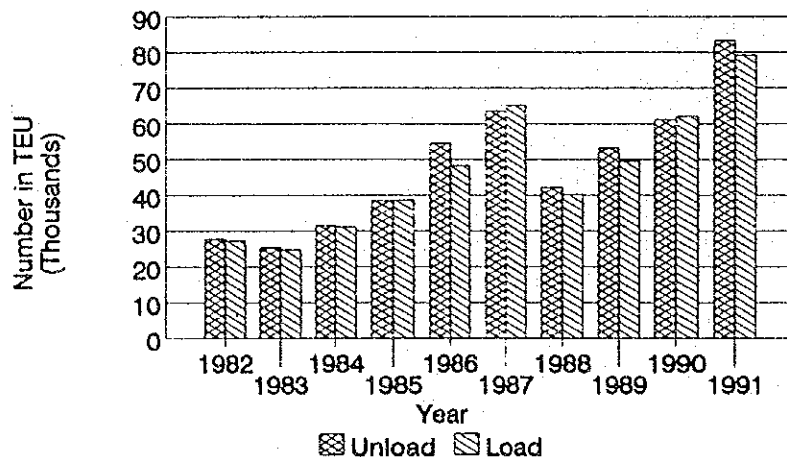
Layout of the Port of Cristobal

(2) Port Activity

The following figure shows the past records of the cargo handled at the three major ports (Cristobal, Coco Solo Norte and Bahia Las Minas). Total cargo volume handled at these 3 ports occupied nearly 50% of the total cargo volume (about 3.3 million metric tons) in Panama in 1992. Cargo of approximately 1 million metric tons was handled at the port of Cristobal in 1992.



All cargo handled at the port of Cristobal is for overseas trade. In 1991, 80% of the volume was imported, and 75% of the total volume was container cargo. Small quantity of general and bulk cargo is handled at the port. The number of containers handled at the port is shown in the figure below. Approximately 162 thousand TEUs were handled, and of those, 100 thousand TEUs (62%) were laden containers in 1991.





The number of ship calls at the port of Cristobal recorded 1,112 in 1992 including those for the purpose of bunkering.

### (3) Port Administration

#### 1) National Port Authority (APN)

Panama has a total of 19 ports. Of those, National Port Authority (APN) is responsible for the management and operation of 13 Panamanian ports.

APN has more than 2,300 personnel and its central office has more than 650 personnel. The Port of Cristobal and the Port of Balboa administration offices have a large number of personnel. The former has about 900 persons and the latter about 500. This is because the administration offices employ their own personnel to conduct cargo handling service by themselves.

#### 2) Management of Port Area

The Panama Canal Commission (PCC) controls navigation of vessels in the water area within the Panama Canal Zone including the port areas of Cristobal and Balboa. Berth allotment is handled by APN. Allotment of berths is generally on a first come first serve basis, however, container vessels without crane are given priority at Pier No. 9 of the port of Cristobal.

All land area of the ports which is owned by APN is managed by each Port Administration Office. APN makes concession contracts with private companies to rent a part of the land area. APN has made more than 200 contracts.

#### 3) Port Service

At the port of Cristobal, APN Port Administration Office and a private company named "Delcarga Inc." provide cargo handling service. APN Port Administration Office also provides mooring and water supply services. Bunkering service is carried out by private companies, using APN facilities.

#### 4) Financial Condition

APN gets no subsidy from the National Government. Conversely, the National Government exacts a contribution from APN. Financial position of APN was not good prior to 1990. The revenue structure has been improving thanks to increase of revenues from cargo handling and concession since 1990.

### 1.3 Findings on Engineering Aspects

On the basis of data and information provided by APN, and the site surveys conducted by the Study Team, major findings on the engineering aspects of the Ports of Cristobal are identified and summarized as follows.

#### (1) Overall Natural Conditions

Natural conditions of the project site are generally fair and favorable for the development of required scale of port facilities as shown below.

- 1) Meteorological condition is quite favorable for the project except for heavy rainfall. Wind speed intensity even during stormy conditions is moderate and no hazardous fog or mist is observed in this area.
- 2) Oceanographic conditions including tidal range and its current, wave height are moderately good.
- 3) Existing topography is generally flat securing preferable conditions for port structure.
- 4) While bathymetric conditions for navigation channels and basins for calling ships differ from spot to spot, the water depth in the bay area is deeper than 10 meters below LWL showing enough allowance in accepting large container vessels with minor dredging works at a few critical spots.
- 5) Basic geotechnical conditions are observed to be generally uniform at the project site. The hard stratum at the site is so called Gatun Rock Formation covered with weathered rock and sediment layer of soft marine clay.
- 6) The past earthquake records show that the site is located in a most calm area.

#### (2) Condition of Major Port Facilities

- 1) Existing port facilities are maintained in fairly good condition in general. The piers which were constructed some 75 years ago are in a healthy condition though some piles are partially damaged but not seriously. Utilities for the piers are well maintained although minor repair works are required.
- 2) Currently APN is making their best efforts to upgrade these facilities through expansion of cargo handling space both on the piers and in backup areas, rehabilitation of fender system etc..
- 3) A narrow and deep shape with irregular alignment of the existing container terminal behind Pier No.9 causes complicated cargo traffic and creates an inefficient container operation as a whole. Concrete pavement at the existing

container yard is maintained in fairly good condition except for minor cracks and holes which can be repaired by routine maintenance work. The access ways to the existing terminal are so complicated that the port traffic is forced to pass through congested part of the roads.

- 4) While the physical conditions of the gantry cranes at Pier No.9 are generally fair, their average rate of handling productivity is substandard mainly due to insufficient quantity of other container handling equipment including 40 ton top-loaders in particular. The procurement of spare parts and execution of major repair works are often delayed due to lack of budget and long complicated procurement procedure.
- 5) Absence of proper replacement/disposal plans and systematic repair records are other causes of the inefficient utilization of total potential capability of APN owned cargo handling equipment.

### (3) Engineering Profile of Alternative Sites for New Terminal Development

Development possibility of three alternative sites for a new container terminal including West Colon Site (Site-C), Coco Solo (Site-CS), and Telfers Island (Site-T) were investigated from the engineering point of view.

Sites-C and CS have disadvantages in that available water depth is relatively shallow and geotechnical conditions are poor as well. Relocation problems concerning the housing areas surrounding these alternate sites may be another disadvantage.

Site-T faces a wide open basin with favorable water depth and geotechnical conditions and is sheltered by the breakwaters and mole providing a good anchorage area and an easy access to the Canal with minimum disturbance to operation. Wide open space behind the coastal area may be another advantage in the development of port related industries.

## 1.4 Findings on Current Management and Operation

APN (Autoridad Portuaria Nacional) is the state-run port management body which manages and operates 13 public ports in the country with five major Departments in its headquarters and Port Administration Offices at the site of the ports supported by a total of about 2,300 personnel including administrative staff, cargo handling workers and terminal operators.

The basic policies and major decisions on APN affairs are discussed and settled under the Board which consists of representatives from port workers, port users and the various Ministries concerned.

Having administrated, managed and operated the ports for the rather short period of 20

years beginning in 1972, the APN ports have not performed well in responding to the increasing cargo traffic through the ports. The current situation and major problem areas in this field are observed and identified as follows:

(1) Positive Findings

- 1) Well organized administration structure of APN in general with some able technocrats for port planning and management.
- 2) Sound financial position as a whole given severe budget constraints and considerable size of contribution to the government.
- 3) Relatively high level of book-keeping on APN account and statistical record preservation.
- 4) Satisfactory service in providing utilities and power supply for port users and bunkering for the calling vessels.
- 5) Well designed system and procedure in keeping good relationship between port laborers and the administration.
- 6) Positive incentives for APN staff to upgrade their business efficiency and be conscientious in carrying out assignments.

(2) Negative Findings

- 1) General shortage of basic port facilities including wharves, container yards and backup areas, and cargo handling equipment for both actual and potential demand of cargo flow through the Ports of Cristobal in particular.
- 2) Substandard level of container handling efficiency mainly caused by lack of well trained operators of container handling equipment (some of which is not well maintained partially due to improper procurement practice of spare parts).
- 3) Obsolete method of container marshaling/operation (T-Card system) of which capacity and efficiency can no longer meet the actual level of container movement.
- 4) Inadequate administrative authority of APN for more effective port management/operation. A more independent and self-sustainable way of administration may encourage APN staff to achieve the expected level of port efficiency.
- 5) Lack of confident policy of the government in commercializing the inefficient parts of public sector, which seems to lead APN to apply the policy to improper fields of port administration.

## **2 Master Plan (2010)**

### **2.1 Basic Policy for the Development of the Ports of Cristobal**

#### **(1) Basic Understanding on Public Ports**

The Study is conducted generally on the understanding that a public port should be considered as an economic infrastructure, or social capital and national asset. (for details, see Section 1 of Recommendation)

#### **(2) Background of Relevant Factors Affecting Future Planning of the Ports in Panama**

With a view to establishing a common base for practical formation of the Master Plan, following major factors are identified:

- 1) Global economic growth of about 4% on average can be expected with corresponding increase of world marine transport demand.
- 2) The number of transit vessels of the Canal will increase with the progress of ongoing Culebra Cut widening.
- 3) A series of ongoing and under-planning schemes for expanding the capacity of the Free Zone will be realized as scheduled.
- 4) Transshipment demand of sea-born cargoes will increase at the Ports of Cristobal with the general future trend of marine traffic in and around the Caribbean Sea area.
- 5) The port related infrastructures including road or railway will be improved according to respective schedules.
- 6) All relevant lands and properties under control of PCC will be gradually transferred to Panama towards the end of the year 2000.
- 7) Flexible application of the government's commercialization policy involving APN can be expected according to its validity and necessity.

#### **(3) Functional Allotment among the Panamanian Ports**

##### **Ports of Cristobal**

- 1) Main terminal services for Free Zone cargoes
- 2) Base port for the main and feeder line services for transshipment cargoes
- 3) Gateway port for domestic cargoes
- 4) Base port for cruising passenger boats
- 5) Center of bunkering services
- 6) CPC (Center Port Concept) port in long term basis

## Port of Balboa

- 1) Base port for main line services for transshipment cargoes
- 2) Gateway port for domestic cargoes
- 3) Center of bunkering and ship repair
- 4) CPC port in long term basis

## Other Local Ports

- 1) Oil importation terminal
- 2) Banana, sugar and shrimp exports
- 3) Domestic port for general cargoes
- 4) Fishery port

## (4) General Scenarios of Future Cargo Flow and Corresponding Function of Ports

The development process is divided into 4 stages, namely Urgent, Short Term, Long Term and Post Master Plan. Outline of development scenario of each stage is as follows.

### Urgent Stage (-1995)

- 1) The basic pattern of cargo flow will be more or less the same as present one.

### Short Term Plan Stage (-2000)

- 1) A new container terminal will be completed at the port of Cristobal.
- 2) Transshipment cargoes will be increasing at the Port of Cristobal.
- 3) Coco Solo Norte will keep its position in handling Free Zone cargoes.
- 4) Containers at Bahia Las Minas will be shifted to the new container terminal.
- 5) At the port of Balboa, commercial and industrial development will progress with the increase of container traffic.

### Long Term Plan Stage (-2010)

- 1) Free Zone cargoes will increase substantially with expansion of Free Zone capacity.
- 2) Cristobal will be a major base port for transshipment.
- 3) Additional container terminals will be completed at Cristobal to meet increased container traffic.
- 4) Piers Nos.6 and 7 will serve general domestic cargoes.
- 5) Pier No.8 will be used for passenger terminal.
- 6) Coco Solo Norte will provide the Caribbean lines with public berths mainly for general cargoes.
- 7) Bahia Las Minas will become a special type of port for dangerous cargoes with

ad hoc handling of containers.

- 8) Transshipment services at Balboa will be upgraded.

Post Master Plan Stage(2010-)

- 1) The post Panamax type vessels will be in service.
- 2) CPC project will be in progress.
- 3) All container cargoes of main lines will be handled at the new container terminals of Cristobal.
- 4) Piers Nos.6 and 7 will mainly provide general ship services rather than cargo handling.
- 5) The major berths of Coco Solo Norte will be used mainly for general cargoes.
- 6) Balboa will be a base port for transshipment operation.

## 2.2 Future Demand of Cargo and Passenger Traffic

### (1) Methodology

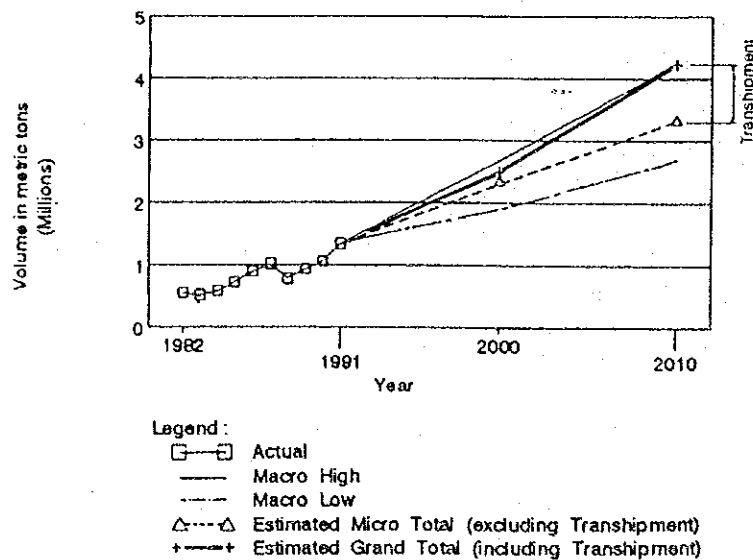
Two different methods, namely macro forecast and micro forecast, are applied in general. The former is to forecast the total cargo volume as a whole by statistical correlation between the cargo volume and socio-economic indices and/or time trend. The latter is a cumulative method forecasting the cargo volume based on the analyses of the patterns of cargo flow, packing type and major commodities individually. The cargo volume forecast was carried out for the total volume of the three ports; Cristobal, Coco Solo Norte and Bahia Las Minas. As for passenger traffic, forecast was carried out based on IPAT's (Instituto Panameno de Turismo) estimate and the past records.

### (2) Result of Forecast

Result of the forecast is shown below.

Result of Forecast

	(Metric Tons)		
	1991	2000	2010
<b>IMPORT :</b>			
General Cargo	850,827	1,543,000	2,185,000
Break Bulk	148,928	278,000	393,000
Containerized	701,899	1,265,000	1,792,000
Solid Bulk	89,721	120,000	157,000
Sub-Total	940,548	1,663,000	2,342,000
<b>EXPORT :</b>			
General Cargo	311,048	583,000	824,000
Break Bulk	93,635	157,000	222,000
Containerized	217,413	426,000	602,000
Liquid Bulk	3,971	5,000	7,000
Sub-Total	315,019	568,000	831,000
TRANSHIPMENT (Break)	47,512	108,000	163,000
TRANSHIPMENT (Containerized)	37,618	144,000	900,000
<b>THROUGHPUT</b>	<b>1,340,697</b>	<b>2,503,000</b>	<b>4,236,000</b>
<b>PASSENGER TRAFFIC</b>	<b>21,488</b>	<b>20,000</b>	<b>75,000</b>

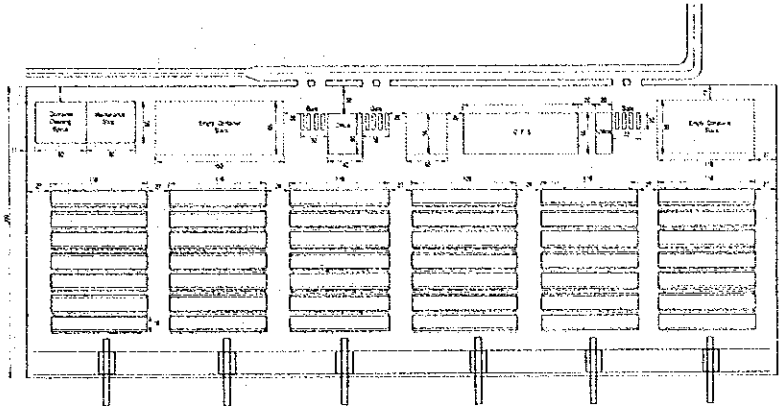




## 2.3 Master Plan Physical Layout Plan

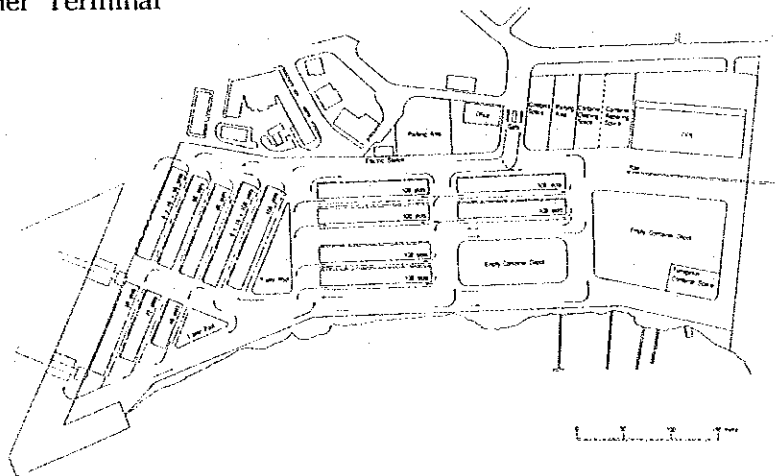
### (1) New Container Terminals in Telfers Island

Berth Depth	-13.0 m
Berth Length	900 m
Terminal Area	31.5 ha
CFS	7,000 m <sup>2</sup>
Ground Slot	4,185 slots
Container Crane	6 nos.
Transfer Crane	21 nos.
Maintenance Shop and Office	6,000 m <sup>2</sup>
Open Storage	20,000 m <sup>2</sup>
Access Road to Boliver Highway (2 lanes)	1.0 km
Bypass Route to R16 (4 lanes)	3.0 km



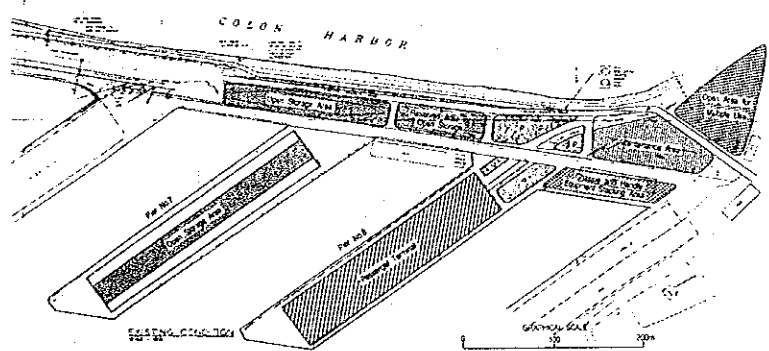
### (2) Modernization of Existing Container Terminal

Berth Depth	-12.0 m
Berth Length	390 m
Terminal Area	13.6 ha
CFS	6,325 m <sup>2</sup>
Ground Slot	1,457 slots
Container Crane	2 nos.
Transfer Crane	7 nos.
Terminal Office	1,000 m <sup>2</sup>
Open Storage	1.8 ha
Yard Expansion	
North Side	1.9 ha
South Side	3.3 ha



### (3) Improvement of Existing Piers and Mole Area

Demolition of Quay Shed	7,900 m <sup>2</sup>
Passenger Terminal	13,700 m <sup>2</sup>
Open Storage (including reserved area)	7,660 m <sup>2</sup>
Parking	4,000 m <sup>2</sup>
Maintenance Shop	5,000 m <sup>2</sup>
Chassis and Handling Equipment Stacking	3,000 m <sup>2</sup>
Open Area for Multiple Use	6,000 m <sup>2</sup>



## 2.4 Approximate Project Cost

As shown in the following table, the total initial investment cost amounts to \$331.0 million for the construction works and equipment purchase. This cost will be spread over the period from 1994 to 2009. The required initial cost for the new container terminal at Telfers Island will amount to \$292.7 million which represents 88.4% of initial cost. The initial cost for the existing container terminal and piers are \$31.5 million and \$6.8 million respectively. Other than this cost, an amount of \$243.5 million should be spent for periodical equipment renewal and replacement and \$738 million should be spent for maintenance and operation by 2029.

### Initial Investment Cost and Periodical Equipment Purchase Cost

Unit: million \$

Cost Category	Project Site			Total	Access Road
	New Container Terminal	Existing Container Terminal	Piers and Mole		
a. Initial Const. Works	204.0	16.0	6.0	226.0	11.4
b. Initial Equip. Purchase	88.7	15.5	0.8	105.0	0
Sub-total (a+b)	292.7 (88.4%)	31.5 (9.5%)	6.8 (2.1%)	331.0 (100.0%)	11.4
c. Periodical Equipment Purchase	130.9	102.6	10.0	243.5	0
Total (a+b+c)	423.6	134.1	16.8	574.5	11.4
d. Maintenance and Operation	450.0	288.0		738.0	-
Total (a+b+c+d)	873.6	438.9		1,312.5	-

Notes: 1. "Periodical Equipment Purchase" includes the required cost by 2029.  
2. Contingency and engineering costs are included.

The annual expenditure schedule of the initial cost elements is shown below. Since the estimate cargo throughput in 2010 is 4.2 million tons, unit initial investment cost is 78.8 \$/ton.

## Annual Expenditure Schedule for Initial Investment

Unit: million S

Year	Initial Const. Works	Initial Equipmt. Purchase	Annual Expenditure	Project Area
1994	3.0	0	3.0	B1 and Piers
5	3.1	2.4	5.5	"
6	-	-	0	
7	-	-	0	
8	36.1	0	36.1	B2
9	36.1	30.2	66.3	B2
2000	-	-	0	
1	7.9	0	7.9	B1 and Piers
2	8.0	0	8.0	"
3	32.9	5.4	38.3	B3
4	33.0	29.5	62.5	B3
2005	-	-	0	
6	-	-	0	
7	-	-	0	
8	32.9	0	32.9	B4
9	33.0	37.5	70.5	B4
2010	-	-	0	
<b>Total</b>	<b>226.0</b>	<b>105.0</b>	<b>331.0</b>	

Note: B1, B2, B3 and B4 show the wharf number.  
 B1: Existing container terminal at Pier No.9.  
 B2: New container wharf : 1st wharf at Telfers  
 B3: " : 2nd wharf at Telfers  
 B4: " : 3rd wharf at Telfers  
 Piers: Existing piers and mole.

## 2.5 Master Plan Implementation Program

The short-term improvement for the existing facilities will be conducted in 1994/1995 due to an urgent requirement. However, the master plan development for the existing facilities will start in 2001.

The first container wharf at 2Telfers Island will be constructed in 1998/1999 after various preparation works. At the beginning of 2000, the wharf would commence the scheduled services.

The remaining two wharves will be constructed separately in 2003/2004 and 2008/2009 to meet the cargo demands in 2010.

Phase	Calendar Year																	
	1a	1a	1a	1a	1b	1b	2	2	2	3	3	3	3	3	3	3	4	4
Project Components	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	—
1. New Container Terminal at Telfers																		
1) 1st Berth (B2)																		
- Finance																		
- Design																		
- Contract																		
- Construction																		
- Operation																		
2) 2nd Berth (B3)																		
- Cargo Review																		
- Finance																		
- Design																		
- Contract																		
- Construction																		
- Operation																		
3) 3rd Berth (B4)																		
- Cargo Review																		
- Finance																		
- Design																		
- Contract																		
- Construction																		
- Operation																		
2. Existing Facilities																		
1) Container Terminal Pier 9 (B1)																		
- Execution																		
2) Mole & Pier 6,7,8																		
- Execution																		

Notes: 1. Periodical purchase of cargo handling equipment is excluded.  
 2. "Finance" means the preparation and arrangement of finance.  
 3. "Design" means both detailed investigation and design.

### Basic Investment Schedule

## 2.6 Management and Operation

### (1) Management and Operation of Terminals of Port of Cristobal

#### 1) Development of management and operation system of container terminal

(a) The management system shown below is considered the best choice.

	Urgent	Short Term (~ 2000)		LONG TERM (~ 2010)			Post M.P.
	Pier 9	Pier 9	Pier X	Pier 9	Pier X	Pier Y....	
Owned by	Public	Public	Public	Public	Public	Public	Same as Long Term Stage
Provide service for	Open	Open	Open	Open	Open	Exclusive	
Cargo Handled by	Public	Private	Private	Private	Private	Private	

Pier X : A new container berth available in 2000

Pier Y.. : Additional container berths available in 2010

Exclusive : The type of operation which allows only a limited number of companies to use berth(s).

(b) An information system for container terminal operation should be introduced.

#### 2) Development of management system for general cargo terminal

(a) General cargo terminals should be open to public use.

(b) Cargo handling service should be privatized.

### (2) Control of Port Area, Infrastructure and Facilities

1) APN should formulate basic policy for national ports and prepare plan concerning development and conservation of port area.

2) Construction work, permission for usage of port infrastructure, facility and area should conform to the port policy and plan.

### (3) Organization and Personnel

1) Each organization should tackle new areas such as development of personnel and tariff system, supervision of new terminal.

2) APN should simplify its organization.

3) A modern personnel evaluation system such as staff evaluation report system should be introduced.

4) Personnel transfer system between APN Central Office and Port Administration Offices should be introduced.

5) APN needs to develop its own training to change mentality of APN office workers in an effort to promote efficiency of port.

(4) APN should appeal to ministries concerned to modernize the procurement system and to define criterion for deciding the amount of the contribution.

(5) Port promotion should be aggressively performed taking aim at container cargo including transshipment cargo.

(6) Improvement of statistic system is necessary to support formulation of the port development policy and port promotion strategy.

(7) The port of Cristobal should continue supplying water and bunkering service.

## 2.7 Recommended Master Plan

After various alternatives of sites and procedures for the development of the port were carefully compared and examined, the following plan was formulated as the best Master Plan.

### (1) Socio-Economic Condition

Population 3.37 million persons  
GDP 9.61 billion US\$ (Estimated 1990's Constant Price)

### (2) Cargo Throughput for the Ports of Cristobal

Containerized Cargo 3,294 thousand M.T.  
Others 942 thousand M.T.  
(Number of Containers 630 thousand TEUs)

### (3) Physical Plan

- 1) Construction of Three New Container Terminals in Telfers Island
- 2) Modernization of Existing Container Terminal
- 3) Modernization of Existing Piers and Mole Area
- 4) Construction and Improvement of Access Road
- 5) Promotion of Land Use of Telfers Island

Necessary cargo handling equipment including container cranes and transfer cranes will be deployed.

### (4) Project Cost (Initial Investment)

(thousand US\$)

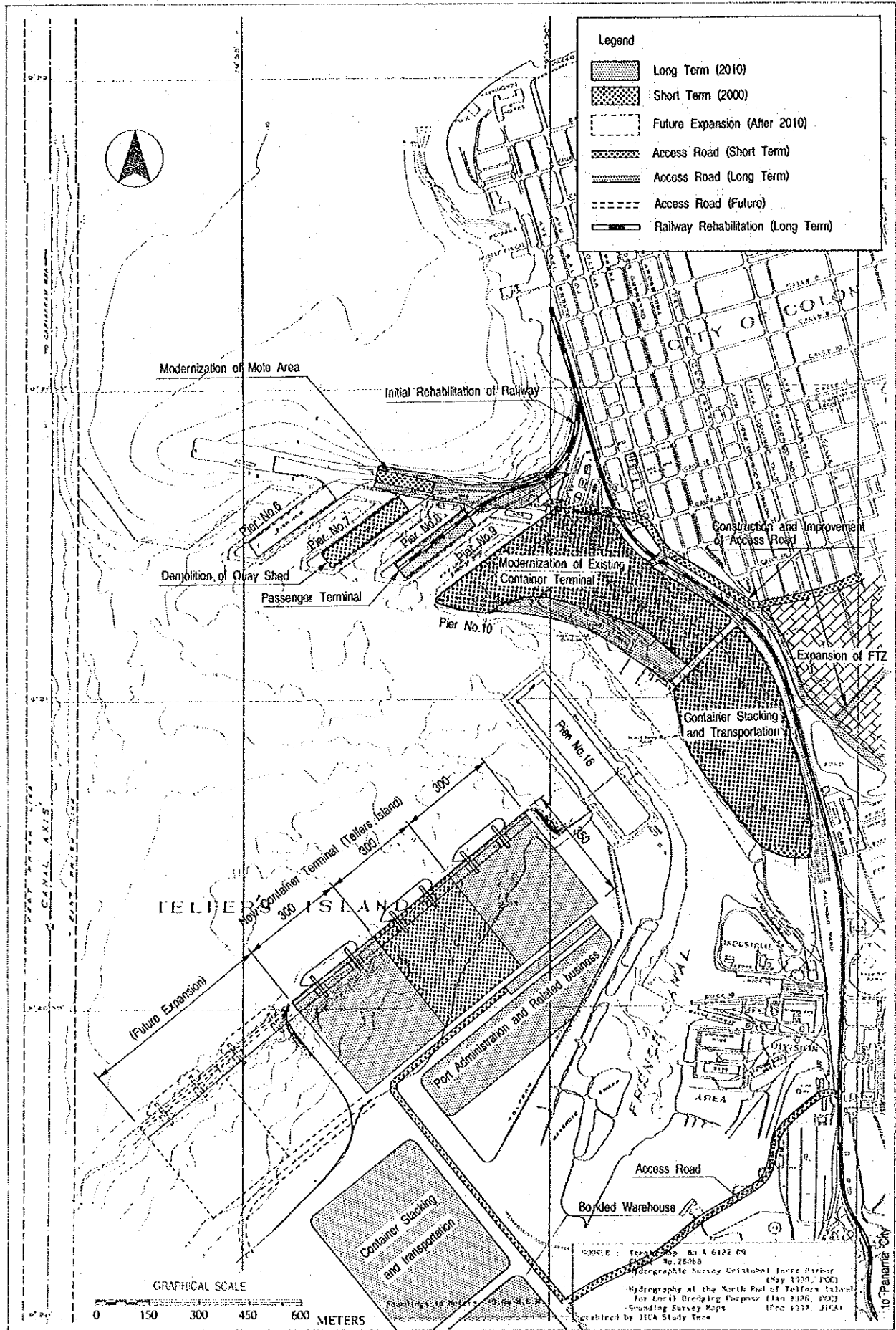
	Construction	Equipment
New Container Terminals	203,986	88,661
Existing Container Terminal	16,064	15,462
Piers and Mole Area	5,952	800
Total	226,002	104,923
Access Road	11,434	--

(5) Implementation Schedule

	Construction	Equipment
New Container Terminals	1998 - 1999 2003 - 2004 2008 - 2009	1999 2004 2009
Existing Container Terminal	1994 - 1995 2001 - 2002	1995, 1999 2002
Piers and Mole Area	1994 - 1995 2001 - 2002	1995 -

(6) Management and Operation

- 1) Users --- Open to Public
- 2) Construction and Ownership --- Public Sector
- 3) Cargo Handling and Operation --- Private Sector



MASTER PLAN (2010)

R16



### 3 Short Term Plan (2000)

#### 3.1 Future Demand of Cargo Traffic

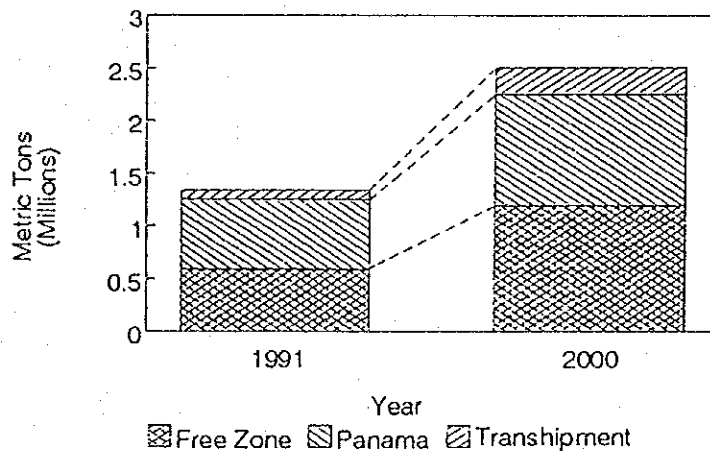
The future demand of cargo traffic in 2000 is summarized as follows. Further, container cargo distribution to/from domestic origins and destinations is estimated as shown below.

Demand of Cargo Traffic in 2000

Total Cargo:		(Metric Tons)	
	IMPORT	EXPORT	TOTAL
Free Zone	780,000	416,000	1,196,000
Panama :			
General	763,000	167,000	930,000
Solid Bulk	120,000	-	120,000
Liquid Bulk	-	5,000	5,000
Transshipment	126,000	126,000	252,000
<b>Total</b>	<b>1,789,000</b>	<b>714,000</b>	<b>2,503,000</b>

Container Cargo:		
	Metric Tons	TEUs
Free Zone	1,055,000	263,000
Panama	636,000	113,000
Transshipment	144,000	16,000
<b>Total</b>	<b>1,835,000</b>	<b>392,000</b>

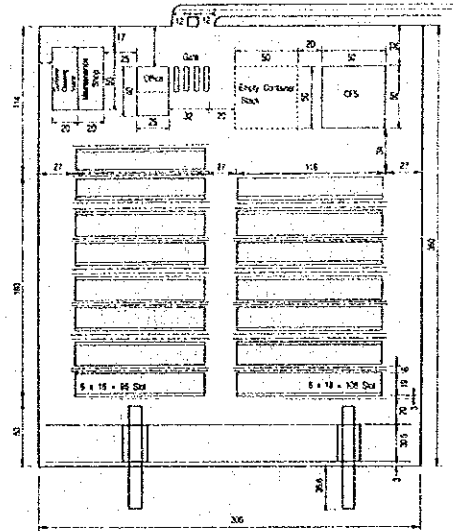
Origins & Destinations



### 3.2 Short Term Physical Layout Plan

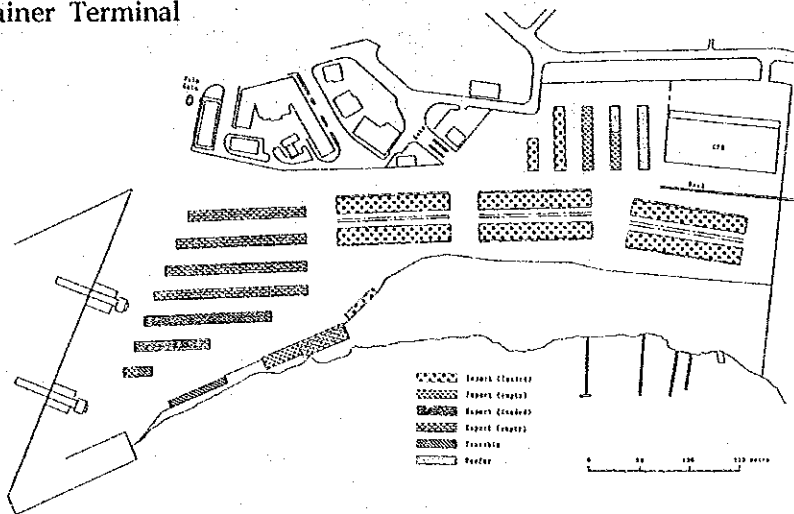
#### (1) New container Terminal in Telfers Island

Berth Depth	-13.0 m
Berth Length	300 m
Terminal Area	10.5 ha
CFS	2,500 m <sup>2</sup>
Ground Slot	1,495 slots
Container Crane	2 nos.
Transfer Crane	7 nos.
Maintenance Shop and Office	2,000 m <sup>2</sup>
Open Storage	2,500 m <sup>2</sup>
Access Road to Boliver Highway (2 lanes)	2.3 km



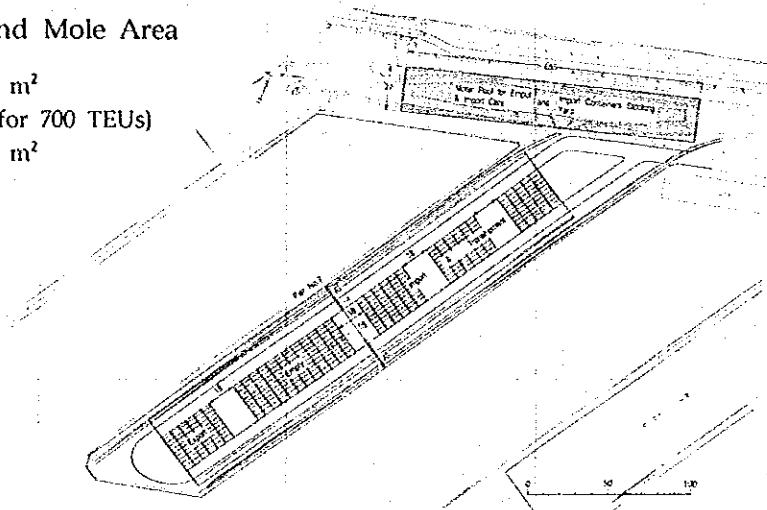
#### (2) Modernization of Existing Container Terminal

Berth Depth	-12.0 m
Berth Length	390 m
Terminal Area	10.2 ha
CFS	6,325 m <sup>2</sup>
Ground Slot	1,457 slots
Container Crane	2 nos.
Transfer Crane	3 nos.
Yard Expansion North Side	1.9 ha



#### (3) Improvement of Existing Piers and Mole Area

Demolition of Quay Shed	7,900 m <sup>2</sup>
(Wharf Side Container Stacking Area for 700 TEUs)	
Open Storage Area (on Mole)	5,000 m <sup>2</sup>



### 3.3 Project Cost

The initial investment cost will amount to \$110.8 million, of which 81.0% is classified to the foreign portion. The required initial cost for the new container terminal at Telfers Island will amount to \$101.8 million which represents 91.8% of initial cost. The required initial costs for the existing container terminal and piers are \$6.3 million and \$2.7 million respectively. Cargo handling equipment cost for the periodical renewal and replacement by 2029 will amount to \$150.6 million, of which \$62.7 million will be spent for the new container terminal at Telfers Island. The remaining \$79.3 million and \$8.6 million are for the existing container terminal and piers respectively.

#### Initial Investment Cost and Equipment Renewal Cost in Short Term Development

Unit: 1000 \$

Cost Category	New Container Terminal	Existing Container Terminal	Piers and Mole	Total
a. Initial Construction Work	(1998/1999) 72,209	(1994/1995) 4,136	(1994/1995) 1,940	78,285
b. Initial Equipment Purchase	(1998/1999) 29,554	(1994/1995) 2,188	(1994/1995) 800	32,542
Sub-total (a+b)	101,763	6,324	2,740	110,827
(Local Portion)	19,280(18.9%)	1,352(21.4%)	464(16.9%)	21,096(19.0%)
(Foreign Portion)	82,483(81.1%)	4,972(78.6%)	2,276(83.1%)	89,731(81.0%)
c. Periodical Equipment (2000/2029) Purchase	62,725	(1996/2029) 79,259	(1996/2029) 8,572	150,556
(Local Portion)	0	0	0	0
(Foreign Portion)	62,725(100%)	79,259(100%)	8,572(100%)	150,556(100%)
Total (a+b+c)	164,488	85,583	11,312	261,383
(Local Portion)	19,280(11.7%)	1,352(1.6%)	464(4.5%)	21,096(8.8%)
(Foreign Portion)	145,208(88.3%)	84,231(98.4%)	10,848(95.5%)	240,287(91.2%)

### 3.4 Short Term Plan Implementation Program

The master construction schedule regarding the proposed Short Term Development components is shown below. As shown in the figure, the urgent program in the required upgrading of existing port facilities will be conducted at the beginning. Implementation of the first container wharf at Telfers Island will be performed at the end of the century. It is assumed that various preparation works should be carried out before the commencement of construction. One of the most important aspects is the financial arrangement.

Project Category	Calendar Year						Remarks
	1994	1995	1996	1997	1998	1999	
1. New Container Terminal (B2)							at Telfers Island
- Financial Arrangement							
- Detailed Design							
- Contract							incl. PQ
- Construction							in 2000
- Operation							
2. Existing C.T Pier 9/10 (B1)							Container Terminal
- Construcion							Urgent Pr.
- Equipment							
3. Existing Piers							with Mole
- Construcion							Urgent Pr.
- Equipment							

PQ : Pre-qualification of applicants to tender.

Master Construction Schedule for Short-Term Development

### 3.5 Management and Operation

#### (1) Outline of Management and Operation System in Short Term Plan Stage

Port service business such as cargo handling service should be transferred to the private sector since improvement of the service level can be expected according to the competition among private companies and it is undesirable that such services are provided by the public sector. It is desirable that it will be transferred to plural private companies and newcomers should be allowed to enter into these businesses. It is thought difficult to introduce commercialization all at once, hence it should be gradually introduced.

#### (2) Major Role of Port Authority in Short Term Plan

##### 1) Administration of Port Area and Port Facilities

It is not desirable that a limited number of companies use the port area exclusively. APN should construct and own basic port facilities so as to control the port in a fair manner. APN has to define its port area and control the area, infrastructure and facilities properly to let the port function efficiently. This should be based on "the port policy and plan". APN should formulate the port policy and plan as soon as possible.

##### 2) Supervision of Port Related Private Entities

APN should be a leader in establishing private companies as well as introducing a proper competitive environment into port businesses. APN should administrate port related private companies and grant licenses under competence of APN.

##### 3) Organization and Personnel

APN must undertake above mentioned new kinds of jobs in an efficient and orderly manner. Good coordination among the divisions and sections, by holding a periodical meeting for section managers, is needed. APN needs experts. Reduction of personnel should be done carefully so as not to lose valuable human resources.

#### (3) Terminal Management

##### 1) Systems for Construction and Management of Terminals

LAQ (Lease a Quay Method) or LUP (License to Use a Port Method) is the best system for this terminal.

##### 2) Operation System for New Container Terminal

It is better that control of container handling in the container yard is centralized. Therefore, it is better if an association comprising all companies which will use the terminal be established, be permitted to use the entire terminal, or leases this terminal.

### 3) Important Items for Lease Contract

#### (a) Lease charge

Flat rate type or Mini-max rate type is the better selection to attract the private sector, and thereby utilize the private sector's power to increase cargo turnover.

#### (b) Infrastructure and facilities to be leased

It is thought better that APN procures only gantry crane, and lessee procures other cargo handling equipment.

## 3.6 Economic Evaluation

### (1) Economic Analysis

The purpose of the economic analysis is to appraise the economic feasibility of the Short Term Plan for the new port facilities of the port of Cristobal from the viewpoint of the national economy.

The economic internal rate of return (EIRR) based on cost-benefit analysis is used in order to appraise the feasibility of the project. The EIRR value is obtained from the annual economic benefit-cost value. The economic benefits are obtained from the difference between the "With" case and "Without" case. In estimating the costs and benefits of the project, "economic pricing" is applied. Economic pricing means that costs and benefits are appraised in terms of international prices (border prices).

### (2) "Without" and "With" Cases

#### 1) "Without" Case

- (a) No investment is made for the new container terminal at Telfers Island.
- (b) Rehabilitation plans are executed at the existing piers.
- (c) Excess portion of potential cargo flow over handling capacity of the existing facilities will be lost.

#### 2) "With" Case

- (a) A container terminal is constructed at Telfers Island.
- (b) Modernization plans are carried out at the existing piers and container terminal. (including procurement of additional cargo handling equipment)
- (c) Cargo will be handled as the cargo was forecast.

### (3) Benefits and Costs

#### 1) Benefits

- (a) Salary paid to new personnel in the expanded Free Zone
- (b) Additional earnings from enterprises working in the expanded Free Zone

(c) Decrease in container dwelling time in the yard

2) Costs

- (a) Initial investment costs consisting of construction costs and equipment purchasing costs
- (b) Maintenance and operation costs
- (c) Renewal investment costs for equipment

(4) Economic Evaluation

The EIRR of the project is calculated as 18.8%.

The project feasibility is normally evaluated by determining whether the EIRR exceeds the opportunity cost of capital which is represented by local interest rates of the country. Local interest rates for industry purposes in Panama range approximately from 10% to 12%. Accordingly, the EIRR exceeds these rates and this project can be considered economically feasible.

After conducting a sensitivity analysis, the EIRRs are still in a feasible range as shown below.

Result of EIRR Calculation

(%)

	Base Case	Case A	Case B	Case C
EIRR	18.8	16.4	16.2	13.9

Note: Case A - Costs +10%  
Case B - Benefits -10%  
Case C - Case A and B

3.7 Financial Evaluation

(1) Methodology of the Financial Analysis

The viability of the project is analyzed using the Financial Internal Rate of Return (FIRR) by means of the discount cash flow method.

The financial soundness of the port management entity is appraised based on its projected financial statements (Profit and Loss Statement, Cash Flow Statement and Balance Sheet). The appraisal is made from the viewpoint of profitability, loan repayment capacity and operational efficiency

(2) Evaluation

1) Viability of the project

The FIRR of this project exceeds the weighted average interest rate of funds

(approx. 9%).

According to the sensitivity analysis, even if the project costs increase by 10 % and the revenues decrease by 10 %, all the cases exceed the weighted average interest rate.

(%)

	Base Case	Case I	Case II	Case III
FIRR	16.3	13.1	12.7	9.6

Note: Case I - Costs +10%  
Case II - Revenues -10%  
Case III - Case I and II

## 2) Financial Soundness of the Port Management Entity

The rate of return on net fixed assets exceeds the weighted average interest rate of funds except in the beginning phase. Throughout the project life, the debt service coverage ratio and the working ratios maintain positive levels.

## 3) Conclusion

Judging from the above analysis, the project is regarded as financially feasible. However, attention should be paid to the following issues.

- (a) APN has to make efforts to heighten the quality of the service, improve cargo handling efficiency to secure forecast cargo volume and to constantly minimize operating expenses. And, APN should select the most appropriate funding scheme for investment as far as possible.
- (b) The Government has to set the Contribution at a level which allows APN to maintain a sound financial condition and to make future investments.
- (c) The lease charge for lessees of the terminals is assumed as 50 % of operational income in this analysis. This ratio is possibly close to the upper limit. Actually, APN will lease the port facilities separately. Thus, APN should conduct a more detailed financial analysis, and set proper charges for each facility.

## 3.8 Environment Impact Assessment

### (1) Rules and Regulations

No authorized norm or technical standard is established.



## (2) Present Environmental Condition

Project site has already been developed for a long time. There is no specific natural environment to be preserved.

Economic and social condition of Colon City is being improved by the administrative control, but is not yet favorable.

## (3) Result of Assessment

The result of Environmental Impact Assessment (EIA) on the items selected through Initial Environmental Examination (IEE) is summarized as follows.

Item	Result of Evaluation
Water Quality	No significant impact by Short Term Plan Further investigation will be needed for future land use of Telfers Island.
Inland Traffic	Can be settled by rerouting port oriented traffic to avoid congested area.
Navigation Safety	No significant impact by Short Term Plan Further investigation will be necessary for Post Master Plan.
Employment	Remarkable effect is expected.
Others	No specific problem is anticipated.

Impact of the project in the Short Term Plan on surrounding natural environment is small and negligible.

Short Term Plan will largely contribute to economic prosperity and social stability of Colon District.

## 3.9 Overall Evaluation

Item	Result	Remarks
Engineering Soundness	Good	Existing major structures are sound. Project site is in good condition for construction.
Economic Feasibility	Good	Project greatly contributes to expansion of Free Zone.
Financial Viability	Good	Project has high profitability. APN can greatly contribute to National Budget.
Environmental Impact	Good	Project has no significant environmental impact and contributes to local economy and social stability.

### 3.10 Recommended Short Term Plan

(1) Socio-Economic Condition

Population 2.85 million persons  
 GDP 7.37 billion US\$ (Estimated 1990's Constant Price)

(2) Cargo Throughput for the Ports of Cristobal

Containerized Cargo 1,835 thousand M.T.  
 Others 668 thousand M.T.  
 (Number of Containers 392 thousand TEUs)

(3) Physical Plan

- 1) Construction of One New Container Terminal in Telfers Island
- 2) Modernization of Existing Container Terminal
- 3) Modernization of Existing Piers and Mole Area
- 4) Construction and Improvement of Access Road

Necessary cargo handling equipment including container cranes and transfer cranes will be deployed.

(4) Project Cost (Initial Investment)

(thousand US\$)

	Construction	Equipment
New Container Terminal	72,209	29,554
Existing container Terminal	4,136	2,188
Piers and Mole Area	1,940	800
Total	78,285	32,542

(5) Implementation Schedule

	Construction	Equipment
New Container Terminal	1998 - 1999	1999
Existing Container Terminal	1994 - 1995	1995, 1999
Piers and Mole Area	1994 - 1995	1995

(6) Management and Operation

- 1) Users --- Open to Public
- 2) Construction and Ownership --- Public Sector
- 3) Cargo Handling Operation --- Private Sector

(7) Economic Feasibility

EIRR 18.8 %

Sensitivity -4.9 % (for 10 % cost increase and benefit decrease)

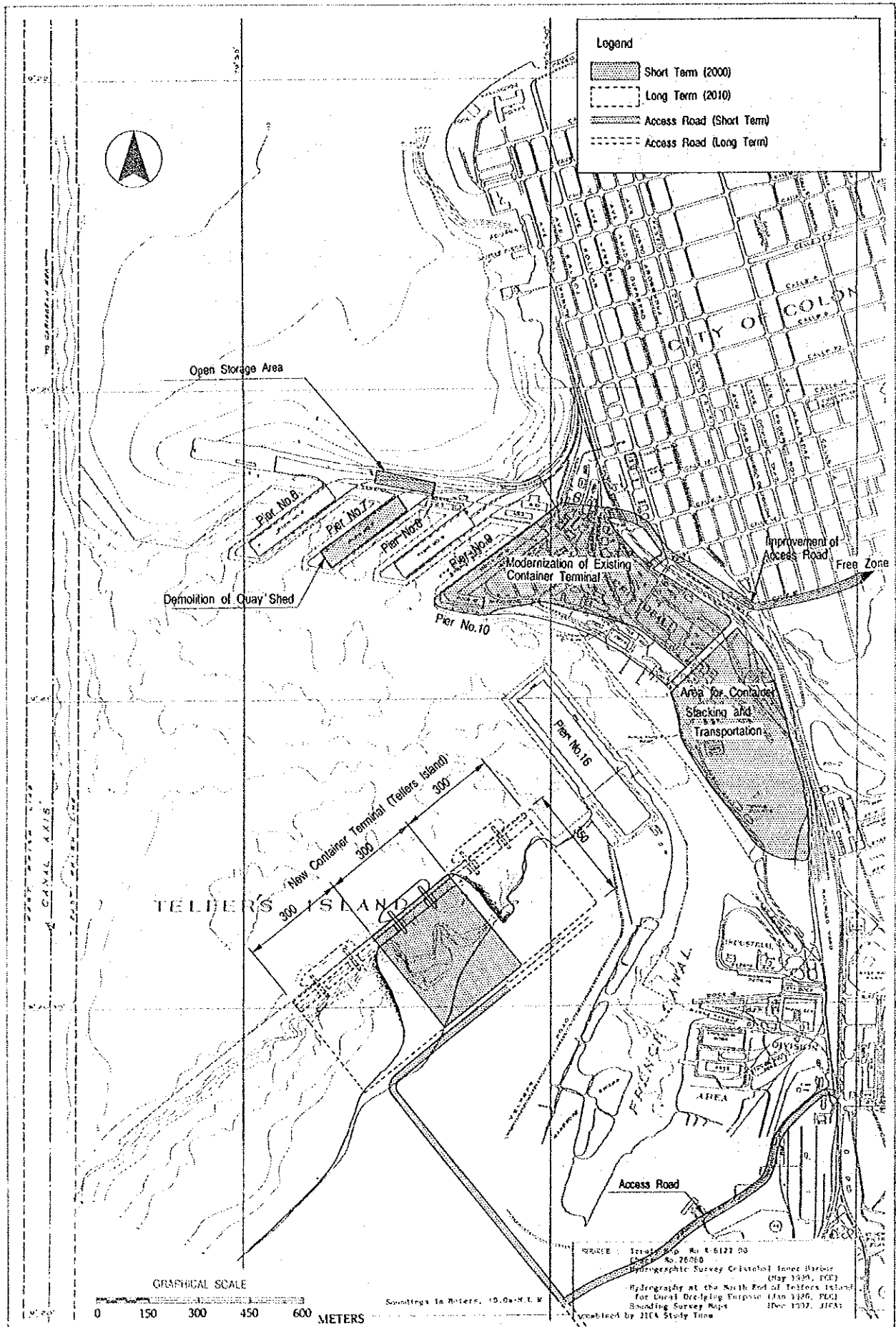
(8) Financial Viability

FIRR 16.3 %

Sensitivity -6.7 % (for 10 % cost increase and revenue decrease)

(9) Environmental Impact

No significant Impact



SHORT TERM PLAN (2000)

## RECOMMENDATION

### 1 Basic Concept of Public Port

Public ports should be considered as economic infrastructure, or social capital, or as a national asset which is vital in promoting the national economy and upgrading total welfare of the citizen. For countries like Panama in particular, where the national economy is greatly dependent on foreign trade with a great amount of cargo flow, sound port activity is very important in providing the framework of national economic security. Under the concept, ports should be owned by the public sector (national or regional government). At the same time, basic policy of port development and management and provision of basic facilities should be controlled by the government.

In other words, such function should not be left to the care of the private sector such as shipping or cargo handling companies. However, this does not always mean that the positive effects of free competition among private entities can be ignored when considering national economic development. Actually, many western countries have fully enjoyed the fruits of the free market system in the course of economic development. It should be noted however, that the very nature of a port, as a basic infrastructure, does neither allow nor accept full commercialization of its core function. It is essential to public ports that the basic port facilities should be planned, constructed, and owned by the government accordingly.

In this sense, it is very important to understand that the port facilities and its services are just for providing private business entities with well cultivated fields in which they can promote their economic activities freely under a liberalized competitive market. The government as an owner of the port should take full responsibility in securing effective provision of such a field ready for open public use.

In addition to the above mentioned points, it is very important from an administrative point of view that a public agency maintains uniform control over the entire area of a public port. This means that existence of privately owned space or facilities in the public port area can often jeopardize normal port administration through possible conflict or trouble between the private owner and port administration agency on the various aspects of port development and operation. From this point of view, it is also fairly justified that the land and water area as well as major port facilities should be owned by the public sector to secure sound and effective port development and its activities.

### 2 Purpose of the Recommended Plans

The purpose of the recommended plans for the ports of Cristobal is summarized as follows:

- 1) to be a guideline for long-term investment and operational improvement scheme

of the target port.

- 2) to be a base for short-term development plan of which contents are required to be consistent with total development scheme.
- 3) to provide port users, investors, and other business entities concerned with future prospect of business environment and thus to guide the business behavior of private sector in proper direction consistent with the port development.
- 4) to promote harmonized development of other infrastructures necessary to realize the proposed port development scheme.
- 5) to be a component of national port plan so that the future development of the target port can appropriately be coordinated with the overall concept of national port development.
- 6) to be a base for consideration of various financing agencies in their investment or financial assistance plan.

In order to secure applicability and practicability of the proposed plan, the following requirements of its functional position are fully considered in the process of the Study.

- (1) Proper time span of the plans should be selected carefully to fit the actual situation of the target ports in relation to other long term national or regional economic development plans, if any.
- (2) The plan should be flexible enough to adjust to possible future contingencies.
- (3) The plan should, if possible, be vested with a certain legal power or be authorized by the government to promote its development scheme.
- (4) Easy access to the contents of the plan should be secured for the interested parties concerned.

On the basis of above understanding on the nature and roles of the Master Plan for the ports of Cristobal, we believe that the benefits of the Plan will be reflected duly in creating a better quality of business environment in Panama, and sincerely hope that appropriate authorization of the Plan and its active utilization by the government will be promoted through the utmost efforts of the agencies concerned.

### **3 Application of Commercialization Policy**

Under the basic understanding on the nature of public port illustrated in para.1, it is recommended that the following guidelines be taken into account in applying the government's commercialization policy to APN.

- (1) The ultimate objective of commercialization of port operation is to maximize economic return from the target port activity for both the public and private sectors under careful consideration on effective removal of possible inefficiency of public sector as well as adverse effects of monopoly by private sector.
- (2) Port functions and activities to be commercialized should be limited within the areas where the commercialized activities can be fully controlled under APN administrative authority, and the areas where the effects of commercialization can be fully expected without any negative impact to sound performance of the port.
- (3) The target areas to be commercialized should be planned and arranged appropriately to guarantee the necessary conditions under which the free market system can be fully activated.
- (4) In principle, ownership of the land and water area necessary for APN port administration, and the basic port facilities such as water area for navigation channels and turning/berthing basins, public wharves, main access roads, utility mains, power supply, reserved space/land for public use or future expansion, should belong to APN.
- (5) Basic port facilities and major cargo handling equipment should be open to public use, in principle, but can be leased out to private firms on a contract basis for their exclusive use under appropriate conditions.
- (6) Practice of commercialization should be step wise considering its applicability to the situation of each target stage including practicality, acceptability, and profitability of the intended commercialization schemes so that they could fully contribute in securing the total efficiency of port administration and its performance.

#### **4 Promotion of Regional Development**

As commonly understood, a port is dependent on the various activities in its hinterland or supporting area. At the same time, such activities relating to the ports can not run well without the necessary port functions. In this sense, the promotion of regional development with a port as its core is considered vital in maximizing economic and social benefits expected from the port activities.

The Ports of Cristobal is located at the heart of Colon Province which is one of the most important industrial and commercial areas in the country. Within a few kilometers from the ports area, there are three major zones with different functions which are significant from the social, economic and regional development points of view; namely, Colon city area, Free Zone and Telfers Island.

The Colon city area was originally developed as a base for construction of the Panama

Canal and has been expanded as a mother city of the ports and Free Zone. The city provides both the ports and Free Zone with necessary labors, accommodations, foods and restaurants, day and night pleasures for the crews of calling ships, and other various ship supplies. In short, the city is indispensable for basic port activities and therefore the improvement and development of the city function is very important for sound growth of the port. Since provision of a safe and peaceful business environment and high quality labor force are the most essential requirements, in particular in this regard, the efforts of the agencies concerned to promote regional development should be focused on these points.

With regard to the possible development of the entire area of Telfers Island, it is really important for the future development of the port to have a concrete and practical plan as soon as possible so that this island can be utilized fully without any adverse effects to the Canal operation. While the development plan of PCC area including the island is to be formulated under ARI (Autoridad de la Region Interoceanica) scheme, it is recommended that APN should propose its own development concept for the island with due regard to possible utilization of this land for port facilities and port related business complex or reserved area for future expansion of port function.

#### **5 Positive Efforts for Better Quality of Environment**

According to the overall assessment conducted under the Study, development of port function itself does not have any adverse impact on the existing environment of the area. However, the possible increase of population with corresponding economic activities as a result of port development may cause general increase of basic load on the environment system.

While the original assignment of APN is to provide adequate port service to the port users for cargo traffic demand, it is considered equally important to conserve or even create a good environment for the residents, workers and visitors of the port so that all people can fully accept and enjoy the existence of the port and its activity.

Under the situation, the following actions are recommended to secure a better quality of environment for the sound future growth of the port.

- 1) Establishment of environmental conservation policy in respect to port development
- 2) Institutional and organizational arrangements for effective environmental administration
- 3) Preparation of action program for environmental conservation activities
- 4) Provision of appropriate level of budget for execution of the policy
- 5) Upgrading of morale and technology of APN staff engaged in the environmental conservation activities.



## **6 Improvement of Statistics and Recording System for Port Planning and Administration**

Systematic collection and compilation of data and information on various port affairs is a basic requirement for sound and effective port administration. While the management system for APN port statistics is considered fairly good as a whole, there remains still considerable room for improvement in its arrangement and practice.

Port statistics required for planning, administration, management, operation, budgeting, accounting and auditing should normally cover the essential fields including port activities, facilities, financial status, organization and personnel affairs, engineering management and other related information.

In light of the current situation of APN port statistics system and its practice, the following points can be recommended for further improvement.

- (1) Commodity, handling site, and loaded/unloaded-wise cargo traffic statistics should be collected and compiled with adequate information on the origin and destination of the flows.
- (2) In respect to commodity-wise statistics, cargoes should be classified in more detailed categories.
- (3) APN should keep reliable original register of port assets with appropriate classification on its own port facilities and equipment.
- (4) From the engineering point of view, structural or mechanical conditions of each major infrastructure and equipment should be carefully observed and recorded to assess their soundness.
- (5) All statistics and records should be well maintained in good condition for easy access of users, and renewed annually or monthly if necessary, to ensure that updated information can be accessed.

## **7 Port Promotion Strategy**

Port promotion or sales is one of the most important fields of activities for attracting port users. APN Marketing Department, which is supposed to be in charge of port promotion, however, does not seem very active in pursuing potential clients. Since competition among the neighboring Caribbean ports in collecting container cargoes will be much tighter in future, sales activities of APN become vital in this particular field. In this respect, the following actions are recommended in securing adequate level of revenues from users at the Ports of Cristobal.

- (1) Establishment of port promotion strategy focusing the most effective target groups

of users.

- (2) Under the systematic action program, APN staff should call for sales at shipping companies or shippers, which create transshipment cargo flow in particular, through active appeals in getting their understanding on the real merits of utilization of the Panamanian ports.
- (3) It is useful for effective sales activities to prepare an attractive brochure in which the sales points including various advantages and merits for the target users are explained plainly.
- (4) To hold seminars to introduce the Panamanian ports to shippers of various countries is another effective way to assist the promotion activities.

## **8 Strategic Tariff Policy for Transshipment Cargoes**

The Panamanian ports have only a limited hinterland with limited volume of cargo flow generated therein. Under the situation, APN recognizes that collecting transshipment cargoes is vital for future prosperity of the ports, and applies a concessional tariff policy (exemption of wharfage and in-yard cargo handling charge) to actual transshipment cargo handling, the effect of which, however, seems to be partially canceled out due to its poor cargo handling operation.

While substantial increase of transshipment cargo handling is expected after completion of a new container terminal with improvement of operational productivity, it is still recommendable that APN should have a more aggressive tariff policy to support the terminal operation in attracting further transshipment cargoes.

For instance, APN may set the tariff for transshipment cargoes far below the normal level, even if operational earnings could not be expected at the initial stage under such a highly concessional tariff. This policy implies that APN could recover any initial losses and get more earnings in the long-term range through dramatic increase of transshipment cargoes expected under the policy if it is prepared appropriately and applied successfully.

## **9 Suggestions on Procurement Policy for Required Funds**

The essential factors to be cleared for timely realization of the proposed Short Term Plan for the Ports of Cristobal are:

- 1) Official confirmation by the government of Panama of technical, economic, and financial viability of the project.
- 2) Timely release from PCC of the project site in Telfers Island to the government of Panama.
- 3) Establishment of authorized executing entity and institutional arrangement for the

project

4) Provision of necessary fund for the project

Each of the above four critical issues is apparently correlative and therefore not able to be discussed separately. Considering the current movement of commercialization policy in Panama, item 3) and 4), in particular, should be discussed jointly in accordance with the possible policies for both items. However, it is considered useful to make suggestions on financial arrangement policy for the project under the prerequisite that APN will take full responsibility as the authorized executing agency and owner of the project. This concept is thoroughly in accordance with the guidelines of commercialization for the port sector proposed in Paragraph 3 of this RECOMMENDATION.

Generally speaking, the available financial sources for a public port development project can be categorized as follows:

- 1) Funds provided by the national budget or government bond issued for the project
- 2) Funds provided by the local government budget or bond
- 3) Funds procured through foreign currency loan from the international multi- or bi-lateral financing agencies (Official Development Assistance (ODA) basis)
- 4) Funds invested by domestic or foreign private sectors
- 5) Funds procured through co-financing arrangement of various different sources

While category 5) is selected mostly for actual project financing, core funds are normally procured from categories 1) to 4) as the major financing source. In respect to the proposed development project of a new container terminal at Telfers Island, it is recommendable to utilize categories 1) and 3) at least for the basic port facilities under the concept that APN shall be the owner of the project. Private funds can also reasonably be introduced for some superstructures and cargo handling equipment.

Considering the general situation around the government of Panama in introducing foreign funds for any development projects at this moment, it may not be easy for APN to make definite selection of available funds for the proposed scheme under its uncertain status of administrative authority on the major part of the project. However, considering what is the most important action to be taken for the future of the country, it may be recommendable, if situation allows, that APN should take the initiative in utilizing some ODA funds as the official executing agency of the project.

While there are many significant barriers or difficulties to be overcome in realizing the project along the above line, the most critical issue may be how to get understanding of the relevant key parties or persons on the real meaning and benefit of the proposed way and system of the port development under the initiative of the public sector in terms of its positive impacts on economic, social and political status of the country.

## **10 Improvement of Administrative Power of APN**

It is generally recognized that APN shows fairly good performance compared with other government agencies under its organization and administrative system. Considering relative importance of port sector in this country, however, the institutional framework of APN administration is not always satisfactory compared with the systems of other countries in the world where the ports play similarly significant roles.

From the above point of view, the following suggestions may be useful for further improvement of administrative power and competence of APN to take full responsibility in promoting total performance of the Panamanian ports for responding to the vital demands of the country.

- 1) Establishment of a unified system for national/international transport administration
- 2) Incorporation of APN administration into the above system
- 3) Expansion of APN administration to more diversified fields necessary to support and promote the required function of Panamanian ports
- 4) Legal identification of the geographical and institutional territory of APN administration in accordance with the above concept for realization of comprehensive port/port district development policy
- 5) Establishment of more independent status of APN in policy making on development and financial/budgetary arrangement
- 6) Improvement of staff employment system to support upgrading of APN administrative power with high quality of performance through introduction of steady and encouraging promotion system, provision of attractive positions for able technocrats, and built-in incentive mechanism of salary/wage system

## **11 Upgrading of Capability of Terminal Operation Staff**

Sorting out containers after discharging and before loading is crucial for effective terminal operation. APN operation at existing container terminal is not really efficient due to various factors including rapid increase of container traffic demand, limited scale and irregular shape of backup area available, obsolete system for container traffic control, and inadequate capability of terminal operation staff.

Upgrading of capability of terminal staff including container handling workers is one of the areas that can not be achieved by improvement of physical facilities or cargo traffic control system. Since improvement of human ability requires a rather long time under

a well designed systematic education and training program, it is recommended that APN should start the necessary action as soon as possible taking the following points into consideration.

Improvement program for APN operational staff, if successfully conducted, implies that APN could transfer a part of these members to private operation companies for the project container terminals in future to provide them with valuable job opportunities.

- 1) Strengthening communication between container control department and other relevant sections.
- 2) Rejuvenation of operation staff by employing youthful workers as a whole.
- 3) Employing mechanical and electrical engineers for maintenance of heavy handling equipment such as gantry crane and top-loader.
- 4) Conducting effective training for different types of work including operation, maintenance, and repair of equipment and facilities.

## **12 Urgent Improvement Measures**

Among the proposed improvement and maintenance tasks for existing container terminal in Short Term Plan Stage, the following items are identified as the urgent measures in respect to instant effects and easy execution of the tasks.

- 1) Carrying out the pavement of expansion area and damaged part of the existing terminal.
- 2) Introduction of a personal computer aided container inventory system at the existing container terminal.
- 3) Full maintenance of the lighting system of the existing container terminal.
- 4) Introduction of personal computer aided supporting system for maintenance and repair works of cargo handling equipment.
- 5) Upgrading of the machines and tools at the workshop including movable repair shop truck.

It is recommended that the above improvement measures be implemented under the 1994 budget of APN.

## **13 Further Actions Required for Successful Implementation of the Project**

In addition to the above recommendation, more detailed actions required for successful implementation of the proposed project are summarized as follows:

- 1) Active promotion of successful negotiation with PCC for early return of relevant PCC area

- 2) Constant dialogue between APN and port users for effective improvement of port operation
- 3) Early commencement of planning study on the port of Balboa for harmonized development with the port of Cristobal
- 4) Periodical review of the proposed scheme for proper modification of the project components
- 5) Consolidation of APN position and its concern in participating in development/expansion scheme of Free Zone
- 6) Promotion of active approaches to MOP for timely construction of access roads to the project site
- 7) Appropriate adjustment of administrative authority between APN and PCC for navigation control at the port of Cristobal
- 8) Early examination/determination of detailed contract conditions for possible leasing of the project facilities
- 9) Immediate action for securing next year's budget for urgent improvement scheme
- 10) Appropriate policy-making on reasonable level of APN contribution to the national revenue

# APPENDIX





### Appendix III-A-1 Final Cost Estimation

This Appendix shows the summary of construction cost. Refer to Chapter 9 of Part II and Chapter 7 of Part III.

\*\* Legend \*\*

Case : SITE-P14 B1

P : Existing Pier and Existing Container Terminal

C : West Colon

T : Telfers

F : French Canal

CS : Coco Solo

14 : Depth of water and Wharf design depth

12 : -ditto-

B1 : Berth at the existing Pier No. 9

B2 : New berth for the Short-term Development

B3/4 : New berths for the Master Plan stage

Note : Cost in case of depth change is also shown in the last page of each case.

TABLE P14 B1 CRISTOBAL PORT COST ESTIMATION - Summary

Case: SITE - P14 B1

Work Category	Works	Unit Rate		Works		Cost
		Unit		Unit		
A. General Works						1,387,500
B. Marine Works						1,732,540
C. On-land Works						5,605,870
D. Building						423,300
E. Utilities						2,970,720
F. Supplemental Works						731,000
G. Others						0
H.	Subtotal					12,850,930
I.	Physical (15 % of H)					1,927,640
J.	Engineering (10 % of H)					1,285,090
K.	Total (H + I + J)					16,063,660
	Land Use					
	Total Area		13.30+0.25	ha	100.0%	
	Back apron		1.50	ha	11.1	
	Inner access		2.13	ha	15.7	
	Yard pavement		0	ha	0	
	Yard pavement		0	ha	0	
	Yard pavement		6.61	ha	48.8	
	Yard pavement C2		0	ha	0	
	Yard pavement C3		0.78	ha	5.8	
	Building		0.20	ha	1.5	
	Parks		1.14	ha	8.4	
	Reserves		1.19	ha	8.7	
	Multi-Purpose Area					
A. General Works	Mobilization/Demobilization					200,000
	Mobilization/Demobilization					0
	Site Common Works					1,187,500
	Subtotal					1,387,500
B. Marine Works	Seabed Clearance	\$/B	101,000	B	0	0
	Dredging and reclamation	\$/m <sup>3</sup>	1.80	m <sup>3</sup>	0	0
	Dredging and reclamation	\$/m <sup>3</sup>	5.40	m <sup>3</sup>	0	0
	Dredging and reclamation	\$/m <sup>3</sup>	54.0	m <sup>3</sup>	0	0
	Dredging and disposal	\$/m <sup>3</sup>	2.76	m <sup>3</sup>	0	0
	Dredging and disposal	\$/m <sup>3</sup>	9.96	m <sup>3</sup>	0	0
	Borrowing and reclamation	\$/m <sup>3</sup>	4.80	m <sup>3</sup>	0	0
	Scawall (1) +3.6 m--±0.0m	\$/m	1,280	m	310	396,800
	(2) ±0.0 -- 5.0	\$/m	2,454	m	310	760,740
	(3) -5.0 -- -10.0	\$/m	7,987	m	0	0
	(4) -10.0 -- -15.0	\$/m	15,375	m	0	0
	Wharf (1) -10.0 m	\$/m		m	0	0
	(2) -12.0 m	\$/m		m	0	0

Work Category	Works	Unit Rate		Works		Cost	
		Unit	Unit	Unit	Unit		
C. On-land Works	Ro-Ro System (Provisional)	\$/m	575,000	m	0	0	
		LS		set	1	575,000	
	Subtotal	Soil Improvement	\$/ha	700,000	ha	0	0
		Inner access	\$/m <sup>2</sup>	69.6	m <sup>2</sup>	0	0
		Back apron	\$/m <sup>2</sup>	131.5	m <sup>2</sup>	(15,000)	0
		Pavement Repairing (O/M cost)	\$/m <sup>2</sup>	100.0	m <sup>2</sup>	(1,848)	0
		Pavement (1) Gravel pave.	\$/m <sup>2</sup>	39.0	m <sup>2</sup>	0	0
		(2) Light pave.	\$/m <sup>2</sup>	69.6	m <sup>2</sup>	0	0
		(3) Normal pave.	\$/m <sup>2</sup>	105.3	m <sup>2</sup>	49,800	5,243,940
		(4) Heavy pave. C2	\$/m <sup>2</sup>	150.0	m <sup>2</sup>	0	0
		(5) Heave pave. C3	\$/m <sup>2</sup>	411.6	m <sup>2</sup>	0	0
		Storm water Drainage	\$/ha	53,000	ha	5.19	275,070
		Pavement Marking	\$/m <sup>2</sup>	20.0	m <sup>2</sup>	4,300	86,860
		Subtotal					5,605,870
		D. Building	Main Gate	\$/m <sup>2</sup>	567	m <sup>2</sup>	(7,850 m <sup>2</sup> )
Control House	\$/m <sup>2</sup>		1,170	m <sup>2</sup>	(450)	0	
Maintenance Shops	\$/m <sup>2</sup>		1,042	m <sup>2</sup>	(800)	0	
CFS	\$/m <sup>2</sup>		846	m <sup>2</sup>	(1,000)	0	
Substation/Power station	\$/m <sup>2</sup>		602	m <sup>2</sup>	(4,400)	0	
Passenger Terminal	\$/m <sup>2</sup>		450	m <sup>2</sup>	(700)	0	
Misc. buildings	\$/m <sup>2</sup>		570	m <sup>2</sup>	500	285,000	
Weigh bridge	\$/set		76,300	set	0	0	
Over-head passenger bridge	\$/m		3,000	m	0	0	
Fence	\$/m		123	m	200	24,600	
Park	\$/m <sup>2</sup>		35	m <sup>2</sup>	2,000	70,000	
Landscaping	\$/m <sup>2</sup>		19	m <sup>2</sup>	2,300	43,700	
Subtotal						423,300	
E. Utilities	Water Supply (Main)		\$/B	175,000	B	0	0
	Water Supply (Dis.)		\$/ha	20,000	ha	0	0
	Fire fighting	\$/ha	2,000	ha	0	0	
	Sewerage	\$/ha	9,300	ha	0	0	
	Power Supply (Dist.)	\$/B	1,020,000	B	2.1	2,142,000	
	Power Supply (P. Plant)	\$/B	530,000	B	0	0	
	Power Supply (W. Crane)	\$/B	455,000	B	0	0	
	Lighting (Yard)	\$/B	240,000	B	2.1	648,000	
	Lighting (Road)	\$/ha	24,000	ha	1.28	30,720	
	Telecommunication	\$/B	42,000	B	0	0	
	Reefers System	\$/B	100,000	B	0	0	
	Bunker System	\$/m	1,000	m	0	0	
	Misc., utilities				1	150,000	
	Subtotal					2,970,720	
	F. Supplemental Works	Navigation aid	\$/B	500,000	B	0	0
Outer access (new)		\$/m <sup>2</sup>	105.3	m <sup>2</sup>	0	0	
Outer access (improve)		\$/m <sup>2</sup>	34.8	m <sup>2</sup>	12,500	435,000	
Demolishing		\$/m <sup>2</sup>	40	m <sup>2</sup>	0	0	

Work Category	Works	Unit Rate		Works		Cost		
		Unit	Unit	Unit	Unit			
G. Others	Demolishing (Small pier)	\$/pier	10,000	pier	0	0		
		\$/m <sup>2</sup>	3	m <sup>2</sup>	32,000	96,000		
		\$/m <sup>2</sup>	100	m <sup>2</sup>	2,000	200,000		
				LS	0	0		
				LS	0	0		
	Subtotal					731,000		
		Flyover	\$/m <sup>2</sup>	2,500	m <sup>2</sup>	0	0	
			\$/set	11,000,000	set	0	0	
			\$/set	440,000	set	0	0	
			\$/m	2,000	m	0	0	
	\$/m		4,000	m	0	0		
	Subtotal					0		
		Cost by Work/Detail					12,850,930	
			Cost P-14/12					12,850,930
				Cost P-12				
								0
							0	
						0		
					0			

TABLE T14 B2 (NCT) CRISTOBAL PORT COST ESTIMATION - Summary

Work Category	Works	Unit Rate		Unit	Works	Cost
		Unit	Unit			
A. General Works						5,230,000
B. Marine Works						29,403,020
C. On-land Works						9,913,140
D. Building						6,172,650
E. Utilities						3,732,500
F. Supplemental Works						3,296,140
G. Others						0
H.	Subtotal					57,767,450
I. Contingency	Physical (15 % of H)					8,665,120
J. Engineering	(10 % of H)					5,776,740
K.	Total (H + I + J)					72,209,310
Land Use						
	Total Area	10.50		ha	100.0 %	
	Back apron	0.50		ha	4.8	
	Inner access	2.63		ha	25.0	
	Yard pavement	0.22		ha	2.2	
	Yard pavement	1.05		ha	10.0	
	Yard pavement	3.78		ha	36.0	
	Yard pavement C2	0.47		ha	4.4	
	Yard pavement C3	0.70		ha	6.7	
	Building	0.21		ha	2.0	
	Parks	0.47		ha	4.5	
	Reserves					
A. General Works						
	Mobilization/Demobilization					500,000
	Site Common Works					1,625,000
	Subtotal					3,125,000
B. Marine Works						
	Scrub Clearance	101,000		B	1	101,000
	Dredging and reclamation			m <sup>3</sup>	90,000	162,000
	Dredging and reclamation			m <sup>3</sup>	90,000	486,000
	Dredging and reclamation			m <sup>3</sup>	0	0
	Dredging and disposal			m <sup>3</sup>	722,500	1,994,100
	Borrowing and reclamation			m <sup>3</sup>	0	0
	Seawall (1) +3.6 m - ±0.0 m			m	607,000	2,913,600
	(2) ±0.0 - -5.0			m	0	0
	(3) -5.0 - -10.0			m	300	1,472,100
	(4) -10.0 - -15.0			m	60	479,220
	Wharf (1) -10.0 m			m	40	615,000
	(2) -12.0 m			m	0	0

Case: SITE - T14 B2 (NCT)

Work Category	Works	Unit Rate		Unit	Works	Cost
		Unit	Unit			
C. On-land Works	(3) -14.0 m	\$/m	65,000	m	300	18,900,000
	Ro-Ro System	LS	2,280,000	set	1	2,280,000
	Subtotal					29,403,020
	Soil Improvement	\$/ha	700,000	ha	0	0
	Inner access	\$/m <sup>2</sup>	69.6	m <sup>2</sup>	26,300	1,830,480
	Back apron	\$/m <sup>2</sup>	131.5	m <sup>2</sup>	(5,100)	0
	Side apron	\$/m <sup>2</sup>	131.5	m <sup>2</sup>	0	0
	Pavement (1) Gravel pave.	\$/m <sup>2</sup>	39.0	m <sup>2</sup>	4,500	175,500
	(2) Light pave.	\$/m <sup>2</sup>	69.6	m <sup>2</sup>	10,500	730,800
	(3) Normal pave.	\$/m <sup>2</sup>	105.3	m <sup>2</sup>	37,800	3,980,340
	(4) Heavy pave. C2	\$/m <sup>2</sup>	150.0	m <sup>2</sup>	4,700	705,000
	(5) Heavy pave. C3	\$/m <sup>2</sup>	411.6	m <sup>2</sup>	4,700	1,934,520
	Storm water Drainage	\$/ha	53,000	ha	10.5	556,500
D. Building	Subtotal					9,913,140
	Main Gate	\$/m <sup>2</sup>	567	m <sup>2</sup>	(7,000 m <sup>2</sup> )	3,988,550
	Control House	\$/m <sup>2</sup>	1,170	m <sup>2</sup>	1,000	1,170,000
	Maintenance Shops	\$/m <sup>2</sup>	1,042	m <sup>2</sup>	1,000	1,042,000
	CFS	\$/m <sup>2</sup>	846	m <sup>2</sup>	2,500	2,115,000
	Substation/Power station	\$/m <sup>2</sup>	602	m <sup>2</sup>	1,050	632,100
	Passenger Terminal	\$/m <sup>2</sup>	450	m <sup>2</sup>	0	0
	Misc. buildings	\$/m <sup>2</sup>	570	m <sup>2</sup>	800	456,000
	Weigh bridge	\$/set	76,300	set	2	152,600
	Over-head passenger bridge	\$/m	3,000	m	0	0
	Fence	\$/m	123	m	1,000	123,000
	Park	\$/m <sup>2</sup>	35	m <sup>2</sup>	2,100	73,500
	Landscaping	\$/m <sup>2</sup>	19	m <sup>2</sup>	2,100	39,900
E. Utilities	Subtotal					6,172,650
	Water Supply (Main)	\$/B	175,000	B	1	175,000
	Water Supply (Dis.)	\$/ha	20,000	ha	10.50	210,000
	Fire fighting	\$/ha	2,000	ha	10.50	21,000
	Sewerage	\$/ha	9,300	ha	10.50	97,650
	Power Supply (Distur.)	\$/B	1,020,000	B	1	1,020,000
	Power Supply (P. Plant)	\$/B	530,000	B	1	530,000
	Power Supply (W. Crane)	\$/B	455,000	B	1	455,000
	Lighting (Yard)	\$/B	240,000	B	1	240,000
	Lighting (Road)	\$/ha	88,320	ha	3.68	88,320
	Telecommunication	\$/B	42,000	B	1	42,000
	Refuel System	\$/B	100,000	B	1	100,000
	Bunker System	\$/m	1,000	m	500	500,000
Misc., utilities	\$/m	1,000	LS	1	253,530	
Subtotal					3,732,500	
F. Supplemental Works	Navigation aid	\$/B	500,000	B	1	500,000
	Outer access (new)	\$/m <sup>2</sup>	105.3	m <sup>2</sup>	20,000	2,106,000
	Outer access (improve)	\$/m <sup>2</sup>	34.8	m <sup>2</sup>	7,200	250,560
	Demolishing					

TABLE T14 B3/4 (NCT) CRISTOBAL PORT COST ESTIMATION - Summary

Work Category	Unit Rate		Works	Unit Rate		Works	Cost
	Unit	Unit		Unit	Unit		
A. General Works							6,437,500
B. Marine Works							52,021,120
C. On-land Works							19,826,280
D. Building							15,079,300
E. Utilities							7,065,000
F. Supplemental Works							4,992,000
G. Others							0
H. Subtotal							105,421,200
I. Contingency (15% of H)							15,813,180
J. Engineering (10% of H)							10,542,120
K. Total (H + I + J)							131,776,500
Land Use							
Total Area				21.00	ha		100.0%
Rack apron				1.00	ha		4.8
Inner access				5.26	ha		25.0
Yard pavement				0.44	ha		2.1
Yard pavement				2.10	ha		10.0
Yard pavement				7.56	ha		36.0
Yard pavement C2				0.94	ha		4.5
Yard pavement C3				2.00	ha		9.5
Building				0.42	ha		2.0
Parks				0.34	ha		1.6
Reserves							
A. General Works							500,000
Mobilization/Demobilization							1,625,000
Site Common Works							4,312,500
B. Marine Works							6,437,500
Seabed Clearance				101,000	B		202,000
Dredging and reclamation				1.80	m³		40,500
Dredging and reclamation				5.40	m³		72,900
Dredging and reclamation				54.0	m³		218,700
Dredging and disposal				2.76	m³		0
Dredging and disposal				9.96	m³		0
Borrowing and reclamation				4.80	m³		324,000
Seawall (1) +3.6 m -±0.0m				2,559	m		1,566,000
Seawall (2) ±0.0 - -5.0				4,907	m		200
Seawall (3) -5.0 - -10.0				7,987	m		300
Seawall (4) -10.0 - -15.0				15,375	m		90
Wharf (1) -10.0 m				58,700	m		170
Wharf (2) -12.0 m					m		0

Case: SITE - T14 - B2 (NCT)

Work Category	Unit Rate		Works	Unit Rate		Works	Cost
	Unit	Unit		Unit	Unit		
Demolishing (Pier No. 7 shed)	\$/m²	80			7,900		(632,000)
Demolishing (Pier No. 16)	\$/m³	40			0		0
Demolishing (Small pier)	\$/m³	10,000			0		0
Demolishing (Onland civil)	\$/m²	3			0		0
Demolishing (Building)	\$/m²	100			1		166,670
Environmental protection	\$/m²	66.0			1		272,910
Misc. works	\$/m²	69.6			7,900		(521,400)
Pavement after P7 shed	\$/m²	100.0			4,860		(338,250)
Mole yard pavement	\$/m²				600		(60,000)
Mole road repair	\$/m²						
Subtotal							3,296,140
G. Others							0
Flyover	\$/m²	2,500			0		0
Bunker pier reinstallation	\$/set	11,000,000			0		0
Loading arms	\$/set	440,000			0		0
Bunker lines	\$/m	2,000			0		0
Breakwater Improvement	\$/m	4,000			0		0
Subtotal							0
Cost by Wharf Depth							
Cost T-14							57,767,450
Marine Works							-2,208,000
Cost T-14/12							-2,208,000
Cost T-14							55,559,450
Marine Works							57,767,450
Cost T-12							-2,208,000
Marine Works							-1,290,000
Cost T-12							-3,498,000
Marine Works							54,269,450

Note: Costs in parenthesis excluded for total.

Case: SITE - T14 B3/4 (NCT)		Works		Unit Rate		Cost	
Work Category	Works	Unit	Unit	Unit	Unit	Unit	Unit
C. On-land Works	Ro-Ro System	(3) -14.0 m	\$/m	63,000	m	600	37,800,000
			LS	2,280,000	set	0	0
		Subtotal					52,021,120
		Soil Improvement		700,000	ha	0	0
		Inner access		69.6	m <sup>2</sup>	52,600	3,660,960
		Back apron		131.5	m <sup>2</sup>	(10,200)	0
		Side apron		131.5	m <sup>2</sup>	0	0
		Pavement (1) Gravel pave.		39.0	m <sup>2</sup>	9,000	351,000
		(2) Light pave.		69.6	m <sup>2</sup>	21,000	1,461,600
		(3) Normal pave.		105.3	m <sup>2</sup>	75,600	7,960,680
	(4) Heavy pave. C2		150.0	m <sup>2</sup>	9,400	1,410,000	
	(5) Heavy pave. C3		411.6	m <sup>2</sup>	9,400	3,869,040	
	Storm water Drainage		53,000	ha	21.0	1,113,000	
	Subtotal					19,826,280	
D. Building	Main Gate		567	m <sup>2</sup>	(20,000 m <sup>2</sup> )		737,100
	Control House		1,170	m <sup>2</sup>	2,000		2,340,000
	Maintenance Shops		1,042	m <sup>2</sup>	3,000		3,126,000
	CFS		846	m <sup>2</sup>	7,000		5,922,000
	Substation/Power station		602	m <sup>2</sup>	2,100		1,264,200
	Passenger Terminal		450	m <sup>2</sup>	3,000		(1,350,000)
	Misc. buildings		570	m <sup>2</sup>	1,600		912,000
	Weight bridge		76,300	set	4		305,200
	Over-head passenger bridge		3,000	m	0		0
	Fence		123	m	2,000		246,000
	Park		35	m <sup>2</sup>	4,200		147,000
	Landscaping		19	m <sup>2</sup>	4,200		79,800
		Subtotal					15,079,300
E. Utilities	Water Supply (Main)		175,000	\$/B	B	2	350,000
	Water Supply (Dis.)		20,000	\$/ha	ha	21.00	420,000
	Fire fighting		2,000	\$/ha	ha	21.00	42,000
	Sewerage		9,300	\$/ha	ha	21.00	195,300
	Power Supply (Disur.)		1,020,000	\$/B	B	2	2,040,000
	Power Supply (P. Plant)		530,000	\$/B	B	2	1,060,000
	Power Supply (W. Crane)		455,000	\$/B	B	2	910,000
	Lighting (Yard)		240,000	\$/B	B	2	480,000
	Lighting (Road)		24,000	\$/ha	ha	176.640	176,640
	Telecommunication		42,000	\$/B	B	2	84,000
	Roader System		100,000	\$/B	B	2	200,000
	Bunker System		1,000	\$/m	m	600	600,000
	Misc. utilities				LS	2	507,060
	Subtotal					7,065,000	
F. Supplemental Works	Navigation aid		500,000	\$/B	B	1	500,000
	Outer access (to Boilwar)		105.3	m <sup>2</sup>	m <sup>2</sup>	27,000	2,843,100
	Outer access (bridge)		700,000	\$/ca	ca	1	700,000
	Demolishing						

Note: Costs in parenthesis excluded for total.

Case: SITE - T14 B3/4 (NCT)		Works		Unit Rate		Cost	
Work Category	Works	Unit	Unit	Unit	Unit	Unit	Unit
G. Others	Demolishing (Pier No. 16)		40	m <sup>3</sup>	m <sup>3</sup>	0	0
	Demolishing (Small pier)		10,000	\$/pier	pier	0	0
	Demolishing (Onland civil)		3	m <sup>2</sup>	m <sup>2</sup>	0	0
	Demolishing (Building)		100	m <sup>2</sup>	m <sup>2</sup>	1,500	150,000
	Environmental protection				LS	1	261,080
	Misc. works				LS	1	537,820
	Mole yard pavement		69.6	m <sup>2</sup>	m <sup>2</sup>	24,000	(1,670,400)
	Mole road pavement		105.3	m <sup>2</sup>	m <sup>2</sup>	1,800	(189,540)
		Subtotal					4,992,000
		Flyover		2,500	m <sup>2</sup>	m <sup>2</sup>	0
Bunker pier reinstatement		11,000,000	\$/set	set	0	0	
Loading arms		440,000	\$/set	set	0	0	
Bunker lines		2,000	\$/m	m	0	0	
Breakwater Improvement		4,000	\$/m	m	0	0	
	Subtotal					0	
	Cost by Wharf Depth						
	Cost T-14						105,421,200
	Mainne Works						
	Supplemental						
	Dredging Reduction		2.76	m <sup>3</sup>	m <sup>3</sup>	170,000	-469,200
	Reduction			LS	0	0	-469,200
	Total reduction						
	Cost T-14/12						104,952,000
	Cost T-14						105,421,200
	Mainne Works						
	Reduction 14/12						-469,200
	Wharf cost reduction		4,300	m	m	600	-2,580,000
	Supplemental reduction			LS	0	0	-3,049,200
	Cost T-12						102,372,000

**Appendix III-A-2 Unit Cost Study Sheet**

Unit Cost Study Sheet

(1)

Works	Specification	Quantity	Unit Rate	Unit Cost	Material	DSS	Remarks	%		
							Plant Labor	M - P - L		
<b>A. General Items</b>										
Mobilization	Const. Machines			500,000	0	450,000	50,000	0-90-10		
	Dredgers			1,625,000	0	1,462,500	162,500	0-90-10		
			Sub-Total	2,125,000	0	1,912,500	212,500	0-90-10		
Site Installation	Common Temp. Work		\$/B	500,000	300,000	100,000	100,000	60-20-20		
Management			\$/B	1,500,000	0	0	1,500,000	0-0-100		
Site Clearance			\$/B	250,000	0	225,000	25,000	0-90-10		
Miscellaneous			\$/B	125,000	15,000	25,000	25,000	60-20-20		
			Sub-Total	2,375,000	375,000	350,000	1,650,000	16-15-69		
			Total	\$/B 4,500,000	375,000	2,262,500	1,862,500	8-50-42		
<b>B. Marine Works</b>										
Seabed Clearance	Wreck Survey	ba/B	21.0 \$/ba	1,000	\$/B	21,000	0	21,000	0-0-100	
	Wreck Survey	ea/B	4 \$/ea	20,000	\$/B	80,000	4,000	56,000	20,000	5-70-25
			Sub-Total	\$/B 102,000	4,000	56,000	41,000	4-55-41		
Dredging/Reclam	(1) Normal Soil		\$/M3	1.60	0.09	1.62	0.09	5-90-5		
	(2) Hard Soil		\$/M3	5.40	0.27	4.86	0.27	5-90-5		
	(3) Rock		\$/M3	54.00	2.70	48.60	2.70	5-90-5		

Unit Cost Study Sheet

(2)

Works	Specification	Quantity	Unit Rate	Unit Cost	Material	DSS	Remarks	%	
							Plant Labor	M - P - L	
Dredging/Disposal	(1) Normal Soil			\$/M3	2.76	0.14	2.48	0.14	5-90-5
	(2) Hard Soil			\$/M3	9.96	0.50	8.96	0.50	5-90-5
Borrow/Reclam				\$/M3	4.80	0.24	4.32	0.24	5-90-5
Caisson Wharf									
Dredging	Hard/Weathered			\$/M3	5.40	0.27	4.86	0.27	5-90-5
Base Rock Bond				\$/M3	70.50	35.30	17.60	17.60	50-25-25
Caisson	Prefabrication			\$/M3	440.00	270.00	70.00	100.00	61-16-23
Caisson	Towing/Setting			\$/ea	50,400	2,520	42,840	5,040	5-95-10
Sand Fill				\$/M3	9.60	4.80	2.40	2.40	50-25-25
Concrete Cap				\$/M3	300.0	180.0	50.0	70.0	60-17-23
Head Beam				\$/M3	330.0	195.0	55.0	80.0	59-17-24
Rubble Backfill	+1.0'-14.0m			\$/M3	56.4	35.0	10.7	10.7	62-19-19
	+3.3'-1.0m			\$/M3	47.0	35.0	8.0	4.0	75-17-8
Sheet	t-5mm			\$/M2	20.0	14.0	1.0	5.0	70-5-25
Crane Beam				\$/M3	440.0	270.0	70.0	100.0	61-16-23
Pile Material	Steel 6900Z16			\$/t	1,282.0	1,089.7	128.2	64.1	85-10-5
Pile Driving				\$/M	54.0	2.7	40.5	10.8	5-75-20
Apron Pavement	Conc t=0.3m			\$/M2	131.5	75.9	24.8	30.8	58-19-23

Unit Cost Study Sheet

(3)

Works	Specification	Quantity	Unit Rate	Unit Cost	Material	Plant Labor	Remarks
Fender			\$/ea	20,000	18,600	1,000	400 93-5-2
Boilard			\$/ea	2,000	1,500	200	300 75-10-15
Fittings	Misc Fit Util Cr		LS	1,600	1,200	120	240 75-10-15
Const. Equip	Fl. Dock Mobil.		LS	3,023	0	2,721	302 0-90-10
	Fl. Dock Oper		LS	9,870	493	8,884	493 5-90-5
Seawall	+4.0'±0.0m						
Concrete Wall		m3/m	1.6 \$/m3	350.0	328	96	136 59-17-24
Concrete Apron		m2/m	10.0 \$/m2	1,053	595	213	245 56-20-24
Crushed Rock		m3/m	7.0 \$/m3	94.0	460	99	99 70-15-15
Sheet		m2/m	3.4 \$/m2	20.0	50.4	3.6	18.0 70-5-25
Armor Rock	+2.0'±1.0m	m3/m	4.6 \$/m3	47.0	161	37	18 75-17-8
			Sub-Total	\$/m	2,559	1,595	448 62-18-20
Seawall	+0.0'±5.0m						
Seawall	+4.0'±0.0m						
Armor Rock	+1.0'±3.6m	m3/m	1.2 \$/m3	70.5	874	218	218 50-25-25
Second Layer		m3/m	20.0 \$/m3	56.4	700	214	214 62-19-19
Sheet		m2/m	17.3 \$/m2	20.0	346	212	17 70-5-25
			Sub-Total	\$/m	4,907	2,975	897 61-18-21

Unit Cost Study Sheet

(4)

Works	Specification	Quantity	Unit Rate	Unit Cost	Material	Plant Labor	Remarks
Seawall	-5.0'±10.0m						
Seawall	+0.0'±5.0m						
Armor Rock	-3.6'±8.6m	m3/m	13.4 \$/m3	70.5	472	236	236 61-18-21
Second Layer		m3/m	22.0 \$/m3	56.4	769	236	236 50-25-25
Sheet		m2/m	14.7 \$/m2	20.0	294	15	73 70-5-25
Miscellaneous		m3/m	20.0 \$/m3	30.0	300	150	150 50-25-25
			Sub-Total	\$/m	4,722	1,534	1,731 59-19-22
Seawall	-10.0'±15.0m						
Seawall	-5.0'±10.0m						
Armor Rock	-8.6'±14.0m	m3/m	24.3 \$/m3	70.5	866	433	433 50-25-25
Second Layer		m3/m	71.0 \$/m3	56.4	2,693	825	825 62-19-19
Sheet		m2/m	17.1 \$/m2	20.0	342	17	86 70-5-25
Miscellaneous		m3/m	32.4 \$/m3	30.0	972	243	243 50-25-25
			Sub-Total	\$/m	15,375	3,052	3,317 59-20-21