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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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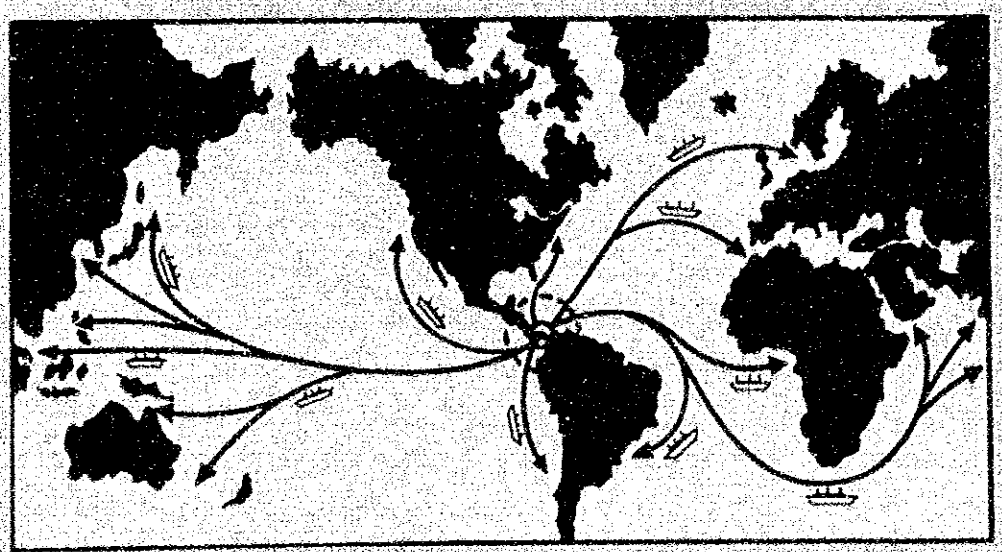
NATIONAL PORT AUTHORITY
THE REPUBLIC OF PANAMA

THE STUDY ON THE REHABILITATION PLAN AND THE CONTAINER TERMINAL OPERATION PLAN AT THE PORT OF CRISTOBAL IN PANAMA

FINAL REPORT

PART II MASTER PLAN



November 1993

THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)
PACIFIC CONSULTANTS INTERNATIONAL (PCI)

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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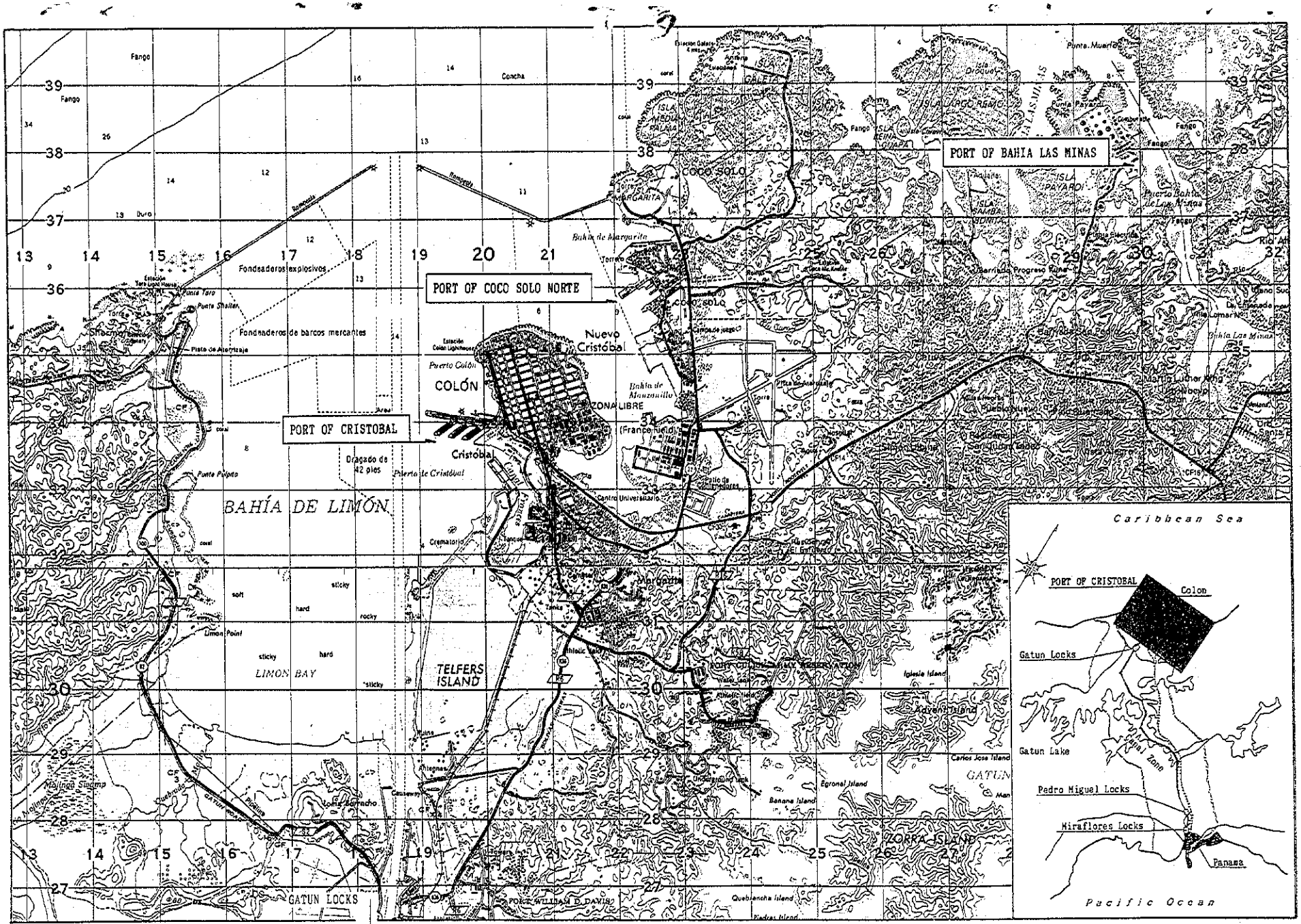
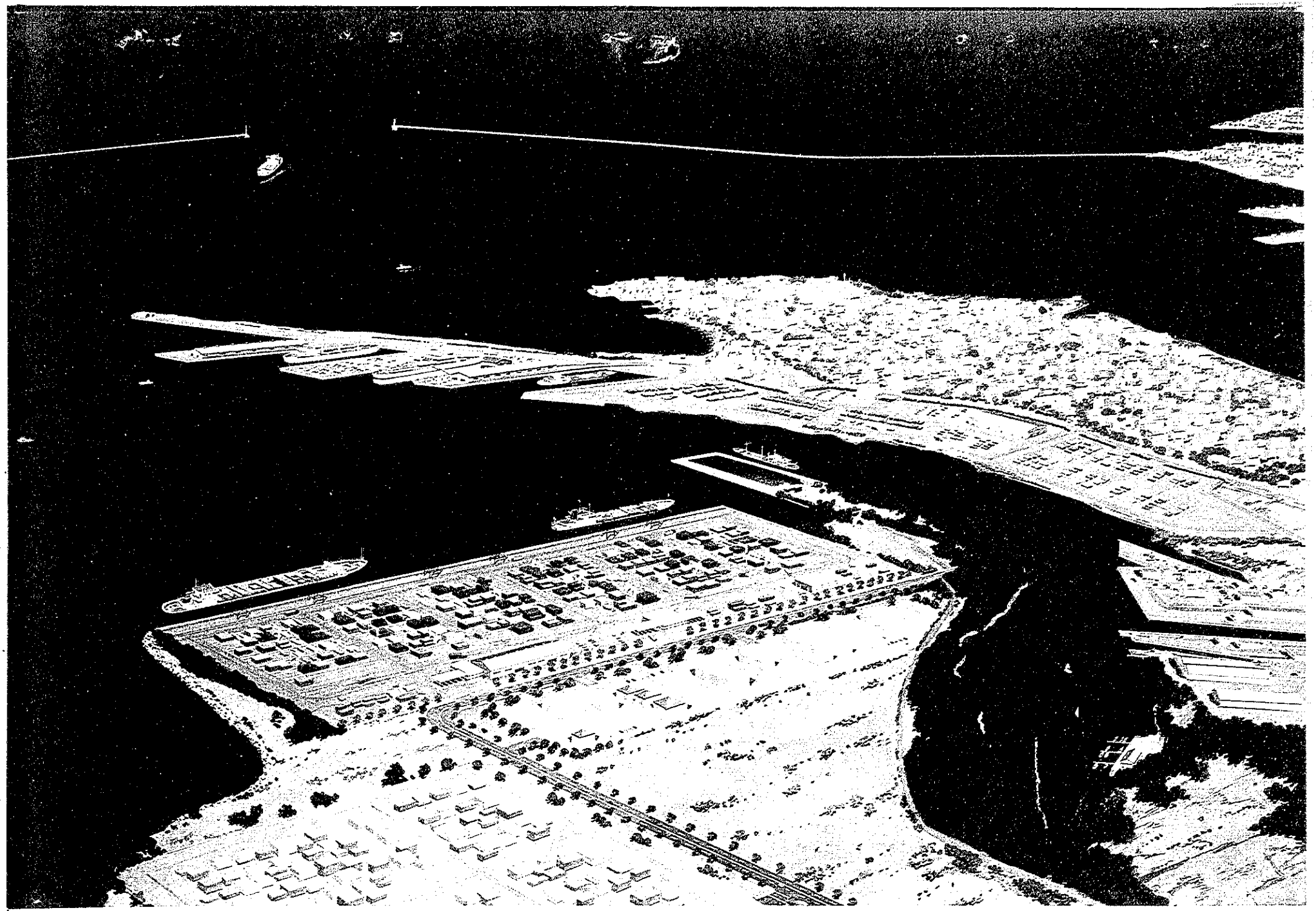


LOCATION MAP



ABBREVIATION LIST

A	APN	Notional Port Authority
	APSA	Atlantic-Pacific, S.A.
	ARI	Interoceanic Regional Authority
B	B/L	Bill of Laden
	BOD	Biochemical Oxygen Demand
	BOT	Build, Operate and Transfer
C	CFS	Container Freight Station
	CIF	Cost, Insurance and Freight
	COD	Chemical Oxygen Demand
	COFRISA	Consortium for the Development of Folk River, S.A.
	CPC	Centerport Concept
D	DO	Dissolved Oxygen
	DWT	Dead Weight Tonnage
E	EIA	Environmental Impact Assessment
	EIRR	Economic Internal Rate of Return
	EPZ	Export Processing Zone
F	FCL	Full Container Load
	FEU	Forty-foot Equivalent Unit
	FIRR	Financial Internal Rate of Return
	FOB	Free on Board
G	GDP	Gross Domestic Products
	GT	Gross Tonnage
H	HHW	Highest High Water
I	IEE	Initial Environmental Examination
	IMO	International Maritime Organization
L	LAQ	Lease a Quay
	LCL	Less than Container Load
	LLW	Lowest Low Water
	LUP	License to Use a Port
M	M/O or O/M	Maintenance and Operation, or Operation and Maintenance
	MHW	Mean High Water
	MIPPE	Ministry of Planning and Economic Policy
	MLB	Mini Land Bridge

	MLW	Mean Low Water
	MLWS	Mean Low Water Spring
	MSL	Mean Sea Level
N	NPV	Net Present Value
O	ODA	Official Development Assistance
P	PCC	Panama Canal Commission
	PLD	Precise Level Datum
R	Ro-Ro	Roll-on Roll-off
S	SS	Suspended Solid
T	TEU	Twenty-foot Equivalent Unit
U	UNCTAD	United Nations Conference on Trade and Development

Exchange Rate

1 US Dollar = 1 Balboa = ¥ 107.5
(as of July 1993)

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CHAPTER 1 BASIC POLICY FOR THE DEVELOPMENT OF THE PORTS OF CRISTOBAL

This chapter illustrates firstly the background and perspectives on relevant factors for establishing the basic port development policy. On the basis of various background factors identified, the basic policy for the physical development and management improvement plan for the ports of Cristobal shall be proposed. The basic items of the policy include the future roles and position of the ports of Cristobal in the context of world and regional maritime transport system, the functional allotment between the ports of Cristobal and Balboa, and a physical planning strategy and development scenarios for the ports of Cristobal, Coco Solo Norte, and Bahia Las Minas.

1.1 Background and Perspectives on Relevant Factors Affecting Future Planning of the Ports in Panama

The ports of Cristobal, Coco Solo Norte, and Bahia Las Minas which are located at the entrance of the Canal facing the Caribbean sea have been developed into a sort of port complex. The port of Balboa, on the other hand, is located just in front of the city of Panama and serves its cargo flow demand. The ports are playing significant roles as the major gateway ports of Panama and also as base ports for Middle and South American countries serving the international maritime traffic passing the Canal as well as transshipment demand of the containers in and around this area.

On the basis of future economic and maritime business trends, it is considered that the basic advantages of the ports of Cristobal and Balboa in container handling activities in particular, will remain unchanged even in the long term. The above general observations can be supported by the various background factors and its future prospects as described here below;

(1) Steadily increasing trend of the economic growth in South American countries can be expected at least for another five or ten years.

(2) The maritime container traffic to and from these countries or the U.S. east and west coast through the Canal will increase accordingly.

(3) Transshipment demand of containers will also increase steadily in this area mainly due to current sub-standard level of container handling and facilities available at competing ports in and around the Caribbean sea. (Details on this subject are discussed in the following section.)

(4) Substantial growth of the container cargo flow in and out of the Colon Free Zone is expected according to the on going expansion scheme of the Free Zone.

(5) The possible expansion of the Canal capacity, which is being deliberated upon by the Panama Canal Alternative Study Commission, could be another factor in

stimulating the cargo flow demand and port activities accordingly.

(6) Mini Land Bridge (MLB) in the United States, which is competing against the Canal as an alternative channel for the cargo flow from/to Far East to/from U.S. east coast, will not substantially influence the future cargo traffic through the Canal mainly because the capacity of MLB is considered limited in its actual level of current inter-modal transport facilities, the railroad network in particular.

(7) While the total idea of the Central Port Concept (CPC) may not have gained official acceptance at this moment due to the various issues pointed out in Chapter-10 of the Progress Report, and thus its implementation is suspended, the basic idea of CPC still appears attractive in the long term basis subject to future public acceptance. Considering the physical location and advantageous position of port function, the improvement works for the ports of Cristobal shall be the first step for realization of CPC.

(8) The Government policy for commercialization of the public sector activities will substantially contribute to improving administrative and business activities related to port operation and management.

(9) The highly productive areas and facilities being released from Panama Canal Commission (PCC) will provide the port sector of the country with potential development capacity of the ports of Cristobal and Balboa.

(10) Land transport systems including Panama railway and transisthmian highway are now in the process of rehabilitation and full scale improvement of the systems can be expected though it will take some more time.

(11) All recommendations of the Study will be made on the basis that various financing sources from international/bilateral financing agencies and private entities will be available for the project.

In addition to the above general prospects, the followings are the details of prerequisites necessary for actual practice of demand forecasts and physical planning of the target ports.

(1) The Panama Canal

1) The maximum acceptable number of vessels will increase gradually through progress of ongoing Culebra Cut widening.

2) The capacity of the Canal for acceptable size of vessel remains unchanged until year 2010.

3) Post Panamax type of vessels with wider beam may come on stage upon completion of possible third locks of the Canal around year 2010.

(2) Areas to be released from PCC

1) All relevant lands and properties under control of PCC will be released to Panama by the end of year 2000.

2) An alternative project site in Telfers Island will be released within a few years, at latest by year 1997.

(3) Panama Railroad

1) Rehabilitation works on the track of 20 km long will be completed by the end of year 1993.

2) Further rehabilitation or up-grading project for another part of track will be completed by/around the end of year 2000.

3) Full scale improvement scheme for entire railroad system, however, may not be expected before year 2010.

(4) Transisthmian Highway

1) Rehabilitation works on the sections of the highway near to the ports of Critobal and Balboa will be executed by the end of year 2000.

2) Between the years of 2000 and 2010, another project for improving capacity of the existing rout will be implemented.

3) Full scale up-grading scheme of the highway with a new additional rout will be completed after year 2010.

(5) Commercialization Policy of the Government

1) Application of the government's commercialization policy to APN is expected to be somewhat flexible, so that APN could manage and select its own course of commercialization appropriately to fit with the nature of port business and current practice of port management.

(6) Expansion Plan of the Free Zone

1) Construction of a bridge connecting the Free Zone in Colon side and French Field will be completed in the beginning of year 1994.

2) A series of ongoing and under-planning schemes for expanding capacity of the Free Zone will be completed by year 1997, except for COFRISA expansion.

3) Further expansion of the Free Zone is expected to mostly be completed around year 2010.

(7) Military Cargo Flow

1) Maritime cargoes for exclusive supply to the military base will gradually decrease towards the end of year 2000.

2) Only minimal volume of military cargoes after year 2000 will remain, if any.

(8) Industrial Development in Margarita Island

1) For lack of information provided so far, perspective of the project is still uncertain at the moment to the Team.

2) Impact of the project to the port planning, if any, would be considered in later

satage of the Study, subject to timely provision of adequate data and information on the project.

(9) Colon Free Port Law

1) While the status of the Law is uncertain at the moment, instant effects of the Law could not be expected on future cargo flow, even if the Law would be enforced in near future.

2) Impact of the Law to the port planning may be neglected under the Study.

1.2 The Current Position of Competing Caribbean Ports and Future Perspective of their Competitive Condition

1.2.1 Outline of Caribbean Ports

There are about 33 major ports in total along the Caribbean sea coast divided among 19 countries (Cuba is excluded as detailed information is not available). The general location of major Caribbean ports is shown in Figure 1-2-1. Since the sizes of most Caribbean countries in terms of their population and economic/trading activities are rather small, the port facilities and their activities remain generally at substandard levels compared with large main ports in countries like the U.S.A. or Japan.

The major functions of the Caribbean ports are to handle the import cargoes for domestic consumption and the export cargoes of domestic products such as banana, sugar and other agricultural or industrial products. Transshipment services for containers are provided at only a few ports such as the ports of Miami, (U.S.A.) San Juan (Puerto Rico), Kingston (Jamaica), and Cristobal (Panama). Table 1-2-1 illustrates major port facilities of selected Caribbean ports. Those of the port of Miami in the U.S.A. are also shown in this table for easy reference. The terminal areas at the ports in this table are mostly small with less than 10 ha. except for the ports of Miami and Kingston. The maximum depth at available berths is around 10-12 meters which makes it possible to accept medium-large size container vessels. The total length of berths varies widely among the ports from less than 100 meters to 2000-3000 meters. While an area for container storage is prepared at most Caribbean ports, their scale is relatively small according to the number of containers being handled. Container gantry cranes are equipped at almost all ports except for Puerto Castilla, Honduras and Port Castries, St.Lucia. Due to the substandard level of current container traffic, an exclusive area for container marshalling is not prepared at all ports in the Table, except for the ports of Miami and San Juan.

Since the ports listed in Table 1-2-1 are all considered leading ports in each Caribbean country, most of them provide direct-call liner service to secure stable import and export channels for a sound national economy and the everyday life of the citizens.

Figure 1-2-1 Major Caribbean Ports

Table 1-2-1 Port Facilities of Major Caribbean Ports

Port Country	Miami U. S. A.	Puerto Limon/ Moin Costa Rica	Puerto Castilla Honduras	Puerto Cortes Honduras	Bahia las Minas Panama	Cristobal Panama	Freeport Bahamas	Bridgetown Barbados	Port-au-Prince Haiti	Kingston Jamaica	Pointe-a-Pitre Leeward Island	Willemstad Netherlands Antilles	San Juan Puerto Rico	Port Castries St. Lucia
1. Direct-call liner services (companies)	41	13	0	16	2	24	1	18	14	10	11	14	24	12
2. Terminal facilities (ha)	242.9	7.5	8	6.2	n.a.	7.5	n.a.	6	4	35.6	25	16	n.a.	2.6
3. Berths*: total	n.a.	2	1	2	1	2	2	n.a.	5	4	2	3	9	2
4. Berths*: total length (m)	3,855	459	150	352	91.4	428	n.a.	702	977	640	400	500	1,688	310
5. Berths: depth (m)	7.6/11.6	10/11	n.a.	10.6	8.5	10.7–12.2	n.a.	9.8	n.a.	10.4–11.9	11	12.2	9	10.7
6. Container/trailer parking & marshalling area (ha)	197.5												28.8	
7. Total container storage (TEU)	24,000	560	2,500	2,800	n.a.	3,000	n.a.	4,000	1,800	6,500	3,000	1,700	6,200	600
8. CFS: total	4	0	0	0	0	1	0	1	1	1	1	1	1	1
9. CFS: total area (ha)	7.2	0	0	0	0	0.63	0	3	8	1	20	0.28	2.18	2.8
10. Container gantry cranes	6	1	0	1	0	2	0	1	1	5	3	1	6	0
11. Rail facilities in port area (km)	5.2	0	0	11	0	0	0	0	0	0	0	0	0	0
12. Future plans	Additional container berths		Additional equipment, expansion of storage area	Extension of berth		Additional equipment	Container terminal, Ro/Ro. terminal		Container berth, CFS, storage areas, equipment	Stacking area, expansion of berth, rail facilities	Industrial & foreign trade zone, container berth			

* Note: berths used for handling containers

To be revised

Source: Containerization Yearbook 1992

1.2.2 Container Traffic and Its Future Prospect at Caribbean Ports

Table 1-2-2 shows the container traffic trend of the last decade in five year intervals at major Caribbean ports plus the port of Miami. Among the Caribbean ports, the port of San Juan, Puerto Rico has the largest through put of container handling amounting to a total of about 1.4 million TEU in 1990, which is slightly less than 65% of the total amount of container handling at 13 Caribbean ports in the Table. At the port of Cristobal, on the other hand, total container handing accounts for about 0.12 million TEU with only 6% in total TEU. During the last decade from 1980 to 1990, the total number of containers including empty vans handled at the Caribbean ports has increased about three times in TEU, namely for about 0.85 million TEU in 1980 to about 2.6 million TEU in 1990.

While the exact statistics on transshipment operation of containers are not available at each Caribbean port, it is estimated that the transshipment containers between main lines and/or main and feeder lines have increased at the ports of Miami, San Juan, Kingston and Cristobal in particular. Considering severe time saving requirement to the large full container vessels serving for main lines, it is fair to say that the transshipment operation with rather small vessels at the selected Caribbean ports will increase even into the deep future. It is considered at this moment that the most competitive ports against the port of Cristobal in handling the transshipment containers in this area are the ports of Miami, San Juan, and Kingston. Considering the above situation, it is vital for the future development of Cristobal to establish firm foundation in providing attractive port facilities and management systems for transshipment operation.

As shown in Table 1-2-1, some of the Caribbean ports have a strong intention to expand their container handling capacity so that they can cope with possible future increase of container traffic demand. While such development projects under planning at the Caribbean ports are not always guaranteed successful completion under severe budget constraint, such movements should be looked into carefully in formulating the future development scheme for the port of Cristobal.

Table 1-2-2 Container Traffic at Major Caribbean Ports

Port (Country)	TEU / Tonnage	1980	1985	1990
Miami (U. S. A.)	Import / Loaded TEU	52,840	83,068	169,619
	Empty TEU			16,775
	Tonnage	326,206	869,977	1,816,349
	Export / Loaded TEU	45,480	60,976	170,584
	Empty TEU			16,872
	Tonnage	432,679	472,218	1,454,542
	Total TEU	98,320	144,044	373,850
	Total Tonnage	758,885	1,342,195	3,270,891
Puerto Limon/Moin (Costa Rica)	Import / Loaded TEU		21,185	(estimate) 28,948
	Empty TEU		25,757	24,868
	Tonnage		278,519	605,587
	Export / Loaded TEU	n. a.	38,613	45,245
	Empty TEU		8,411	6,023
	Tonnage		471,008	901,869
	Total TEU		93,966	105,084
	Total Tonnage		749,524	1,507,456
Puerto Castilla (Honduras)	Import / Loaded TEU			7,192
	Empty TEU			16,954
	Tonnage			41,318
	Export / Loaded TEU	n.a.	n.a.	23,170
	Empty TEU			196
	Tonnage			210,258
	Total TEU			47,512
	Total Tonnage			251,576
Puerto Cortes (Honduras)	Import / Loaded TEU	6,245	79,663	29,788
	Empty TEU	9,611		36,407
	Tonnage	83,136	201,287	221,581
	Export / Loaded TEU	13,462	79,515	55,233
	Empty TEU	2,451		11,313
	Tonnage	225,384	642,947	522,301
	Total TEU	31,769	159,178	132,741
	Total Tonnage	308,520	844,234	743,882
Bahia las Minas (Panama)	Import / Loaded TEU	9,729	11,581	25,137
	Empty TEU	64	323	650
	Tonnage	81,199	79,216	188,607
	Export / Loaded TEU	2,492	5,404	10,191
	Empty TEU	7,886	4,330	6,673
	Tonnage	18,124	28,277	67,723
	Total TEU	20,171	21,638	42,651
	Total Tonnage	99,323	107,493	256,330
Cristobal (Panama)	Import / Loaded TEU	27,758	37,134	59,092
	Empty TEU	1,468	1,393	2,064
	Tonnage	180,619	267,632	447,011
	Export / Loaded TEU	4,325	7,736	14,577
	Empty TEU	22,884	31,038	47,531
	Tonnage	26,188	52,687	100,980
	Total TEU	56,435	77,301	123,264
	Total Tonnage	206,807	320,319	547,991

To be revised

Table 1-2-2 (continued)

Port (Country)	TEU / Tonnage	1980	1985	1990
				(Jan-May)
Freeport	Import / Loaded TEU	7,106	11,065	3,336
	Empty TEU	268	76	509
	Tonnage	76,596	103,323	51,015
(Bahamas)	Export / Loaded TEU	163	1,386	473
	Empty TEU	6,127	5,947	3,001
	Tonnage	13,508	10,618	2,617
	Total TEU	13,664	18,474	7,319
	Total Tonnage	90,104	113,941	53,632
Bridgetown	Import / Loaded TEU	9,275	13,173	17,754
	Empty TEU	138	1,557	528
	Tonnage	139,401	263,460	390,588
(Barbados)	Export / Loaded TEU	2,213	3,367	3,852
	Empty TEU	6,961	12,755	14,567
	Tonnage	47,117	67,340	84,744
	Total TEU	18,587	30,852	36,701
	Total Tonnage	186,518	330,800	475,332
Port-au-Prince	Import / Loaded TEU	15,637	19,441	13,801
	Empty TEU	994	665	643
	Tonnage	276,504	161,002	201,925
(Haiti)	Export / Loaded TEU	8,006	9,056	5,226
	Empty TEU	7,814	11,132	9,319
	Tonnage	65,844	53,584	49,326
	Total TEU	32,451	40,294	28,989
	Total Tonnage	342,348	214,586	251,251
Kingston	Import / Loaded TEU	39,852	78136	34,501
	Empty TEU	16,307	33,392	8,448
	Tonnage	708,110	1,071,297	887,482
(Jamaica)	Export / Loaded TEU	32,085	65,405	20,576
	Empty TEU	21,319	45,738	21,097
	Tonnage	531,932	900,048	548,768
	Total TEU	109,563	222,671	84,622
	Total Tonnage	1,240,042	1,971,345	1,436,250
Pointe-a-Pitre	Import / Loaded TEU		35,400	51,571
	Empty TEU		267	2,672
	Tonnage		447,143	668,946
(Guadeloupe)	Export / Loaded TEU	n.a.	19,876	17,338
	Empty TEU		19,327	30,559
	Tonnage		316,141	310,255
	Total TEU		74,870	102,140
	Total Tonnage		763,284	979,201
Willemstad	Import / Loaded TEU	11,228	10,046	28,996
	Empty TEU	293	761	1,839
	Tonnage	155,527	172,664	258,570
(Curacao)	Export / Loaded TEU	1,379	2,836	12,607
	Empty TEU	9,848	7,893	17,930
	Tonnage	13,644	66,210	115,209
	Total TEU	22,748	21,536	61,372
	Total Tonnage	169,171	238,874	373,779

Table 1-2-2 (continued)

San Juan (Puerto Rico)	Import / Loaded TEU	214,050	440,815	635,445
	Empty TEU	--	0	55,256
	Tonnage	3,328,568	3,871,311	5,283,838
	Export / Loaded TEU	214,050	176,326	138,140
	Empty TEU	--	264,488	552,562
	Tonnage	967,312	1,334,807	1,239,419
	Total TEU	428,100	881,629	1,381,403
	Total Tonnage	4,295,880	5,206,118	6,523,257
Port Castries (St. Lucia)	Import / Loaded TEU	2,206	3,282	13,720
	Empty TEU	--	342	4,036
	Tonnage	34,828	54,000	261,888
	Export / Loaded TEU	395	447	7,536
	Empty TEU	1,866	3,079	10,585
	Tonnage	10,552	8,000	148,267
	Total TEU	4,467	7,150	35,877
	Total Tonnage	45,380	62,000	410,155

Source: Containerization Yearbooks

Notes: 1) Container figures are in 20ft equivalents (TEU).

2) Tonnage units in the table as they relate to tare weights are specified below.

Miami:	Short tons include tare weight except in 1985.
Puerto Limon/moin:	Metric tons include tare weight in 1990.
Puerto Castilla:	Short tons exclude tare weight in 1990.
Puerto Cortes:	Metric tons exclude tare weight.
Bahia las Minas:	Metric tons exclude tare weight.
Cristobal:	Metric tons exclude tare weight.
Freeport:	Short tons exclude tare weight.
Bridgetown:	Metric tons include tare weight.
Port-au-Prince:	Metric tons are used in 1980 and 1985, while long tons are used in 1990. In each case tare wieight is included in tonnage.
Kingston:	Metric tons are used in 1980, while freight tons are used in 1985 & 1990. In each case tare weight is excluded from tonnage.
Pointe-a-Pitre:	Metric tons include tare weight.
Willemstad:	Metric tons include tare weight except in 1985 when tare weight is excluded from tonnage.
San Juan:	Short tons exclude tare weight.
Port Castries:	Short tons, freight tons and revenue tons are used respectively in 1980, 1985 and 1990. Tare weight is excluded in each case.

1.2.3 Comparative Advantages in Container Handling Function at the Ports of Cristobal against the Competing Caribbean Ports

As to be discussed in the following chapters, most container traffic through the ports of Cristobal is and will be generated by the Free Zone activities and domestic consumption demand. These container traffic demands are considered independent from the conditions of other Caribbean ports and not substantially affected by the activities of those ports. Competing situation between the ports of Cristobal and Caribbean ports is only in handling transshipment containers.

While the exact amount of total transshipment container flow in this area is not available in the relevant port statistics, at least 10-20 % of total container traffic can be identified as transshipment demand, substantial part of which is currently being handled at the ports of Miami, San Juan and Kingston. Contribution of the ports of Cristobal in this field remains at a sub-standard level at this moment mainly due to inadequate port facilities and inefficient operation.

However, when you consider the future power structure in attracting the transshipment container traffic among these competing ports, it is quite understandable that the situation could be drastically changed through full utilization of the various advantages of the ports of Cristobal. In other words, it is fair to say that the ports of Cristobal have not realized its excellent advantages under sever budget constraints and absence of proper improvement scheme both for port facilities and operation.

Though the future pattern of transshipment container flow will be governed by comparative power of the competing ports in attracting such container ships, the following advantages of the ports of Critobal suggest that it will in future assume a superior position in serving transshipment demand of container cargo in this region.

(1) Location of the Port

The ports of Cristobal are located close to the Caribbean side entrance of the Canal which is the most convenient point to distribute the transshipment cargoes to small Carbbean ports.

(2) Existence of the Colon Free Zone

The ports of Cristobal have the large scale Free Zone which is very active in generating container cargo flow. This means that frequent calls of full container vessels with transshipment cargoes can be expected.

(3) Availability of Various Port Function

In addition to the basic port facilities such as full container terminal or general cargo berths, many kind of ship services including ship repairs bunkering, ship chandlery supply, and safe anchorage are provided at the port.

(4) Water Area Availability

Wide, calm and deep water area protected by a set of breakwaters is available for

expanding container cargo facilities and anchorage area.

(5) Potential Socioeconomic Condition of Panama

Steady growth of economic activity and social stability in Panama will provide the ports with an attractive environment for container vessels calling for transshipment operation in the area.

1.3 Functional Allotment among Major Panamanian Ports

1.3.1 Functional Allotment of Port Activities between the Port of Cristobal, Balboa and Other Local Ports

(1) The Ports of Cristobal

Based on the positions described in the previous sections, the possible future functions and services expected at the ports of Cristobal can be identified as follows.

1) Main terminal services for containers and general cargoes to and from the Free Zone. The ports of Cristobal will maintain their important position as a gateway port supporting the activities of the Free Zone.

2) Base port for the main and feeder line services for transshipment cargoes to/from major Caribbean ports. For the time being, these services would be rather limited in handling transshipment containers to those ports on the Caribbean sea and U.S. east coast from Far East via north bound transit of the Canal. This is likely to be expanded in future, however, to transshipment services for those cargoes from European ports to Caribbean ports.

3) Gateway port for import cargoes for domestic consumption, and export cargoes of domestic production of Panama.

4) Base port to accept cruising passenger boats calling for sight seeing and shopping at the expended Free Zone.

5) Center of bunkering services for the vessels passing the Canal or calling the ports of Cristobal. More active and diversified bunkering services including fuel, water, and other ship supplies will be required for supporting increased cargo handling activities of the ports.

6) Ship repair and maintenance center for calling vessels will be another potential function expected at the ports of Cristobal.

Regarding container transshipment services at the ports of Cristobal, a more economical and efficient way of operation should be adopted to secure the strong competitive position of the ports. From the long term point of view, however, the potential

advantage of the ports of Cristobal will be enlarged through the completion of deep water berths equipped with full capacity of gantry cranes for post-Panamax type vessels to be in service through the up graded Canal with possible third lock.

(2) The Port of Balboa

The port of Balboa, the second largest port in the country, is located at the Pacific side entrance of the Canal, and has the capital of the nation, Panama city, directly behind it. The actual level of port activities is about half of that at Cristobal in general. (With regard to the details of the current situation of the port, see Chapter 4 and 5 of Progress Report)

Considering the location and hinterland of both Cristobal and Balboa, the basic functions expected at the ports can be clearly allocated. In comparison with the required roles of the ports of Cristobal as described in the above section, those of the port of Balboa are rather simple as illustrated below:

1) Base port for the transshipment operation of containers between main liner services to/from Far East and U.S. west coast from/to South American west coast.

2) Gateway port for import cargoes for domestic consumption, and export cargoes of domestic production in Panama.
Because of its close distance to Panama city, which has the largest population in the country with high density of economic activities, it is apparently more economical to handle most consumer goods imported from Far East countries at the port of Balboa rather than handling them at Cristobal.

3) Center of ship repair and bunkering for the vessels calling from Far East, U.S. west coast and Middle or South American west coast.

4) From long term point of view, inter-modal transshipment center for CPC system functioning as possible counter part terminal of the port of Cristobal.

(3) Other Local Ports

In addition to the ports of Cistobal and Balboa, there are fifteen other ports in Panama, most of which are small scale local ports. The total cargo volume handled at all Panamanian ports in 1992 was about 2.1 million metric tons, 62% of which was handled at the ports of Cristobal and Balboa, while 38% was handled at the local port including private oil importation jetties. (For more details on current situation of Panamanian ports, see Chapter 4 of the Progress Report). These local ports will basically maintain their current function at least for 10-20 years as shown here below.

1) Oil importation terminals (Chiriqui Grande, Bahia Las Minas, Almirante and Charco Azul)

2) Banana, sugar and shrimp exportation ports (Almirante, Almulles, Aguadulce and Pedregal)

3) Domestic ports for general cargoes (Bocas del Toro, La Palma and Mutis)

4) Fishery port (Vacamonte)

(4) Functional Allotment among the Ports

On the basis of the above expected function of the ports of Cristobal, Balboa and other local ports, the general allotment plan by type of activities at the ports is summarized in Table 1-3-1.

Table 1-3-1 Functional Allotment by Port Activities

	CRISTOBAL	BALBOA	OTHER PORTS
FREE ZONE CARGO	A	C	C
IMPORT (DOMES.COMSMP.)	B	A	C
EXPORT (DOMES.PRODCT.) (AGRI.FISHERY ETC.)	C	C	A
EXPORT (DOMES.PRODCT.) (INDUSTRIAL PRODCT)	B	A	C
TRANSSHIPMENT (CARIBBEAN)	A	C	C
TRANSSHIPMENT (PACIFIC)	C	A	C
SHIP REPAIR	C	A	C
BUNKERING	A	B	C
CPC PORT	A	A	C

* Note: Allotment degree A: High
B: Medium
C: Low

1.3.2 *Allotment Plan of Port Function among the Ports of Cristobal*

With a view to setting the proper arrangement for functional allotment in the two major planning stages (target year 2000 as short term and 2010 as long term) among the ports of Cristobal, namely the port of Cristobal, Coco Solo Norte, and Bahia Las Minas, we divided the cargo flow through the ports into twenty different categories according to the types of cargoes and their origin and destination together with the current structure of cargo flow by approximate percentage of each category as shown in Table 1-3-2.

Considering the current situation of port operation/facilities and their utilization, we propose the category wise allotment of port function among the ports of Cristobal in each planning stage as summarized in Table 1-3-3.

Table 1-3-2 Category Wise Structure of Current Cargo Flow of Cristobal

No	Category of Cargo Flow		Share of Cargo Flow (% in 1991)
1	Containers imported for Free Zone	(C/FZIM)	27.6
2	Containers exported for Free Zone	(C/FZEX)	11.4
3	General cargoes imported for Free Zone	(G/FZIM)	0.5
4	General cargoes exported for Free Zone	(G/FZEX)	4.9
5	Containers imported for domestic consumption	(C/DIM)	20.2
6	Containers of domestic products exported	(C/DEX)	4.3
7	General cargoes imported for domestic consumption	(G/DIM)	10.0
8	General cargoes of domestic products exported	(G/DEX)	1.6
9	Containers imported for transshipment	(C/TIM)	1.8
10	Containers exported for transshipment	(C/TEX)	1.0
11	General cargoes imported for transshipment	(G/TIM)	2.2
12	General cargoes exported for transshipment	(G/TEX)	1.3
13	Containers imported for military base	(C/MIM)	4.6
14	Containers exported for military base	(C/MEX)	0.6
15	General cargoes imported for military base	(G/MIM)	0.6
16	General cargoes exported for military base	(G/MEX)	0.5
17	Liquid bulk cargoes imported for domestic consumption	(LB/DIM)	–
18	Liquid bulk cargoes of domestic products exported	(LB/DEX)	0.3
19	Dry bulk cargoes imported for domestic consumption	(DB/DIM)	6.7
20	Dry bulk cargoes of domestic products exported	(DB/DEX)	–

Table 1-3-3 Functional Allotment among the Ports of Cristobal, Balboa and Other Local Ports

PORTS	Cristobal			Coco Solo			Bahia Las Minas			Balboa			Oter Local Ports		
STAGE	P	S	L	P	S	L	P	S	L	P	S	L	P	S	L
C/FZIM	A	A	A	B	B	C	B	B	D	B	B	B	D	D	D
C/FZEX	A	A	A	B	B	C	B	B	D	C	C	C	D	D	D
G/FZIM	A	B	C	B	B	A	D	D	C	B	B	B	D	D	D
G/FZEX	A	B	C	B	B	A	D	D	C	C	C	C	D	D	D
C/DIM	B	A	A	B	C	C	B	C	D	A	A	A	D	D	D
C/DEX	B	A	A	B	C	D	B	C	D	C	B	A	D	D	D
G/DIM	B	C	D	B	B	A	D	D	C	A	A	A	C	C	C
G/DEX	B	C	D	B	B	A	D	D	C	C	B	A	B	B	B
C/TIM	B	A	A	B	C	D	D	D	D	C	B	A	D	D	D
C/TEX	B	A	A	B	C	D	D	D	D	C	B	A	D	D	D
G/TIM	B	A	A	B	C	D	D	D	C	C	B	A	D	D	D
G/TEX	B	A	A	B	C	D	D	D	C	C	B	A	D	D	D
C/MIM	B	B	A	B	C	C	C	C	D	B	B	A	D	D	D
C/MEX	B	B	A	B	C	D	C	C	D	B	B	A	D	D	D
G/MIM	A	B	C	B	B	B	C	C	C	B	B	A	D	D	D
G/MEX	A	B	C	B	B	B	C	C	C	B	B	A	D	D	D
LB/DIM	D	D	D	D	D	D	B	B	B	B	B	B	A	A	A
LB/DEX	C	C	C	D	D	D	C	C	C	C	C	C	A	A	A
DB/DIM	B	B	B	C	C	C	D	D	D	A	A	A	D	D	D
DB/DEX	D	D	D	D	D	C	D	D	C	A	A	A	D	D	D

Note :
P ; Present / Urgent Stage ---- Year 1995
S ; Short Term Stage ---- Year 1995
L ; Long Term Stage ---- Year 1995

Allotment Degree A : High
B : Medium
C : Low
D : Minimal

1.4 Framework of Planning Stage and Development Scenarios for the Ports of Cristobal

1.4.1 Framework of Planning Stage

According to TOR of the Study, the planning stage shall be divided basically into two stages, namely, short term stage with the target year of 2000 as 1st stage, and long term stage for the year of 2010 as 2nd stage.

For the 1st stage, we shall carry out the detailed feasibility study for the proposed short term project. This stage of planing shall include the Consultant's recommendation on the urgent countermeasures for instant improvement in port operation, management and its facilities as well.

The 2nd stage is to formulate the Master Plan of the project which illustrates the Consultant's proposal on the basic development policy for long term planning of the project up to the year 2010. This stage is essential as the basis of the short term planning and hence this stage shall be carried out in advance of the detailed feasibility study in actual planing works. Throughout the process of formulating the Master Plan of the project, we shall always keep in mind the possible further expansion of the project.

In summarizing the total staging of the planning process, we proposed a total of four planning stages as shown here below.

1) Urgent stage for instant improvement scheme with the target year of 1995.
2) 1st stage for detailed feasibility study with the target year of 2000.
3) 2nd stage for master plan study with the target year of 2010.
4) Post master plan stage for conceptual proposal for further expansion of the project after the year of 2010.

Since the urgent and post master plan stages are not the major planning stages, only brief and preliminary discussions shall be made for those stages, namely:

1) Recommendations for the proposed urgent stage will mainly include instant counter measures for current inefficient parts of the port operation/facilities without any detailed cost benefit analysis. While small scale improvement scheme on necessary civil works or provision of required cargo handling equipment may be proposed at this stage, substantial changes in institutional arrangement for the port operation will be discussed only for 1st and 2nd stages.

2) Since the purpose of post master plan stage is to draw a conceptual image of long future development of the project as a base map of the master plan, and since timing of development is too deep into the future, no details of the scheme will be proposed for this stage.

1.4.2 General Scenarios of Future Cargo Flow and Correspondent Functions of the Ports of Cristobal and Balboa at each Planning Stage

On the basis of the functional allotment policy illustrated in Tables 1-3-1 and 1-3-2, the detailed scenarios of future cargo flow in each planing stage and corresponding port function expected at the ports of Cristobal are summarized as follows.

(1) Urgent Stage (-1995)

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

2) The port of Cristobal will serve the vessels operated on main lines for Far East and North America.

3) The port of Coco Solo Norte will serve the feeder transport to Middle/South America. The port will also handle Ro-Ro cargoes as a sub-port of Cristobal.

4) At the port of Bahia Las Minas, a part of container cargoes imported from the United States will be handled.

5) Cargoes for consumption in Panama city will be imported mostly through the port of Balboa.

(2) Short Term Plan Stage (-2000)

1) The port of Cristobal with a new container terminal will serve the rapidly increasing container traffic for Free Zone.

2) The transshipment containers including those shifting from the competing Caribbean ports will be handled at the existing and/or new container terminal of the port of Cristobal.

3) The port of Coco Solo Norte will keep its position in handling the increasing traffic of containers and break bulk cargoes to/from Free Zone.

4) The container cargoes handled at the port of Bahia Las Minas will gradually be shifted to the container terminals of the port of Cristobal as costruction Progresses.

5) At the port of Balboa, of which container handling facilities will be up graded, the commercial and industrial development will progress with the increase of container cargo flow.

(3) Long Term Plan Stage (-2010)

1) The expansion project of Free Zone and the construction of a new industrial area will mostly be completed. The cargo flow to/from these area through the container terminals at the port of Cristobal will increase accordingly.

2) The port of Cristobal will establish its position as a major base port for transshipment operation for Caribbean lines.

3) The development of new container berths at possible alternative site around the port of Cristobal will substantially be completed. The new container terminal shall be open to public use.

4) At the existing piers Nos. 6,7,and 8, the general break bulk cargoes for Free Zone or domestic consumption will be handled.

5) The port of Coco Solo Norte will provide medium sized vessels with the

public berths for general break bulk cargoes. The berths to be used exclusively by the semi-container ships serving for the Caribbean lines will be prepared to handle the containers or break bulk cargoes as well.

6) The port of Bahia Las Minas will become a special type of port for exclusive use for the dangerous cargoes such as oil or fuel. The minimal function for container handling will, however, be kept for ad hoc use of existing facility.

7) The transshipment services for Middle/South American west coast at the port of Balboa will have been upgraded substantially.

(4) Post Master Plan Stage (-2020)

1) As a result of possible expansion of the Canal capacity, the post Panamax type of vessels will be in service with increased number of transit.

2) In accordance with progress of CPC projects, the full scale services for transshipment operation between main lines will be realized at both ports of Cristobal and Balboa.

3) All container cargoes of main liners will be handled at the new container terminals of the port of Cristobal.

4) The existing piers Nos. 6, 7, and 8 will provide the vessels passing the Canal with general services including bunkering, waiting moorage, small repair works, and miscellaneous supplies.

5) The major berths of Coco Solo Norte will be used only for general break bulk cargoes.

6) The port of Balboa will establish its position as a base port for transshipment operation for Middle/South American west coast lines.

CHAPTER 2 DEMAND FORECAST OF PORT TRAFFIC

2.1 Methodology

There are two different methods of forecasting demand for port traffic in general. One is the so-called macro forecast method on the basis of socio-economic conditions, and the other is the so-called micro forecast method on the basis of the characteristics of cargo flow by origins and destinations, packing types and commodities of cargo.

The former method is to forecast the total cargo volume as a whole by statistical correlation between the cargo volume and socio-economic indices such as GDP (gross domestic products) of the hinterland of the port and/or population and the past time trend.

The latter one is a cumulative method forecasting the cargo volume based on the analyses of the patterns of cargo flow (origins and destinations), packing types (break bulk, dry and liquid bulk, containerized cargo) and major commodities individually. In this Study, however, since the data regarding commodities handled at the ports are insufficient (the latest data is for the year 1987 and those were not recorded throughout the entire year), a commodity-wide forecast was not carried out except for vehicles, dry and liquid bulk cargo.

As for the Free Zone cargo, transhipment container cargo and passenger traffic, different approaches are required. The details of forecasting these types of traffic are described in each subsection.

The cargo volume forecast is to be carried out for the total volume of the three ports of Cristobal, Coco Solo Norte and Bahia Las Minas. The forecast of cargo volume is prepared for the years 2000 for the short-term development plan and 2010 for the master plan of the ports.

The flow chart for port traffic forecast is shown in Figure 2-1-1.

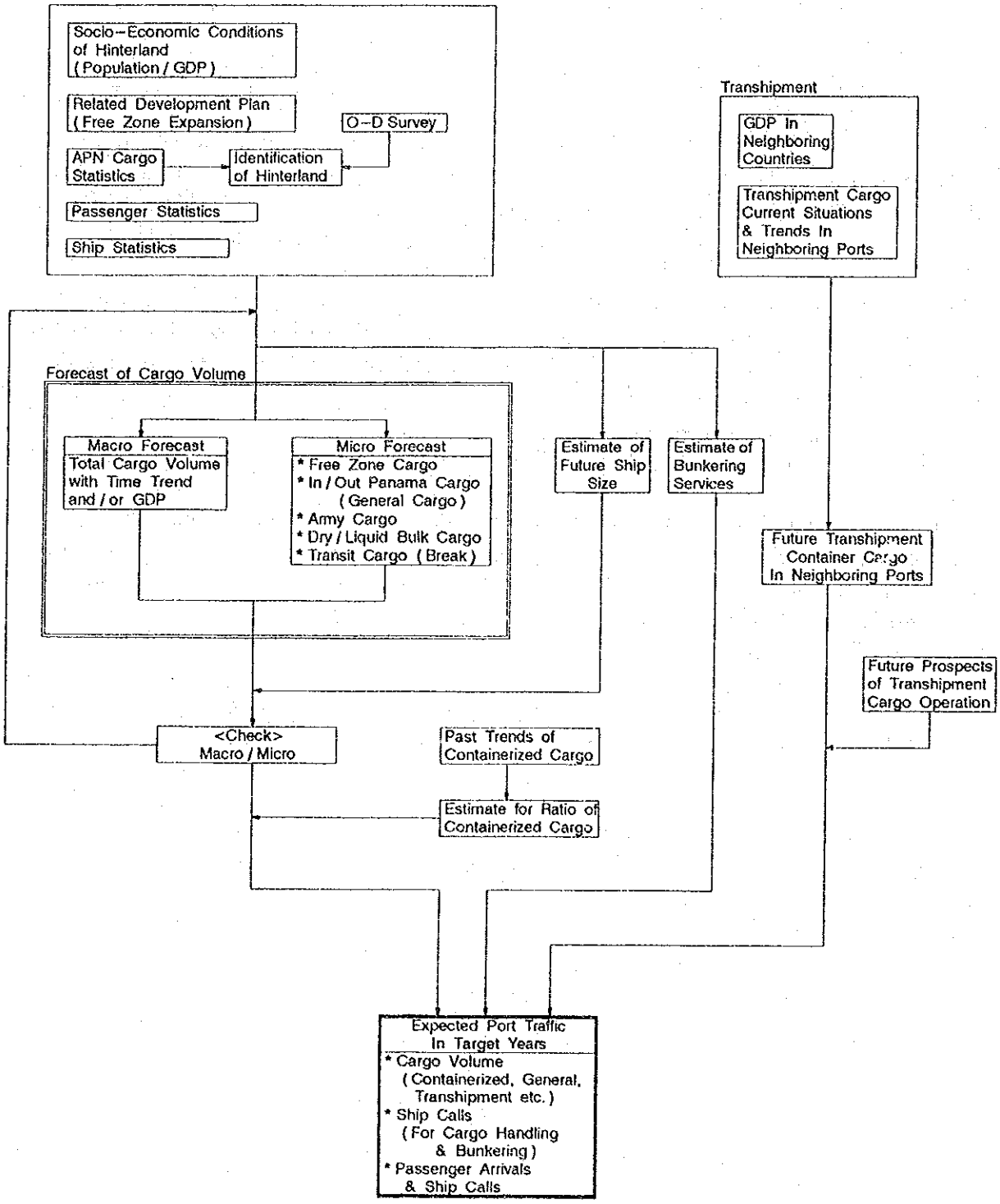

Figure 2-1-1 Flow for Port Traffic Forecast

2.2 Future Projection of Socio-economic Indices

2.2.1 Hinterlands of Ports of Cristobal

According to the information prepared by APN and the results of the Origin and Destination Survey conducted by the Study Team during the first visit (from October 13 to December 24, 1992), the city of Panama and the Colon Free Zone were identified as the major hinterland areas.

Imports and exports to/from Panamanian local areas are concentrated in the city of Panama and its vicinity. However, it is obvious that the cargo is distributed to virtually all areas of the country from the city of Panama because most overseas cargo handled in Panamanian ports is concentrated in the ports of Cristobal and the port of Balboa (58% of the total volume in 1991). Therefore, the whole country of Panama is considered as the hinterland of the ports of Cristobal.

The Colon Free Zone is also a vital international trade center which is regarded as one of the important hinterlands of the ports of Cristobal.

2.2.2 Projection of Socio-economic Indices

(1) Population

A census has been taken every ten years since 1911. According to the data, the population of Panama has been increasing steadily with average annual growth rates ranging from 2.4 to 2.9% since 1940 and an annual growth rate of 2.6% was recorded in the years between 1980 and 1990.

The Government of Panama has no projection for population on the long-term basis at present. In this Study, therefore, the future population is estimated to increase linearly from 1990 with the same inclination between 1980 and 1990.

Accordingly, the estimated population for the target years 2000 and 2010 is as follows.

Table 2-2-1 Projection of Population

Year	2000	2010
Population ('000 persons)	2,850	3,370
Average Annual Growth (%)	2.04 (1990-2000)	1.69 (2000-2010)

(2) Gross Domestic Products (GDP)

There are no authorized or published figures of the future GDP in Panama. Center of Economic Study of Panama's Chamber of Commerce (CEECAM) estimated GDP of 1992, which indicated that the GDP of 1992 will increase at a annual growth rate of approx. 8.9% of the previous year 1991 on the basis of 1970's constant prices. This rate is almost the same as the growth rate of 1991 (9.3%). After a negative increase was recorded in 1988 and 1989 through the U.S. imposed economic sanctions in 1988, GDP has been increasing since 1990.

Given that GDP has fluctuated in the last decade, it is uncertain that the growth rate of 1991 will continue into the future (up to 2010). Therefore, the Study Team estimates the future GDP by a linear regression using the actual records of the last four years. The estimated GDP is shown in Table 2-2-2.

Table 2-2-2 Estimation of GDP at 1970's Constant Prices

Year	2000	2010
GDP in million US$ (1970's Constant Prices)	2,730	3,560

According to the report conducted by LM/TAMS (LOPEZ MORENO Y ASOCIADOS S.A. and TIPPETTS-ABBETT-McCARTHY-STRATTON) in 1981, the estimated GDP of the year 2000 was approx. 3.07 billion US$ in 1970's constant prices which was converted from 1960's prices. The estimation by the Study Team is conservative in comparison to the LM/TAMS's estimate.

2.3 Demand Forecast of Port Traffic

2.3.1 Macro Forecast

As mentioned in the methodology, the forecast of the port traffic is carried out by correlation between the cargo volume and GDP and/or the past time trend.

(1) Time Trend Analysis

1) 10 Years Data (from 1982 to 1991)

The past records of the total cargo movement of the three ports from 1982 to 1991 are shown in Figure 2-3-1.

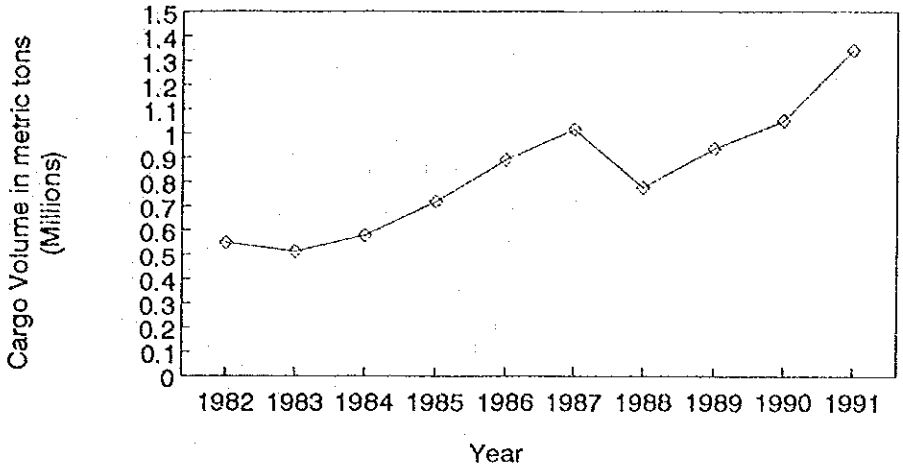

Figure 2-3-1 Cargo Movement of Ports of Cristobal
(1982 - 1991)

Correlation between the total cargo volume and years by a linear regression is shown below.

V = 78,895.9 * Y - 155,890,257 (r=0.91) ..... (MA-1)

where,

V: Total cargo volume (metric tons)
Y: Year
r: Correlation coefficient

2) 7 Years Data (excluding 1988, 1989 and 1990)

Among the 10 years data, the years 1988, 1989 and 1990 are regarded as abnormal by its time trend, thus data from these years are not included in the calculation. Using data of the remaining seven years, correlation between the total cargo volume and years by the same method as above 1) is shown below.

V = 99,100.7 * Y - 195,957,057 (r=0.98) ..... (MA-2)

(2) Correlation between Cargo Volume and GDP

Correlation between the total cargo volume and GDP of the country from 1982 to 1991 is shown in Figure 2-3-2.

As shown in Figure 2-3-1, the tendency of the cargo movement is considered to be different before and after 1988. Therefore, correlation between the total cargo volume

and GDP is calculated using the data of the last four years (1988-1991). The correlation can be obtained by a linear regression as follows.

$$V = 1{,}900.8 * G - 2{,}520{,}432 \quad (r=0.95) \ldots\ldots\ldots \text{(MA-3)}$$

where,

V: Total cargo volume (metric tons)
G: GDP (1970's constant prices, million US$)
r: Correlation coefficient

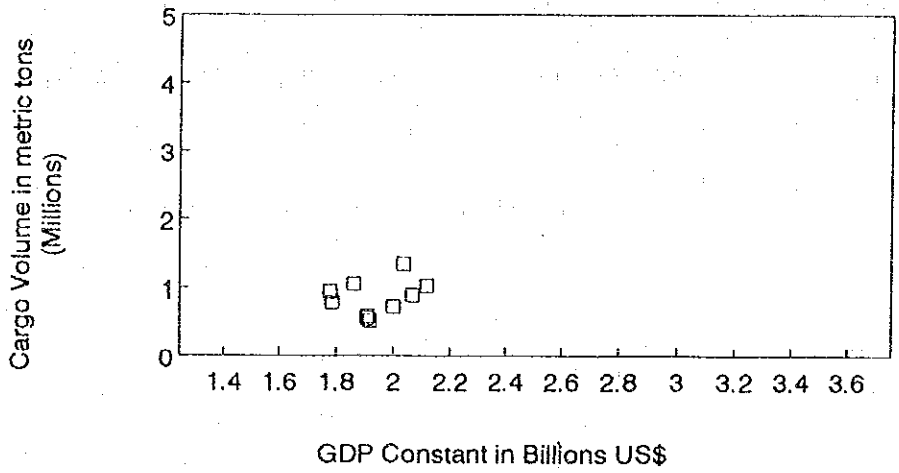

Figure 2-3-2 Correlation between Total Cargo Volume and GDP (1982 - 1991)

(3) Summary of Macro Forecast

According to the above calculations, the results of the macro forecast are summarized in the following Table.

Table 2-3-1 Summary of Macro Forecast
(unit: thousand metric tons)

Year	2000	2010
MA-1	1,902	2,690
MA-2	2,244	3,235
MA-3	2,681	4,257

* Excluding transhipment container cargo

2.3.2 Micro Forecast

Micro forecast is performed based on the origins and destinations of Panama, namely, the Free Zone, local and US Army, by import and export. As for the existing break bulk transit cargo, it consists mostly of vehicles after analyzing the cargo movement in 1991 and through interviews with APN. Therefore, it was determined that the volume of vehicles is forecast as break bulk transit cargo.

(1) Cargo through Free Zone

Cargo for the Free Zone cargo is imported through the ports and is re-exported to Central and South American countries. Therefore, the cargo to/from Free Zone is independent of social and economic conditions of Panama.

Accordingly, the forecast of the cargo to/from Free Zone is based on the productivity obtained from the past trade activities in the Free Zone.

1) Imports to Free Zone

Productivity of the Free Zone is identified as the cargo volume handled per unit area (hectare) in the calculation.

According to the past records of imported cargo to the Free Zone through the ports and the commercial area expansion history obtained from the Free Zone Administration, the productivity is about 3,000 to 4,000 metric tons per hectare. The former figure appeared after area expansion and continued a few years, and the latter appeared just a few years prior to the next area expansion. The past productivities are shown in Figure 2-3-3.

As of 1992, the gross area of the Free Zone is 110.3 hectares (56.3 hectares in Colon and 54.0 hectares in France Field). Additional expansions of 12.8 hectares of COFRISA in Colon, 61.5 hectares in France Field (west and south sides) are under construction. The total expanded area covers 74.3 hectares and will be completed by 1996 according to interviews with the Free Zone Administration.

After 1995, further expansion of 114 hectares in Coco Solito is under planning. However, a container yard of approx. 14 hectares exists in Coco Solito at present and an alternative area for this has not yet been decided. As for the remaining area of 100 hectares, the completion of land preparation for commercial use from 2000 is doubtful considering the present expansion work in france Field and the soil conditions (very soft). Therefore, it is assumed that the land preparation of 75% of the 100 hectares will be completed by 1999 and the area will be used from 2000. It is still unclear whether expansion areas in France Field (north-west and north) and the remaining area in Coco Solito will be ready for commercial use in 2010, so these areas are not considered for the cargo forecast in the Study.

Accordingly, a total area of 260 hectares will be used for calculation of the future cargo of the Free Zone (110.3+74.3+75.0=259.6) for both 2000 and 2010.

The results of forecast are shown in Table 2-3-2.

Table 2-3-2 Cargo Imported to Free Zone

Year	1991	2000	2010
Productivity (metric tons/ha.)	4,010	3,000	4,000
Area (ha.)	94	260	260
Cargo Imported (metric tons)	376,927	780,000	1,040,000

2) Re-exports from Free Zone

As for forecasting re-exported cargo volume from the Free Zone, the same method as with imports is applied.

According to the past records, the productivity for the re-exported cargo through the ports is about 1,600 to 2,300 metric tons per hectare and, as in 1), both figures correspond to before and after area was expanded. The past productivities are shown in Figure 2-3-3.

Table 2-3-3 shows the re-exported cargo volume from the Free Zone in the target years.

Table 2-3-3 Cargo Re-exported from Free Zone

Year	1991	2000	2010
Productivity (metric tons/ha.)	2,314	1,600	2,300
Area (ha.)	94	260	260
Cargo Re-exported (metric tons)	217,481	416,000	598,000

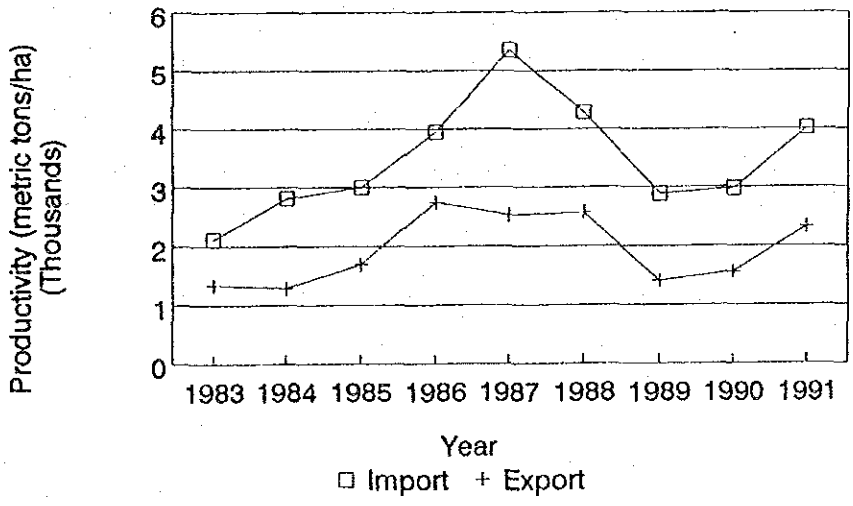

Figure 2-3-3 Past Productivity Records in Free Zone

(2) Cargo to/from Panama

The cargo to/from Panama is divided into the following two types.

i) general cargo (break bulk and containerized cargo)
ii) dry and liquid bulk cargo

The general cargo is forecast in this section. Dry and liquid bulk cargo are described in (5).

1) Imports

The cargo volume imported to Panama is estimated by a linear regression analysis based on figures of the last five years. Correlation between imported cargo volume and GDP is shown below.

$$V = 460.06 * G - 534,497 \quad (r=0.91)$$

where,

V: Total cargo volume (metric tons)
G: GDP (1970's constant prices, million US$)
r: Correlation coefficient

The estimates are shown in Table 2-3-4.

Table 2-3-4 Estimated Cargo Imported to Panama

(metric tons)

Year	1991	2000	2010
Cargo Imported	404,332	721,000	1,103,000

2) Exports

As for cargo exported from Panama, there is no relationship between the cargo volume and economic conditions because exported cargo is related to conditions of countries for export in general. The exported cargo volume has a time trend though it has fluctuated. Therefore, the cargo volume exported from Panama is forecast by a linear regression analysis with time. Correlation between the total exported cargo volume and time (year) is obtained as follows.

$$V = 7{,}163.2 * Y - 14{,}183{,}946 \quad (r=0.90)$$

where,

V: Total cargo volume (metric tons)
Y: Year
r: Correlation coefficient

The estimates are shown in Table 2-3-5.

Table 2-3-5 Estimated Cargo Exported from Panama

(metric tons)

Year	1991	2000	2010
Cargo Exported	79,412	142,000	214,000

(3) Cargo to/from U.S. Army

According to the information provided by APN, the U.S. Army quartered in Panama (mainly in the Canal Zone) will withdraw in stages until 2000 under the Canal Treaty of 1979. It was also learned from APN that the U.S. Army will still be quartered in Panama or some cargo from/to the Canal Zone will still be handled until 2010 on a minimal scale.

Therefore, the following assumptions are established for the cargo forecast.

a. Imported cargo will remain at the present level until 1995. After 1996, it will gradually decrease to 60% of the present volume towards the end of 2000, and remain unchanged until 2010.

b. Exported cargo will increase at growth rates of 10% until 1995 and 5% until 2000 due to the demand and withdrawal of the Army. After 2000, the cargo will decrease to 60% of the cargo of 1995 and continue until 2010.

According to the above assumptions, the cargo for U.S. Army is estimated as shown in Table 2-3-6.

Table 2-3-6 Estimated Cargo to/from U.S. Army

(metric tons)

Year	1991	1995	2000	2010
Imports	69,568	70,000	42,000	42,000
Exports	14,155	20,000	25,000	12,000

(4) Break Bulk Transit Cargo

According to the analysis regarding break bulk transit cargo, approx. 90% of the transit cargo were vehicles in 1991. Therefore, forecast of vehicles handled represents the forecast of break bulk transit cargo.

The past records of vehicles handled at the ports are shown in Figure 2-3-4. Transition of the vehicle handling indicates a time trend as shown in Figure. The future volume of vehicles handled is estimated by the following formula obtained by a linear regression.

Imports:

$$V = 3{,}873.6 * Y - 7{,}674{,}555 \quad (r=0.85)$$

Exports:

$$V = 2{,}287.9 * Y - 3{,}429{,}883 \quad (r=0.91)$$

where,

V: Volume of vehicles (metric tons)
Y: Year
r: Correlation coefficient

The results of estimation are shown in Table 2-3-7.

Table 2-3-7 Estimate of Vehicles Handled
(Break Bulk Transit)

(metric tons)

Year	1991	2000	2010
Imports	30,143	73,000	111,000
Exports	17,369	35,000	52,000
Total	47,512	108,000	163,000

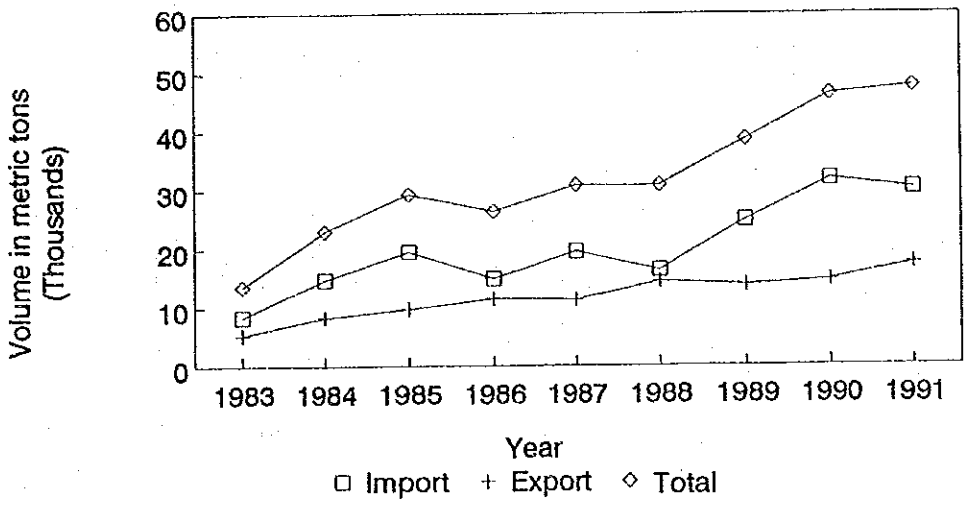

Figure 2-3-4 Past Records of Vehicles Handled

(5) Dry and Liquid Bulk Cargo

1) Imports (Dry Bulk only)

Major commodities of dry bulk cargo handled at the ports are charcoal and gypsum. However, their composition is not available. The dry bulk cargo is mainly for consumption by a cement factory and other industries. No relationship between cargo volume and GDP, construction sector in particular, can be observed these years. However, this kind of cargo is generally related to domestic industry. Therefore, the forecast of dry bulk cargo is carried out using the future trend of the projected GDP. The average annual growth rate is approx. 3.3% until 2000 and 2.7% from 2001 to 2010. The results are shown in Table 2-3-8.

2) Exports (Liquid Bulk only)

Major commodity of liquid bulk is alcoholic beverage. The forecast is carried out by the same method as dry bulk. The results are shown in Table 2-3-8.

Table 2-3-8 Estimate of Dry and Liquid Bulk Cargo

(metric tons)

Year	1991	2000	2010
Import (Dry Bulk)	89,721	120,000	157,000
Export (Liquid Bulk)	3,971	5,000	7,000

2.3.3 Forecast of Containerized Cargo

Among the above forecast cargo volume, containerizable cargo volume is summarized as shown in Table 2-3-9, excluding dry and liquid bulk cargo.

Table 2-3-9 Summary of Containerizable Cargo

(metric tons)

Year	1991	2000	2010
Import	850,827	1,543,000	2,185,000
Export	311,048	583,000	824,000
Total	1,161,875	2,126,000	3,009,000

(1) Laden Container

The ratio of the containerized cargo volume to the total containerizable cargo, excluding dry and liquid bulk, had increased, from approx. 71% to 82% for import and 68% to 73% for export these five years. After 1989 and 1990, however, the ratio began to decrease. This means that the ratio of containerized cargo at the ports of Cristobal has already recorded a maximum value. Therefore, these ratios for import and export will remain into the target years 2000 and 2010. In this Study, the maximum ratios of the last five years data are adopted, that is, 82% for import and 73% for export.

The average cargo volume per container is 7.3 and 6.6 metric tons per TEU for import and export respectively. These values will be adopted for calculating numbers of container handled provided that composition of commodities handled remains unchanged

in the future.

The results of estimates are summarized in Table 2-3-10.

Table 2-3-10 Estimate of Containerized Cargo

Year		1991	2000	2010
Import	Cargo Volume (metric tons)	701,899	1,265,000	1,792,000
	No. of Containers (TEUs)	103,268	173,000	245,000
Export	Cargo Volume (metric tons)	217,413	426,000	602,000
	No. of Containers (TEUs)	35,140	65,000	91,000

(2) Empty Container

Number of empty containers handled at the ports of Cristobal has been recorded on average around 6% of total imported and 66% of total exported containers. Since these ratios have fluctuated since 1982 and no clear tendency to increase or decrease has been observed after 1987, it is assumed that these ratios will remain in the future. The forecast results of empty container are shown in Table 2-3-11 below.

Table 2-3-11 Estimate of Empty Containers Handled

(TEUs)

Year	1991	2000	2010
Incoming	10,060	12,000	17,000
Outgoing	72,474	126,000	177,000
Total	82,534	138,000	194,000

(3) LCL Container

Number of LCL (less than container load) containers handled at the ports of Cristobal decreased from 1983 to 1988 (approximately from 13% to 4% of the total laden

containers), however, it has been stable in these four years at around 4%. This ratio will continue into the target years 2000 and 2010 and the estimate is as follows.

Table 2-3-12 Estimate of LCL Containers

Year	1991	2000	2010
No. of LCL Containers (TEUs)	5,124	9,500	13,400

(4) Refrigerated Container Cargo

As for refrigerated container cargo, the volume of refrigerated cargo has fluctuated and ranged from 2.8% to 5.1% of the total cargo volume handled at the ports of Cristobal since 1983 and it is considered to be around this range. Therefore, the average ratio of 4% obtained by using data from 1983 to 1991 is adopted for the estimate in this Study. The result is shown in Table 2-3-13.

Table 2-3-13 Estimate of Refrigerated Container Cargo

Year	1991	2000	2010
Ref. Cargo Volume (metric tons)	41,662	68,000	96,000
No. of Reefer Containers (TEUs)	5,800	9,500	13,400

2.4 Forecast of Transhipment Container Cargo

Transhipment container cargo handled at the ports of Cristobal is very limited at present even though the ports represent an important link in the container transportation system between the Far East and U.S. East Coast. Low efficiency of container cargo handling mainly causes this situation and makes shipping operators reluctant to use the ports as a mother port for transhipment feeder services to the Caribbean, Central and South American countries.

The ports of Cristobal have great potential to supply such feeder services and can play an important role in the Central American and Caribbean area in the future considering its location. Therefore, transhipment container cargo will increase to some extent provided that the current efficiency of container handling is improved to a competitive

level compared to the other ports such as Miami, Kingston, which handle transhipment containers in the Caribbean and Central America.

2.4.1 Method of Forecast

To forecast transhipment container cargo to be handled at the ports is very difficult. Needless to say, the method of forecast of transhipment cargo is different from that of the cargo mentioned in 2.3.

Therefore, the following premises are established;

a. transhipment container cargo handled at present remains unchanged basically until 2000 since substantial improvement in container handling efficiency cannot be expected until 2000 when first full scale container terminal will be completed,

b. additional transhipment container cargo is induced after 2000 due to some improvement of handling efficiency,

c. ports of Miami, Kingston and San Juan (Puerto Rico) are considered as other competitive transhipment centers,

d. transhipment container cargo in Caribbean, Central and some of South American countries is handled at the above three ports and the ports of Cristobal after year 2000.

First of all, total container cargo handled at ports in Caribbean, Central and South American countries (these areas are referred to as "the Area" hereinafter) and total GDP of the Area are calculated from the past records. (Colombia and Venezuela are selected from South American countries.)

Second, the total future GDP of the Area is projected by a simple linear regression analysis and the future container cargo is forecast from correlation between total container cargo and total GDP of the Area.

The total container cargo obtained above is regarded as cargo transhipped to the countries in the Area from the above four ports.

2.4.2 Total Transhipment Container Cargo in the Area

(1) Total Container Cargo in the Area

The total container cargo was calculated using the data from 1983 to 1990 from "Containerization Yearbook 1992".

The following thirteen ports were selected for calculating the total container cargo in the Area.

Belize City (Belize), Puerto Limon (Costa Rica)
Santo Tomas (Guatemala), Puerto Cortes (Honduras)
Freeport (Bahamas), Bridgetown (Barbados)
Port-au-Prince (Haiti), Port of Castries (St.Lucia)
Port of Spain (Tri.& Tobago), Cartagena (Colombia)
Buenaventura (Colombia)
Oranjestad and Willemstad (Netherlands Antilles)

For the three ports of La Guaira, Maracaibo and Puerto Cabello of Venezuela, since the last two years data (1989 and 1990) were not available, container cargo of those ports was excluded.

The total container cargo in the Area is shown in Table 2-4-1.

Table 2-4-1 Total Container Cargo in the Area

Year	Container Cargo (TEUs)
1983	541,262
1984	581,147
1985	553,201
1986	634,556
1987	652,978
1988	685,460
1989	777,037
1990	809,064

Source: Containerization Yearbook 1992

(2) Total GDP of the Area

The total GDP of the above countries was calculated using the data from "World Table 1992, the World Bank" as shown in Table 2-4-2.

Table 2-4-2 Total GDP of the Area
(1987's constant prices)

Year	GDP (million US$)
1983	98,254
1984	100,058
1985	102,224
1986	107,654
1987	111,689
1988	116,590
1989	114,232
1990	118,815

Source: World Tables 1992,
The World Bank

Using a linear regression analysis, the projected total GDP of the Area is described as the following formula.

$$G = 3{,}118.2 * Y - 6{,}085{,}708 \quad (r=0.97)$$

where,

G: GDP at 1987's constant prices (million US$)
Y: Year
r: Correlation coefficient

The GDP for the target years is shown in Table 2-4-3.

Table 2-4-3 Total Projected GDP of the Area
(1987's constant prices)

Year	2000	2010
Total GDP (million US$)	150,786	181,968

(3) Total Container Cargo for Target Years

Correlation between total container cargo and total GDP of the Area is shown below.

$$V = 11.54 * G - 600,352 \quad (r=0.91)$$

where,

V: Total container cargo of the Area (TEUs)
G: Total GDP of the Area (million US$)
r: Correlation coefficient

According to the above formula, the projected container cargo was calculated as shown in Table 2-4-4.

Table 2-4-4 Projected Container Cargo of the Area

Year	2000	2010
Total Container Cargo (TEUs)	1,140,000	1,500,000

2.4.3 Transhipment Container Cargo at Ports of Cristobal

According to the past records, transhipment container cargo handled at the ports of Cristobal corresponds approx. from 0.5% to 1.2% (average 0.7%) of the total container cargo of the Area.

It is assumed that transhipment container cargo is handled at the current rate of 0.7% of the total container cargo of the Area until 2000.

The port of Colombo has been very popular as a transhipment center recently and its transhipment container cargo has increased at an annual average growth rate of more than 16% in the last five years (1987 to 1991). After 2000, transhipment container cargo handled at the ports of Cristobal will be expected to increase at the same annual growth rate or more due to the port improvement and its increased competitiveness in the Area. Thus, an annual average growth rate of 20% is applied to the calculation between 2000 and 2010 in this Study.

Under the above assumption, the possible transhipment container cargo at the ports for the target years is estimated in the following Table 2-4-5.

Table 2-4-5 Estimate of Transhipment Container Cargo

Year	2000	2010
Transhipment Container Cargo (TEUs)	8,000	50,000
Throughput (TEUS)	16,000	100,000
Estimated Cargo Volume (*) (metric tons)	144,000	900,000

(*) Calculated with an average volume of 9 metric tons per TEU according to the past records.

Accordingly, the total container cargo handled at the ports of Cristobal becomes 392,000 TEUs in 2000 and 630,000 TEUs in 2010. The above throughput of transhipment container cargo represents 4.1% and 15.9% of the total container cargo on the basis of TEU in 2000 and 2010 respectively. In the world container transport system, ports of Singapore, Colombo (Sri Lanka), Hong Kong and Dubai (UAE) are well-known as transhipment ports and the ratios of transhipment containers to total containers handled were approx. 60 to 70% (not publicized) at Singapore, 70% at Colombo, 22% at Hong Kong and 39% at Dubai in 1991.

2.5 Summary of Cargo Forecast

The results of the forecast of port traffic performed above are summarized in Table 2-5-1 and 2-5-2.

Table 2-5-1 Summary of Cargo Forecast

(Metric Tons)

	1991(Actual)	2000	2010
IMPORT			
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 (1)	940,548	1,663,000	2,342,000
	100	177	249
EXPORT			
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 (2)	315,019	588,000	831,000
	100	187	264
TRANSHIPMENT (Break Bulk)			
Sub-Total (3)	47,512	108,000	163,000
	100	227	343
Total (1)+(2)+(3)	1,303,079	2,359,000	3,336,000
	100	181	256
TRANSHIPMENT (Containerized)			
Sub-Total (4)	37,618	144,000	900,000
	100	383	2,392
TROUGHPUT	1,340,697	2,503,000	4,236,000
((1)+(2)+(3)+(4))	100	187	316

Table 2-5-2 Details of Container Cargo Forecast

	1991(Actual)	2000	2010
IMPORT			
Laden in metric tons	701,899	1,265,000	1,792,000
in TEUs	100,605	173,000	245,000
Empty in TEUs	10,060	12,000	17,000
Sub-Total (1) in TEUs	110,665	185,000	262,000
	100	167	237
EXPORT			
Laden in metric tons	217,413	426,000	602,000
in TEUs	33,584	65,000	91,000
Empty in TEUs	72,474	126,000	177,000
Sub-Total (2) in TEUs	106,058	191,000	268,000
	100	180	253
TRANSHIPMENT			
in metric tons	37,618	144,000	900,000
in TEUs	4,219	16,000	100,000
{Sub-Total (3)}	100	379	2,370
THROUGHPUT in metric tons	956,930	1,835,000	3,294,000
{(1)+(2)+(3)} in TEUs	220,942	392,000	630,000
	100	177	285

	1991(Actual)	2000	2010
LCL Container in TEUs	5,124	9,500	13,400
	100	185	262

	1991(Actual)	2000	2010
Refrigerated in metric tons	41,662	68,000	96,000
Cargo in TEUs	5,819	9,500	13,400
	100	163	230

2.6 Forecast of Ship Size and Number of Ship Calls

2.6.1 Current Trends of Ship Transits at the Panama Canal

According to the annual reports by the Panama Canal Commission (PCC), the number of transits of oceangoing vessels increased until 1982 (from approx. 13,000 to 14,000 transits) and decreased in 1983 and 1984 (11,384 transits in 1984). However, the number has been slightly increasing since 1985.

On the other hand, average loaded cargo of the oceangoing vessels per transit has slightly increased ranging from approx. 12,000 to 13,000 long tons although it has fluctuated. This means that the oceangoing vessels transiting the Canal are large-sized. The average annual growth rate of loaded cargo from 1979 to 1991 was 0.65%.

According to an investigation of full container ships around the world by a Japanese ship operator, loaded TEUs per container ship largely increased until 1973. After that, it remained almost constant until 1982, increased again from 1984 to 1990 and it can be considered that it is still increasing to some extent at present.

Among international shipping routes for containers, the volume of container cargo between Far East - North America and Far East - Central/South America is very large in particular. A large growth of container cargo volume has been recorded recently on the latter route.

Taking the above facts into account, oceangoing vessels (container ships) that transit the Canal and call at the port of Cristobal will be enlarged slightly and it is also expected that capacity of transporting container cargo will increase in the future with the large ship size.

2.6.2 Current Ship Size at the Ports

According to the past records from 1983 to 1991 regarding size of ships calling at the ports of Cristobal, Bahia Las Minas and Coco Solo Norte, the average ship size by ship type is shown below.

	Average G.T.	Average Cargo Handled
Cristobal:		
Container ship	14,000	160 TEUs
Ro/Ro ship	13,000	180 TEUs
Mix type ship	10,000	700 m.t.
Bulk carrier - solid	14,000	10,000 m.t.
liquid	14,000	3,500 m.t.

Bahia Las Minas:		
Ro/Ro ship	9,000	170 TEUs
Mix type ship	6,000	1,500 m.t.
Bulk carrier - solid	14,000	10,000 m.t.
Coco Solo Norte:		
Container ship	19,000	300 TEUs
Mix type ship	150-200	

Note:
1. Mix type ship handles both break bulk and container cargo.
2. "G.T." means gross tonnage.
3. "m.t." means metric tons.
4. Figures for container handling represent laden container only.

2.6.3 Future Ship Size

According to the recent trends in the size of ships calling at the ports and transiting the Canal as mentioned above, the following is found;

a. size of container ships tends to be enlarged,
b. size of Ro/Ro, mix type, solid and liquid bulk carriers remains unchanged.

The sizes of ship for Ro/Ro, mix type, solid and liquid bulk carrier are adopted from the above average ship sizes. As for container ship, the recent trend in size of world full container ships is applied. According to the trend, the future size at the ports of Cristobal will be approx. 15,300 G.T. in 2000 and approx. 16,000 G.T. in 2010. Therefore, average ship size by ship type is determined as follows.

Container ship:	16,000 G.T. in 2000
	17,000 G.T. in 2010
Ro/Ro ship:	11,000 G.T.
Mix type ship:	10,000 G.T.
Solid bulk carrier:	15,000 G.T.
Liqd. bulk carrier:	14,000 G.T.

2.6.4 Estimate of Number of Ship Calls at the Ports

According to interviews with major shipping agents, container handling of approx. 400 to 700 TEUs per ship is recorded at present. The present maximum number of 700 TEUs is applied to year 2000 and the number will increase to 900 TEUs with enlarged ship size and increased competitiveness of the port in 2010. As for mix type ship, cargo of 1,200 to 1,500 metric tons per ship has been handled actually at the port of Bahia Las Minas and thus, volume of 1,200 metric tons is handled per ship in 2000 and 1,500 metric tons (maximum figure of the past records) in 2010. Bulk carriers handle cargo

at the same level in the future.

Therefore, the following handling volume per ship is applied to the calculation. It is assumed that container cargo is handled by only container and Ro/Ro ships for calculation.

		2000	2010
Container ship & Ro/Ro ship (TEUs)		700	900
Mix type ship (break bulk, m.tons)		1,200	1,500
Bulk carrier (m. tons)	Solid	10,000	10,000
	Liqui	3,500	3,500

Using the above figures, estimated number of ship calls by ship type for the target years is summarized in Table 2-6-1.

Table 2-6-1 Estimated Number of Ship Calls

In 2000;

Ship Type	Cargo Volume	Ship Calls
Container & Ro/Ro Ship	392,000 TEUs	560
Mix Type Ship	543,000 m.t.	453
Solid Bulk Carrier	120,000 m.t.	12
Liqd. Bulk	5,000 m.t.	2
TOTAL		1,027

In 2010;

Ship Type	Cargo Volume	Ship Calls
Container & Ro/Ro Ship	630,000 TEUs	700
Mix Type Ship	778,000 m.t.	519
Solid Bulk Carrier	157,000 m.t.	16
Liqd. Bulk	7,000 m.t.	2
TOTAL		1,237

2.7 Forecast of Passenger Traffic

2.7.1 Current Situation

According to the information from IPAT (Instituto Panameno de Turismo), which was obtained by the field survey conducted by the Study Team, 21,488 passengers entered the port of Cristobal by ship in 1991. Data as of September 1992 showed that the number of passengers by ship in 1992 would reach the same level as in 1991. However, a remarkable decrease has been recorded since 1985. The major reason why the number of passengers to the port decreased in these years was the unsafe social situation in the city of Colon. Very poor security continues to be a problem. Shipping agents which serve passenger ships in Panama (or through the Canal) have no intention for their ships to berth at the port of Cristobal at the moment. There is no sign that security is being improved in the city of Colon. Therefore, the number of passengers arriving at the port will not increase in the future unless security in the city is improved significantly.

2.7.2 Forecast of Passenger Arrivals

(1) For Year 2000

As aforementioned, around 20,000 passengers arrived at the port of Cristobal in 1991, but only few passengers (no precise figure is available) actually disembarked because of poor facilities, insufficient security measures and lack of attractions around the port.

It is considered that shipping agents do not intend to increase passenger ship calls instantly at the port of Cristobal even though the above situations will be improved to some extent. While no practical settlement of the above situations has been reached so far, APN, IPAT and the Panama Railroad would like to promote tourism in Panama using port facilities. Therefore, assuming that minimal passenger ships will call until 2000, the current number of passengers, that is 20,000 persons, will disembark and stay in Panama. According to IPAT's estimate for possible passenger arrivals, approx. 55,000 persons will arrive at Panamanian ports with 134 passenger ships annually. Number of passenger ship calls will be obtained proportionally based on the above estimate. Then, expected number of passenger ship calls in 2000 is 49.

(2) For Year 2010

Subsequent to year 2000, it is assumed that the number of passengers will increase due to some substantial improvements of the port facilities and social conditions around the port.

The IPAT's information indicates that a total of 44 passenger ships are in service currently by the eight Panamanian agents and the total service frequencies of those ships are 134 per year. According to the IPAT's estimate, mentioned above (1), around 55,000

passengers could be on board and visit the port and the city annually. On the other hand, from the past records from 1982 to 1991 from IPAT, a maximum number of 75,087 passengers was recorded in 1985.

Therefore, the maximum number of the past records is adopted for the target year 2010 in this Study, that is, 75,000 passengers will be expected to arrive at the port of Cristobal.

According to the Past records regarding the monthly distribution of the passengers, the maximum number was recorded during the dry season, from December to April (heaviest concentration is in January). The maximum number was around 15% of the annual total passengers. Therefore, a maximum of 11,250 (0.15*75,000) passengers per month will arrive at the port during dry season.

(3) Summary

The forecast result is summarized in the following table.

Table 2-7-1 Summary of Passenger Arrivals

Year	2000	2010
Annual Passenger Arrivals (persons)	20,000	75,000
Monthly Maximum (persons)	3,000	11,250
No. of Passenger Ship Calls	49	183

* Monthly maximum number of passengers in 2000 is calculated by the same method as in 2010.

2.8 Demand for Bunkering Services

2.8.1 Current Situation

(1) General

The port of Cristobal has the advantage of supplying fuel and water to ships transiting the Panama Canal according to its geographic location. However, ship operators tend to decline such services due to lack of facilities, mainly at Pier No.16, and high fuel supply price.

According to the report by UNCTAD and IMO, the current service has fallen to much lower level than in the 1970's. The report also showed that the primary disadvantage of the port was high cost (both fuel price and wharfage), followed by the lack of facilities, inadequate service availability, and so on.

Current bunkering service is done by the APSA (Atlantic-Pacific, S.A.), which has a fuel oil terminal behind Pier No.16 (behind Telfers Island). Besides this service, two private companies and a Texaco Refinery supply bunkering services by using bunker barges to ships at anchorage areas. APSA also supplies fuel oil to these two private companies. Fuel oil to APSA is supplied from Texaco Refinery and directly imported.

(2) Current Services to Ships

The bunkering service at port of Cristobal in 1991 is summarized as follows.

By purpose of berthing:	
Cargo handling	51.0 %
Only bunkering	33.8 %
Bunkering and cargo handling	15.2 %
By service type:	
Fuel supply	47.1 %
Fuel and water supply	22.3 %
Water supply	28.0 %
Others (inspection, etc.)	2.6 %
By ship type:	
Mix type ship	32.7 %
Container ship	10.4 %
Ro/Ro ship	9.6 %
Tanker	7.1 %
Refrig. ship	6.0 %
Tuna ship	4.8 %
Others	29.4 %

By pier used:

Pier No. 6	11.9 % (3.0)
No. 7	13.5 % (2.1)
No. 8	10.4 % (9.6)
No. 9	4.8 % (0.3)
No.10	4.4 % (0)
No.16	55.0 % (85.0)

( ) indicates percent share of ships only for bunkering.

As for origins and destination of ships, 75% of ships transit the Canal and 25% of ships do not. 74% of ships transiting the Canal pass the Canal from Atlantic side to Pacific.

2.8.2 Demand for Bunkering

According to the statistics of PCC and APN from 1984 to 1991, ratio of number of ships for bunkering at the port of Cristobal to the total Canal transits of oceangoing ships has decreased from 9.1% to 5.6% as shown in Figure 2-8-1. As mentioned above, demand for bunkering depends upon increased competitiveness such as price and service quality. In this Study, the ratio will recover to the past higher level of 9% provided that service levels will be improved until 2010.

As for number of Canal transits, it is assumed that the maximum figure of the PCC statistics from 1979, that is, 14,000 transits, is adopted for calculation. Further, the same condition that 25% of ships for bunkering do not transit the Canal remains unchanged in the future.

(1) For Year 2000

The ratio of number of ships for bunkering to the total Canal transits has been almost constant since 1988 at about 6%. Therefore, it is assumed that this situation will remain until 1995. The average number of ships for bunkering of the last four years is 720. Among those, 540 ships (75%) pass through the Canal. Subsequently, 720 ships berth for bunkering until 1995 and after that, the number increases at the same annual growth rate to the number (1,260 ships) in 2010 as estimated in the following section (2).

Average annual growth rate: 5.8 %
(540 to 1,260 in fifteen years)

$540 * (1.058)^5 = 716$ (only ships transiting the Canal)

$716 / 0.75 = 955$ (total ships for bunkering)

(2) For Year 2010

As aforementioned, the number of ships for bunkering among ships transiting the Canal will be 9% of the assumed Canal transits of 14,000.

14,000 * 0.09 = 1,260 (only ships transiting the Canal)

1,260 / 0.75 = 1,680 (total ships for bunkering)

(3) Summary

The estimate is shown in Table 2-8-1.

Table 2-8-1 Summary of Demand for Bunkering

Year	1991	2000	2010
Ships with Canal Transit	424	716	1,260
Ships without Canal Transit	141	239	420
Total	565 (390)	955 (663)	1,680 (1,166)

( ) indicates the number for only bunkering, not for simultaneous cargo handling.

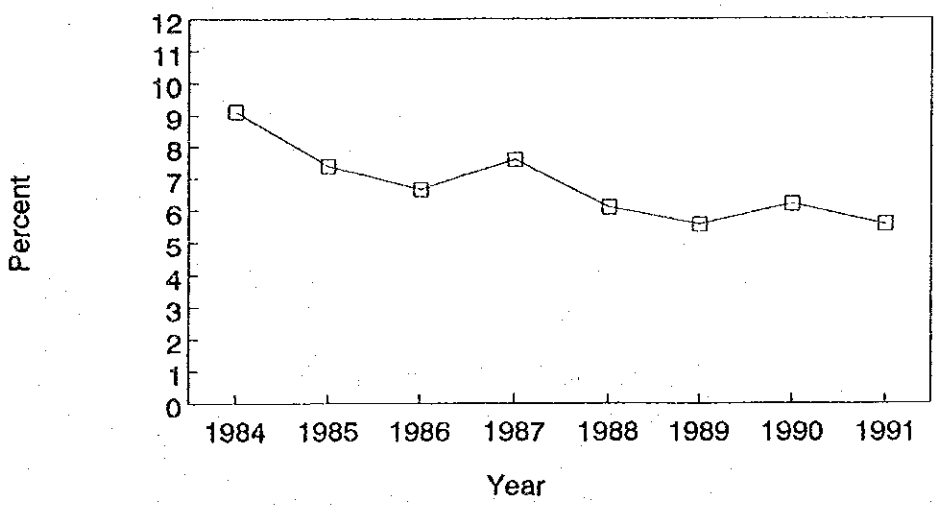

Figure 2-8-1 Ratio of Number of Ships to Total Canal Transit

CHAPTER 3 FUNCTIONAL ALLOTMENT OF PORT ACTIVITY

Basic concept of deployment and utilization of port facilities is described in this chapter.

3.1 Selection and Estimation of Developing Site

3.1.1 Basic Concept for Development of Limon Bay

Both sides of Limon Bay are separated from each other by the Panama Canal. There is restricted access to the west side coastal zone. The natural condition on the west coast is well preserved, different from that on the east side which has been developed for a long period. There is no significant environmental object to be preserved. Traffic infrastructure is also well equipped on the east coast. On the basis of above situation, development shall be concentrated or integrated on the east side of Limon Bay.

3.1.2 Alternative Areas for the Port Development on the East Coast.

The coast line of the east coast is divided into eight parts from A to H as shown in Figure 3-1-1 according to natural and social conditions. The viability of each area as a construction site for the new port is evaluated. The characteristics of each area are as follows:

A to C : These areas are located in the Cristobal Basin which is efficiently protected by a mole from the dominating north wind in winter. These areas are also in close proximity to the existing port facilities and have good access to the transport facilities. These areas are favorable for new port construction.

D : This area is located in the back side of existing finger piers. The new facilities if built under the project can keep close relation with the existing container terminal. A high return on the investment will be expected.

E : This area is on the coast line of the north side of Colon City. The city area is very close to the coast line and there is no room for new port development. It has another disadvantage in that the water depth around this area is shallow. It will require a large amount of investment for dredging works.

F : This area is named Folks River Area which has shallow water and inflow from some rivers. This area is not suitable for the port development.

G : This is the Coco-Solo Area which includes existing Coco-Solo Norte Port. This area has three advantages. Firstly, this area is close to the France Field of the Colon Free Zone. Secondly, there is open space which was formerly a terminal for hydro-airplanes during World War II. Thirdly, in this area, the new port facilities can be constructed close to existing port facilities in the port of Coco-solo Norte and the investment can be more effective and productive.

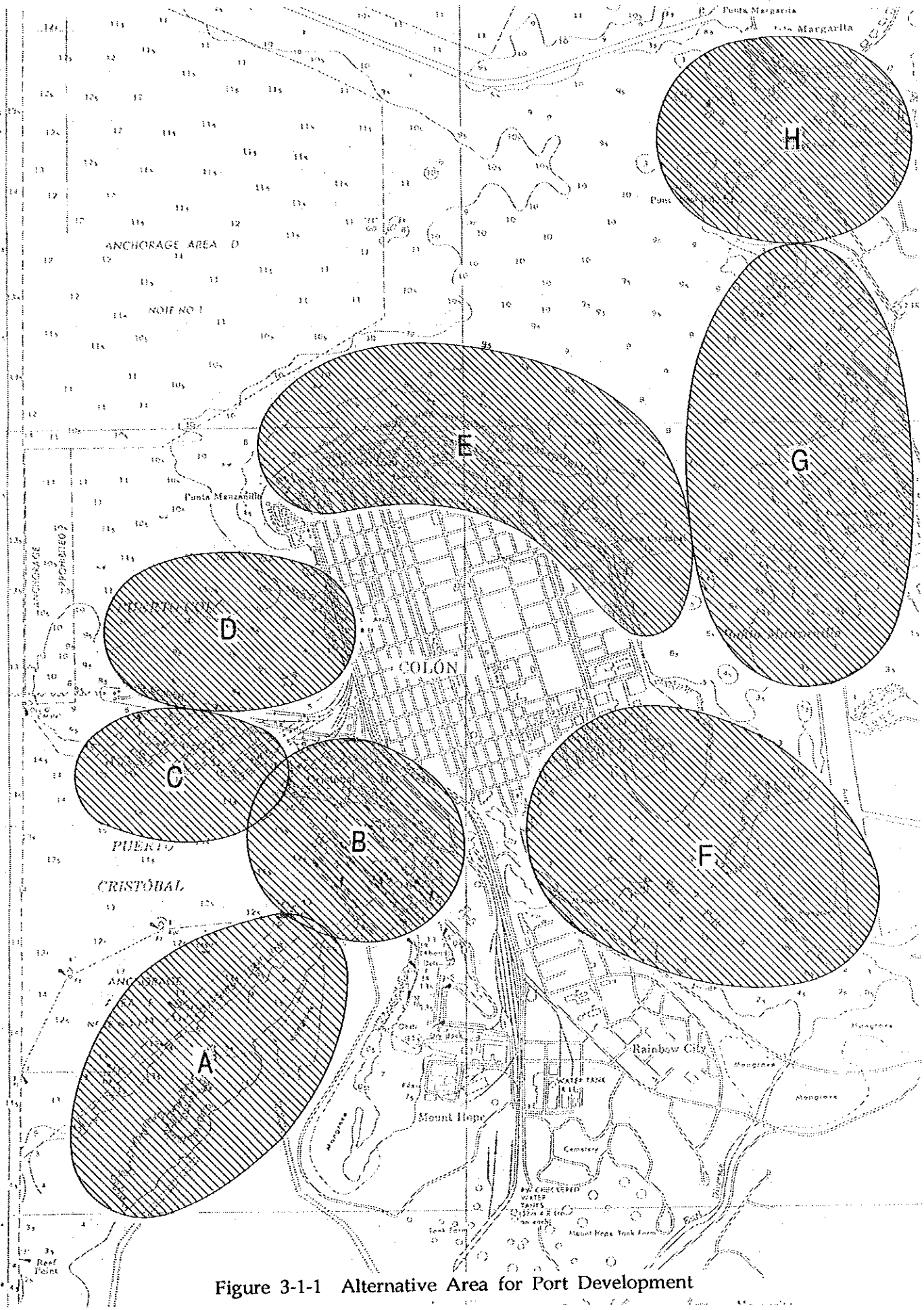

Figure 3-1-1 Alternative Area for Port Development

H : This area is located within the east breakwater. It has good natural conditions with deep water and calm wave condition. However, it is located far from the existing port of Cristobal and the Colon Free Zone. There is not sufficient space on the land side. It has a disadvantage in that investment cannot be integrated because of the distance from the existing port facilities.

Accordingly, Areas E,F,G are eliminated as candidate areas for new port construction.

3.2 Evaluation and Selection of Alternatives for the Placement of Container Terminals.

In this section, alternatives of the placement for container terminals are formulated at Telfers Island, French Canal Area, West Colon Area and Coco Solo. Those alternatives are evaluated and compared in order to select the best alternative. The preconditions of the evaluation are as follows:

* Port function shall be concentrated as much as possible for efficient investment.
* In the course of implementation, existing port function shall be interrupted as little as possible.
* Newly constructed terminals in each time stage are assumed as one berth in the short term plan and two berths in the long term plan. Two more berths will be constructed in the post master plan stage.

3.2.1 Telfers Island Area (Site-T)

New container terminals will be constructed in Telfers Island consecutively.(Figure 3-2-1)

This alternative has many advantages as follows:

* Easy to access from the navigation channel of the Panama Canal
* Protected by the mole from wind and wave
* The water depth of the area in front of the site is maintained around -12 m as an anchorage area for the Panama Canal.
* Geo-technical condition of this site is affirmative because supporting layer is rather shallow and convenient to build gravity type structure.
* Future expansion is possible, up to five consecutive terminals, because Telfers Island has a large virgin area presently under administration of PCC.
* Implementation of the development will not affect the activity of existing port facilities.

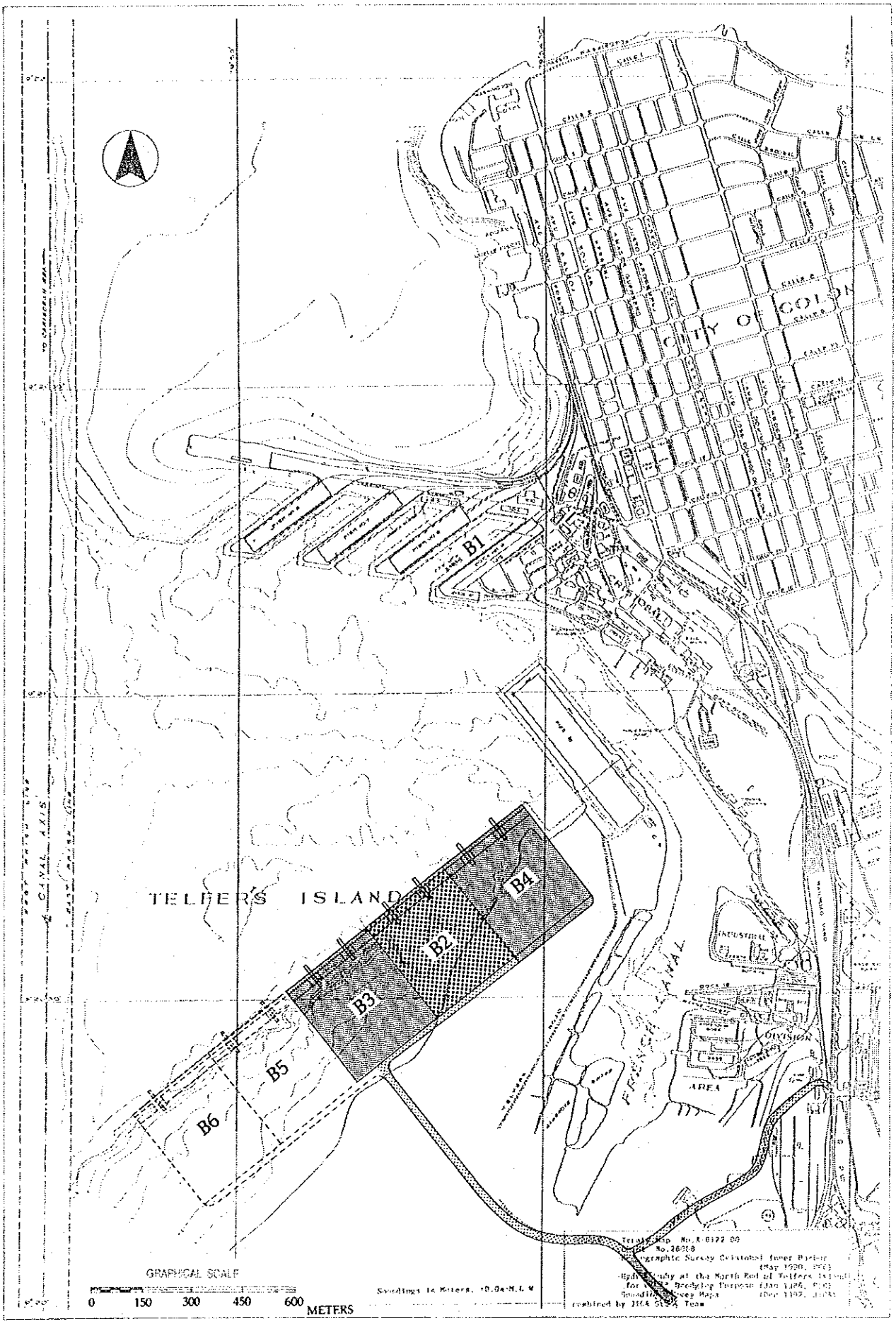

Figure 3-2-1 Alternative Site-T

* Accessibility to the hinterland is fairly good.

On the other hand there are some demerits in this alternative.

* Cristobal Basin in front of the site is rather narrow and turning area can barely be secured.

* The anchorage area "F" just in front of the site must be removed.

* Separated from the existing container terminal, the functional relationship is rather week.

* Since Telfers Island is now under the administration of PCC, the time at which this Site could be available is not certain at this moment.

3.2.2 French Canal Area (Site-F)

French Canal Area will be excavated or reclaimed in order to construct new berths. Since new terminal will be constructed next to the existing terminal, both terminal can be operated efficiently in this alternative.

There are a variety of possible terminal placements in this alternative. The most important issue is the future prospect of the ship and machine repair facilities located in the Mount Hope Area, known as "Industrial Division of PCC". These facilities will be reverted to the government of Panama by the year 2000 according to the Panama Canal Treaties. Even after the reversion, these facilities may be fully utilized for the maintenance and repair of the Panama Canal's facilities and other ship repair works on a commercial basis.

Since the repair facilities will not be reverted until the year 2000, construction of new container terminals at the French Canal Area will begin after the year 2000.

(1) Alternative in case that repair facilities will be removed in the future

French Canal Area will be totally reclaimed. Existing terminal and Telfers Island are combined directly (Figure 3-2-2). All berths can be organized efficiently and high efficiency of berth utilization will be expected. This alternative can be the most rational plan among all alternatives of berth and terminal placement from the operational point of view. This alternative needs large amount of fill for reclamation. If dredging spoil can be used for the reclamation, construction cost can be reduced to a certain extent.

The area for the removal of the repair facilities must be secured. The inside area of the east side breakwater can be the area for the removing. The cost for the removing cannot be estimated at this moment.

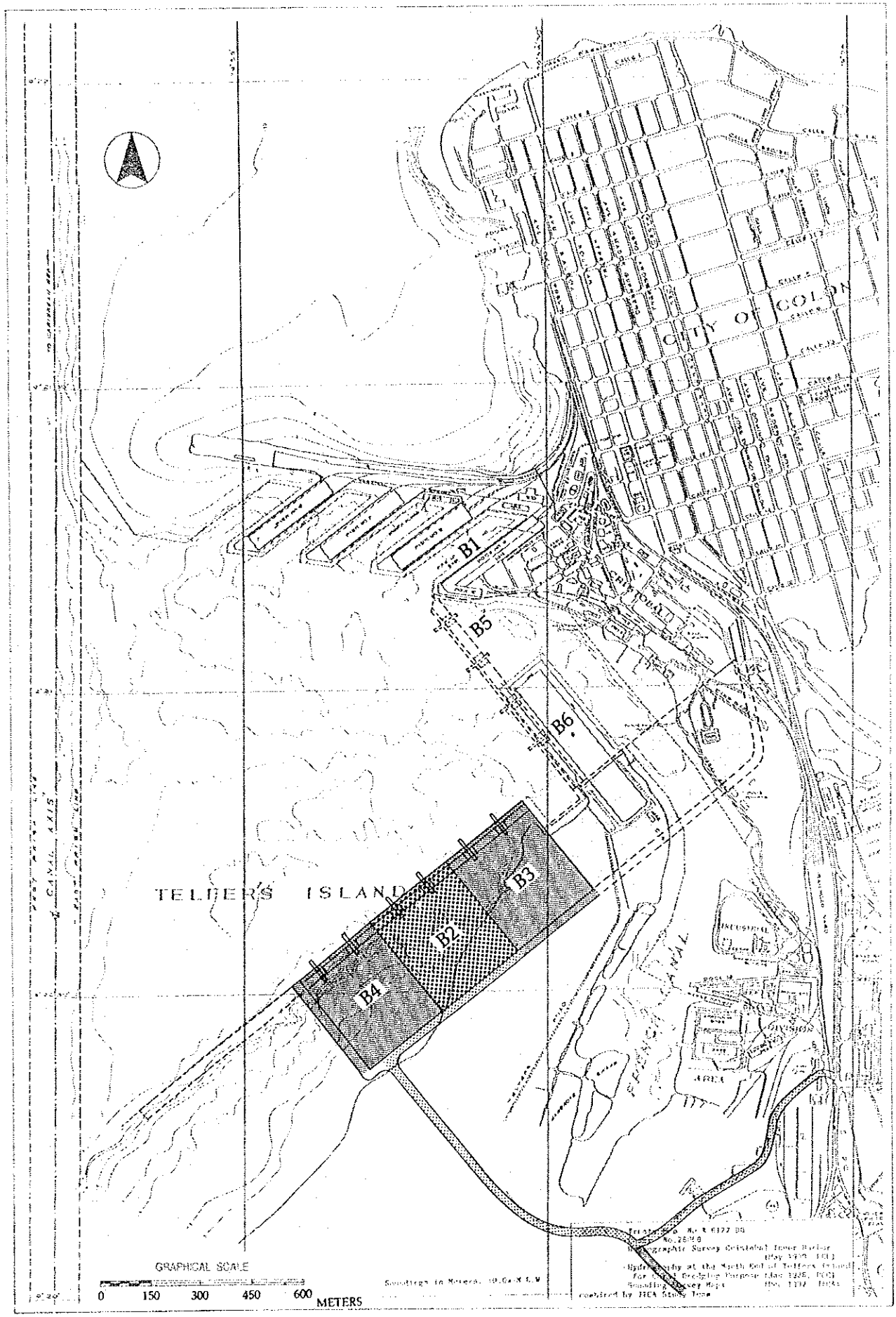

Figure 3-2-2 Alternative Site-F(a)

It seems probable that terminals will be placed on Telfers Island until the long term master plan phase and French Canal Area will be developed in the post master plan phase.

In place of bunkering facilities on Pier No.16, a new detached pier for bunkering service will be constructed next to new container terminals in Telfers Island.

(2) Alternative in case that repair facilities will not be removed in the future.

In order to secure the navigational access to the repair facilities, Pier No.16 will be partially removed or some part of Telfers Island will be excavated. Three alternative plans are considered according to the scale of the excavation.

1) Alternative F(b)

The existing container terminal will be partly expanded toward French Canal through reclamation. One new container berth will be constructed on the face line in the French Canal. In order to secure sufficient water area in front of the new berth, some part of Pier No.16 will be removed. This alternative is somewhat irregular in that space for those container terminals is limited compared to other alternatives (Figure 3-2-3).

2) Alternative F(c)

The two new container berths will be constructed along the east side face line of Pier No.16. In order to secure the access channel to the repair facilities, the south side of Pier No.16 will be excavated. In this alternative, a wide container yard can be constructed next to the existing one (Figure 3-2-4).

3) Alternative F(d)

A wide open water area will be created in front of the repair facilities by demolishing Pier No.16 and a large amount of excavation on Telfers Island. Three consecutive new berths will be constructed by expanding the shoreline on the south side of existing container yard (Figure 3-2-5). Total amount of dredging and reclamation will be large, however, the construction cost can be largely reduced by keeping good balance between excavation and reclamation.

There are many variations of this scenario according to the order of construction of these berths. Two berths on the Telfers side can be allocated either along the excavated face line or along the existing shore line. In this alternative, the remaining water area of the French canal can be utilized as a berthing place for small ships. The repair facilities can affirm their full potential due to the good condition of navigational accessibility.

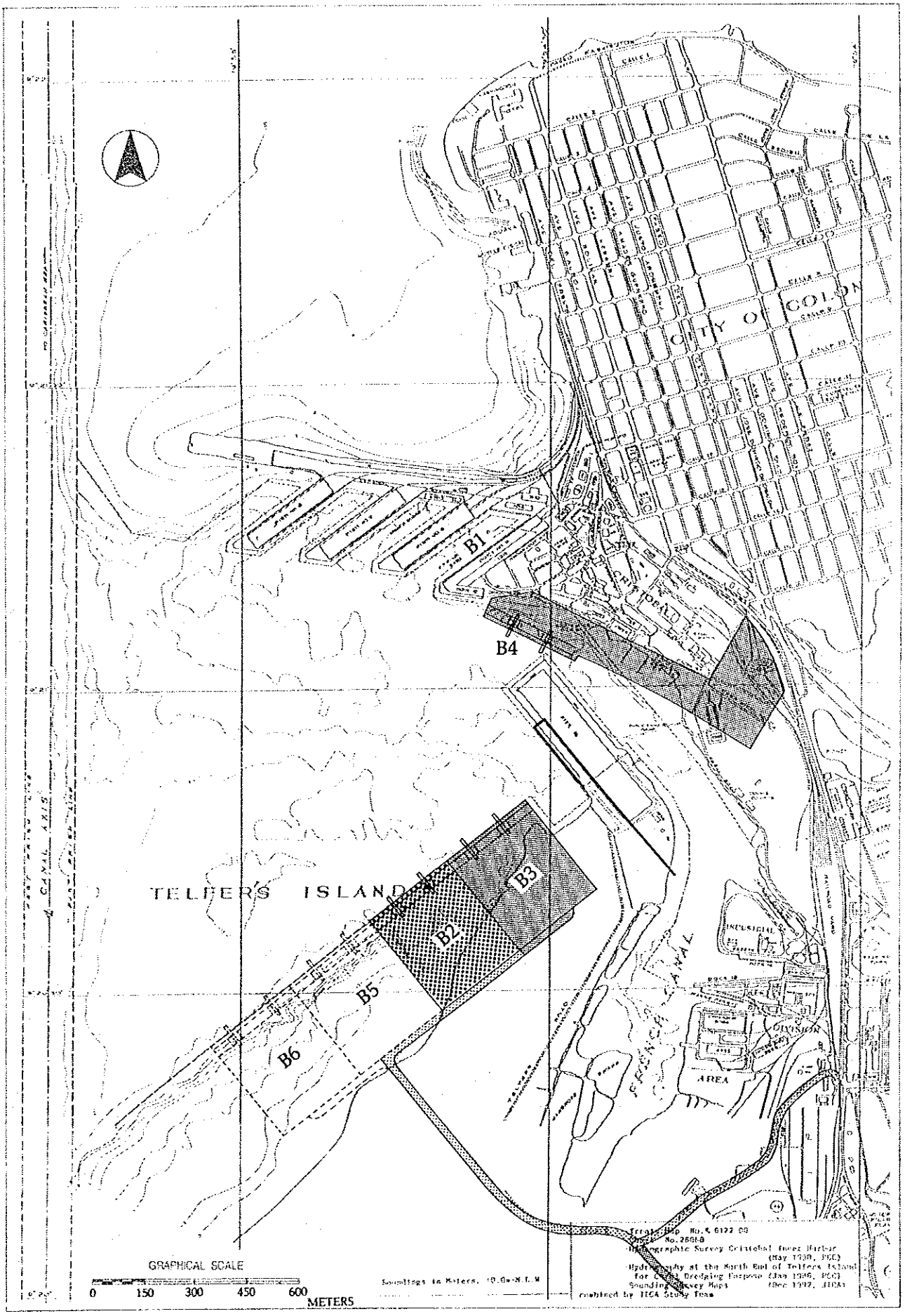

Figure 3-2-3 Alternative Site-F(b)

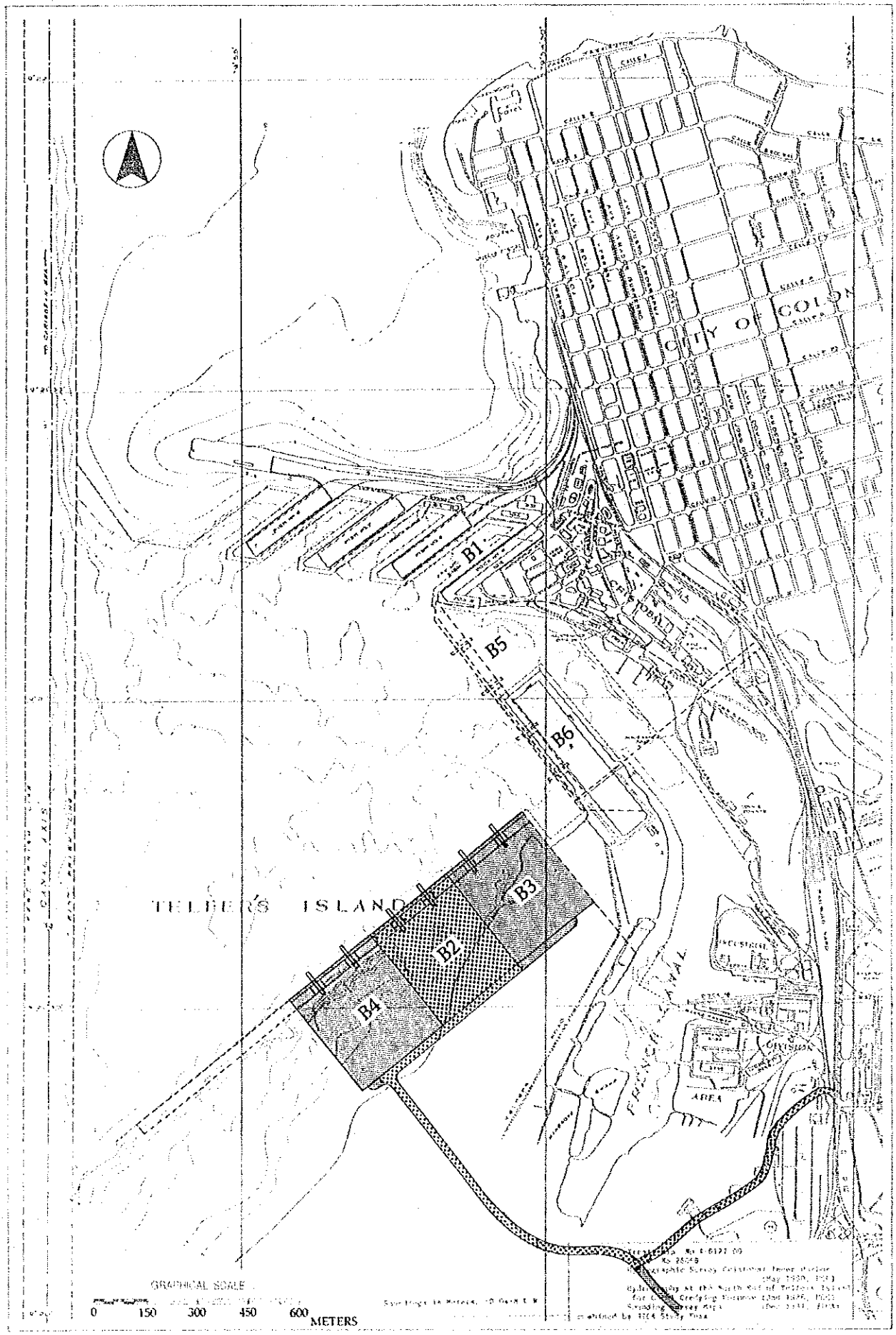

Figure 3-2-4 Alternative Site-F(c)