Chapter 7 CARGO HANDLING SYSTEM

A. General Conditions

1) Type of ships expected in the future

1. Unless major commodities handled at ports along the West Coast of South America change, type of ship will remain the same. Most of the cargoes coming to this area have already been containerized, however, the exports from these ports are mainly primary products and thus the major carriers servicing this area are reluctant to introduce full container ships.

2. Though the banana export from the port of Guayaquil (hereafter referred to as "the GYE) accounted for 75% (in 1993) of the total export, most are not containerized. The reason which obstructs containerization in banana transportation is the extremely high per-diem of the refrigerated container. Cost per day for a 40 foot refrigerated container is US$20-25. If the round voyage days for a certain service route are 90 days(GYE-Far East), per diem for a 40 foot refrigerated container would be a minimum US$ 1,800, placing a heavy burden on the ship operator. Though the freight rate for refrigerated cargo is two or three times higher than dry general cargo, freight rate for the banana (plant) is far below that of fish (seafood). Also the freight rate is not proportional to the transportation distance, the banana in refrigerated container is suitable for short transportation (Dole:GYE-Los Angeles) but not long transportation (Noboa:GYE-Far East,GYE-Europe; Dole:GYE-Mediterranean). Instead, for the long transportation, a refrigerator ship and/or multipurpose with reefer chamber is more efficient.

3. A distinctive feature of the West Coast of South America is that there is a shortage container handling equipment. Proper container cranes are installed only in the GYE and in Valparaiso, Chile thus, regardless of the type, every ship being placed into this trade route is equipped with whatever type of ship's crane and because of it's reliability and high productivity, the loading and discharging of containers take place with these cranes instead of the land equipped container crane. The condition of the ports along the West Coast of South America is listed in Table II-7-1.

2) Modernization and Privatization

(a) Removal of the transit sheds located behind the wharf # 2-6

4. Though the implementation was postponed, in the schedule of UNCEMP, removal of the transit sheds was once scheduled. To raise the efficiency of breakbulk cargo handling, effective utilization of the transit shed directly behind the wharf is indispensable.

5. If the existing transit sheds are removed and rebuilt at a location deep inland, cargo movement between the ship's tackle and the shed would require a tremendous number of trucks. In addition, this will require additional lift on/off of the cargo, additional movement of the equipment and also additional man-power which will result in a high cost to the Cargo Operator in the Port(*)(hereafter referred to as "the OPC") and a high handling rate for the customers.

(*) the OPC - Operador Portuario de Carga - is the person or legal firm that by means of a method determined by theseregulations provides service to ships by assignment of the Port Authority.

Table II-7-1 Condition of the ports along the West Coast of South America

(COUNTRY) PORT	NO.OF BERTH	TYPE OF BERTH	DEPTH (m)	CONTAINER CRANE
(COLOMBIA)				
BUENAVENTURA	10	LO/LO, RO/RO	4.5/9	SELF
(ECUADOR)				
GUAYAQUIL	5/3	G.C./CNTR	9.8	PEINER 40T
(PERU)				
CALLAO	22	G.C.	9/10.7	SELF
(CHILE)				
ARICA	6	G.C.	4/10.4	SELF
IQUIQUE	3	G.C.	9.2	SELF
ANTOFAGASTA	7	G.C./BULK	9/11.2	SELF
VALPARAISO	2	CNTR	11.0	HITACHI 36T/ DEMAG 40T
SAN ANTONIO	2	G.C.	9.7	SELF/ DEMAG 50TX2

SELF = only for Self-sustaining vessel

Future Plans

Buenaventura : Feasibility study being undertaken for possible container terminal.

Valparaiso : A container terminal, depth 12m, equipped with gantry cranes and a new stacking area is under construction.

(Source: Containerisation International Year Book 1995)

6. Of greatest concern to APG might be the loss and/or theft of the cargo, the possibility of which will increase tremendously.

(b) Privatization

7. No matter wich privatization scheme is adopted, concession or contract, it is said that the occupation of the wharf and apron will remain under APG's custody. If this means that the competence of berth allocation remains entirely under APG, the ship affiliated to the OPC or contracted with the OPC is unable to berth at the wharf in front of the OPC's yard. If so, the effectiveness of the privatization in terms of the cargo handling will be half reduced because neither efficient use of the transit shed nor quick and smooth cargo handling is expected.

8. Several cases in point exist in the GYE. Currently, Noboa leases shed # 3 from APG where palletizing of their banana take place. If Noboa's ship is able to berth at # 3, ideal cargo handling can be expected with the minimum number of forklifts. Damage to the banana will be minimized. However, if wharf # 3 is occupied by another ship and Noboa's ship is obliged to berth at wharf # 1, it will be necessary to pick up the banana boxes on pallets again on the truck at shed # 3 to connect to the ship's tackle at wharf # 1. Though the distance from the wharf is far away (more than 300m), Dole has its own open yard leased from APG where the most ideal loading operation (production 26 x 40'/hour/ crane) has been executed with 16 to 18 tractors to connect Dole's yard and ship's tackle. If Dole's yard is directly behind the apron, more efficient operation with minimum number of tractors can be expected.

3) Documentation

9. Current documentation system in the GYE is very poor. Most of the documents which APG, as the terminal operator, should be in charge of, are prepared by the agent. What APG is performing is only the documents of their billing purpose thus the essential data APG should file is not accumulated with them. When the terminal operation is privatized, most of the documents will be transferred to the OPC and taking this opportunity, the world-wide standardized documentation system should be introduced.

4) Recommendation

(a) Privatization

10. Since current APG has already lost the ability to handle cargo/container at the GYE by reasons of reduction the work force/absence of the proper management/shortage of the skilled labor/lack of cargo handling equipment/lack of knowledge in modern cargo handling/ etc., immediate introduction of the private sector vitality is strongly requested.

(b) Berth allocation

11. To perform more efficient cargo handling operation, it is commonly held that the distance between the place of rest and the ship's tackle should be shortened. For this purpose, hauling of the cargo across the wharf should be avoided or, in other words, ships related to the OPC should berth at the OPC's wharf. APG should give the OPC preferential use of the wharf in front of their yard for the ships related to the OPC. Even in this case, APG might be entitled to levy the berthage/wharfage on cargo on the shipping line to recover the construction cost of the wharf/apron and administration cost of APG.

(c) Adoption of Cut-off Time System for the export cargo/containers

12. This system is to close receiving of the export cargo/containers at some time on the previous day of the ship's arrival, while preparation for cargo/containers loading, i.e. palletizing of cargo, preparation of sequence check list etc. can be done prior to the ship's arrival. This system is quite common throughout the world to reduce ship's staying time in the port and to avoid interruption in the cargo handling. In the case of banana, freshness is essential, and thus the system should adopt the sailing time, i.e. cut-off receiving of the banana 3 hours prior to ship's ETD(*), instead of the previous day.
(*) ETD: estimate time of departure

(d) Division of APG site/Unit of the terminal operation

13. Current APG site should be divided into sections/yards based on the required berth length expected in the future. A different OPC is designated for each yard for administration and physical operation of the yard. In case of the breakbulk general cargo wharf, berth length should be treated flexibly to meet with the OPC's estimated ship size in the future. The OPC is able to operate multiple wharves if the volume of cargo/containers is sufficient.

14. When the container yard is divided into sections, it is necesary to build a gate complex for each terminal and throughout operation (from the gate to the ship or vice versa) should be carried out independently. This will result in :

(1) Administration and management of the terminal will be conducted indepednently by the OPC with absolute responcibility.
(2) Stimulate effective competition among the OPCs.
(3) Loss and/or theft of cargo will be minimized.

B. Proposed Cargo Handling System

1) Difficulty in cargo handling

15. The main difficulty in cargo handling in the GYE is the mixed stowage of containers and breakbulk cargo on the same ship. Although the current arrangement of port facilities is divided into three types, one bulk wharf, three container wharves and five breakbulk general cargo wharves, the breakbulk cargo to and from the container ship is handled at the container wharf and containers to and from the conventional breakbulk ship are handled at the breakbulk general cargo wharf. The container ship does not always berth at the container wharf and the breakbulk ship sometimes berths at the container wharf. If the shipping line, which operates multipurpose and/or conventional breakbulk ships, accepts loss time and additional cost for shifting of the ship, difficulty will be solved.

2) Handling of containers to/from multi/conventional ship

16. When the multi/conventional ship has more than 10-15 containers to be loaded/unloaded, it is recommended to first allocate the ship to the container wharf until container handling is completed, and then shift the ship to the breakbulk wharf. If the ship has only a few containers, these containers could be handled at the breakbulk wharf. Handling of containers to/from multi/conventional ship is the same as at container wharf but straddle carrier should not be used at the apron of breakbulk wharf. From the view point of security, these containers should be stowed near the transit shed under control of the OPC.

C. Proposed Container Handling System

1) Standard combination of container handling equipment

17. Generally, a combination of container handling equipment in the standard container terminal in the 2nd/3rd generation (250-300m x 300-350m) is as follow;

	Number of unit	
Container Crane	1	
Yard Tractor/Chassis	4)	
Transfer Crane	1 (loading/discharging)	or
Straddle Carrier	4 (loading/discharging)	
Transfer Crane	1 (receiving/delivery)	or
Straddle Carrier	1-2 (receiving/delivery)	
Top-lifter	2-3 (empty container handling)	
Yard Tractor	2-3 (CY*-CFS* transportation)	and
Chassis	as requested (CY-CFS transportation) according to the number of container bays in the CFS, 20'/40' respectively.	

Number of equipment to connect container between the quay-side container crane and transfer crane (yard tractor/chassis or straddle carrier) is in accordance with the distance between the two and also with the maximum lifting cycle of the container crane.

(*) CY : Container Yard
CFS : Container Freight Station

2) Standard flow of the container (outline)

18. Flow and documentation of the export container

(1) According to the booking list received from the shipping line/agent, the OPC secures the space in the CY for export containers. Reserved space for the ship shall be further divided by the destination of the container.

(2) Based on the booking list, the shipping line issues the Equipment Dispatch Order (EDO) to the shipper and informs them to pick up the empty container. The OPC releases the empty container to the holder of the EDO and then issues the Equipment Interchange Receipt-Out (EIR-Out).

(3) The OPC receives the loaded container from the shipper at the terminal gate. On receipt, following items are checked.
Container Number/Seal Number/Outside Condition

(4) At the gate, the container is weighed to ensure the accuracy of the shipper's weight mentioned in the following shipping documents.
Container Load Plan (CLP)/Gate-in Slip/Export Declaration (ED) etc.

(5) Details of the container, as follows, shown in the Gate-in Slip are also checked and put into the Terminal Computer for succeeding procedures.
Name of the Shipping Line/Name of the Ship/Voyage Number/Destination/ Size/Kind of the Cargo/Weight/Situation of Customs Procedure/other items and/or conditions such as Dangerous, Refrigerated (temperature should be

shown) etc. if any

(6) Immediately after key-in of the above information into the Terminal Computer, the computer determines the location (address) to be stacked in the marshalling yard.

(7) The address is informed to the driver of the shipper's trailer and the transfer crane operator and the trailer proceeds to the address, simultaneously, the transfer crane moves to the address to pick up the container for stacking.

(8) Prior to the ship's arrival, the OPC (yard/ship planner) prepares the loading sequence check list and the schematic plan, which are distributed to the transfer crane/container crane operator and signal man (tally man) on board of the ship or on the apron. The weight of the containers is taken in account for the ship's stability calculation.

(9) After the ship's arrival or completion of discharge of the import containers, loading is carried out based on the loading sequence check list in coodination of the transfer crane operator, the tractor driver and the container crane operator.

(10) When the loading of containers is completed, securing/lashing of on-deck containers will be done with stacking cones and/or lashing bars/wires.

(11) The stowage plan is prepared by the OPC, while the cargo/freight manifest, dangerous cargo list, reefer container list and so on are prepared by the agent.

(12) In case of the Straddle Carrier System, the Switching Point is located between the gate and marshalling yard, where the receiving of the export containers takes place.

19. Flow and documentation of the import container

(13) According to the cargo manifest and the stowage plan received from the shipping line/agent, the OPC reserves the space in the CY for import containers.

(14) Prior to the ship's arrival, the OPC (yard/ship planner) prepares the discharging sequence check list based on the stowage plan.

(15) After the ship's arrival, discharging of the import containers is carried out in accordance with the discharging sequence check list.

(16) The delivery of the import container to the consignee is carried out with the EDO, the Deliverly Order (D/O) and the Import Declaration (I/D).

(17) When the devanning is completed by the consignee, empty container is returned to the shipping line's depot or the terminal.

(18) In case of the Straddle Carrier System, delivery of the container is carried out at the Switching Point.

3) Movement of the container handling equipment

20. To ensure the safe and smooth operation on the apron and in the CY, the

mobilization of equipment should be in a one-way/one direction. Berthing of the ship, port or starboad, should also be fixed so that the course of the movement of the equipments shall always be the same. Consequently, the direction of the container door in the marshalling yard shall be the same so that the lift on/off to and from the customer's trailer will be much easier.

4) Recommendation

(a) Rehabilitation of the container yard

21. For effective terminal operation, overall repavement of the CY is required taking account of new operation mode and new container handling system to be employed by the OPC. As mentioned in b) below, the Straddle Carrier System is very suited to the GYE, however, existing transfer cranes should be utilized by some of the OPC while they are workable. In general, in view of the supply of the spare parts and flexible use of equipment, uniformity of equipment type is desireable. The top-lifter should be used only to handle empty containers and not be used on the apron.

(b) Container handling equipment

22. In the Transfer Crane System, yard tractor plays the important role of carrying containers between quay-side container crane and transfer crane in the yard. Spotting of the spreader onto the container or of the container onto the yard tractor/chassis is quite easy when containers are handled with the regular type of container crane or bridge-type ship's crane equipped on the deck, however, in the case of the GYE, so many non cellular multipurpose and conventional breakbulk ships are involved and containers on these ships are usually handled with Jib Crane on the ship's deck and/or Crawler Crane on the apron without attaching spreader. Under such conditions, because of the sway and twist of container caused by use of such non-standardized container crane, spotting is not so easy, time consuming and sometimes will cause accidents. Contrary to the Transfer Crane System, in the Straddle Carrier System, the yard tractor/chassis is not involved in the course of the operation and the straddle carrier always picks up containers, which are lain on the ground standing still with whatever type of gantry crane, directly from the ground. If the ship type remains unchanged, the Straddle Carrier System is very suited to the GYE.

23. Though current container yard to be divided and operated by multiple OPCs, container handling equipment including straddle carriers (if any in the future) can be pooled or owned by an independent firm. Purposes of which are as follow;

(1) to avoid excessive investment
(2) to use equipment flexibly
(3) to make maintenance easy and economical

(c) Introduction of computerized container operation system

24. Since it will be difficult to introduce the total computer system right away, it will thus be necessary to start with a small scale computer system which has the following functions;

(1) promoting the stacking plan
(2) determining container stacking location (address)
(3) promoting the sequence plan of loading and discharging

25. As the next step, the total computer system should be introduced. The basic

concept of this system is divided into following three systems;

(1) Terminal control system

This system includes the following two major programs;
Marshalling yard cotrol program, functions of which are as follow;
- determination of export container location
- determination of import container location
- determination of change of location, introduction and revision
- storage container list inclusive of container location and status

Gate cotrol program, functions of which are as follow;
- inbound container control
- outbound container control

(2) Terminal planning system

This system includes the following three major programs;
Loading schedule program, functions of which are as follow;
- inputting and filing the number of loading containers and their status
- preparing pleliminary plans
  bay plan
  stowage plan
  schematic plan
  sequence check list etc.
- finalization/revision of preliminary plans
- calculation of weight/height of center of gravity of the ships/cargo combinations/monitoring/and others
- monitoring of operation

Discharging schedule program, functions of which are as follow;
- inputting and filing the number of discharged containers and their status
- preparing preliminary plans
  schematic plan
  sequence check list
  rehandling list
- monitoring of operation

Program for optimal handling equipment procedure

(3) Documentation system

This system finalizes all the information processed and/or developed in the systems described above. Preparing documentation to submit to the parties concerned and filing the necessary information for APG statistics can be carried out with this system.

D. Proposed Breakbulk Cargo Handling System

1) Cargo handling equipment

26. Generally, breakbulk cargo handling is carried out with a forklift which conveys the cargo between the ship's tackle and the transit shed. To eliminate interruption in cargo handling, adequate number of forklifts are assigned to meet the cycle of the ship's derrick.

27. In order to conduct safe and smooth operation, crossing of the handling equipment should be avoided.

2) Standard flow of the breakbulk cargo (outline)

28. Flow and documentation of the export cargo

(1) According to the booking list received from the shipping line/agent, the OPC secures the space in the transit shed for export cargo. Reserved space for the ship shall be further divided by the destination of the cargo.

(2) The OPC receives the cargo from the shipper at the land-side door of the transit shed with the following shipping documents.
Export Declaration(ED)/Shipping Order(S/O) issued by the shipping line/etc.

(3) Details of the cargo shown in the S/O are checked at the receiving point and put into the OPC's computer for succeeding procedures.
Name of the Shipping Line/Name of the Ship/Voyage Number/ Destination /Kind of the Cargo/Number of packages/Weight/Situation of Customs Procedure/other items and/or conditions such as Dangerous, Refrigerated (temperature should be shown), Heavy, Bulky, Lengthy etc. if any

(4) Received cargo proceeds to the place of rest in the shed and pre-loading arrangement, i.e. palletizing etc., is conducted.

(5) After the ship's arrival or completion of discharge of the import cargo, loading is carried out, palletized cargo is picked up by forklift and conveyed to under the derrick of the ship.

(6) The derrick of the ship picks cargo up from the apron/down on the hold of the ship then stores in the hold, sometimes leaves the cargo on pallet or removes the pallet from the cargo.

(7) When the cargo crosses the ship's tackle, tallymen both from the carrier-side and the shipper-side count the number of packages to ensure whether the number of packages listed in the shipping document is properly loaded.

(8) Before cargo is stowed in the ship's hold, dunnage should be spread wherever necessary to ensure that cargo is secure.

(9) The stowage plan is prepared by the OPC, while the cargo/freight manifest, dangerous cargo list, reefer cargo list and so on are prepared by the agent.

29. Flow and documentation of the import cargo

(10) In accordance with the cargo manifest and/or stowage plan previously

obtained from the shipping line/agent, the space in the transit shed can be secured beforehand.

(11) Immediately after the ship's arrival, discharging of the import cargo is carried out. Some cargo is left on-pallet at the loading port and the other is in breakbulk. Forklift is also used in the ship's hold to move and pile up cargo on the rope basket.

(12) Similar to the loading procedure, tallymen are employed to ensure whether the proper number of packages is unloaded.

(13) Conveyance of the cargo between the apron and the place of rest in the treansit shed is usually carried out with the forklift. The cargo carried in the transit shed is assorted by each Bill of Lading (B/L) preparing for delivery to the consignee.

(14) The delivery of the cargo takes place at the land-side door or place of rest in the transit shed, in exchange for the Delivery Order (D/O) issued by the shipping line.

3) Recommendation

(a) Width of the Apron

30. Existing apron covering wharf # 2-6 should be widened to at least 25m to handle containers with heavy duty equipment. Taking this opportunity, existing transit sheds should be removed and reconstructed to meet the new operation mode to be conducted by the OPC or, as an alternative, shift the existing transit sheds to 10 to 15m inland if physically possible.

(b) Practical use of the transit shed

31. In order to conduct more efficient cargo handling, practical use of the transit shed directly behind the wharf/apron is indispensable. When the following conditions are in order, practical use of the transit shed will be readily accomplished.

(1) Reconstruction or rehabilitation of the transit shed
(2) Preferential assignment of the wharf

32. Since the wharf for berthing shall be assigned far before the ship's arrival, receiving of the cargo prior to the ship's arrival at the transit shed is possible, thus the sufficient previous arrangement for loading of the export cargo, i.e. palletizing etc. is possible and also preparation of cargo handling equipment can be arranged with ease. Because of the short transportation distance of the forklift, number of equipment will be minimized and possibility of loss and/or theft will also be minimized.

E. Proposed Bulk Cargo Handling System

33. Establishment of the Preventive Maintenance Program and the replacement of the parts for the silos and the Hitachi unloader is immediately required to recover the original unloading capacity of 200 tons/hour.

34. When the bulk cargo is unloaded with the Bucket, because of the structual defect of the wharf, interruptions in the unloading operation often occur. In case of the current T-type wharf, a truck waiting for unloading operations of another truck to finish must make a U-turn or T-turn wich entails shifting into reverse, an operation which is both tedious and time consuming. Instead, in case of TT-type (trestle bridges are provided at both ends of the wharf), the waiting truck is able to move in a circular direction along the sides of the wharf and the time of switching over will be minimized. If the time for switching over of the trucks is less than a cycle of the ship's derrick, interruption in the unloading operation will be eliminated.

F. Maintenance of the Cargo/Container Handling Equipment

35. In order to ensure smooth and efficient operation, maintenance for the cargo/container handling equipment is indispensable, however, because of the scheduled Modernization and Privatization in APG, the aggressive maintenance, systematic purchase of the spare parts and the training of the mechanic staff are all frozen. If the condition continues for any length of time, it will be necessary to scrap a considerable amount of APG equipment.

36. Maintenance is usually divided into two categories;

(1) Preventive maintenance
(2) Corrective maintenance

1) Preventive maintenance

37. In order to keep equipment in a safe and good working condition, preventive maintenance is very important. This maintenance is also divided into two types, one is the time based maintenance and the other is the condition based maintenance.

38. The time based maintenance, sometimes called periodical maintenance, is more popular, however, condition based maintenance is considered to be more effective to keep the equipment in good condition.

39. The condition based maintenance is carried out in response to significant deterioration in some parts of the equipment.

2) Corrective maintenance

40. Corrective maintenance is a passive form of maintenance which restores the original function of the equipment by carrying out repairs after trouble has occurred.

Chapter 8 INITIAL ENVIRONMENTAL EXAMINATION

A. Policy on Environment in Ecuador

1) Environmental Considerations

1. In Ecuador, several areas have been identified where suitable environment is a top priority, the areas of greatest concern are described below.

2. Erosion and deforestation are recognized as the greatest environmental problems in Ecuador. The country's deforestation rate is one of the highest among tropical countries and, if this does not change, it is estimated that, by the year 2010 to 2030, the native forest, with the exception of those located in protected areas, will have been eliminated. Conversely, reforestation rates are extremely low. Over 12% of the nation's territory is already seriously eroded, and forecast predicts that this figure will rise to 36% of the nation's territory.

3. Destruction of tropical forest have caused the loss of unparalleled biodiversity found no where else in the world. Ecuador's 17 protected areas, around 15% of the nation's territory, have not -with few exceptions- been efficiently utilized due to the lack of effective, management plans and their enforcement.

4. Water resources are becoming persistently more polluted: overall, coliform bacteria and sedimentation, and localized -but intense and hazardous- uncontrolled discharge of effluents into the water courses that pas by cities or areas where petroleum, mining, agroindustrial and export agriculture activities are pursued. Rapid deterioration of watersheds is altering hydrological parameters and consequently the volumes of runoff waters intensifies the impact of flooding and drought.

5. The coastal zone, where major export-oriented agricultural projects are concentrated (banana, cacao, coffee, sugar cane and shrimp) and Ecuador's pot infrastructure is located, has undergone the greatest growth in population and productive activities. The negative environmental impacts have been significant. These impacts are over fishing of various species, deterioration of fresh water quality, destruction of mangroves for shrimp ponds, improper use of waterfront areas, pollution by wastes from various industrial and urban sources, and economic and social disenfranchisement of the population.

6. Few activities have provoked such serious extensive environmental damage in Ecuador as petroleum exploration and exploitation, which began in Ecuador's Amazonian region in 1970. Large gas reserves are known to exist under the Guayas Estuary, but as yet have not been exploited. Development of this resource or discovery of new oil reserves will transform the coastal economy, and pose new threats to coastal resources.

7. During the 1970s, the industrial sector grew rapidly, concentrating in a few cities, specially Quito and Guayaquil, and on a smaller scale in Cuença. These cities have born the impact of industrial activities, with increased water pollution from chemicals and metals, increased air pollution, soil pollution from garbage and industrial wastes, and heald hazards for the population.

8. In addition to industrial concentration, the large and medium cities are concentrating Ecuador's population. Between 1950 and 1990, Ecuador's urban population multiplied six fold, rising from 29% to 55% of the nation's total, largely due to rural-urban migration. The urbanization process has generated a growing gap between the demand

for and supply of basic services. Largo and medium cities have become major sources of environmental pollution, exceeded only by petroleum and mining activities. Rivers and estuaries near cities are subject to intense, complex pollution, which spreads great distances. Sewage and waste water are dumped without prior treatment. Guayaquil, Quito, Cuenca, and other smaller cities are in critical situation. Air pollution by industry and vehicles is becoming increasingly dangerous. Urban land areas are poorly planned causing greater inefficiency, which increases the cost of providing utilities and other services, and often impacts negatively on the ecological system that protect the cities.

9. Ecuador is a high-risk country in regard to natural phenomena such as earthquakes, volcanic eruptions, flooding and drought. Over time, earthquakes and eruptions have caused severe environmental impact on people, water, soil, air, flora and fauna. These events are not, of course, preventable, but their impact is worsened by improper use of high risk zones, deficiencies of infrastructure, and limited action taken before, during and after their occurrence.

2) Policy

10. In view of these considerations, Ecuador Government, thorough Executive Decree 1802 dated June 1, 1994 established 17 Basic Environmental Policies for Ecuador; the relevant articles and items to the Study of the Decree will be mentioned.

(1) Ecuadorian society must permanently observe the concept of minimizing risks and negative environmental impacts, while maintaining social and economic opportunities of sustainable development.

(2) Each inhabitant in Ecuador, its institutions, and public and private organizations shall carry each action, in a manner to promote to be socially just, economically profitable, and environmentally sustainable, in a simultaneous way.

(3) Environmental action in Ecuador will be basically founded on the solidarity, corresponsability, cooperation and coordination between all the inhabitants, directed to grantee a sustainable development, based on the equilibrium and harmony between the social, economic and environmental.

(4) Special nationwide effort must be put into an effective and efficient application of the existing laws and regulations, as well as for taking advantage of the institutional capacities of the country.

(5) The Ecuadorian Government shall establish incentives of various sorts to facilitate compliance with regulations or apply the initiatives originating in Ecuador's people or organizations, to attain adequate environmental management.

(6) Ecuador will maintain a continual attitude of openness toward reaching agreements with other countries regarding commitments and forms of cooperation to improve environmental management and ensure common benefits for all involved.

(7) Without precluding an integrated approach to environmental matters, including legal regulations, special priority will be granted to prevention and monitoring, to prevent environmental damage by pollution and other degrading forces, paying attention in the gathering of permissions, limits of tolerance for each substance, exercise of supervision and control by the State in the potentially

damaging or polluting activities.

(8) The Ecuadorian Government establishes, as a mandatory prerequisite to engage in activities that could degrade or pollute the environment, that all parties interested in such activities must prepare an Environmental Impact Assessment (EIA) and the corresponding Program for Environmental Mitigation Program (PEM), and attach them to their applications for authorization from cognizant authorities; the latter must decide whether to grant authorization, and monitor compliance with these assessment and programs stipulations. The EIA and the PEM shall be based on the principle of obtaining the most adequate actuation level to the space or resource to protect, through the most efficient action.

(9) The Ecuadorian Government shall require foreign companies, national subsidiaries of transnational firms, and national enterprises in general, to behave technologically in Ecuador in observance of no less than the highest standards and requirements in force in their own countries of origin, in the case of foreign and transnational companies, all companies must comply as well with relevant Ecuadorian regulation.

(10) The Ecuadorian Government, without prejudice of the attendance of the all aspects of the environmental action in the country, shall give priority to the treatment and solution of eleven aspects recognized as prioritary environmental problems of the country, some of them are mentioned; among them:

(i) Erosion and disorderly use of land.

(ii) Deforestation

(iii) Diversity and genetic resources loss.

(iv) Disorderly and irrational exploitation of natural resources in general.

(v) Growing pollution of air, water and soil.

(vi) Production and poor management of wastes, including toxic and dangerous wastes.

(vii) Big heald national problem due to pollution and bad nutrition.

(viii) Process of decertification and increment of drought phenomena.

(11) The Ecuadorian Government, shall give priority to the treatment and solution to the environmental problems that affect or threaten some geographical regions:

(i) Mangrove ecosystems of the Ecuadorian coast.

(ii) Gulf of Guayaquil.

(iii) Cities of Quito, Guayaquil, and others.

(iv) Marshy Systems.

(12) Propounding towards all the productive activities realized in Ecuadorian territory and the in the marine areas under its soberany, to perform in order to avoid damage and/or environmental pollution, special attention shall be

paid to the following;

(i) All hydrocarbon activities (exploration, production, transport, industrialization).

(ii) Industries and activities generating dangerous and toxic waste in the main cities.

(iii) Transportation sector.

3) Legal Frame

11. There are around 100 legal instruments with over 1,800 regulations for environmental control in Ecuador; very often the same problem is under the responsibility of several institutions. The concern of the environmental aspect of the study comprises three major legal topics: Water Quality, Protected Areas, and Port Development. Relevant legal instruments and a brief description will permit to follow adequate procedures in the planning process.

(1) Law of Waters (Supreme Decree, published in the Official Record (O.R.) N° 69, the 30th on May of 1972) with its reglamentation published in the O.R. N° 233 the 26th of January) of 1973, norms the use of all kinds of water and prohibits its contamination. Supreme Decree N° 2939-B, published in the O.R. N° 676, the 23rd of October of 1978: It is forbidden the development of areas not delimited by the Ministry of Agriculture and Cattle-Raising (MAG). This Law joints Ecuadorian Institute of Hydraulic Resources (INERHI) and Ecuadorian Institution of Sanitary Matters (IEOS) in control and prevention of contamination. The results of their goals have not been achieved.

(2) Law of Prevention and Control of the Environmental Pollution (Supreme Decree N° 374 the 21st of May of 1976): Promotes the protection of resources air, water, and soil; conservation, improvement, and restoration of the environment. Ministerial Agreement N° 2144, published in the O.R. N° 204 the 5th of June of 1989, provides reglamentation for water resources control. Ministerial Agreement N° 11,338-A, published in the O.R. N° 726 the 15th of July of 1991, defines air quality standards. This Law assign responsibility on this matter, to IEOS, INERHI, DIGEIM, Ecuadorian Institute of Forestal and Natural Areas (INEFAN), and Energy Ministry.

(3) Law of Hidrocarbons (supreme Decree N 1459, published in the O.R. the 1st of October of 1971), with several regulations and modifications: O.R. 80, 14/6/72; O.R. 603, 13/8/82; O.R. 711, 15/11/78; O.R. 427, 7/2/83; O.R. 27,7/2/83; O.R. 681, 8/5/87. Part of this Law refers to environmental contamination related to the preservation of ichtyological resources. The National Direction of Hydrocarbons, a Department of the Ministry of Energy, shares with DIGMER, the responsibility of the protection of air, water, and soil against spills and unadequate disposal of hydrocarbons.

(4) Law of Forestry and Conservation of Natural Areas and Wildlife (N° 74), published in the O.R. N° 64, the 24th of August of 1981: Constitute forest patrimony of the State, the forest lands that according to the Law are of its property and the natural forest that exist in them... Executive Decree N° 74, published in the O.R. N° 436, the 2th of February of 1983: general regulation of application of the Law of Forestry and Conservation of Natural Areas and Wildlife.

(5) Ministerial Agreement N° 498, published in the O.R. N° 591, the 24th of December of 1986: Declares protective forests the existing in a total area of 362,742 hectares covered by mangrove, of other forest goods and of brine areas included with the ecosystem.

(6) Ministerial Agreement N° 238, published in the O.R. N° 722, the 6th of July of 1987. Reform to the first clause of the article 1, of the Ministerial Agreement N° 498: Declares protective forest that conform 306,802 hectares.

(7) Executive Decree N° 824A, published in the O.R. N° 208, the 17th of June of 1988: Will be of public interest the conservation, protection and reinstatement of the existing mangrove forest in the country. In consequence, cutting or exploiting mangrove is forbiden.

(8) Law N° 91, published in the O.R. N° 495, the 7th of August of 1990. Reformatory law of the Law of Forestry and Conservation of Natural Areas and Wildlife: The mangroves, yet the existing in particular properties, are considered goods of the State and they are outside of trade. They are not susceptible of possession or any other way of appropriation, and only will be able to develop through granted grant of compliance with this Law and its Regulation...).

(9) Ministerial Agreement N° 406, published in the O.R. N° 547 the 21st of October of 1986, reformed on 1986 and 1987, declares Protector Forest to the Estero Salado canal, located in the Gulf of Guayaquil Estuary

(10) Law of Ports (Supreme Decree N° 289, published in the O.R. N° 67 the 15th of April of 1976), establishes the reglamentation of port construction and enlargement, under the authority of DIGMER. It includes the assignment of study the betterment of organization, administration, operation, maintenance, and countability systems in commercial ports, as well as well as supervise that programming for port construction and enlargement, is accomplished.

(11) Marine Policy Code (Supplement to the O.R. N° 1202 the 20th of August of 1960), with modifications, observes the use of shore lands granting appropriate permissions to construction.

12. These legal instruments has been demonstrated to be useless for an adequate environmental management due to institutional failures. Absence of unique legal frame in Ecuador is the cause of the environmental deterioration problem. National and Regional legislation do not contain legal definitions about environment, linked to the economic, urban, and industrial development policies. There are limitations, unnecessary duplication and frequent contradictions between legal norms. laws in force, as well as an adequate enforcement of them. Some of the problems detected are:

(1) Procedures existence disperse and in some incoherent cases.

(2) Jurisdictions and competitions overlapping to judge the infractions.

(3) Lack of proportionality of the penalties in relation to the infraction.

(4) Lack of ecological-legal consistence.

(5) Lack of harmony among the legal procedures and the development policy.

(6) Nonexistence of a digest.

4) Institutional Issues

13. Several institutions have responsibilities in the implementations concomitant to laws and regulations related to the environment in Ecuador. The items parts of the Study are considered in order to relate institutions to legal regulations:

Table II-8-1 National institutions related to items to be considered in the present study

Organization concerned	Port Infrastructure	Air Quality	Water Quality	Mangroves
DIGMER	X	X	X	X
MAG - INEFAN			X	X
IEOS	X	X	X	
INERHI	X	X	X	X
MUNICIPALITIES	X		X	X
MINISTRY of ENERGY	X		X	

(1) DIGMER (General Direction of Merchant Marine). Depend upon General Marine Comandancy. Its main responsibility items are navigation, ports, water pollution and shore land occupation. The National Department of Ports is responsible for Ecuadorian commercial ports construction and betterment, as development policy, general Law of Ports and Code of Marine Policy are the main legal documents. APG, legally depends of DIGMER; every project in APG has to be considered and approved by DIGMER.

(2) INEFAN (Ecuadorian Institute of Forestal and Natural Areas) (previously DINAF), depends of the MAG. Its objective is to implement the Law of Forestry and Conservation of Natural Areas and Wildlife, concerning all protected areas. All applications for development activities in protected areas have to be considered by INEFAN.

(3) IEOS (Ecuadorian Institution of Sanitary Matters). Depends of the Ministry of Heald; its objective is planification, direction and advisement in development projects of water supply, sewage systems, and environmental heald, as well as ecology, research, control and pollution prevention of air, water and soil. The Law of Waters is the main legal instrument that shares with INERHI.

(4) INERHI (Ecuadorian Institute of Hydraulic Resources). Created by Supreme Decree N° 1151, published in the O.R. N° 158 on November, 11 of 1966. Depends of the MAG. The purpose of creation is to promote better use and protection of the hydric resources of the country. The Law of Waters is the principal legal document. Corresponds to INERHI supervise the adequate use of municipal treatment systems and to control the emissions.

(5) MUNICIPALITIES. Design and plannification of physical urban development. Both, Municipio and DIGMER grants construction permissions in beaches and shore areas.

(6) MINISTRY OF ENERGY. The National Direction of Hydrocarbons, through the Law of Hydrocarbons and Code of Marine Policy, is the entity that shares with DIGMER aspects related to hydrocarbon matters.

B. Strategy for Environmental Consideration

14. Environmental issues cover a wide scope and the preparation of an environmental strategy should be comprehensive, covering technical know-how and institutional frame. Some basic elements in drafting an environmental strategy are listed below.

Clear understanding of the present situation of environment
Estimation and forecasting of the impact and future situation
Possible countermeasure to prevent the impact
Process to acquire social consensus
Coordination with other organizations concerned

15. There are many kinds of environmental components related to the port. The water front zone, in paticular, has various features from the environmental viewpoint. So, one of the most important issues in the first stage is clearing understanding the environment of the port in question.

16. When planning port development project, careful consideration should be given to the possible effects which may happen during the port construction stage as well as operation stage. If degradation of environment is forecasted, countermeasures should be taken to prevent the environmental burden.

17. Results of environmental analysis sometimes remains at a qualitative level. The evaluation of projects is often relative and decisions should be made through social consensus.

18. Environmental issues cover a wide scope, thus, the countermeasures to the issues should be examined and carried out through coordinated efforts of related organizations.

19. The function of collecting the information, understanding and evaluating what is happening and what will happen in the port, know-how on necessary countermeasures for environmental problems should be carried out by the port management body.

C. Initial Environmental Examination

20. The environmental impact by the development will be examined according to the following steps.

Understanding and evaluation of the present situation
Preliminary check on the impact by the development
Identifying the important components to be assessed.
Estimation of the level of the
impact on the important components
Examination of countermeasures, if necessary
Evaluation of the project from the environmental viewpoint

1) Environmental Screening

21. The present situation of environment of the port of Guayaquil was ascertained through an analysis of existing data, field surveys and interviews with personnel concerned. The environmental components to be studied are identified as mentioned above.

22. The environmental screening was carried out according to the form of Table II-8-2. Selected components are subjected to a preliminary check to measure the impact by the development.

23. The components consists of three groups, social environment, natural environment and pollution. In general air pollution and water pollution do not result from port activities but from other activities such as urban and/or industrial activities. In this step the components which are assumed to be related to the port development and operation are identified and checked.

<Social Environment>
Traffic and Public facilities
Health and Sanitation
Waste
<Natural Environment>
Topography and Geology
Hydrological situation
Coast and ocean
Flora and Fauna
Landscape
<Pollution>
Air Pollution
Water Pollution
Noise and Vibration
Offensive odor

Table II-8-2 Environmental Screening

Component	Note	Eval
<Social environment>		
Settlement	Resettlement by expansion	no
Economic Activity	Loss of opportunity	no
Traffic / Public Facilities	Affect to public activity	yes
Community	Separation of community	no
Cultural Property	Devaluation of property	no
Rights of water utilization etc.	Damage to common right etc.	no
Health and Sanitation	Degradation of sanitary	yes
Waste	Increase of waste	yes
Hazards	Increase of opportunity	no
<Natural environment>		
Topography and Geology	Change of valuable site etc.	yes
Erosion	Loss of surface soil	no
Groundwater	Exhaust or change	no
Hydrological Situation	Change of water flow etc.	yes
Coast and Ocean	Erosion and sedimentation	yes
Flora and Fauna	Exterminate of species etc.	yes
Whether	Change of phenomena	no
Landscape	Dis-harmonization	yes
<Pollution>		
Air Pollution	Polluted gas discharge / dust spread	yes
Water Pollution	Polluted water discharge / soil spread	yes
Soil Contamination	Sedimentation of material	no
Noise and Vibration	Generation by traffic etc.	yes
Ground subsidence	Change of Ground level	no
Offensive Odor	Occur from cargo handled / dredging	yes

yes ; to be examined in scoping check

2) Environmental Scoping Check

24. The components picked up in the Table II-8-3 are evaluated from the viewpoint of relation to the Master Plan. The relation and necessity of the next step study on these components are described below.

(a) Traffic and Public Facilities

25. Under the Master Plan, the volume of cargo through the port of Guayaquil is expected to increase. Most of the cargo is transported by trucks from the port to its hinterland and vice versa. A road with six lanes for each direction connects directly to the port of Guayaquil. On the other hand the road connects to a circular road around the city of Guayaquil and so the trucks from/to the port are able to reach the trunk roads to the hinterland without passing through the center of the city. Therefore the influence to this component by the increase of the traffic in the Master Plan will not be serious.

26. On the way to some parts of the hinterland trucks must go across the Rafael Mendoza Aviles Bridge where traffic jam sometimes occur. But the traffic problem at the bridge should be solved based on the urban road network planning rather than on the port development plan.

(b) Health and Sanitation

27. There is currently no waste treatment plant in the port. In the Master Plan, the cargo handling volume is expected to increase as is the number of people passing through the port such as workers and crews. Thus waste generated in the port is expected to increase. The situation in future is not expected to be serious but the possible methods to treat the waste will be discussed in the stage of the feasibility study.

(c) Waste

28. As the waste from the port activity itself, the waste oil and other waste material produced in ships and to be unloaded at the port should be considered. There are currently no special facilities for them at the port. This component should be also discussed in the stage of the feasibility study.

(d) Topography and Geology

29. The reclamation results in a change of topography and geology at the site. In the Master Plan the alignment of headline of reclamation is almost along the existing shore line and the size of reclamation is not large. Thus the plan will not largely affect the topography and geology.

(e) Hydrological situation

30. The surface feature of some part of the port area will change from waste land to paved land and facilities and from mangrove forest to paved land. But it is assumed that there will be no effect on the hydrological situation in the area because these changes are on small scale.

(f) Flora and Fauna

31. Mangrove inhabits the expansion area. Mangrove is predominant in the area of the Gulf of Guayaquil and many parts of coastal areas in this area including near the port are covered by mangrove.

32. According to the field survey at the mangrove forest in the port, no special species of mangrove was found in this area.

33. Some kinds of fauna and flora were also observed in this field survey and other species are assumed to inhabit the mangrove forest based on existing reports. But according to these reports there are no special and/or precious species in this area. The species reported are also found in the surroundings.

34. In the stage of the feasibility study this component should be discussed because conservation of the mangrove is one of the important policies in the field of environment in Ecuador

(g) Landscape

35. There is not special landscape near the port at present and in the Master Plan structures and topographical change which would drastically alter the present landscape are not included.

(h) Air Pollution

36. The level of the air quality in the city of Guayaquil is not good. Air quality near the port is the same as is observed throughout the city. As mentioned above the air pollution is mainly caused by other activities not directly related to the port.

37. Because of the importance of air pollution, the load of exhausted gas from traffic from/to the port will be discussed in the stage of the feasibility study.

(i) Water Pollution

38. One of the biggest environmental problem of the city of Guayaquil is water pollution. Countermeasures are currentry being implemented by the organizations concerned. The water quality in the water area of the port of Guayaquil shows a very poor level. But the origin of the pollution is mainly not the port activity but urban and industrial activities. The pollutant flows into the port area from other places, lowering the water quaility in the port. In this sense the port is not intimately relatedi to the water pollution problem. Because the water quality is one of the most important components in the port further discussion will be heald in the stage of feasibility study.

39. By dredging work, suspended soil will be produced and spread throughout the water area. But the current is small and there are no fishery activities near the planned dredging area Therefore the spread of suspended soils will not have a serious effect but the impact by dredging will be discussed in the stage of feasibility study.

(j) Noise and Vibration

40. Noise and vibration will occur by traffic from/to the port. Because the access road from/to the port has 6 lanes for each direction the effect to the inhabitants along the road will be small. But this component is supposed to be important for the inhabitants and impact will be discussed in the stage of the feasibility study.

(k) Offensive Odor

41. An offensive odor sometimes results from handling certain kinds of cargo and dredging of polluted sea bed. In the Master Plan such special cargo will not be handled.
Moreover there are no inhabitants near the dreading area and cargo handling area.

3) Initial Environmental Examination

42. According to the evaluation of the present situation and preliminary examination on the impact on environment by the Master Plan, the Master Plan will not give a serious impact to the environment.

43. In the feasibility stage, next step examination on components which are supposed to be affected and/or important for the environment in the port of Guayaquil should be conducted as the environmental impact assessment. The components are listed with main point to be examined below.

- Health and sanitation; disposal of waste produced in the port
- Waste; oil treatment and disposal
- Flora and Fauna; on mangrove forest
- Air pollution; load from traffic from/to the port
- Water pollution; impact by dredging
- Noise and Vibration; load from traffic from/to the port

Table 8-II-3 Environmental Scoping for the Port Development Plan

Component	Impact	chec
<Social environment>		
Settlement		
Economic Activity		
Traffic / Public Facilities	Traffic to/from port	neg.
Community		
Cultural Property		
Rights of water utilization etc.		
Health and Sanitation	Disposal of waste	EIA
Waste	Generate from ship/port	EIA
hazards		
<Natural environment>		
Topography and Geology	Reclamation/dredging	neg.
Erosion		
Groundwater		
Hydrological situation	Reclamation/dredging	neg.
Coast and Ocean	Reclamation/dredging	neg.
Flora and Fauna	Expansion in mangrove area	EIA
Whether		
Landscape	No big facilities/change	neg.
<Pollution>		
Air Pollution	From ship/car/others	EIA
Water Pollution	From ship/port area/construction	EIA
Soil Contamination		
Noise and Vibration	From car from/to port	EIA
Ground subsidence		
Offensive Odor	From cargo handling / dredging	neg.

EIA ; to conduct next step examination in the stage of feasibility study
neg ; impact to be supposed is nothing or negligible small

PART III

FEASIBILITY STUDY

OF

THE PORT OF GUAYAQUIL

Chapter 1 BASIC POLICY FOR SHORT TERM PLAN

A. Short Term Prospect of the Circumstance of Ports in Ecuador

1. The modernization of the State is one of the most important policies in Ecuador. CONAM (Consejo Nacional de Modernization del Estado) has strongly pushed ahead this policy and the legal frame on modernization has been arranged in these years.

2. The legal frame of the delegation of ports service to private sectors has been recently established. Therefore the privatization of port services will proceed in the near future.

3. On the other hand, some legal schemes of promoting export such as Zona Franca and Maquila have been recently established also. The spread of these schemes will cause to increase export and vitalization of economy of Ecuador.

4. The economic activity of Ecuador should grow steadily. To realize steady growth of national economy, the ports have to increase productivity and capacity corresponding to increase of export and import cargo.

5. Each port authority in Ecuador will make efforts to expand cargo volume through each port under the modernization of the port including privatization of port services. Competition among the ports is expected.

B. Objective of the Short Term Plan

6. Taking into consideration various requirements of the current situation of the port of Guayaquil and traffic demand through the port, the main objective of the short term plan with target year of 2003 are identified as follows:

(1) Progress of modernization

(2) Increased productivity and capacity of the port by improvement of cargo handling

(3) Increased capacity of the port by construction of additional berths required

(4) Establishment of appropriate port management system and efficient operation system

(5) Strengthening of the role as only main gateway port of Ecuador

(6) Identification of scale and substance of the physical development project as intermediate step of development, in achieving proposed goal of the Master Plan

(7) Appropriate investment

(8) Environmental consideration

Chapter 2 DEMAND FORECAST FOR SHORT TERM PLAN

A. Condition

1. In the Master Plan, two cases are assumed in the projection of socio-economic indices of GDP. One is based on past trends, the other is based on the national development plan. Demand forecast of the master plan is carried out based on the above two cases.

2. Considering the recent economic indices, economic growth will not increase rapidly because of a shortage of positive factors. The socio-economic indices of GDP suggest lower growth judging from the actual conditions. So demand forecast will be carried out on the assumption that economic growth rate will be only 3% from 1994 to 2003.

3. Demand forecast of port traffic has been carried out for the target year 2010 of the Master Plan in Chapter 3 of Part II. Demand forecast of the Short-term plan for year 2003 will be carried out in the same way as in the Master Plan. The results of the demand forecast for the Short-term plan are summarized in this chapter.

B. Cargo Volume in 2003

1) Import Cargo

(1) Wheat

4. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of wheat in 2003 is estimated as 546,000 tons. Private berth shares 60%, so APG is expected to handled 218,000 tons.

(2) Sugar

5. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of sugar in 2003 is estimated as 155,000 tons. The volume of APG is 146,000 tons.

(3) Cereal

6. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of cereal in 2003 is estimated as 163,000 tons. The volume of APG is 113,000 tons.

(4) Vegetable oil

7. The projection is carried out using the proportional allotment between the cargo in 1993 and in 2010. The total import volume of vegetable oil in 2003 is estimated as 44,000 tons. The volume of APG is 23,000 tons.

(5) Paper and its derivative

8. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of paper and its derivative in 2003 is estimated as 378,000 tons. The volume of APG is 377,000 tons.

(6) Material and minerals

9. The projection is carried out using the proportional allotment between the average cargo from 1991 to 1993 and the cargo in 2010. The total import volume of vegetable oil in 2003 is estimated as 123,000 tons. The volume of APG is 113,000 tons.

(7) Construction materials

10. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of construction material in 2003 is estimated as 11,000 tons. The volume of APG is 11,000 tons.

(8) Manure and fertilizer

11. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of manure and fertilizer in 2003 is estimated as 322,000 tons. The volume of APG is 162,000 tons.

(9) Chemical product and others

12. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of chemical product and others in 2003 is estimated as 524,000 tons. The volume of APG is 327,000 tons.

(10) Iron, steel and materials

13. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of iron, steel and materials in 2003 is estimated as 302,000 tons. The volume of APG is 302,000 tons.

(11) Vehicle and machinery

14. The projection is carried out using the proportional allotment between the average cargo from 1991 to 1993 and the cargo in 2010. The total import volume of vehicle and machinery in 2003 is estimated as 67,000 tons. The volume of APG is 67,000 tons.

(12) Merchandise and other product

15. Demand increase is commensurate with annual growth rate of GDP. This method uses annual growth rate of GDP and cargo demand elasticity for GDP is calculated and set to be 1.05. The import volume in the target year is estimated as 270,000 tons. The import volume of APG excluding the private berth cargo is 147,000 tons.

(13) Manufacturing and metal product

16. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total import volume of manufacturing and metal product in 2003 is estimated as 117,000 tons. The volume of APG is 117,000 tons.

(14) General Cargo

17. Demand increase is commensurate with annual growth rate of GDP. This method uses annual growth rate of GDP and cargo demand elasticity for GDP is calculated and set to be 1.05. The import volume in the target year is estimated as 57,000 tons. The import volume of APG excluding the private berth cargo is 36,000 tons.

(15) Summary of Import Cargo

18. Import cargo at Guayaquil port in 2003 is summarized in the following table.

Table III-2-1 Summary of Import cargo at Guayaquil Port in 2003

Unit: Ton

No	Commodity	G. Cargo	Solid Bulk	Liquid Bulk	Bag cargo	Total
1	Wheat		218,000			218,000
2	Sugar				146,000	146,000
3	Cereals		113,000			113,000
4	Vegetable Oil			23,000		23,000
5	Paper and its derivative	377,000				377,000
6	Materials and Minerals		113,000			113,000
7	Construction Material		11,000			11,000
8	Manure and Fertilizer		162,000			162,000
9	Chemical Product	327,000				327,000
10	Iron. Steel		302,000			302,000
11	Vehicle and Machinery		67,000			67,000
12	Merchandise and Other	147,000				147,000
13	Manufacturing and Met.	117,000				117,000
14	General Cargo	36,000				36,000
	Total	1,004,000	986,000	23,000	146,000	2,159,000

2) Export Cargo

(1) Banana

19. The future cultivated area is estimated as 203,590 ha the same as in 1993. The improved yield is 20.5 ton/ha. The production in 2003 will be 6,012,000 tons. Domestic consumption is estimated as 1,868,000 tons. (= population x consumption = 13,343,000 pers. x 0.14 kg/pers.).

20. Export volume is estimated by deducting the domestic consumption volume from the production volume. According to the statistics of export, 50% of the export volume of banana has been handled through the port of Guayaquil. Based on the above, future export volume of banana through the port of Guayaquil is estimated as 2,072,000 tons.

(2) Green banana

21. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total export volume of green banana in 2003 is estimated as 67,000 tons. The volume of APG is 67,000 tons.

(3) Coffee

22. The forecast is carried out following the same equation given in Chapter 2 of Part II. The production volume is estimated as 203,000 tons. The export volume of coffee in Guayaquil port is forecasted by its correlation with production volume. The total export volume of coffee in 2003 is estimated as 105,000 tons by the equation between the export volume of coffee and production volume. The volume of APG is 104,000 tons.

(4) Cacao and its derivative

23. The projection is carried out using the proportional allotment between the average cargo from 1991 to 1993 and the cargo in 2010. The total export volume of cacao and derivation in 2003 is estimated as 90,000 tons. The volume of APG is 89,000 tons.

(5) Rice, cereals and its product

24. The projection is carried out using the proportional allotment between the cargo in 1993 and the cargo in 2010. The total export volume of rice, cereals and product in 2003 is estimated as 1,000 tons. The volume of APG is 1,000 tons.

(6) Sugar

25. The projection is carried out using the proportional allotment between the cargo in 1993 and the cargo in 2010. The total export volume of sugar in 2003 is estimated as 18,000 tons. The volume of APG is 18,000 tons.

(7) Molasses

26. The projection is carried out using the proportional allotment between the cargo in 1993 and the cargo in 2010. The total export volume of molasses in 2003 is estimated as 13,000 tons. The volume of APG is 6,000 tons.

(8) Fruit, vegetable and others

27. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total export volume of fruit, vegetable and others in 2003 is estimated as 45,000 tons. The volume of APG is 45,000 tons.

(9) Wood and balsa

28. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total export volume of wood and balsa in 2003 is estimated as 36,000 tons. The volume of APG is 36,000 tons.

(10) Fish, shellfish and mollusk

29. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total export volume of fish, shellfish and mollusk in 2003 is estimated as 176,000 tons. The volume of APG is 181,000 tons.

(11) Fishmeal

30. The projection is carried out using the proportional allotment between the cargo in 1993 and the cargo in 2010. The total export volume of fishmeal in 2003 is estimated as 1,000 tons. The volume of APG is 1,000 tons.

(12) Materials and minerals

31. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total export volume of materials and minerals in 2003 is estimated as 47,000 tons. The volume of APG is 47,000 tons.

(13) Chemical product and others

32. The forecast is carried out following the same equation given in Chapter 2 of Part

II. The total export volume of chemical product and others in 2003 is estimated as 6,000 tons. The volume of APG is 5,000 tons.

(14) Canned food

33. The forecast is carried out following the same equation given in Chapter 2 of Part II. The total export volume of canned food in 2003 is estimated as 98,000 tons. The volume of APG is 98,000 tons.

(15) Manufacturing and metal product

34. Demand increase is commensurate with annual growth rate of GDP. This method uses annual growth rate of GDP and cargo demand elasticity for GDP is calculated and set to be 1.20. The export volume in the target year is estimated as 5,000 tons. The export volume of APG excluding the private berth cargo is 4,000 tons.

(16) General cargo

35. Demand increase is commensurate with annual growth rate of GDP. This method uses annual growth rate of GDP and cargo demand elasticity for GDP is calculated and set to be 1.20. The export volume in the target year is estimated as 25,000 tons. The export volume of APG excluding the private berth cargo is 25,000 tons.

(17) CEDEGE Project

36. Fruit production (Lemon, Mango, Papaya, Melon etc.) will be exported from the year 2000 and is estimated to reach 250,000 tons in 2010. These fruits cargo will be carried from Guayaquil Port. The projection is carried out using the proportional allotment between the cargo in 2000 and in 2010. The total export volume of APG in 2003 is estimated as 75,000 tons.

(18) Summary of export cargo

37. The summary of export cargo at Guayaquil port in 2003 is summarized in the following table.

Table III-2-2 Summary of Export cargo at Guayaquil Port in 2003

Unit: Ton

No	Commodity	G.Cargo	Solid Bulk	Liquid Bulk	Bag Cargo	Banana	Total
1	Banana					2,072,000	2,072,000
2	Green Banana					67,000	67,000
3	Coffee	104,000					104,000
4	Cacao and Derivat.	89,000					89,000
5	Rice, Cereals				1,000		1,000
6	Sugar				18,000		18,000
7	Molasses	6,000					6,000
8	Fruit, Vegetables	45,000					45,000
9	Wood and Balsa		36,000				36,000
10	Fish, Shellfish	176,000					176,000
11	Fishmeal	1,000					1,000
12	Materials and Minerals		47,000				47,000
13	Chemical Product	5,000					5,000
14	Canned Food	98,000					98,000
15	Manufacturing	4,000					4,000
16	General Cargo	25,000					25,000
17	CEDEGE Project	75,000					75,000
	Total	628,000	83,000	0	19,000	2,139,000	2,869,000

3) Volume of Container Cargo

38. The container cargo in 2003 expressed in metric tons and TEU is shown in Table III-2-3 and Table III-2-4.

Table III-2-3 Estimate of Transhipment Container Cargo

Year	2003
Transhipment Container Cargo (TEU)	1,050
Transhipment Container Cargo 20 ft (TEU)	580
Transhipment Container Cargo 40 ft (TEU)	470
Estimated Cargo Volume (metric tons)	12,000

Remarks: Above transhipment cargo is shown only one way.

Table III-2-4 Summary of Container Cargo in 2003

Unit: ton

Year 2003	Import	Export	Total
Refrigerator for Banana	-	932,000	932,000
General Cargo	763,000	597,000	1,360,000
Total	763,000	1,529,000	2,292,000
Containerized Cargo	1,004,000	2,767,000	3,771,000
Percentage of Containerization	76%	55%	61%

Remarks: Container of import; 14.20 ton/No, Container of export; 16.39 ton/No, Total 15.33 ton/No between 1992 and 1993.

Container	Import Unit: No	Export Unit: No	Total Unit: No	Import Unit: TEU	Export Unit: TEU	Total Unit: TEU
Full						
Banana 40 ft	0	52,000	52,000	0	104,000	104,000
General 20 ft	29,000	25,000	54,000	29,000	25,000	54,000
General 40 ft	25,000	16,000	41,000	50,000	32,000	82,000
Total	54,000	93,000	147,000	79,000	161,000	240,000
Empty						
Banana 40 ft	26,000	0	26,000	52,000	0	52,000
General 20 ft	5,000	28,000	33,000	5,000	28,000	33,000
General 40 ft	6,000	19,000	25,000	12,000	38,000	50,000
Total	37,000	47,000	84,000	69,000	66,000	135,000
Full+Empty						
Banana 40 ft	26,000	52,000	78,000	52,000	104,000	156,000
General 20 ft	34,000	53,000	87,000	34,000	53,000	87,000
General 40 ft	31,000	35,000	66,000	62,000	70,000	132,000
Total	91,000	140,000	231,000	148,000	227,000	375,000

4) Forecast by Cargo Type

39. Estimated cargo volume of each main commodity at Guayaquil port is classified into cargo type.

Table III-2-5 Cargo Volume by Cargo Type in 2003

Cargo type	Import	Export	Total
General Cargo	242,000	31,000	273,000
Solid Bulk	493,000	83,000	576,000
Grain Bulk	331,000	0	331,000
Fertilizer Bulk	162,000	0	162,000
Liquid Bulk	23,000	0	23,000
Bag Cargo	146,000	19,000	165,000
Banana Box Cargo	0	1,207,000	1,207,000
Container Banana 40 foot	0	932,000	932,000
Container General Cargo 20 foot	381,000	380,000	761,000
(Container terminal 20 foot)	(174,000)	(173,000)	(347,000)
(Multi-terminal 20 foot)	(207,000)	(207,000)	(414,000)
Container General Cargo 40 foot	381,000	217,000	598,000
(Container terminal 40 foot)	(174,000)	(99,000)	(273,000)
(Multi-terminal 40 foot)	(207,000)	(118,000)	(325,000)
Total	2,159,000	2,869,000	5,028,000

Table III-2-6 Container Cargo in 2003

Unit: No

	Import	Export	Total
Banana 40 foot	0	52,000	52,000
Full Container Ship 20 foot	14,000	11,000	25,000
Full container Ship 40 foot	12,000	7,000	19,000
Empty Banana 40 foot	26,000	0	26,000
Empty 20 foot	2,000	12,000	14,000
Empty 40 foot	3,000	8,000	11,000
Transhipment 20 foot	580	580	1,160
Transhipment 40 foot	235	235	470
(Sub Total)	(57,815)	(90,815)	(148,630)
Multi Ship 20 foot	15,000	14,000	29,000
Multi Ship 40 foot	13,000	9,000	22,000
Empty 20 foot	3,000	16,000	19,000
Empty 40 foot	3,000	11,000	14,000
(Sub Total)	(34,000)	(50,000)	(84,000)
Total	91,815	140,815	232,630

5) Vessel in 2003

40. Using the time series analysis, the projected load per ship is described in the formula (Referring to Section F. Chapter 2 of Part II). In the target year, the load per ship will achieve 2,700 ton/Ship. Rate of calculation of 1993 year by one of 2003 is 1.2.

41. Result of estimate for number of ship calls in 2003 is shown in Table III-2-7. Average DWT per ship is 13,700 DWT in 2003. Average load volume per ship is 5,028,000/1,790=2,800 ton/ship in 2003. Rate of handled volume per DWT in 2003 is 20 % compared with 19% in 1993.

Table III-2-7 Calling Ship in 2003

Ship Type	DWT (ton)	Handled Volume (ton/ship)	Cargo Volume (ton)	Ship Calls (No)
Mix Type Ship	12,000	2,400	3,121,000	1,300
Grain Bulk	26,000	14,000	331,000	20
Liquid Bulk	9,000	2,600	23,000	10
FC Banana	12,000	1,260 TEU	156,000 TEU	120
FC G.Cargo	20,000	300 TEU	101,100 TEU	340
Total				1,790

Source: APG, modified by JICA Study Team
Remarks: DWT; Dead Weight Ton, FC; Full Container (TEU includes empty container.) Above data is including transhipment cargo.

Chapter 3 PHYSICAL PLAN OF PORT FACILITIES

A. Physical Requirement in 2003

1) Required Number of Berth in 2003

1. Under the framework of Case 1A of the Master Plan considering the policy of APG, the Short Term Plan with a target year of 2003 is proposed.

2. The number of berths depends on both cargo volume and cargo handling efficiency. The cargo volume in 2003 is forecasted in Chapter 2. On the other hand, the modernization program is now progressing and APG is making efforts for improvement of cargo handling efficiency.

3. As the Short Term Plan, Case X and Case Y will be prepared for different levels of cargo handling efficiency. It is assumed that the cargo handling capacity is improved to half the level of the target of the Master Plan and the non-working time during berthing is decreased to the same level of the Master Plan in Case X and that the cargo handling efficiency is improved to the level of assumed efficiency in 2010 up to 2003 in Case Y.

(a) Case X

4. The required number of berths is calculated using the same method as in the Master Plan and results are shown in Table III-3-1. The required number of berths for container cargo and conventional type of cargo exceeds the capacity of one container berth and seven multi-purpose berths and one additional container berth and one additional multi-purpose berth are constructed.

5. The required number of berth is increasing year by year in general. Figure III-3-1 demonstrates how the number of berths will increase in future (1993, 2003 and 2010) based on required berthing hours. This figure is prepared only to facilitate understanding of the situation and does not show the exact annual requirement.

6. In the figure three kinds of lines are drawn. One line represents the increasing cargo volume. Other lines are required berthing time and supplied time in hours. If cargo handling efficiency remains at the 1993 level, the lines of cargo volume and required time should be parallel. As cargo handling efficiency is assumed to be improved the distance between both becomes smaller and smaller. The necessity of new berth construction occurs at the year in which the line of required time exceeds the line of supplied time. If the berth is not constructed by that year the occupancy ratio will be more than the planning level.

Table III-3-1 Required Number of Berth in Case X

Case X	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>		
cargo Parameter	Banana	General	Container	Conventional	Banana	Grain	Liquid	
Cargo Volume ton(box)/year*	78,000	71,551	787,935	1,176,000	1,207,000	331,000	23,000	
Cargo Volume /Berthing Time	39	12	82	48	84	110	102	
Required Berthing Time (hour)	2,000	5,871	8,970	24,742	14,346	3,018	226	
Calculated Number of Berth	0.38	1.12	1.46	4.03	2.34	0.49	0.04	
Required Number of Berth	2 (1.50)		8 (7.84)			1 (0.53)		11

Note(*); ton; for Multi-Purpose Terminal, Bulk Terminal, box; for Container Terminal

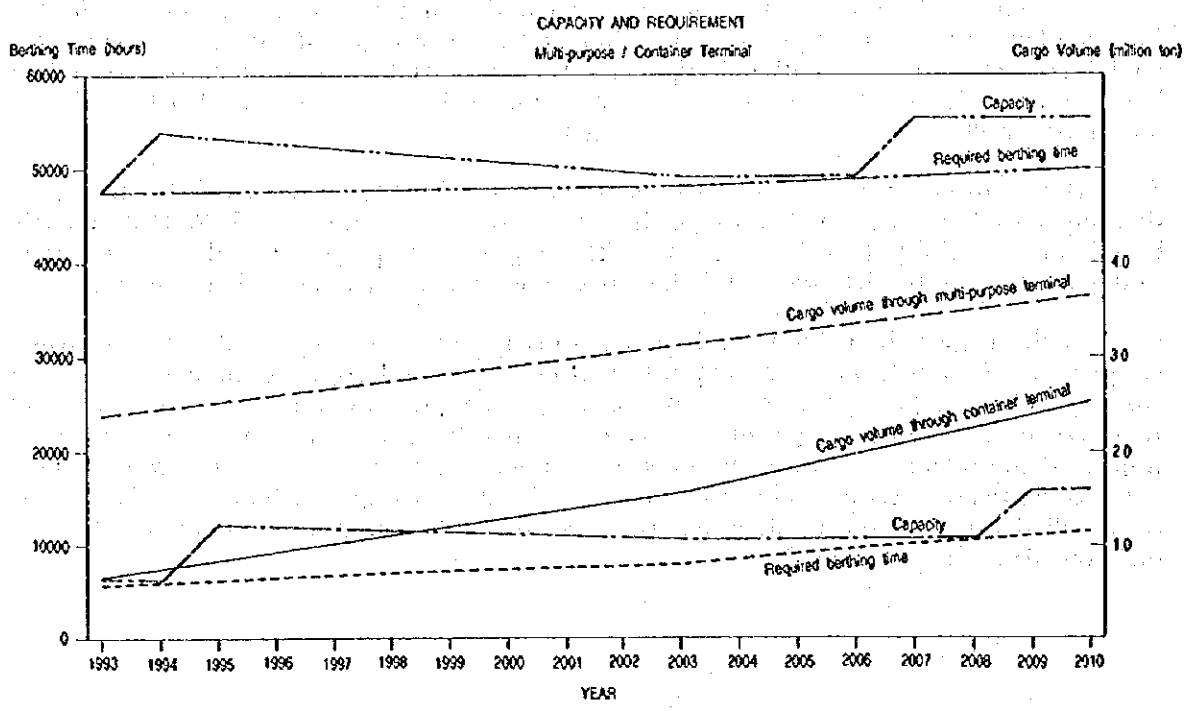


Figure III-3-1 Time Trend of Berth Requirement and Planning Number of Berth

(b) Case Y

7. The required number of berths is calculated using the same method as in the Master Plan and results are shown in Table III-3-1. The required number for the container terminal is 2, the number for the multi-purpose terminal is 7 and the number for the bulk terminal is 1. Container cargo exceeds its capacity and conventional type cargo can be handled with present capacity.

Table II-3-2 Required Number of Berth in Case Y

Case Y	<Container terminal>		<Multi-Purpose Terminal>			<Bulk Terminal>		
cargo Parameter	Banana	General	Container	Conventional	Banana	Grain	Liquid	
Cargo Volume ton(box)/year*	78,000	71,551	737,935	1,176,000	1,207,000	331,000	23,000	
Cargo Volume /Berthing Time	41	16	91	53	102	130	132	
Required Berthing Time (hour)	1,920	4,403	8,073	22,267	11,870	2,546	177	
Calculated Number of Berth	0.37	0.84	1.32	3.63	1.94	0.42	0.03	
Required Number of Berth	2 (1.20)		7 (5.88)			1 (0.44)		10

Note(*); ton; for Multi-Purpose Terminal, Bulk Terminal, box; for Container Terminal

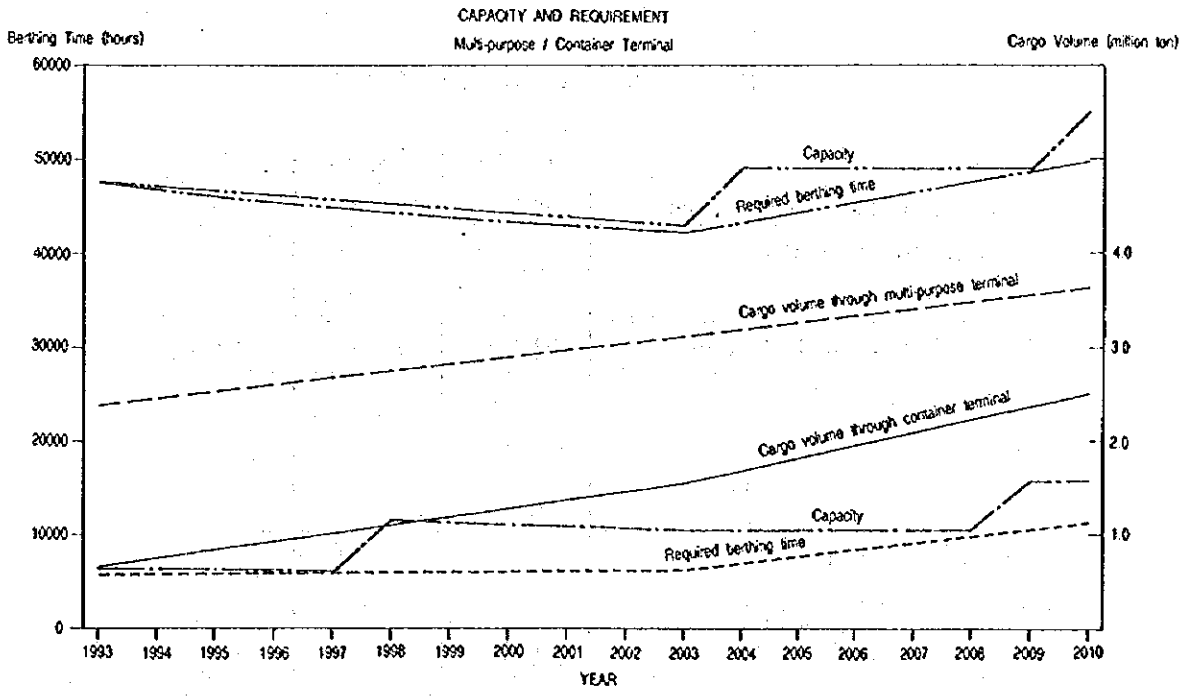


Figure III-3-2 Time Trend of Berth Requirement and Planning Number of Berth

2) Container Termninal

8. The required container terminal facilities in 2003 are calculated using the same method as in the Master Plan. The result is summarized as follows. The required areas of container yard and CFS are shown is Table III-3-3 and Table III-3-4. The planned berth lengh is the same as at present assuming that the ship size forecasted for the short term plan will remain unchanged.

Number of Berth	;	3 (185 m in length)
Apron	;	40 m in width
Container Yard	;	56,550 m^2
CFS	;	3,614 m^2
Attached Area for Other Facilities	;	7,000 m^2
Terminal Gate	;	4 lanes

Table III-3-3 Required Area of Container Yard

Parameter / Cargo	Import	Export	Banana	Empty	Transit	Total
Throughput(TEU)	36,103	26,060	104,000	89,944	1,630	257,738
Dwelling Days	4	3	1.5	10	3	-
Peak Ratio	365					-
Operating Days	1.3					-
Required Number	514	279	556	3,204	17	4,569
Stacking Height	3	3	2	3	3	-
Required slots	171	93	278	1,068	6	5,616
Required area (m^2)						56,550

Table II-3-4 Required Area of CFS

Parameter	Import	Export	Total
Annual Handling Volume (ton)	348,235	272,830	621,065
Ratio of Storage in Port	0.95	0.97	-
Ratio of LCL	0.05	0.4	-
Annual Volume of LCL (ton)	33,082	105,858	138,940
Dwelling Day at CFS	7	5	-
Peak Ratio		1.3	-
Volume of cargo per Unit Area (ton/m2)		1.5	-
Utilization Ratio of CFS		0.5	-
Operating Days per Year		365	-
Required Area of CFS (m^2)	1,100	2,514	3,614

(c) Multi-Purpose Terminal

9. The requirements in the multi-purpose terminal are calculated using the same method as in the Master Plan. The requirements for aprons, transit sheds and sorting areas, warehouses and open sheds are shown in Table III-3-4 and Table III-3-5.

Number of Berth ; 8 for Case X and 7 for case Y
Apron ; 30 m in width
Transit Shed ; 14,330 m^2
Sorting area ; 3,850 m^2
Warehouse ; 21,100 m^2
Open shed ; 32,330 m^2

Table III-3-5 Required Area of Transit Shed and Sorting Area

Parameter	Banana	Solid Bulk	Other Cargo
Annual Handling Volume (ton)	1,207,000	576,000	600,000
Ratio of Transit Shed	1.0	0.9	0.9
Volume through Tarnsit Shed (ton)	1,207,000	518,400	540,000
Peak Ratio		1.3	
Turnover Ratio	365		50
Volume per Unit Area (ton/m^2)		2.5	
Utilization Ratio		0.7	
Required Area (m^2)	2,456	7,702	8,023

Table III-3-6 Required Area of Warehouse and Open Shed

Parameter	Solid Bulk (open shed)	Solid Bulk (warehouse)	Other Cargo (warehouse)
Annual Handling Volume (ton)	288,000	288,000	600,000
Ratio of Storage		0.5	
Volume through Warehouse (ton)	144,000	144,000	300,000
Peak Ratio		1.0	
Turnover Ratio		12	
Volume per Unit Area (ton/m^2)		2.5	
Utilization Ratio		0.7	
Required Area (m^2)	6,857	6,867	14,285

B. Short Term Plan

10. The Sort Term Plan is prepared respectively for Case X and Case Y.

1) Case X

11. The capacity of existing facilities other than berths is sufficient even at the stage of the Master Plan. In the Short Term Plan existing facilities are used as much as possible.

12. The facilities to be constructed in the Short Term Plan are as follows;

185 m container berth
185 m multi-purpose berth
reclamation work accompaning the berth construction
capital dredging to depth of 10.5 m accompaning the berth construction
pavement work
removal and installment of pontoon

13. With the exception of a gantry crane to be installed for the new container berth, no new equipment will be procured in the Short Term Plan.

14. The layout plan should be considered under the conditions of minimum cost for investment and continuity of utilization of port facilities. As a result container berth has been planned at the area next to berth No.1B.

15. The Layout Plan is shown in Figure III-3-3.

16. In the Master Plan the length of container berth of 220 m in length is planned for longer container ships. This means that some part of container berth is not used as mooring facilities for standard size container ships. This area is used by longer ships or berthing of four smaller container ships.

2) Case Y

17. In Case Y, only number of berth differs compared with in Case X. One container berth is required to be constructed. The layout plan should be considered under the conditions of minimum cost for investment and continuity of utilization of port facilities. Container berth has been planned at the area next to berth No.1B.

18. The facilities to be constructed in the Short Term Plan are as follows;

185 m container berth
reclamation work accompaning the berth construction
capital dredging accompaning the berth construction
pavement work
removal and installment of pontoon

19. The Layout Plan is shown in Figure III-3-4.

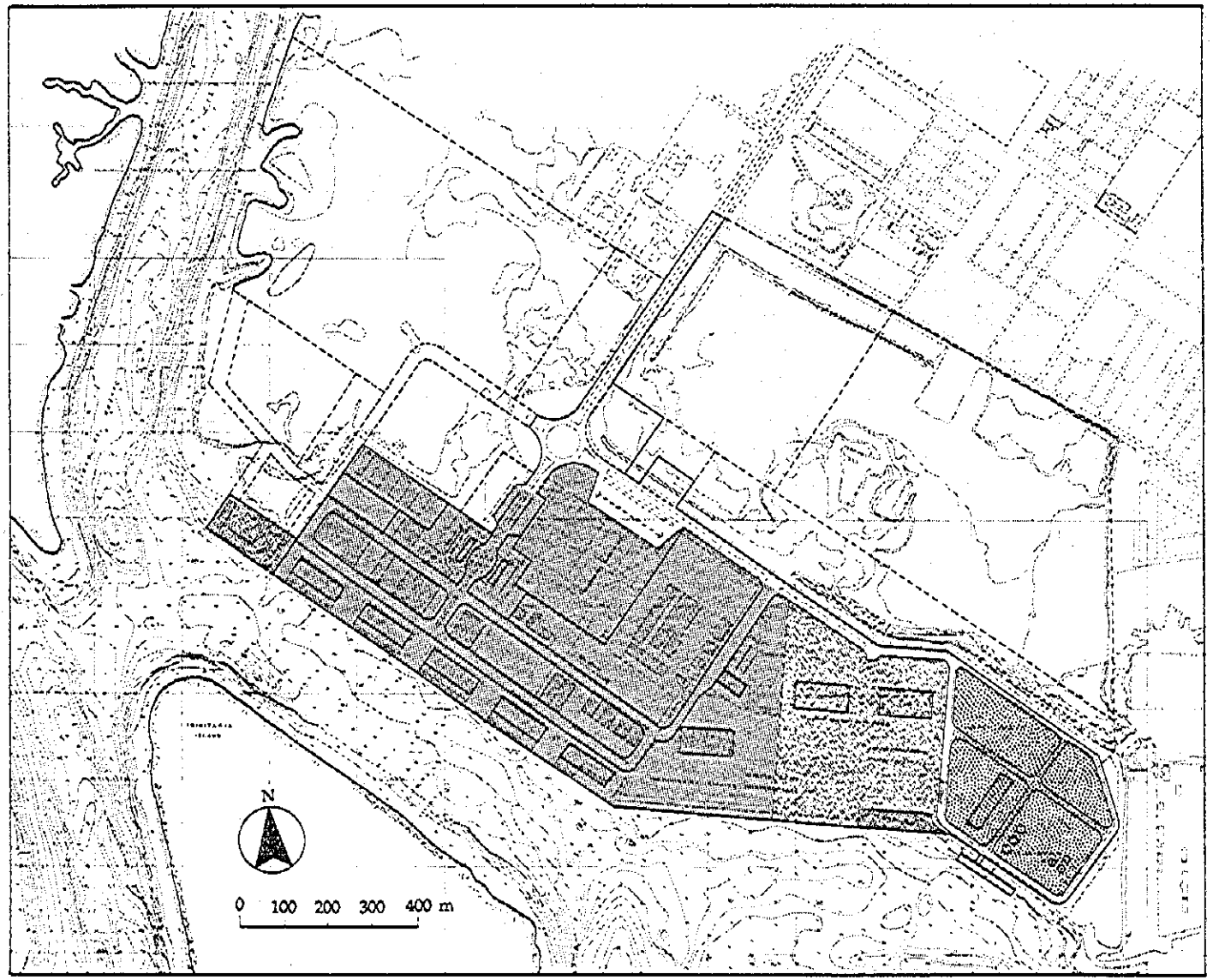


Figure III-3-3 Short Term Plan in Case X

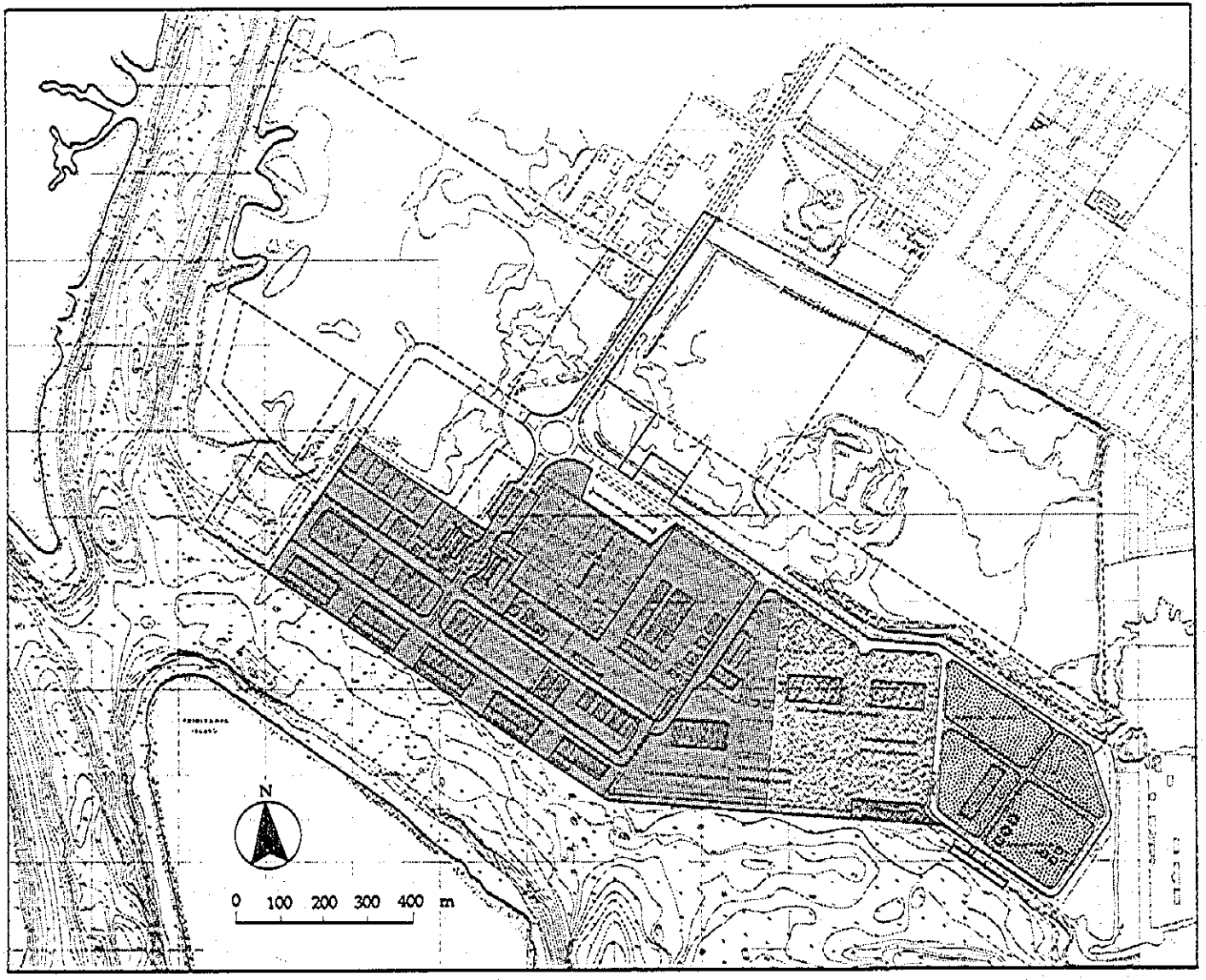


Figure III-3-4 Short Term Plan in Case Y

Chapter 4 PRELIMINARY DESIGN

A. General

1. In the Master Plan for the Port of Guayaquil, the rough design was carried out as mentioned in Chapter 4, Part II. In the Short Term Plan, two alternatives were planned in Chapter 3, and main facilities to be designed are summarized as follows:

Table III-4-1 Facility to be Designed

No.	Facility	Case X	Case Y
1)	Container Berth	Depth : -10.5 m Length : 185.0 m	Depth : -10.5 m Length : 185.0 m
2)	Multi-Purpose Berth	Depth : -10.5 m Length : 185.0 m	None
3)	Landing Stage for Small Boats	Length : 45.0 m (Pontoon)	Length : 45.0 m (Pontoon)

B. Design Conditions

2. As concerns design conditions, surcharge on apron, soil conditions, safety factors and others are the same as that in Master Plan (Refer to Chapter 4, Part II).

C. Preliminary Design

3. Regarding the structure type of each facility, the open-deck on concrete piles was recommended as described in Chapter 4, Part II.

1) Container Berth

4. Figure III-4-1/III-4-2 shows the assumed typical cross section/the arrangement of the piles-foundation which will be analyzed.

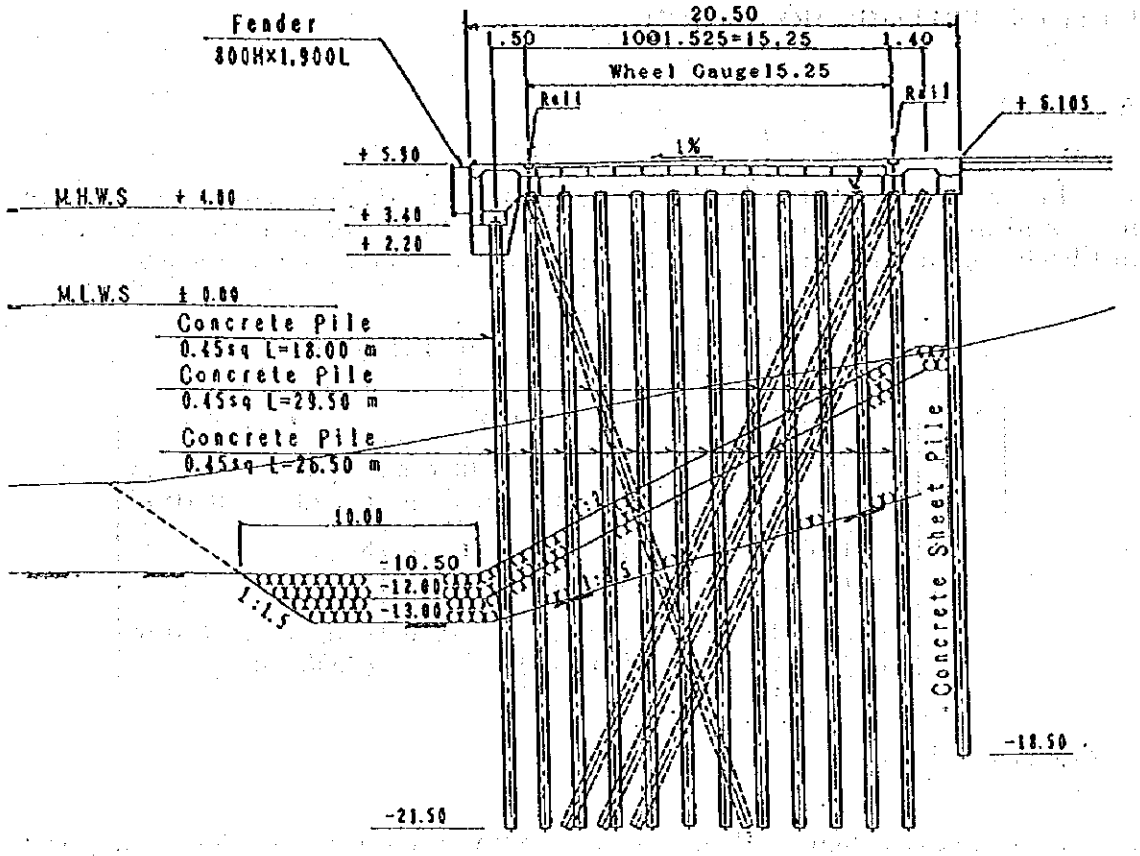


Figure III-4-1 Typical Cross Section of Container Berth

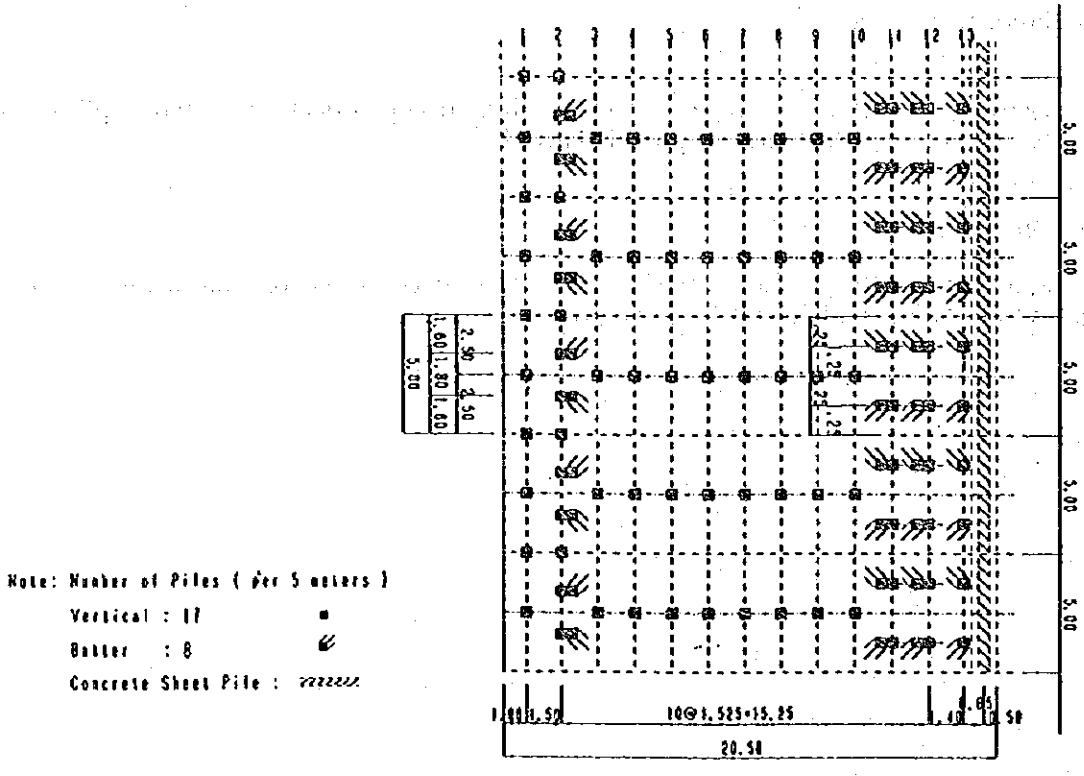
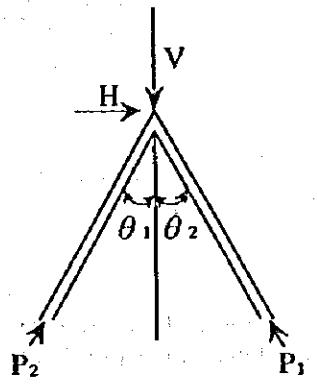


Figure III-4-2 Arrangement of Pile-Foundation

5. The pile foundation consists of 17 vertical piles and 8 batter piles at every five meters length along the berth head line. The 11 vertical piles and the 8 coupled piles, 19 sets in total, share the vertical load, such as dead weight, surcharge, and crane loads, in proportion to their own area. On the other hand, 8 coupled piles share even the lateral force such as ship berthing of tractive force and earth pressure in the normal condition, and sesmic force in earthquake conditions.

6. If lateral force "H" and vertical force "V" act on a couple piles, the axial compressive stress and axial pulling stress on each pile can be calculated as follows:



1 coupled pile

$$P_1 = \frac{V\sin\theta_1 + H\cos\theta_1}{\sin(\theta_1 + \theta_1)} \text{(Compressivestress)}$$

$$P_1 = \frac{V\sin\theta_1 + H\cos\theta_1}{\sin(\theta_1 + \theta_2)} \text{(Pullingstress)}$$

where

V = Verticalforce

H = Horizontalforce

θ_1, θ_2 = Angle of batter pile

7. The maximum compressive stress is 82.97 tons on a vertical pile in 12th row of pile foundation (Refer to Figure III-4-2) due to V=65.87 tons and H=8.33 tons of ship's berthing in normal conditions. Regarding a pulling force, maximum stress is 50.71 tons on batter pile in 2nd row due to V=18.53 and H=15.67 in case of earthquake.

8. On the other hands, the axial ultimate bearing capacity of a single pile is obtained by loading tests or a statical bearing capacity formula. In the design, the bearing capacity shall be calculated in accordance with a statical formula, and the formula for sandy soil is shown as follows:

$$Ru = CNAs + \frac{\bar{N}As}{5}$$

where

Ru	:	Ultimate bearing capacity of the pile (t).
C	:	Coefficient and 30 according to "Technical Standards for Port and Harbour Facilities in Japan"
As	:	Total circumferential surface area of the pile (m^2)
Ap	:	Tip area of the pile (m^2)
N	:	N value of the subsoil at the tip of the pile.
$\bar{N}$	:	Mean N value for the total embedded length of the pile.

9. In this case, N shall be calculated in accordance with the following formula:

$$N = \frac{N_1 + \bar{N}_2}{2}$$

Where N_1 : N value at the tip of the pile
$\bar{N}$: Mean N value in the range from the tip of the pile to 4B above
B : Diameter or width of the pile (m)

10. On the other hand, the maximum pulling resistance of a single pile shall be estimated by the following statical formula:

$$Rut = \frac{\bar{N}As}{5}$$

where

Rut : Maximum pulling resistance of the pile (t)
$\bar{N}$: The same as above
As : The same as above

11. According to the formula and the N - Values which are derived in Chapter 4, Part II, the ultimate capacity for compression and pulling are calculated, and the safety factor of each pile are as the following table.

Table III-4-2 Capacity of Pile

Depth	Embeded length	$\bar{N}$	$\frac{\bar{N}As}{5}$	N1	$\bar{N}2$	CNAp
-9 m,-14 m	5 m	30	54	-	-	-
-14 m,-21.5 m	7.5 m	40	108	40	40	244
Total			162			244

Total of Ru = 406t
Total of Rut = 162t

12. The axial ultimate bearing capacity and maximum pulling resistance of a single pile were calculated according to the above formulas and the results are as follows:

$$\text{Safety Factor} = \frac{\text{Resisting Force}}{\text{Acting Forece}}$$

Table III-4-3 Safety Factor of Pile

	Acting Force (t)	Resisting Force (t)	Safety Factor
Compression	82.97	406	4.89
Pulling	50.71	162	3.19

2) Multi-Purpose Berth

13. The cross section and the plan (piling plan) of the Berth is shown in Figure 4. The procedure of the design/analysis is the same with Container Berth, and each pile capacity is satisfied the safety factor.

3) Landing Stage for the Small Boats

14. The existing landing stage for the small boats is designed referring to the existing stage.

Chapter 5 CONSTRUCTION WORK PLAN

A. Premise of Construction Work Plan

1) Planned Facilities

1. The following alternatives are proposed for the Short-Term Plan.

Table III-5-1 Planned Facilities

Facilities	Unit	Short-Term Plan	
		Case-X	Case-Y
		Quantity	Quantity
Container Terminal:			
Wharf (-10.5 m)	m	185	185
Reclamation	m^3	14,430	14,430
Pavement	m^2	3,700	3,700
Dredging (-10.5 m)	m^3	29,600	29,600
Multi-Purpose Terminal:			
Wharf (-10.5 m)	m	185	
Revetment (-5.0 m)	m	85.5	
Reclamation	m^3	189,810	
Pavement	m^2	13,043	
Road (185 m)	m^2	2,775	
Service Boats Area:			
Pontoon	No.	1	1
Cargo Handling Equipment:			
Gantry Crane	Nos.	1	1
Straddle Carrier	Nos.	4	4

2) Premise of Construction Work

2. The following are adopted for the premise of construction work.

(a) The following limit marine conditions are experimentally assumed for off-shore work planning. But, the Guayaquil Port is located at the deepest point of the estuary, Estero Salado, and has a good marine conditions for the construction work as well as a good weather conditions.
Therefore, non-workable days caused by marine conditions are approximately negligible. So, the net workable days per year are assumed to be 256 days or 21 days per month excepting the holidays. (see, Chapter 5 PART II)

Table III-5-2 Limit Marine Conditions for Off-Shore Work

Work	Significant Wave Height (m)	Average Wind Velocity (m/sec)	Max. Current Velocity (kt)
Transportation by barge	0.6	10	2.5
Dredging by grab dredger	0.6	11	2
Dredging by pump dredger	0.6	11	2
Stone filling	0.7	10	2
Pile driving	0.4	8	1
Leveling	0.5	8	1

(b) Seabed materials at the Guayaquil port are almost clay up to around -10 m depth, and silt or silty sand strata continue after this. These strata show 40 of N-value. As such, piles and sheet piles might be driven without any obstacles.

(c) Main construction materials needed for the Short-Term Plan are reclaimed sand, stones (core stone, armor stone), ready mixed concrete, plant mixed asphalt concrete, prestressed concrete piles, concrete sheet piles and steel bars. The dredged materials are used for the reclamation. But the clayey soil from the surface of the seabed are not available. Those materials should be disposed within the sheltered waters of the Estero Salado or Estero Cobina including low land areas.

- The earth cutting materials are estimated to be almost same cost as the dredged materials.
- The earth cutting materials are desirable in the environmental view points.

The quantities of the main construction materials are shown in Table III-5-3.

(d) Rubber fenders and bollards are imported from the overseas areas.

Table III-5-3(1) Main Construction Materials (Case X)

Materials	Unit	Quantity	Remarks
Earth Cutting Material	m^3	204,240	
Armor Stone	m^3	15,780	1,000kg
Filing Stone	m^3	39,340	500kg
Ready Mixed Concrete	m^3	6,580	
Asphalt Concrete	m^3	3,900	
Prestressed concrete Pile	Nos.	1,419	0.45x0.45, l=24-28 m
Concrete Sheet Pile	Nos.	370	0.2x1.0, l=23.5 m
Steel Bar	ton	660	100 kg/m^3

Table III-5-3(2) Main Construction Materials (Case Y)

Materials	Unit	Quantity	Remarks
Earth Cutting Material	m^3	14,430	
Armor Stone	m^3	7,220	1,000kg
Filling Stone	m^3	19,800	500kg
Ready Mixed Concrete	m^3	3,790	
Asphalt Concrete	m^3	740	
Prestressed Concrete Pile	Nos.	925	0.45x0.45, l=24-28 m
Concrete Sheet Pile	ton	185	0.2x1.0, l=23.5 m
Steel Bar		380	100 kg/m^3

(e) The standard type and size of construction equipments are available in Equador. But, the working vessels are limited to a few types. So, grab dredgers, barges, tug boats should be brought in from the overseas areas for this project.

(f) Skilled and unskilled labors required for the construction works are available in Equador. But, foreign personnel will be required for special skills such as seamen for the working vessels. Divers who can work for leveling underwater are also needed from the overseas areas.

B. Construction Work Method

1) Dredging and Reclamation

3. According to the construction record, channels and water basin was dredged by using self-propelled trailer dredger. In this project, dredging volume and planned area are small, and it is not appropriate to use large dredger because of its large cost. Therefore, the grab dredger is recommended in this case. A grab dredger is usually suitable for small/medium size of dredging, and its activity is not restricted largely by the dredging depth and the characteristics of the dredging materials. It is possible to dredge in front of the structures and at the narrow areas. On the other hand, it is not easy to make seabed flat compared to pump dredger. A grab dredger is categorized to self-propelled and nonpropelled types. Usually, a self-propelled dredger is larger and more resistible to wave action than the nonpropelled type. But, in this project the combination of the nonpropelled grab dredger barges and tug boats is planned for dredging work considering the site conditions comprehensively.

Table III-5-4 Combination of Working Vessels for Dredging

Grab Dredger	Tug Boat	Barge	Anchoring
Nonpropelled D2.0 m^3, 210 ps, 1 vessel	Wooden,20t, 80ps, 1 vessel	Loading Cap. 90 m^3, 2 vessels	Lifting Cap. 3t, 60ps 1 vessel

4. Planned dredging volume per hour:

$$q_0 = qxExn$$

Where;

q_0: Planned dredging volume of grab dredger per hour (m^3/hr)
q^* Working capacity of grab dredger per hour (91.2m^3/hr)
Grab capacity, 2.0m^3
Soil condition, N=4-10
E: Working efficiency, 0.95
n: Actual working time efficiency, 0.85

Therefore;

q_0 = 74m^3/hr

5. Assuming the distance between spoil disposal site and dredging site is 2km, the optimum combination of working vessels for dredging work is decided as follows:

Grab dredger, D2.0 m^3: 1
Tug boat, 80 ps: 1
Barge, 90 m^3:
Anchoring vessels, 3t: 1

6. Planned dredging volume is estimated as: water basin in front of the Container Terminal berth (-10.5 m); 29,600 m^3, foundation of the Container Terminal berth; 48,655 m^3, and foundation of the Multi-Purpose berth; 32,930 m^3. Dredged materials from the water basin are assumed to be unavailable and planned to be off-shore disposed. Other dredged materials will be used for the reclamation. The balance of dredging and

reclamation volume is planned below.

Table III-5-5(1) Balance of Dredging and Reclamation Volume (Case X)

(Unit: m^3)

Dredged, Earth Cutting Mat.	Off-Shore Disposal	Reclamation		Total
		Container Terminal	Multi-Purpose Terminal	
Water Basin	29,600	-	-	29,600
Container Berth	-	14,430	34,225	48,655
Multi-Purpose Berth	-	-	32,930	32,930
Earth Cutting Material	-	-	122,655	122,655
Total	29,600	14,430	189,810	233,840

Table III-5-5(2) Balance of Dredging and Reclamation Volume (Case Y)

(Unit: m^3)

Dredged & Earth Cutting Mat.	Off-Shore Disposal	Reclamation		Total
		Container Terminal	Multi-Purpose Terminal	
Water Basin	29,600	-	-	29,600
Container Berth	34,225	14,430	-	48,655
Multi-Purpose Berth	-	-	-	-
Earth Cutting Material	-	-	-	-
Total	63,825	14,430	-	78,255

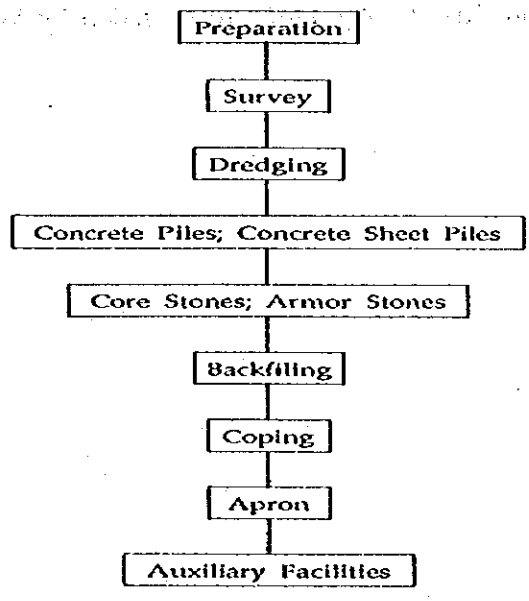


Figure III-5-1 Construction Flow of Wharf

2) Wharf (-10.5 m)

7. Structural type of wharf at Container Terminal is open-type wharf with concrete piles, and its construction process is shown below.

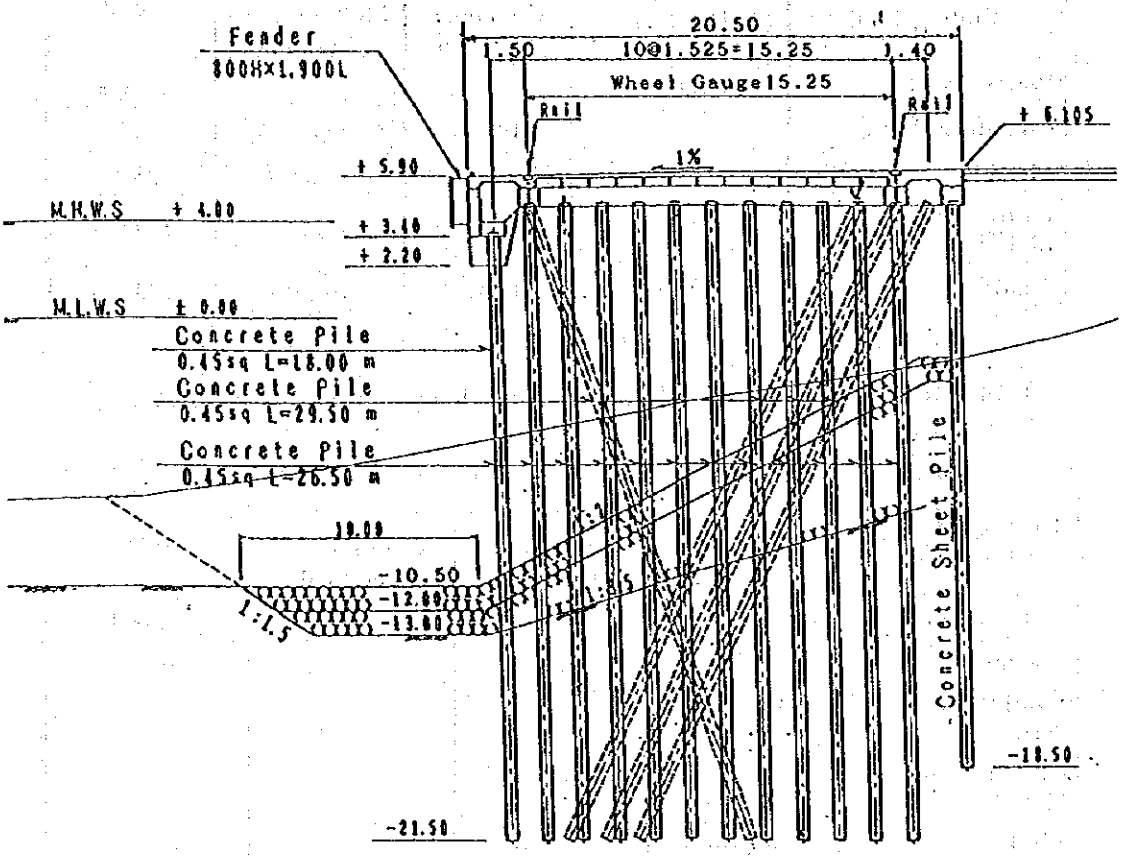


Figure III-5-2 Standard Cross Section by Work

8. In the construction of the wharf at Multi-Purpose Terminal,' reclamation work will be carried out in advance of the construction of the structure. Construction flow of the wharf is same as above.

(1) Dredging
Dredging at the foundation of wharf is carried out by using the grab dredger.

(2) Concrete Pile Driving, Concrete Sheet Pile Driving
Prestressed concrete piles for the wharf are manufactured locally. Above works will be done by using diesel pile hammer, D32 (ram weight 3.5ton), on a crawler crane.

(3) Core Stone, Armor Stones
Stones are loaded, transported and thrown on the foundation by using the barge. The surface of armor stones should be leveled by divers roughly. (±30 cm)

(4) Backfilling
This work is planned to reduce the soil pressure toward the sheet piles caused by reclamation, and stones under 50kg are chosen for the backfilling.

(5) Coping
After the pile driving, concrete coping consisting of beams and slabs is carried out by in-situ concrete.

(6) Apron
Apron is paved by asphalt concrete. The standard cross section of apron is shown below.

(Unit:cm)

Dense Graded Asphalt Conc.	5
Open Graded Asphalt Conc.	15
Graded Crusher Run	25
Crusher Run	35
	Design CBR=6

Figure III-5-3 Standard Cross Section of Apron

C. Construction Schedule

9. Construction schedule is made based on the following considerations.

(1) The construction of the port facilities is to start from 2000 and will be completed by 2002.

(2) The survey and detailed design will be implemented in advance of the construction works.

(3) The existing land area neighboring the container yard will be used as the temporary yard for the construction materials and machines. The access to this area should be constructed in advance.

(4) Working efficiency of main works is assumed as follows.

Table III-5-6 Working Efficiency

Works	Equipment	Working Efficiency
Dredging	Nonpropelled Grab Dredger D2.0 m^3, 210 ps	412 m^3/day
Pile Driving	Diesel Pile Hammer D32, Crawler Crane	3.4 piles/day
Sheet Pile Driving	Diesel Pile Hammer D32, Crawler Crane	3.1 piles/day
Core Stone	Clamshel, Barge, Tug Boat Floating Crane	247 m^3/day
Armor Stone	Clamshell, Barge, Tug Boat Floating Crane	168 m^3/day
Leveling	Diver's Boat	54 m^2/day
Pavement	Motor grader 3.1 m, Macadam roller 10-12t, Tire roller 8-20t, Finisher 2.4-5 m	98-102 m^2/day

(5) The revetment at the Multi-Purpose Terminal with a total length of 85.5 m needs a construction period of 2.4 months. After the completion of this facility, reclamation, pavement and road construction are planned to continue.

(6) The procurement and installation of the cargo handling equipments are planned for the final year.

10. The construction schedule is shown in Figure III-5-4.

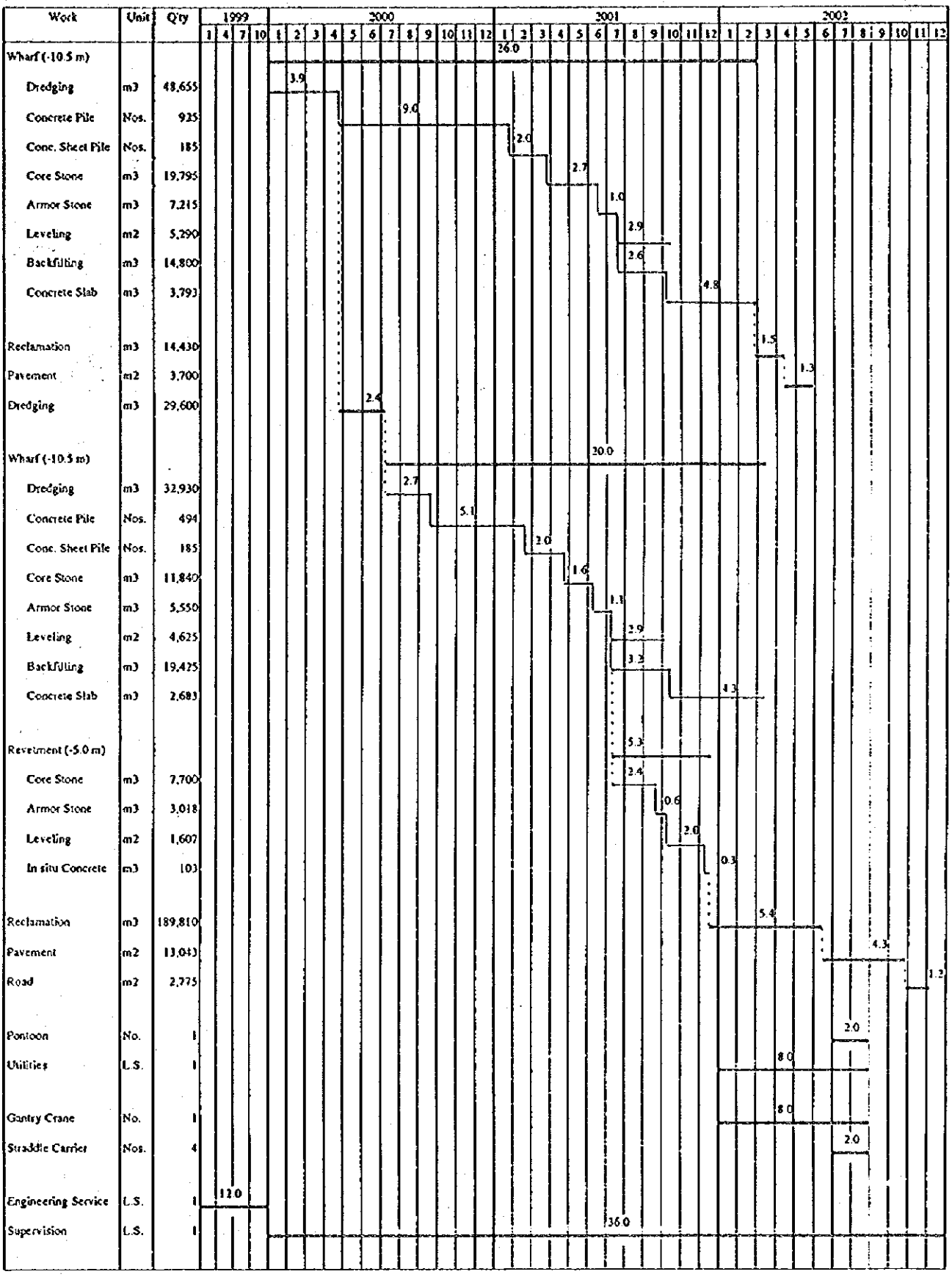


Figure III-5-4 Construction Schedule

Chapter 6 COST ESTIMATE

A. Conditions of Cost Estimate

1. The cost estimate is based on the following conditions.

(1) The cost of the construction materials, equipment and the labor rates are based on the market prices as of August 1994.

(2) The exchange rate is:

1 US$ = 2,240 Sucre
1 US$ = 100 Japanese Yen.

(3) Inflation is not taken into account.

(4) Foreign currency portion.
The cost estimate consists of a foreign currency portion and a local currency portion.
The costs of the foreign currency portion comprise:

- Costs of foreign labors.
- Imported material.
- Indirect foreign exchange components included in the materials/machines which are locally procurable such as cement and tractors.
- Rubber fenders, bollard and their attachments.
- Cargo handling equipment such as gantry cranes, straddle carriers etc.
- Consultation and supervising fee.

(5) Unit cost of labors, materials and rental charge of main construction machinery are the same price as that shown in Chapter 5, PART II.

(6) Taxes/duties on the imported equipment are excluded from the cost estimate.

(7) The cost of land acquisition is excluded from the cost estimate.

(8) The ratios of the utilities, engineering fee and physical contingency are shown below:

Table III-6-1 The Ratios of the Utilities

Facilities	Utilities
Wharf/Dolphin	4%
Dredging/Reclamation	0%
Container Yard	6%
Yard/Road	4%
CFS/Warehouse	8%

Table III-6-2 The Ratios of the Engineering Fee

Items	Engineering Fee
Civil Works	5%
Cargo Handling Equipment	3%

Table III-6-3 The Ratios of the Physical Contingency

Facilities	Physical Contingency
Wharf, Training Wall, Dolphin, Building	8%
Dredging, Reclamation, Revetment, Yard, Road	4%
Cargo Handling Equipment	0%

B. Construction Cost of Short-Term Plan

2. The construction costs of the Short-Term Plan are estimated at around 78,119,562 thousand Sucres in Case X and 55,784,287 thousand Sucres in Case Y respectively. The costs comprise:

Case X

	(Unit:1000 Sucres)
Civil Works	42,109,498
Utilities	1,622,789
Cargo Handling Equipment	28,153,664
Engineering Fee/Physical Contingency	6,233,611
Total	78,119,562

Case Y

	(Unit:1000 Sucres)
Civil Works	22,880,843
Utilities	903,829
Cargo Handling Equipment	28,153,664
Engineering Fee/Physical Contingency	3,845,951
Total	55,784,287

3. The project components of the Short-Term Plan and their costs are tabulated in Table III-6-4, III-6-5 and the yearly investments based on the construction schedule (Figure III-5-4) are shown in Table III-6-6, and III-6-7.

Table III-6-4 Project Cost of the Short-Term Plan (Case X)

(Unit: Thousand Sucres)

Facilities	Unit	Q'ty	Unit Cost	Foreign	Local	Total
Container Terminal:				9,174,609	13,415,034	22,589,643
Wharf(-10.5m)	m	185	119,625	8,962,903	13,167,722	22,130,625
Reclamation	m3	14,430	6.61	17,169	78,213	95,382
Pavement	m2	3,700	47	38,954	134,946	173,900
Dredging(-10.5m)	m3	29,600	6.41	155,584	34,152	189,736
Multi-Purpose Terminal:				6,916,254	12,312,401	19,228,655
Wharf(-10.5m)	m	185	83,937	6,288,980	9,239,365	15,528,345
Revetment(-5.0m)	m	85.5	19,909	234,906	1,467,313	1,702,220
Reclamation	m3	189,810	6.61	225,836	1,028,808	1,254,644
Pavement	m2	13,043	47	137,317	475,704	613,021
Road(185m)	m2	2,775	47	29,215	101,210	130,425
Service Boats Area:				291,200	0	291,200
Pontoon	No.	1	291,200	291,200	0	291,200
Sub-Total				16,382,063	25,727,435	42,109,498
Utilities	L.S.	1	1,622,789	639,339	983,450	1,622,789
Cargo Handling Equipment:				28,153,664	0	28,153,664
Gantry Crane	No.	1	19,857,600	19,857,600	0	19,857,600
Straddle Carrier	Nos.	4	2,074,016	8,296,064	0	8,296,064
Sub-Total				28,793,003	983,450	29,776,453
Total Cost				45,175,066	26,710,885	71,885,951
Engineering Service	L.S.	1	3,031,224	3,031,224	0	3,031,224
Physical Contingency	L.S.	1	3,202,387	1,277,006	1,925,381	3,202,387
Grand Total				49,483,296	28,636,266	78,119,562

Table III-6-5 Project Cost of the Short-Term Plan (Case Y)

(Unit: Thousand Sucres)

Facilities	Unit	Q'ty	Unit Cost	Foreign	Local	Total
Container Terminal:				9,174,609	13,415,034	22,589,643
Wharf(-10.5m)	m	185	119,625	8,962,903	13,167,722	22,130,625
Reclamation	m3	14,430	6.61	17,169	78,213	95,382
Pavement	m2	3,700	47	38,954	134,946	173,900
Dredging(-10.5m)	m3	29,600	6.41	155,584	34,152	189,736
Multi-Purpose Terminal:				0	0	0
Wharf(-10.5m)	m	0	83,937	0	0	0
Revetment(-5.0m)	m	0	17,365	0	0	0
Reclamation	m3	0	6.61	0	0	0
Pavement	m2	0	47	0	0	0
Road(185m)	m2	0	47	0	0	0
Service Boats Area:				291,200	0	291,200
Pontoon	No.	1	291,200	291,200	0	291,200
Sub-Total				9,465,809	13,415,034	22,880,843
Utilities	L.S.	1	903,829	371,722	532,107	903,829
Cargo Handling Equipment:				28,153,664	0	28,153,664
Gantry Crane	No.	1	19,857,600	19,857,600	0	19,857,600
Straddle Carrier	Nos.	4	2,074,016	8,296,064	0	8,296,064
Sub-Total				28,525,386	532,107	29,057,493
Total Cost				37,991,195	13,947,141	51,938,336
Engineering Service	L.S.	1	2,033,844	2,033,844	0	2,033,844
Physical Contingency	L.S.	1	1,812,107	748,796	1,063,310	1,812,107
Grand Total				40,773,835	15,010,451	55,784,287

Table III-6-6 Yearly Investments for Short-Term Plan (Case X)

(Unit: Thousand Sucres)

Facilities	Grand Total			1999			2000			2001			2002		
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
Container Terminal:	9,174,610	13,415,033	22,589,643	0	0	0	4,292,308	6,111,563	10,403,871	4,136,724	6,077,410	10,214,135	745,577	1,226,061	1,971,638
Wharf(-10.5m)	8,962,903	13,167,722	22,130,625				4,136,724	6,077,410	10,214,135	4,136,724	6,077,410	10,214,135	689,454	1,012,902	1,702,356
Reclamation	17,169	78,213	95,382										17,169	78,213	95,382
Pavement	38,954	134,946	173,900										38,954	134,946	173,900
Dredging(-10.5m)	155,584	34,152	189,736				155,584	34,152	189,736						
Multi-Purpose Terminal:	6,916,254	12,312,402	19,228,655	0	0	0	1,792,359	2,633,219	4,425,578	3,986,133	6,872,507	10,858,640	1,137,761	2,806,675	3,944,437
Wharf(-10.5m)	6,288,980	9,239,365	15,528,345				1,792,359	2,633,219	4,425,578	3,773,388	5,543,619	9,317,007	723,233	1,062,527	1,785,760
Revetment(-5.0m)	234,906	1,467,314	1,702,220							212,745	1,328,888	1,541,633	22,161	138,426	160,587
Reclamation	225,836	1,028,808	1,254,644										225,836	1,028,808	1,254,644
Pavement	137,317	475,704	613,021										137,317	475,704	613,021
Road(185m)	29,215	101,210	130,425										29,215	101,210	130,425
Service Boats Area:	291,200	0	291,200	0	0	0	0	0	0	0	0	0	291,200	0	291,200
Pontoon	291,200	0	291,200										291,200	0	291,200
Sub-Total	16,382,063	25,727,435	42,109,498	0	0	0	6,084,667	8,744,782	14,829,449	8,122,857	12,949,917	21,072,775	2,174,539	4,032,736	6,207,274
Utilities	639,339	983,450	1,622,789	0	0	0	0	0	0	0	0	0	639,339	983,450	1,622,789
Cargo Handling:	28,153,664	0	28,153,664	0	0	0	0	0	0	0	0	0	28,153,664	0	28,153,664
Gantry Crane	19,857,600	0	19,857,600										19,857,600	0	19,857,600
Straddle Carrier	8,296,064	0	8,296,064										8,296,064	0	8,296,064
Sub-Total	28,793,003	983,450	29,776,453	0	0	0	0	0	0	0	0	0	28,793,003	983,450	29,776,453
Total Cost	45,175,066	26,710,885	71,885,951	0	0	0	6,084,667	8,744,782	14,829,449	8,122,857	12,949,917	21,072,775	30,967,542	5,016,186	35,983,727
Engineering Service	3,031,224	0	3,031,224	1,485,300	0	1,485,300	515,308	0	515,308	515,308	0	515,308	515,308	0	515,308
Physical Contingency	1,277,006	1,925,381	3,202,387	0	0	0	425,669	641,794	1,067,462	425,669	641,794	1,067,462	425,669	641,794	1,067,462
Grand Total	49,483,296	28,636,266	78,119,562	1,485,300	0	1,485,300	7,025,644	9,386,575	16,412,219	9,063,834	13,591,711	22,655,545	31,908,518	5,657,979	37,566,498

Table III-6-7 Yearly Investments for Short-Term Plan (Case Y)

(Unit: Thousand Sucres)

Facilities	Grand Total			1999			2000			2001			2002		
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
Container Terminal:	9,174,610	13,415,033	22,589,643	0	0	0	4,292,308	6,111,563	10,403,871	4,136,724	6,077,410	10,214,135	745,577	1,226,061	1,971,638
Wharf(-10.5m)	8,962,903	13,167,722	22,130,625				4,136,724	6,077,410	10,214,135	4,136,724	6,077,410	10,214,135	689,454	1,012,902	1,702,356
Reclamation	17,169	78,213	95,382										17,169	78,213	95,382
Pavement	38,954	134,946	173,900										38,954	134,946	173,900
Dredging(-10.5m)	155,584	34,152	189,736				155,584	34,152	189,736						
Service Boats Area:	291,200	0	291,200	0	0	0	0	0	0	0	0	0	291,200	0	291,200
Pontoon	291,200	0	291,200										291,200	0	291,200
Sub-Total	9,465,810	13,415,033	22,880,843	0	0	0	4,292,308	6,111,563	10,403,871	4,136,724	6,077,410	10,214,135	1,036,777	1,226,061	2,262,838
Utilities	371,722	532,107	903,829	0	0	0	0	0	0	0	0	0	371,722	532,107	903,829
Cargo Handling:	28,153,664	0	28,153,664	0	0	0	0	0	0	0	0	0	28,153,664	0	28,153,664
Gantry Crane	19,857,600	0	19,857,600										19,857,600	0	19,857,600
Straddle Carrier	8,296,064	0	8,296,064										8,296,064	0	8,296,064
Sub-Total	28,525,386	532,107	29,057,493	0	0	0	0	0	0	0	0	0	28,525,386	532,107	29,057,493
Total Cost	37,991,196	13,947,140	51,938,336	0	0	0	4,292,308	6,111,563	10,403,871	4,136,724	6,077,410	10,214,135	29,562,163	1,758,168	31,320,331
Engineering Service	2,033,844	0	2,033,844	996,584	0	996,584	345,753	0	345,753	345,753	0	345,753	345,753	0	345,753
Physical Contingency	748,796	1,063,311	1,812,107	0	0	0	249,599	354,437	604,036	249,599	354,437	604,036	249,599	354,437	604,036
Grand Total	40,773,836	15,010,451	55,784,287	996,584	0	996,584	4,887,660	6,466,000	11,353,660	4,732,077	6,431,847	11,163,924	30,157,515	2,112,605	32,270,120

Chapter 7 PORT MANAGEMENT AND OPERATION PLAN

A. Background of Short Term Plan

1. At present APG conducts almost all port related business including cargo handling service. However, to promote efficiency of port operation, privatization of port service is being studied by UNCEMP. The laws and regulations related to privatization, such as the General Regulation of National Modernization Law, Privatizing Law and Present Public Service by Private Initiative Law, have already been established. According to these laws and regulations, all port service for users of Guayaquil port will be provided by APG or private entities licensed as Port Operator (Operador Portuario, OP) by DIGMER.

2. The OP license is classified into three categories, namely Port Cargo Operator (Operador Portuario de Carga, OPC), Port Ship Operator (Operador Portuario de Buque, OPB) and Supplementary Service Company (Empresa de Servicio Complementarios, ESC). The scope of each is as follows.

OPC : provide service concerned with transfer of cargo
OPB : provide service concerned with ships
ESC : complementary activities or the support of port services

3. And if the OP intends to provide port services by use of land or water in the jurisdiction area of the port, he must make a contract of concession or permission or storage with APG. Concession contract is entered into when the use period will be more than 3 years or OP wants to erect buildings or install facilities. Permission contract carries an occupation term of less than 1 year and OP cannot erect buildings. Storage contract is applied when it is necessary to temporarily store cargo (this is the same as a commercial lease).

4. APG can enter contracts with OP for the concession of land, facilities and equipment. Cargo handling machines or equipment not for concession, can be rented or bought by OP. OP operates and maintains this equipment.

5. But, from the viewpoint of public interest, important main facilities such as berth, apron, gantry crane, road and so on are not for concession.

6. The service contents of APG, OPC, OPB and ESC are shown in Table III-7-1.

Table III-7-1 Service Contents of APG, OPC, OPB and ESC

Service	APG	OPB	OPC	ESC
Pilotage service		+		
Tug service		+		
Assignment of Berth, Mooring and Anchorage zone	+			
Lighterage and Line handling service		+		
Dredging	+			
Water, Electricity, Telephone and Fuel supply		+		
Security service		+		
Cleaning service		+		
Ships Repairs				+
Other supplementary and aid service (Laundry, Medical etc.)				+
Cargo handling (including cargo security)			+	
Cargo transport			+	
Deposit and Storage service			+	
Labor provision service			+	
Machine provision service (by way of concession, rental, sale)	+			
Main facilities (except berth, apron etc.) provision service (by way of concession, rental)	+			

7. After privatization, the main role of APG will be as follows.

- To ensure that there is fair competition and that efficient port services are provided
- To collect charges from OP
- To plan future port development based on users' demands
- To collect and analyze users' demand
- Port services, berth allocation etc., and collect charge from user

B. Role of Port Authority in Short Term Plan

8. Public sector is not always efficient in the field of service provision such as cargo handling service, because it is often difficult for the public sector to be flexible in investment and personnel management. The monopolistic nature of the public sector tends to adversely affect the level of services. These services should thus be transferred to the private sector.

9. To create a proper competitive environment it is desirable that each of the services should be transferred to plural private companies; each company would be able to directly enter into contracts with shipper and shipping companies, each would have the opportunity to make a profit. Newcomers should be allowed to enter into these businesses as well.

1) Administration of Port Area and Port Facilities

(a) General

10. Ports are important infrastructure for the national economy and have a public character in general. Ports should be controlled properly to preserve national benefits and keep fair use for the public. In principle, it is not desirable that only a limited number of persons use the port area exclusively.

11. Port Authority has to define and control its port area, port infrastructure and port facilities properly to make the port function efficiently. The port area should include a future development area in which new waterways, basins and piers will be constructed.

12. Port authority should own basic port facilities even if a part of port facilities such as mobile cranes or forklifts are owned by the private sector, so as to control the port in a fair manner. Port infrastructure and facilities which port authority should own, possess and control in principle are shown below.

- Water facilities (waterways and basins)
- Mooring facilities (berth, dolphins, mooring buoys)
- Cargo handling facilities (shed, cargo sorting area, major crane)
- Port and harbor environmental protection facilities (green areas)
- Port access facilities (main road)

13. Port authority has to strictly supervise use of the facilities to avoid exclusive use and to ensure they are not used for other purposes. For administration of port water area and land area, the same conditions apply.

14. According to results of the study by UNCEMP, all port facilities will be owned by APG and will be rented to the OP, by concession and permission etc.. In addition, some of APG's equipment may be sold to OP for cargo handling. Based on the above, to the extent that APG wishes to promote the national economy and port, it will be possible to control and supervise OP.

(b) Port Planning

15. Private companies bring their ability into full play to increase profit in the short term through efficient operation and determined efforts to collect customers, but private entities are often indifferent to the long term future plan from the standpoint of the national economy. Therefore, as the important public facilities, port planning should be conducted by public entities.

16. In any case, administration of port area, infrastructure and facilities should be based on "the port policy and plan". So APG should formulate the port policy and plan as soon as possible, because the number of applications for usage of port infrastructure and facilities will increase rapidly after commercialization.

17. In this sense, it would be effective for APG install a technical executive as the top ranking person of technical personnel.

(c) Maintenance

18. When the OP operates the cargo handling equipment which will be rented by concession and permission from APG, APG should make OP maintain the equipment.

19. To impose a duty on the OP to maintain this equipment not only helps reduce the maintenance cost for the OP, but also forces the OP to use the facilities responsibly.

20. But, it is inefficient for each OP to maintain various kinds of equipment from the view point of procuring parts and securing technical person. Therefore it is hoped that private entities specializing in maintenance would enter the port service business.

21. Whether a private entity already exists or will be newly established, it is reasonable that the technical employees and labors in APG be transferred to the private entity. Since they are both familiar and skillful with the equipment, training is unnecessary.

22. Furthermore, this transfer means that the unemployment rate will not be affected and also that the dismissal allowance paid by APG will be minimized. Therefore, introduction of a private maintenance company has advantages for both APG and OP.

(d) Port Statistic System

23. To formulate a port development plan, estimation of future demand is necessary. Thus analysis of present turnover or actual condition of port is indispensable. To formulate marketing strategy, such an analysis is also necessary.

24. Establishment of a quick and proper information service system is also desirable. Port users require accurate and updated information. APG should improve its statistic system to provide quick information.

(e) Operation System

25. When we take into consideration that a port should be open to public use, it is preferable to avoid conceding the berth or apron to a specific private company. However, land, warehouse, yard etc. behind apron can be conceded to private entities by concession contract without causing any problems.

26. APG is studying a case in which it would be better for cargo handling that the berth allocated by APG is in front of the concession area.

27. Therefore, APG should allocate the berth with due consideration given to cargo handling efficiency. It is necessary to coordinate between APG and related entities and to collect information about ships, such as arrival/departure time, contracted OP etc.

(f) Tariff

28. At present APG wants to introduces private companies into port related businesses through concession, permission and rent. But, the charges have not yet been decided. After commercialization, APG permits OP to use shed, port facilities such as cargo handling facilities on a normal basis. APG has to establish a new tariff to be applied to these facilities.

29. Without this tariff system, commercialization can not be realized; therefore, this tariff must be established.

2) Supervision of OP

30. APG intends to diligently pursue effort for efficient cargo handling, improvement of port service and security of cargo through privatization. The flexibility and rationality of organization and investment and high morale of personnel due to incentives in the wage system are the results that are expected from privatization. All of these effects and results are based on the competitive principle.

31. Therefore even private entities will not be able to achieve efficient operation in every stage without the competitive principle.

32. On the other hand, if private entities depart from the original purpose of a port, that is, supporting the national economy and the life of a people, and trade by dishonest means in the sole pursuit of profit, the country will suffer heavy damage.

33. APG is charged with the heavy responsibility of bringing out the strong points and holding down the weak points in the OP.

34. There are other important functions for APG in addition to that mentioned above. APG has to tackle many kinds of delicate situations.

- forecast future demand and control the OP
- introduce a proper competitive environment into port businesses
- adjust conflicting interests.

3) selection of OP

35. After modernization, most port services will be properly operated by OP to realize fair and efficient port activities.

36. As to the relationship between APG and contractor, it is realistic that APG selects, contracts and supervises OP on the register as licensee. And the license should be given by public entity because it is necessary to select the licensee on fair and neutral grounds.

37. APG selects licensee and concedes the land, warehouse, yard and so on to them. In this case, a specific shipper or consignee is not suitable as a contractor to conduct fair operation because these is a fear they would be partial to their related companies, and the port would cease to be open to public use. So it is better that APG contracts with plural shipping agents or cargo handling companies as the concessionaires. And APG will strictly prohibit these concessionaires from showing favoritism toward specific shipping companies.

38. In case of multi purpose berths it is possible that there are only a few OP which want to make a concession contract. Multi purpose berths will mainly carry conventional general cargo, vehicles, containers carried by conventional ships; these cargoes are normally handled irregularly at different sites and times. So profit of cargo handling service for rent of yard and sheds when necessary is higher than the concession rate. In this case, port service business should also be provided by the licensed OP. APG rents them the yard and warehouse each time, and collects fees.

39. As mentioned above, APG has final power to select OP directly. Therefore, APG should collect and analyze OP's information, and at last APG itself makes a registration list. This is because APG must always supervise and observe OP's ability, efficiency, effort, enthusiasm and so on.

4) Concession Contract between Private and APG

(a) Outline of Concession

40. In case of privatization by concession at newly expanded berth, it is important to examine and decide which type of facilities or equipment should be conceded in the early stage, taking procurement ability of concessionaires into consideration. Otherwise, Port Authority will be unable to decide which facilities and equipment should be procured for the port.

41. Generally, there are few big private entities that can procure expensive port facilities, such as new berth, gantry crane in developing countries. In this case, it is thought better that Port Authority procures these expensive facilities, and concessionaires procure other cargo handling equipment such as straddle carrier, forklifts, tractors and chassis if concessionaires can afford them.

42. Concerning existing berth, if possible, Port Authority should concede all facilities and equipment to private entities, except main port facilities such as berth and gantry crane. If not, Port Authority should sell all equipment excluding gantry crane, though negotiations are often troublesome.

43. APG will not procure new facilities and equipment in order to reduce initial investment cost, and reduce tiresome works concerning maintenance and replacement of facilities and equipment. But it may be reasonable for APG to prepare another choice for concession of multipurpose berths and procurement of gantry crane by OP.

(b) Lease Charge

44. In general, types of concession charge are classified as shown below.

- Flat rate type
- Mini-max rate type
- Shared revenue type

The contents of these types and the better selection for APG ("Flat rate type" or "Mini-max rate type") are mentioned in Chapter 8.

45. It may be necessary for APG to keep the charge at a reasonably low level in the first stage. But APG must be careful when setting this kind of charge. This kind of incentive sometimes makes the concessionaire too dependent on an indulgent owner. After setting the charge at such a low level, to subsequently raise the tariff sometimes becomes difficult in actual practice.

(c) Period of Concession

46. If an investment is required of the concessionaire, the period of concession should be set taking the loan period of the investment into consideration. In Japan, the lease period is generally 10 years, which may be an instructive example.

47. At APG the upper limit of the period is not decided under the regulation. It may be decided case - by - case by contract. But it is desirable that APG decide criteria for the upper limit of contract term.

(d) Others

48. The items concerning conditions of cancellation should be included in the contract. At some ports, the concession contract states that the owner can cancel the contract if the concessionaire cannot collect more than a certain volume of cargo. But APG should carefully examine whether to include this kind of item because this may intervene with the concessionaire's activity.

49. The following are items which should be included in the concession contract.

- Procedure to cancel or change the contract
- Restriction of use outside the scope of purpose
- Insurance with owner as the insured party
- Interest on delinquent payment
- Obligatory submission of statistical data

5) Organization and Personnel

(a) Organization

50. APG is responsible for managing ports, and must undertake new kinds of jobs such as commercialization of port service in an efficient and orderly manner. New jobs of each department for commercialization are shown below.

a) Technical Executive

51. At present, APG is studying this post as the supervisor of technical businesses. After the modernization, port planning and maintenance of main facilities, berth, road etc., will become more important to support the activities of OP. Therefore, APG should establish this post as soon as possible.

b) Legal Department

52. This department must establish contracts and supervise system concerning OP. It also plays a leading role in creating an institutional system to introduce a proper competitive environment.

c) Administrative Department

53. This department must draft the administration system after privatization. There are many difficult problems concerning working conditions.

d) Personnel Department

54. This department must draft the personnel system after privatization. There are many difficult new tasks such as personnel affairs, transfer of APG personnel and personnel training.

e) Financial Department

55. As a result of modernization, items of income and expenditure will be drastically changed. This department must assess the new financial picture to cope with the change in the financial structure and establish a sound financial condition.
It will also be necessary to compile more detailed statistics and conduct detailed demand forecast regularly.

f) Technical Department

56. This department is in charge of design, supervision of construction works which may be entrusted to OP such as maintenance and repair of berth, road and administrative building.
In addition, formulation of the port policy and plan is one of most important jobs.

(b) Personnel

57. If privatization is introduced in APG, certain number of personnel will be transferred to other entities. On the other hand, APG has to tackle many kinds of difficult jobs for which it has no experience. To cope with this situation, APG needs experts as mentioned above. Reduction of personnel should be done carefully, so as not to lose valuable human resources.

Chapter 8 CARGO HANDLING SYSTEM

A. General Conditions

1) Preface

1. The cargo handling system may not be treated in a specific stage such as "short term" or "master plan". Rather, the cargo handling should be modified or changed as required throughout the course of the study. In some cases, immediate treatment is required while in others the need for improvement might not be quite so urgent.

2) Privatization

2. Since current APG has already lost the ability to handle cargo/container at the GYE by reasons of reduction of the work force/absence of the proper management/shortage of the skilled labor/lack of cargo handling equipment/lack of knowledge in modern cargo handling/ etc., immediate introduction of the private sector vitality is strongly requested.

3) Berth allocation

3. To perform more efficient cargo handling operation, it is commonly held that the distance between the place of rest and the ship's tackle should be shortened. For this purpose, hauling of the cargo across the wharf should be avoided or, in other words, ships related to the Cargo Operator in the Port (hereafter referred to as "the OPC") should berth at the OPC's wharf. APG should give the OPC preferential use of the wharf in front of their yard for the ships related to the OPC. Even in this case, APG might be entitled to levy the berthage/wharfage on cargo on the shipping line to recover the construction cost of the wharf/ apron and administration cost of APG.

4) Adoption of Cut-off Time System for the export cargo/containers

4. This system is to close receiving of the export cargo/containers at some time on the previous day of the ship's arrival, while preparation for cargo/containers loading, i.e. palletizing of cargo, preparation of sequence check list etc. can be done prior to the ship's arrival. This system is quite common throughout the world to reduce ship's staying time in the port and to avoid interruption in the cargo handling. In the case of banana, freshness is essential, and thus the system should adopt the sailing time, i.e. cut-off receiving of the banana 3 hours prior to ship's ETD (Estimate Time of Departure), instead of the previous day.

5) Division of APG site/Unit of the terminal operation

5. Current APG site should be divided into sections/yards based on the required berth length expected in the future. A different OPC is designated for each yard for administration and physical operation of the yard. In case of the breakbulk general cargo wharf, berth length should be treated flexibly to meet with the OPC's estimated ship size in the future. The OPC is able to operate multiple wharves if the volume of cargo/containers is sufficient.

6. When the container yard is divided into sections, it is necesary to build a gate complex for each terminal and throughout operation (from the gate to the ship or vice versa) should be carried out independently. This will result in the following ;

(1) Administration and management of the terminal will be conducted independently by the OPC with absolute responcibility.
(2) Effective competition among the OPCs will be promoted.
(3) Loss and/or theft of cargo will be minimized.

B. Proposed container Handling System

1) Rehabilitation of the container yard

7. For effective terminal operation, overall repavement of the CY is required taking account of the new operation mode and new container handling system to be employed by the OPC. As mentioned in 2. below, the Straddle Carrier System is very suited to the GYE, however, existing transfer cranes should be utilized by some of the OPC while they are workable. In general, in view of the supply of the spare parts and flexible use of equipment, uniformity of equipment type is desirable. The top-lifter and/or front loader should be used only to handle empty containers and not be used on the apron.

2) Container handling equipment

8. In the Transfer Crane System, yard tractor plays the important role of carrying containers between quay-side container crane and transfer crane in the yard. Spotting of the spreader onto the container or of the container onto the yard tractor/chassis is quite easy when containers are handled with the regular type of container crane or bridge-type ship's crane equipped on the deck, however, in the case of the GYE, so many non cellular multipurpose and conventional breakbulk ships are involved and containers on these ships are usually handled with Jib Crane on the ship's deck and/or Crawler Crane on the apron without attaching spreader. Under such conditions, because of the sway and twist of container caused by use of such non-standardized container crane, spotting is not so easy, time consuming and sometimes causes accidents. Contrary to the Transfer Crane System, in the Straddle Carrier System, the yard tractor/chassis is not involved in the course of the operation and the straddle carrier always picks up containers, which are lain on the ground standing still with whatever type of gantry crane, directly from the ground. If the ship type remains unchanged, the Straddle Carrier System is very suited to the GYE.

9. Though current container yard is to be divided and operated by multiple OPCs, container handling equipment including straddle carriers (if any in the future) can be pooled or owned by an independent firm. Purposes of which are as follow ;

(1) to avoid excessive investment
(2) to use equipment flexibly
(3) to make maintenance easy and economical

3) Introduction of computerized container operation system

10. Since it will be difficult to introduce the total computer system right away, it will thus be necessary to start with a small scale computer system which has the following functions;

(1) promoting the stacking plan
(2) determining container stacking location (address)
(3) promoting the sequence plan of loading and discharging

11. As the next step, the total computer system should be introduced. The basic concept of this system is divided into following three systems (refer to the Master Plan for details);

(1) terminal control system
(2) terminal planning system
(3) documentation system

4) Provisional lay-out of the container terminal

12. Provisional lay-out for the current wharf # 1-A, where the Straddle Carrier System is to be applied, is shown in Figure III-8-1. Storage capacity of the container terminal is calculated as follows;

		ground	tier	total
Dry container	15 (rows) x 13 (bays) = 195			
	x 4 (blocks)	780	2.5	1,950
Reefer container	25 (plugs)x 2 (blocks)=	50	2.0	100
Total	Min. (in case all reefer containers are 20')			2,050(TEU)
	Max. (in case all reefer containers are 40')			2,150(TEU)

13. Based on the above lay-out, flows of the container are shown in Figure III-8-2 (receiving/delivery) and Figure III-8-3 (loading/unloading) respectively.

14. The mobilization of container handling equipment should always be uni-directional so that the door of the container on the ship always faces the stern, however, in case of refrigerated container, instead of the container door, freezing machine should always face the stern in order to avoid damage to the machine by water hammer. In the Figure III-8-3, flow of the container is drawn anticlockwise, however, in this lay-out, loading of refrigerated container requires long hauling and U-turn on the apron. Therefore, in this case only, to save long hauling and minimize the number of straddle carriers, clockwise mobilization might be allowed on condition that there is no interference with flow of other type of container handling.

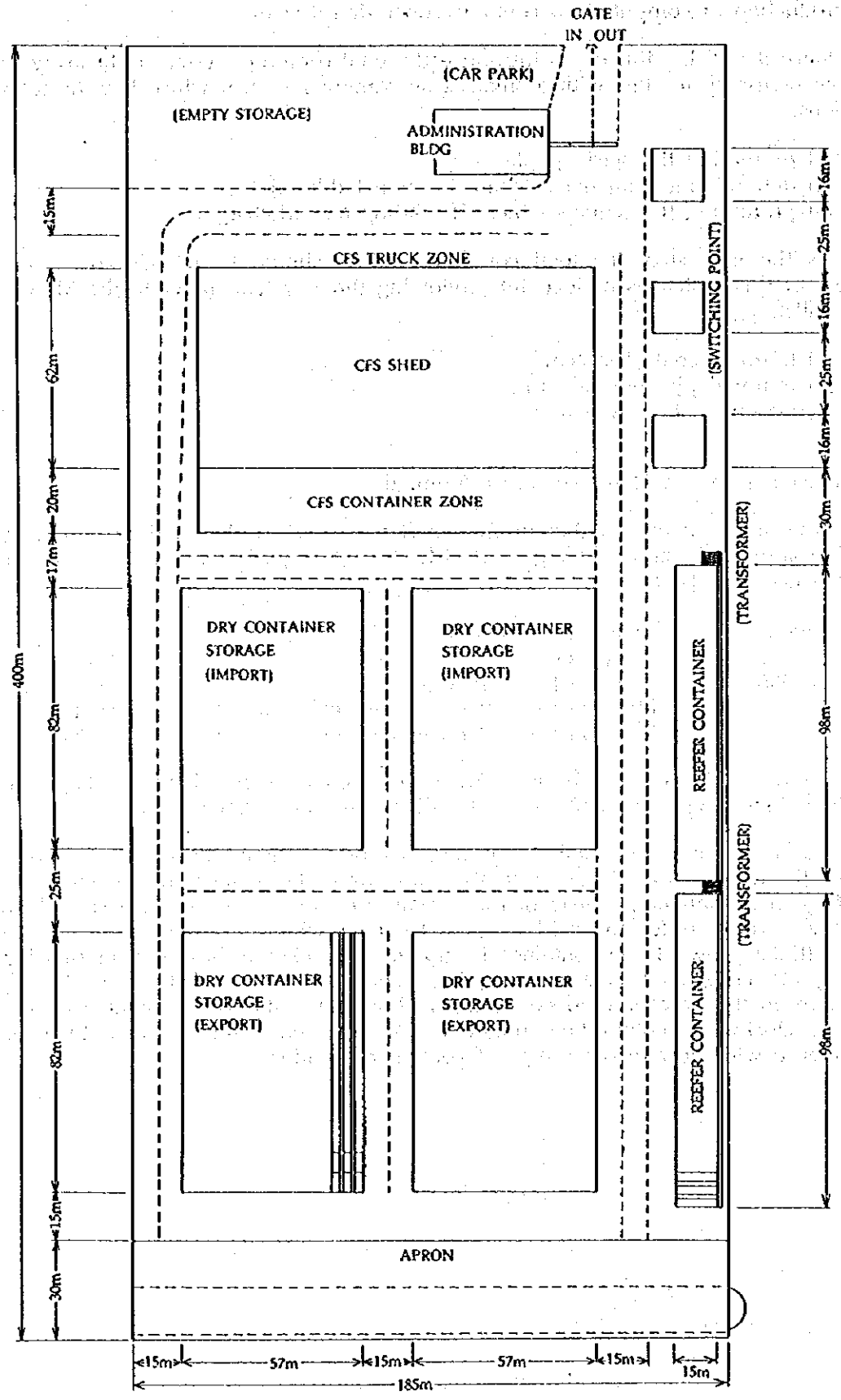


Figure III-8-1 Container Terminal Provisional Lay-out (Straddle Carrier Operation)

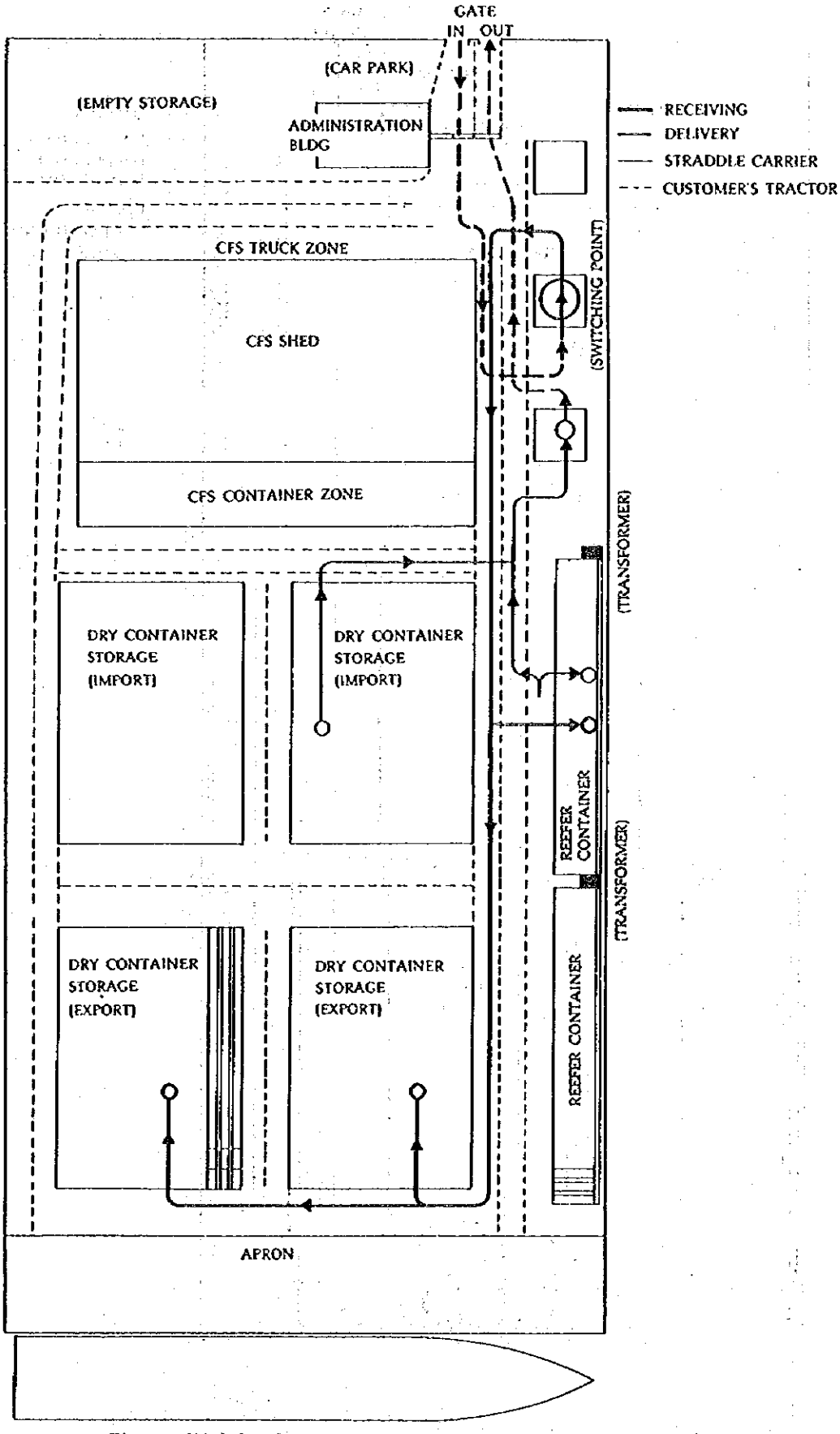


Figure III-8-2 Container Flow (Receiving and Delivery)

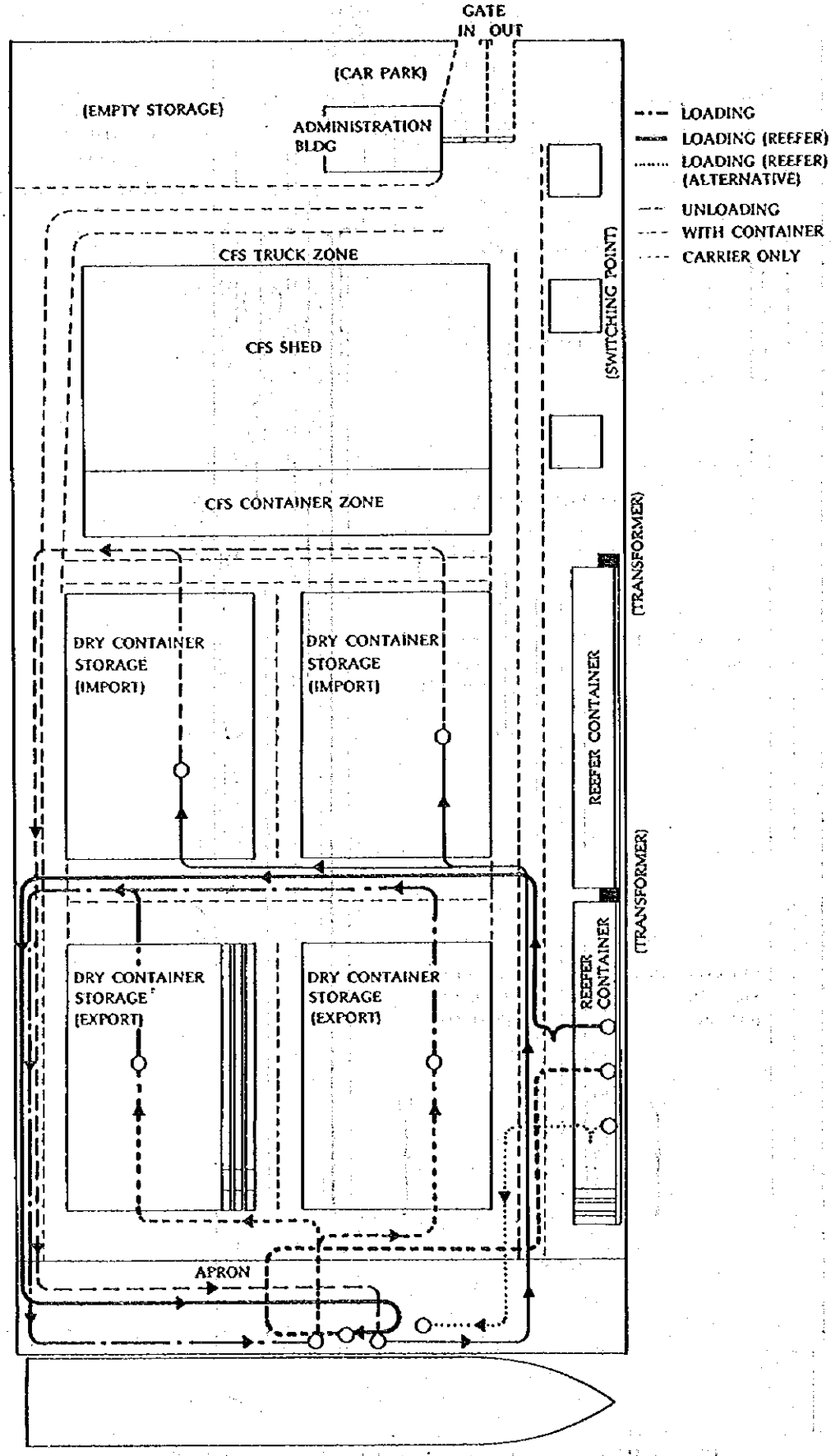


Figure III-8-3 Container Flow (Loading and Unloading)

C. Proposed Breakbulk Cargo Handling System

1) Width of the Apron

15. Existing apron covering wharf # 2-6 should be widened to at least 25m to handle containers with heavy duty equipment. Taking this opportunity, existing transit sheds should be removed and reconstructed to meet the new operation mode to be conducted by the OPC or, as an alternative, shift the existing transit sheds to 10 to 15m inland if physically possible.

2) Practical use of the transit shed

16. In order to conduct more efficient cargo handling, practical use of the transit shed directly behind the wharf/apron is indispensable. When the following conditions are in order, practical use of the transit shed will be readily accomplished.

(1) reconstruction or rehabilitation of the transit shed
(2) preferential assignment of the wharf

17. Since the wharf for berthing shall be assigned far before the ship's arrival, receiving of the cargo prior to the ship's arrival at the transit shed is possible, thus the sufficient previous arrangement for loading of the export cargo, i.e. palletizing etc. is possible and also preparation of cargo handling equipment can be arranged with ease. Because of the short transportation distance of the forklift, number of equipment will be minimized and possibility of loss and/or theft will also be minimized.

Chapter 9 ECONOMIC ANALYSIS

A. Purpose of the Economic Analysis

1) Purpose

1. The purpose of this chapter is to appraise the economic feasibility of the Short-term Plan for the port development from the viewpoint of the national economy. Thus, this chapter focuses on whether the net benefits of this development project exceed those which could be derived from other investment opportunities in the Republic of Ecuador.

2) Methodology of the Economic Analysis

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

3. There are various methods to evaluate the feasibility of this type of development project. Here, the economic internal rate of return (EIRR) based on cost-benefit analysis is used to appraise the feasibility of this project. The EIRR is a discount rate which makes the costs and the benefits of the project during the project life equal, and it is calculated using the following formula:

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

Where, Bi : Benefits in the i-th year
Ci : Cost in the i-th year
r : Discount rate
n : Period of project life

4. The procedure used for this economic analysis is shown in Figure III-9-1.

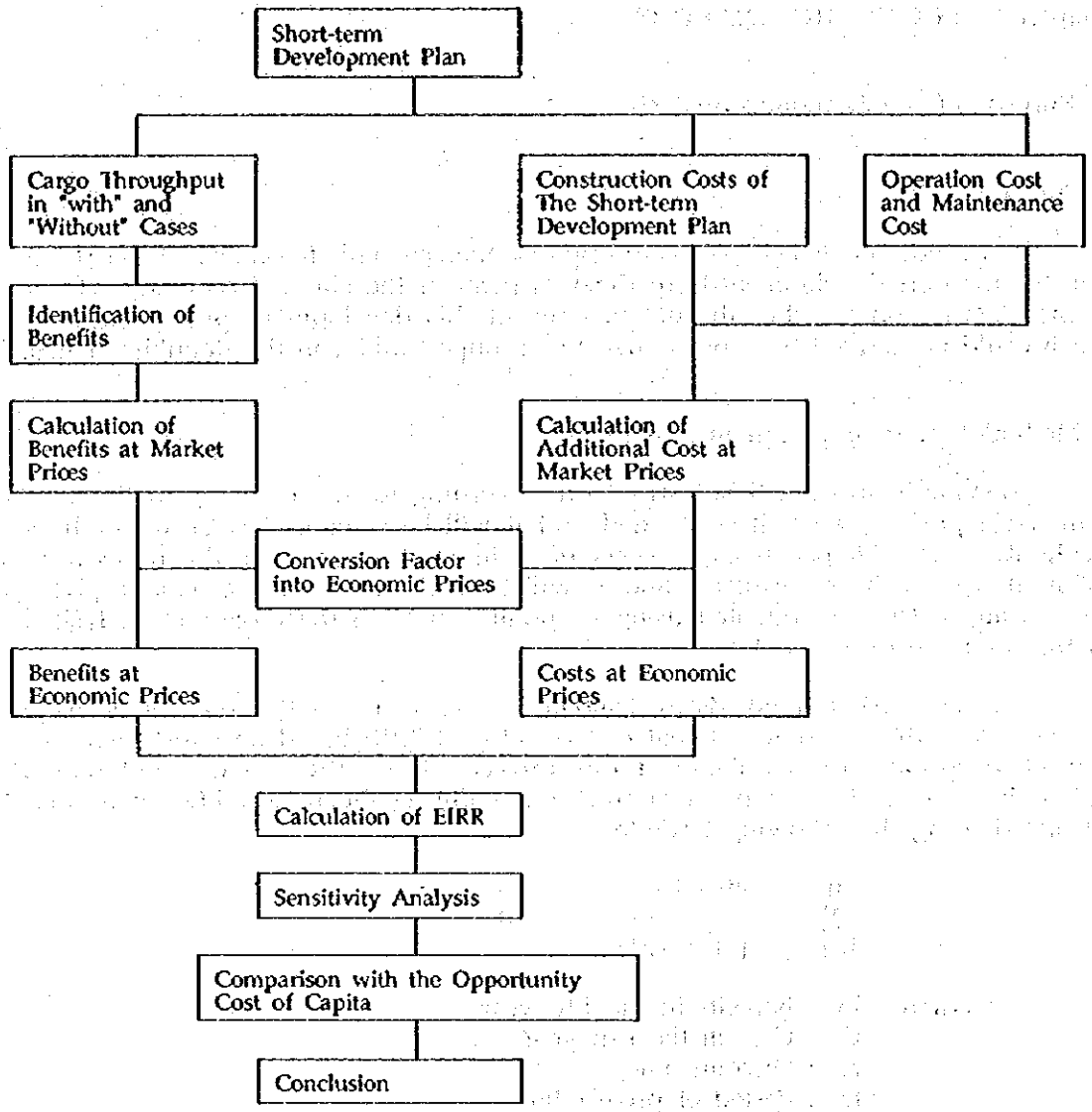


Figure III-9-1 The Procedure of the Economic Analysis

B. Prerequisites of the Economic Analysis

5. In order to estimate the costs and benefits under the "With" and "Without" cases, the following prerequisites are assumed for the analysis.

1) Base Year

6. The "Base Year" here means the starting year of the economic analysis. Taking into consideration the construction schedule in chapter 5 of this part, 1999 is set as the "Base Year" for this Study.

2) Project Life

7. Taking into consideration the depreciation period of the main facilities mentioned in the chapter of Financial Analysis and construction period of four years, the period of calculation ("project life") in the economic analysis is assumed to be thirty years from the beginning of construction.

3) Foreign Exchange Rate

8. The foreign exchange rate adopted for this analysis is;

US$ 1.00 = 2,240 Sucres
US$ 1.00 = ¥ 100 as of August, 1994.

4) "Without" Case and "With" Case

9. In the cost-benefit analysis, the benefits and the project costs are defined as the difference between the "Without" the project and the "With" the project cases. Therefore, it is very important to define the difference between "Without" case and "With" case in the economic analysis in order to evaluate the feasibility of the development project. In this study, the following conditions are adopted as the "Without" case considering the existing situation.

(a) "Without" Case

10. In the "Without" case, it is assumed that no additional investment will be made to enlarge the existing port facilities but the required funds will be provided to maintain the existing facilities at their current level of services. Thus the capacity levels of the port, which are related to efficiency of loading and unloading and available berth length and so on, are not improved.

(b) "With" Case

11. In the "With" case, it is assumed that the Short-term plan for the port development is completed and the capacity levels of the port are improved. The conditions of "With" case are assumed as follows.

a) "With" Case X

12. In this case, it is estimated that the handling capacity will be improved slightly. One Container berth and one Multi-purpose berth will be added.

b) "With" Case Y

13. In this case, it is estimated that the handling capacity will be significantly improved. Only one Container berth will be newly built.

(c) Cargo Handling Volume and Calling Vessels

14. The cargo volume handled at the port of Guayaquil in target year was forecasted in Chapter 2 of this part. The cargo volume will increase after 2003 and cargo volume by ship type in "With" and "Without" cases is assumed as follows. As no new bulk berths are planned, cargo of bulk berth is excluded.

15. In the "With" Case X, Berth Occupancy Rate (BOR) will exceed the optimum BOR (container berth 60%, multipurpose berth 70%) in 2009, so after that, the volume is assumed to be fixed with that in 2008, and the excess volume will be dealt with in the next phase project.

16. In the "With" Case Y, BOR will exceed the optimum BOR (container berth 60%, multipurpose berth 70%) in 2010, so after that, the volume is assumed to be fixed with that in 2009, and the excess volume will be dealt with in the next phase project.

Table III-9-1 Distributed Cargo Volume by Ship Type

Year	Item	Container Berth (Cargo No)			Multi Berth
	Type	FC Banana	FC GC	Total	Mix Type
	DWT	12,000	20,000	-	12,000
2003	Cargo (ton)	932,000	621,000	1,553,000	3121,000
	Container (No)	78,000	70,630	148,630	-
	Ship (No)	124	336	460	1,300
2004	Cargo (ton)	983,000	714,000	1,697,000	3,184,000
	Container (No)	83,000	81,710	164,710	-
	Ship (No)	132	389	521	1,327
2005	Cargo (ton)	1,025,000	786,000	1,811,000	3,274,000
	Container (No)	86,000	90,770	176,770	-
	Ship (No)	137	432	569	1,364
2006	Cargo (ton)	1,080,000	885,000	1,965,000	3,329,000
	Container (No)	90,000	100,830	190,830	-
	Ship (No)	143	480	623	1,387
2007	Cargo (ton)	1,124,000	964,000	2,088,000	3,417,000
	Container (No)	93,000	110,900	203,900	-
	Ship (No)	148	528	676	1,424
2008	Cargo (ton)	1,169,000	1,057,000	2,226,000	3,493,000
	Container (No)	98,000	121,960	219,960	-
	Ship (No)	156	581	737	1,455
2009	Cargo (ton)	1,214,000	1,156,000	2,370,000	3,563,000
	Container (No)	101,000	131,020	232,020	-
	Ship (No)	160	624	784	1485

Handling Capacity

Year Case X	Container Berth		Multi Berth
	FC Banana	FC GC	GC
2003	16.15	17.50	36.81
2004	16.04	16.70	36.16
2005	15.92	15.98	35.56
2006	15.81	15.31	34.97
2007	15.69	14.70	34.41
2008	15.58	14.13	33.87

Source: Estimated by Study Team

Unit: HR/Ship No

Year Case Y	Container Berth		Multi Berth
	FC Banana	FC GC	GC
2003	15.37	13.13	32.40
2004	15.37	13.13	32.46
2005	15.37	13.13	32.54
2006	15.37	13.13	32.61
2007	15.37	13.13	32.68
2008	15.37	13.13	32.73
2009	15.37	13.13	32.76

C. Economic Prices

1) Methodology

17. The purpose of the economic analysis is to examine the value of the project, that is to see if it represents an efficient allocation of resources in the national economy. The value of goods quoted at a market price do not always represent the true value of resources from the viewpoint of the national economy. The local currency portion of zgoods and materials at market prices often includes sales tax, custom duties and so on. The labor cost at market prices is often influenced by a minimum wage system. Therefore, "Economic Pricing" should be conducted for the economic analysis.

18. The market prices are changed to economic prices by excluding transfer items such as sales tax and applying various conversion factors selectively.

2) Method of Applying Conversion Factors

19. Generally, all costs are divided into labor, traded goods and non-traded goods. Labor is further divided into skilled labor and unskilled labor. The cost of skilled labor is obtained by multiplying its market price by the Conversion Factor for Consumption (CFC), and the cost of unskilled labor is calculated by multiplying its market price by a rate of the Shadow Wage Rate and the CFC. Traded goods are expressed by the CIF value for imports and by the FOB for exports. As for non-traded goods, the economic price is calculated by multiplying the Standard Conversion Factor (SCF).

3) Conversion Factors

20. Conversion factors for goods and labor are determined as follows:

(a) Standard Conversion Factor (SCF)

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

$$SCF = \frac{E + I}{(E - De) + (I + Di)}$$

Where, E : Value of exports
I : Value of imports
De : Value of taxes on exports
Di : Value of taxes on imports

22. The standard conversion factors for the last five years for which data are available (1989 - 1993) are shown in Table III-9-2. In this study, for the average standard conversion factor over the four years, 0.965 is adopted.

Table III-9-2 Estimation of Standard Conversion Factor

	1989	1990	1991	1992	1993
Export (FOB US$)	2,353,881	2,713,927	2,851,416	3,007,577	2,903,853
Import (CIF US$)	1,854,775	1,861,745	2,398,585	2,430,403	2,562,202
Export Tax US$	-	-	-	-	-
Import Tax US$	168,783	189,791	171,412	151,945	197,320
Rate Sucres/US$	643.50	880.43	1,244.10	1,806.00	1,989.00
SCF	0.961	0.960	0.968	0.973	0.965

Source: Central Bank of Ecuador, Estimated by the Study Team

(b) Conversion Factor for Consumption Goods (CFC)

23. This conversion factor is used to convert the market prices of consumption goods into the border prices. The conversion factor for consumption goods is usually calculated in the same manner as the SCF, replacing total imports and exports by those of consumption goods only. In this study, the CFC is estimated as 0.954 based upon data of Central Bank of Ecuador in 1993.

Table III-9-3 Estimation of Conversion Factor of Consumption

	1993
Export (FOB US$)	500,995
Import (CIF US$)	584,996
Export Tax US$	-
Import Tax US$	52,143
Rate Sucres/US$	1,989.00
CFC	0.954

Source: Central Bank of Ecuador, Estimated by the Study Team

(c) Conversion Factor for Labor (CFL)

24. For the economic analysis, labor costs are usually measured in terms of their opportunity costs, that is the value of the foregone marginal product from other alternate employment due to the employment of labors for the project.

a) Conversion factor for skilled labor

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

Thus, the conversion factor for skilled labor

= (Market wage rate) x (CFC)
= 1 x 0.954
= 0.954