7.4 Grain Terminal (Phase 1 and Phase 2)

7.4.1 Traffic Demand and Basic Requirements of Grain Terminal

There are two new proposed terminals which are simply required by the fact that present terminals in the port are not sufficient to meet future traffic demand. These are Container Terminal and Grain Terminal.
The former is financed by JBIC and currently under implementation.

This section deals with the preliminary design of grain terminal. Grain cargo forecast was carried out for the two cases, namely **Case 1: High Scenario and Case 2: Medium Scenario**. Among these **Case 1** was selected as the objective for the design.
According to the traffic demand forecast outlined in Chapter 3, bulk grain export traffic volumes in 2010 and 2020 for the Case 1 forecast are as follows:

Bulk Grain Export Traffic Demand Forecast: Case 1: High Scenario, unit: Million tons

	Net Traffic	Fluctuation	Total	Existing Total	Balance	
2010	4.41	1.99	6.40	3.70	2.70	(Phase 1)
2020	6.48	1.99	8,47	3.7 + 2.0	2.77	(Phase 2)

It is proposed to provide the port with a terminal of 2.00million tons annual export capacity in each phase.

Phase 1 2.00million tons
Phase 2 2.00million tons

For imports, it is assumed that the port will be provided with a half million tons of annual handling capacity at the Phase 1.

7.4.2 Future Grain Terminal Development

The existing grain terminals, both in the North Port and South Pier S1, are currently providing similar services. The study team was informed that the existing handling capacity was estimated to be about 6.4 million tons, including the north-port handled 4.4 million tons and the 2 million tons of Silotrans in the South Port. Study team evaluated this suggestion and estimated different conclusion.

It is believed that this will be overestimated if the narrow space and shallow water at the north port are taken into consideration. Actual grain handling capacity at the north port should be 1.0 million tons. Thus the existing capacity is about 3.0 million tons. The study team was

informed that MOT has already approved for several private operators to install and/or increase present capacity about 0.7 million tons. If this possible future increase is taken into account, the total grain handling capacity will be 3.7 million tons.

- ✓ North Port 1.0 million tons (Improving to 1.0 million tons)
- ✓ South Port 2.0 million tons (Existing 1.5 m.t and Plus 0.5m.t)
- ✓ Additional 0.7 million tons (Increasing to 0.7 million tons)

  Total 3.7 million tons

This indicates that two grain terminal of 2.0 million tons each should be installed in each phase.

- ✓ **Phase 1 before 2010**
- ✓ **Phase 2 before 2020**

7.4.3 Site Selection

Development site of grain terminal should be fixed at certain location. It is assumed that the south pier S3 is the best, confirming this alternative study was carried out.

There are three development alternatives, namely:

a) Development at the new Pier S3 next to S2 container terminal pier.
b) Development at existing Pier S1 close to the existing 2 million tons terminal
c) Development at the existing Berth 31/33 at the north port.

The major difference with regard to the facilities thereof is minor since each terminal should handle 2 million tons of grain. The S3 terminal however, will require the construction of a new quay-wall and also land reclamation in order to be able to form the operation and silo yard.

The possible future project includes the World Bank grain terminal project located at the south pier S3, for which implementation, however, no work started.

The major work components are the following:

a) Quay Construction (only for the S3 terminal)
b) Site Development (only for the S3 terminal)
c) Terminal Yard
   (Ordinary works at S3, however just minor works in S1 and Berth 31/33)
d) Yard Utilities (Power, Water, Sewage, Telephone, etc.)
e) Road, Rail Access and extension of substation

f) Silo and Administration Office
g) Equipment (Loader: 2 x 400 t/h, Unloader: 1 x 800 t/h, etc)

The SOGREAH report on the S3 terminal design is referred to after the preliminary design. **Figures 7.4.1 and 7.4.2** show the plan and cross sections of the terminal from the report.

The alternatives to this plan are shown as below:

Figure 7.4.3a Grain Terminal Alternative: South Pier 3. - Proposed
Note: The quay face-line from the Alternative South Pier 3 was modified from original in order to provide enough slip between the Grain Wharf and the Container Wharf as provided for Phase 3.
Figure 7.4.3b Grain Terminal Alternative: South Pier 1.
Figure 7.4.3c Grain Terminal Alternative: North Berth 31/33

If Pier S1 were available for the proposed new grain terminal, the required cost should be minimum. Addition to this, there is a wary about a monopoly of grain terminal operation by a single operator who was managing existing grain terminal at S1.
The required cost for the North berth 31/33 is minimum, however its water depth is not meet to call the Panamax type grain carriers.

Pier S3 site is selected to be the site of Phase 1 Grain Terminal construction area.

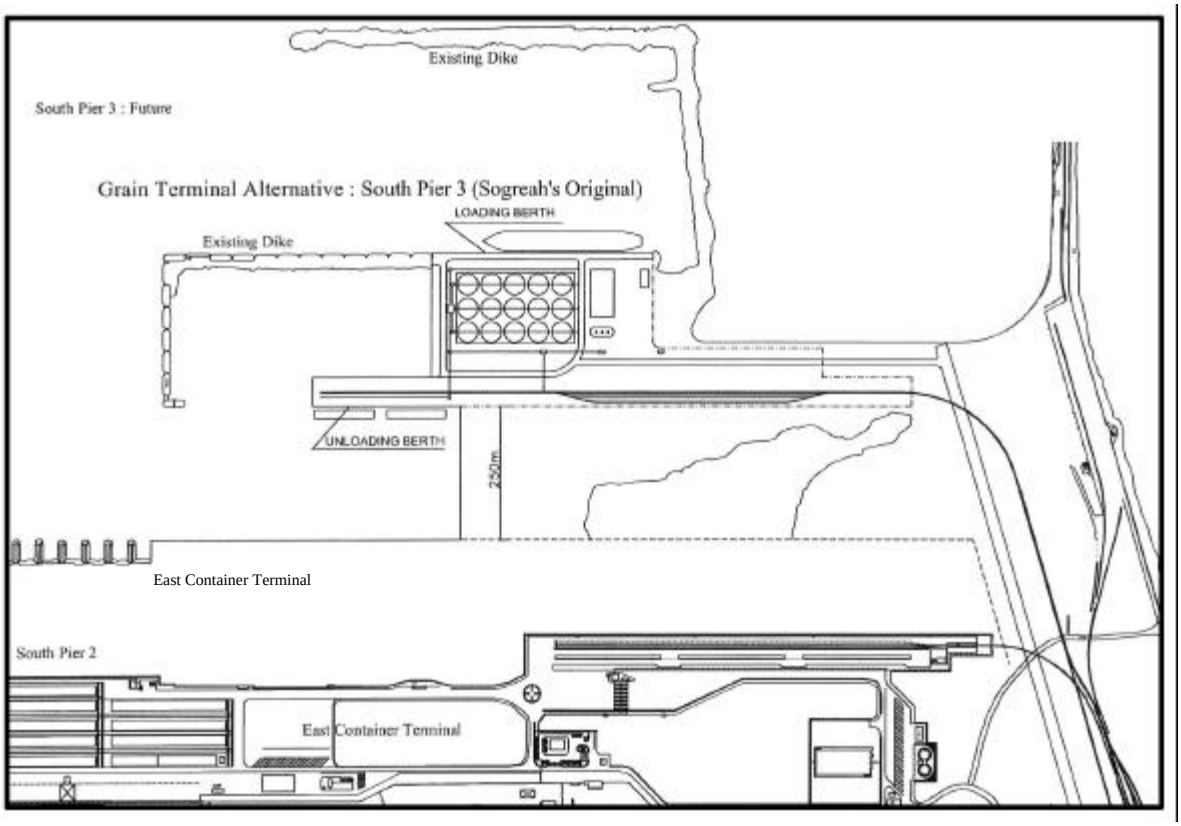

Figure 7.4.1 Plan of Grain Terminal, South Pier 3 (Sogreah's Original)

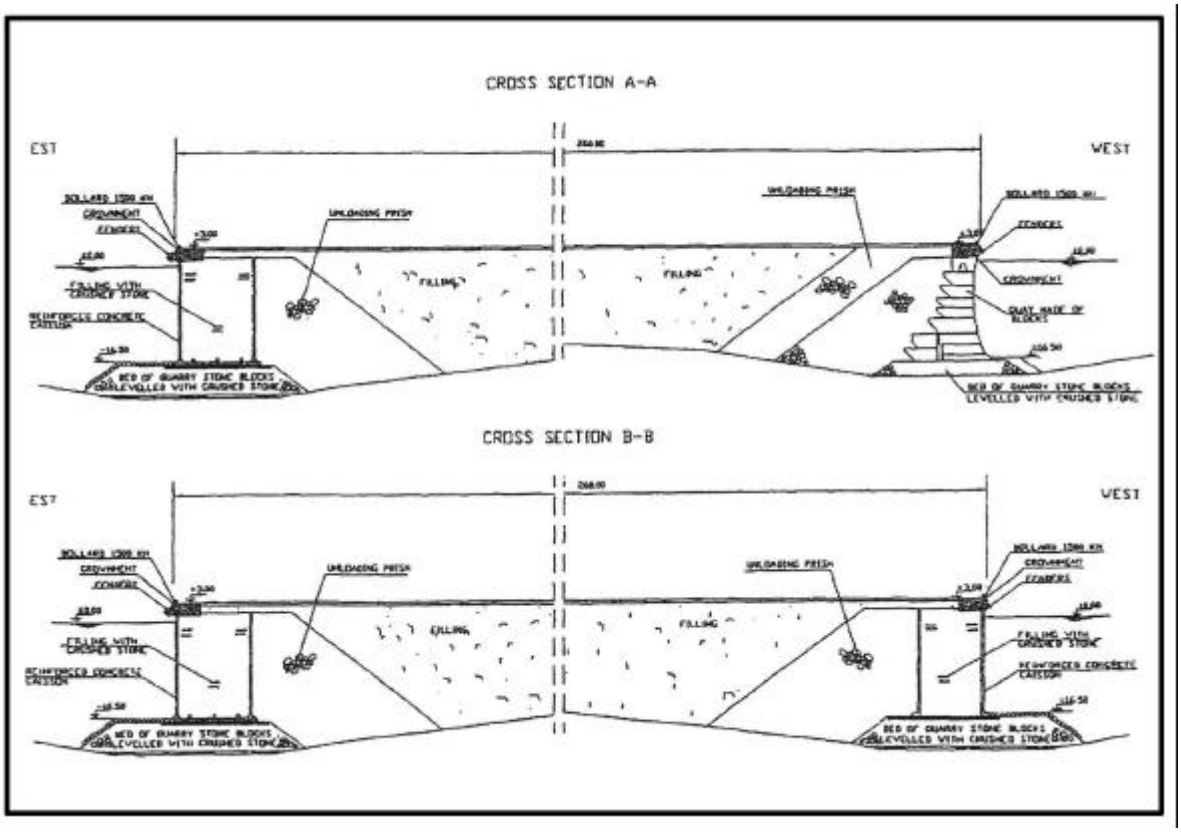

Figure 7.4.2 Cross Section of Grain Terminal

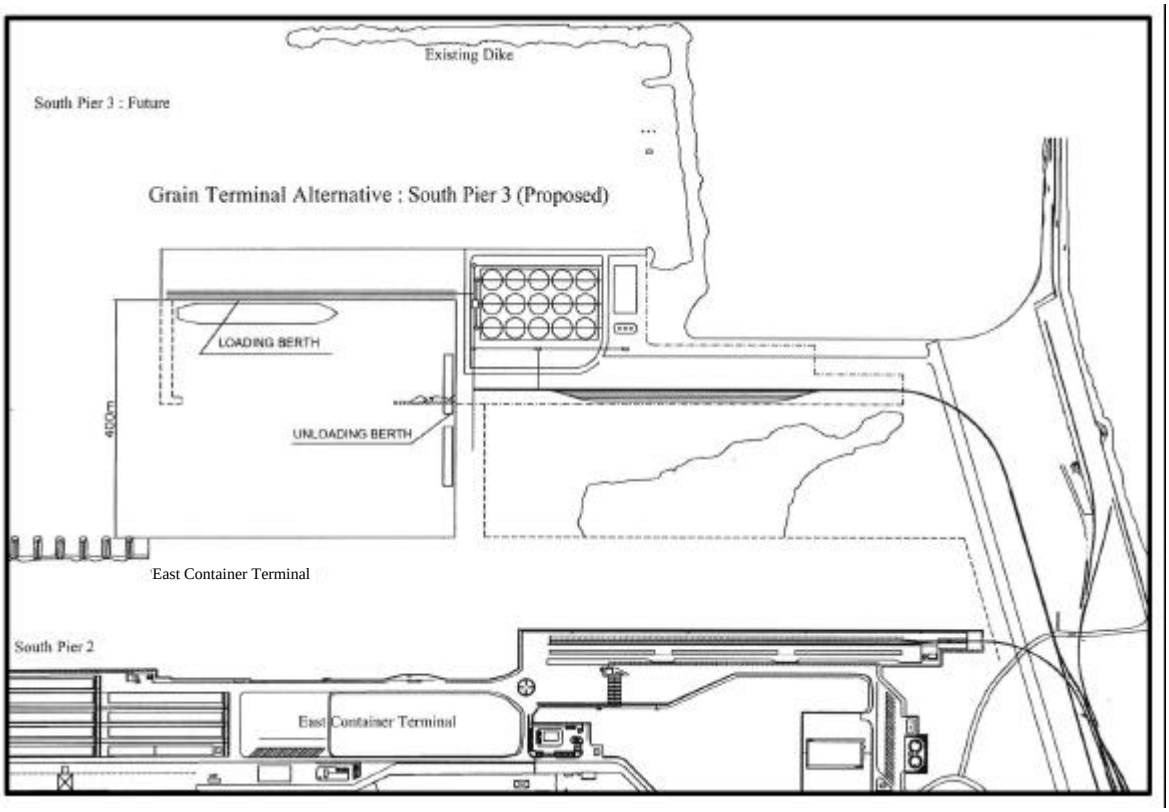

Figure 7.4.3a Grain Terminal Alternative: South Pier 3. - Proposed

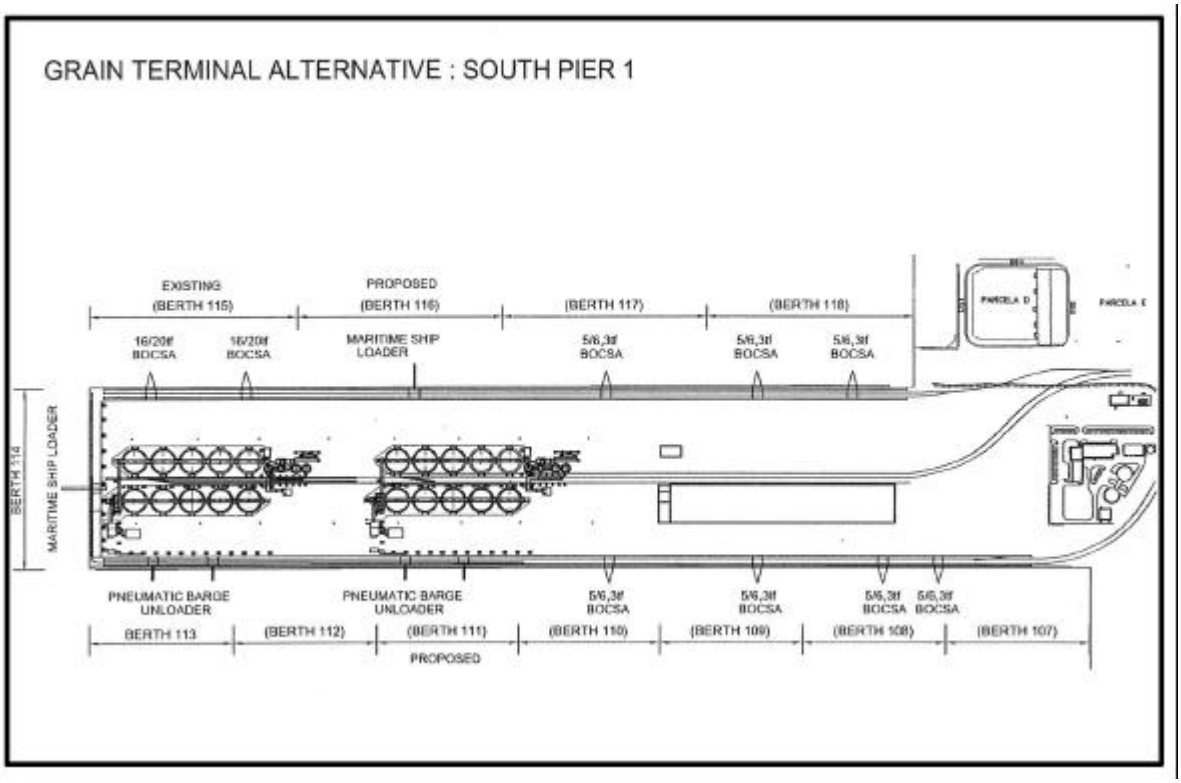

Figure 7.4.3b Grain Terminal Alternative: South Pier 1.

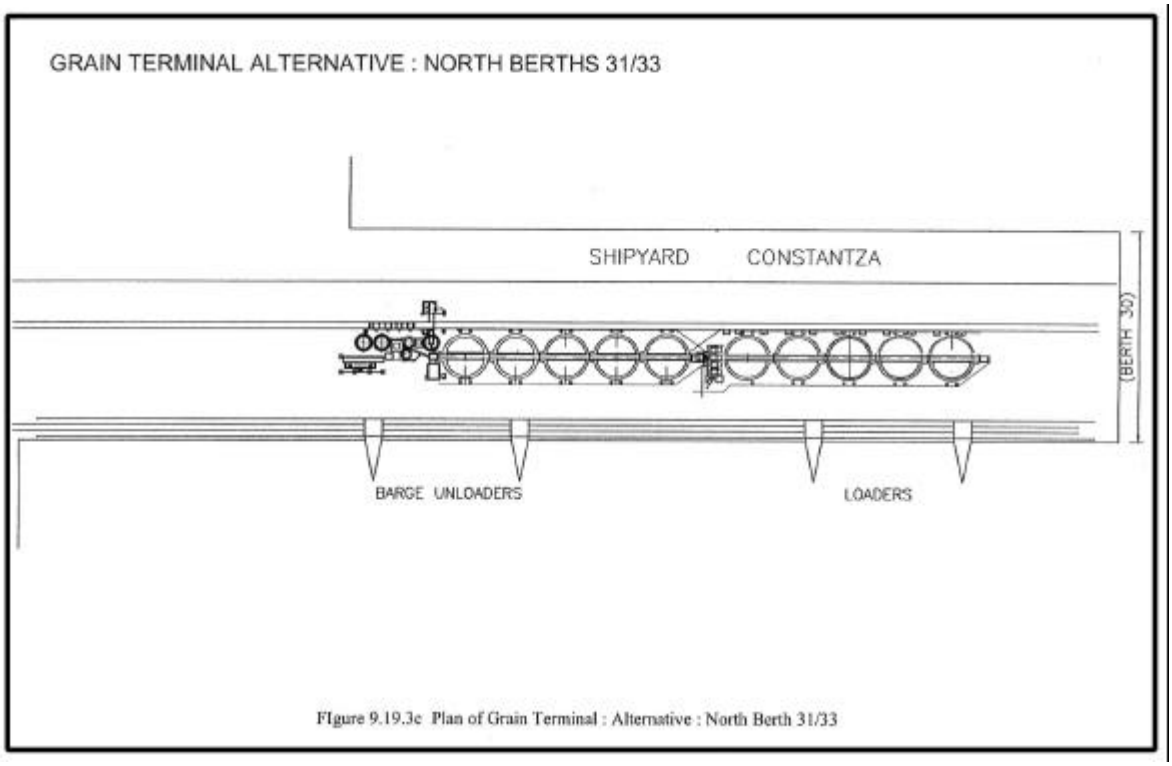

Figure 7.4.3c Grain Terminal Alternative: North Berth 31/33

7.4.4 Required Works for Grain Terminal

The grain terminal in Pier S3 will consist of a 250 m long barge unloading berth and a 300 m long ocean-going vessel loading berth. These berths at the Pier S3 are partially built, however the land shape has not been completed yet.

The works will consist of civil works and as well provision of cargo handling equipment. The former will provide the silo with handling equipment, and will include the pavement work, the supplemental quay strengthening, and others. The latter will include two quayside unloaders needed for receiving grain from the barges as well as two quay-side loaders that will go down to the ocean-going dry bulk carrier.
The silo capacity will be about 100,000 tons as recommended in Chapter 6.

The discussion on the preliminary design of the grain terminal to be provided can be seen below. The necessary study will be undertaken for the facilities required for the proposed South Pier 3.

7.4.5 Quay Construction

Present plan indicates that the slip between the Pier S2 and Pier S3 is about 220m. This wet basin is important to provide congest maneuvering the container terminal and grain terminal with a safety water surface.
As shown in the proposed master plan, it is proposed to maintain this slip as at least 400 m. This can be carried out by moving the scheduled West face line 180m of S3 East to form an 80meter wide Pier S3. This is necessary to provide the port area with enough safety maneuvering area for vessels such as Panamax both to/from container terminal (phase 2) and grain terminal.

It should also be noted that four barges carrying 1,500 tons of grain each will berth and leave every one hour. This will generate congestion between the barge and large ocean-going vessel.

It is noted that none of the quay wall of Pier S3 is completed yet.

As shown in Part III Chapter 4, the east surface of S3 will not be sufficient area for berthing since the rough waves before the completion of North Breakwater extension. It is not known when it is take place. Thus it is prudent to arrange both the unloading berth and loading berth at the west face of S3. Technical discussion on these berths is given below.

(1) Unloading Berth

A: Basic Idea

For unloading barges and river ships, the West Side or corner end-wall of Pier 3S will be used. Part of the works related to this quay are already finished. The depth at the berth is about –16.5 m, while the crown elevation is about +3.0m. Of the total projected length, a section about 110m long at the southern end has been constructed with pre-cast concrete blocks, followed by about 400 m long section of concrete caissons. In this Master Plan, the total length of 250m is required and some 100 m of remaining section will be constructed with concrete caissons. The foundation for the Unloaders and the quay accessories such as bollards and fenders will additionally be provided.

B: Alternatives

In order to widen the slip between Pier S2 and Pier S3 as needed to perform vessel maneuvering specific to a modern port, the west wall will move to the east about 180m. New elongated West Side quay-wall will provide barges with unloading.

The study team was informed that the concession on end–wall between S2 and S3 was already given to other private developers by MOT/CPA. Thus the Alternative A was not adopted.

(2) Loading Berth

To load exporting and transiting grains on ocean-going vessels, a loading berth will be also constructed on the West Side of Pier 3S. The concrete caissons, Type No. 13,and the quarry run backing at the east side have been already installed. The depth at the berth is about –16.5 m, while the crown design elevation would go up to +3.0m. West side wall should be installed in order to complete the quay, the crown concrete, the foundation of Loaders and other quay accessories will be provided.

(3) Quay Wall Structure Alternatives

Whenever a new quay construction is needed, the best structure type to meet various requirements can be selected from either concrete caisson type or concrete block type. The typical cross section of these alternatives is shown in Figures 7.4.4 and 5.

However it is recommendable to use the caisson type due to its high stability against seabed settlement. A large and firm foundation for the quay unloaders and loaders will be an advantage for the terminal.

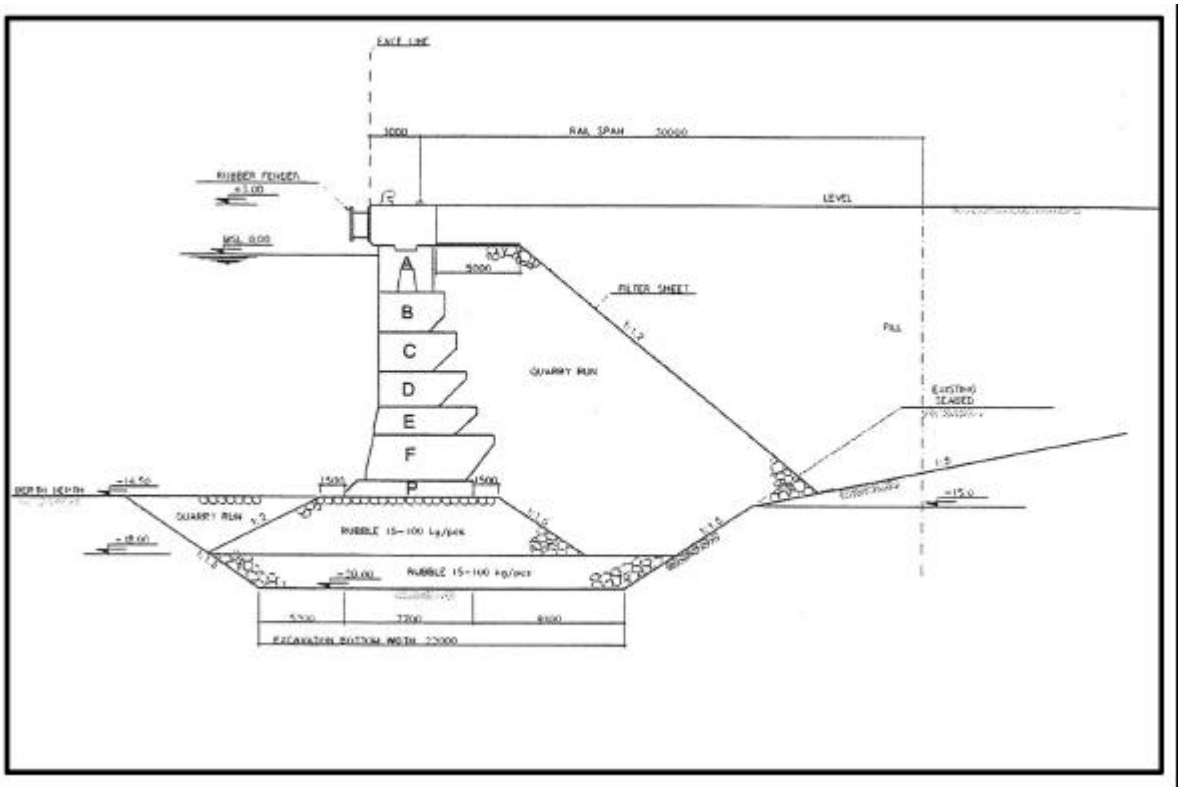

Figure 7.4.4 Proposed Cross-section - Concrete Block Type Quay-wall

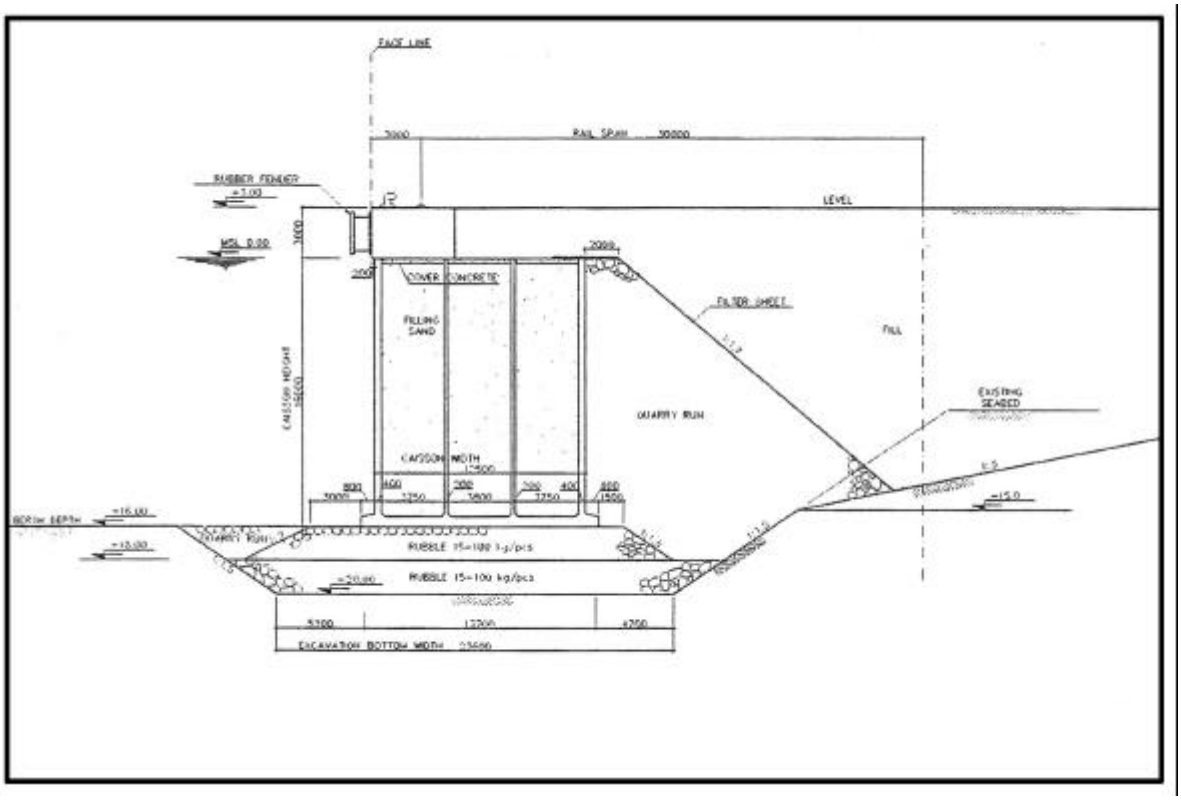

Figure 7.4.5 Proposed Cross-section - Concrete Caisson Type Quay-wall

7.4.6 Site Development

Similarly to the container terminal, the required site area should be reclaimed for Case S3. The land will be reclaimed up to approximately + 3.0 m to + 5.0m. The material dredged from the Danube – Black-Sea-Canal and dredging spoil from the port will be used.

A paving system, a storm drain system, a train marshalling yard, security fence, etc will be also provided. Similarly to the container terminal, the pavement type will have an asphalt coating.

7.4.7 Yard Utilities

The yard utilities such as power, water, sewage, telephone, fire-fighting system, etc will be supplied or obtained by making connections to the existing network. Since it is supposed that the new terminals will be operated by a different operator, the basic distribution lines should be provided separately.
In order to supply electricity to silos and berths 7 MW of power is required. 3.5 MW transformers at the Port IV station will be provided in case of development at either S1 or S3.

7.4.8 Road and Railway Access

In case that a new grain terminal is developed at S1 or S3, the road and railway access will be similar to the transport system of the container terminal.

As given in Subsection 7.3.5, an independent plan to connect the South Port to the Romanian national road network, DN 39, by means of a four-lane elevated road exists. A fly-over extension is planned to connect the Container Terminal by S2 and Grain Terminal by S3 together with an access road between the fly-over and the terminal yard and berths. It is assumed that the construction of the four-lane road between DN 39 and Container Terminal at S2 is completed beforehand.

In the South Port, a railway network already connects to the national railway. In order to facilitate the railway access and the operation of freight trains, a marshalling yard and a dedicated wagon unloading track are needed.

7.4.9 Silo and Administration Office

A transit silo to receive the grains that get unloaded mainly from barge, trucks or freight train, that are stored for a short period, and then are at high speed loaded on ocean-going vessels. This facility will be provided in the reclaimed area, behind the berths. Based on future maximum vessel size and traffic demand, the capacity of silo is determined to be about 100,000 ton.

The silo will connect to unloders or loaders that are to be installed on the quay by means of a chain belt conveyor system.

There are basically two silo structural types, namely the galvanized steel structure and the concrete structure. The former was selected taking into account the site condition and construction economy. The silo will consist of fifteen to twenty unit bins that can be used simultaneously to store different types of grain according to market demand. The silo will be an integrated system, as well include the following facilities:

a) Measurement and weighing system
b) Mechanical room
c) Lift room
d) Operation room
e) Dumping facilities
f) Truck unloading/loading facilities

The 500 m^2 Administration Office will be provided adjacent to the Silo. The major facilities to be installed in these buildings are:

- Administration Room
- Manager Room
- Control Room

7.4.10 Equipment

The equipment for the ship-loading/unloading, for truck receiving, railway wagon receiving and the transfer systems thereto will be also provided. The major items are the following:

- Ship Unloader: 2 x 400 ton/hour
- Ship Loader: 2 x 800 ton/hour
- Receiving Hopper
- Conveyors

This equipment will be located on the best route of the grain flow, by means of series of conveyors and by other means. It is most important that the equipment should be provided in and around the silo bins. The number of bins should be sufficient and of such combination to receive any possible variation of grain type. Unloaders are key equipment to carry the grain on the barges onto the transfer conveyors and finally to the silo. The loaders will take grains from the silo and carry it up to the ocean going vessel.

For more detail, refer to Chapter 6, Section 6.4.

7.5 Steel Product Terminal (Multipurpose General Cargo Terminal)

7.5.1 General Description

Steel products (Classified into Ferrous and non-ferrous Metals) of 1.45 million tons was handled in 1999, sharing 6.3 % of 22.96 million tons of total cargoes. Among these, 1.33 million tons was the trade exports with however almost no transit. Traffic forecasts indicate total 2.00 million tons, 1.90 million tons of export and 0.1 million tons of transit, will be loaded in 2010 and 2020. This shows that no significant increase of volume is estimated after 2010.

Steel and non-steel products are typical general cargo. Since the port has many general cargo berths with low general cargo demand compared to its handling capacity, this cargo can be handled at any part of the port.

Currently, general cargo berths are mainly located at the north port area and they do handle steel products and non-ferrous metal products. Although moderate demand of this kind is assumed, most of the existing general cargo berths located in the north port can provide related services.

The present handling operations of steel and non-ferrous metal products is performed through the berths of DEZROBIREA, MINMETAL, and a few others.

The existing general cargo handling capacity is sufficient to handle this cargo in 2010 and 2020 even after considering other cargo demand. Thus, one of the planning concepts for the metal product handling berths should be physical integration into one location, to obtain easy maintenance and kind of economic operation.

In order to achieve this, among these existing facilities, it is assumed that a single specified area in the north port or even in the south port will be selected for the future steel product terminal. The berths No. 116 to 110 at the south port would be one of the best choices thereto during the implementation of the Master Plan.

Proposed terminal including location is offered as a model and the best location will be finally decided by the port and operators after taking into account of various factors, namely:

a) Cargo volume
b) Port development strategy
c) Duty and responsibility of MOT/CPA
d) Duty and responsibility of existing operators
e) Duty and responsibility of new operators

f) Terminal area availability
g) Present concession contract
h) Capacity of existing general cargo handling
i) Private development concepts
j) Condition of inland transport modes
k) Others

Among these, area availability and present concession contracts are the most important.

7.5.2 Scope of Works

Similar to the timber terminal, the required works for renovation will mainly consist of civil works with minor works for providing the cargo handling equipment. The former will cover the pavement works and the overlay works to the existing quay crane foundations. As necessary, supplemental rehabilitation civil works will have to be added thereto. The latter will include only minor repair sessions to the existing equipment as needed.

Major civil work components are as follows:

a) Temporary works
b) Site preparation
c) Soil improvement
d) Railway track improvement
e) Apron pavement improvement
f) Yard pavement improvement, (overlaying)
g) Terminal office
h) Repair shop
i) Improvement of utilities

7.6 Timber Terminal (Multipurpose General Cargo Terminal)

7.6.1 General Description

Timber (Classified in Timber and charcoal) in 0.64milion tons was handled in 1999, sharing 2.8% of 22.96 million tons of total cargoes. All these cargoes were the trade exports without any transit cargo. Traffic forecast indicates the same cargo sharing at present will continue and become 1.13 million tons in 2010 then decrease to 0.68 million tons of export in 2020. This shows that even no minor increase of volume is estimated after 2010. It is assumed that cargo volume will start decreasing after 2010 and go down in 2020 to the same amount recorded in 1999.

Timber products are also typical general cargoes. Since the port has many general cargo berths under conditions of low general cargo demand compared to its handling capacity, this cargo can be handled at any part of the port. This cargo should be close to the berths where closed transit sheds are provided in order to maintain the good quality of the cargo .

Currently the general cargo berths located at the north port area also handle timber products. Although moderate demand in this trade is assumed, most of the existing general cargo berths at the north port can provide related services.

The existing handling operations for timber are carried out through the berths no. 45 to 52, that belong to MINMETAL, DECIROM, and SOCEP. Their capacity is estimated to be about 0.50 million tons. However it is also assumed that there are many empty general cargo berths at the North Port and one million tons of timber can be handled there, even though the handling efficiency is rather low.

According to the cargo volume forecast for 2010, timber demand will increase to 1.13 million tons as the peak and then decrease to almost half by 2020. Thus, it is not justified to make too much investment since the project life will be so short. It is assumed that the earliest possible year of commencement of the renovated timber terminal will be 2007 based on six years of preparation and construction time.

Thus, one of the planning concepts for the timber berths should also be the physical integration to one location to obtain easy maintenance and as well economic operations.

In order to achieve this, and taking into account all these existing facilities, it is assumed that a single specified area from the north port might be selected for the future timber terminal. The berth No. 45 to 52 area can be one of best choice.

Proposed terminal including location is used as a model and the port and operators will finally decide the best location after taking into account various factors, namely:

a) Cargo volume
b) Port development strategy
c) Duty and responsibility of MOT/CPA
d) Duty and responsibility of existing operators
e) Duty and responsibility of new operators
f) Terminal area availability
g) Present concession contract
h) Capacity of existing general cargo handling
i) Private development concepts
j) Condition of inland transport modes
k) Others

Among these, area availability and present concession contract will be the most important.

7.6.2 Scope of Works

Similar to the metal product terminal, the required works will mainly consist of civil works with minor works to provide the cargo handling equipment. The former will cover the pavement works and the overlay works to the existing quay crane foundations. One of the important renovations might be provision of canopy type close transit sheds for maintaining the quality of the timber. Necessary supplemental rehabilitation civil works will have to be added thereto. The latter will include only minor repair sessions to the existing equipment as needed.

Major civil work components are as follows:

a) Temporary works
b) Site preparation
c) Demolishing existing building and rebuilding in 1600m2
d) Railway track improvement
e) Apron pavement improvement
f) Yard pavement improvement, (overlaying)
g) Canopy type close transit sheds, if any
h) Improvement of utilities

7.7 Barge Terminal

7.7.1 General Description

According to the traffic record of Constantza in 1999, 10.9million tons of cargoes are hauling through the canal. Since the total cargo including transits was 22.96 million tons, this indicates that about 47.4% of cargo relates to the canal. This is due mainly to the strategic position of Constantza located close to a river canal which connects to central and western Europe. No other port neighboring Constantza has this privilege and priority.

In order to maintain the advantages of Romania in industrial development, efficient and economical transport means through the canal should be sought.

Cargo traffic forecast data including the transits shows total cargo volume as 43.72 million tons and 53.1 million tons in 2010 and 2020 respectively. Against these, the cargo volumes to be handled by barges through the canal are estimated as:

Present: 10.9 million tons
In 2010: 17.2 million tons
In 2020: 20.3 million tons

According to field observation, it is reported that 150 barges stay at the existing barge terminal. Although this situation does not happen every day, it will increase in the future. Hence, the existing barge terminal is believed to be near its capacity.

7.7.2 Existing Physical Conditions

Physically, the barge operation area and waiting zone thereto are divided into two parts: namely the "River Basin Area" and "Island Basin Area."

The former River Basin Area, 80ha (800m x 1000m), is located near the narrow channel that connects to the North Port and is equipped with 18 berthing dolphins. The former is surrounded by four waterfront perimeters, whereas the North and West quay walls belong to the mainland as the East and South waterfronts are located along the island.

The existing structure of the West quay wall and North quay wall is gravity concrete block Type no.1. Design water depth is –7m however it becomes shallow due to deposit of fine materials on the seabed. The structure itself is durable enough and can be reused if back-up facilities are provided including apron pavement and supporting utilities. Access to there should also be improved.
On the opposite side of it is an artificial island with East and South waterfronts function as an important location of the barge terminal however no significant facilities are provided. The only structures for berthing the barges are concrete dolphin structures installed every 50m. These are well designed; however water depth seems shallow and dolphin fittings are not properly provided. South of these dolphins is a mole rock mound. This is not for the berthing of barges due to slope of rock preventing berthing. Thus many barges should berth in the middle of channel between canal exit and the north port.

The latter Island Basin Area of 48ha (600m x 800m) is a closed basin that opens towards the south Piers and actually has no berthing facilities. The mole length is about 1600m consisting of a rock mound dike. The Eastern part of this closed basin is the place for dumping spoils and dredged materials. The entrance to the basin opens towards the South and faces directly to the second channel connection between the canal entrance and port entrance.
These areas are called **"River Basin"**. Refer to Figure 7.7.2.

The present cargo handling is mainly specialized for dry bulk via the neighboring dry bulk berths.

7.7.3 Understanding of the Present Problems for Preliminary Design

(1) Present Conditions: Circulation and Operation of Barges in the South Port

The convoys are arriving in the river basin of the Constantza Port South in the Agigea area. Presently in order to come up for anchoring and waiting operations, it is observed that the barges are moving freely unclassified ways as follows:

- The east bank area that is close to the connection canal is used for the barges that are waiting to move to the operating berths. Mainly in this area the empty barges wait before being loaded at the river berths 94-96 with raw materials; also the loaded barges with steel products and other metal products in this area wait to get unloaded at other berths including berths 65-66.

- The maximum estimated number of waiting barges in this area is about 150.

- The berths 91-93 area (600m), that are in the present non operating area, are used for the barges waiting to be operated at the berths 94-96, and as well for the waiting times of the pushers and to maneuver tug-boats;

- The main area for the waiting barges, loaded and empty, is the river basin named "the island". This area is utilized mainly by waiting cereal and steel products loaded barges that have been operated in the areas of Piers I S and II S. This area provides good safety conditions in regards to protection against waves.

- The berth 103 area, although it is only partially finished, is also used for waiting barges.

- The interior of the "Natural Basin or small port" – behind the berth 99 – is used for barge waiting times , and also for pushers and tug boats. This area provides a good anchorage place for about 20-30 units of barge and tugboats.

- The area of the berths 97-99 is used for the waiting barges.

At the berths 100-101, the barge can receive commodity directly from CF (railroad) that are gravitationally unloaded directly to the barge. The loaded barges are used as temporary storing points and afterwards are moved to the loading berths of ocean-going ships from South Port Constantza. The unloading of barges and the vessel loading are performed as direct transshipping.

Berth 102 provides operations of loading/unloading of tar.

(2) Existing Problems: Regarding the Barge Maneuvers and Convoy Circulation

Existing Maneuvering Problems can be summarized as follows:

1) Problems including the convoy formation caused by the unreasonable concentration of operations to a certain area basin.
2) Problems caused by lack of a clear and precise organization that could facilitate the dismantling and forming of convoys.
3) Problems caused by lack of a clear and precise operation rules and regulations with regard to their circulation in the basin.

For instance, the basin's east bank area is so congested by mixed manoeuvring to and forth from the connection canal where the convoys are often in disorder. As a result, there are a lot of maneuvering problems when having to move the barge to a point or when it comes back from the operating point. Shipping companies are compelled to prevent empty barges from anchoring and berthing in this area or quay wall.

As can be seen on the site, the barges maneuvering operations are performed with difficulties, such that if more requests are received simultaneously for barges to go to different operating points, the tug boats can not manage simultaneously the maneuvering. This leads to longer maneuvering time and that implies a longer barge operation time waiting by the berth.

In the same way, these elements also affect the convoy formation that should depart. Actually, the barges anchored in the interior of the island are also facing the same kind of problems.

7.7.4 Design Concept for Improving the Barge Terminal

The returning laden barges will unload their cargo at the specified berths where they will be staying in the waiting basin for loading cargo. The empty returning barges will also have to stay in the waiting basin. The empty barges that are moored in the waiting basin will have to go to the loading berths to be loaded and then they will have to stay at the laden barge stay-basin. Finally the laden barges and the empty ones, if so needed, will have to go to the assembly basin in order to may be grouped into a convoy for the eventual next trip up-stream.

Currently the barge berths at the south port area are used as waiting basins. However in case there is an increase in barge traffic demand, a larger basin space should be provided. This situation is actually enhanced by the low efficiency of the present basin use due to the absence of a quay wall which would keep the barges close one to another by berthing.

One of the design concepts of the barge berths should be physical integration to one single location. This concentration will lead the terminal to easier maintenance and as well to more

economic operation and efficient use of the wet basins by providing quay wall structures to which the barges would be able to berth in groups.

In order to achieve this and looking to the existing facilities, it is recommended that a single specified area at the existing barge terminal of the South Port could maintain its present service level provided it makes a more efficient use of the area. In addition, it is also recommended to provide a new quay wall long of about 2,000 m, i.e. along the existing artificial island.

7.7.5 Required Works to Improvement

According to a report drawn up by IPTANA, the canal capacity may increase up to 20 million tons in case eight convoys of six 1,500 tons barge each would pass through daily. Actually the daily barge arrivals needed for obtaining the 20 million tons/year would have to be as high as 50 barges. When considering a dwelling time of 3days, it is to calculate that some 150 barges would be berthed elsewhere within the port.

According to the cargo volume forecast for 2020, the barge cargo demand might go as high as 20.3 million tons. This means that about 150 barges should be waiting for a next trip every day.

In order to cope with the congestion, existing barge terminal should be urgently improved. Improvement should be carried out by two means: namely, (1) institutional arrangement and (2) provision of physical facilities.

(1) Institutional Approach

The preliminary design of the Barge Terminal has been carried out taking the present problem into consideration.

As seen in the above discussion, it is also important to prepare the rules and regulations for utilization of terminals. This is essential to provide improvement to the operator. The terminal improvement should be implemented to provide an efficient operation and a systematical management of the terminal itself.

(2) Proposed Major Civil Works

The required physical works will only consist of civil works. These will cover the quay wall, pavement works and other minor utilities. It is also recommended to undertake necessary rehabilitation works to the existing civil structures.

The work would consist of several groups classified by utilization and locations as follows:

Main Quay: Mother Land Side. (West Side)

1) New West Barge Operation Main Quay, 700m –4.5m depth
2) New Supplemental Tugboat Basin : Quay wall 450m

River Basin: East Face and South Face : Island Side

1) New North Preparation Quay, 600m –4.5m depth
2) Improvement of Existing Mole : 600m
3) Improvement of Existing 18 Dolphins.

Island Basin: Island Side

1) New South Preparation Quay, 500m –4.5m depth
2) New South Dolphins. 11 units

(3) Preliminary Design Consideration: Quay Wall Structures.

1) Gravity type wall consisting of concrete block type is recommended by example at the neighbors and construction economy.
2) Dredging work is required to deepen and to provide firm foundation.
3) Apron should be paved of reinforced concrete in 25cm
4) Fender and mooring fittings are provided.
5) Minimum utilities including lighting and water supply are provided at the main quay wall at the mother land side.
6) No utility is provided in the Island.

(4) Preliminary Design Consideration: New Berthing Dolphin Structure

1) Gravity type structure of concrete is recommended by example at the neighbors and construction economy.
2) Cat-way is provided in order to provide access to mooring line works
3) Dredging work is required to deepening and to provide firm foundation.
4) Apron should be paved of reinforced concrete in 25cm
5) Fender and mooring fittings are provided.
6) No utilities are provided.

(5) Preliminary Design Consideration: Improvement of Existing Berthing Dolphin Structure

1) Upgrading of existing 18 dolphin units providing stability reinforcement by foot protection.
2) Cat-way is provided in order to provide access to mooring line works

3) Dredging work is required to deepening the water for the design depth and strengthening of the foundation
4) Apron should be paved of reinforced concrete in 25cm
5) Fender and mooring fittings are reinstalled.
6) No utilities are provided.

Refer to **Figure 7.7.1** for the General Layout of Grain Terminal and Barge Terminal in the South Port.
Refer to **Figure 7.7.2** for the General Arrangement of Barge Terminal.

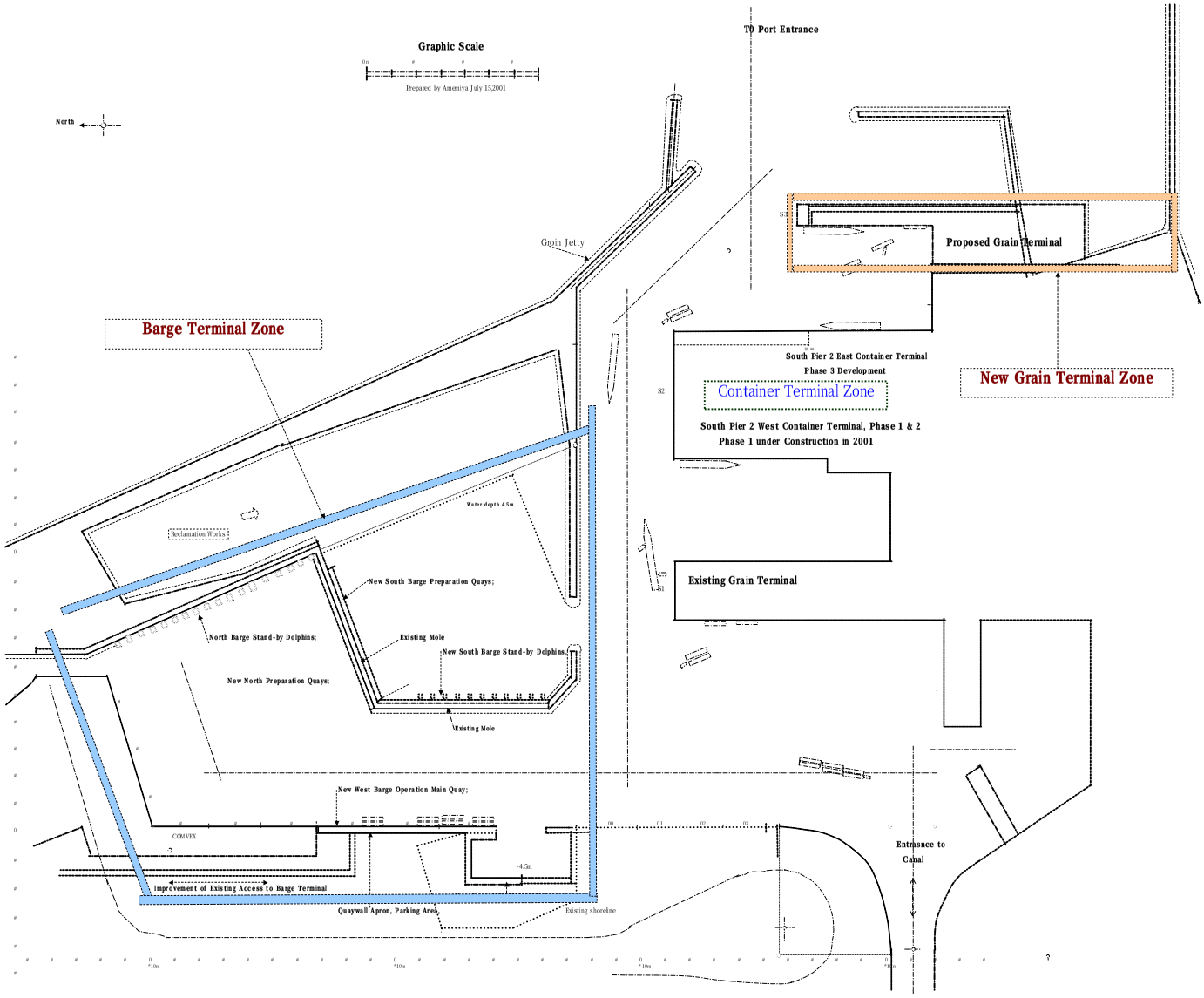

Figure 7.7.1 General Layout of Grain Terminal and Barge Terminal in the South Port

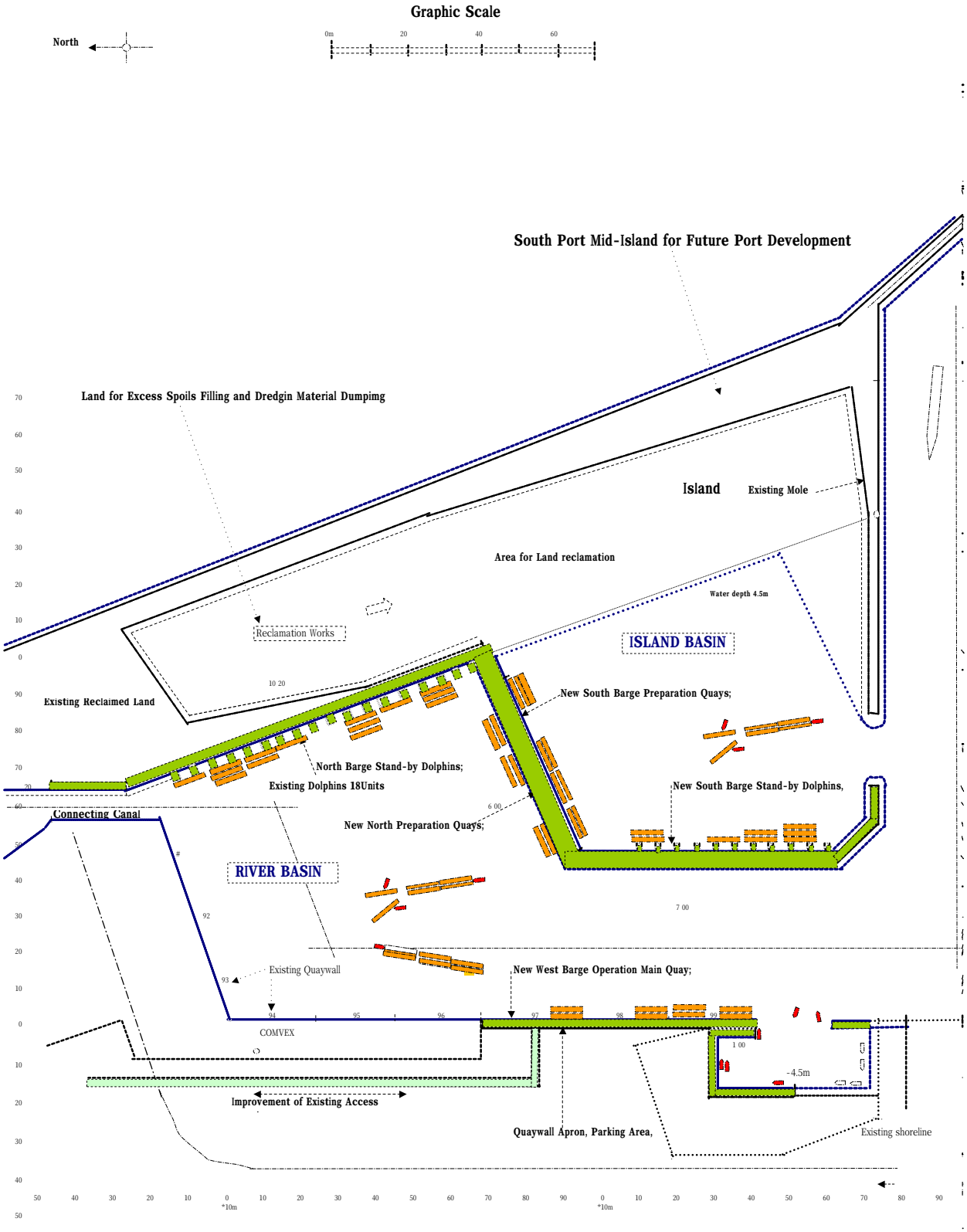

Figure 7.7.2 General Arrangement of Barge Terminal

7.8 Inland Transport Facilities

7.8.1 Introduction

This chapter deals with the proposed restructuring and systemization of the land access within the port area for traffic efficiency. The inner port traffic should be maintained as economically as possible. These services cover the traffic circulation in the Master Plan area and include railway, roads and barge transport through the canal. These systems do connect the cargo flow between the quayside and the inland transport systems of the port hinterland.

Both the inbound and outbound traffic require a smooth connection with their origin and destination or consignees and consignors from well-prepared inland traffic systems.

Each system outside of port area services has the following characteristics:

1) **Railway:** If consignees or consignors are located near the rail stations, this mode should be the most efficient transport means and at a lower traffic cost than another in-land transport mode, such as trucks. It is supposed that this mode will maintain its predominant status in inland transport. This system is available in Romania and may be used for all cargoes except crude oil. This situation will remain into the foreseeable future.

2) **Roads:** If roads are provided approaching the consignees or consignors, this mode will be the most efficient and convenient transport means due to its direct transport to/from the cargo origin. However such transport cost is higher than that of railway if the existing rail system is located near the destination or connected directly with consignors. It is supposed that this mode will mostly provide port users with collection and delivery services of the general cargo and partly of the dry bulk cargo. This mode will also preserve its predominant status as the short haul transport mode between the railway station and consignors.
   This system is available in Romania and useful for all the break-bulk cargoes and part of dry bulk cargoes.

   It is assumed that truck transport will increase its service quota in the foreseeable future, if any shifting-to-trucks in inland transport happen also in Romania, as has been seen in the developing countries when their economy expands.

3) **Inland Waterway Transport:** If consignees or consignors are located near the canal, the barge transport system should be the most efficient transport means due mainly to its having the lowest transport cost. The existing canal used for barge transport is the only one in Romania and its location and route is already fixed. This situation provides the users with the highest benefit if the cargoes are carried for a long haul,

such as transshipment or direct transport to/from the origin of the cargo. However, the transport cost by barge will increase if the existing canal system is neither not located near the destination, nor connected directly with consignors.

It is supposed that this mode will mostly provide port users with quick collection and delivery services of dry bulk cargoes, but only a few possibilities for general cargoes. This mode will preserve its predominant status for the long haul transport of dry bulk.

It is also assumed the barge transport through the canal will increase its services, if the rehabilitation of damaged part of the canal is performed.

Discussion on the traffic system in the port area is presented below.

7.8.2 Discussion of Two On-land Transport Modes: Railway and Roads

Inland waterway transport has been discussed in Section 9.8, so this section concentrates on discussion of the rail and roads within the port area.

(1) Railway

The railway facilities including their related systems occupy a large area of the Constantza port area. It is so estimated that railway currently shares a two times larger port area than the area used by roads. It is assumed that the railway will keep up with their activity range, that is for the cargo transport, as well sharing high cargo amounts as can be seen for the foreseeable future. Thus, the present role played by the railway in the port area will be maintained more or less.

However, the modification of the existing railway system should be discussed seriously due to two reasons:

a) Modification of the existing high occupation of the port area by railway will be required in the near future to maintain a balanced share with truck traffic;
b) Modification of the existing direct railway occupation of the quay area will be required near future to maintain a balanced share of cargo handling mode when comparing to trucks and belt-conveyors:

In addition, the port area behind the northern end basin will not be used for cargo handling activities. It is expected to clean the area and abandon the railway facilities.

The works required by the Master Plan will abandon a part of the existing railway and their relocation to a new alignment.

(2) Roads

Contrary to the railway facilities, it seems that a lower priority has been given to the roads system in the past. Industrialization will require more integrated and convenient transport services between the port and factories.

According to the inspection of the port access roads by the Study Team, the present road access seems insufficient to meet the modern port access planning concepts as follows:

a) Access to the quay is not sufficient.
b) Access to the open storage areas is not sufficient.
c) Access road alignment is not well prepared, for example there are steep slopes at the port boundary and also some sharp cornering. This might be attributed to the staged development at an unscheduled times.
d) Limited car parking areas
e) No truck terminal

It is also noted that past industrialization history indicates an increase of general cargo demand and not for bulk cargo. This automatically suggests paying more attention to road transport. As mentioned above, the railway will maintain its activities for the cargo transport as well snatching a high share as it has now. However the modification of the existing inner port access roads should be discussed seriously.

Works required in the Master Plan Development Plan will be:

a) Widening the existing access
b) Provision of parking areas
c) Realignment and classification of roads
d) Smoothing the road alignment especially near the gates
e) Better connection between the North and South

7.8.3 Preliminary Design of Civil Works

(1) Introduction to Outline Design

The study of the road network planning in the Master Plan Study has been carried out. In order to fix the scale of the project, the scope of work will be studied for the estimated quantities. The work will generally consist of civil works with no provision of cargo handling equipment. The former will cover the road works, bridges and improvement pavement overlay works.

(2) Preliminary Design Concepts

The followings are major work elements and considerations from the Study Team referring to the study carried out by IPTANA.

① Separation of traffics
② Smooth connecting the access over the boundary
③ Rearrangement of road alignment at the North Port
④ Rearrangement of road alignment at the South Port
⑤ Connection between the North and South
⑥ Connection to new High Ways

(3) Scope of Work

Basic work quantities were roughly estimated in order to determine the required scale of investment to improve the inner-port access.

1)	Roads (North Port Area) C-A	25m	4,000m
2)	Roads (North Port Area) C-B	20m	3,000m
3)	Roads (North Port Area) C-C	15m	3,000m
4)	Bridges (North Port Area : Gate No.5)		
	Fry-over bridge : 10m wide,		500m
5)	Roads (South Port Area) C-A	25m	5,000m
6)	Roads (South Port Area) C-B	20m	4,000m
7)	Bridges (South Port Area)		
	A long span bridge	20m	200m
8)	Bridges (South Port Area)		
		15m	300m

(4) Special Provisions

A smoother access should be provided despite the height difference between the town area and port area. The city plan should refer to the arrangement of inner-port access roads. The plan should be harmonized with the railway arrangement. If the rearrangement of railway goes first, the bridges and flyovers should be planned to meet the traffic requirements.

7.9 Navigation Channel and Turning Basin

7.9.1 Outline of Inner Port Basin Dredging

Two dredging operations are needed in order to maintain the water depth in the wet basins, that is lee side of the breakwater, namely: (a) the maintenance dredging and (b) capital dredging.

(a) Maintenance Dredging

It is reported that CPA is currently undertaking the maintenance dredging operation. The related data indicates that the average annual dredging volume is about 0.25 million m^3. This is considered to be moderate when compared to the dredging volume in other ports of the same scale.

(b) Capital Dredging

The other dredging work is capital dredging for deepening the seabed down to the design depth. According to the seabed soil data, the depth at the existing berths is shallower by two meters than the planned depth. This situation at the north port is attributed to three reasons:

(1) the existence of a rock layer at a relatively shallow depth, that is –10m to –13m;
(2) the present vessel size is relative moderate, i.e. of average dimension, excepting the large crude oil tankers and
(3) the quay wall design is rather old fashioned.

On the other hand, the south port presents a deeper depth due to the following situation:

(1) the existing of rock layer at a depth of –15m or deeper,
(2) the design vessel size is of relative larger dimension, except the barges and
(3) the design of the quay wall and the terminal can be considered as relative modern.

The common condition at both port areas is caused by the fact that the quay wall structure is made of a typical gravity wall, consisting of concrete blocks or concrete caisson boxes. These structures generally provide the port berths with a firm and durable quay wall for long service period.

According to the report provided by IPTANA, certain works still remain undone, that is plenty of rock dredging works - about 1.1 million m-3, to meet the original design depth of the quay wall. Refer to Appendix IA.

It is actually recommended that this capital dredging works should be limited to the area and depth according to the proposed requirements, as recommended within the Master Plan. It is assumed that the rock dredging works of about 0.6 million m^3 will prove sufficient to meet the original design depth of the quay wall and as well the Master Plan requirements. In order to be able to accomplish this kind of work, suitable dredging plants that match the rocky material characteristics should be introduced. This will cost about US$24 million when considering a dredging unit price for rocky material is about 40 $/$m^3$.

It is also noted that it is not recommendable to dredge deeper than the design depth in front of the existing quay wall unless strengthening of the structure is conducted.

7.9.2 Channel Alignment

A navigation channel is defined as a certain stretch of waterway that links the berths of a port to the open sea. The channel would normally terminate at the inner end with a turning and/or port basin, which usually permit vessel stopping and turning manoeuvres.

PIANC suggests that the channel alignment should be assessed with regard to the following:

(a) The shortest channel length,
(b) Conditions/basins, etc. at either end of the channel,
(c) The need to avoid obstacles or areas of accretion which are difficult or expensive to remove or that would require large (and hence costly) maintenance dredging,
(d) Prevailing winds, currents and waves,
(e) Avoiding bends close to port entrances,
(f) The edge of the channel should be so shaped, that ships that pass along it do not cause disturbance or damage.

Straight channel legs are preferable to the curved ones.

7.9.3 Turning Basin in the Port

Immediately after the port entrance, the navigable width of the channel should be increased. Here vessels usually have to make more complicated maneuvers than in the approach channel. The most basic of these maneuvers is done when turning the vessel.

A general indication for the space required to turn a vessel is a circle with a diameter four times larger than the ship's length, where there is no tug assistance. Wherever tug assistance is available, a circle of about half this size is considered as adequate. These are the average figures, and the actual area required will additionally depend on wind, wave and current conditions according to each particular case.

The maximum vessel length expected at the Pier S3 for the year 2020 is estimated to be about 250m and the vessels will be assisted by tugs. Therefore, the minimum diameter of turning basin in front of Pier S3 is to be 500m.

7.10 Breakwaters

7.10.1 Outline of the Coastal Protection

(1) Summary

This sub-section deals with the basic requirements for the coastal protection works which are required to be provided in the Master Plan. Due to the nature of the port, every waterfront line faces are exposed to the high water, storms and waves. Since all berthing facilities are provided for calling and leaving vessels, the wet basins that connect the berths should be so arranged to provide the vessels with sufficient safety conditions and with an easy maneuverability position under the prevalent climate conditions.

(2) Coastal Protection and Breakwater

The Port of Constantza is located in the middle of the Western Coast of the Black Sea. The natural conditions that surround the port change with the season.

During the summer, the climatic conditions can be considered rather moderate. In winter time, the north wind is prevailing and generates waves of the same direction. These waves are the main sources and cause of disturbance to the coastal areas. Thus the climate conditions provide the port areas with various turbulence and hazardous occurrences.

In the event that waves are propagating along the coast, they also generate coastal currents which carry fine soil particles and sand whereby there appears some coastal erosion. In order to protect the coastal area against these forces, three kinds of works are employed according to the actual phenomena.

a) Coastal protection Works
b) Sea Wall Construction
c) Breakwaters

a) Coastal protection Works

The coastal protection works will cover the natural coast against the coastal changes. For the time being, there is no natural coast within the port area. However this work should be undertaken when necessary at the coastal areas that are neighboring the port as well as the beach resorts in the North and South. No reports are however indicating serious coastal problems in the near vicinity of the port. Actually no major coastal protection work will be taken into account for the Master Plan.

b) Sea Walls

Within the port basins, the reclaimed land should be protected by an artificial defense structure such as a sea wall. The waves that propagate onto the inner basin crossing the port entrance will eventually penetrate deep into reclaimed areas and thus provide forces and water storming to the inland areas if proper protection work is not correspondingly provided. The sea walls will have to be constructed in front of these facilities, to form a typical structure that will prevent the land from erosion and wave run-up.

Sea walls will be provided at the place and at such elevations to meet the requirements of the Mater Plan.

There are two major areas in Constantza Port where sea walls are currently provided, namely: the artificial mid-island and the starting point of the South Pier 3. The former was constructed to form a container terminal area in which excess soil fill and also dredged soil from the canal could be dumped in order to generate new land for port development.

According to the proposed Master Plan herein, additional landfill work will be undertaken for the future. The existing mid-island is currently only beginning to contain fills due to limitation of such materials. However, if financial support will be ensured, it is assumed that carrying the excess fill soil to the enclosed area by the sea walls will restart. The average dumping depth is about 10m.

The present enclosing capacity: approx. 2,000m x 2,000m x 10m = 40,000,000m^3
Estimated annual excess and dredged soil volume: 1,000,000m^3
Expected life span of the mid-island: 40,000,000m^3 / 1,000,000m3 = 40years

Rearrangement and extension of the sea wall line is needed to meet the Master Plan requirements. It is estimated that in total a 3,000m long sea wall will be constructed under the Master Plan. The average water depth by these sea walls will be about 7 meters, and the structural type will be the rock-mound type, as can be seen on site.

The sea wall at the South Pier 3 and those located further east should meet the requirements indicated in the Master Plan. It is estimated that in the total a 4,000m long sea wall, a temporary dike will be required to form the earth retaining wall and the quay back wall as mentioned in the the Master Plan requirements. The average water depth of these sea walls is about 15 meters and the structural type will be the rock-mound type as seen on site or a mixed structure type that is a combination between the gravity wall and the rock-mound type.

7.10.2 Breakwaters

(1) General Description

The most important structure among these works is the breakwater since it can reduce the wave energy before they break over the sea walls the and berth structures. The present structural type of breakwater at Constantza is a typical rock-mound structure laying in water at a depth starting from –10 meters at the North, and –25 meters at the South.

The rehabilitation work on these dikes is currently being undertaken by the CPA in order to repair the damaged sector. It is however reported that there is a plan to extend the existing North breakwater by 1000m further South and down to a –28m water depth.

It is recommended to rearrange the breakwater line and to extend it to meet Master Plan requirements. The best alternative will be selected from the following:

a) to extend the existing north breakwater by 1000m to further south down to a -28m water depth as planned, or
b) to extend the existing south breakwater by 1000m to the further north down to a -20m water depth.

It is estimated in total to build a 1,000m long breakwater so as to meet the Master Plan.

(2) Recommendation

It is recommended to continue the effort to extend the North Breakwater further 1,000m to the South.

Note: Refer to PART III Chapters 2 and 4 for the breakwater arrangement in the Short Term Development Plan.

(3) Wave Conditions for Breakwater Study

Since breakwater construction was the one of major marine works in this port, various reference data is already available with regard to the planning and design of the breakwaters, and this existing design is followed.

"Part I – Chapter 6, Natural Conditions" describes the wave conditions. The following table presents excerpts from that chapter for the design version for the present wave conditions, and as well as for the current breakwater design.

Table 7.10.1 Design Wave Conditions (Unit: m)

Water Depth from MSL (m)	Estimated from Ship Observation			Estimated from the European Waters Model	Estimated by IPTANA
	T = 9 sec	T = 10 sec	T = 12 sec	-	T = 9.05 sec
-16	5.52	6.16	6.86		6.22
-18	5.68	6.38	7.13	6.9	6.30
-20	5.81	6.54	7.29		6.35
-22	5.96	6.76	7.49		6.40
-24	6.11	6.95	7.62		6.44

Note: T: Wave period
Source: Review of Original Breakwater Design (1997, Frederic R. Harris B.V)

(4) Preliminary Wave Calmness Study

The preliminary wave calmness study was carried out as reported in PART III Chapter 4 to evaluate the effect of the breakwater extension project, including a 1,000m extension of the existing north breakwater down to the South and as well other possibilities. The case study includes the following four cases, namely:

Case 1: Wave Calmness at Present Breakwater Alignment
Case 2: 1000m Extension of the existing north breakwater to the South. (Recommended)
Case 3: 1000m Extension of the existing south breakwater to the North.
Case 4: 1000m Extension of the existing south breakwater to the North and Demolishing the existing 1,000 long inner dike that is located at the south-east of the Mid-island.

Refer to Figures 7.10.1 for Case 2 proposed.

(5) Possible Cross Section of Breakwater

The Structural breakwater type will be the rock-mound as seen at the site or combination that is between the gravity wall and rock-mound foundation types.

Considering the existing breakwaters, the following cross-section is proposed.
Refer to Figure 7.10.2.

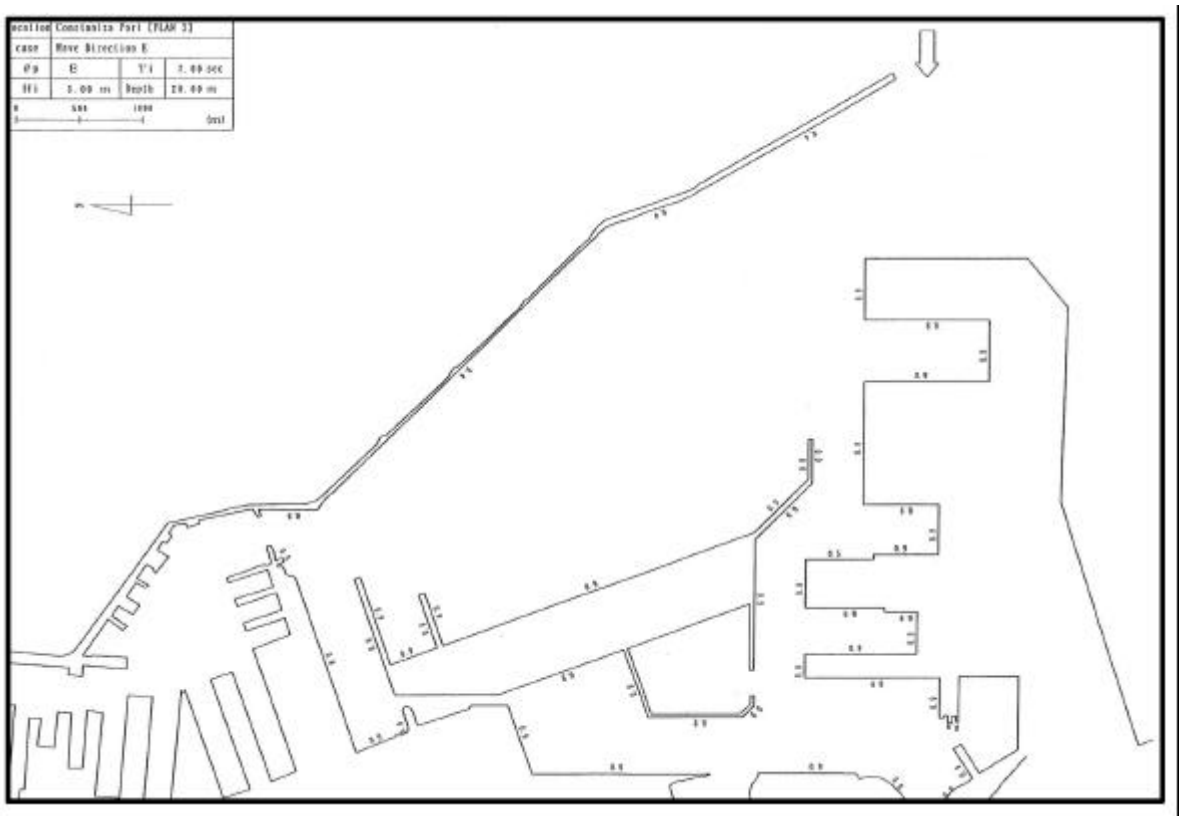

Figure 7.10.1 Case 2: 1000m Extension of the Existing North Breakwater to South.

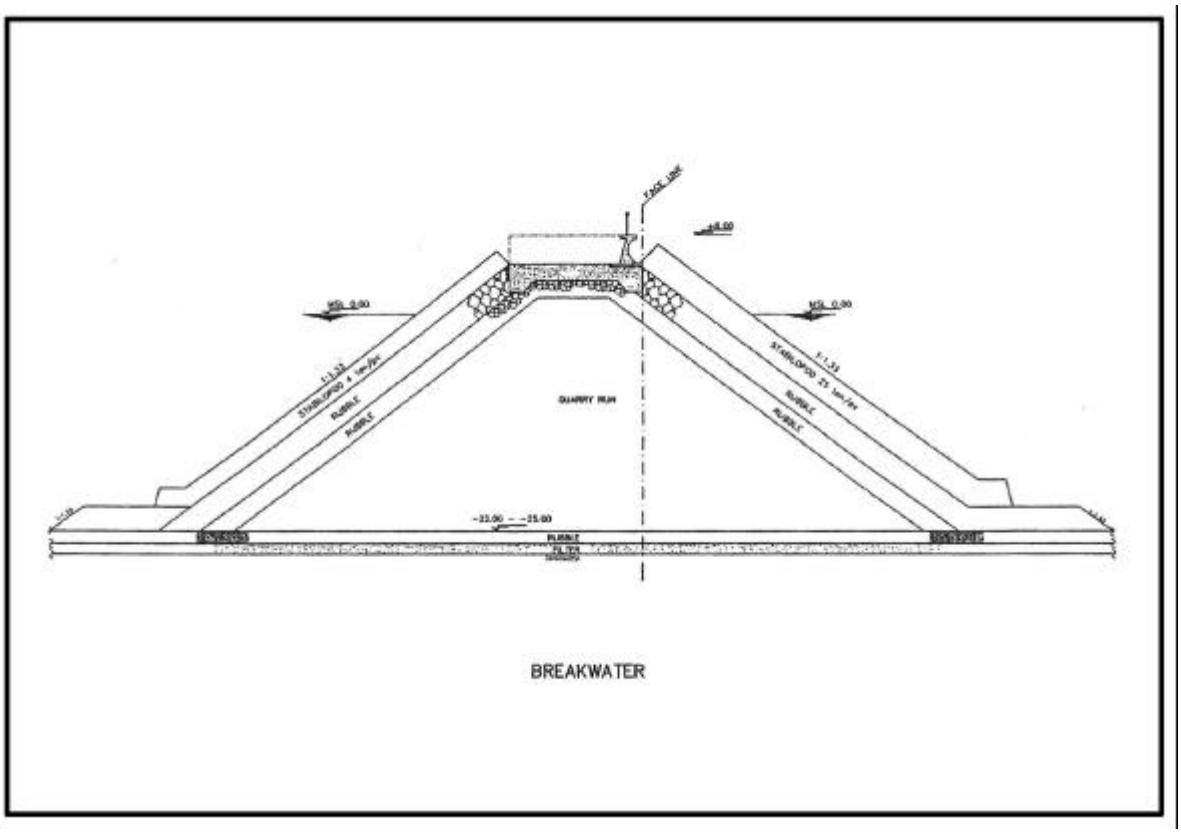

Figure 7.10.2 Basic Crossing Section of North Breakwater

7.11 Environmental Related Facilities

The strategic Plan for Waste Management in Constantza Port was prepared in 1998 as a part of the project on improving the waste management and aim at fulfilling the MARPOL 73/78 conventions. The study suggests to implement the following provisions:

(1) Vessel waste, sanitary waste and solid waste in the port basins will be treated in incinerators which will cost about 5.4 million Euro.
(2) Waste delivered from the port areas, that is solid waste from the private companies operating in the port and others, will be stored in an ecological ramp provided with a special sector for dangerous waste materials: the required cost thereto - about 5.2 million Euro.
(3) Waste water, liquid waste on the surface and water resulting from oil tankers cleaning will be treated in a water treatment plant: required cost about 4.6 million Euro.
(4) Collection of wastewater is to be performed by a collection vessel: required cost about 1.4 million Euro.
(5) The total cost of the above list will be 16.6 million Euro, excluding VAT and other taxes.

The incinerators will be located at the existing Gate No.6. Location of the wastewater treatment plant will be selected to meet the requirements of the oil terminal.

It is recommended to pursue these projects to realise their objectives. Refer to Part II Chapter 10, Part III Chapter 12 and EIA Final Report issued separately.

7.12 Edible Oil Terminal

7.12.1 General Description

Existing edible oil terminal is located at the north-most old part of port.
Edible oil terminal for exports will be relocated to a new site from the present location, following the planning concept not to use the aged port area for cargo handling activities. It is assumed that this terminal will be located near the grain terminal. Thus the possible locations are a) S3, b) S1 or c) existing berth nos.31/33. Please refer to Section 7.4.

This terminal may be set together with other types of edible liquid products and other similar products if conditions are met. Since the traffic there is rather minor and limited, co-existence with other terminals related with this agricultural product terminal is recommended.

Currently the grain terminal at the North Port is providing the same kind of services. The existing handling capacity there is estimated to be about 0.55 million tons of - FRIAL.

According to the cargo volume forecast for 2020, the edible oil demand will increase to 0.25 million tons.

The major works for this terminal include the following:

- Site Development
- Terminal Yard
- Yard Utilities, Fire fighting system
- Road, Rail Access and extension of substation
- Tank and Administration Office
- Equipment (Loading/unloading arm: 2 x 100 ton/hour)
- Pipelines
- Quay wall , if required

7.12.2 Quay Wall Construction

The Edible Oil Terminal is planned to be provided with a berth length of about 150m and a depth of about 6.5m. However for the cost estimation purpose, it is assumed that one of the existing quay walls, where the backfill has not yet been completed, will be utilized as the terminal.

7.12.3 Site Development

The area behind the berth will be reclaimed up to the necessary levels, that is approximately 3.0m - 5.0m using the materials described in the Section 7.4. This work will however be rather minor if the terminal is installed on the existing reclamation area.

The yard will be paved with an asphalt surface and also a drainage system will be provided. The operating vehicle traffic will be minor since the pipelines are to transfer the cargo. Hence, the storage tank yard should be provided with the proper protection works.

It is assumed that the road and rail networks will be located close to the terminal. A connection between the network and the terminal will be provided.

7.12.4 Yard Utilities and Fire Fighting Systems

Yard utilities will be provided including the power supply, water supply, sewage, telephone, and fire-fighting systems. It is assumed that all the already existing services, except the power supply, have sufficient capacity for servicing the facility where the connection points are located close to the terminal.

7.12.5 Storage Tanks and Administration Office

Since the cargo is liquid, pipelines and storage tanks will be provided. In order to meet the traffic demand, the terminal will be provided with 4 tanks of about 3000 m^3 capacity each, and all of them will have independent filling/emptying systems. The tanks will be made either of stainless steel, or of carbon-steel, as well equipped with stainless steel pumping/piping systems. The tank yard will be connected to the berth by means of a pipeline about 1000 m long and about 150mm diameter, as well made of stainless steel or carbon steel.

The administration Office of about 200 m^2 will be provided in the terminal yard to accommodate the staff.

7.12.6 Equipment

As described in Chapter 8, some loading/unloading arms with a capacity of 100 ton/hour each will be provided. The terminal is also fitted with a truck loading/unloading station and with a railway wagon receiving system.

7.13 Utmost North-Port Area and its Restructuring

Supplemental works will be provided according to the planning concepts specified in the Master Plan. One of the planning concepts is to be the optimization and systemization of the North Port area. Another criterion is the preparation of basic and supporting facilities for the commercialization.

Actually there are two aspects to be discussed in detail: namely, the improvement of land use in the North Port area and the improvement and realignment of the facilities existing in the same area .

a) **The improvement of land use at the North Port area:** Space for a commercial center, including a business center, is needed to enhance the private development in the North Port area.
b) **The improvement of existing facilities at the North Port area:** Action are required to rehabilitate the present facilities and achieve efficient port operation including renewal of the aged cargo handling equipment that is scattered in the North Port area. This action will also enhance the private companies in regards to efficient cargo handling operation in the North Port area.

In order to accomplish these works, it is recommended for the authority to continue with its initiatives and provide these areas with maximum assistance.