Chapter 14 Master Plan for Tema Port

14.1 Planning Requirement for Master Plan

Master Plan has to propose solutions to the bottlenecks that the port currently faces. The present condition is analyzed and bottlenecks are identified in Chapter 7. The bottlenecks of the port are listed below.

As the largest port in Ghana, Tema Port has played a very important role in the Ghanaian economy. In line with economic development of Ghana experienced in future, export volume of non-traditional goods will increase rapidly and Tema is expected to enhance its function as an export port. To become a middle-income country, the role of Tema Port as the gateway of Ghana is very important. Tema Port is expected to fulfill the roles listed below.

- Sustaining and developing physical distribution of Ghana as the largest port.
- Functioning as a leading container port in West Africa.
- Functioning as a main import port of commodities consumed in Ghana such as foodstuffs, consumer goods and materials.
- Functioning as an export port of commodities produced in the east part of Ghana such as aluminium, petrol products, other manufactured goods, cocoa products and other foodstuffs.
- Supporting EPZ and industrial estates by providing necessary facilities for import of materials and export of manufactured goods.
- Supporting agriculture by providing necessary facilities for import of fertilizer and export of crops.

Based on the appropriate role sharing between Tema Port and Takoradi Port, future cargo throughput at Tema Port is estimated. Results of the cargo forecast are summarized from Table 14.1.1 to Table 14.1.2.

Table 14.1.1 Future Cargo Demand Forecast at Tema Port

(tons)

IMPORT	1991	2000	2010	2020
Dry Bulk	1,061,685	1,652,557	2,157,747	3,426,302
Alumina	365,906	301,775	384,950	800,645
Clinker	470,277	972,772	1,262,240	1,855,840
Liquid Bulk	1,106,336	1,853,315	3,439,000	5,815,000
Crude Oil	165,112	1,000,000	2,575,747	4,357,500
Petrol Products	168,901	850,000	858,500	1,452,500
Bagged Cargo	301,253	537,553	597,518	618,367
General Cargo	201,898	235,135	701,388	1,326,602
Containerized Cargo	397,663	833,529	1,875,000	4,423,300
Total	**3,068,835**	**5,112,088**	**8,770,653**	**15,609,571**

EXPORT	1991	2000	2010	2020
Liquid Bulk	198,070	246,584	401,659	867,152
Bagged Cargo	84,092	104,370	26,891	25,062
General Cargo	192,109	156,230	106,734	103,908
Containerized Cargo	103,904	382,371	820,835	1,728,055
Total	**578,175**	**889,555**	**1,356,118**	**2,725,276**
Grand Total	**3,647,010**	**6,001,643**	**10,126,771**	**18,334,847**

Table 14.1.2 Future Container Cargo Demand Forecast at Tema Port

(TEUs)

	1991	2000	2010	2020
Import	35,071	81,861	202,447	468,693
Export	35,852	79,782	213,282	485,494
Transit		2,648	10,835	16,801
Transshipment		1,858	58,749	78,952
Total	**70,923**	**166,149**	**485,313**	**1,049,940**

14.2 Facility Requirement for Master Plan

(1) Cargo Handling Productivity

When the scale of new facilities is calculated, improved cargo handling productivities are used. This is because although the present cargo handling productivities are low due to insufficient facilities, equipment and vague responsibility demarcation system of cargo handling between the port authority and port users, there is much room to improve cargo handling productivities once appropriate facilities are developed, appropriate methods is adopted and an appropriate institutional framework is set up. Target of cargo handling productivities are set considering improved future cargo handling conditions which are proposed in the master plan and cargo handling productivities of foreign ports. Cargo handling productivities which are used are given in

Table 14.2.1.

Table 14.2.1 Gross Cargo Handling Productivity at Tema Port in 2000 and 2020

Type	Commodity	Unit	Productivity 2000	Productivity 2020	Remark
IMPORT					
DB	Alumina	t/hour/vessel	210	210	Belt conveyor
DB	Clinker/Gypsum	t/hour/vessel	300	500	Ship gear, grab
DB	Wheat	t/hour/vessel	70	150	Ship gear, grab
LB	Petro products	t/hour/vessel	385	600	Pipeline
BC	Rice, Fertilizer	t/hour/vessel	50	100	Ship gear
GC	Cars, Steel product	t/hour/vessel	70	100	Ship gear, grab
GC	Gen. Valco	t/hour/vessel	125	125	
CO	Container	box/hour/vessel	16	30	Container crane
T					
LB	Petro products	t/hour/vessel	385	385	Pipeline
DB	Cocoa beans	t/hour/vessel	35	100	Belt conveyor
BC	Aluminuim	t/hour/vessel	84	100	Ship gear
BC	Cocoa beans	t/hour/vessel	30	100	Ship gear
GC	Cocoa products	t/hour/vessel	30	100	Ship gear
GC	S/Timber, Wood product	t/hour/vessel	30	100	Ship gear
CO	Container	box/hour/vessel	16	30	Container crane

Note: Productivity 2000 is calculated from data of Jan. to Nov. in 2000

(2) Vessel Size at Target Year

Vessel sizes in the target year are set based on the present calling vessels' size distribution, users' intention and trend of world fleet considering development cost. Vessel sizes in the target year are listed in Table 14.2.2.

Table 14.2.2 Vessel Size at the Target Year 2020 at Tema Port

Vessel type	2000		2020 (Standard Size)		
	Max. DWT	DWT1/4	DWT	Length	Draft
	(tons)	(tons)	(tons)	(m)	(m)
Bulk carrier	51,694	47,263	30,000	185	11.0
Tanker	87,307	n.a.	30,000	180	10.9
Cellular container	31,975	20,245	50,000	290	13.0
RO-RO	39,900	28,175	28,000	210	11.0

Note: $DWT_{1/4}$ means DWT of one fourths largest vessel

(3) Number of Berths for Master Plan

Based on studies above, the number of new berths for the master plan are determined. The result is shown in Table 14.2.3.

Table 14.2.3 Scale of New Berths for Master Plan of Tema Port

Berth	Commodity	Number	Depth	Length / berth
Container Berth	Container	4	13 – 14m	300 – 350m
Multi-purpose Berth	RoRo, Clinker	2	11.5m	280m
Valco Berth	Alumina	1	11.5m	240m
Oil Berth	Petroleum products	1	11.5m	Dolpin
Total		8		

14.3 Alternatives of Port Facility Layout Plan

Based on field surveys, cargo demand forecast and other study results, three (3) alternative port facility layout plans are proposed. There are two main concerns in formulating these alternatives, that is, how to solve the present problems such as lack of deep berths and shortage of yards, and how to minimize the construction cost.

The main issues of the layout plan is where and how new container berths will be planned. Focusing on new container berths, 3 alternatives are formulated.

(1) Alternative-1 New container berths consecutive with Quay 2 at the west side of the port (see Fig. 14.3.1)

New container berths will be constructed continuously with Quay 2 and a new breakwater will be constructed to protect the berths.

(2) Alternative-2 New container berths parallel to the west part of the main breakwater at the west side of the port (see Fig. 14.3.2)

Similar to alternative-1, new container berths will be constructed at the west side of the port. However, the new berths in this alternative-1 will run parallel to the west part of the main breakwater and thereby decrease the volume of dredging works. The length of a new breakwater however will become longer.

(3) Alternative-3 New container berths and breakwater at the offshore side of the existing breakwater (see Fig. 14.3.2)

New container berths will be constructed at the offshore side of the main breakwater and a new breakwater will be constructed to protect the berths. And a new connecting road to Quay 2 will be constructed. The disadvantages of this alternative are that the new container terminal is isolated from other terminals and further expansion space is very limited. The advantage is that there is no need to dredge soil and rock and it is suitable to construct deep berths although construction cost of the new breakwater and berths will be increased.

(4) Comparison of Alternatives

Alternatives are evaluated by 7 items: quality of berths, calmness of water, navigational safety, future development, disturbance to existing facility, harmonization with environment and cost. Table 14.3.1 summarizes the evaluation of alternatives from many aspects. Alternative-1 is recommended as the master plan of Tema Port.

Table 14.3.1 Comparison of Alternatives

	Alternative-1	Alternative-2	Alternative-3
Quality of berths	***	***	**
Calmness of water	***	***	**
Navigational safety	***	***	**
Future development	***	***	**
Disturbing existing port facility	***	***	***
Harmonization with environment	***	***	***
Cost Index	100	112	107

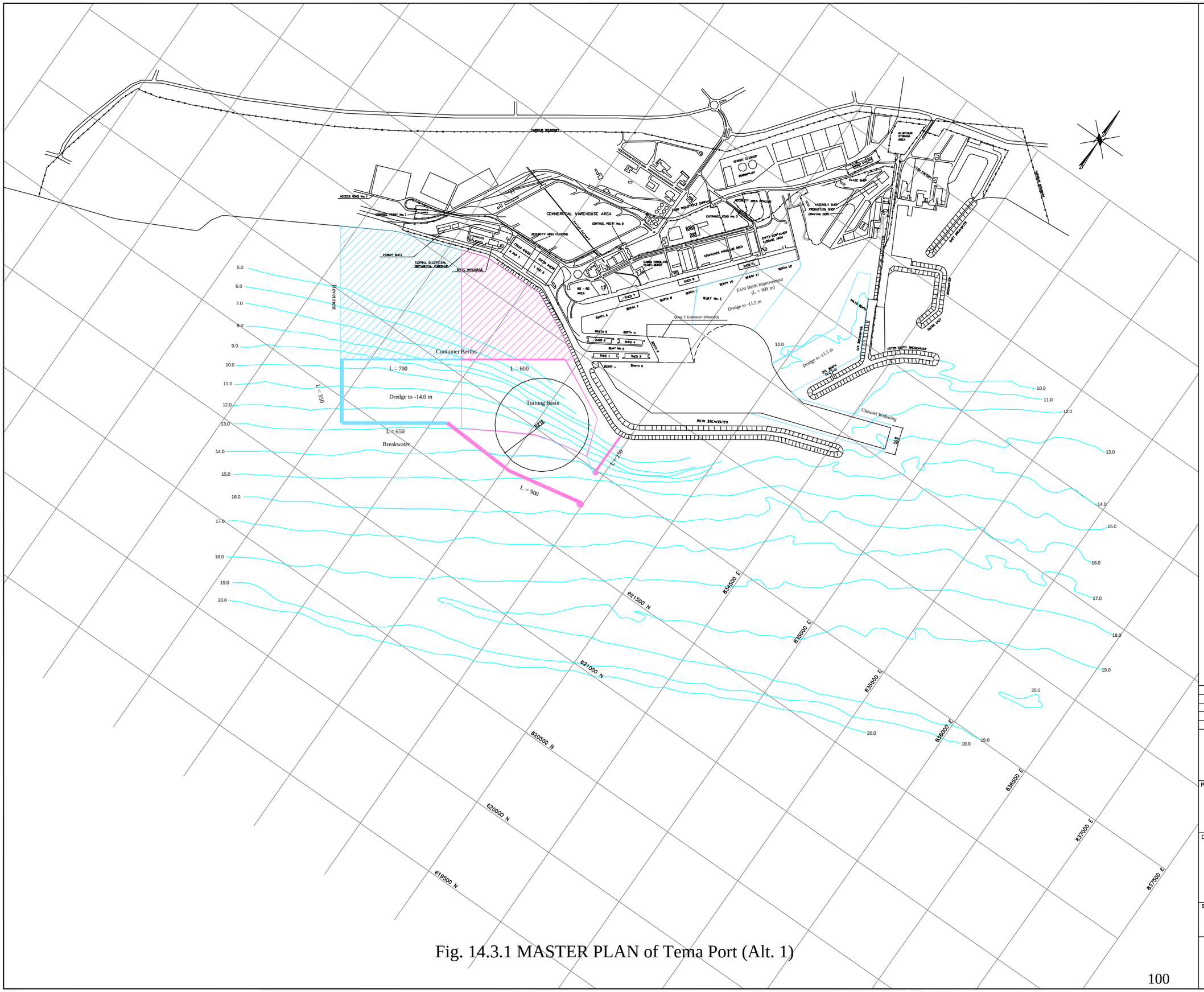
Note *** Good ** Fair * Poor

14.4 Port Facility Layout Plan

Fig. 14.4.1 shows the detailed layout plan of port facilities of the selected alternative in chapter 14.3. Table 14.4.1 shows the list of main facilities of the master plan.

Table 14.4.1 List of Main Facilities for Master Plan of Tema Port

Facility	No.	Dimension / Capacity
Container Berths	4	Length 300 - 350m, depth 13-14m
Multipurpose Berths	2	Length 274m, depth 11.5m
Valco Berth	1	Length 190m, depth 11.5m
Oil Berth	1	Dolpin, depth 11.5m
Navigational aids	1	4 Light beacons, 4 Buoys
Tug boat	2	2,500 Hp
Existing approach channel	1	One way, width 160m, depth 12.5m
New approach channel	1	One way, width 160m
New turning basin	1	Radius 290m, depth 14m
Container yard	1	45.5 ha
New breakwater	1	2,150m
Revetment	1	700m
Main road development	1	1 set
Inner harbour road	1	1 set
Container crane	8	45 tons
Transfer crane	24	40 tons, 1 over 4
Tractor head	32	For container cargo



NOTES:

1. Geodetic information:
   Ellipsoid: WGS84
   DATUM: WGS84
   Projection: UTM Zone 31
2. Coastline digitized from British Admiralty Chart 3102
3. Levels referenced to Chart Datum

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GHANA PORTS AND HARBOURS AUTHORITY (GPHA)

PROJECT

THE DEVELOPMENT STUDY OF GHANA SEA PORTS IN THE REPUBLIC OF GHANA

Drawing Title

TEMA PORT
MASTER PLAN

SCALE	DATE	Drawing No.	Rev. No.
1:20,000			

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Fig. 14.3.1 MASTER PLAN of Tema Port (Alt. 1)

NOTES:

1. Geodetic information:
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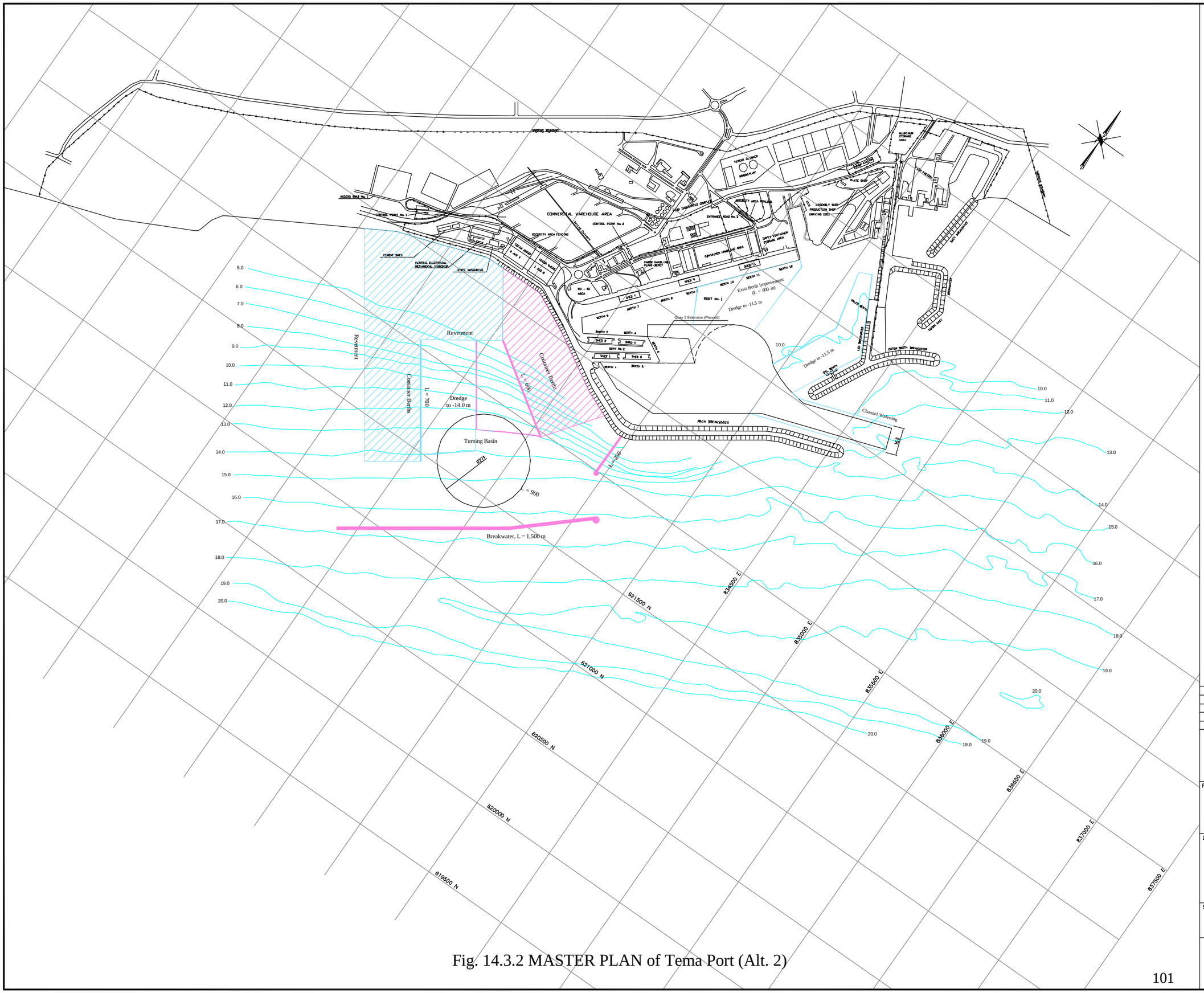

Fig. 14.3.2 MASTER PLAN of Tema Port (Alt. 2)

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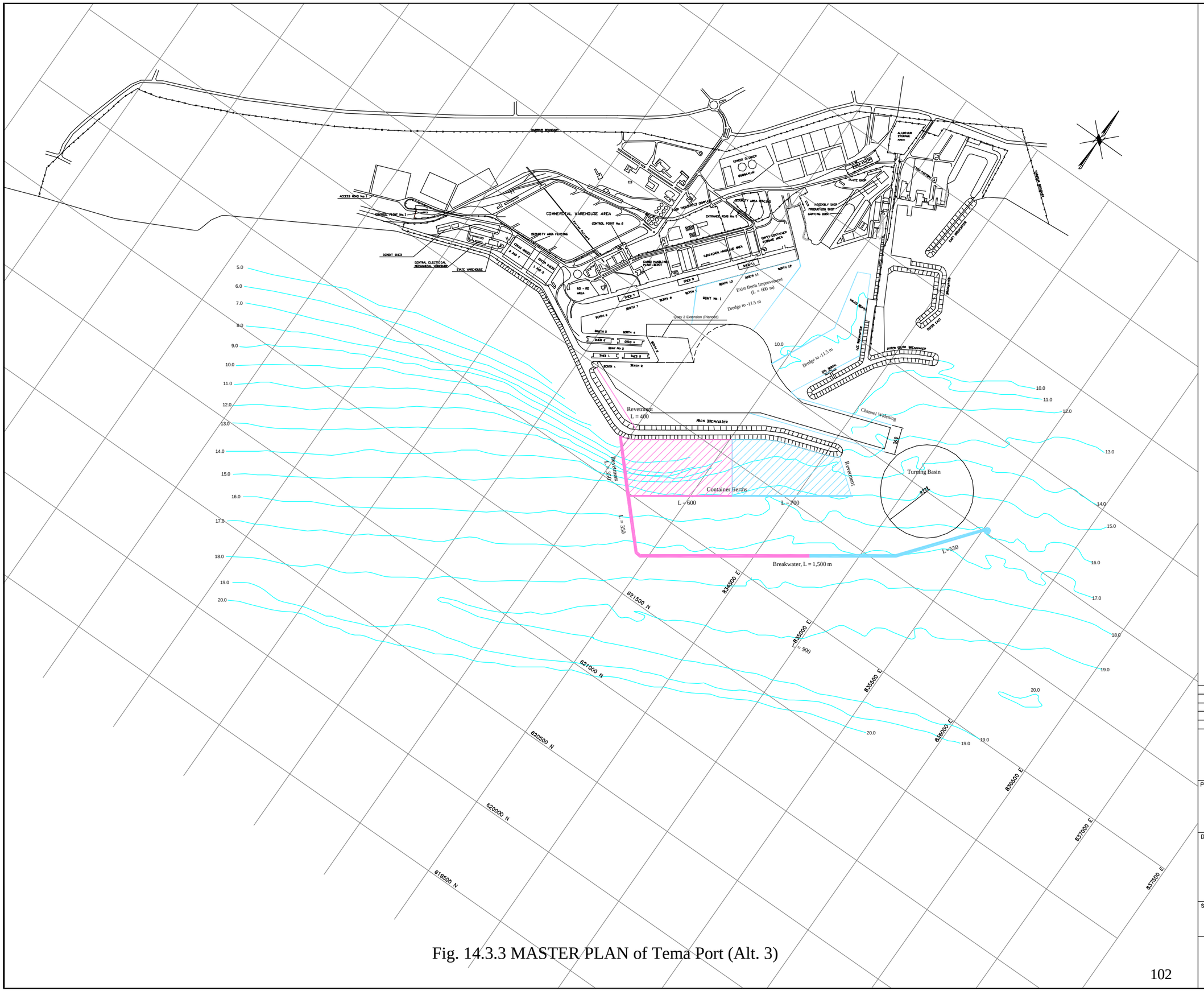

Fig. 14.3.3 MASTER PLAN of Tema Port (Alt. 3)

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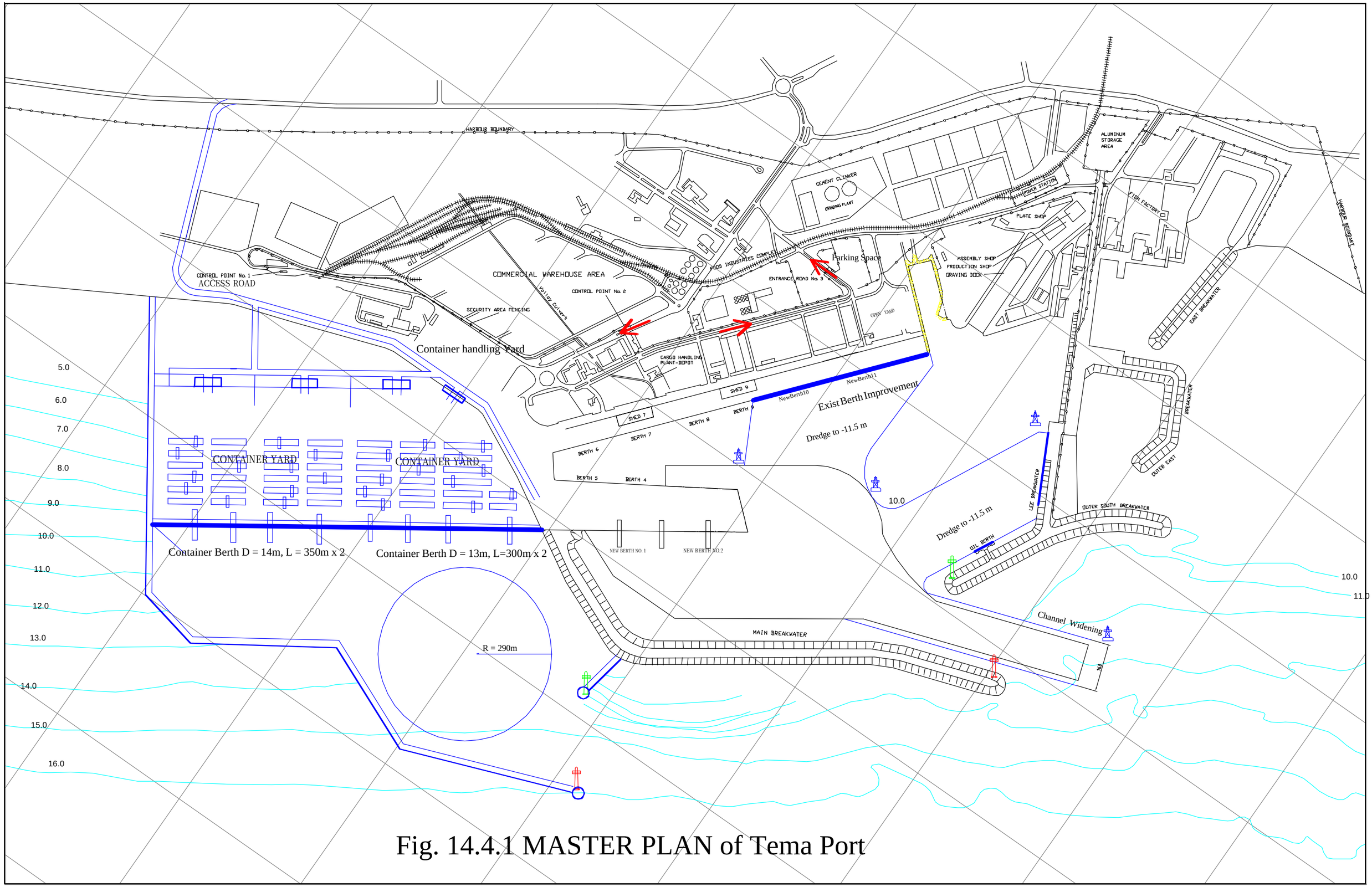

Fig. 14.4.1 MASTER PLAN of Tema Port

14.5 Proposal for Efficient Port Operation

14.5.1 General Principles of Port Management and Operation

Refer to Chapter 13.5.1.

14.5.2 Proposal for Efficient Cargo Handling System

(1) Container Cargo

(a) Selection of Container Handling Equipment

Generally speaking there are three types of container handling equipment as listed below;

Type : Rubber Tire Mounted Gantry Crane (Transfer Crane)
: Straddle Carrier
: Top Lifter / Reach Stacker

(b) Container Handling System at New Container Terminals

Table 14.5.5 Estimated Storage Area for Container cargo

Port of Tema		2000	2010	2020	unit
Volume of Container Cargo		166,149	485,313	1,049,940	TEU
Volume of Container Cargo		128,798	376,212	813,907	Box
Productivity		16	24	30	box/hour/vessel
Working day		365	365	365	day
Cargo throughput in a day		455	1,330	2,877	TEU/day
Average Dwelling Time(Target)		12	6	4	day
Peak Ratio		1.3	1.3	1.3	
		2000	2010	2020	
Required Capacity Volume for Container storage		7,098	10,374	14,960	TEU
Required Area for Container Storage	2 tiers	88,725	129,675	187,005	m2
	3 tiers	59,150	86,450	124,670	m2
	4 tiers	**44,363**	**64,838**	**93,503**	**m2**

Size of 20ft Container	
Length(l)	6.058 m
Widgh(w)	2.438 m
Height(h)	2.438 m
Bottom Area(=l x w)	15 m2
Area for 1slot	
(+ 50cm space on each side)	
lengh + 50cm x 2(ls)	7.058 m
widgh + 50cm x 2(ws)	3.438 m
Bottom Area(=ls x ws)	25 m2

- The construction of new container terminals at the western side of Tema is proposed in the Master plan (depth -14m x 300m x 2berths and depth -14m x 350m x 2berths). The transfer crane method is suitable for both terminals because it results in the most effective storage capacity in the same area.
- Eighty percent of container cargo will be handled at the new container terminal, and the rest (20%) will be handled at the existent berths of Quay1 and Quay2.
- 8 gantry cranes should be installed in the new container berths (2 gantry cranes in 1 berth x 4 berths).
- The required number of transfer crane (RTG) for each gantry crane is 24 units.
- Between quay side and marshaling yard, container cargo should be carried by yard tractor-trailers. The required number of yard tractor-trailers for each gantry crane is 32 units for 8 gantry cranes.

In total for new container terminals:	Quay side gantry crane:	8 units
	Transfer crane:	24 units
	Yard tractor trailer:	32 units
	Storage capacity:	15,460 TEUs
	(layouts	Figure 14.5.7 and 14.5.8)

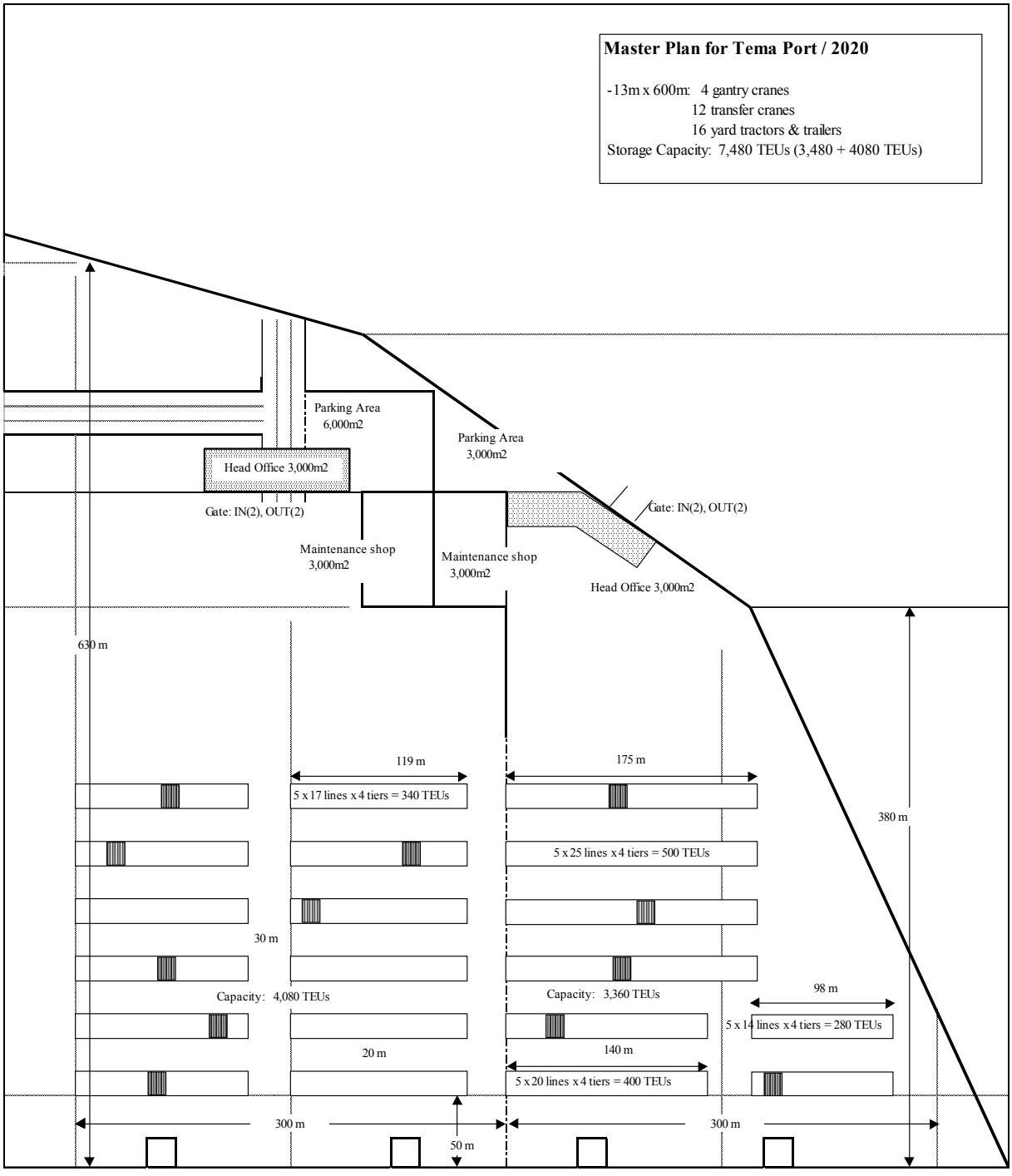

Figure 14.5.7 Layout of New Container Berths -1 (Depth -13m, 300m x 2 berths)

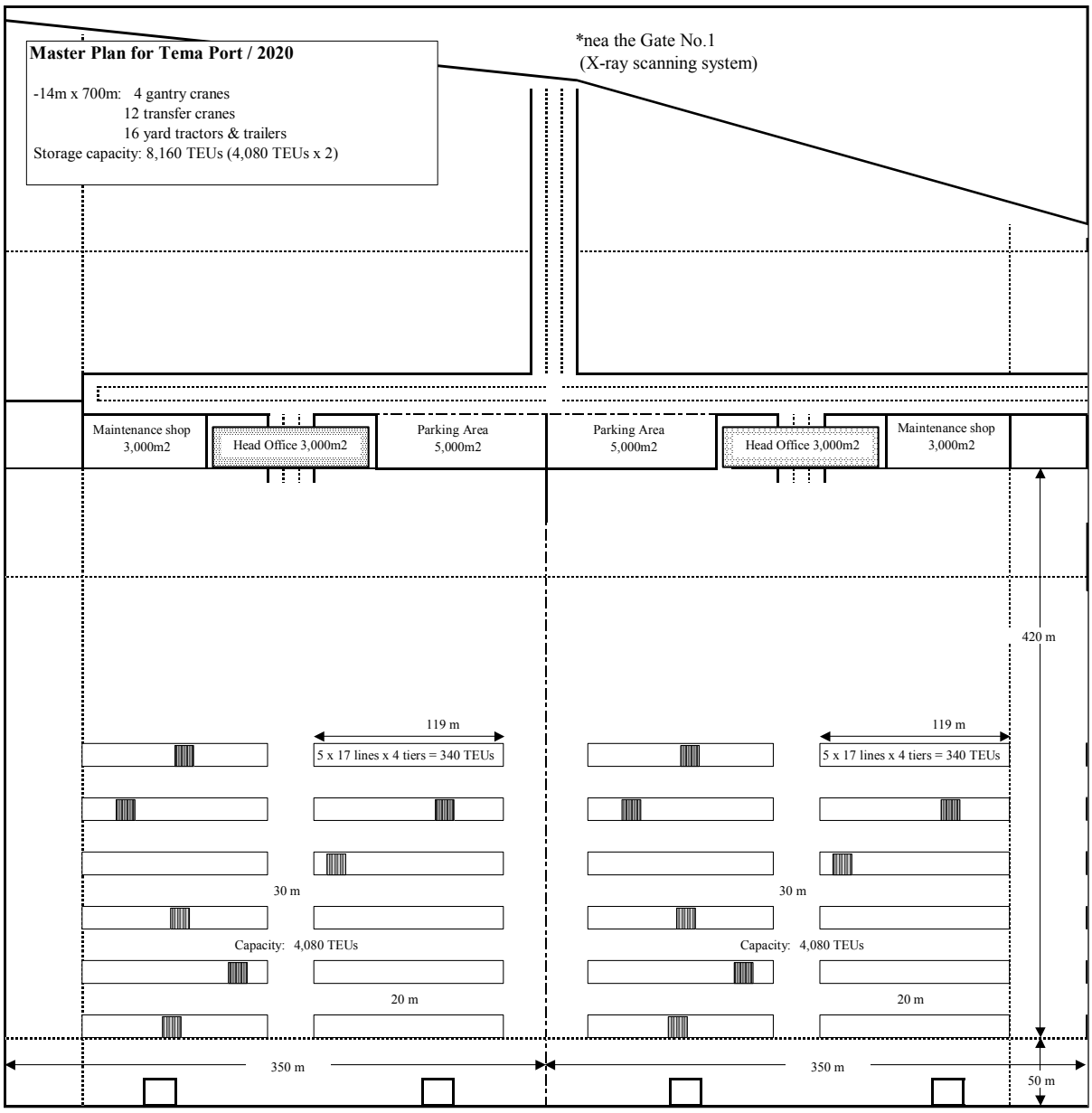

Figure 14.5.8 Layout of New Container Berths -2 (Depth -14m, 350m x 2 berths)

(c) The Container Yard at the existing port area (Quay1 and Quay2)

- Twenty percent of container cargo will be handled at the Quay1 berths and at the container terminal on Quay2 that will be re-constructed by GPHA.
- At present, there are some container yards behind berths 10-11 (about 37,000m^2). In addition, GPHA plans to establish a new container yard at the Quay2 (945 slots, 23,625 m^2) and in the area where the cocoa shed is currently located (about 52,000m^2). These container yards behind berth 10-11 and new container yard are sufficient for future container storage (3-tier stacking) at the existing port area.

(d) Additional Measures to Increase Efficiency of Port Operation

Refer to Chapter 13.5.2 (f).

(2) Bulk Cargo (Alumina, Clinker)

- Alumina is handled at Valco berth. Dredging the basin and deepening Valco berth is proposed in the master plan to increase cargo handling efficiency. A lighting system also need to be introduced to make night navigation possible.
- Bulk vessels for clinker cannot be accommodated at berth 12 with their full draft because of insufficient depth. The deepening of berth 12 will eliminate the need for these vessels to shift berths and also increase handling productivity. For highly bulk cargo handling efficiency, these bulk cargo such as clinker, gypsum are supposed to be handled mainly at the berths 10-12.

(3) Liquid Bulk (Crude Oil, Petrol Product)

- Introduction of a lighting system is also required at the oil berth to allow night navigation.

(4) Bagged Cargo

- Wheat and Rice are imported as bagged cargo in Tema port. These cargoes should be carried with pallet or net and be de-palletized at a shed or another appropriate place. In the case of unloading, palletized cargoes are lifted to the apron by ship gears and then onto the trucks by forklift, or lifted directly to the truck by ship gear. And the same number of extra sling nets or pallets should be prepared for the next loading/unloading at vessels. This system will make the performance of bagged cargo handling better.
- For highly bagged cargo handling efficiency, bagged cargo handling is desired to concentrate at berths 6-9.
- To further improve efficiency, the introduction of a three-shift working system is desirable.

(5) Ro/Ro Cargo, General Cargo

- Berths 1-11 will be available because the handling efficiency of the other cargo such as container or bulk will be better. The congestion will be expected to decrease and Ro/Ro and general cargo can be handled more efficiently.
- Container with Ro/Ro should be handled in berths 1-4 in Quay2 with other containers in the same place.
- Wheat is also imported as a grain bulk cargo, and is discharged using ship gear, grab bucket and hopper to trucks. These grain bulk wheat is desired to handle at mainly berths 6-9.

(6) Introduction of a Three-Shift Working System and Training System.

Refer to Chapter 13.5.2 (4).

(7) Introduction of the Port EDI System

The port EDI system is described in Chapter 15.1.4.

14.6 Preliminary Design

(1) Design Criteria and Condition

1) Same design criteria and conditions used in the design for the Master Plan of Takoradi Port are applied other than the natural conditions and objective vessels.

2) Natural conditions and objective vessels used in the design for the Master Plan of Tema Port are indicated in Table 14.6.1 and Table 14.6.2 respectively.

Table 14.6.1 Natural Conditions

Item	Design Conditions			
Oceanographic condition - Tide	HWL: CD+1.60 m, LWL: CD 0.00 m			
- Deep water waves	Wave direction	SW	S	SE
	Wave Height(Ho) Wave Period (To)	5.0 m 9-11 sec.	5.4 m 9-11 sec.	4.8m 9-11 sec.
- Current	Design max. velocity : 1.0 m/sec.			
Subsoil condition	Rock type	Unit weight	Compressive strength	
- New Container Berth Area	Quartz Gneiss	24.5 KN/ m^3	Max.60 MPa	
- Other areas	Granitic Gneiss	29.9 KN/ m^3	150~250 MPa	
Seismic Force	Seismic coefficient : 0.15			

Table 14.6.2 Objective Vessels for Tema Port

Vessel Type	DWT	Length Overall (LOA) m	Breadth (B) m	Max. Draft (Df) m
Bulk Carrier	30,000	185	27.5	11.0
Container Ship	50,000	266	32.3	13.0
Ro/Ro Ship	28,000	210	-	11.0
Oil Tanker	30,000	180	29.2	10.9

(2) Structural Design of Main Facilities

1) Breakwater

The breakwaters proposed in the Master Plan are located at the areas where water depth ranges from –8.0 m to－16.0 m. The same design which is recommended in the Master Plan for Takoradi Port is adopted (Rubble Mound type ,-15.0 m design depth).

2) New Container Berths

New container berths with total length at 1,300 m and required water depth of –13.0 to-14.0 m are planned at the west side of the existing port having about same alignment with Quay No. 2.

The structural type for these berths proposed in the design is a concrete caisson type as recommended in the design of Master Plan for Takoradi Port.

3) Existing Port Improvement

- Existing Berths at Quay No.1/Valco Berth

Same design which is proposed in the design of Takoradi Port Master Plan for the existing main wharf improvement is applied since the design conditions are very similar.

- Oil Berth Modification

After deepening in front of the existing berths, new dolphins will be provided at the locations appropriate for safe berthing of the design vessels.

Due to very hard rock conditions (anticipated compressive strength is around 250 MPa), a bore-pile structure is recommended assuming that the deepening by dredging is possible close to the existing structures (within 5 m) without adverse effects to the structures.

It should be noted that this structural design be further reviewed based on the further examination on the existing structural conditions.

4) Other Facilities

(a) Revetment : Rubble Mound Type is recommended.

(b) Yard Paving : Concrete block paving is proposed.

14.7 Implementation Plan and Preliminary Cost Estimate

(1) Implementation Plan

The construction component proposed in the Master Plan is indicated in Table 14.7.1 and the estimated construction schedule is 5 years as shown in Figure 14.7.1.

Table 14.7.1 Construction Component of Master Plan

Facilities	Description	Quality
1. Dredging and Reclamation		
1) Dredging	Rock and Soil	1,870,000 m^3
2) Reclamation		4,020,000 m^3
2. Breakwater		
-15.0 m (average)	Rubble Mound	L = 900 m
-10.0 m (average)	Rubble Mound	L = 1,250 m
3. Wharf and Berth		
1) New Container Berth (-13.0 ~ -14.0 m)	Concrete Caisson	L = 1,300 m
4. Revetment		
1) -5.0 m to –10.0 m depth	Rubble Mound	L = 350 m
2) Less –5.0 m depth	Rubble Mound	L = 350 m
5. Exist. Port Improvement		
1) Dredging	Rock/Soil	569,000 m^3
2) Existing Berths Improvement	Concrete block	600 m
3) Valco Berth Modification	Concrete block	240 m
4) Oil Berth Modification	Dolphins	1 set
6. Paving/Miscellaneous Works	Yard, Road, Drainage	1 set
7. Buildings and Utilities	Gate, Maintenance shop, Electrical/Mechanical Works	1 set

Note: Procurement of Equipment is excluded

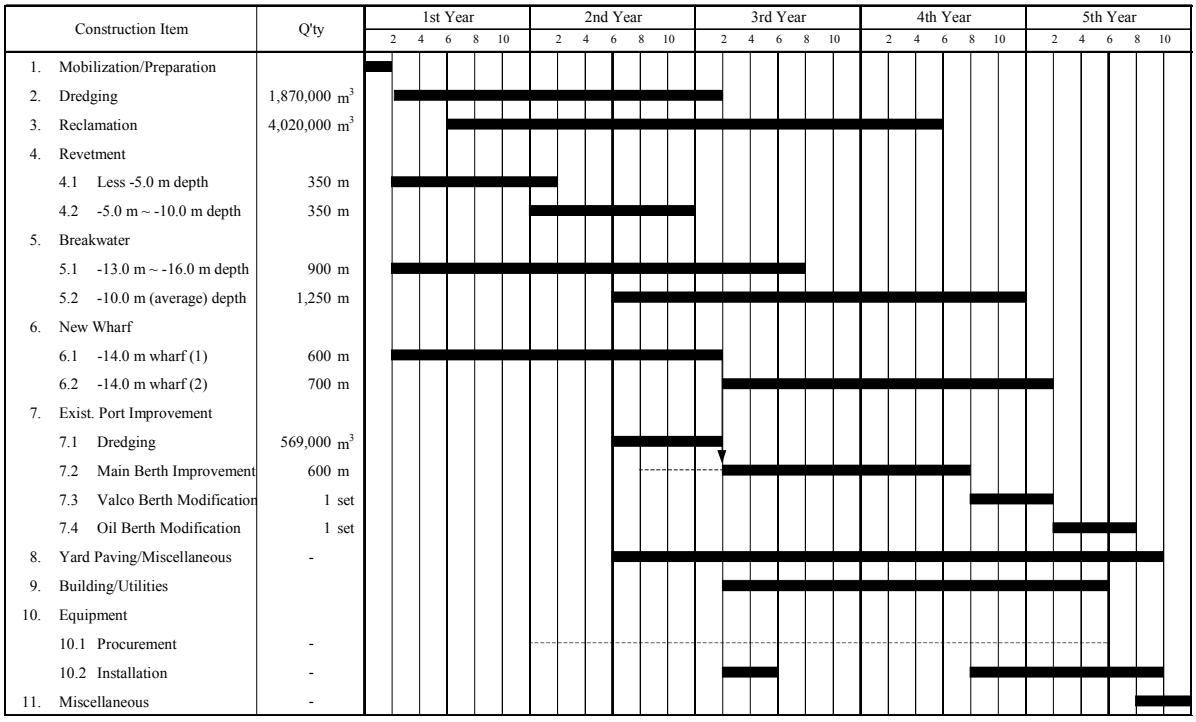

Figure 14.7.1 Implementation Plan for Tema Port Master Plan

(2) Estimated Cost for the Master Plan .

The total estimated cost for the implementation of the Master Plan of the Tema Port is approximately U.S. $ 365 Million as indicated in Table 14.7.2.

Table 14.7.2 Implementation Cost of Master Plan for Tema Port

Item	Description			Construction Cost (USD)	Remarks
	Type/Material	Unit	Quantity		
1. Civil & Building Works					
1.1 Dredging and Reclamation					
・Dredging work	Rock/Soil	m^3	1,870,000	51,954,000	
・Reclamation work		m^3	4,020,000	22,973,000	
1.2 Breakwater					
・Breakwater (-15.0m)	Rubble mound	m	900	28,800,000	
・Breakwater（-10.0m）	Ditto	m	1,250	24,375,000	
1.3 Wharf					
・-14m New Bulk Berth	R.C. Caisson	m	1,300	47,840,000	
1.4 Revetment					
・-5.0m to -10.0m Revetment	Rubble mound	m	350	2,100,000	
・Less -5.0m	Rubble mound	m	350	3,500,000	
1.5 Exist. Port Improvement					
・Dredging	Rock/soil	m^3	569,000	30,880,000	
・Main Berth Deepening	Concrete block	m	600	13,200,000	
・Valco Berth modification	Concrete block	m	1	2,840,000	
・Oil Berth modification	Additional dolphins	L.S	1	2,000,000	
1.5 Paving & Miscellaneous works		L.S	1	13,000,000	
1.6 Buildings & Utilities Works		L..S	1	6,800,000	
Sub-total				**250,262,000**	
2. Equipment					
2.1 Cargo Handling Equipment		L.S	1	74,000,000	
2.2 Other Equipment		L.S	1	5,200,000	
Sub-total				**79,200,000**	
Total				**329,462,000**	
3. Phisical Contingency	8% of 1,4% of 2	L.S	1	23,188,960	
4. Engineering Cost	5% of Item 1	L.S	1	12,513,100	
Grand Total				**365,164,060**	

14.8 Initial Environmental Examination (IEE)

An IEE was conducted based on the Master Plan of Tema Port and the results were compiled in a form of Scoping Report following the EIA Guidelines of Ghana. Fourteen (14) environmental factors were identified for the EIA (Table 14.8.1) through the scoping. Environmental factors with the ratings A, B, or C in Table 14.8.1 should be subject to the EIA. A TOR for EIA were prepared for the master plan (see Appendix B of Main Report).

Table 14.8.1 Scoping check list (Tema Port)

Environmental elements		Rating	Justification
Pollution	Air quality	B	Increase in numbers of calling ships and vehicle traffic.
	Water quality	B	Dredging, landfill, breakwater, increase in port activity
	Bottom sediment quality	B	Dredging, landfill, stagnation of water in the port
	Noise/vibration	B	Increase in vehicle traffic, port activity
	Odor	B	Smell from wastewater and commodities
	Land subsidence	D	Stable substrate (bed rock)
Biophysical environment	Topography, geology, soils	D	No important topography and geology
	Erosion	B	Active littoral drift at present
	Groundwater	D	No influence to the groundwater
	Lake/River flow	D	No lakes or rivers in the surrounding vicinity
	Coast/sea area	D	No important coastline
	Flora/fauna	B	Impacts on the aquatic ecosystem and the Ramsar site
	Landscape	D	No scenic value due to the existing port structure
Social environment	Economic activities	B	Increase in revenue of local community and employment opportunity
	Resettlement	C	Possible minor relocation of residential area and factories located near the port
	Infrastructure	C	Upgrade of infrastructure is expected accompanied with port expansion
	Cultural assets	D	No significant cultural assets in and around the port area
	Fisheries	B	Minor extinction of fishing ground for local fisherman
	Land use	C	Minor change expected
	Natural disaster	D	No influence to the occurrence of natural disaster
	Waste	B	Increase in calling ships and port activity
	Public health and safety	B	Possible traffic accidents

A Significant potential impact

B Potential impact of less significance

C Undecided (Possible impact in the future)

D No potential impact

14.9 Preliminary Economic Analysis

14.9.1 Methodology

The method of analysis in this case is the same as that of Takoradi Port mentioned in Chapter 13.9.

14.9.2 Costs of the Projects

The items that should be considered as costs of the projects are construction costs and maintenance costs.

(1) Construction Costs

Construction costs are divided into such categories as civil costs and mechanical costs. Main mechanical costs are purchasing of cargo handling equipment.

(2) Maintenance Costs

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

(3) Renewal Investment Costs

The renewal costs for cargo handling equipment after their economic durable periods should be considered. The economic durable periods of equipment are planned as follows.

Table 14.9.1 Economic Durable Periods and Costs of Equipment

Equipment	Durable Periods	Costs('000US$)
Gantry Crane, Transfer Crane, Tug Boat	20 Years	79,200

Costs of the projects are summarized in the following table.

Table 14.9. 2 Costs of the Projects for Master Plan – Tema Port

Items	Costs('000US$)
Civil Works	250,262
Equipment	79,200
Total	329,462
Maintenance Costs for Structure	1,313
Maintenance Costs for Equipment	3,168
Total (per year)	4,481

14.9.3 Benefits of the Projects

The following items are considered as tangible benefits in terms of the cost-benefit analysis in this study.

1) Savings in staying costs of ships

2) Savings in water transportation cost by increase of cargo volume per ship

3) Savings in land transportation costs

4) Earnings of foreign currency in handling transshipment cargoes

Benefits of the projects are summarized in the following table.

Table 14.9.3 Benefits of the Projects for Master Plan – Tema Port

(Unit: thousand US$)

Items	Benefits
Ships' Staying Time	8,589
Water Transportation	15,624
Land Transportation	35,953
Earnings of Foreign Currency	12,192
Total	72,358

14.9.4 Evaluation of the Projects

The EIRR of the master plan for Tema Port is calculated as 14.8%. The results of calculation are shown in Table 14.9.4.

It is generally recognized that the project is feasible if the EIRR exceeds the opportunity cost of capital. Usually, the opportunity cost of capital is considered to range from 8% to 10% according to the degree of development in each country. It is acceptable that a project with an EIRR of more than 8% is economically feasible for infrastructure or social service projects.
As for this project, even though the economic calculation only takes into account the items which are easily quantified, the EIRR exceeds 8%. Therefore, this master plan development project is feasible from the viewpoint of the national economy.

Table 14.9.4 Results of Sensitivity Analysis on Master Plan for Tema Port

	EIRR 14.8%	Increase in Investment Cost		
		0%	10%	20%
Decrease Benefits	0%	14.8%	13.6%	12.5%
	10%	13.5%	12.3%	11.3%
	20%	12.0%	10.9%	9.9%

Chapter 15 Improvement Plan of Port Management and Operation

15.1 Principles of Port Management and Operation

15.1.1 Background on Management, Operation and Institutional Matters of Ghana Sea Ports

Ghana Sea Ports are service ports, and GPHA has to do all of the maintenance, management and operation of the port. GPHA drafted the Landlord Port Bill in July 2000 and the Bill is being deliberated by the Government now. When the Bill is passed by parliament, Ghana Sea Ports will be a Landlord Port, in other words, GPHA will own the land while private companies will participate in the port operations.

15.1.2 Privatization of Port Management and Operation

(1) Basic Concept and Pattern of Port Management and Operation

Ports are managed in a variety of ways depending on the state system, local characteristics, economic conditions etc. In order to raise the ability of the port authority to its highest level, it is necessary to adhere to the essential principles such as "Autonomy", "Financial independence", "Principle of competition", "Unitary management"

(2) Patterns of Port Development, Management and Operation Body

Port management and operation systems differ by each port. Possible patterns of development, management and operations for the new port are shown in Table 15.1.1.

Table 15.1.1 Patterns of Port Development, Management and Operations Body

Pattern		A	B	C	D	E	F
Master Plan		○					
Construction	Channels	○		○		○	○
	Breakwater						
	Infrastructure					●	●
	Superstructure			○	●		
Ownership	Land	○		○	○	○	●
	Terminal Facilities			●*2	●*2	●*2	●
Berthing Scheme		○	○*1	●	●	●	●
Terminal Operations		○	●	●	●	●	●
Tug & Pilotage		○ or ●					

Note 1 ○: Public ●: Private
Note 2 *1: Exclusive system *2: Land lease system

(3) General Problem for the Privatization

(4) Measures to Mitigate the Impact brought by Privatization and Private Sector Participation

The following mitigation measures shall be taken.

1) To conduct gradual and prudent restructuring so as not to cause social unrest due to unemployment.
2) To retrain the current employees so as to enable them to find new jobs.
3) To provide government assistance for displaced workers looking for new jobs.
4) To generate new employment opportunities within the port through the increase in port capacity and promotion of new port business by GPHA.

(5) Proposal for the Privatization in Ghana Sea Ports

For Ghana Sea ports, Case D form of privatization is recommendable as appropriate role sharing between the public sector and the private sector for the following reasons:

- Private sector can avoid the risk of huge initial investment cost.
- Public sector can utilize cargo handling know-how and flexibility of the private sector.
- The public sector (GPHA) can control overall port development and management.

However, different approaches should be taken in some instances. Details are as follows:

1) In the case of Takoradi Port

- Management and operation of manganese, bauxite, clinker, and oil handling berth would be the responsibility of private companies.
- Since berths 5-6 will function as the multipurpose berths, it is appropriate for them to be managed by GPHA, including facilities and equipments such as quay-side gantry cranes. Maintenance of facilities and equipment will be done by GPHA or contracted to private company.
- New container terminal at the inner port area should be leased to a single operator as a public berth because many companies will utilize this single container terminal. GPHA constructs the basic facilities and the operation company procures cargo handling equipment, and operates this new container terminal. However, there are plural possibilities concerning the make-up of that single operator.
  - One private company such as shipping company, stevedoring company
  - One joint venture company of private companies.
  - One joint venture company of these private companies and GPHA

2) In the case of Tema Port

- All of the new container berths (4 berths) on the western side of Tema port are desired to be leased one by one to private companies as public berth. For the first 2 container berths, GPHA should construct the facilities (reclaiming and pavement) and then lease these berths to a single operator such as:

- One private company such as shipping company, stevedoring company
- One joint venture company of private companies.
- One joint venture company of these private companies and GPHA

・For subsequent berths, a different strategy such as "BOT scheme" might be considered. GPHA has a few options in this regard.

(i) Full construction (includes dredging and reclaiming) is done under BOT scheme or;

(ii) Dredging, reclaiming and pavement is done by GPHA and the rest of construction is done under BOT scheme by

- One private company such as shipping company, stevedoring company
- One joint venture company of private companies.
- One joint venture company of these private companies and GPHA

However because of the high construction cost of the new container terminal, option(ii) is recommended. Land reclamation and dredging will be done by GPHA while the superstructure will be built by the private sector.

・Valco berth and Oil berth are desired to be leased to private companies for exclusive use.

・New berth11(for Clinker) in Quay1 is desired to be leased to a private company as an exclusive berth. Maintenance of equipment and operation would be in the hands of the private company. Berths 6-10 in Quay1 should be managed by GPHA as public berths because general cargo, bagged cargo are handled by many private companies at these berths. Maintenance of facilities and equipment will be done by GPHA or private companies by contract with GPHA.

15.1.3 Monitoring the Performance of Operation

GPHA should monitor the performance of operators and recommend the improvement of productivity if the performance is poor and could cancel their license if improvement is not expected. GPHA needs to put pressure on port operators to improve the productivity of operation.

If GPHA participates in the operating company as one of the joint venture in future, GPHA is required to keep its monitoring section independent from the operating section.

15.1.4 Introduction of Port EDI System

The GCNET, new custom EDI system developed by CEPS is linked to all stockholders such as CEPS, GPHA, Ministry of Finance, Ministry of Trade and Industry, Ghana Statistics Service Ghana Shipping Council, Social General de Surveillance and so on. Ghana Sea Ports will be more convenient with this port EDI system. However, it is necessary to provide training to staff who operate the port EDI system to avoid delays and mistakes. And it is worth considering that GPHA or a community of port related companies jointly establish a governing body of this port EDI system.

15.2 Proposal for Efficient Port Promotion

At GPHA, the marketing unit was established in 1994, and some port promotional activities are carried out now. Current activities for port promotion/sales are listed below:

1）Advertising in international maritime trade journal to attract vessels to Ghana Sea Ports.
2）Exhibiting port facilities and services at local and international fairs.
3）Occasional trade missions to landlocked countries（Burkina Faso）to attract their trade through the Ghanaian corridor.
4）Trade visit to shippers in Kumasi and northern parts of the country to attract shippers to use Takoradi Port.
5）Trade visit to shipping companies/agents to identify their problems and propose measures to resolve them.

In West Africa, Ghana Sea Ports enjoy a reputation for reliability thanks to the stability of the Ghanaian government. Recently, some seaports in neighbouring countries have problems concerning reliability, and some shipping companies plan to their cargo handling to Ghana Sea ports. Important points for promoting Ghana Sea Ports in future are below:

・To emphasize the high stability and reliability of Ghana Sea Ports.
・To emphasize the greater convenience and performance of Ghana Sea Ports that can be effected once the Landlord Port Bill is passed.

15.2.1 Port Promotional Activities in Ghana

Port promotion activities in Ghana should be done in cooperation with organizations concerned such as Ghana Export Promotion Council. In addition, GPHA should have periodic meetings with port users such as shipping companies and agents to identify their problems and propose measures to resolve them.

15.2.2 Port Promotional Activities in Landlocked Countries

It will be necessary to continue this activity in liaison with organizations concerned such as Ghana office of Burkina Faso, Mari and other private companies of landlocked countries.

15.2.3 Port Promotional Activities in Foreign Countries

GPHA should expand their port promotion activities to attract more cargo volume to/from important regions such as North America, Europe and Asia. GPHA should frequently visit headquarters of foreign shipping companies that have routes with Ghana and increase participation in Trade Fairs and Exhibitions in foreign countries.

15.2.4 Port Promotional Activities for Cruise

There are many historically valuable and attractive ruins in Ghana such as Cape Coast where the sightseeing potential is high. When a cruise ship comes to Ghana as a tramper（non-periodically）, GPHA should accept the vessel if possible. Promotional activities to attract cruising vessels are also important from the viewpoint of not only national economy but the increase of port revenue.