3.3 CARGO HANDLING CAPACITY

3.3.1 General

Existing cargo handling capacity and improved cargo handling capacity of the Marmara sea is calculated in this section. Existing cargo handling capacity is calculated based on the existing facilities of the existing main port in the Sea of Marmara, namely Haydarpasa, Ambarli, Tekirdag, Gelibolu, Canakkale, Bandirma, Mudana, Gemlic, and Derince. As for the improved cargo handling capacity, improved cargo handling facilities of above mentioned ports and additional private ports are considered. Private container and cargo port proposals for which no objection has been raised by other organizaitons on the stage of approval of settlement plans by the Ministry of Public Works and the ones which already have approved settlement plans are taken into consideration.

3.3.2 Regulation for Private Ports

The procedure which is to be applied in coastal construction by investors was decided in July 1995 by the representatives of the Ministry of Public Works and Settlement, Ministry of Tourism, Ministry of Finance, Ministry of Transport, Undersecretariat of Maritime, Ministry of Environment and Private Environmental Protection Directorate.

The definitions in the above decision are as follows;

Investor; *all private and public institutions and individuals who are involved in the construction of the structures which are mentioned in this decision.*

Structures; *the infrastructure and facilities such as pier, port, shelter, berthing space, wharf, breakwater, bridge, hole, retaining wall, light house, towing vehicle space, boat building plant, sea water refining and pumping stations, ship building plant, ship disassembling place, marine products processing facilities, infrastructure facilities regarding land/sea and air transportation, park, children playgrounds, open sport areas, fair/picnic and amusement area including restaurants, tea garden, exhibition units and administrative buildings.*

Reclamation; *any kind of permanent structure which cover the area which is located in the sea side of the coast edge line.*

The procedure is as follows;

(1)The investor is to submit;
a) covering memorandum report including local information and the necessary explanation regarding the structure to be constructed,

b) proposed layout plan including the key plan and the characteristics and dimensions of the structure to be constructed, to the relevant provincial office (Directorate of Public Works and Settlement, Ministry of Public Works and Settlement) and to make his first application.

(2) The provincial office is to consider the demand regarding the filling and to send the following information and documents to the Ministry;
a) if there are existing lands and particles which were previously subject to allocation or possession in the area related to the filling, the placement of the situations of these lands and particles regarding possession, building density and the approved coast edge line on the currently existing maps
b) organization of these in coordination with the settlement plans in effect, if any settlement regulation plan
c) making of coordinated sketch extracted from Environment Order
d) making of the sketch regarding the service target of proposed filling area.

(3) The Ministry is to consider the proposal in terms of General and Regional Planning Principles, General Settlement Order and plan decisions.
In case of approval;
a) the Ministry requires consultancy of Undersecretariat of Maritime, Ministry of Transport and Ministry of Environment and if necessary, information and documents including comments
b) the opinion of the Ministry of Environment will be included in the document indicating "EIA positive-negative or Environmental Impact is unimportant." This document is necessary to satisfy EIA regulation only.

(4) The Ministry considers the proposal within the framework of the obtained opinions and in case of approval, instructs the relevant provincial office to prepare a Proposal Settlement Plan. The Ministry completes the approval process according to the Coast Law.

(5) The Settlement Plans which have been approved by the Ministry are submitted to the relevant provincial office, the relevant Municipality, Undersecretariat of Maritime, Ministry of Transport, Ministry of Tourism, Ministry of Environment, Ministry of Finance and the relevant institutions.

(6) Investor is to submit the documents below to DLH for approval.

- Implementation projects
- Calculations of any kind
- Geotechnical report
- Model documents required by DLH.

The investor is to submit the reclamation settlement plan which is approved by the Ministry, to DLH and the documents above must be prepared according to this plan. DLH evaluates and approves these projects.

(7) The investor is to apply to the Ministry of Finance in order to obtain the permission which is required to obtain construction license together with the documents below;

— Approved reclamation settlement plan

— Implementation projects approved by DLH

— The investment certificate from Ministry of Tourism for the construction related to tourism.

(8) The investor is to obtain "Construction License" from the relevant administration office, together with the permission certificate which was given by the Ministry of Finance. The process for Construction License is to be carried out according to the relevant articles of the Settlement Law.

(9) The building is to be constructed under the supervision of DLH as much as possible as the responsibility belongs to the investor.

(10) When the construction is completed, the investor applies to Undersecretariat of Maritime and obtains "the Certificate of Eligibility for operation" and forwards a copy of this certificate to the Ministry of Finance for its information.

(11) The investor is to apply to the relevant administration submitting "the Certificate of Eligibility for operation" in order to obtain "the Operation License."

(12) The administration office which grants Construction License, Operation License and Tourism Operation Certificate is to forward a copy of the official letter proving that the certificates were granted to the Ministry of Environment and the other relevant institutions in order to allow the monitoring and controlling of the matters identified in the Environment Impact Report.

3.3.3 Principle for Container Terminal Development

In discussing the port development policy in the sea of Marmara, the most important item is container. The capacity of container handling facilities at present is far behind the demand and Haydarpasa port, which is the major container port in the region, is seriously congested and still the demand seems to continue increasing. And, in general, more valuable goods and important items in foreign trade are containerized. Therefore if Turkey does not provide enough container handling facilities in terms of both quantity and quality, it could affect the development of foreign trade activity.

The Marmara area is divided into four regions in the study. At present, container facilities are facilitated only in the Izmit bay region. Even in the Izmit bay area, container handling facilities are not constructed based upon a firm policy but permission has been given to applications for construction of container terminal in a makeshift way. As a consequence, many small scale terminals sprawl along the bay area. This phenomena is not desirable. The relevant authority should have had a policy for development plan of container terminal in the region and control so that such sprawl does not occur.

Arrangement of container terminal should be examined from the transport economy point of view as a whole nation. Shipping companies and terminal operators have their own opinions based on their own interests and they are not always consistent with national interests. This is very important and care must be taken.

General speaking, it is more efficient to centralize the facilities into one big terminal rather than sprawl them in many small scale ones in a definite region. On the other hand, sea transportation is more economical than land transportation if transportation distance exceeds a certain distance. For example, in transporting a commodity in container from the region 200km apart from the port in Japan to U.S., it happens that the transportation cost for land transportation from the region to the port is approximately equivalent to the sea transportation cost from Japan to U.S.. Therefore if a region has a certain amount of container cargo, the region should have its own port.

The Marmara area is divided into four regions in the study, namely, Izmit, Thrace, Balkesir and Chanakkale. The container volumes estimated in above section 2.3.1 to be handled in each region in 2015 are 1340, 690, 130 and 20 thousand TEU respectively. Taking the factors mentioned above into consideration, the following principles for the development of container terminal in Marmara sea are recommended.

(1) Izmit, Thrace and Balkesir should be considered as independent areas serviced by their own terminals. These regions are separated from each other by more than 200km. In particular, there are densely populated urban areas of Istanbul and Bospholus Strait between Izmit and Thrace regions. More over each region has considerable amount of its own cargo.

(2) In Thrace region, it is necessary to construct a new port and equip it to handle the containers generated from the region.

(3) In Balkesir region, because container volume to be handled in the target year is not so large though it is expected to increase in the future, by modification and expansion of Bandirma port, the requirement is fulfilled. If the potential demand of container throughput in the region exists, it would not materialize without any facilities. Therefore the important thing is to show that the port is ready to handle container.

In this context, it is recommended to prepare a container storage yard by reclaiming the slip between berth no.2,3 and 4,5. Any special container handling equipment is not necessarily required and it can be started with ship gear and mobile crane. Although 4 berths are canceled, till 2005 it could be managed by the existing facilities. After that expansion toward the west side and moving the coal handling equipment is recommended. This measure has the added bonus of separating the dirty cargo far from the urban district of Bandirma city, leaving only clean cargo like container or general cargo to be handled in the vicinity of urban area, which will improve the urban environment. And it is recommended that container should be considered as a main cargo of the modern port in future for the sake of the region and for the port itself.

(4) One of the most serious problems of container handling facilities in the region of Izmit is that the facilities tend to sprawl along the bay in a small size, though the total capacity may meet with the demand.

In general, small scale terminal is difficult to equip with large scale and modern equipment with high efficiency, thus it can not be competitive with the ports in the neighboring country and can not attract any mother vessel. This forever relegates the status of the port to that of feeder port. This would affect the national economy through high transportation cost.

Therefore it is strongly recommended that the relevant authority should have a firm policy on future container terminal development and prevent the sprawl phenomena from continuing. It would be difficult to cancel permission once given, but at least those applications not yet processed should be strictly denied. And a large scale terminal, at least 1milion TEU class, should be planned and preparations should begin to be made.

Derince is one of the candidate sites for the main terminal in the district, but the soil condition at the site is not quite favorable. Therefore because necessity of the terminal is not so urgent and the investment required would be huge, a careful study is recommended including alternative sites to ensure that no misjudgments are made.

In the context of the concept described above, container terminal handling capacity of the planned Demport should not be included when estimating future container capacity. Because it has not been planned as a container terminal but a multipurpose terminal and its plan consists of three(3) jetty type mooring facilities at the moment. Though they are thinking to handle containers of 300 thousand TEU in future, it is very difficult to evaluate whether the port can handle a significant amount of containers due to its planned configuration. And the more important matter is that newly planned container terminals of a small scale in the bay should not be approved any more.

The Derince container terminal will be included in the study team's master plan. But since the soil conditions are not favorable, it is recommended that other alternative sites be found. Derince is one of the candidates and the other is the site suggested by TCDD. At any rate, from the long term point of view, a large scale container terminal like the planned Derince is definitely necessary.

3.3.4 Methodology for Capacity Calculation

In order to estimate the total cargo handling capacity of the Sea of Marmara, cargo handling capacity of each port is estimated. Methodology for this estimation is as follows.

(1) General Cargo and Bulk Cargo

General cargo and bulk cargo is handled by shore crane and/or ship gear using slings or conventional grab bucket. Therefore, cargo handling efficiency per hour per gang is calculated and estimated by the following basic formula. Considering the depth of the berth, -4.0m to -7.4m, cargo handling capacity is estimated as two-thirds of this figure, and as for the narrow shaped pier, simultaneous operation of both sides of the pier is not considered.

For break bulk cargo — @"x" x 20 cycle x 0.9

@"x"	: Assumed cargo weight of one sling (ton)
20 cycle	: Cycle of cargo slinging per hour
0.9	: Coefficient of stoppage of cargo work

For bulk cargo — @"y" x "z" cycle x 0.9

@"y"	: Using a certain capacity of bucket x bulk density
"z"	: Cycle of cargo slinging (grab bucket)
0.9	: Coefficient of stoppage of cargo work

Estimated cargo handling efficiency by commodities is as follows.

a. General cargo

One sling (@2 ton) x 20 cycles/hr x 0.9 = 36 ton / hr/ gang (for 5 ton crane)

One sling (@4 ton) x 20 cycles/hr x 0.9 = 72 ton / hr/ gang (for 10 ton crane)

b. Bagged cargo

One sling (@1.5 ton) x 20 cycles/hr x 0.9 = 27 ton / hr/ gang (for 5 ton crane)

c. Cement, Sand

$3.5m^3$ x 1.5 x 30 cycles/hr x 0.9 = 142 ton/hr/gang (for ship gear)

d. Grain

$3.5m^3 \times (0.70 \sim 0.75) \times 30$ cycles/hr $\times 0.9 = 66 \sim 71$ ton/hr/gang

e. Coal

$2.0m^3 \times 0.75 \times 30$ cycles/hr $\times 0.9 = 40.5$ ton/hr/gang : (for 5 ton crane)
$5m^3 \times 0.75 \times 30$ cycles/hr $\times 0.9 = 101$ ton/hr/gang : (for 10 ton crane)
$10m^3 \times 0.75 \times 30$ cycles/hr $\times 0.9 = 203$ ton/hr/gang : (for 20 ton crane)
$15m^3 \times 0.75 \times 30$ cycles/hr $\times 0.9 = 304$ ton/hr/gang : (for 30 ton crane)

f. Ore

$3.5m^3 \times (2.0 \sim 2.6) \times 30$ cycles/hr $\times 0.9 = 189 \sim 246$ ton/hr/gang : say 215ton/hr/gang

Example of type and capacity of grab bucket is shown in Table 3.3.1.

(2) Container cargo

Container cargo handling capacity is estimated based on the storage capacity of each port and present dwelling time (15 days). Cargo weight of 1 TEU container is estimated as 8.3 tons based on the present cargo handling statistics. Estimated container handling capacity of each port is as shown in Table 3.3.2. Container ship statistics of Haydarpasa port in March 1996 are shown in Table 3.3.3.

Cargo handling efficiency of RO/RO cargo is estimated as 247 ton/hour by the present handling efficiency in Haydarpasa port, which is calculated from the cargo handling statistics of March, 1996. Details are provided in Table 3.3.4.

Cargo handling capacity of TMO facility is calculated from the data sheet of TMO in following Table 3.3.5.

Handling capacity of liquid cargo is estimated from the past maximum handling records of each port.

TABLE 3.3.1 Example of Type and Capacity of Grab Bucket for Unloaders

Type of grab bucket	Cargo handling equipment	Applicable cargo	Capacity of grab (m^3)	Grabbing weight (ton)	Grab weight (ton)	Total weight (ton)
Shell type single wired Bucket	Various type of crane	Coal	1.6	1.6	1.5	3.1
			2.0	2.0	1.7	3.7
			2.5	2.5	1.9	4.4
			3.0	3.0	2.8	5.8
			3.5	3.5	3.2	6.7
			4.0	4.0	3.6	7.6
			4.5	4.5	4.0	8.5
			5.0	5.0	4.5	9.5
			6.0	6.0	5.5	11.5
			10.0	10.0	9	19
			13.0	13.0	12	25
			15.0	15.0	15	30
		Ore	3.5	8.4	8.5	16.9
		Grain	2.5	2.0	1.5	3.5
			3.0	2.4	1.8	4.2
			3.5	2.8	2.1	4.9
			5.0	4.0	3.0	7.0
			6.0	4.8	3.7	8.5
		Sand	3.5	5.3	3.6	8.9
			4.0	6.0	4.0	10
			4.5	6.8	4.5	11.3
			5.0	7.5	5.0	12.5

TABLE 3.3.2 Container handling capacity

		Container Storage (1)	Average Dwelling Time (2)	Annual Capacity (1)*365/(2)	
		TEU	day	TEU/year	ton/year
Container	Haydarpasa	6,000	15	146,000	1,211,800
	Derince	2,000	15	48,667	403,933
	Gemport	3,000	20	54,750	454,425
	Total			249,417	2,070,158

TABLE 3.3.3 Container Ship Statistics of Haydarpasa Port (March, 1996)

		Berth No.6		Berth No.12		Berth No.13		Berth No.14		Berth No.15		Total	Average
		Total	Average	Total	Average	Total	Average	Total	Average	Total	Average		
Number of Vessel		18		23		11		11		14		77	
Handling Equip.		Ship Gear		Gantry Crane		Ship Gear		Ship Gear		Ship Gear			
Import	20'FULL	887	49.3	2,466	107.2	1,077	97.9	783	71.2	703	50.2	6,322	71.8
	20'EMPTY	145	8.1	117	5.1	24	2.2	46	4.2	129	9.2	494	5.6
	40'FULL	750	41.7	1,542	67.0	622	56.5	519	47.2	372	26.6	3,998	45.4
	40'EMPTY	0	0.0	15	0.7	24	2.2	29	2.6	1	0.1	69	0.8
Import Subtotal	Box	1,782	99.0	4,140	180.0	1,747	158.8	1,377	125.2	1,205	86.1	10,883	123.7
	TEU	2,532	140.7	5,597	243.3	2,393	217.5	1,925	175.0	1,278	91.3	14,550	165.3
Export	20'FULL	386	21.4	892	38.8	409	37.2	363	33.0	183	13.1	2,428	27.6
	20'EMPTY	575	31.9	1,055	48.0	645	58.6	414	37.6	159	11.4	3,065	35.6
	40'FULL	189	10.5	778	33.8	341	31.0	232	21.1	68	4.9	1,685	19.1
	40'EMPTY	664	36.9	765	34.8	218	19.8	348	31.6	192	13.7	2,484	28.6
Export Subtotal	Box	1,814	100.8	3,490	155.3	1,613	146.6	1,357	123.4	602	43.0	9,662	110.9
	TEU	2,829	157.2	5,157	224.2	2,216	201.5	1,954	177.6	786	56.1	14,103	160.3
Total Container	Box	3,596	199.8	7,630	331.7	3,360	305.5	2,734	248.5	1,807	129.1	20,545	233.5
	TEU	5,361	297.8	10,754	467.6	4,609	419.0	3,879	352.6	2,064	147.4	28,653	325.6
CARGO Tonnage	VOLUM(TON)	39,269	2,310	104,792	4,556	37,461	3,746	29,453	2,945	22,068	2,207	249,309	3,196
Ship Tonnage	GRT	61,611	3,624	173,768	7,899	54,060	5,406	40,231	4,023	24,257	2,426	382,660	4,970
DURATION	in Pier(Hr)	801	47.1	1,436	62.4	759	75.9	533	53.3	643	64.3	4,527	58.0
WORKING	TIME (HR)	518	30.4	1,350	58.7	758	75.8	488	48.8	323	32.3	3,690	47.3
TOTAL Work Hr	GROSS	493	29.0	1,350	58.7	735	73.5	488	48.8	323	32.3	3,620	46.4
(GANG*HOUR)	WAITING	23	5.6	28	3.4	19	4.6	24	4.7	12	2.9	110	4.1
Container Hand	Box/Hr		6.7		5.6		4.3		4.4		4.9		5.5
Efficiency	TEU/Hr		9.6		7.8		5.8		6.0		5.4		7.5
Berth Occupancy Ratio		0.54		0.97		1.02		0.72		0.86			
Empty Container Ratio - Import		0.08		0.03		0.03		0.05		0.11		0.05	
Empty Container Ratio - Export		0.68		0.52		0.54		0.56		0.58		0.57	
40' Container Ratio - Import		0.42		0.38		0.37		0.40		0.31		0.37	
40' Container Ratio - Export		0.47		0.44		0.35		0.43		0.43		0.43	
40' Container Ratio		0.45		0.41		0.36		0.41		0.35		0.40	

TABLE 3.3.4 Statistics of RO/RO Vessel at Haydarpasa poort (March, 1996)

Ship Name	Tonnage GRT	Pier No.	Arrival Date&Time	Flag	Duration in Pier Hr	Duration in Port Hr	Cargo Handling Ton	Cargo Handling Work
UND H.EKINCI	21,213	17	3/1/96 11:40	TURKEY	19.5	20	4,657	With their own resources
UND TRANSPORT	15,225	17	3/2/96 8:30	TURKEY	15.5	16	5,630	〃 〃
UND SAFFET BEY	19,689	17	3/3/96 1:00	TURKEY	23	23.5	6,563	〃 〃
K.B. ISIM	18,653	17	3/4/96 1:00	TURKEY	23	23.5	4,284	〃 〃
K.A. DORAN	18,685	17	3/5/96 1:15	TURKEY	23	23.5	4,983	〃 〃
UND DENIZCILIK	21,213	17	3/6/96 2:30	TURKEY	28.5	29	6,092	〃 〃
UND TRANSFER	15,225	17	3/7/96 9:20	TURKEY	15	15.5	6,586	〃 〃
UND PRENSES	19,689	17	3/8/96 1:10	TURKEY	23	23.5	6,261	〃 〃
UND H. EKINCI	21,213	17	3/9/96 8:25	TURKEY	16	16.5	5,555	〃 〃
UND TRANSPORT	15,225	17	3/10/96 7:30	TURKEY	20	20.5	5,383	〃 〃
UND SAFFET BEY	19,689	17	3/11/96 6:10	TURKEY	18	18.5	4,671	〃 〃
K.B. ISIM	18,653	17	3/12/96 1:00	TURKEY	14.5	15	2,378	〃 〃
K.A.DORAN	18,685	17	3/13/96 2:10	TURKEY	23.5	24	3,152	〃 〃
UND DENIZCILIK	21,213	17	3/14/96 3:00	TURKEY	27.5	28	4,795	〃 〃
UND TRANSFER	15,225	17	3/15/96 7:45	TURKEY	18	18.5	4,264	〃 〃
UND PRENSES	19,689	17	3/16/96 3:15	TURKEY	21.5	22	5,921	〃 〃
UND H.EKINCI	21,213	17	3/17/96 7:35	TURKEY	16.5	17	5,711	〃 〃
UND TRANSPORTER	15,225	17	3/18/96 7:15	TURKEY	18.5	19	6,098	〃 〃
UND SAFFET BEY	19,689	17	3/19/96 6:30	TURKEY	18	18.5	6,897	〃 〃
UND DENIZCILIK	21,213	17	3/22/96 3:00	TURKEY	21	21.5	7,323	〃 〃
UND TRANSFER	15,225	17	3/23/96 1:00	TURKEY	23	23.5	6,300	〃 〃
UND PRENSES	19,689	17	3/24/96 1:15	TURKEY	23.5	24	7,175	〃 〃
UND H.EKINCI	21,213	17	3/24/96 6:00	TURKEY	42	42.5	6,085	〃 〃
K.A.DORAN	18,685	17	3/21/96 1:20	TURKEY	23	23.5	6,121	〃 〃
UND TRANSPORT	15,225	17	3/26/96 7:00	TURKEY	17	17.5	5,496	〃 〃
UND SAFFET BEY	19,689	17	3/27/96 2:20	TURKEY	45.5	46	3,771	〃 〃
K.B.ISIM	18,653	17	3/27/96 15:40	TURKEY	9.5	10	2,949	〃 〃
UND SAFFET BEY	19,689	17	3/28/96 11:00	TURKEY	13	13.5	3,951	〃 〃
UND DENIZCILIK	21,213	17	3/30/96 2:30	TURKEY	22	22.5	6,908	〃 〃
UND SAFFET BEY	19,689	17	3/31/96 3:00	TURKEY	21	21.5	6,444	〃 〃
AVERAGE	18,850				21.4	22	5,413	
							247	Ton/Hour(ave)

TABLE 3.3.5 TMO Cargo Handling Capacity

		Applicable Loading Rate (1) ton/day	Working Days (2) days /year	Capacity BOR=0.7 (1)*(2)*0.7 ton/year
Grain (TMO)	Haydarpasa	4,500	330	1,039,500
	Tekirdag	5,000	330	1,155,000
	Bandirma	2,500	330	577,500
	Gelibolu	650	330	150,150
	Derince	24,000	330	5,544,000
	Total			8,466,150

Port service is to be provided to vessels every day of the week and 24 hours a day by three shifts. Net working hours are considered as 19.5 hours per day excluding the rest hour of each shift and the 30 minutes of rest time between each shift. Net working days are considered as 330 days per year considering non-workable days due to bad weather such as heavy rain, snowfall, and strong wind.

Another method to calculate the cargo handling capacity of berth using the converted berth length is also considered. Converted berth length is obtained using the following formula.

Water depth of berth -2.1 ~ -3.9m : Original berth length x 1/3
Water depth of berth -4.0 ~ -7.4m : Original berth length x 2/3
Water depth of berth -7.5m ~ : Original berth length x 1

General cargo handling capacity per meter of the berth is calculated from the past record, such as,

Unit productivity = Converted Cargo Volume / Converted Berth length
= 1,000 ton per meter

By this calculation method, converted cargo handling capacity of the Marmara Sea is estimated as 14,742,000 tons. This result is similar to the earlier calculation result.

3.3.5 Capacity of Existing Facilities

(1) Present Capacity

In accordance with above mentioned assumption, existing cargo handling capacity of the Marmara Sea is calculated as shown in the Table 3.3.6.

(2) Comparison of Present Capacity and Future Demand

A comparison of cargo demand of the Marmara Sea in 2015, which is treated in Chapter 4, and existing cargo handling capacity is presented in Table 3.3.7.

As shown in this table, dry bulk cargo handling capacity and general cargo handling capacity, both for containerized cargo and non container cargo, and dry bulk cargo will be insufficient in the Thrace area. As for the Izmit area, container handling capacity and dry bulk cargo handling capacity will fall short of the demand. At Balkesir area, container handling capacity and dry bulk cargo handling capacity will also not be able to cope with the demand. At Canakkale area, container, noncontainer and dry bulk cargo handling capacity will be insufficient to meet the demand.

TABLE 3.3.6 Existing Cargo Handling Capacity

No Port	Berth	Cargo	Handling Gear	Unit Capacity (ton/hour) (1)	Gang No. (2)	Efficiency (3)	Total Capacity (ton/day) (4) =(1)x(2)x(3)x19.5	Total Capacity (ton/year) (4)x365x0.7 General Cargo	Dry Bulk	Container	RO/RO	TMO	Liquid	Total	Remarks
1 Haydarpasa	1	Ferry													
	2	General	5T,3T	24.0	2	0.8	749	172,973							
	3	Grain	Pneuma				4,500					1,039,500			by TMO
	4/5	General	3T,5T,3T,5T,5T	36.0	5	0.8	2,808	648,648							
	6	General	5T,25T,3T	36.0	3	0.8	1,685	389,189							
	7/8	General	5T,3T,5T,3T	36.0	4	0.8	2,246	518,918							
	9	General	Ship Gear	36.0	2	0.7	983	227,027							
	10/11	General	3T	36.0	1	0.8	562	129,730							
	12	Container	GC35T,GC35T							1,211,800					
	13/14	Container	10T,35T,10T												
	15	General	3T,5T	36.0	2	0.8	1,123	259,459							
	16	General	Ship Gear	36.0	2	0.7	983	227,027							
	17	Ro/Ro		247.0	1	0.8	3,853	890,089			890,089				
	18	Ro/Ro													
	19	General	Ship Gear												
	20/21	General	Ship Gear												
Sub Total								3,463,060	0	1,211,800	890,089	1,039,500	0	6,604,449	
2 Ambarli	1	General	Ship Gear	36.0	2	0.7	983	227,027							
	2/3	Sand	Ship Gear	94.7	2	0.7	2,584		596,996						
	4/5	Sand	Ship Gear	94.7	2	0.7	2,584		596,996						
	6/7	Sand	Ship Gear	94.7	2	0.7	2,584		596,996						
	8/9	Sand	Ship Gear	94.7	2	0.7	2,584		596,996						
	10/11	Cement	Ship Gear	142.0	2	0.7	3,877		895,495						
	12/13	Sand	Ship Gear	94.7	2	0.7	2,584		596,996						
	14/15	Sand	Ship Gear	94.7	2	0.7	2,584		596,996						
	16/17	Sand	Ship Gear	94.7	2	0.7	2,584		596,996						
	18/19	Cement	Ship Gear	142.0	2	0.7	3,877		895,495						
	20	Ro/Ro		247.0	1	0.7	3,372				778,828				
	21	Oil Product											5,000,000		
Sub Total								227,027	5,969,964	0	778,828		5,000,000	11,975,819	
3 Tekirdag	TMO	Grain	Pneuma				5,000					1,155,000	60,000		by TMO GC=0.96
	New	General	5T,3T,3T, M.C	36.0	4	0.8	2,246	497,593							
	Old	General		24.0	1	0.8	374	86,486							
	Fishing	Fish													
	Wine	Wine													
Sub Total								584,079	0	0	0	1,155,000	60,000	1,799,079	
4 Gelibolu	1	Grain	Mobile Crane x 2				650					150,150			by TMO
	2	Ferry													
Sub Total								0	0	0	0	150,150	0	150,150	
5 Canakkale	1	General/Pass	Ship Gear	24.0	2	0.7	655	86,486							BOR=0.4
	2	Ferry	Ship Gear												
	3														
	4	Service Boat													Construction
(Kepez)	5														

No Port	Berth	Cargo	Handling Gear	Unit Capacity (ton/hour) (1)	Gang No. (2)	Efficiency (3)	Total Capacity (ton/day) (4) =(1)x(2)x(3)x19.5	Total Capacity (ton/year) (4)x365x0.7 General Cargo	Dry Bulk	Container	RO/RO	TMO	Liquid	Total	Remarks
Sub Total								86,486	0	0	0	0	0	86,486	
6 Bandirma	1	Passenger													
	2/3	General	5T,5T	36.0	2	0.8	1,123	259,459							
	4/5	General	5T,5T,5T	36.0	3	0.8	1,685	389,189							
			10T	72.0	1	0.8	1,123	259,459							
	6	Dry Bulk	Ship Gear	71.0	2	0.7	1,938		340,411				350,000		DB=0.76
	7	Coal	5T,5T	40.5	2	0.8	1,264		291,892						
	8	Coal	5T	40.5	1	0.8	632		145,946						
			10T,10T	101.0	2	0.8	3,151		727,927						
			25T	203.0	1	0.8	3,167		731,531						
	9	Grain	5T,5T	71.0	2	0.8	2,215		511,711						
	10	Grain	Ship Gear	69.0	1	0.7	942		217,567						
	11	Grain	Pneuma				2,500					577,500			by TMO
	12	Ore	Ship Gear	215.0	2	0.7	5,870		1,355,855						
	13	Dry Bulk	Ship Gear	71.0	2	0.7	1,938		447,747						
	14	Sack		27.0	1	0.8	421	97,297							
	15-20	Domestic													
	1	Passenger													
Sub Total								1,005,404	4,770,586	0	0	577,500	350,000	6,703,491	
7 Mudana	1/4	General	Ship Gear	24.0	1	0.7	328	75,676							
	2/3	General	Ship Gear	30.0	1	0.7	410	94,595							
	New	Dry Bulk	Ship Gear	71.0	1	0.7	969		223,874						
Sub Total								170,270	223,874	0	0	0	0	394,144	
8 Gemlik	1	Container	40TMobile Crane							454,425					
	2	Container	40TMobile Crane												
	3	Dry Bulk		47.3	1	0.7	646		149,249						
	1,2	General		24.0	2	0.7	655	151,351							
Sub Total								151,351	149,249	454,425	0	0	0	755,025	
9 Dennce	1	Domestic	3T,3T,	24.0	2	0.8	749	172,973							
	2	General	5T	24.0	1	0.8	374	86,486							
	3/4	Grain	Pneuma,5T				24,000					5,544,000			by TMO
	5	Ro/Ro		247.0	1	0.8	3,853				445,045				RO/RO=0.5
		Dry Bulk	Ship Gear	71.0	2	0.7	1,938		223,874						DB=0.5
	6	Container	25T,35T,5T,5T,5T							403,933					
	7	Dry Bulk	5T,10T,5T	71.0	3	0.8	3,323		736,023				60,000		DB=0.96
	8	Dry Bulk	Ship Gear	47.3	2	0.7	1,292		298,498						
		Container													Construction
Sub Total								259,459	1,258,395	403,933	445,045	5,544,000	60,000	7,970,832	
Grand Total								5,947,137	12,372,068	2,070,158	2,113,962	8,466,150	5,470,000	36,439,475	

TABLE 3.3.7 Existing Cargo Handling Capacity and Cargo Demand in Year 2015

Hinterland	Port		General Container 1000TEU	General Non Container 1000ton	Dry 1000ton	Liquid 1000ton
Thrace	Tekirdag	Capacity	0	584	1,155	60
		Demand	863	584	1,155	4
		Difference	-863	0	0	56
	Ambarli	Capacity	0	1,006	5,970	5,000
		Demand	0	1,493	17,757	0
		Difference	0	-487	-11,787	5,000
	Total	Capacity	0	1,590	7,125	5,060
		Demand	863	2,077	18,912	4
		Difference	-863	-487	-11,787	5,056
Izumit	Haydarpasa	Capacity	146 (250)	4,353	1,040	0
		Demand	300	3,059	1,040	0
		Difference	-154	1,294	0	0
	Derince	Capacity	49	705	6,802	60
		Demand	1,276	412	9,058	907
		Difference	-1,227	292	-2,255	-847
	Gemlik	Capacity	55	151	149	0
		Demand	100	151	149	0
		Difference	-45	0	0	0
	Mudana	Capacity	0	170	224	0
		Demand	0	170	224	0
		Difference	0	0	0	0
	Total	Capacity	249	5,379	8,215	60
		Demand	1,676	3,793	10,470	907
		Difference	-1,427	1,586	-2,255	-847
Balkesir	Bandirma	Capacity	0	1,005	5,348	350
		Demand	182	550	5,899	89
		Difference	-182	456	-551	261
	Total	Capacity	0	1,005	5,348	350
		Demand	182	550	5,899	89
		Difference	-182	456	-551	261
Canakkale	Gelibolu	Capacity	0	0	150	0
		Demand	0	0	150	0
		Difference	0	0	0	0
	Canakkale	Capacity	0	86	0	0
		Demand	61	120	668	0
		Difference	-61	-34	-668	0
	Total	Capacity	0	86	150	0
		Demand	61	120	818	0
		Difference	-61	-34	-668	0
Total		Capacity	249	8,061	20,838	5,470
		Demand	2,782	6,540	36,100	1,000
		Difference	-2,533	1,521	-15,262	4,470

3.3.6 Capacity of Improved or Planned Facilities

(1) Improvement Plan

In order to accommodate the cargo demand in the Sea of Marmara, following improvement plan is considered for each port.

1) Haydarpasa Port

①Container Terminal Improvement Plan

TCDD is planning to expand the container storage facility of the Haydarpasa port. Existing container storage area will be re-arranged to use new type transfer crane and new container storage area will be constructed at the back area of No.9 berth and No.6 berth. Total planned container storage capacity is as follows. Development plan and layout of container storage area of improved Haydarpasa port is described in 3.7.5.

In addition to the expansion of container storage area, new container handling equipment will be introduced as follows.

TABLE 3.3.8 Improved Container Storage Capacity

			No. 12 Berth	No. 6 Berth	No. 9 Berth	Inland Depot	Total
Existing Capacity	Ground Slot Number	TEU	1500	0	0	749	2249
	Max. Capacity	TEU	5000	0	0	2247	7247
Improved Capacity	Ground Slot Number	TEU	1682	423	303	749	3157
	Max. Capacity	TEU	6611	1269	909	2247	11036

TABLE 3.3.9 Container Handling Equipment in the Haydarpasa Port

Equipment	Number			Remarks
	Existing	New Purchase	Total	
Gantry Crane	2	2	4	Moved from Mersin Port
Transfer Crane 5x4	0	7	7	
Transfer Crane 3x3	9	0	9	
Reach Stacker	4	3	7	
Tractor	17	15	32	
Trailer	0	32	32	

② **Evaluation of Improvement Plan**

To reveal container movements in the improved facilities of Haydarpasa Port, a computer simulation was conducted. Details of the simulation model are described in Chapter 4.2. In the simulation, the number of container arrivals is a given condition. Several alternative cases are introduced with different container handling volumes, dwelling time in the yard and crane handling productivity. The conditions for the simulation and results are as follows.

- Arrival times of container ship : the average arrival record of Haydarpasa Port in March 1996. Three different cases are considered to evaluate the container handling capacity of the improved facilities, namely 250,000 TEU/year, 300,000TEU/year and 350,000 TEU/year.
- The number of containers discharged/loaded per ship : the average container handling record of Haydarpasa Port in March 1996. Three ship types are considered as shown in Table 3.3.10.
- Net container handling productivity at dock side : 10, 15, 20 boxes per hour for each gantry crane.
- Percentage of 20 ft. boxes : 50 %
- Percentage of empty export containers : 50 %
- Percentage of empty import containers : 5%
- Percentage of import CFS cargo : 10 % of laden containers
- Annual working days : 330 days
- Daily working hours : 18 hours by three shifts
- Dwelling time of FCL container in the terminal : average 5, 10, 15 days
- Dwelling time of FCL container in the CFS : average 3days

TABLE 3.3.10 Type of Arrival Ships

	Ship Size	Number of Containers Handled		Remarks
		Import (TEU)	Export (TEU)	
Feeder Vessel 1	300 TEU	150	150	
Feeder Vessel 2	500 TEU	250	250	
Feeder Vessel 3	700 TEU	350	350	

Result of simulation calculation for the relation of container dwelling time and required storage capacity is shown in Figure 3.3.1. Required container storage capacity is increased in proportion to the increase of dwelling time of containers in the yard. Assuming that container dwelling time in Haydarpasa port in the year 2015 is 10 days, the Haydarpasa port can handle about 300,000 TEU/year by the improved container storage capacity of 11,036 TEU. However, if the container dwelling time is not improved and remains as 15 days as at present, capacity of the port will be less than 250,000 TEU/year in spite of the increasing of storage capacity.

Secondly, relation of handling productivity and berth occupancy ratio is shown in Table 3.3.11 and Figure 3.3.2. Berth occupancy ratio is increased due to the reduction of handling productivity of crane. In a case that container throughput is 300,000 TEU/year, berth occupancy ratio is more than 80% if handling productivity is less than 11 box/hour. Consequently, berth waiting condition is generated for some ships as shown in Table 3.3.11 and Figure 3.3.3.

By this simulation result, capacity of improved Haydarpasa port is about 300,000 TEU per year, and number of berths and cranes is sufficient to handle this container through put, if the container handling productivity can be kept at more than 15 boxes/hour,

③ Container Handling Capacity Estimated by TCDD

TCDD estimated the container handling capacity of Haydarpasa Port by the storage capacity and dwelling day using the following formula.

Yc = Ml x YOR x (Dy / Dw) x Nc

where, Yc : Annual container handling capacity (TEU/year)
Ml : Storage capacity of the container yard (11,036 TEU)
YOR : Yard Occupancy Ratio
Dy : Operating days (360 days/year)
Dw : Average total dwelling days as Import and Export (15 days)
Nc : Container handling number by gantry crane (= 2)

As a result of the calculation, annual container handling capacity is 529,728 TEU per year in case yard occupancy ratio is 100 %, and 423,782 TEU per year in case yard occupancy ratio is 80%.

Difference in the opinion between TCDD and the Study Team is as follows.

	TCDD	Study Team
Operating Days	360 days /year	330 days / year considering inoperable days of 30 days due to the heavy rain and wind
Peak Ratio	not considered	1.3

There is no theoretical difference between TCDD and the Study Team, however annual container handling capacity is calculated as follows applying annual operating days of 330 days and peak ratio of 1.3.

Yc = 11,036 x 0.8 x (330 / 15) x 2 / 1.3
= about 300,000 TEU / year

FIGURE 3.3.1 Container Dwelling Time and Required Storage Capacity

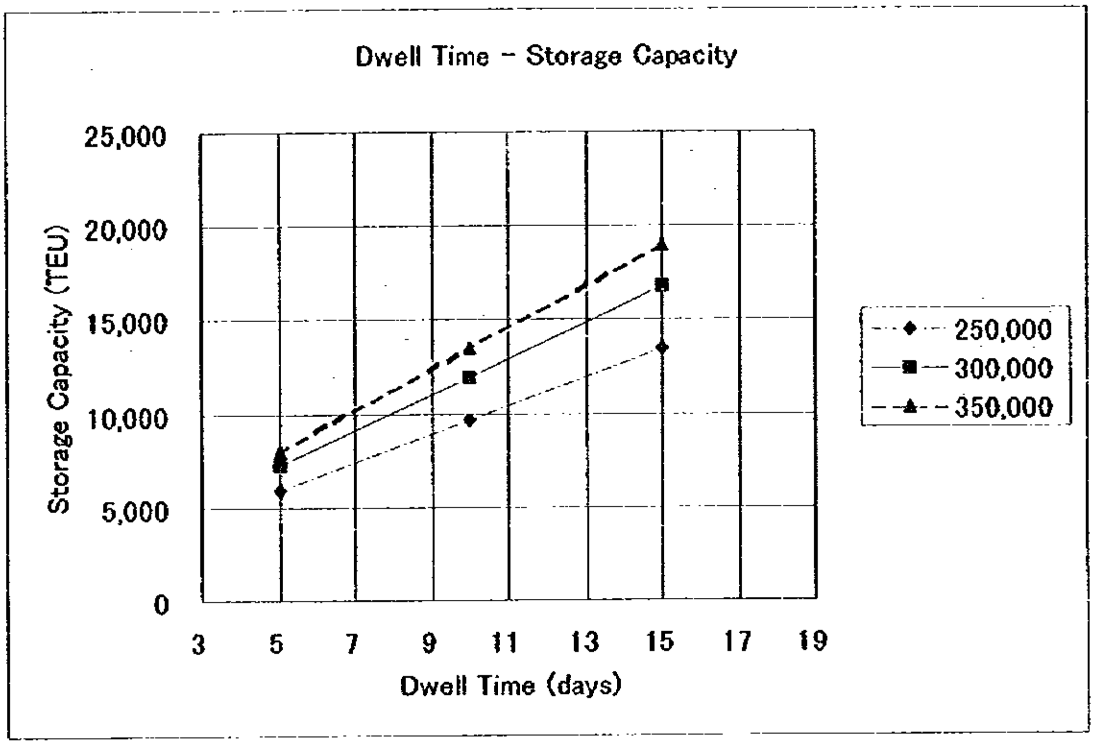


TABLE 3.3.11 Simulation Result of Handling Productivity and Berth Condition

Container Throughput	Handling Productivity of Crane	Ship Waited	Average Waiting Time	Berth Occupancy Ratio
TEU/year	Box/Hr	%	Hour	%
300,000	20	0	0	45.8
	15	0	0	61.2
	12	0	0	76.7
	11	67.4	4.0	83.5
	10	92.6	28.8	88.6
350,000	20	0	0	53.3
	15	0	0	71.8
	12	12.4	1.2	89.5
	11	71.9	7.1	92.7
	10	90.0	83.9	92.6

FIGURE 3.3.2 Crane Productivity and Berth Occupancy Ratio

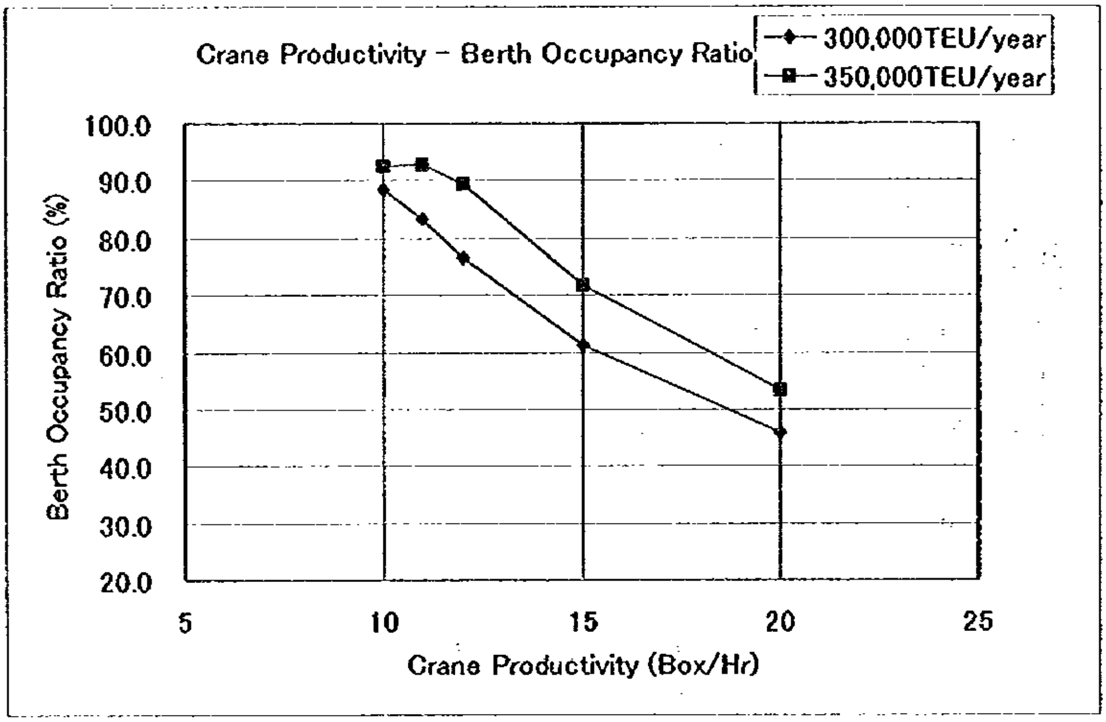
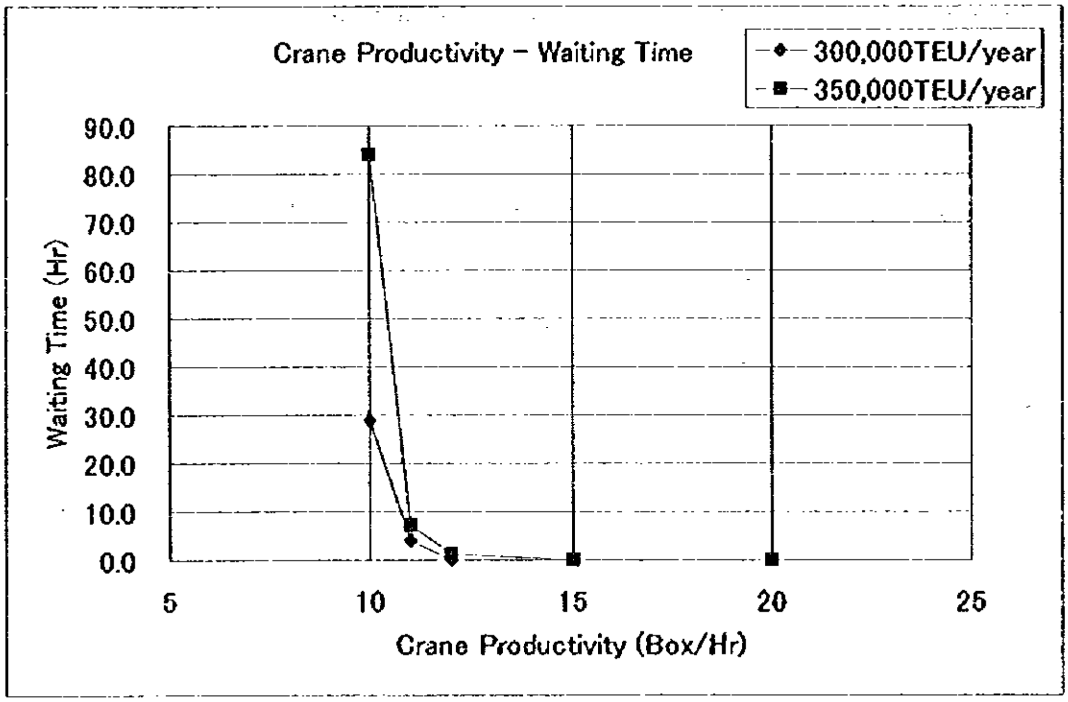


FIGURE 3.3.3 Crane Productivity and Berth Waiting Time



2) Derince Port

Container cargo throughput at Derince Port in 2015 is expected to be 613,000TEU as mentioned in Chapter 2.3. Derince port is planning to construct a container berth in 1997 between Ro/Ro berth and No. 6 berth. This new container berth and existing Ro/Ro berth will be utilized to handle container cargo. In addition to these berths, new container terminal is planned to be constructed to handle the further demand in the year 2015.

TABLE 3.3.12 Required Storage Capacity of Derince Container Terminal

		Laden Containers				Empty	Total
		Import	Export	Domestic	Transit		
Existing Port Area							
Annual Container	TEU	76,341	55,192	39,375	0	29,092	200,000
Dwell days	days	10	5	5	3.5	10	
Req. Storage	TEU	3,007	1,087	776	0	1,146	6,016
Ave. Stacking height	box	3.0	3.5	3.5	3.5	5.0	
Req. Ground Slot	TEU	1,002	311	222	0	229	1,764
New Terminal							
Annual Container	TEU	420,617	304,094	0	215,000	160,289	1,100,000
Dwell days	days	10	5	5	3.5	10	
Req. Storage	TEU	16,570	5,990	0	2,964	6,314	31,838
Ave. Stacking height	box	3.0	3.5	3.5	3.5	5.0	
Req. Ground Slot	TEU	5,523	1,711	0	847	1,263	9,344

TABLE 3.3.13 Container Terminal Expansion Plan of Derince Port

		Existing Port Area	New Terminal	Total
Ground Slot	TEU	1,800	9,400	11,200
Max Storage Capacity	TEU	7,200	37,600	44,800
Gantry Crane	set	2	9	11
Annual Container Throughput	TEU / year	200,000	1,100,000	1,300,000

Dry bulk cargo throughput in 2015 is expected to reach 9,083,000 tons. The shortage of existing handling capacity shall be made up by utilizing No. 6 berth. Liquid cargo shall be handled at No. 7 berth. Liquid cargo ship occupancy at No. 7 berth is considered to represent 10 % of the total calling vessels of this berth.

Development plan and general layout of Derince port in future is described in 3.5.7.

3) Bandirma Port

As mentioned in 3.5.7, the slip between general cargo berths, No.2, 3 and 4, 5 will be reclaimed and used as container yard, and new berth which will be converted to container berths from revetment and two multipurpose cranes will be installed at the berth. Instead of the canceled berths, three(3) new bulk cargo berths of 12m depth will be constructed at the western side of the port by reclamation. The extension of the main breakwater at deep water by around 25m will be necessary to obtain tranquillity at the new constructed berths. The petroleum pier at sub breakwater will be relocated to newly reclaimed land.

According to the principle in 3.3.3, container and general cargo will be handled at the depth of the port and dusty cargo such as bulk cargo will be separately handled at the mouth of the port.

TABLE 3.3.14 Container Terminal Ground Slot Calculation of Bandirma Port

		Laden Containers			Empty	Total
		Import	Export	Domestic		
Year 2015						
Annual Container	TEU	58,120	42,019	4,712	22,148	127,000
Dwell days	days	10	5	5	10	
Req. Storage	TEU	2,290	828	93	873	4,083
Ave. Stacking height	box	3.0	3.5	3.5	5.0	
Req. Ground Slot	TEU	763	236	27	175	1,201

Development plan and general layout of Bandirma port is described in 3.5.7.

4) Canakkale

New pier is under construction by DLH in Kepes, about 8 to 10 km south of Canakkale port. Shortage of existing cargo handling capacity shall be made up by this new pier. Containers shall be handled by mobile crane or RO/RO vessel.

5) Private Ports

There are several private ports in the Sea of Marmara which are officially permitted to handle public cargo. Location of private ports in the Izmit Bay is shown in Figure 3.3.4. Public cargo handling capacity of the major private ports is shown in Table 3.3.15. Detailed evaluation of each port is described hereinafter.

FIGURE 3.3.4 Location of Ports in the Izmit Bay

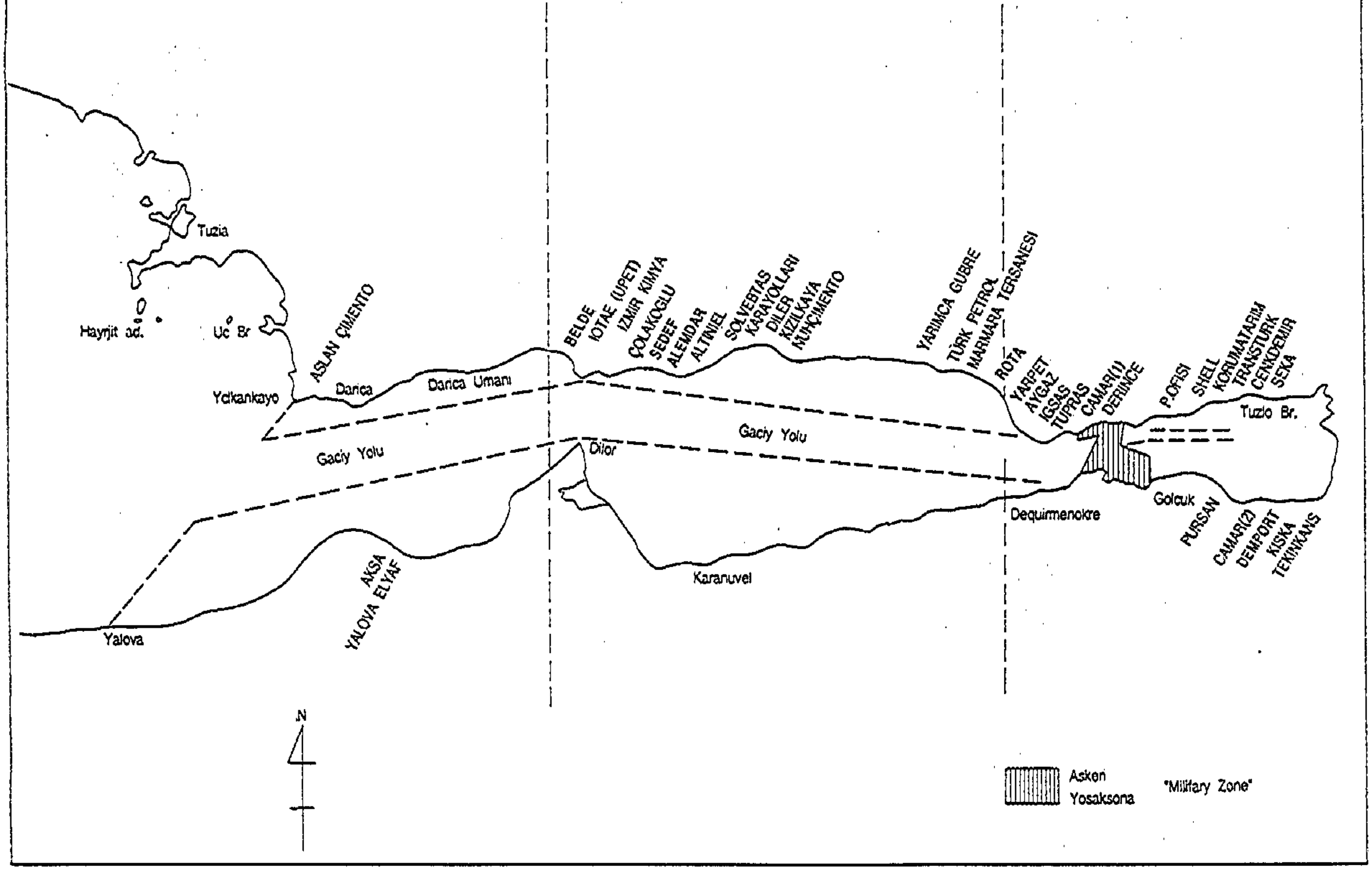


TABLE 3.3.15 Public Cargo Handling Capacity of Major Private Ports

Port	Container	Non Container	Dry Bulk	Liquid Bulk	Remarks
	TEU	1000 ton	1000 ton	1000 ton	
DEMPORT	(300,000)	(450)	0	0	Planned
ROTA	0	0	2,400	0	by 3 jetties
ALEMDAR	0	1,300	0	400	In operation
BELDE	360,000	0	0	0	Under construction
SEDEF	50,000	600	0	0	In operation
Others	0	250	1,120	0	In operation
Izmit Bay Total	710,000	2,600	3,520	400	
AMBARLI	50,000	900	9,300	0	1996/11~
MARTAS	0	260	1,500	0	In operation
Thrace Total	50,000	1,160	10,800	0	

Detail and layout plan of the above mentioned private ports are described in Appendix 8.

3.3.7 Comparison of Improved Capacity and Demand

Cargo handling capacity of the Sea of Marmara in the year 2015 is calculated as shown in the Table 3.3.16, and comparison of cargo demand of the Sea of Marmara in 2015 and improved cargo handling capacity is shown in Table 3.3.17.

In these tables, private ports mentioned in Chapter 3.3.5 are included except DEMPORT.

At Izmit area, container cargo will be handled at Haydarpasa, Derince, Gemlik(GEMPORT), and other private port such as BELDE and SEDEF. Shortage of container handling capacity is about 433,000 TEU. This amount shall be handled by the new container terminal built at Derince or another place.

At Thrace area, container handling capacity of existing port is about 50,000 TEU. Shortage of container handling capacity is about 638,000 TEU including transshipment containers. This amount shall be handled by the new container terminal in the New port. There is a large cargo demand for dry bulk cargo. Dry bulk cargo shall be handled by existing ports and also the New port.

At Balkesir area, Bandirma port will handle all demand of this area including container cargo utilizing the new container terminal and extended berth for bulk cargo.

At Canakkale area, Gelibolu port and Canakkale port can handle all demand of this area.

TABLE 3.3.16 Improved Cargo Handling Capacity

No Port	Berth	Cargo	Handling Gear	Unit Capacity (ton/hour) (1)	Gang No. (2)	Efficiency (3)	Total Capacity (ton/day) (4) =(1)x(2)x(3)x19.5	Total Capacity (ton/year) (4)x330x0.7 General Cargo	Dry Bulk	Container	RO/RO	TMO	Liquid	Total	Remarks
1 Haydarpasa	1	Ferry													
	2	General	5T,3T	24.0	2	0.8	749	172,973							
	3	Grain	Pneuma				4,500					1,039,500			by TMO
	4/5	General	3T,5T,3T,5T,5T	36.0	5	0.8	2,808	648,648							
	6	Container	GC35T							498,000					60,000TEU
	7/8	General	5T,3T,5T,3T	36.0	4	0.8	2,246	518,918							
	9	General	Ship Gear	36.0	2	0.8	1,123	259,459							
	10/11	Container	GC35T,GC35T							996,000					120,000TEU
	12	Container	GC35T,GC35T							996,000					120,000TEU
	13/14	Container	10T,35T,10T												
	15	General	3T,5T	36.0	2	0.8	1,123	259,459							
	16	General	Ship Gear	36.0	2	0.8	1,123	259,459							
	17	Ro/Ro		247.0	1	0.9	4,335				1,001,350				
	18	Ro/Ro													
	19	General	Ship Gear												
	20/21	General	Ship Gear												
Sub Total								2,118,917	0	2,490,000	1,001,350	1,039,500	0	6,649,767	
2 Amberli	1	General	Mobile Crane	36.0	2	0.8	1,123	129,730							GC=0.5
		Container	Mobile Crane							415,000					50,000TEU
	2/3	Sand	Mobile Crane	121.5	3	0.8	5,686		1,313,512						
	4/5	Sand	Mobile Crane	121.5	3	0.8	5,686		1,313,512						
	6/7	Sand	Mobile Crane	121.5	3	0.8	5,686		1,313,512						
	8/9	Sand	Mobile Crane	121.5	3	0.8	5,686		1,313,512						
	10/11	Cement	Pneumatic	750.0	1	0.6	8,775		1,621,620						Cement 0.8
		Dry Bulk	Mobile Crane	142.0	2	0.8	4,430		204,684						Clinker 0.2
	12/13	Dry Bulk	Mobile Crane	36.0	3	0.8	1,685		389,189						Scrap
	14/15	Dry Bulk	Mobile Crane	36.0	3	0.8	1,685		389,189						Scrap
	16/17	Dry Bulk	Mobile Crane	36.0	3	0.8	1,685		389,189						Scrap
	18/19	Cement	Mobile Crane	142.0	2	0.8	4,430		1,023,422						
	20	Ro/Ro		247.0	1	0.7	3,372				778,828				
	21	Oil Product											0		Private
Sub Total								129,730	9,271,342	415,000	778,828		0	10,594,900	
3 Tekirdag	TMO	Grain	Pneuma				5,000					1,155,000			by TMO
	New	General	5T,3T,3T, M.C	36.0	4	0.8	2,246	497,593					60,000		GC=0.96
	Old	General		24.0	1	0.8	374	86,486							
	Fishing	Fish													
	Wine	Wine													
Sub Total								584,079	0	0	0	1,155,000	60,000	1,799,079	
4 Gelibolu	1	Grain	Mobile Crane x 2				650					150,150			by TMO
	2	Ferry													
Sub Total								0	0	0	0	150,150	0	150,150	
5 Canakkale	1	General/Pas	Ship Gear	24.0	2	0.7	655	86,486							BOR=0.4
	2	Ferry	Ship Gear												
	3														
	4	Service Boat													
(Kepes)	5	Container	Mobile Crane, RO/RO							506,300					61,000TEU

No Port	Berth	Cargo	Handling Gear	Unit Capacity (ton/hour) (1)	Gang No. (2)	Efficiency (3)	Total Capacity (ton/day) (4) =(1)x(2)x(3)x19.5	Total Capacity (ton/year) (4)x330x0.7 General Cargo	Dry Bulk	Container	RO/RO	TMO	Liquid	Total	Remarks
		General	Mobile Crane	72.0	2	0.8	2,246	51,892							GC=0.1
		Dry Bulk	Mobile Crane	122.0	2	0.8	3,806		690,862						DB=0.5
Sub Total								138,378	690,862	506,300	0	0	0	1,335,540	
6 Bandirma	1	Passenger													
	New	Container	Multi Purpose Crane x 2							1,178,600					142,000TEU
	8	General	5T,5T	36.0	2	0.8	1,123	259,459							G.C.=0.5
	9	General	5T,5T	36.0	2	0.8	1,123	129,730							D.B.=0.5
		Grain	5T,5T	71.0	2	0.8	2,215		255,856						
	10	Grain	Ship Gear	71.0	1	0.8	1,108		255,856						
	11	Grain	Pneume				2,500					577,500			by TMO
	12	Ore	Ship Gear	215.0	2	0.7	5,870		1,355,855						
	13	Dry Bulk	Ship Gear	71.0	2	0.7	1,938		447,747						
	14	Sack		27.0	1	0.8	421	97,297							
	15~20	Domestic													
	NEW	Dry Bulk	10T	101.0	3	0.8	4,727		1,091,891						
	NEW	Coal	10T	101.0	3	0.8	4,727		1,091,891						
	NEW	Coal	10T	101.0	3	0.8	4,727		1,091,891						
	New	Liquid Bulk											350,000		
Sub Total								486,486	5,590,985	1,178,600	0	577,500	350,000	8,183,571	
7 Mudana	1/4	General	Ship Gear	24.0	1	0.7	328	75,676							
	2/3	General	Ship Gear	30.0	1	0.7	410	94,595							
	New	Dry Bulk	Ship Gear	71.0	1	0.7	969		223,874						
Sub Total								170,270	223,874	0	0	0	0	394,144	
8 Gemlik	1	Container	GC40T							830,000					100,000TEU
	2	Container	GC40T												
	3	Dry Bulk		47.3	1	0.7	646		149,249						
	1,2	General		24.0	2	0.7	655	151,351							
Sub Total								151,351	149,249	830,000	0	0	0	1,130,600	
9 Derince	1	Domestic	3T,3T,	24.0	2	0.8	749	172,973							
	2	General	5T	24.0	1	0.8	374	86,486							
	3/4	Grain	Pneuma,5T				24,000					5,544,000			by TMO
	5	RO/RO		247.0	1	0.8	3,853				178,018				RO/RO=0.2
		Container	Ship Gear							415,000	0				50,000TEU
	6	Dry Bulk	5T,5T,5T	71.0	3	0.8	3,323		767,567						
			25T	203.0	1	0.8	3,167		731,531						
			35T	304.0	1	0.8	4,742		1,095,494						
	7	Dry Bulk	5T,10T,5T	71.0	3	0.8	3,323		690,810						DB=0.9
		Liquid											906,840		
	8	Dry Bulk	Ship Gear	47.3	2	0.7	1,292		298,498						
	New	Container	GC40T, GC40T							1,245,000					150,000TEU
	New	Container	GC40T x 9							9,130,000					1,10,000TEU
Sub Total								259,459	3,583,900	10,790,000	178,018	5,544,000	906,840	21,262,217	
10 Alemdar	1	Liquid											400,000		
	2	General	Mobile Crane					450,000							Timber

No Port	Berth	Cargo	Handling Gear	Unit Capacity (ton/hour) (1)	Gang No. (2)	Efficiency (3)	Total Capacity (ton/day) (4) =(1)x(2)x(3)x19.5	Total Capacity (ton/year) (4)x330x0.7 General Cargo	Dry Bulk	Container	RO/RO	TMO	Liquid	Total	Remarks
	3	General	Mobile Crane					450,000							Timber
	4	General	Mobile Crane					400,000							Timber
Sub Total								1,300,000	0	0	0	0	400,000	1,700,000	
11 Rota	1	Dry Bulk	Mobile Crane						400,000						
	2	Dry Bulk	Mobile Crane						1,000,000						
	3	Dry Bulk	Mobile Crane						1,000,000						
Sub Total								0	2,400,000	0	0	0	0	2,400,000	
12 SEDEF	1	General	Ship Gear					300,000							
	2	Container	Ship Gear							415,000					50,000TEU
	3	General	Ship Gear					300,000							
Sub Total								600,000	0	415,000	0	0	0	1,015,000	
13 BELDE	1	Container	GC40T,GC40T							1,494,000					180,000TEU
	2	Container	GC40T,GC40T							1,494,000					180,000TEU
Sub Total								0	0	2,988,000	0	0	0	2,988,000	
14 DEMPORT	1	General	Mobile Crane							0					
	2	Container	GC40T,GC40T							0					
	3	Container	GC40T								0				
		RO/RO													
Sub Total								0	0	0	0	0	0	0	
15 MARTAS	1	Dry Bulk	Mobile Crane	101.0	2	0.8	3,151		727,927						
	2	Dry Bulk	Mobile Crane	101.0	2	0.8	3,151		727,927						
	3	General	Mobile Crane	36.0	2	0.8	1,123	259,459							
	4	Dry Bulk	Mobile Crane												Own Cargo Only
Sub Total								259,459	1,455,854	0	0	0	0	1,715,314	
16 Other Private Port															
Izmir Kimya		Dry Bulk	Mobile Crane						350,000						
Diler		Dry Bulk	Mobile Crane						420,000						
Kizilkaya		General	Mobile Crane					250,000							
		Dry Bulk	Mobile Crane						350,000						
Sub Total								250,000	1,120,000	0	0	0	0	1,370,000	
Grand Total								6,448,130	24,486,067	19,612,900	1,958,196	8,466,150	1,716,840	62,688,283	

TABLE 3.3.17 Improved Cargo Handling Capacity and Cargo Demand in Year 2015

Hinterland	Port		General Container 1000TEU	General Non Container 1000ton	Dry 1000ton	Liquid 1000ton
Thrace	Tekirdag	Capacity	0	584	1,155	60
		Demand	0	526	1,040	3
		Difference	0	58	116	57
	Ambarli	Capacity	50	909	9,271	0
		Demand	50	818	8,808	0
		Difference	0	91	464	0
	Private Port	Capacity	0	259	1,456	0
		Demand	0	234	1,383	0
		Difference	0	26	73	0
	New Port	Capacity	720	256	5,498	0
		Demand	638	230	5,223	0
		Difference	82	26	275	0
	Total	Capacity	770	2,008	17,380	60
		Demand	688	1,807	16,454	3
		Difference	82	201	927	57
Izumit	Haydarpasa	Capacity	300	3,120	1,040	0
		Demand	270	1,697	1,040	0
		Difference	30	1,423	0	0
	Derince	Capacity	200	437	9,128	907
		Demand	180	229	9,083	559
		Difference	20	209	45	348
	New Container Terminal	Capacity	1,100	0	0	0
		Demand	433	0	0	0
		Difference	667	0	0	0
	Gemlik	Capacity	100	151	149	0
		Demand	90	136	134	0
		Difference	10	15	15	0
	Mudana	Capacity	0	170	224	0
		Demand	0	153	201	0
		Difference	0	17	22	0
	Private Port	Capacity	410	2,150	3,520	400
		Demand	369	1,935	3,344	360
		Difference	41	215	176	40
	Total	Capacity	2,110	6,029	14,061	1,307
		Demand	1,342	4,150	13,802	919
		Difference	768	1,879	258	388
Balkesir	Bandirma	Capacity	142	486	6,168	350
		Demand	127	478	5,132	78
		Difference	15	8	1,036	272
	Total	Capacity	142	486	6,168	350
		Demand	127	478	5,132	78
		Difference	15	8	1,036	272
Canakkale	Gelibolu	Capacity	0	0	150	0
		Demand	0	0	150	0
		Difference	0	0	0	0
	Canakkale	Capacity	30	138	691	0
		Demand	20	104	562	0
		Difference	10	34	129	0
	Total	Capacity	30	138	841	0
		Demand	20	104	712	0
		Difference	10	34	129	0
Total		Capacity	3,052	8,662	38,450	1,717
		Demand	2,178	6,540	36,100	1,000

3.4. Sea of Marmara in Future

3.4.1. Role of the Sea of Marmara in the Year 2005 and 2015

The area surrounding the Sea of Marmara accounts for 10% of Turkey's total land area, 17% of its coastline, 25% of its population, 30% of its public investment, 40% of Gross Domestic Product and 50% of cargo handling volume at ports. Obviously the Marmara region has great potential in terms of maritime utilization.

According to the international transportation environment estimated in 1.2 and the Marmara area's demand forecast in 2.3, the Sea of Marmara will still be important intersection of international traffic. The international transportation network connected with the Marmara area is shown in Figure 3.4.1, Figure 3.4.2 and Figure 3.4.3.

The cargo volume handled in the ports at the Sea of Marmara will increase by about four times in comparison with that in 1995. The traffic volume passing through the Sea of Marmara is estimated to double.

3.4.2. Framework in the Target Year 2015

The port demand in the target year 2015, estimated in Chapter 2, as a framework of Long term Marmara ports development plan is as follows;

TABLE 3.4 1 Framework in 2005 & 2015

Port Demand	2015	2005	1995
Public Cargo Volume(ton)	65,000,000	34,200,000	16,803,279
Container Cargo Volume(TEU)	2,178,000	1,024,000	297,756
Transshipment Container Volume(TEU)	108,000	46,000	0
Passenger(International) (Domestic)	102,000 2,450,000	65,800 2,100,000	42,000 962,000
Average Size of Conventional Ship(DWT)	11,900	-	4,200
Maximum Size of Container Vessel(DWT)	50,000	20,500	6,800

Note: Average size of conventional ship was estimated by using data of Bandirma port. Concerning container vessel, data of Haidarpasa port in March 1996 was used.

According to the Table, public cargo volume in 2015 will increase by 3.8 times over that in 1995. Especially, container cargo in 2015 will increase 7.3 times of that in 1995 and transshipment container cargo is expected to reach 108,000TEU in 2015. Passenger in 2015 will increase by 2.5 times over the level in 1995.

3.4.3 Regional Development Concept

(1)Coastal Development Direction

This area has a coast line of 1,300km, which is 17 % of the total in Turkey. Present situation of coastal utilization around the Sea of Marmara is shown in Figure 3.4.1.

Industrialization in Turkey first began in the Istanbul area. Because of its location as a key transportation point and its special geographical position, rapid urbanization and industrial development have taken place in this area. Various branches of industry have been developing and factories generally cover fertile agricultural land alongside roads, such as the Istanbul - Edirne (and Kirklareli) highway and the .Istanbul - Tekirdag - Canakkale highway.

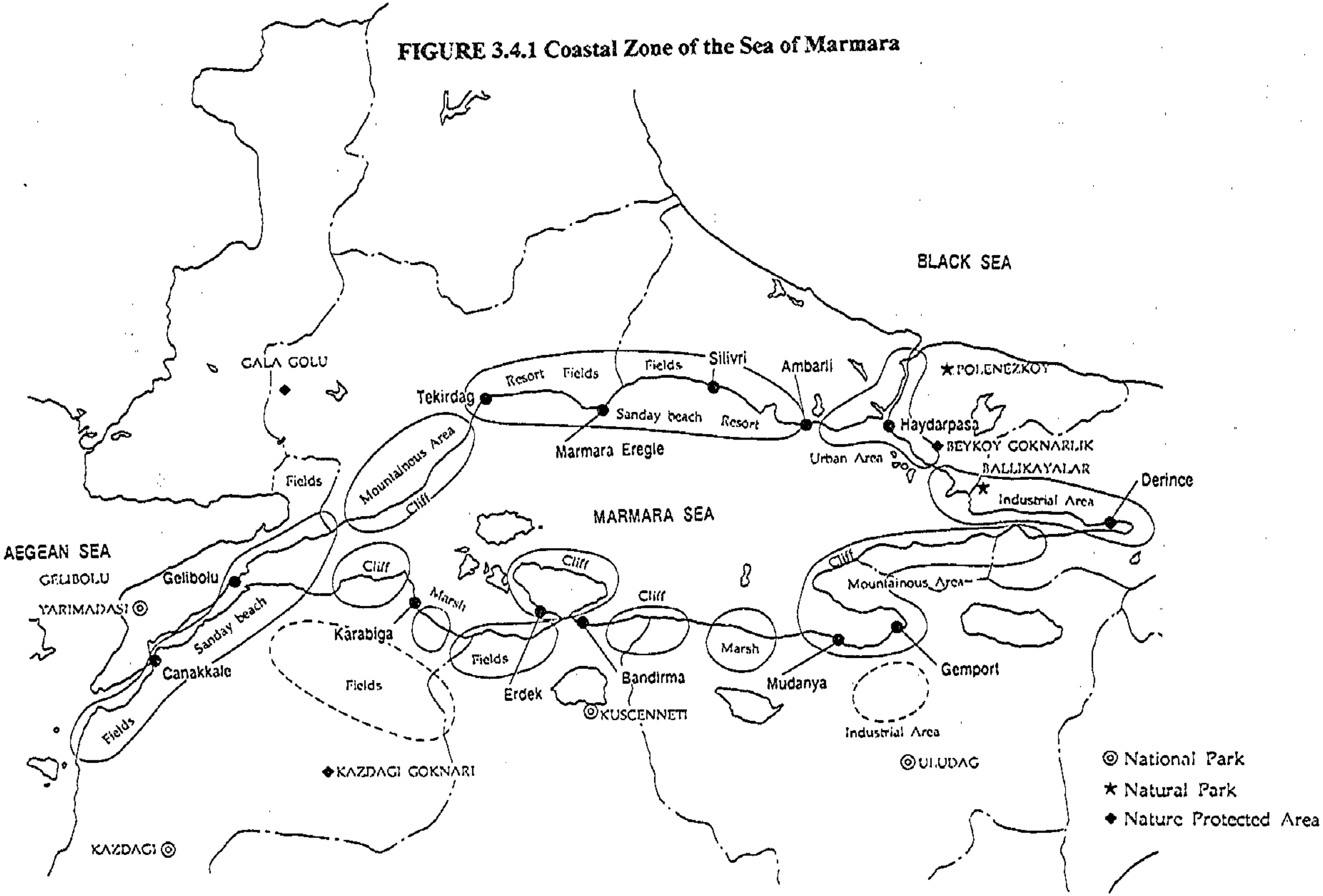
The large organized industries and their secondary branches are undergoing steady development in the Bursa area. The spread of industrial growth in this region is centered in three different directions around the transportation network.

Room for future coastal development seems to be along the northern central coast and the southern coast between Gemlik Bay and Bandirma Bay, and also the southern coast of Erdek Bay. Developing area such as industrial area and second house area, will gradually surround the Sea of Marmara.

Coastal development direction has a close relation to regional development. According to the present environmental condition and future regional development direction, coastal development direction of the Sea of Marmara is to control industrial development in the Istanbul and Kocaile area, to decentralize industrial function along the coast of the Sea of Marmara and to preserve the coastal environment, so as to maintain the sustainable development in the Sea of Marmara..

(2)Land transportation Development Direction

FIGURE 3.4.1 Coastal Zone of the Sea of Marmara



The railway network or motor-way network projects, related to the cargo movement in coastal zone around the Sea of Marmara, which are authorized in governmental plan or idea at present are shown in Figure 3.4.2 and Figure 3.4.3.

It is not definite when these land transportation projects will be started and terminated. However, the direction of land transportation development will surely indicate to a figure which are targeted in above plans or idea, because the Marmara coastal area will be more significant from the viewpoint of physical distribution in future

The land transportation network has been rather expanded spoke-like from main cities around the Sea of Marmara to Ankara and inland cities. Now the relationship between cities around the Sea of Marmara will intensify step by step. That is, the priority of land transportation development has been shifting from spoke-like networking to circle like, and "Marmara corridor" will be formulated in the 21st century.

In future, strengthening of the route between Istanbul and Tekirdag on the northern coast, widening of the route between Istanbul and Izmit, and strengthening of the route between Izmit and Bursa will proceed.

(3)Environmental Preservation Direction

The Sea of Marmara, with an area of 11,500 km^2 and a volume of 3,378 km^3, connects the Black Sea with the Bosphorus strait and the Aegean with the Dardanelles strait. The Sea is bounded by a series of deep depressions of about 1,000m in depth from east to west in its northern portion. Because it forms a transitional region between the Black Sea and the Aegean, the oceanographic characteristics of the Sea of Marmara are closely related to the variations caused by the oceanographic characteristics of its adjoining seas.

Waters originating from the Black Sea and the Aegean form two distinct layers in the straits as well as in the Sea of Marmara. In terms of pollution, the coasts of the Marmara are home to Turkey's densest population and industrial centers. Efficient self-purification of the Sea is therefore impossible, owing both to its stratified structure and to its water discharge potential, which is limited by the straits.

This Sea is exposed to pollution from the industries located around the Bay of Izmit, which are the most polluting in the entire country, as well as being a receptacle for the wastes of the city of Istanbul, which accounts for a sizable fraction of Turkeys total population. Eutrophication and oil pollution in the Sea of Marmara have reached serious proportions.

In order to prevent intensive pollution of the Sea from the discharge of untreated wastewaters, a new system was proposed which has now been realized to a large extent. The system is to pass through a filter and disinfectant process, and to release into the lower strata of the Sea of Marmara. The removal, clean-up and replacement of old facilities from the waterfront of the Sea is also one of the most important items to discharge its accumulating pollution load.

However, in particular, Istanbul and Izmit regions already experience serious environmental problems. Therefore, any incremental growth such as new facilities or capacity expansion, in industrial production of these areas could be detrimental in terms of environmental pollution (air, water and soil), if proper mitigation measures are not implemented. In addition, implementation of environmental protection measures just for the new facilities may not be sufficient. In other words, a great majority of the already existing facilities should also implement pollution control measures and conform with the pertinent environmental legislation, currently existing ones or those which may become effective in the near future due to E.U. etc..

FIGURE 3.4.2 Motorway Network Plan around the Sea of Marmara

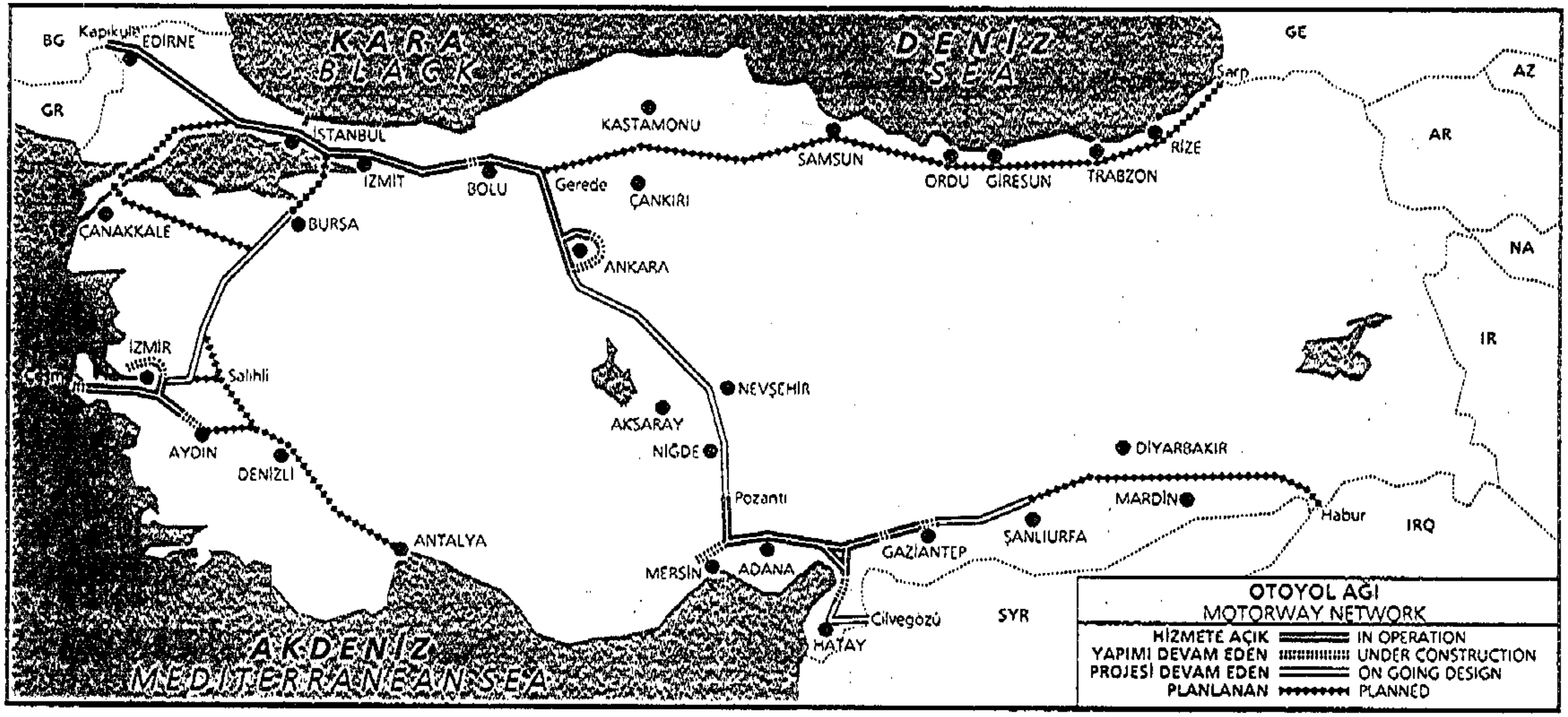
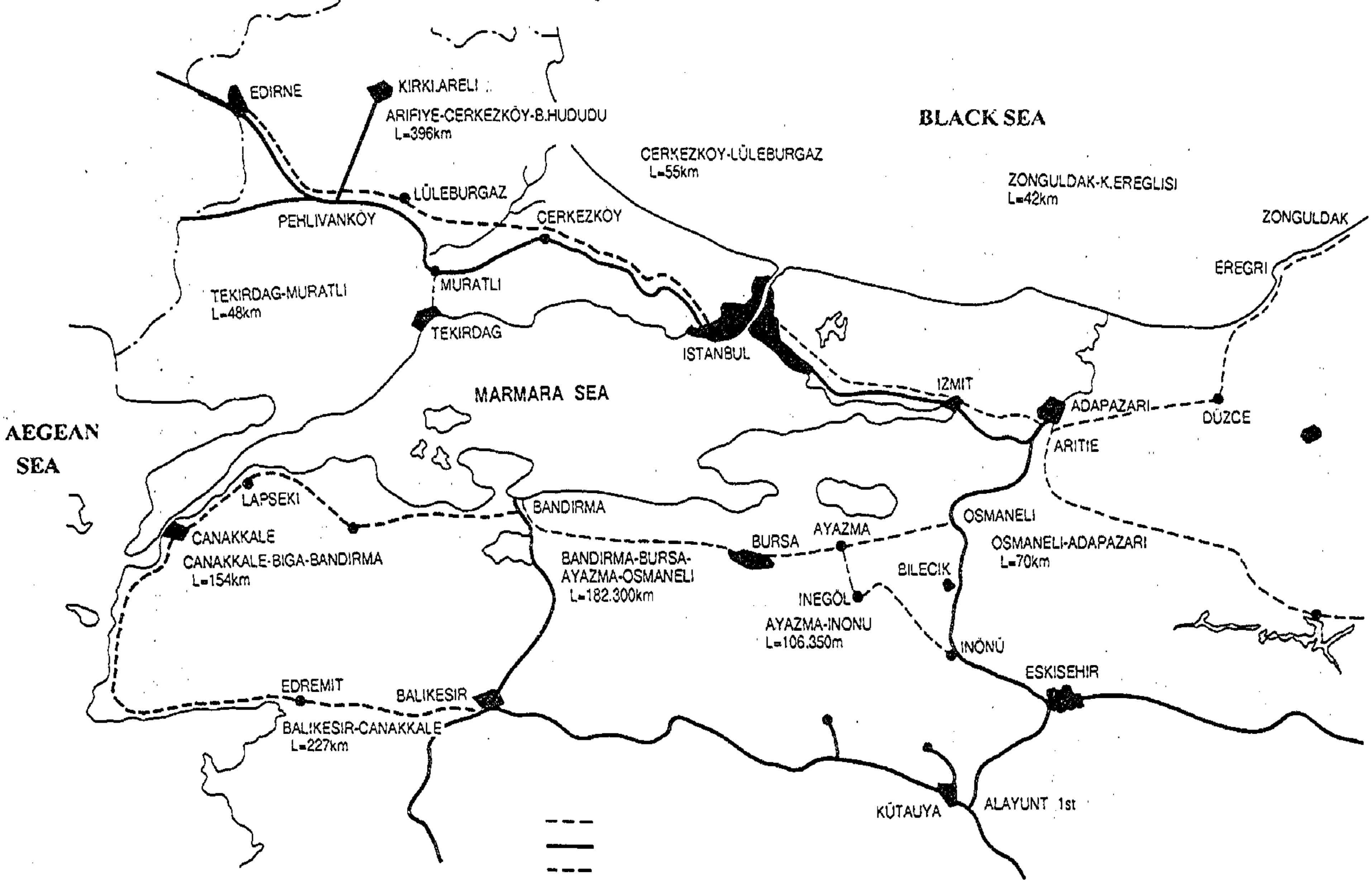


FIGURE 3.4.3 Railway Network Plan around the Sea of Marmara



3.5. Necessity of New Ports or New Port Facilities

3.5.1 Necessity

According to the comparison with cargo demand and cargo handling capacity in above section 3.3.7, on the assumption that construction of private ports and improvements of existing port facilities excluding Derince new container terminal would be completed, cargo handling capacity in the Thrace and Izmit regions will not be sufficient for the cargo volume in 2015.

Container cargo volume of approximately 638,000TEU, general cargo volume of 230,000 tons and dry bulk cargo volume of 5,223,000 tons will exceed the capacity of ports in the Thrace region. These cargoes will be originating to/from the Thrace region and it will be impossible to transport across the Bosphoros strait because the large volumes involved would result in stunning congestion. To better understand the magnitude of these volumes, 638,000TEU is equivalent to 2.5 times the container throughput of Haydarpasa port in 1995 and 545,000 tons is equivalent to 0.8 times the cargo handled at Ambarli port in 1995.

And in the Izmit region, container cargo volume of 433,000TEU will exceed the capacity of ports. This 433,000TEU is equivalent to 1.8 times the container throughput of Haydarpasa port in 1995.

To handle the above volume of cargo, it is necessary to increase the capacity of ports in the Thrace and Izmit regions. A simple extension of the existing port will not be enough to deal with the forecast cargo. A new commercial port to mainly handle container and bulk cargo should be constructed in the Thrace region and a new container terminal or new container port should be constructed in the Izmit region by 2015.

3.5.2 Scale, Facilities and Timing

(1) Thrace region

The cargo volume to be handled in the new port will be 638,000TEU of container, 230,000 tons of general cargo and 5,223,000 tons of bulk cargo in 2015, which is equal to about 11,000,000 tons. According to the results of the examination in 2.3 and 3.5.3, the port will be probably a mother container vessel calling port. The number of container berths will be 4. For bulk cargo and general cargo, about 6 berths will be necessary. In this case, the handling capacity of container berth and bulk berth are assumed 200,000TEU/berth/year and 1,000,000 ~ 1,200,000 ton/berth/year respectively. Total length of berth will be 2,200m. The required area of storage yard for container and bulk cargo will be 450,000m^2 and 520,000m^2 respectively, for a total of 970,000m^2. However, these figures related to the scale of the new port will be examined in detail in chapter 4.

(2) Izmit region

The container cargo volume to be handled in the new terminal or port will be 433,000TEU. On the same assumption of above berth productivity, the necessary number of container berths will be 2 or 3. Total length of berths will be 840m and required area of container yards will be 340,000m^2. These figures related to the scale of the new facilities as well as location will be examined in detail in the supplementary feasibility study as mentioned in 3.1.

3.5.3 Probability of Container Mother Port

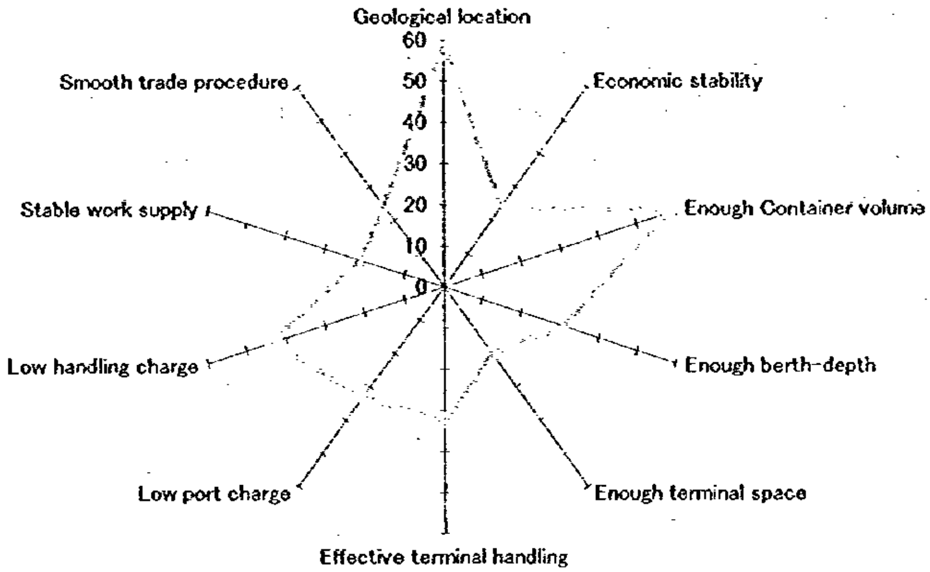
The probability of a mother container vessel calling at the new port in the Sea of Marmara in future, is examined in this section.

(1) General

The result of a survey by OCDI, concerning what are the most important conditions in selection a port for mother vessel operated in main routes in the world, is shown in Figure 3.5.1, in which their opinions are converted into numerical value in order of intensity.

Most shipping companies pointed out that a large amount of container volume and geographical location are the most important reasons. Shipping companies naturally wish to collect and transport container cargo more efficiently, and economically. The second reason is container handling charge and port charge, though this is not as important as the former two reasons. The third reason is physical condition of container terminal such as berth depth and berth length.

FIGURE 3.5.1 Terms of Mother Port



Ports which mother vessel operated in main routes in the world call at can be categorized into four types as shown in Figure 3.5.2. Those are International transship port, Gateway port, Trunk port and Periphery port. The mother port in this report is defined as type C, Trunk port.

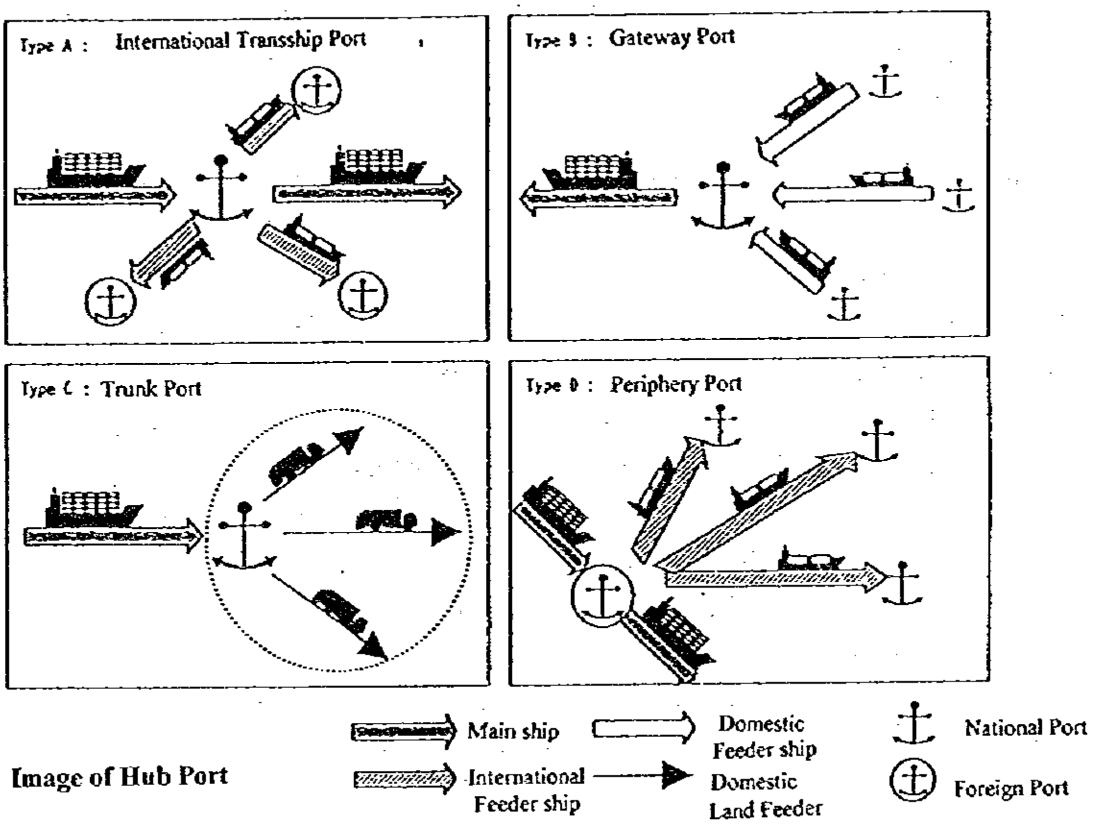
(2) Probability of mother port from a viewpoint of container volume

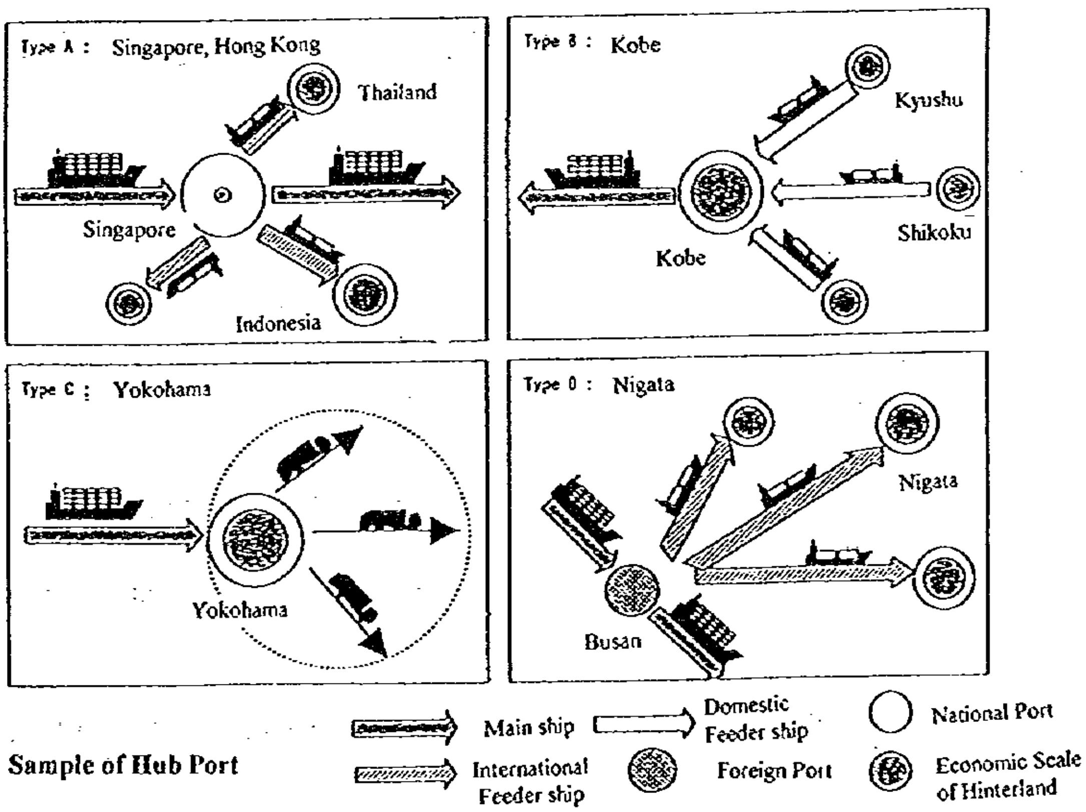
Table 3.5.1 shows world's top 150 container ports in the world in 1994. In this table, prerequisites for mother port are ① calling on by vessel with capacity of 3,000 TEU or over, ② weekly service, ③ connection of same shipping company's feeder service.

According to this table, ports handling over 1,500,000TEU in a year except the San Juan port in Puerto Rico are semi-mother port with conditions of above ①, ②, despite the deviation from main route.

Concerning ports ranked between top 20 and 50, which handle less than 1,500,000TEU a year, the Seatle Port and the Xingang Port are semi-mother ports,

FIGURE 3.5.2 Category of Hub-Port





Source: Japan transport Economics Research Center despite the fact that these two ports deviate over 800 nautical mile from the route. On the other hand, Bangkok Port, Tanjung Priok Port, the Hampton Roads Port and Zeebrugge Port are not mother ports, though these four ports deviate less than 600 nautical miles from the route.

(3) Probability of mother port from a viewpoint of deviation from main route

In this section, the relationship between container handling volume, deviation from the route and mother port is examined. The data of container handling volume(TEU) and deviation from the route of world 100 top container ports in 1994 are plotted in Figure 8.4.3. The data of ports ranked between from 20 to 50, which habdle container less than 1,500,000 TEU in a year, are plotted in Figure 3.5.4.

It is axiomatic that the further a port deviates from the route, the more feeder ports increase. It is natural for mother vessels to call directly on ports that are not far from the main route to lessen the operation cost. However, with regard to Bangkok Port, Tanjung Priok Port, the Hampton Roads Port and Zeebrugge Port, small deviation does not always guarantee mother port status. In some cases, container handling volume and port facilities are important factors as well.

Based on the relationship between container handling volume and deviation from the route among ports handling between 500,000 TEU and 1,500,000 TEU in a year, a port could be probably become a container mother port if it satisfies the conditions according to the following formula in Figure 3.5.4..

$$Y < (1/1{,}200)X - (500/3)$$

Y : Deviation from the main route (nautical mile)
X : Container handling volume in a year (TEU)

The assumed main route in the world, New York - Norfork - Savannah - Cristobal - Long Beach - Oakland - Yokohama - Osaka - Keelung - Hongkong - Singapore - Colombo - Le Havre - Antwerp - Rotterdam - Bremenhaven, is shown in Figure 3.5.5.

For example, if container handling volume of a port would be 1,000,000

TABLE 3.5.1 World 150 Major Container Ports

No.	Port	Mother or Feder	1994TEU	1993TEU	1992TEU	1991TEU	1990TEU	93 Country Region	Deviation(NM)
1	Hong Kong	M	11,050,030	9,204,236	7,972,235	6,161,912	5,100,637	1 Hong Kong	0
2	Singapore	M	10,399,400	9,046,100	7,560,000	6,354,000	5,223,500	2 Singapore	0
3	Kaohsiung	M	4,899,879	4,635,896	3,960,518	3,913,108	3,494,631	3 Taiwan	0
4	Rotterdam	M	4,539,254	4,161,160	4,125,409	3,782,595	3,666,666	4 Netherlands	0
5	Busan	M	3,212,637	3,070,681	2,751,006	2,570,734	2,348,475	5 South Korea	130
6	Kobe	m	2,915,854	2,696,084	2,608,272	2,635,425	2,595,940	6 Japan	0
7	Hamburg	M	2,725,718	2,486,130	2,268,481	2,188,953	1,968,986	7 Germany	0
8	Long Beach	M	2,573,827	2,079,491	1,829,457	1,767,829	1,598,078	10 USA	0
9	Los Angeles	M	2,518,618	2,318,918	2,289,038	2,038,363	2,116,410	8 USA	0
10	Yokohama	m	2,317,103	2,167,792	1,886,789	1,796,368	1,647,891	9 Japan	0
11	Antwerp	M	2,208,173	1,876,296	1,835,595	1,761,422	1,549,113	12 Belgium	0
12	Keelung	m	2,035,354	1,856,419	1,940,553	2,007,752	1,828,144	13 Taiwan	0
13	New York New Jersey	m	2,033,919	1,972,692	2,014,055	1,865,471	1,871,859	11 USA	0
14	Dubai	m	1,881,990	1,678,778	1,481,807	1,255,260	916,363	14 UAE	1140
15	Tokyo	m	1,805,401	1,537,626	1,728,548	1,783,838	1,555,138	17 Japan	0
16	Felixstowe	M	1,734,352	1,638,644	1,542,551	1,433,736	1,435,634	15 UK	45
17	San Juan		1,522,101	1,553,421	1,563,672	1,584,038	1,381,404	16 Puerto Rico	635
18	Bremen Bremenhaven	m	1,502,878	1,357,636	1,308,460	1,277,898	1,197,775	18 Germany	0
19	Manila	m	1,501,965	1,251,257	1,157,912	1,047,900	1,038,905	21 Philippines	570
20	Oakland	M	1,491,000	1,305,135	1,287,379	1,194,718	1,124,123	19 USA	0
21	Seattle	m	1,414,000	1,151,000	1,151,000	1,154,854	1,171,090	23 USA	840
22	Bangkok		1,394,769	1,273,797	1,303,308	1,170,697	1,018,290	20 Thailand	600
23	Tanjung Priok		1,252,153	1,000,126	867,509	736,360	643,963	25 Indonesia	525
24	Nagoya	m	1,224,422	1,154,928	1,097,986	1,001,055	897,781	22 Japan	105
25	Shanghai	m	1,130,166	900,256	330,000	576,000	456,123	27 PRC	225
26	Tacoma		1,027,928	1,074,558	1,101,000	1,020,708	937,691	24 USA	850
27	Algeciras	M	1,003,528	806,543	780,336	761,795	552,555	31 Spain	20
28	Charleston	m	981,627	838,295	804,373	808,505	807,106	30 USA	0
29	Colombo	M	972,642	858,392	676,041	669,489	583,811	29 Sri Lanka	0
30	Port Kelang	m	943,844	771,901	677,588	607,626	496,526	33 Malaysia	30
31	Hampton Roads		896,044	786,023	830,256	826,968	788,760	32 USA	12
32	Jeddah	m	880,187	912,504	847,252	721,192	549,934	26 Saudi Arabia	68
33	Le Havre	m	872,940	894,691	746,388	918,528	857,765	28 France	0
34	Honolulu		852,873	703,687	656,221	631,148	605,330	36 USA	1400
35	La Spezia	M	816,280	764,970	595,738	464,470	450,146	34 Italy	363
36	Melbourne		801,244	723,967	658,797	604,648	622,983	35 Australia	4213
37	Montreal		728,799	598,120	537,256	575,554	568,103	40 Canada	1080
38	Durban		724,199	635,171	569,730	579,234	511,634	39 South Africa	2930
39	Damietta	M	702,257	561,172	416,032	251,708	97,575	42 Egypt	17
40	Fujairah		694,452	649,332	527,046	475,734	414,353	38 UAE	993
41	Osaka	m	654,786	679,881	617,184	541,267	483,036	37 Japan	13
42	Zeebrugge		639,184	511,300	547,757	312,370	342,410	47 Belgium	24
43	Xingang(Tianjin)	m	630,743	481,906	390,000	339,000	286,000	53 PRC	1050
44	Miami	m	629,000	572,170	519,954	408,034	373,850	41 USA	251
45	Santos		613,578	538,777	494,763	427,889	438,120	43 Brazil	4979
46	Barcelona	m	605,356	501,146	525,000	488,917	447,920	50 Spain	215
47	Southampton	M	597,653	506,449	416,562	426,424	345,438	49 UK	44
48	Houston		579,868	538,732	490,106	533,887	504,854	44 USA	1019
49	Savannah	m	550,432	524,627	517,277	479,348	422,635	46 USA	0
50	Port Botany(Sydney)		539,000	483,088	552,186	519,703	477,395	51 Australia	4098
51	Buenos Aires		532,000	450,338	350,000	254,745	209,150	55 Argentina	5745
52	Baltimore	m	530,643	482,049	468,933	465,491	474,301	52 USA	290
53	Piraeus		517,000	537,064	511,465	462,682	426,204	45 Greece	209
54	Karachi		513,001	509,938	510,017	469,705	390,391	48 Pakistan	892
55	Genoa		512,098	342,277	337,624	344,353	310,217	68 Italy	396
56	Vancouver(BC)	m	493,843	434,004	441,064	383,563	383,563	57 Canada	1350
57	Bombay		486,993	427,630	315,400	279,556	324,216	59 India	555
58	Jacksonville		480,616	458,687	423,409	304,843	278,084	54 USA	129
59	Valencia		466,881	385,341	370,546	364,445	387,162	62 Spain	136
60	Marseilles	m	437,088	431,546	350,331	446,470	481,710	58 France	317
61	Khor Fakkan	m	433,806	416,475	358,760	268,777	162,620	56 UAE	1000
62	Qingdao		430,000	264,384	222,306	184,340	135,419	80 PRC	698
63	Haifa		424,320	405,398	386,067	322,706	237,000	60 Israel	170
64	Gothenburg	M	420,848	369,537	369,973	340,171	351,633	64 Sweden	292
65	Tanjung Perak		411,321	393,612	328,012	256,140	198,135	61 Indonesia	525
66	Liverpool		404,242	379,114	353,285	289,392	238,958	63 UK	341
67	Penang		386,182	330,922	303,367	251,849	222,441	69 Malaysia	88
68	Marsaxlokk	M	383,060	288,192	259,232	157,631	94,603	77 Malta	0
69	Tilbury		369,221	360,755	368,508	331,270	362,588	67 UK	64
70	Cebu		365,574	205,557	-	199,665	185,299	99 Philippines	742
71	Taichung		360,837	302,651	277,765	208,807	128,138	74 Taiwan	208
72	Leghorn		359,710	360,961	333,756	411,182	416,371	65 Italy	334
73	Laem Chabang		348,448	218,526	33,705	-	-	96 Thailand	661
74	Moji		316,189	303,902	269,857	282,211	256,267	73 Japan	250
75	Helsinki		344,954	329,694	236,240	219,433	245,857	70 Finland	640
76	Auckland		341,167	310,000	252,196	212,500	221,103	72 New Zealand	4737
77	Kingston	m	339,095	265,022	189,213	164,636	144,576	79 Jamaica	555
78	Anchorage		333,138	320,518	262,722	267,078	272,558	71 USA	1838

79 Portland,OR	m	317,961	239,439	217,422	175,900	162,987	85 USA	668
80 Halifax	m	311,097	300,933	302,367	357,436	447,270	76 Canada	527
81 Dalian		305,000	256,158	217,464	172,536	131,259	83 PRC	852
82 Dammam		287,206	301,181	303,277	342,612	232,456	75 Saudi Arabia	2003
83 Alexandria		284,427	257,773	236,532	263,852	197,732	82 Egypt	57
84 Hull		281,477	259,977	274,419	195,948	156,843	81 UK	178
85 Lisbon		272,175	273,731	293,857	285,538	263,817	78 Portugal	45
86 Izmir		268,908	212,949	162,507	143,109	122,503	97 Turkey	368
87 Las Palmas		268,657	235,437	220,313	143,109	122,503	88 Canary Islands	720
88 Bilbao		267,713	222,264	204,421	193,823	189,004	93 Spain	275
89 Limassol		266,200	224,300	218,296	228,567	273,805	95 Cyprus	198
90 Dublin		262,000	222,000	102,348	171,576	215,485	94 Eire	292
91 Jiuzhou		260,611	198,548	181,888	-	-	104 PRC	1058
92 Veracruz		256,055	193,936	178,181	121,682	110,082	106 Mexico	1096
93 Port Everglades		251,743	226,674	209,605	185,860	200,098	92 USA	226
94 Ashdod		250,350	227,450	181,941	156,990	179,000	91 Israel	125
95 Abidjan		247,544	238,822	188,728	179,501	181,037	86 Cote D'Ivoire	2977
96 Jawaharlal Nehru		244,070	173,071	142,669	109,495	54,643	113 India	612
97 Thamesport	m	241,000	210,781	191,531	135,689	8,953	98 UK	54
98 Valparaiso		240,456	250,157	246,842	145,108	110,022	84 Chile	2615
99 Hakata	m	238,304	204,106	193,562	179,185	150,485	100 Japan	416
100 Johor		238,008	168,315	128,558	96,931	66,083	119 Malaysia	22
101 Shimizu	m	236,213	238,142	219,017	191,903	164,433	87 Japan	
102 Brisbane		232,873	228,055	212,100	200,105	183,380	90 Australia	
103 Cape Town		231,369	202,810	189,918	172,071	146,247	102 South Africa	
104 Beirut		229,922	203,661	80,989	131,175	-	101 Lebanon	228
105 Xiamen		225,000	154,500	-	-	30,000	125 PRC	
106 Aarhus		208,000	200,000	184,000	164,000	156,000	103 Denmark	
107 Madras		200,386	162,631	119,000	127,360	110,423	122 India	
108 Naples		194,000	181,284	163,985	154,191	132,633	112 Italy	236
109 Reykjavik		193,312	189,995	177,781	186,346	159,832	110 Iceland	
110 Cristobal		191,041	192,438	177,890	162,446	123,264	107 Panama	
111 Fremantle		189,272	169,174	142,839	132,093	120,645	117 Australia	
112 Port Said	m	185,240	170,927	116,884	60,095	54,783	114 Egypt	0
113 New Orleans		182,987	168,647	403,840	349,704	352,469	118 USA	
114 Tomakomai		181,981	183,026	186,693	180,901	25,405	111 Japan	
115 Ravenna		180,966	170,609	157,075	150,382	151,700	115 Italy	645
116 Haydarpasa		179,831	232,634	179,189	143,046	111,705	89 Turkey	538
117 Belawan		176,911	161,341	133,844	102,731	81,565	123 Indonesia	
118 Santa Cruz		176,766	154,808	171,221	161,330	150,306	124 Canary Islands	
119 Leixoes		176,657	167,044	174,007	151,920	147,625	120 Portugal	
120 Thessaloniki		173,733	166,186	133,585	85,944	53,809	121 Greece	458
121 Copenhagen		172,990	146,968	173,785	153,794	146,097	132 Denmark	
122 Teesport		172,906	141,607	124,181	123,228	109,728	136 UK	
123 Shuwaikh		172,258	91,776	158,338	57,113	66,594	175 Kuwait	
124 Boston		169,595	152,240	130,436	124,859	141,805	127 USA	
125 Casablanca		169,196	147,938	178,548	174,698	164,901	131 Morocco	
126 Salerno		169,019	144,522	-	60,625	51,875	134 Italy	246
127 Palm Beach		166,591	144,756	140,740	127,536	118,568	133 USA	
128 Guayaquil		164,290	126,627	-	113,463	97,030	143 Ecuador	
129 Huangpu		160,483	131,095	118,161	-	-	141 PRC	
130 Mombasa		160,293	144,137	135,324	135,541	136,406	135 Kenya	
131 Wilmington,DE	m	154,298	170,108	142,227	88,370	89,258	116 USA	
132 Helsingborg		153,390	148,921	45,397	35,657	-	129 Sweden	
133 Ipswich		151,493	114,487	141,477	139,182		152 UK	
134 Waterford		149,931	131,477	144,203	120,012		140 Eire	
135 Belfast		146,460	135,570				138 UK	
136 Trieste		146,129	150,445	134,439	136,121		128 Italy	645
137 Apra		144,254	148,417				130 Guam	
138 Oslo		140,360	127,524	106,095	133,526		142 Norway	
139 Cagayan De Oro		139,742	118,540				147 Philippines	
140 San Antonio		136,922	95,553				170 Chile	
141 Lattakia		132,961	120,495	92,554	82,832		145 Syria	295
142 Mersin		131,454	116,794	105,822	102,733		151 Turkey	348
143 Lyttelton		127,935	104,915	85,142	86,840		159 New Zealand	
144 Port of Spain		127,498	101,521	28,583	22,756		165 Trinidad & Tobago	
145 Nanjing		126,000	89,500	73,301	52,260		179 PRC	
146 Mina Zayed		125,416	101,809	101,409	45,019		164 UAE	
147 Gdynia		122,694	111,599	97,894	115,387		153 Poland	
148 Rio Grande		119,641	101,899	104,135	94,689		163 Brazil	
149 Calcutta/Haldia		117,777	102,018	80,925	66,812		162 India	
150 Port Elizabeth		115,624	116,871	91,000	91,498		150 South Africa	

Source: Container Year Book

Note: M: Weekly service, Over 3,000TEU vessel, Same shipping company's feeder service
m: Weekly service, Over 3,000TEU vessel

FIGURE 3.5.3 Relationship between container handling volume & deviation from main route

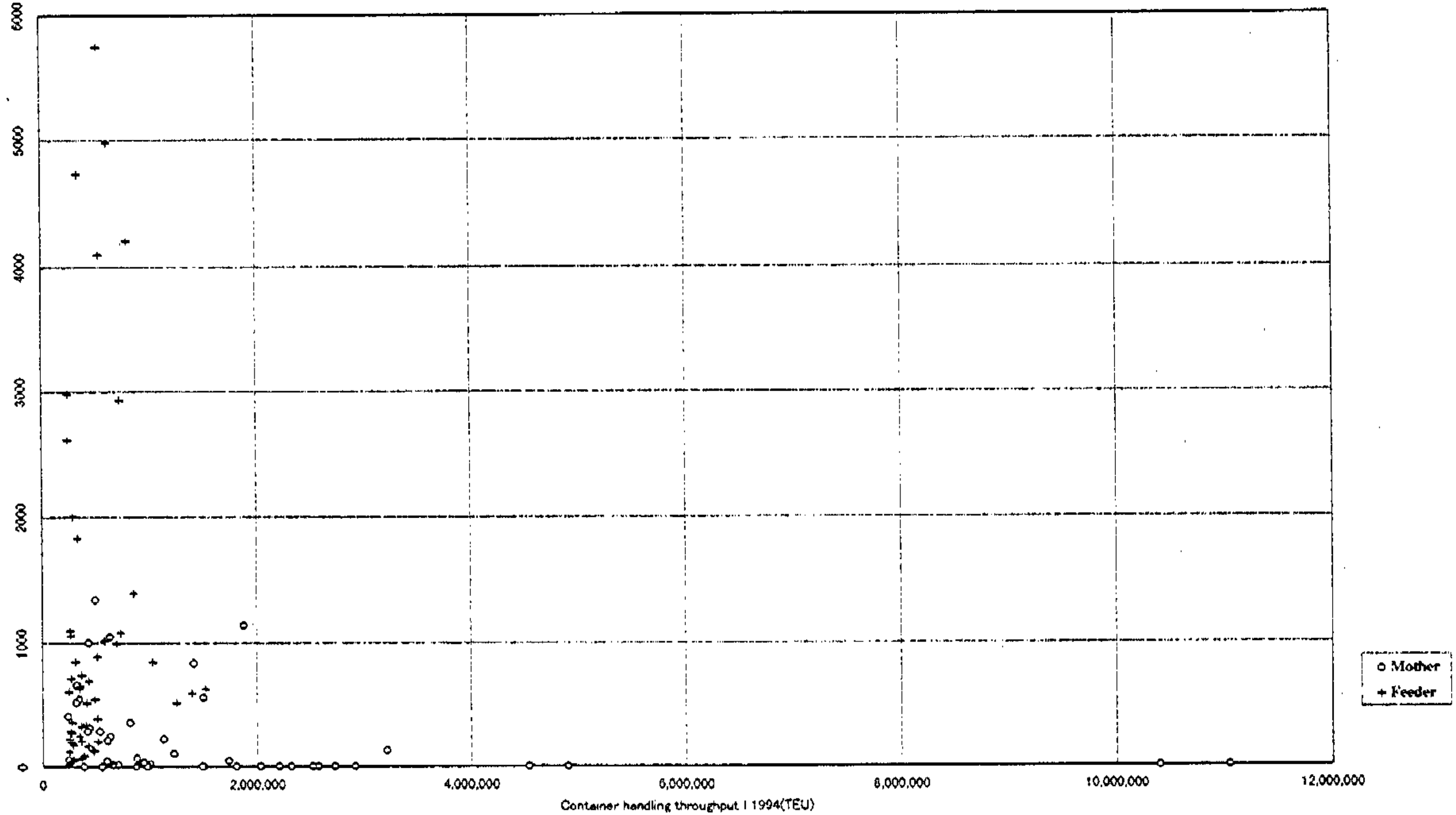
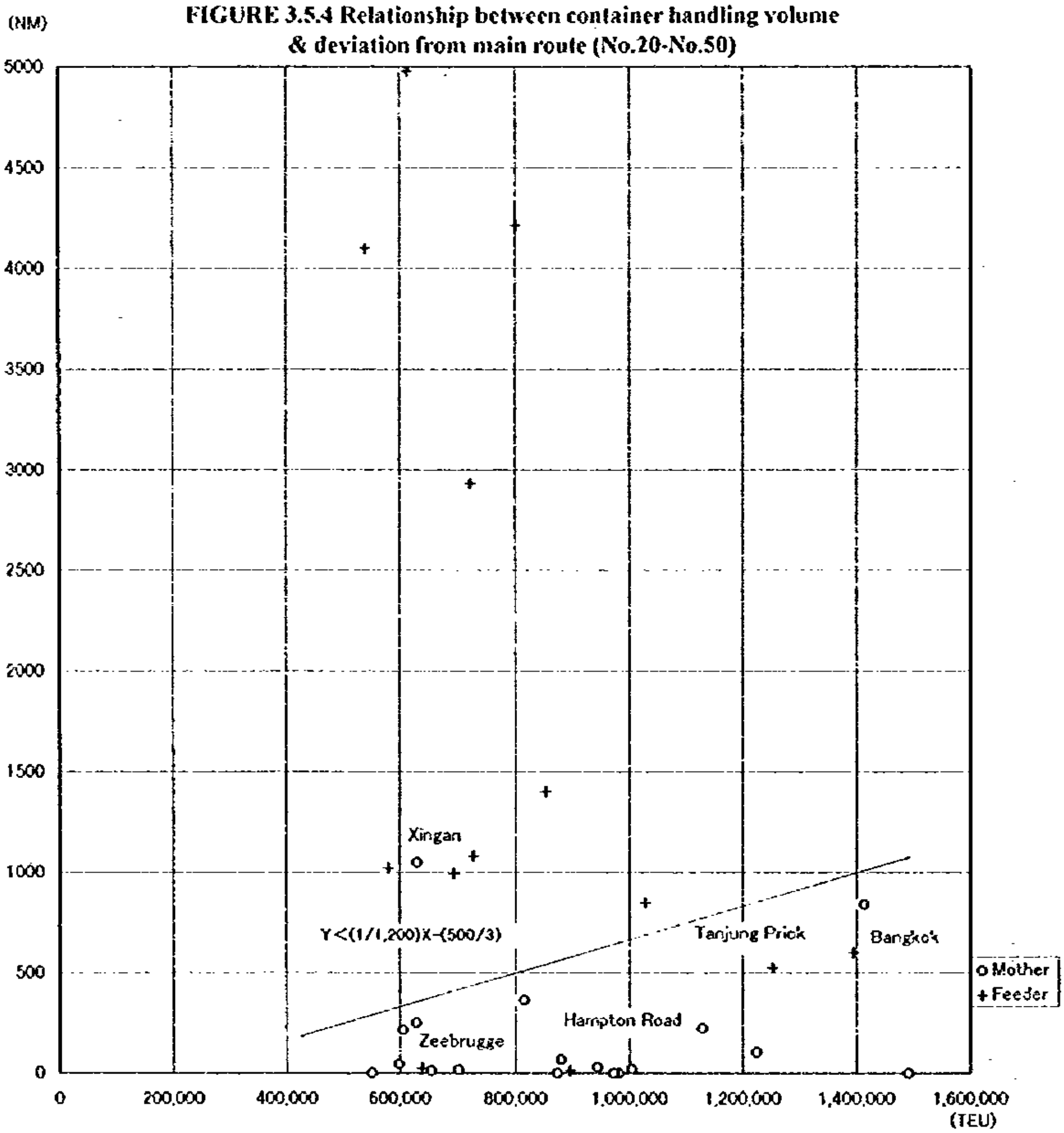


FIGURE 3.5.4 Relationship between container handling volume & deviation from main route (No.20-No.50)



TEU/year and deviation from the route would be less than 500 nautical miles, the port would most likely be a container mother port.

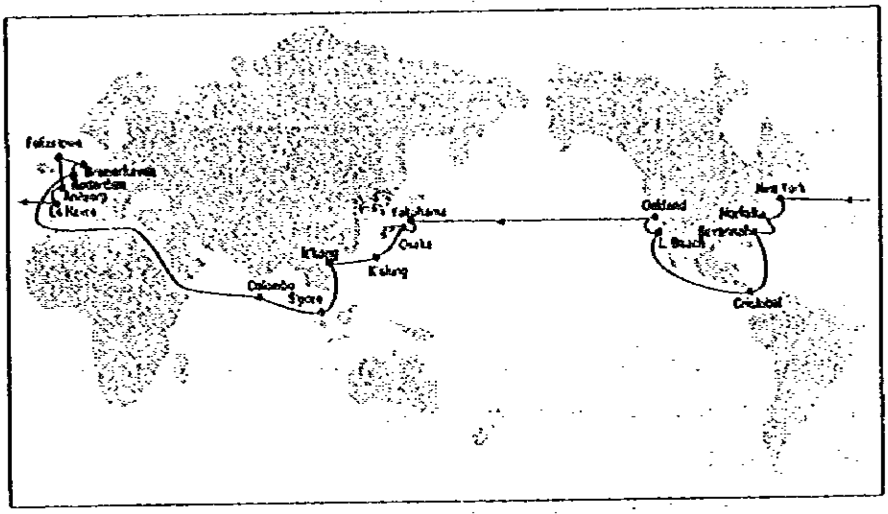


FIGURE 3.5.5 Main Route of Mother Vessel

According to the examination in above (2), (3), it is possible to assume that fixed level (some 1,500,000 TEU/year) of container handling volume of a port is a condition to be a container hub port, and for ports where the container volume is less than the fixed level, it is possible to classify it as a mother port or feeder port by comparing the container handling volume and deviation from the route.

(4) Probability of mother port from a viewpoint of operation cost

1) Purpose of the examination

This examination is to discuss whether the new container port in the Sea of Marmara will be able to further grow as a hub-port in the Mediterranean, comparing transport cost between a main container ship and a feeder ship.

2) Basic idea of the examination

There seem to be many reasons for feeder services distributing container to/from a hub-port instead of direct service. Two major factors whether a main container ship directly calls at the feeder port or not are the cost difference between a main ship's diversion/extension and a feeder ship transportation, and the amount of container cargo per one call of the main ship. Accordingly, the relation between the diversion/extension distance and the amount of container cargo necessary for every call of the main ship is to be analyzed to clarify the possibility whether the new port will become a transshipment port to handle container.

3) Premises of calculation

Cost for container ship operation consists of the followings:

a) Expenses for ship
Depreciation cost, crew expense, maintenance cost, expense for ship articles, lubricating oil cost, insurance fee, interest and other costs
b) Expense for operation
Port charge, fuel cost, cost for agent and others
c) Container terminal charge
Handling charge, terminal rental charge and crane rental charge
d) Fixed expense for container box and related equipment
Interest, maintenance cost and depreciation cost
e) CFS charge
f) Others

On the premise that a main ship carries the same amount of container cargo as a feeder ship does, it is considered that the expenses for a) and b) among the costs above differ between the main ship and feeder ship. However, since the cruising operation pattern of the main and feeder ships differ from each other, the balance in the expenses of both ships does not necessarily coincide with that in transportation cost.

In this examination, it is assumed that a new direct port is located on an expansion line of the main ship route. In this assumption, the navigation distance of the main ship is the same as that of feeder ship and the expense components are respectively shown as follows:

a) Expenses for the feeder ship

① Feeder ship expense converted from time duration of round-trip between the main and feeder ports, and of cargo handling at both ports

② Fuel consumption cost derived from the time duration of ① above
③ Main ship expense converted from time duration of cargo handling at the main port
④ Port charge of both ports for the feeder ship
⑤ Port charge for the main ship(one port counted)
⑥ Cargo handling cost for the feeder ship at feeder port
⑦ Transshipment cost for the feeder ship at the main port

b)Expenses for the main ship

① Main ship expense converted from the time duration of round-trip between both ports, and of cargo handling at the feeder port
② Fuel charge of both ports for the main ship
③ Port charge of both ports for the main ship
④ Cargo handling cost for the main ship at the feeder port

Among these expenses above, it can be assumed that ③ of a), ⑤ of a) and ⑥ of a) are equal to the latter half expense of ① of b), a part of ③ of b) and ④ of b)respectively. Therefore, these expenses that equal each other are deducted from total costs to simplify the comparison, since the aim of this examination is to clarify the most economical transport service.

4) Comparison of Transportation Cost for Main and Feeder Ships

In this connection, relationship between transportation cost and navigation distance can be analyzed by ship size. The results are shown in Figure 3.5.6 and Figure 3.5.7.

Figure 3.5.6 and Figure 3.5.7 can be read as follows:

In case that a feeder ship loading 500TEU is engaged in feeder service for a distance of 600 miles (round-trip), the transportation cost of the service can be read as US$70,000 under conditions of 0.45$/t port charge and of 50$ transshipment cost in a main port (Figure 3.5.6). On the other hand, if the size of a main ship is 3,000TEU, increased cost generated by additional 600 miles extension for direct call made by the main ship can be read as about US$63,000 (Figure 3.5.7). Accordingly, the direct call by the 3,000TEU ship, in this case, is more economical than the feeder service by the

500TEU ship.

Other figures under different conditions are attached as Appendix 6.

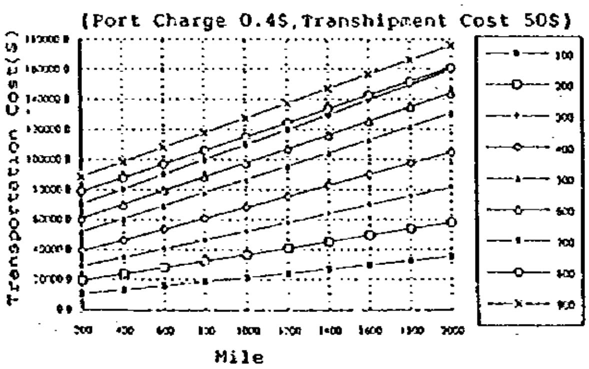


FIGURE 3.5.6 Operation Expense of Feeder Ship

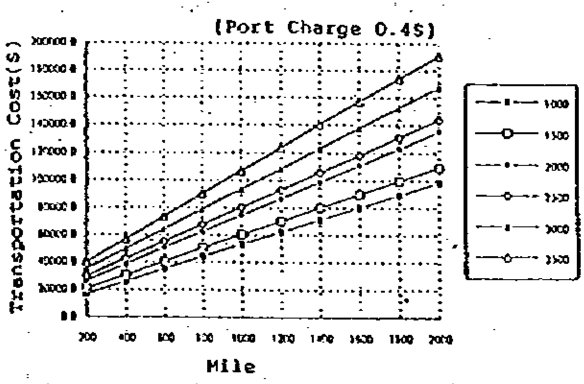


FIGURE 3.5.7 Increment of Expense necessary for Direct Call Main Ship

5) Break-even point between feeder ship and main services

As examined in section 4 above, cargo volume(TEU) as a break-even point between the feeder service and the direct call service can be obtained by comparing the transportation cost of feeder service with the increased cost derived from the direct call, in case that the new call port of the main ship is loaded on an extension line(Pattern-1) or deviation line(Pattern-2) of the existing route (Refer to the following figure).

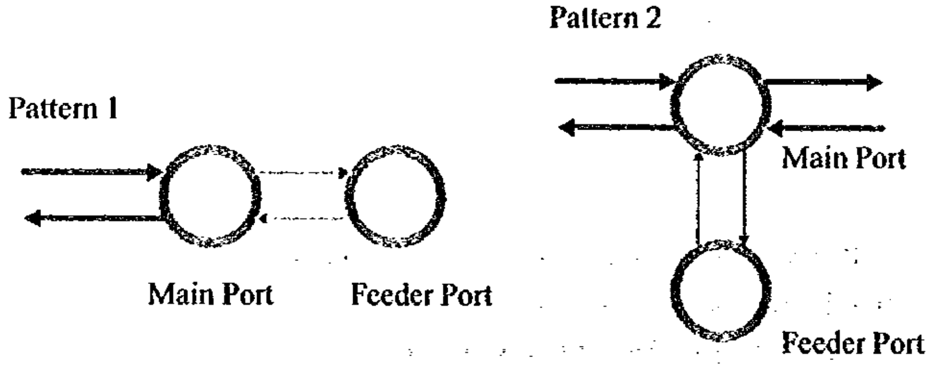


Figure 3.5.8 shows the cargo volume(TEU) to enable the main ship to call a new port directly by extending or deviating the route. In the case of 3,500TEU ship,

when the extension or deviation distance is 1,200 miles, it may not call the new port directly and feeder service is more economical when the cargo volume is less than 800TEUs.

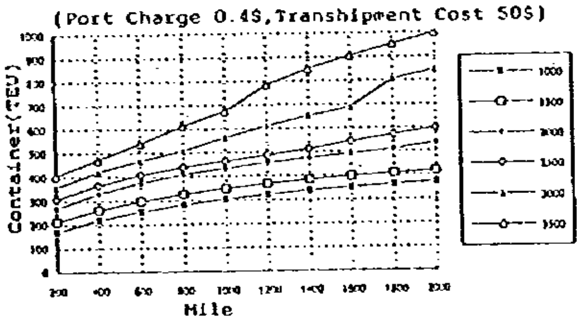


FIGURE 3.5.8 Container(TEU) necessary for direct Call of Main Ship

It is considered that the results obtained here can not be necessarily realized for the following reasons:

a)Containers discussed here means one lot of cargo which should be collected by a shipping company and/or a forwarder both by ship-route and by ship call. In view of the present container cargo volume handled in the east Mediterranean, it is thought to be difficult to collect containers, as one lot by ship-route at a time, more than 500TEUs which seems to be the average feeder ship size in the Mediterranean. However, in line with cargo increase in neighboring countries, it will be easier for these countries to collect cargo of such lot size.

b) This examination is only based on the comparison of transport economy. Whether a main ship directly calls at other ports or whether new port in the Sea of Marmara will be a transshipment port is dependent on not only transport economy, but also on the amount of container ship holdings and commercial transactions of a shipping company, even if the shipping company distributes its container ship to a nearby port.

6) Maximum Size of Container Vessel

The trend of vessel size regarding container vessel and full container vessel are shown in Table 3.5.2 and Table 3.5.3. The average capacity of a newly completed container vessel had increased in the 1980's but has decreased in the 1990's. The average size of a newly completed full container vessel was 2,003 TEU capacity in

1995. On the other hand, the average size of total full container vessels has been gradually increasing since 1968 and the average size was 1897 TEU capacity. Figure 3.5.9 shows the maximum size of full container vessel in a year. The maximum size has also increased to 6,674 TEU in 1998 from 738 TEU in 1966.

Container vessels first appeared on the world maritime transportation scene in the middle of the 1960's. Table 3.5.5 shows the different generations of the container vessel. The 30-year history of the container vessel can be categorized into six generations.

7) Feeder vessel's size

The size of feeder vessel depends on dimension of port facilities, such as berth depth, and economy, such as operating days and cost. Comparing with regional feeder service in terms of ship size, feeder service vessels operated in Asia differ from main feeder vessels in Europe, leading feeder vessels on the east coast of North and Central America, and feeder vessels in the Caribbean Sea.

The most popular feeder vessels in European trade have a capacity of 350～500TEU. Feeder vessels with some 400TEU capacity are operated as the most profitable size on the east coast of North and Central America. Prevailing feeder vessels in the Caribbean Sea are still smaller. On the other hand, the capacity of almost all feeder vessels operated in Asia is more than 1,000TEU, because of the rapid growth of regional trade in Asia these days. Moreover, the capacity of almost all newly ordered feeder vessels is 1,200TEU.

As shown in Figure 3.5.10, feeder vessel size in the east Mediterranean and the Black Sea ranges from 100 to 200TEU.

(5) Probability of Port in the Sea of Marmara as a Container Mother Port

The new port in the Sea of Marmara will handle approximately 860,000TEU in a year. The deviation of new port from the main route is about 530 nautical miles. According to the results of 3.5.3 (2), it is not possible to be a hub port from the viewpoint of container volume, because the total container handling volume(TEU) of the new port is less than 1,500,000TEU.

TABLE 3.5.2 Completion, Capacity & Average size of Container Vessel in the World

Year	New Completion Volume			Total Capacity(end of year)		
	Number	'000 GT	Average GT	Number	'000 GT	Average GT
1970	-	-	-	167	1908	11.4
1971	-	-	-	231	2781	12
1972	51	1667	32.7	312	4310	13.8
1973	31	728	23.5	394	5899	15
1974	10	134	13.4	412	6261	15.2
1975	29	485	16.7	419	6244	14.9
1976	39	674	17.3	443	6685	15.1
1977	61	1159	19	507	7543	14.9
1978	72	1396	19.4	531	8674	16.3
1979	51	1062	20.8	549	9996	18.2
1980	46	1001	21.8	662	11274	17
1981	36	692	19.2	707	12292	17.4
1982	44	902	20.5	718	12942	18
1983	63	1350	21.4	786	14194	18.1
1984	60	1524	25.4	940	16913	18
1985	76	1846	24.3	1011	18364	18.2
1986	59	1785	30.3	1064	19609	18.4
1987	24	659	27.5	1093	21089	19.3
1988	46	1660	36.1	1115	22109	19.8
1989	42	1138	27.1	1112	22735	20.4
1990	70	1641	23.4	1169	23900	20.4
1991	83	2015	24.3	1249	25930	20.8
1992	87	2117	24.3	1322	28037	21.2
1993	99	2290	23.1	1461	31662	21.7
1994	142	2155	15.2	1603	35102	21.9
1995	164	3773	23	about 1740	about 38870	about 22.3
1996	about 217	about 4500	about 20.7	about 1950	about 43350	about 22.2
1997		about 4200			about 47550	
1998		about 2300			about 49850	

Source: Lloyd' statistics. The Bulletin of Japan Maritime Reseach Institute No.362
Note: Completion Volume have been collected data over 200GT and 100GT after 1990.
Total Capacity have been collected data over 100GT.

TABLE 3.5.3 Completion, Capacity, Average Size of Full Container Vessel in the Worl

YEAR	New Completion Volume			Total Capacity(end of year)		
	Number	TEU	Average(TEU)	Number	TEU	Average(TEU)
1968	-	-	-	76	34212	450
1970	-	-	-	120	78636	655
1975	24	24127	1005	325	355323	1093
1976	43	40708	947	354	389856	1101
1977	63	66550	1056	385	440351	1144
1978	107	105225	983	463	525625	1135
1979	94	99228	1056	542	623685	1151
1980	61	84873	1391	634	734895	1159
1981	41	53776	1312	704	782778	1112
1982	51	52873	1037	739	823469	1114
1983	59	85801	1454	779	916416	1176
1984	55	112990	2054	794	1010339	1272
1985	48	98211	2046	809	1111450	1374
1986	58	121804	2100	805	1135070	1410
1987	35	78305	2237	840	1219895	1452
1988	30	90579	3019	881	1352181	1535
1989	38	86189	2268	918	1442424	1571
1990	31	75550	2437	952	1527112	1604
1991	44	102241	2324	970	1644621	1695
1992	54	127932	2369	1028	1812350	1763
1993	67	157722	2354	1046	1931282	1846
1994	109	233828	2145	1147	2158616	1882
1995	161	322525	2003	1308	2481000	1897
(Projection)1996		about 370000			about 2850000	
(Projection)1997		about 351000			about 3200000	
(Projection)1998		about 189000			about 3390000	

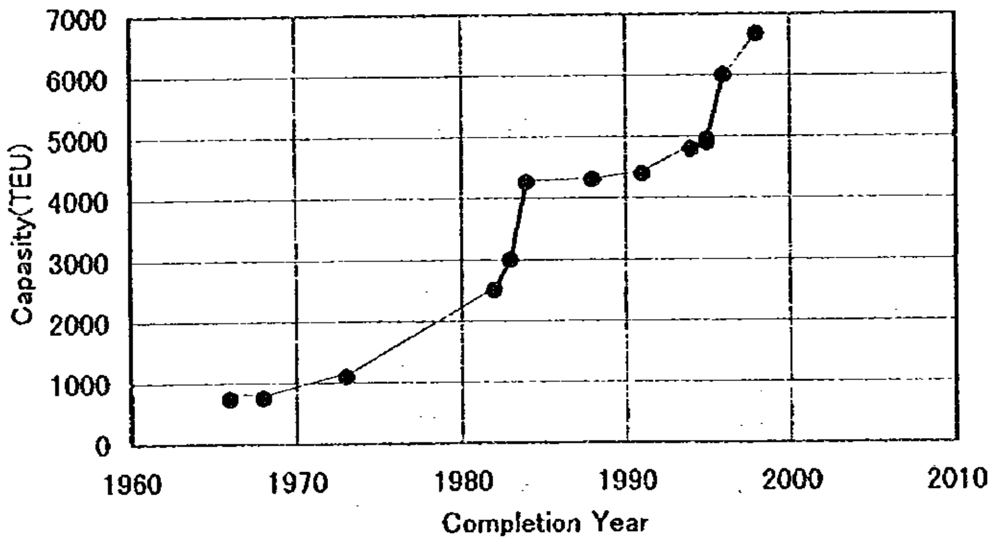
Source: World Container Fleet NYK. The Bulletin of Japan Maritime Reseach Institute No 360

TABLE 3.5.4 Maximum Size of Full Container Vessel (as of May, 1996)

Completion Year	Shipping Company	Capacity(TEU)	(length × width)(m)
1966	CONTAINER MARINE LINES(CML)	738	187 × 26.0
1968	NIHON YUSEN K.(Hakone Maru)	752	288 × 32.2
1973	SEA LAND(SL-7, US.Navy)	1,096	262 × 32.2
1982	APL	2,500	230 × 32.2
1983	EVERGREEN(G type)	2,728	270 × 32.2
1983	MAERSK	3,000	289 × 32.2
1984	USL	4,258	275 × 39.4
1988	APL(C-10 type, Post Panamax)	4,300	294 × 32.25
1991	HAPANG-LLOYD(Panamax)	4,400	253 × 32.2
1991	NEDLLOYD(Hatch Coverless type, UCC)	3,568	283 × 37.2
1994	NIHON YUSEN K.(Post Panamax)	4,800	268 × 40.0
1995	EVERGREEN(Post Panamax, U type)	4,900	262 × 40.0
1995	OOCL(Post Panamax)	4,950	262 × 40.0
1996	COSCO(Post Panamax)	5,250	280 × 39.8
1996	MAERSK(Post Panamax)	6,000	318 × 42.8
1998	P&OCL(Largest in the World)	6,674	300 × 42.8

Source: The Bulletin of Japan Maritime Reseach Institute No.362

FIGURE 3.5.9 Maximum Size of Full Container Vessel



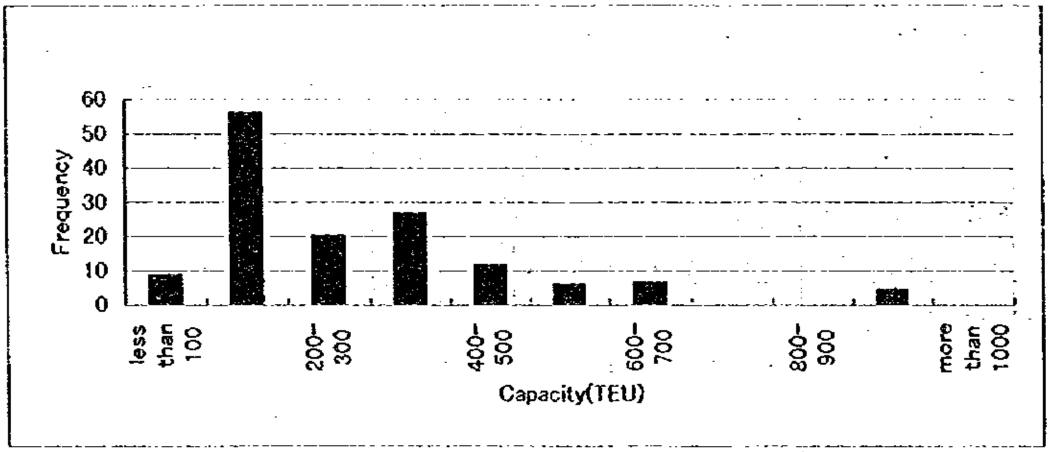
Source: The Bulletin of Japan Maritime research Institute, No. 360

TABLE 3.5.5 Trend of Container Vessel's Generation

Generation / ITEM	I	II	III	IV	V	VI
	Full scale	Panamax Hi speed	Energy Save	Panamax Max	Post Panamax	Super Container
	'60's latter	'70's	'70's end ~ '80's first	'80's latter (P'max)	'90's first (over P'max)	'90's later
Capacity(TEU)	700~1,500	1,800~2,300	2,000~2,500	2,500~4,400	4,300~5,400	6,000~6,670
Dimension						
(TEU)	(752)	(1,887)	(2,464)	(4,407)	(4,340)	(6,000)
Length(m)	187.0	263.3	258.5	281.6	260.8	318.0
Breadth(m)	26.0	32.2	32.2	32.25	39.4	42.8
Depth(m)	15.5	19.6	24.1	21.4	23.6	
Draft(m)	10.5	11.5	13.2	13.5	12.5	14.0
GT	16,240	37,799	53,050	53,800	61,900	81,488
Stacking Hight						
(In hold)	(6)	(7~9)	(8)	(8)	(8)	(9)
(On deck)	(2)	(2~3)	(3)	(5)	(4)	(6)
Lows						
(In hold)	7	9	10	11	12	14
(On deck)	9	12	13	13	16	17
Main Engine(PS)	27,800	69,600	53,600	49,640		74,640
Speed(Kn)	22.6	26.0	19.5	24.5	24.0	22.5
Shipping Company	NYK	MOL	SAFMARINE	HAPAG-LLOYD	APL.C-10	MAERSK
(Completion year)	1968	1973	1979	1991	1992	1996
Ship Name	HAKOME-MARU	NEW JOURNEY	WATER PALK	REBAKSEN EXPRESS	PRESIDENT	

Source: Japan Maritime Research Institute The Bulletin, No.360

FIGURE 3.5.10 Frequency of Feeder Vessel by Capacity(TEU)



Note: Frequency= Σ (Calling Frequency per month in each line)

However, according to the results of 3.5.3 (3), it is possible to be a mother port from the viewpoint of deviation from the main route.

The Damietta port is assumed as a container hub port, nearest to the new port in the Sea of Marmara, because the Damietta port has been building up its status as a hub port in the east Mediterranean. The round-trip distance from Damietta is about 1,500 nautical miles. If port charge, transshipment handling charge and main ship size would be 0.4\$, 50\$ and 3,000TEU respectively, feeder ship with capacity of less than 680TEU is economical.

As total container volume will be 860,000TEU in 2015, if 5 shipping companies operate container vessels weekly, one lot of container cargo loaded for one ship will be about 1,700TEU. Therefore, it has a possibility to become a mother port from the viewpoint of operation cost.

On the other hand, since container vessel size is increasing more and more, shipping companies carefully select hub ports under intensive price competition at present.

In conclusion, if the new port offer superior port service, the new port could probably be a container mother port.

3.6 Site Selection for New Port or Facilities

According to the comments in the steering committee on 7th of October, 1996, the study team implemented site observations again by boat and car during the second survey in Turkey, and interview related persons about the sites. The results of site selection are shown in Table 3.6.1 and Table 3.6.2.

3.6.1 North Coast of the Sea of Marmara

Two sites in Thrace region are shown in Figure 3.6.1, namely Tekirdag Port (Figure 3.6.2), Military Owned Coastal Area(Figure 3.6.3). A geographical outline of the two sites is given as follows;

(1) Tekirdag Port

To handle excess of public cargo which originates to/from the Thrace region, in the existing Tekirdag Port, it is necessary to expand port facilities. They have an extension plan. A part of the water area is already occupied by existing piers. Investment cost for new port facilities in existing Tekirdag could be slightly minimized by making use of existing facilities, compared with new port construction. State highway runs behind the port. The port is surrounded by a town area and also is put between recreation area and military area.

(2) Military Owned Coastal Area

Long coastal line and land along the coast of the military owned area has been kept undeveloped. Few houses are located behind and on the western side of the land. On the eastern side of the land, second houses stand in a row along the coast. The state road runs behind the land, parallel with the coastal line.

(3) Recommended Site

Two proposed sites have been examined from various points of view in Table 3.6.1.

First of all, without new port construction in Thrace region or extension of

Tekirdag port, there would be serious traffic congestion on the bridges across the Bosphorous by tracks transporting cargo to Hyadarpasa port, Derince port or private ports in the Izmit Bay.

Generally, keeping economical effect of accumulated industrial infrastructure in city of Istanbul and Kocaeli region, the decentralization of industrial infrastructure to the outskirts of the Sea of Marmara should be accelerated to remove the negative effects of centralization.

According to the result in Table 3.6.1, Tekirdag Port is inferior to Military Owned Coastal Area in terms of space for a new port, room for future extension, environmental affect and removal for access road.

Therefore, Military Owned Coastal Area is superior as a site for the new port in the Thrace region. It is important to secure room for port expansion after 2015 in Military Owned Coastal Area and it would be possible to appoint adjacent land for "development control area".

3.6.2 South Coast of the Sea of Marmara

Six sites in Izmit region are shown in Figure 3.6.1, namely Derince Port(Figure 3.6.4), Balik Gölu(Figure 3.6.5), Çayirova(Figure 3.6.6), Seymen(Figure 3.6.7), Kursunlu(Figure 3.6.8) and Kocacay Delta(Figure 3.6.9). A geographical outline of the six sites is given as follows;

(1) Derince Port

The construction of a new container terminal is planned and a feasibility study has been implemented by DLH and Istanbul Technical University. If this project were combined with the new port project, investment cost for the container facility of the new port could be minimized.
This site is very near to the state road and motorway between Istanbul and Ankara.

(2) Balik Gölu

Balik Gölu is located on the northern foot of the Tuz cape near Tuzla. There are some marshy patches between the Aydinli port and the cape, lying at the depth of a small bay. This area is about 1.5km far from the state road.

(3) Çayirova

This area recommended by TCDD is located on the northern coast of Izmit Bay and lying on the seaside of half-round inlet at the south of Tuzula. The area is 2km from the state road and 1.5km from the railway. The coastline strip is only 1.3km in length which is between Turkish Automobile Industry and Glass Factory in the middle of which there lies a creek. Most of the land is owned by the Automobile Industry .

(4) Seymen

Seymen is located around the dead end of the Izmit Bay. It is approximately 70km from the mouth to the depth of the Bay. It is said that the ground around here is soft. Only marshy areas are left as it is. Many private companies are submitting applications to the Ministry of Public Works and Settlement to construct a port in this area. The area is very accessible to the state road and motorway.

(5) Kursunlu

Kursunlu, which is 14km from Gemlik and 35km from Bursa, is situated on the south-eastern coast of the Gemlik Bay. The site is on marshy and wetland and its coast is sand beach, approximately 1km in length. According to the bathymetric data in the DLH Report, sea bottom in front of Kursunlu is very steep with the slope of one tenth. The ground of site is soft and its firm bottom is very deep at more than -27m. At the southern edge of site, mountain is at hand and at the opposite end, there is a village.

(6) Kocacay Delta

The Kocacay Delta, located at the mouth of the Kocacay river between the Bandirma Port and the Mudanya Port, has an area of 1,200 hectares and is 0 - 2 m above sea level. The delta which is located on the migration route over Thrace and the straits is of importance for birds and is a famous wetland in Turkey.
The Imrali island is on the north of the delta.

(7) **Recommended Site**

Six proposed sites have been examined from various points of view in Table 3.6.2.

Since Derince Port, Balik Gölu, Çayirova and Seymen do not have sufficient space in land area or enough stretch for a new container terminal, it is indispensable to reclaim land for the terminal. And as Derince port and Seymen are lying on soft grounds, the reclamation cost in these area including soil improvement would be high.

The road to Kursunlu from state road is 14km long and very narrow. In case of construction of container terminal in Kursunlu, the road through olive tree field should be widened on a large scale. Since the seabed in Kursunlu is very steep, breakwater is unable to be constructed offshore and huge volume of dredging into land is necessary to secure a basin. It also seems to be necessary to implement soil improvement for container yards.

Poor transportation infrastructure, such as no state road and railway, is a weak point of the Kocacay Delta. In addition, very precious plants are found here and birds of passage take a rest around the Delta. Construction of a new port may change the ecosystem around the Delta.

Since the areas of Balik Bölu and Kocacay Delta belong to nationally protected areas, it is impossible to develop a container terminal in these areas as discussed in the steering committee on 7th of October, 1996.

The state road along the southern coast of the Izmit Bay is rather congested with traffic from/to Bursa. In case of container terminal in Seymen, congestion on the road will be spurred on by traffic generated from the container terminal.

To construct an access road to the new Balik Gölu terminal, Çayirova terminal, Derince new terminal, removal or expropriation for road construction will be unavoidable.

Construction of a new container terminal in Derince site would have lesser impacts to the sea water environment than reclamation work in Seymen. And since private factories of heavy - chemical industry have accumulated around the coast of the Izmit Bay, speaking ideally, additional environmental load by new terminal construction to water environment would not be desirable.

According to the result in Table 3.6.2, Derince Port site is superior .to the other five sites totally and from viewpoints of access, congestion on access road and environment. Therefore, Derince Port is superior as a site for the new container terminal or new container port in Izmit region.

TABLE 3.6.1 Evaluation of Two Proposed Sites for New Port in Thrace Region

	Tekirdag Port	*Military Owned Coastal Area*
Land Space for new port	× *Town Area, None*	△ *Grass land, 100m ×3km*
Future Extension Room		
1.Land	×*(None)*	△*(Narrow)*
2.Sea	△*(Reclamation)*	O*(Wide, Reclamation)*
Natural Condition		
1.Water Depth	△*(not gradually shoaling beach)*	△*(not gradually shoaling beach)*
2. Wave	△*(inland sea, open coast)*	△*(inland sea, open coast)*
3. Littoral Drift	△	△
4. Ground	O*(not soft ground)*	O*(not soft ground)*
Environment		
1.Water	△*(Reclamation)*	△*(Reclamation)*
2.Air	△*(Town)*	O
3.Ecosystem	△	△
4.Noise	△*(Town)*	O
Access		
1.Road	△*(State Rd.)*	△*(State Rd.)*
2.Railway	×*(New line)*	×*(New line)*
3.Distance to main city	△*(Istanbul)*	△*(Istanbul)*
Congestion on the Bosphorus	O*(Solved)*	O*(Solved)*
Construction Cost	△*Reclamation*	△*Reclamation*
Removal	△*(Access road)*	O
Total Evaluation	△	O

Note: " —"means lack of information, .◎: most suitable, O: suitable, △: half-and-half, ×: unsuitable

TABLE 3.6.2 Evaluation of Six Proposed Sites for New Container Terminal in Izmit Region

	Derince Port	*Balik Golu*	*Çayirova*	*Seymen*	*Kursunlu*	*Kocacay Delta*
Land Space for New Container Terminal	*Port Area* △ *Little* *(Reclamation)*	*Marshy place* △ *Little* *(Reclamation)*	*Grass land* △ *Some* *(Reclamation)*	*Marshy place* △ *Some* *(Reclamation)*	*Marshy place* ○ *Enough*	*Delta* ○ *Unlimited*
Future Extension Room ***1.Land*** ***2.Sea***	×*None* △ *Reclamation (deep)*	△*Limited (Pond)* △ *Reclamation (Inlet)*	×*None* △ *Reclamation (Inlet)*	×*None* ○ *Reclamation*	△*Limited* × *(deep ,steep)*	○*Easy Extension* △ *Reclamation (open sea)*
Natural Condition ***1.Water Depth*** ***2. Wave*** ***3. Drift*** ***4. Ground***	○Acceptable ○*Small* ○ ×*Very Soft*	○Acceptable △ △ △	○Acceptable △ △ △	○Acceptable ○*Small* ○*None* ×*Very Soft*	×*Very Deep* △ △ △	△ △ × —
Environment ***1.Water*** ***2.Air*** ***3.Ecosystem*** ***4.Protected area***	△*Reclamation* △Industrial area △ ○	△*Reclamation* △Industrial area △ ×	△*Reclamation* △Industrial area △ —	×depth of bay △ △ ○	○ ○ △ ○	○ ○ × ×
Access ***1.Road*** ***2.Railway*** ***3.Distance to main city***	○*(Motorway)* ○ ○*(Izmit)*	○*(Motorway)* ○ ○*(Izmit)*	○*(Motorway)* ○ ○*(Izmit)*	△*(State Rd)* △*(New line)* ○*(Izmit)*	×*(Widen)* ×*(New line)* ○*(Bursa)*	×*(New road)* ×*(New line)* △*(Bursa)*
Congestion on Accuses Rd.	○	○	○	×	△	△
Construction Cost	△*Reclamation* *Soil improve*	○*Reclamation*	○*Reclamation*	△*Reclamation* *Soil improve*	×*Deepsea breakwater Dredging*	○*Dredging*
Removal	△*(Access)*	△*(Access)*	△*(Access)*	○	○	○
F/S Study	○*(Finished)*	×	×	×	△*(pre F.S)*	×
Total Evaluation	○	×	△	△	△	×

Note: " — "means lack of information, .◎: most suitable, ○: suitable, △: half-and-half, ×: unsuitable
New Port does not include Derince New Container Terminal which is on premise.

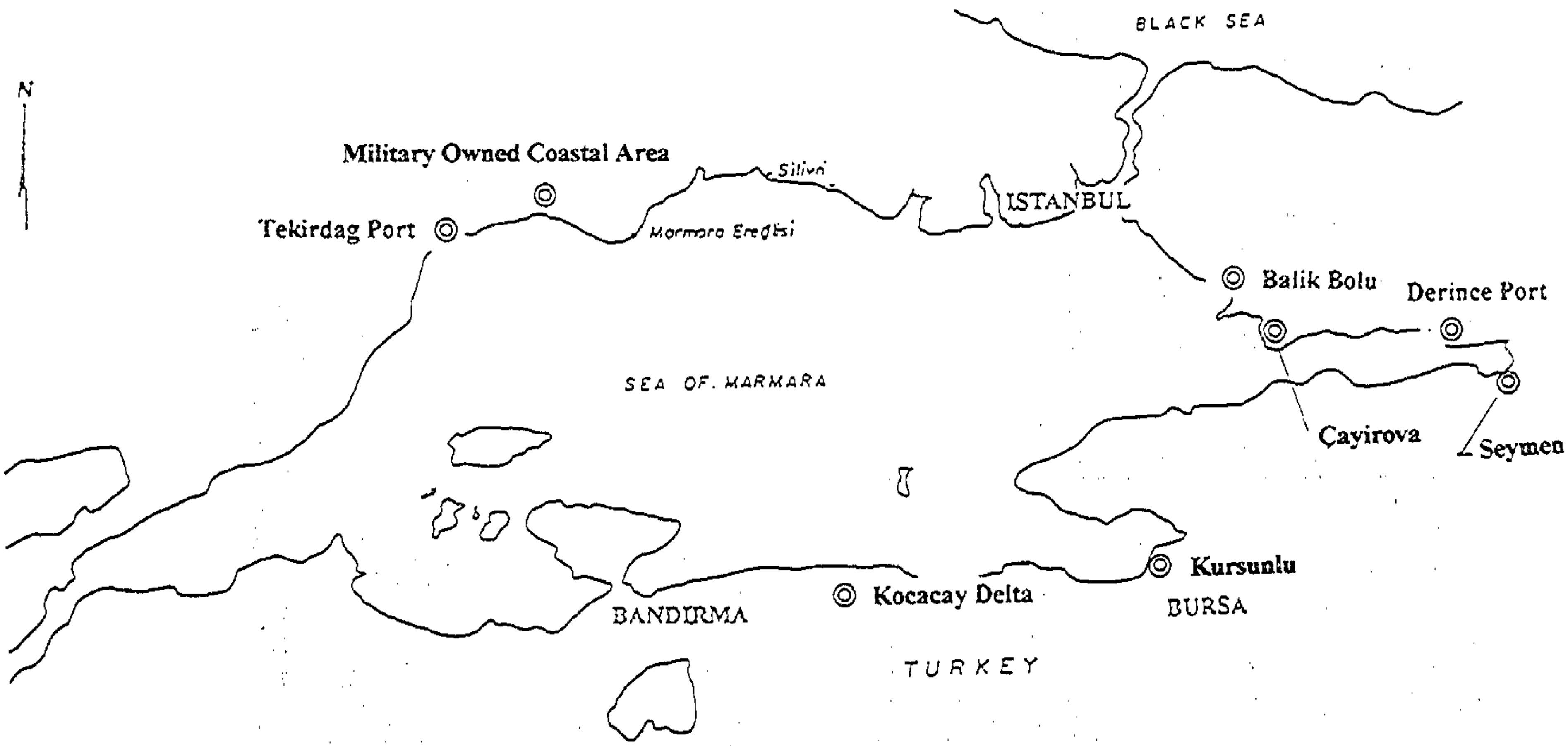


FIGURE 3.6.1 Proposed Sites for New Port or New Port Facilities in the Sea of Marmara

FIGURE 3.6.2 Tekirdag Port

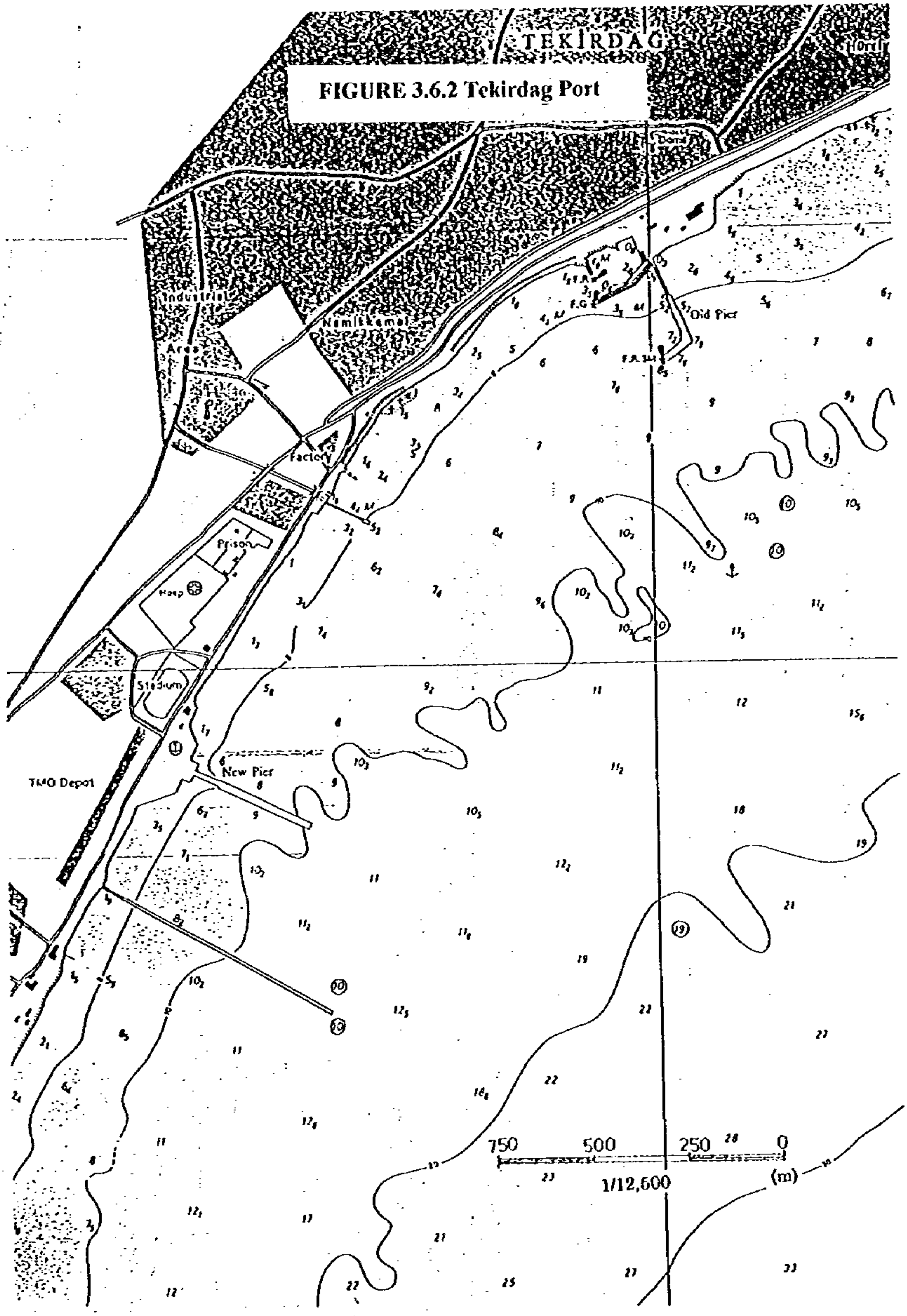


FIGURE 3.6.3 Military Owned Coastal Area

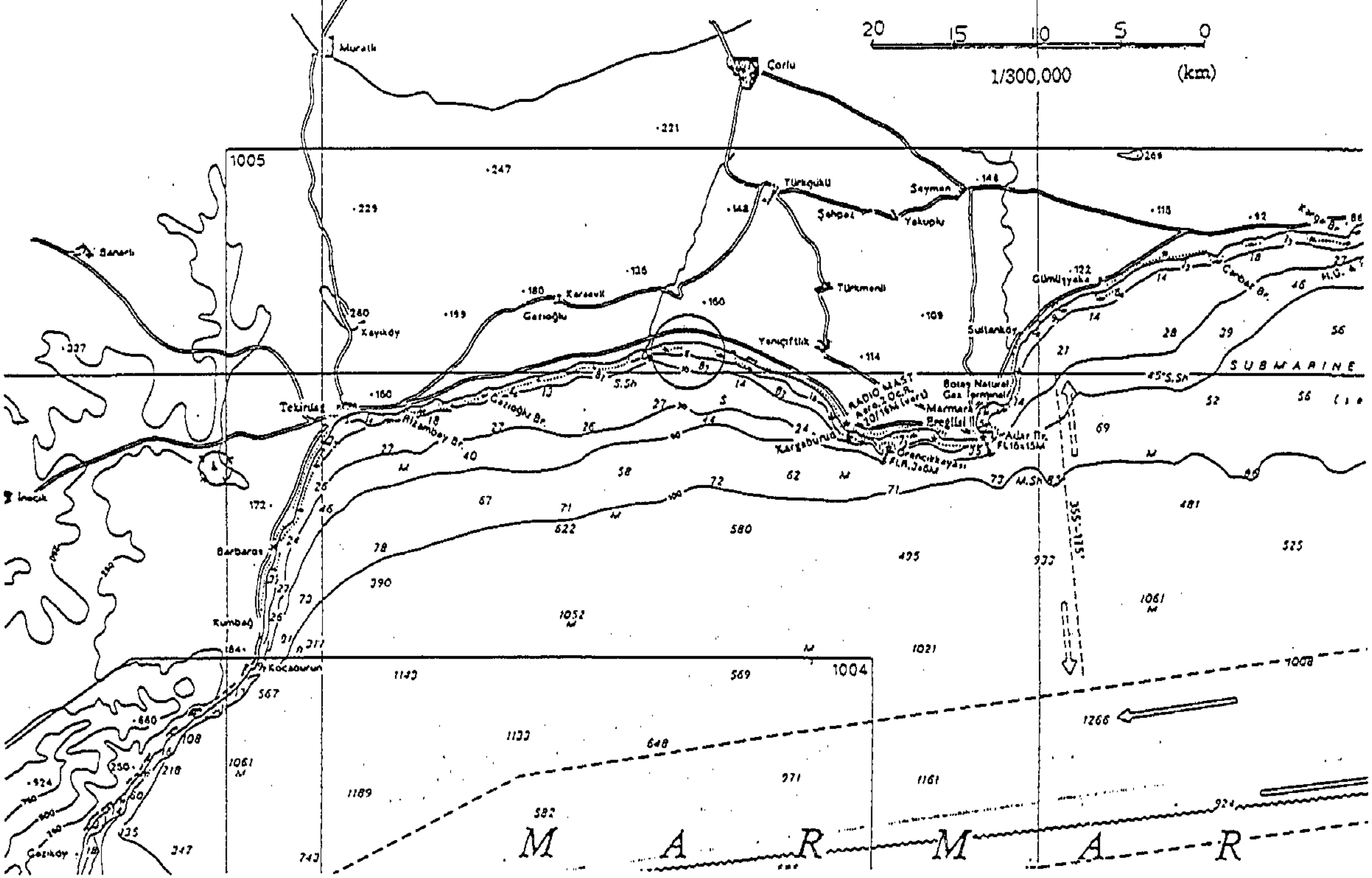


FIGURE 3.6.4 Derince Port

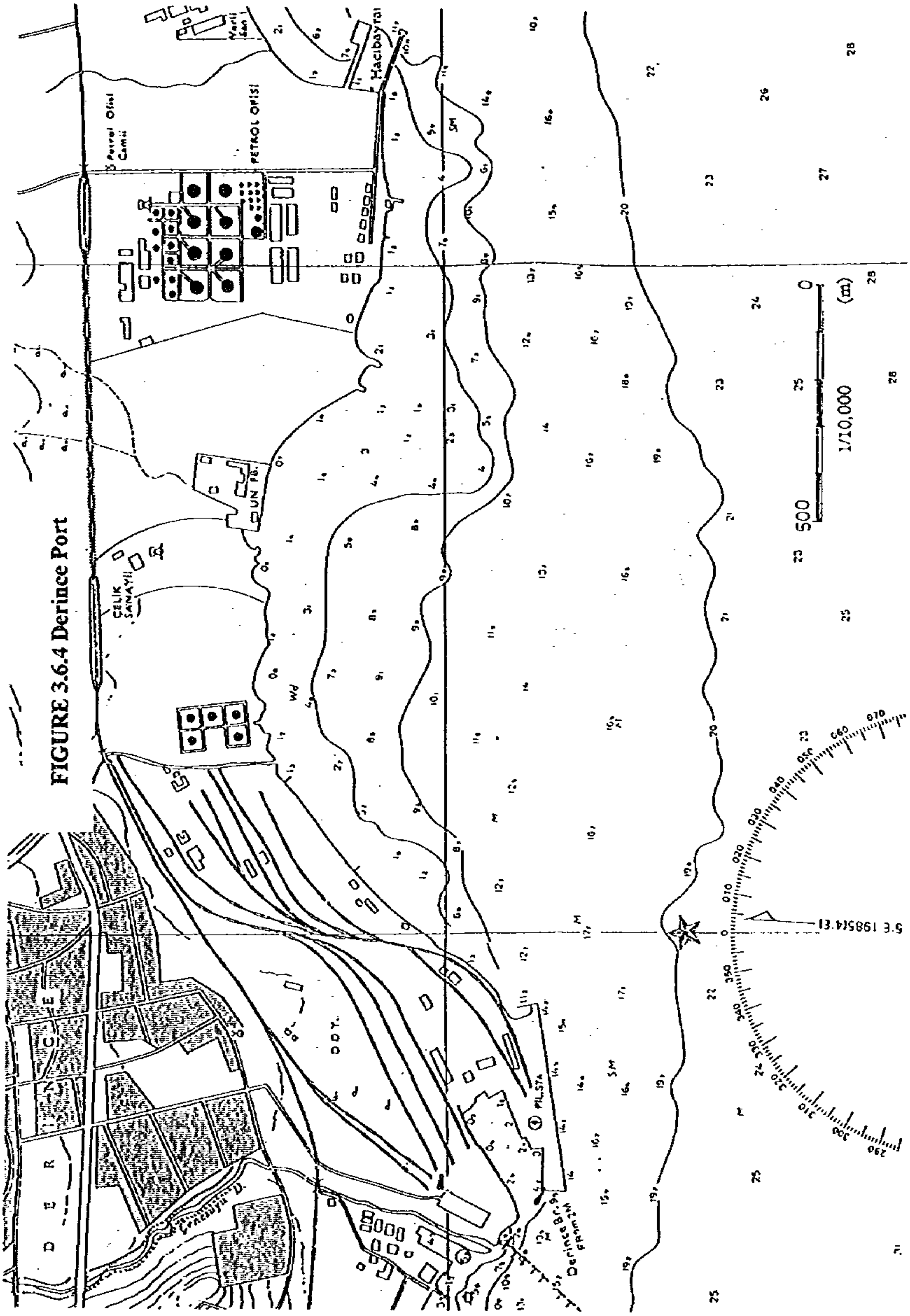
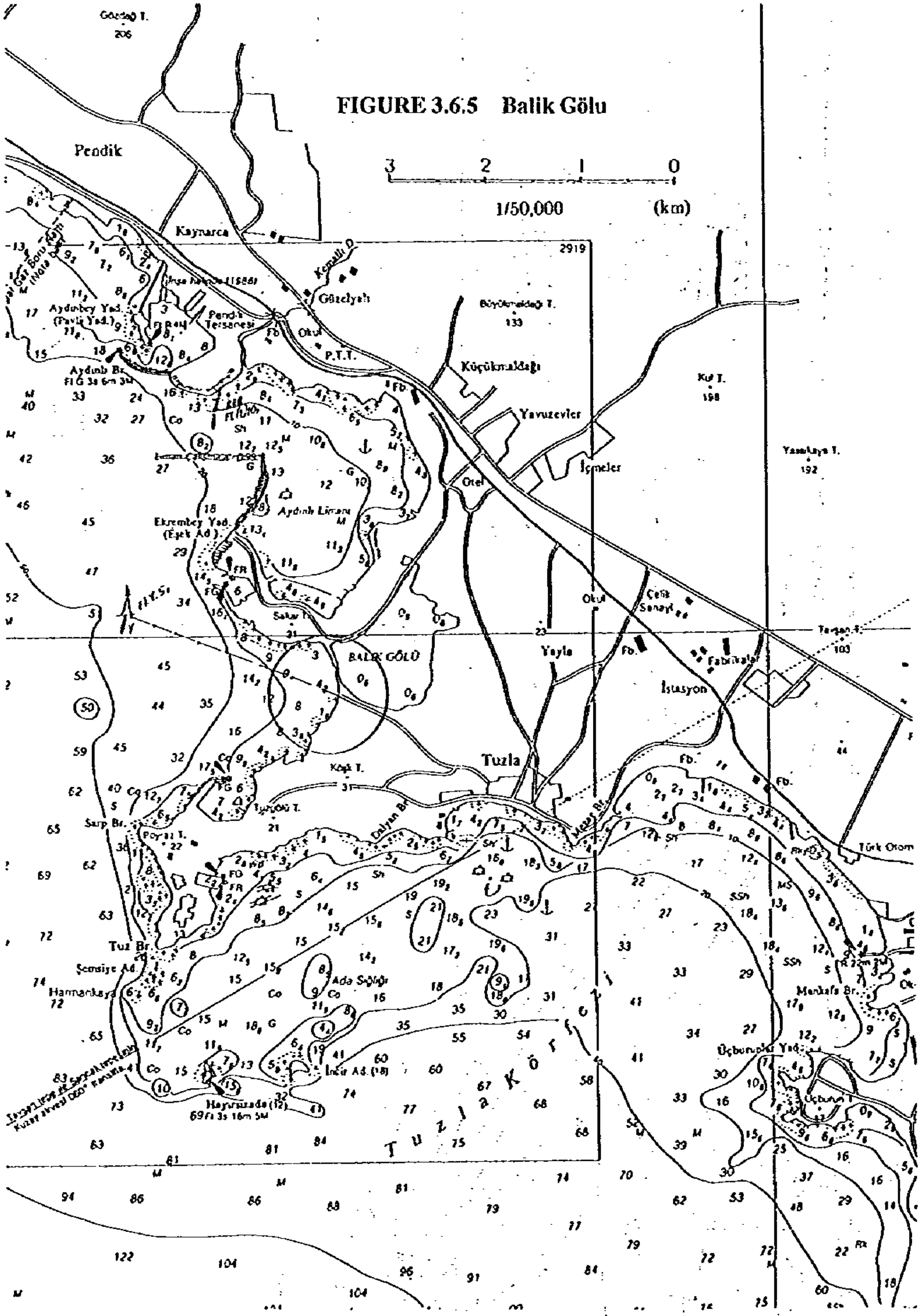


FIGURE 3.6.5 Balik Gölu



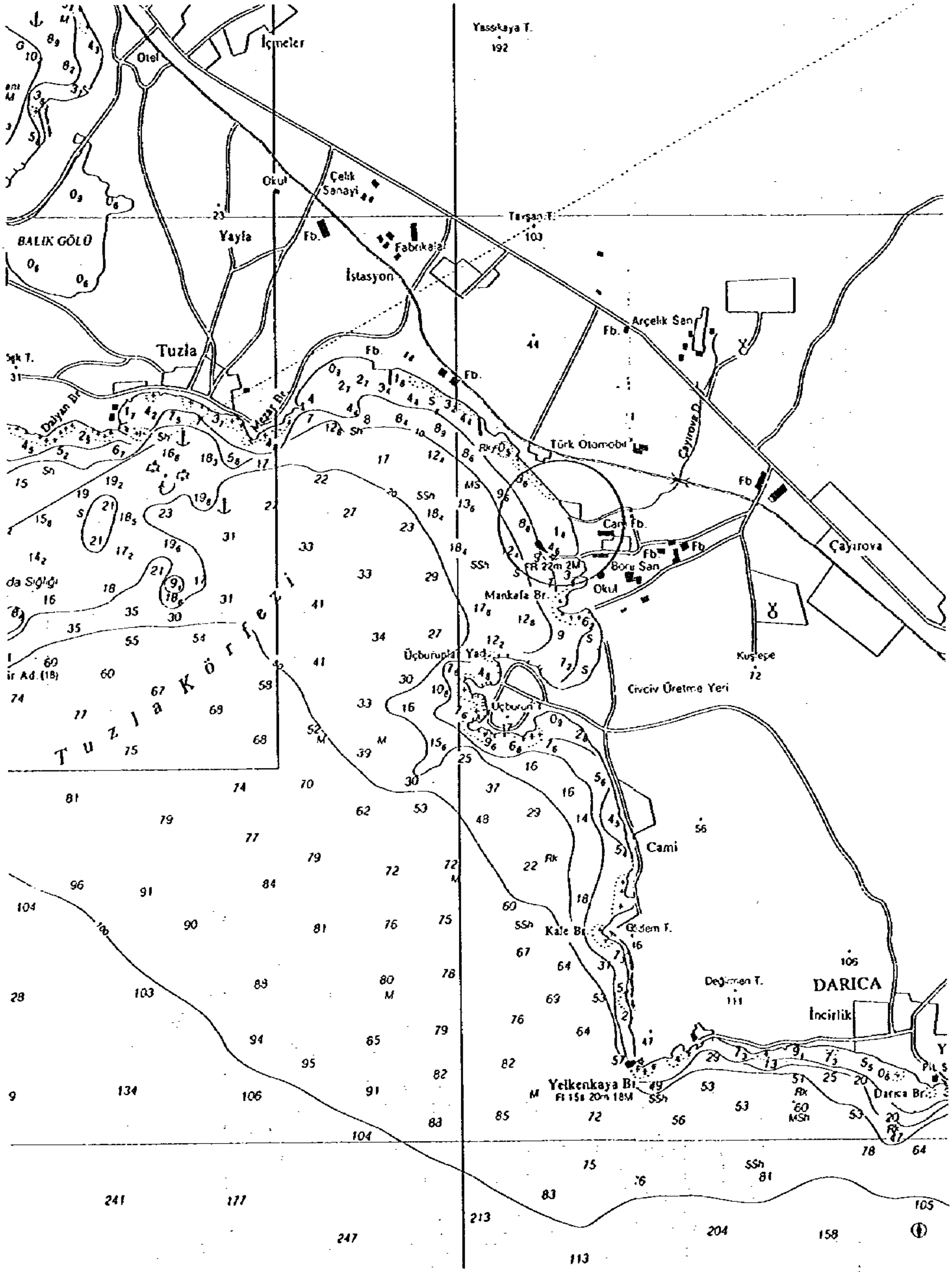


FIGURE 3.6.6 Çayirova

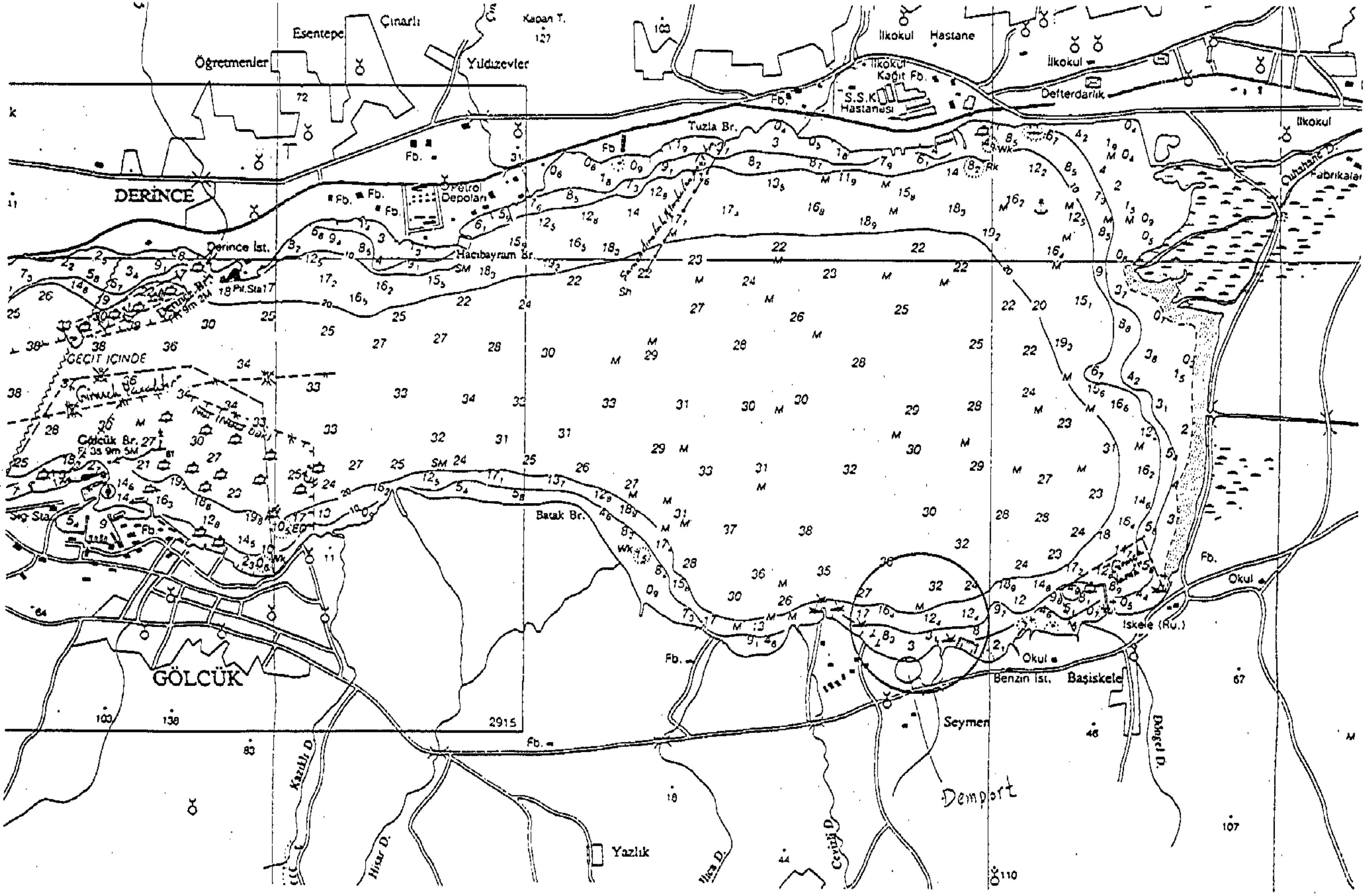


FIGURE 3.6.7 Seymen

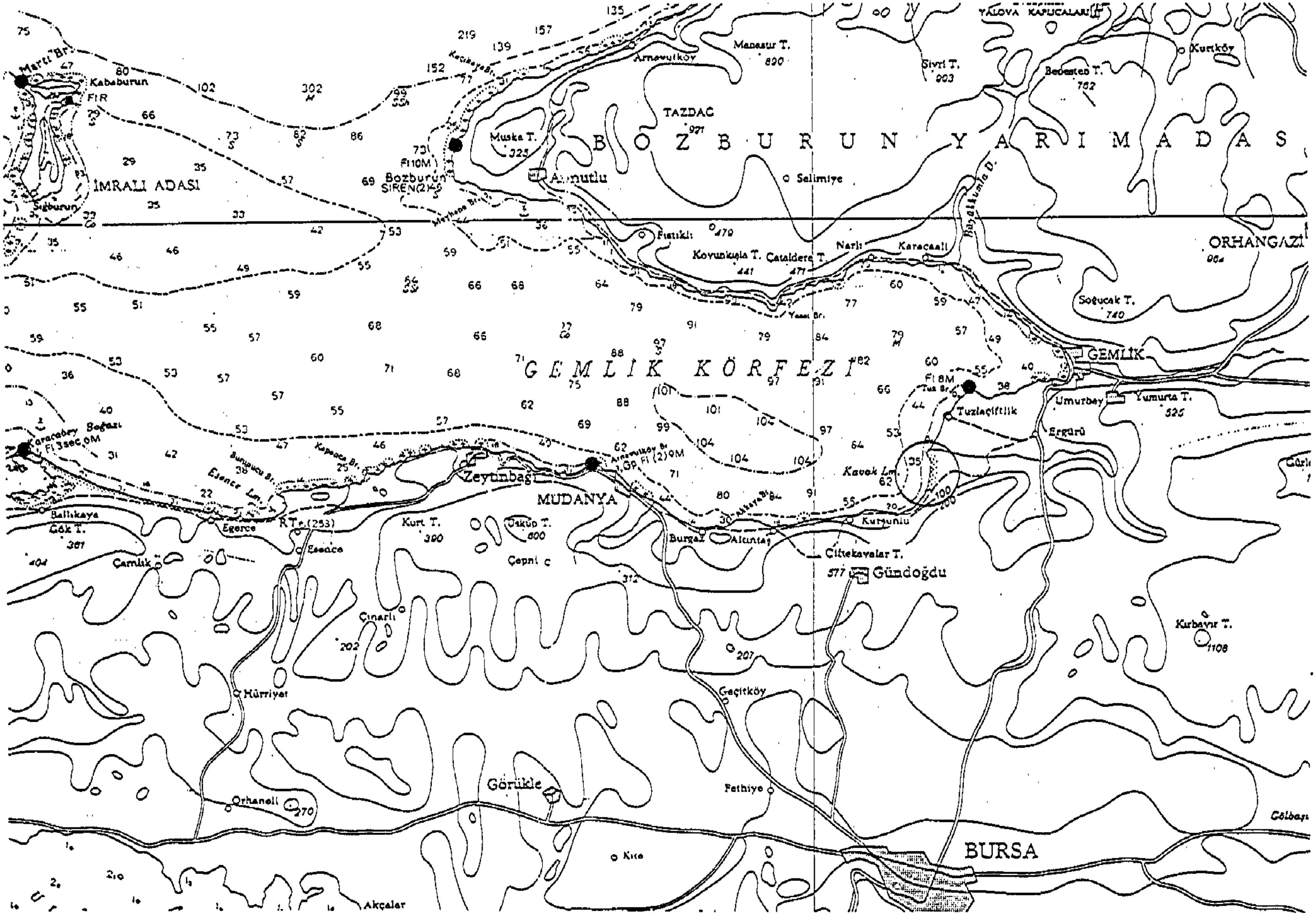


FIGURE 3.6.8 Kursunlu

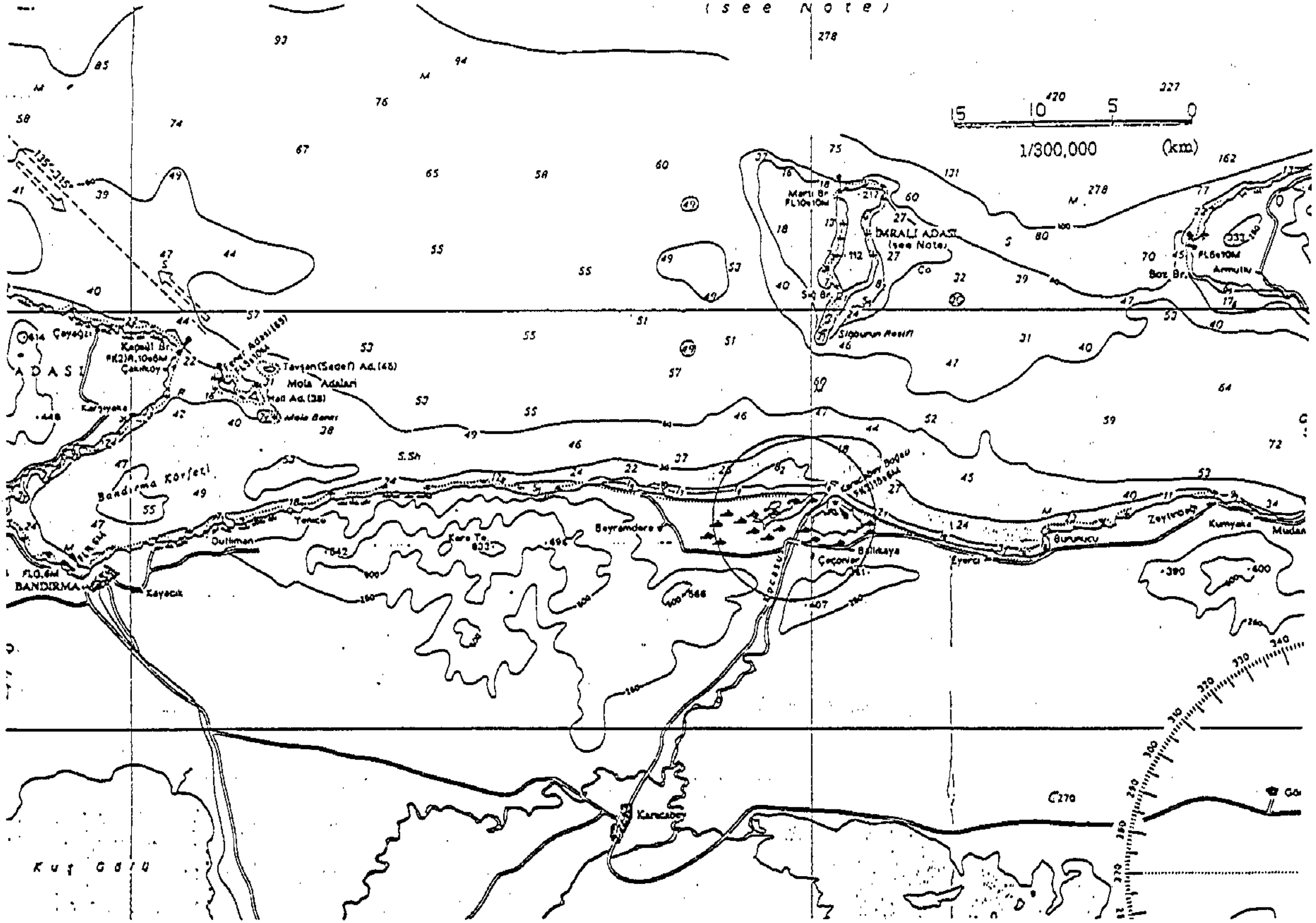


FIGURE 3.6.9 Kocacay Delta

3.7 Long Term Marmara Ports Development Plan

3.7.1 Principle for Formulating Long Term Ports Development Plan

After examining the present situation of coastal utilization and future demand for coastal zone, the study team identifies the following as principles for formulating the Long Term Ports Development Plan of the Sea of Marmara.

(1) Restructuring of coastal zone around Istanbul and Izmit
(2) Formulation of space for international trade and global exchange
(3) Development of friendly and pleasant waterfront
(4) Creation of vitalized and safe coastal zones that enrich the lives of people
(5) Development of unused coastal land into attractive space of high potential
(6) Enhancement of coastal zone environment for sustainable development

Especially, principle for arrangement of container terminals in the Sea of Marmara is shown in Table 3.7.1.

TABLE 3.7.1 Principle for Container Terminal Arrangement

Hinterland (Region)	Container Demand in 2015	Principle for Arrangement of Container Terminal
Thrace	688,000TEU	-Construction of a new container port -Practical use of an existing private port
Izmit	1,342,000TEU	-Improvement of Haydarpasa port -Practical use of existing and under-construction private ports -Construction of Derince new container terminal
Balkesir	127,000TEU	-Improvement at the depth of Bandirma port
Canakkale	20,000TEU	-Use of new pier of Canakkale port

3.7.2 Conceptual Zoning Plan for Development of the Sea of Marmara

By considering the natural condition and utilization of coastal area in the Sea of Marmara, the Marmara coastal area can be divided into 9 zones. The conceptual zoning plan for development of the Sea of Marmara based on above principles is shown in Table 3.7.2.

TABLE 3.7.2 Utilization of Coastal Zone (Conceptual Zoning Plan)

Zone	Present Utilization	Future Utilization
1.Istanbul, Bosphorus	-Urban, commercial, residential and recreation areas -Densely developed area -Commercial & recreation ports	to restructure as urban space to restrain industrial development to concentrate port facilities toward clean cargo & passenger to preserve environment strictly
2.Izmit Bay	-Industrial(heavy, chemical) area -Industrial & commercial ports -Residential area -Resort/Cliff(south)	to restrain industrial development to preserve environment strictly to limit development of general cargo facilities
3.Gemlik Bay	-Ports(around depth) -Residential & resort area(dotted) -Cliff	to control coastal development to make existing facilities efficient to prevent environmental deterioration
4.Mudanya ~ Bandirma	-Un-utilized area & piers (natural coast & marsh) -Commercial & industrial ports -Residential area	to make sustainable develop at port to preserve environment
5.Kapidag Peninsula	-Resort area(cliff, island) -Ferry ports & piers	to preserve environment to promote tourism
6.Erdek Bay	-Un-utilized area (sandy beach, marsh) -Field area -Local port	to develop access roads & railway to develop port gradually
7.Dardanels	-Residential & resort area(sandy beach & field) -Ferry ports & piers	to develop roads & passenger port
8.Gelibolu ~ Tekirdag	-Un-utilized area (Mountainous) -Piers	to preserve environment
9.Tekirdag ~ Istanbul	-Resort, residential & field area -Commercial & energy ports	to promote tourism to develop resort & port in part

3.7.3 Principle for Each Port Development

Based on the conceptual zoning plan and above principle for container terminal arrangement, principle for each port development is shown in Table 3.7.3. Detailed principle for container terminal development in the Izmit Bay is shown in Table 3.7.4.

TABLE 3.7.3 Principle for Each Port Development

PORT	Principle for Port Development
1.Haydarpasa	-Advanced International Port (Container, Ro/Ro, General cargo, International & Domestic Passenger Terminal) -Restructuring port facilities(Expansion of container yard, Improvement of Passenger Terminal)
2.Derince	-Commercial Port (Container, General & Bulk cargo) -Construction of New container terminal & Enhancement of existing facilities
3.Gemlik	-Commercial Port(Efficient Operation, Gradual improvement of Gemport)
4.Mudanya	-Regional main port & Supplementary port of Gemport -Enhancement of Facilities for Recreation
5.Bandirma	-Commercial Port(Core port for bulk cargo in the south) -Construction of Container Terminal and Bulk Terminal -Development of land transportation network
6.Gelibolu	-Regional main port(Regional cargo & Domestic Passenger)
7.Canakkale	-Commercial Port(Regional cargo & International and Domestic Passenger) -Completion of Sub-port
8.Tekirdag	-Commercial Port(Regional cargo)
9.Ambarli	-Commercial Port(Core port for bulk cargo in the north & General cargo/Container cargo) -Completion of Port
10.Istanbul	-Restructuring Waterfront(International & Domestic Passenger Terminal, Ferry Terminal, Park & Restaurants)

TABLE 3.7.4 Detailed Principle for Container Terminal Development in the Izmit Bay

	~2005	~2015	2015~
Container Demand	633,000TEU/y	1,342,000TEU/y	over 1,342,000TEU/y
Container Handling Capacity of ports (TEU/year)	Hayd 270,000 Dexi 180,000 Dnew 0 Priv 510,000	Hayd 270,000 Dexi 180,000 Dnew 482,000 Priv 510,000	Hayd 270,000 Dexi 180,000 Dnew over 482,000 Priv 510,000
Total Capacity(TEU)	960,000	1,442,000	over 1,442,000
Haydarpasa port	Increase of Gantry Crane Extension of CY		
Existing Derince	Construction & Open of CT		
New Derince CT	Construction Commencement of New CT(Phase I)	Open & Use of New CT(Phase I)	Construction & Open of New CT(Phase II)
Private ports	Use of Sedef Construction & Open of Belde		

Note: Hayd; Haydarpasa port, Dexi; Existing Derince port, Dnew; New Derince container terminal, Priv; Private ports

3.7.4 Priority on Port, Facility to be Developed

According to the annual growth of cargo volume, container cargo volume will increase remarkably. On the other hand, container cargo demand for Marmara region exceeds the capacity of ports in the Sea of Marmara. The most urgent matter is to increase container cargo handling capacity. Therefore, priority should be given to the followings:

(1) Improvement of Haydarpasa container terminal
(2) Construction of new container port in Thrace region
(3) Conversion to container terminal at Bandirma port

3.7.5 Development plans in State Owned Ports

(1) Haydarpasa Port

Main cargo of Haydarpasa port is container cargo. However, there is no room for expansion of the container storage area, because the port area is restricted by the breakwater, ship turning basin near the berths and urban area.

Haydarpasa port shall be developed in accordance with the following plan.

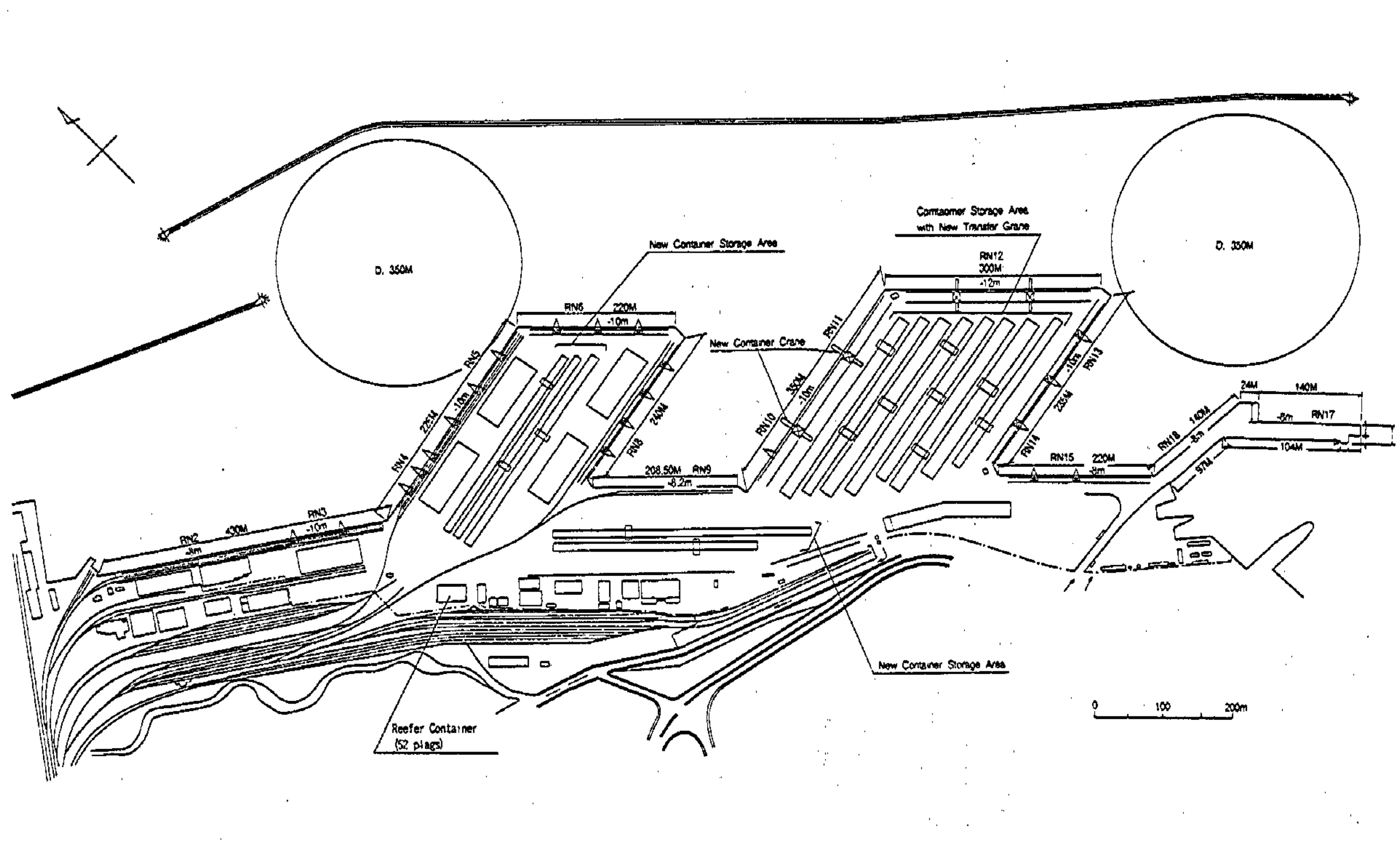
1) Haydarpasa port shall be developed to handle container cargo and RO/RO cargo mainly. General cargo and dry bulk cargo shall be handled at No. 2 to No. 5 berth and the cargo volume shall be limited.

2) Container storage area shall be expanded to the extent possible. New container handling equipment shall be introduced to handle the container efficiently.

Existing container storage area will be re-arranged to allow use of new type transfer crane and new container storage area will be constructed at the back area of No.9 berth and No.6 berth. Total planned container storage capacity is approximately 11,000 TEUs.

Layout of container storage area of Haydarpasa port after improvement is shown in Figure 3.7.1.

FIGURE 3.7.1 Layout of Haydarpasa Port



(2) Derince Port

Main cargo of the Derince port is dry bulk including grain, RO/RO and liquid bulk. Grain shall be handled at No. 3 & 4 berth and other dry bulk cargo shall be handled at No. 6 to No. 8 berth. RO/RO cargo shall be handled at new RO/RO berth. Existing container cargo handling volume is small, however, it will increase in the near future. Therefore, appropriate container handling facilities shall be provided.

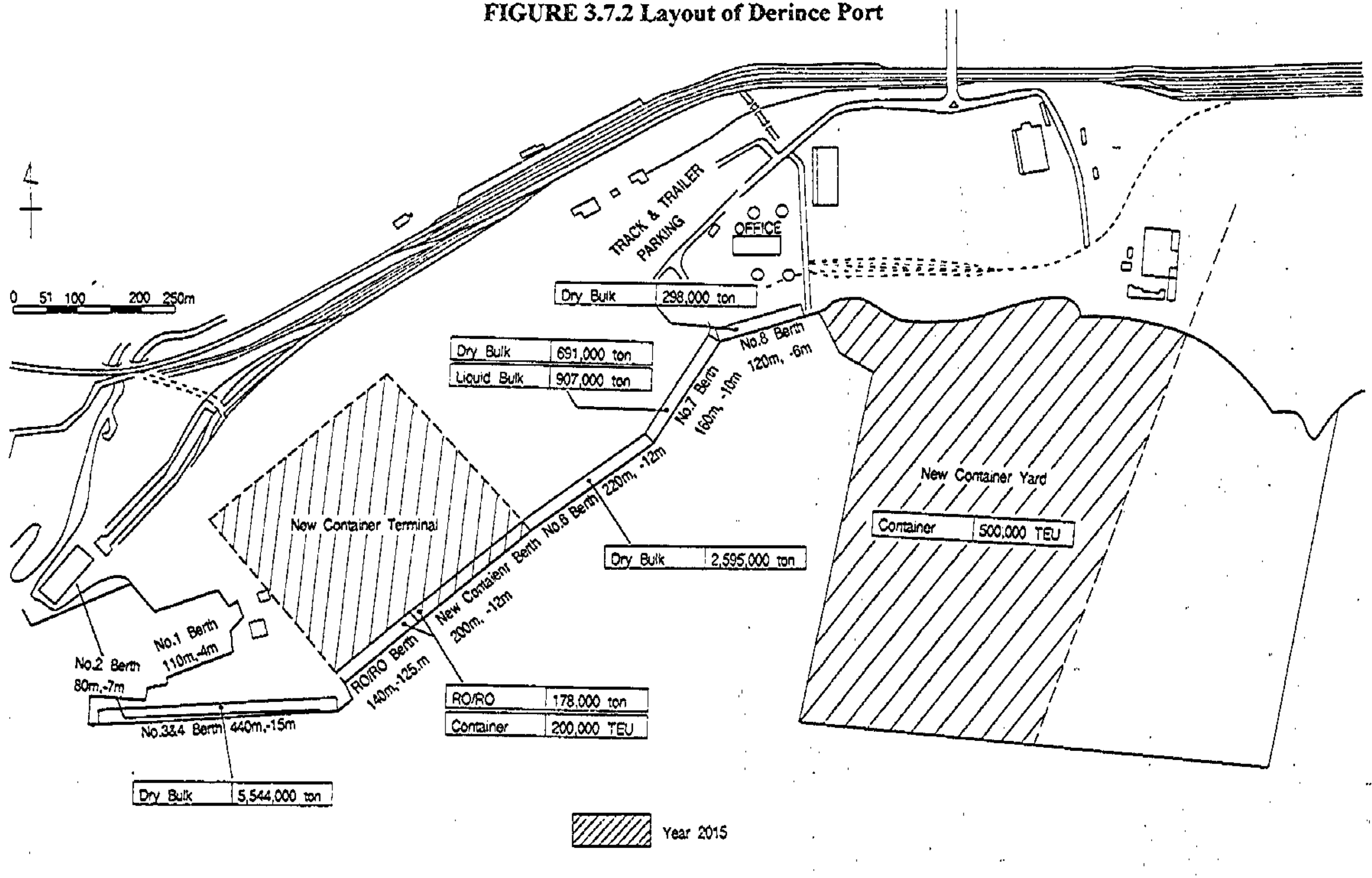
Derince port development plan is as follows;

1) New container berth shall be constructed between new RO/RO berth and No. 6 berth. Back side area of this new container berth shall be prepared as container storage area. Proper container handling equipment shall be provided.

2) New container yard shall be provided in addition to the above mentioned container terminal in the existing port area to handle the further demand in the year 2015..

Layout plan of Derince port development is shown in Figure 3.7.2.

FIGURE 3.7.2 Layout of Derince Port



(3) Bandirma Port

In order to cope with the surging container cargo demand, existing conditions must first be identified as follows.

① at present the port has excess capacity.
② configuration of the port facilities is characterized by narrow wharves, which is considered as old fashioned.
③ the main cargo handled at the port is coal which will decrease in volume in the future because of energy transformation and because coal destined for Ankara will be handled at a different port.
④ coal dust generated by coal handling at the port contaminates the city of Bandirma.
⑤ the sea bed of the area west of the existing port is rather steep. Therefore construction of a break water in this area would likely be very expensive.

Since the port has excess capacity, investing in new facilities should be avoided as much as possible. To construct a breakwater to the west of the existing one is expensive work. On the other hand, in order for the port to play an important role in regional transportation, it is necessary to handle containers. Furthermore it is important to let shipping lines know that the port is ready to handle container. But unfortunately the existing configuration of the port is an old type and not suited to handling containers.

The best solution in meeting the above requirement at the least cost is to reclaim the slip between berth No.2,3and 4,5 and convert it to a more modern shaped multipurpose berth at which the general cargo or other clean bulk cargo as well as container could be handled. According to the demand forecast this multipurpose berth is expected to be able to accommodate container handling demand up to about the year of 2020.

After the year 2005, when the total cargo handling demand at the port starts to exceed the capacity, expansion of the port toward the west should be studied. In this case, it would be carefully investigated which cargo is better to be moved to the new wharf at the west end: container and general cargo or coal. But it is recommended that the dirty cargo like coal must be moved so that the port activity does not have a detrimental effect on urban life by generating coal dust.

The wharf conversion work should be started before the year 2005 as a short term plan when there is sufficient port capacity for construction work. This will reveal the port's intention of the port to handle container. And the extension work toward west, as a long term plan, could be commenced after the year 2005, taking actual performance of the port till the year 2005 into consideration.

Alternative development plans have been discussed among members of DLH, TCDD and the study team. Those plans are summarized according to the location of newly constructed container terminal as follows;

(1)a plan to reclaim the slip between No. 2/3 and 4/5 berths at depth of the port, construct a new container berth and arrange a container-yard at the back of the berth

(2)a plan to convert No.7 berth to a container berth and reclaim the small ship basin as a container-yard

(3)a plan to convert No.7 berth to a container berth and construct container-yard at inland area

General layout of the above three alternatives in the year 2005 and 2015 is shown in Figure 3.7.3~3.7.8. Necessary berth length and storage area for each alternative are shown in Table 3.7.5. Merits and demerits of the three alternatives are shown in Table 3.7.6.

In Bandirma port, the volume of container cargo is predicted to gradually increase. Container cargo is essential for modern ports, therefore, efficient container cargo handling should be given first priority in the future port development plan. Furthermore, from a viewpoint of economical investment port facilities should be used efficiently according to cargo demands for each facility in the target year.
Based on the above viewpoints, Alternative-(1) which is highly evaluated in all aspects is the most advisable.(See Table 3.7.7.)

TABLE 3.6.5 Sufficient rate of facities in Bandirma Port in 1995, 2005 and 2015

Year	1995	2005	2015
Total cargo handling volume(ton)	2,119,297	3,716,000	7,304,000
Container(TEU)		60,000	127,000
Non containerized general cargo(ton)	556,104	230,000	478,000
Dry bulk cargo handled by TMO berth(ton)	15,555	1,500,000	1,500,000
Dry bulk cargo except TMO berth(ton)	1,547,638	1,986,000	5,326,000
(Coal : ton)	211,930	371,600	730,400
Alternative-(1)			
(1)Area for container handling(m2)		78,000	78,000
(2)Area for bulk cargo strage(m2)	80,000	80,000.00	253,000
(3)Required berth length for general & container cargo(m)	556	537.00	1,119
(4)Required berth length for bulk cargo except TMO berth(m)	619	794	2,130
(a)S.R of container handling area		2.41	1.27
(b)S.R of storage area for bulk cargo	2.17	1.69	2.00
(c)S.R of berth length for general & container	1.33	1.12	1.13
(d)S.R of berth length for bulk cargo	1.82	1.26	1.03
Alternative-(2)			
(1)Area for container handling(m2)		63,140	79,180
(2)Area for bulk cargo strage(m2)	80,000	80,000.00	245,600
(3)Required berth length for general & container cargo(m)	556	318	663
(4)Required berth length for bulk cargo except TMO berth(m)	619	794	2,130
(a)S.R of container handling area		1.41	1.00
(b)S.R of storage area for bulk cargo	2.17	1.69	1.94
(c)S.R of berth length for general & container	1.33	2.84	1.21
(d)S.R of berth length for bulk cargo	1.82	1.10	1.09
Alternative-(3)			
(1)Area for container handling(m2)		50,500	81,500
(2)Area for bulk cargo strage(m2)	80,000	80,000	253,000
(3)Required berth length for general & container cargo(m)	556	318	663
(4)Required berth length for bulk cargo except TMO berth(m)	619	794	2,130
(a)S.R of container handling area		1.02	1.04
(b)S.R of storage area for bulk cargo	2.17	1.69	2.00
(c)S.R of berth length for general & container	1.33	2.84	1.21
(d)S.R of berth length for bulk cargo	1.82	1.10	1.09

Note; S.R means sufficient rate of facilities(ex. existing/required)

General cargo handling productivity per meter is 1,000tons.

Bulk cargo handling productivity per meter is 2,500tons.

New bulk cargo berths' handling productivity will be double of 2,500 ton/m at present.

TABLE 3.7.6 Merits and Demerits of the Three Alternatives

Alternative	Merits and Demerits
Alternative -(1)	M Since container-yard is located just behind container berth, handling productivity is high and traffic noise and congestion by trailers will be slight. M Mooring facilities and storage areas are fully used for sorting cargoes in accordance with cargo handling type. Further more, handling clean cargoes such as container near urban area is desirable from an environmental point of view. M Mooring facilities would be efficiently used for cargo type in future. M Existing small ship basin can be used in future. D To arrange a container-yard in the port area, slip has to be reclaimed and existing berths No.2~5 have to be demolished.
Alternative -(2)	M Existing large mooring facilities can be used. D Container handling productivity would be lower, as a result of the distance between container berth and container-yard. D Cargo shifts in the port area are not efficient, because of utilities' mixture by cargo handling type. D In order to construct a container-yard, reclamation at the small ship basin would be necessary.
Alternative -(3)	M Existing facilities can be efficiently used for cargo handling and storage. D Container-yard is located far from container berth, therefore container cargo handling productivity will largely be lowered. D Traffic congestion and noise by trailers between container berth and inland container-yard would be serious.

Note; M; Merits, D; Demerits

TABLE 3.7.7 Evaluation of Alternatives

Item to be evaluated	Alternative-(1)	Alternative-(2)	Alternative-(3)
1.Container handling productivity	○ (1.0)	△ (0.6)	× (less than 0.43)
2.Construction Cost (Newly constructed facilities)	△ CB+CY(Rec.)	△ CY(Rec.)	○ CY
3.Efficient Use of Facilities	○	×	×
4.Traffic Noise & Congestion(C.B.~C.Y.)	○	△	×

Note: 1)Rec. means reclamation. C.B, means container berth. C.Y. means container yard.
2)A figure in parenthesis in item 1 presents the productivity in case that the productivity of alternative-(1) is 1.

Detailed development plan of the port is as follows;

(1)the slip between general cargo berths, No.2, 3 and 4, 5 will be reclaimed and used as container yard.

(2)the revetment at the head of pier will be converted to container berths with depth of 12m.

(3)two multipurpose cranes will be installed at the berth.

(4)instead of the canceled berths, three(3) new bulk cargo berths of 12m depth will be constructed west of the port by reclamation.

(5)the extension of main breakwater at deep water around 25m will be necessary to obtain calmness at the new constructed berths.

(6)the petroleum pier at sub breakwater will be removed to newly reclaimed land.

The general layout of Bandirma port is shown in Figure 3.7.2.

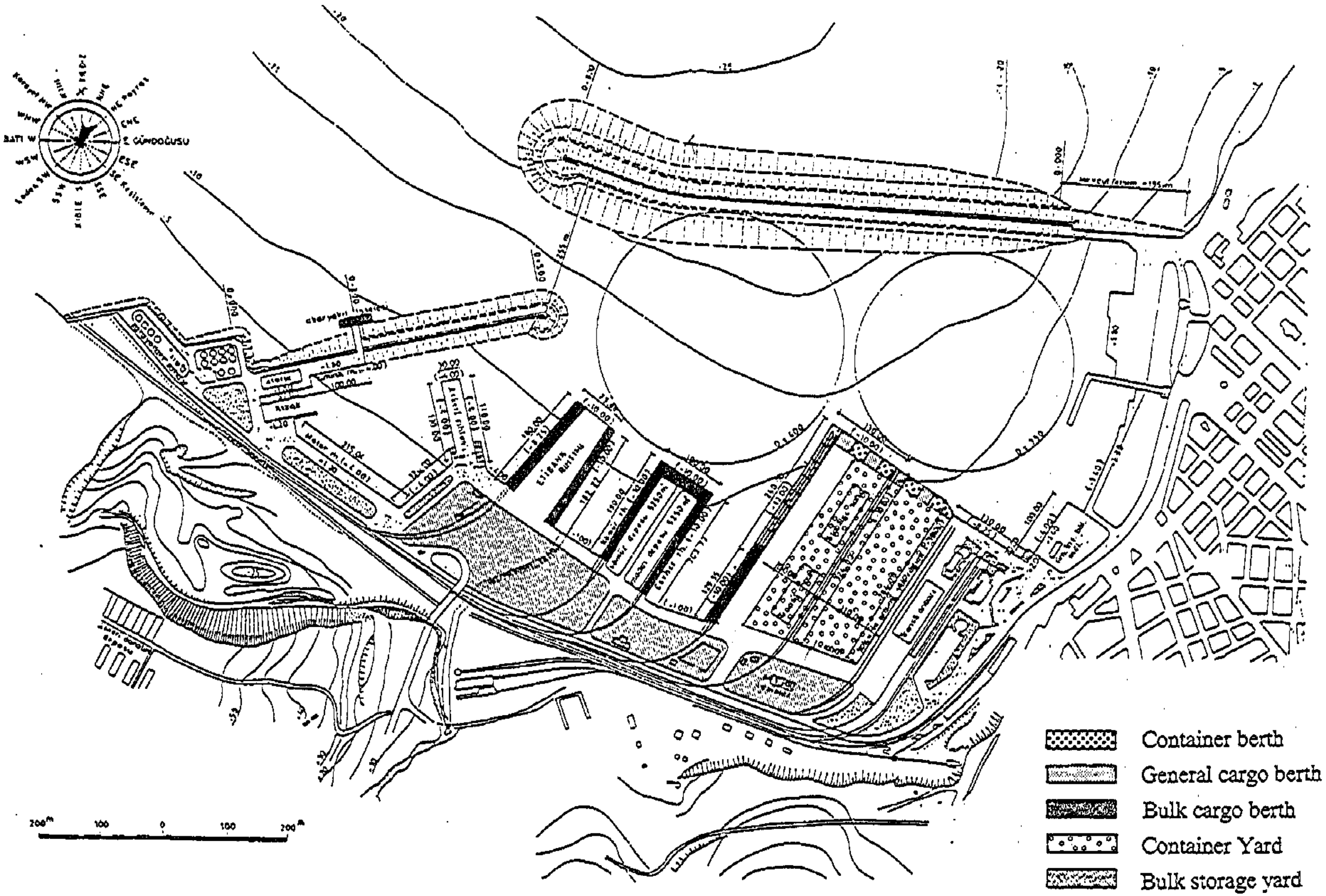


FIGURE 3.7.3 Development Plan of Alternative (1) for 2005

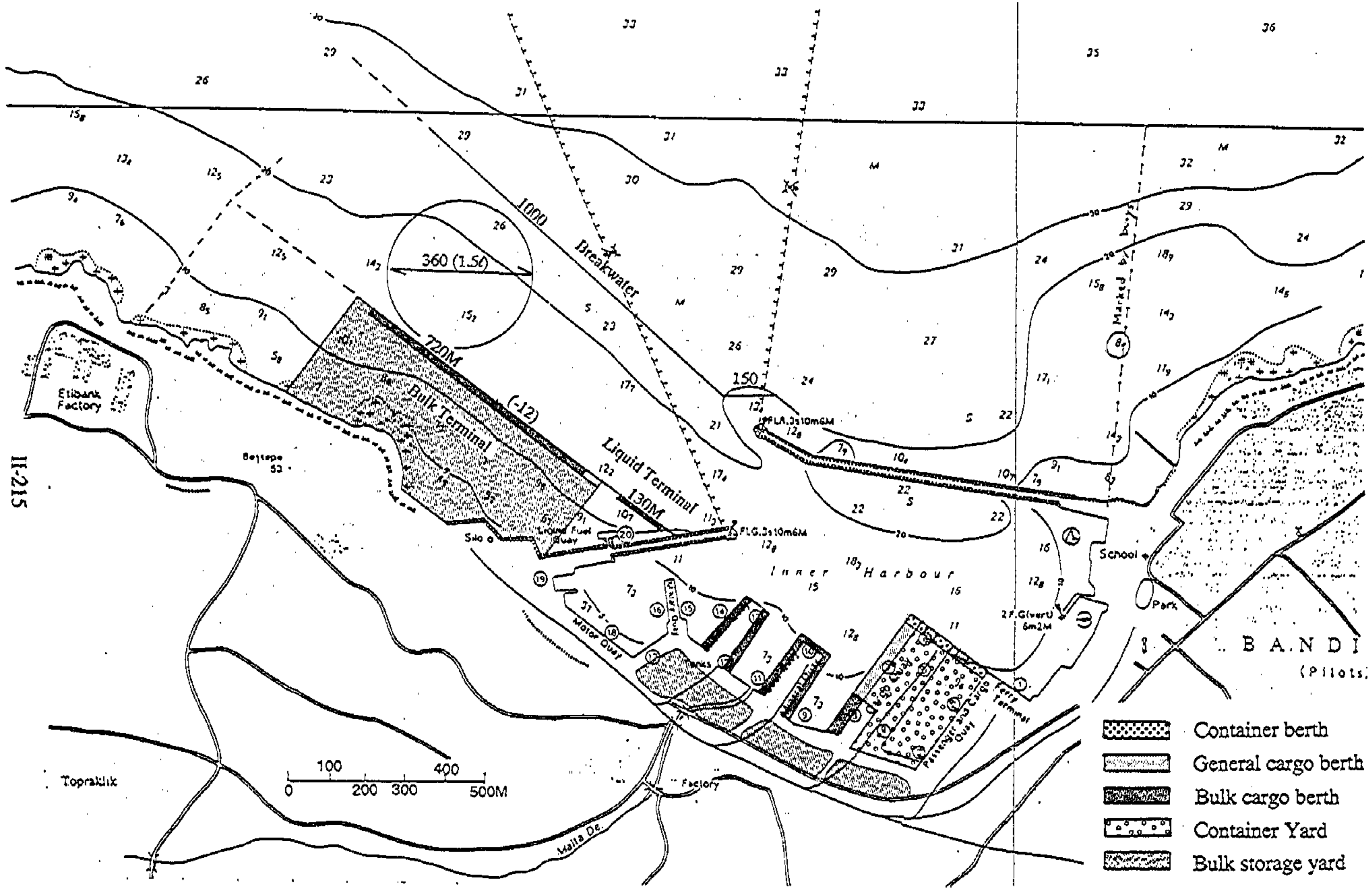


FIGURE 3.7.4 Development Plan of Alternative (1) for 2015

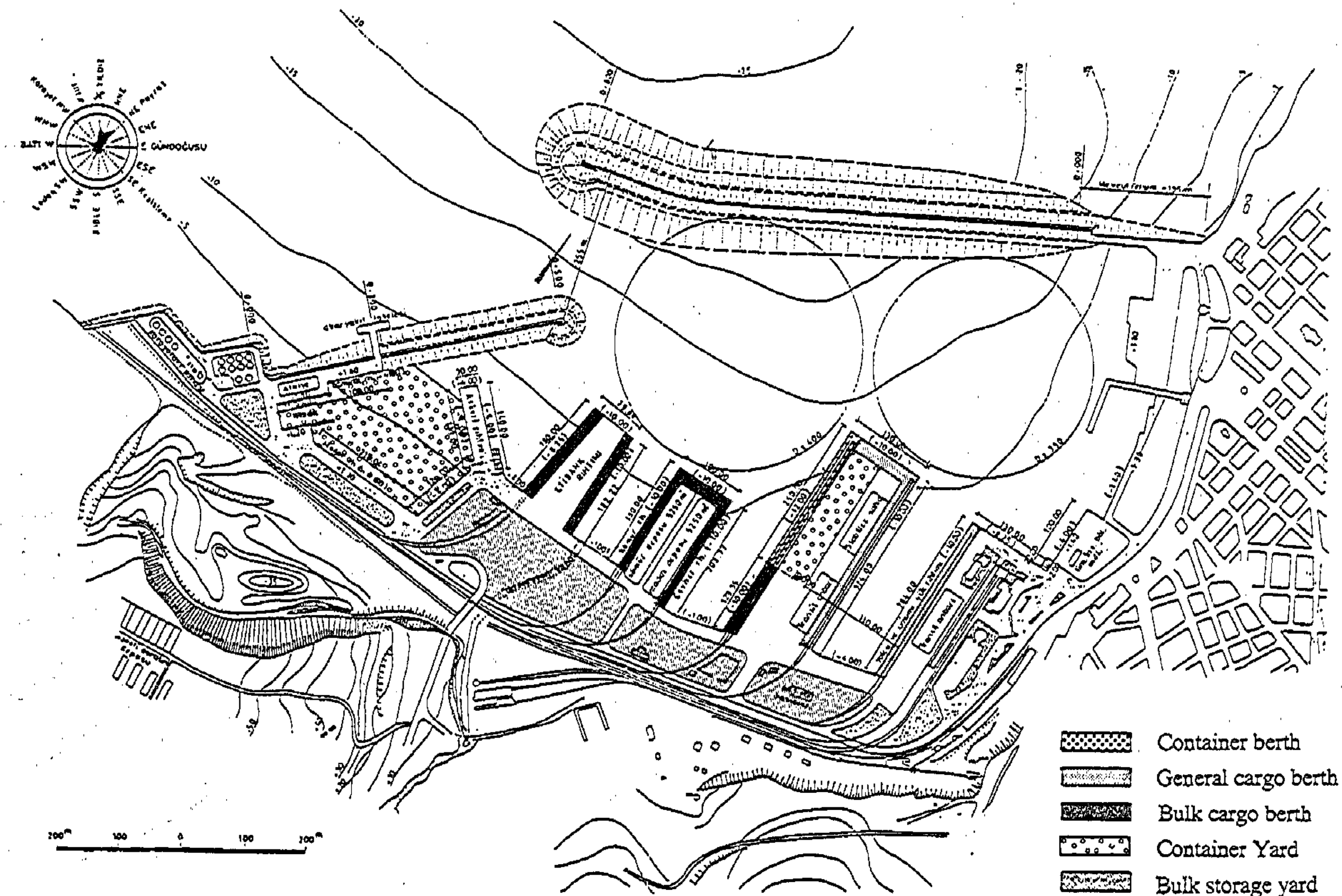


FIGURE 3.7.5 Development Plan of Alternative (2) for 2005

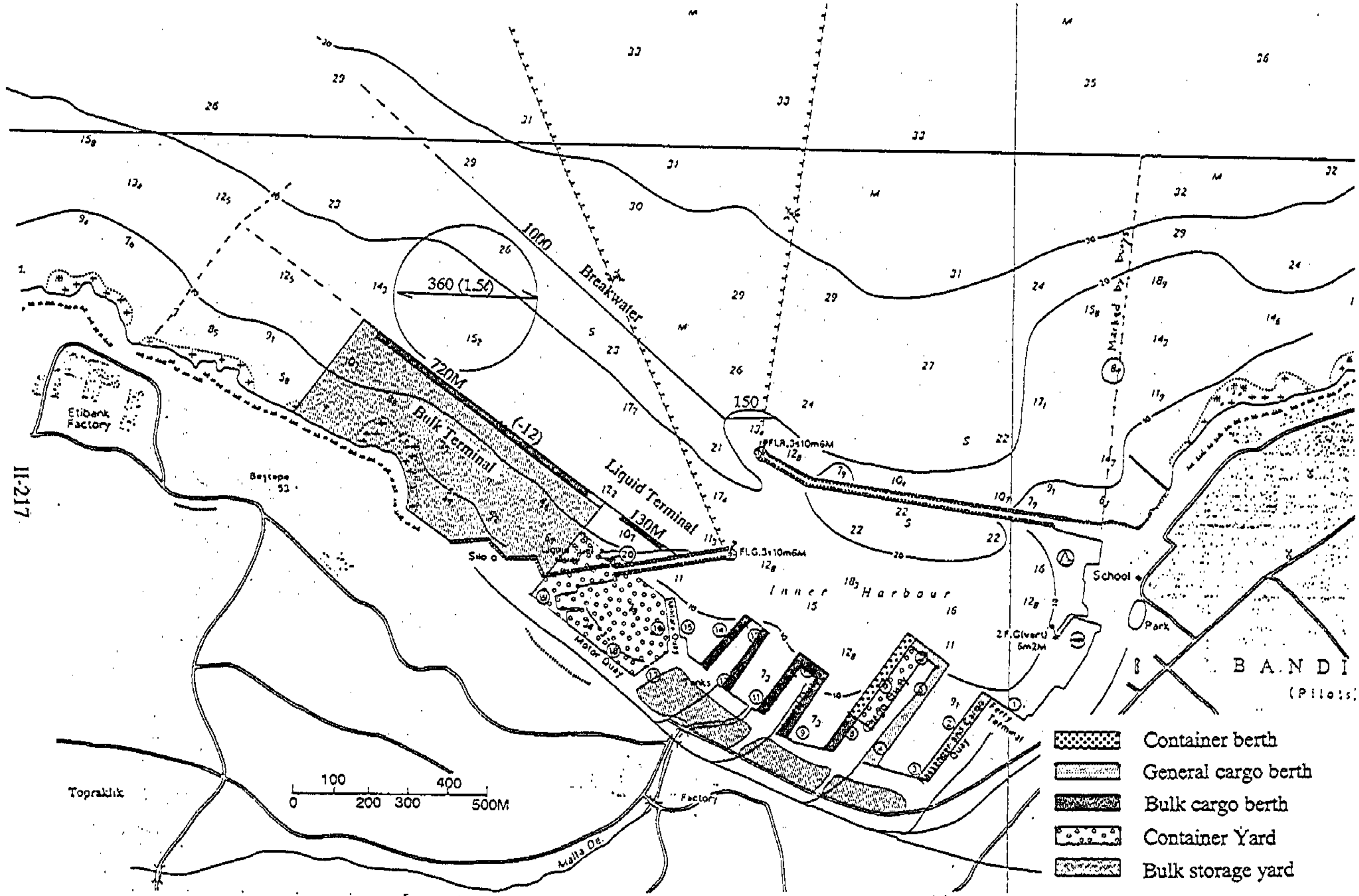


FIGURE 3.7.6 Development Plan of Alternative (2) for 2015

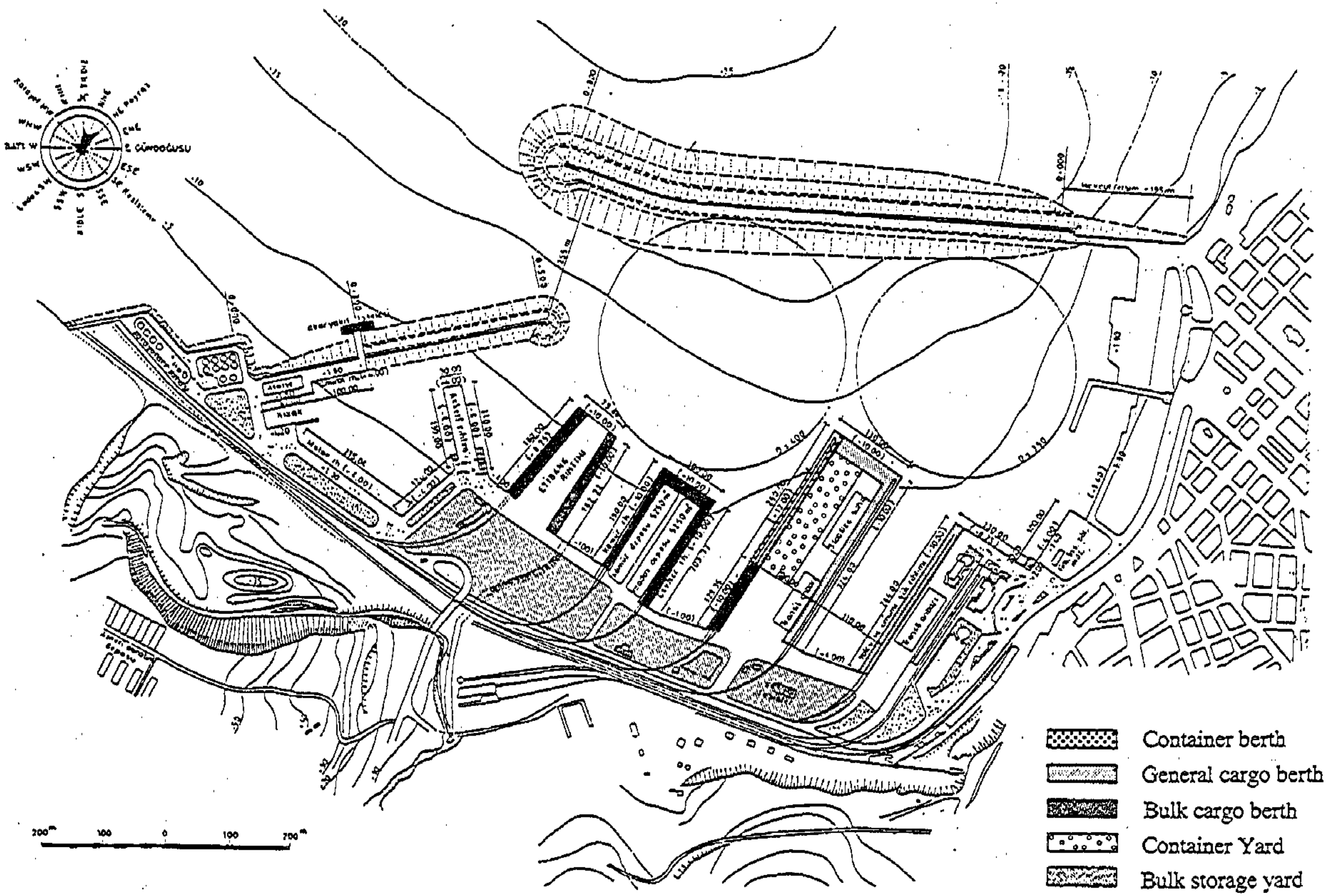


FIGURE 3.7.7 Development Plan of Alternative (3) for 2005

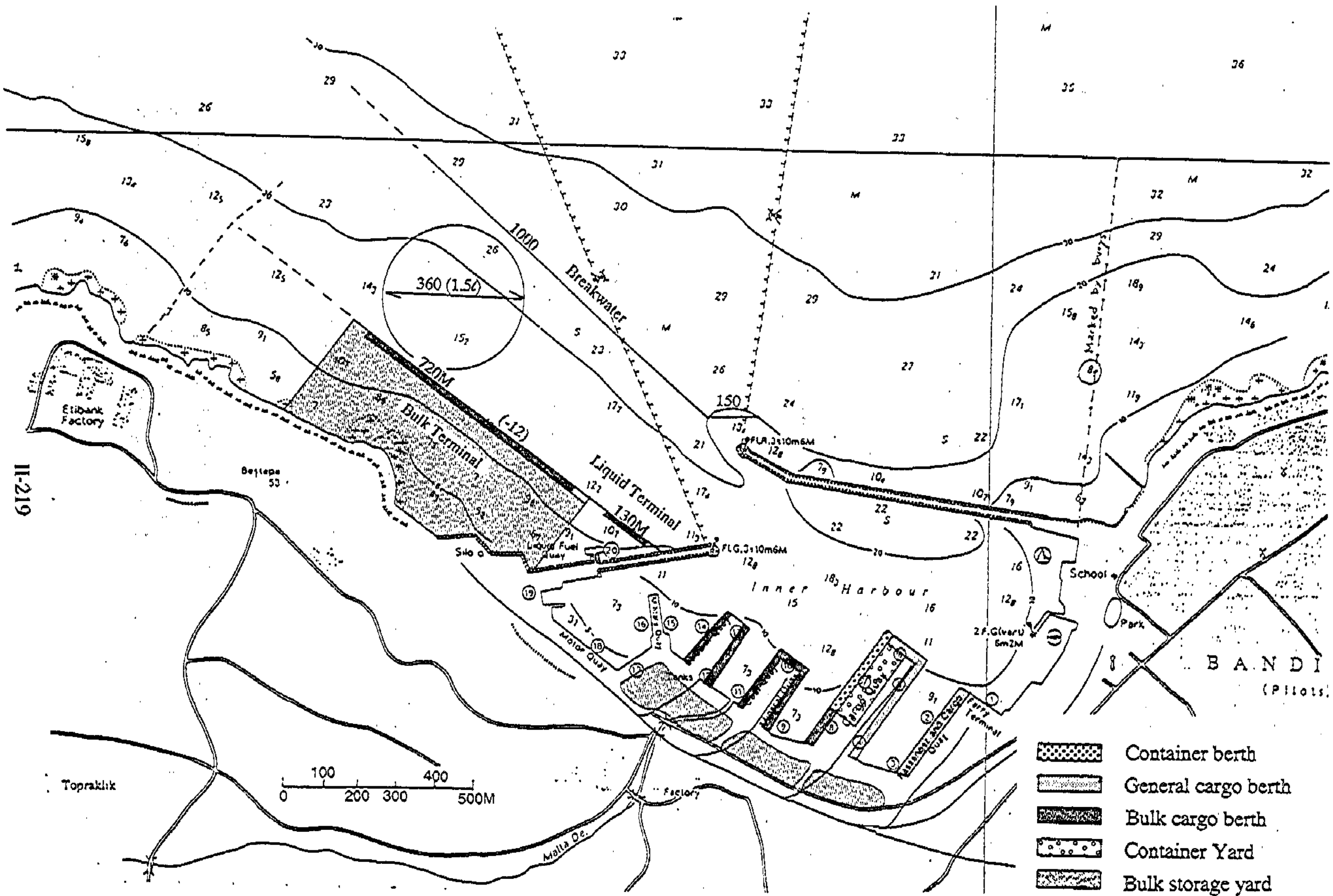


FIGURE 3.7.8 Development Plan of Alternative (3) for 2015