CHAPTER 3 TERMINAL PLANNING

CHAPTER 3 TERMINAL PLANNING

3.1 Traffic Demand Forecast

3.1.1 Future Scenario of Traffic Movements through the La Union Port

Currently, most of the sea-borne cargo to and from El Salvador are imported and exported through the Acajutla Port or the Quetzal Port in Guatemala. A large share of the transit cargo through the Quetzal Port is chiefly attributed to an inadequate cargo handling capacity of the Acajutla Port. Once the La Union Port has become operational, it is expected that considerable part of the El Salvador O/D (Origin/Destination) cargo will be handled through the La Unión Port Port. This would be particularly so for the container traffic that will be preferably handled through a highly efficient and modernized container terminal of the La Unión Port, which is located deep inside the Fonseca Gulf and no operational problem will occur due to wave actions as experienced in the Acajutla Port.

In addition to the shift of the El Salvador-O/D cargo mentioned above, the development of the La Unión Port will trigger a more extensive regional shift of the container traffic, including the neighboring countries. Currently, their container cargo are handled through their own ports, such as the San Lorenzo Port in Honduras, the Corinto Port in Nicaragua and the Quetzal Port in Guatemala. A highly efficient container handling service expected at the La Unión Port and the recent progress of the expanding inland road network linked to the Pan-American Highway will encourage the cross-border container traffic to the La Unión Port. This tendency will be more enhanced, if major container shipping lines take a policy that their vessels will minimize the number of calling ports, only calling at the selected strategic container terminal like the La Unión Port in order to save the sailing costs for their ships' route deviations and create economies of scale by use of larger-size container vessels.

In the meantime, it is reasoned that the existing traffic pattern of bulk cargo will not be significantly affected by the La Unión Port. The domestic movements of dry bulk such as cereal and fertilizer have been already established, well linked to the silos located near the Acajutla Port. The Acajutla Port is now promoting the privatization of a dry bulk terminal at the port. Under these circumstances, no drastic shift of dry bulk cargo shipment from the Acajutla Port to the La Unión Port will take place in a short term. The liquid bulk such as diesel oil and gasoline has been mainly consumed in and around the capital area, so the development of the La Unión Port will also not induce a significant impact to the ongoing shipment centered on the Acajutla Port.

3.1.2 Procedures of Traffic Forecast

The basic steps of the traffic forecast for the La Unión Port are outlined hereinafter and major activities of the traffic forecasting are further illustrated in Figure 3.1.1 "Traffic Forecast Study Flow". In accordance with this study flow, the detailed traffic analysis has been undertaken in the successive sections.

(1) In the macroscopic forecast, the historical trends of El Salvador-O/D import/export cargo in all transportation modes have been examined, and the future demands projected by use of the economic indicator of GDP.

(2) Out of all-mode total, the sea traffic portion of El Salvador-O/D cargo has been projected, considering the past trend of its share.

(3) In the microscopic forecast, the sea traffic has been divided into import/export cargo and classified on a package-style basis, and further sub-divided into individual commodities such as cereals and iron & steel.

(4) For each commodity, detailed analysis has been made to project its future demand.

(5) The results of macroscopic and microscopic forecasts have been crosschecked each other, and the results of microscopic forecasts have been finalized.

(6) Out of the sea traffic total of El Salvador-O/D, the portion for the La Unión Port has been projected through the transport cost analysis. (In this step, only conventional cargo has been estimated)

(7) Out of the traffic forecast results (6), containerizable cargo has been identified for estimating the El Salvador-O/D containers.

(8) In addition to the El Salvador-O/D containers, transit containers to and from the neighboring countries' ports through the La Unión Port have also been projected, considering the transport economy and commercial situations.

(9) On the basis of the past statistics of passenger ship callings at the Acajutla Port, the passenger ship demands have been estimated for the La Unión Port.

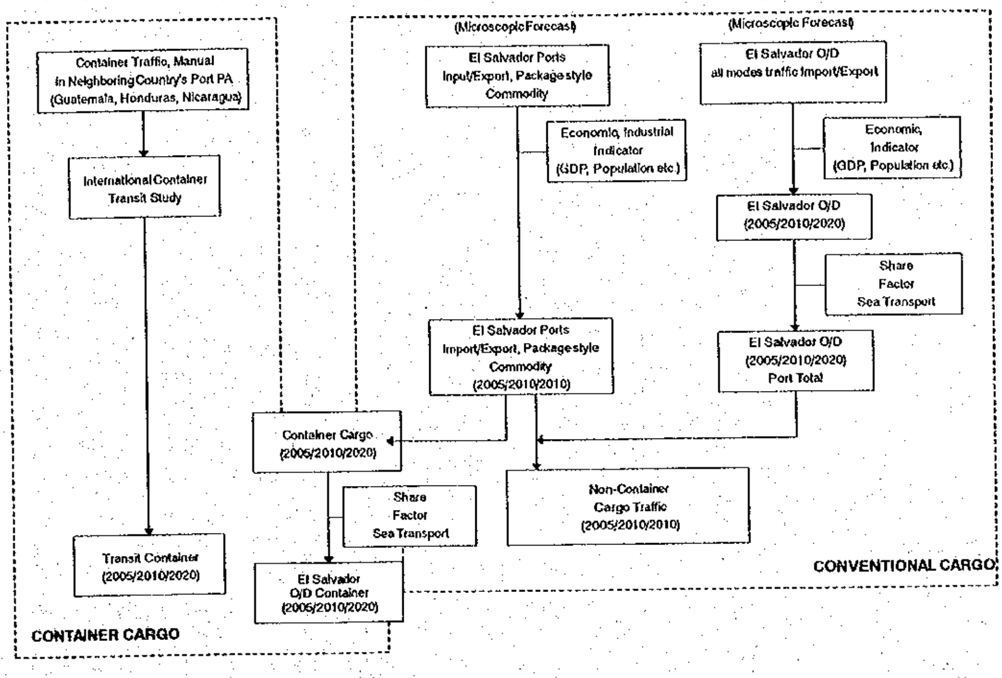


Figure 3.1.1 Traffic Forecast Study Flow

3.1.3 Economic Indices for Traffic Projection

(1) Population

In the last five years of 1996-2000, the annual population growth rates remained in a narrow range of 1.97% - 2.10% with an average of 2.06%. Compared with the last ten years data, the trend shows a slight decline in population growth rates as shown below.

Table 3.1.1 Historical Trend of Population between 1991-2000

	'000 (growth rate (%) to the preceding year)										Average growth rate	
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	1991-2000	1996-2000
Population	5,206	5,310	5,421	5,541	5,669	5,788	5,911	6,035	6,154	6,277	2.10%	2.06%
	-	2.00%	2.09%	2.21%	2.31%	2.10%	2.13%	2.10%	1.97%	2.00%	-	-

Source: BCR (Banco Central de Reserva: de El Salvador Central Bank of El Salvador). World Bank)

The United Nations forecast population growth rate of 1.53% in 2001 – 2010 and 1.27 in 2011 – 2020 in Latin America. But this forecast seems too small compared with the above historical trend. The forecast figures of the previous JICA study are in the middle of the gap between UN's forecast and the recent trend. There is no reason why the previous JICA's forecast figures should be modified. Thus, in this Study, the population growth rates of 1.84% in 2001 – 2005 and 1.50% in 2005 – 2015 are adopted, the same as those in the previous JICA's study.

(2) Growth Prospects

The average annual growth rate of Gross Domestic Product (GDP) was 3.5% during the period of 1995-2000 (see Table 2.1.2). The GDP growth in the future as forecast by different organizations is in the range of 3.5% - 5%. This range happens to coincide with the forecast of the previous JICA's study; the lowest figure of 3.5% in the above range is the same as JICA's "Low Case" and the highest figure of 5%, JICA's "High Case". The lowest figure of 3.5% also coincides with the average annual growth rate of GDP in the last five years. Referring to those figures of GDP growth, and taking account of conservative estimation to steer the Project on a safe side, the GDP growth rate of 3.5% towards the target years is adopted in this Study.

3.1.4 Macroeconomic Traffic Projection

(1) Import

In the case of import, the statistics of GDP of El Salvador and the total volume of imports of El Salvador in the last ten years were correlated, and then the future volume of imports is estimated by applying the future GDP mentioned above. The resulting volumes of imports are 7.3 million MT, 9.6 million MT and 12.4 million MT in 2005, 2010 and 2015, respectively (see Table 3.1.2).

Table 3.1.2 Correlation between Salvadorean GDP and Total Volume of Imports by All Modes between 1991-2000

		Actual Record in Statistics										Forecast		
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2005	2010	2015
X	GDP (billion US$)	6.90	7.42	7.97	8.45	8.99	9.14	9.53	9.87	10.20	10.41	12.81	15.47	18.69
Y	Imports (1000 MT)	2,489	2,763	2,781	3,572	4,245	3,230	4,380	4,953	5,032	5,630	7,307	9,622	12,418

Note (1): GDP at 1995 constant price (2): Linear regression equation: $Y = a \times X + b$, $a = 868074$, $b = -3808668$, $r = 0.94$

(2) Export

In the case of export, the statistics of GDP of El Salvador trade partners and the total volume of exports of El Salvador in the last ten years are correlated, the future volume of export is then estimated by applying the future GDP. Among the Salvadorean trade partners, USA accounted for 65.3% of the total exports in 2000 in money value followed by the rest of the countries in Central America (25.1%), and Germany (3.2%). They cover 93.6% of the total. The shares of export trade between El Salvador and its main trading partners are used to compute a weighed figure from individually forecast figures (see Tables 3.1.3 to 3.1.5). The resulting weighed volume of the exports in million MT are 2.5, 3.6 and 4.9 in 2005, 2010 and 2015, respectively. The total cargo volumes of Salvadorean imports and exports by all transport modes are in million MT 9.8, 13.2 and 17.3 in 2005, 2010 and 2015, respectively (see Table 3.1.6).

Table 3.1.3 Correlation between Trade Partners' GDP (Central America) and Total Volume of Exports by All Modes between 1991-2000

		Actual Record in Statistics										Forecast		
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2005	2010	2015
X	GDP (billion US$)	26.13	27.71	29.04	30.08	31.43	32.12	33.73	35.67	37.36	39.02	48.61	60.62	75.69
Y	Exports (1000 MT)	454	605	643	457	665	845	1,188	1,333	1,409	1,654	2,534	3,713	5,193

Note (1): GDP at 1995 constant price (2): Linear regression equation: Y = a x X + b, a = 98185, b = -2239250, r = 0.95

Table 3.1.4 Correlation between Trade Partners' GDP (USA) and Total Volume of Exports by All Modes between 1991-2000

		Actual Record in Statistics										Forecast		
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2005	2010	2015
X	GDP (billion US$)	6,607	6,809	6,990	7,272	7,466	7,732	8,075	8,428	8,731	9,057	10,876	13,060	15,683
Y	Exports (1000 MT)	454	605	643	457	665	845	1,188	1,333	1,409	1,654	2,500	3,589	4,896

Note (1): GDP at 1995 constant price (2): Linear regression equation: Y = a x X + b, a = 498, b = -2921291, r = 0.96

Table 3.1.5 Correlation between Trade Partners' GDP (Germany) and Total Volume of Exports by All Modes between 1991-2000

		Actual Record in Statistics										Forecast		
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2005	2010	2015
X	GDP (billion US$)	-	-	2,201	2,253	2,292	2,309	2,342	2,393	2,428	2,505	2,656	2,863	3,085
Y	Exports (1000 MT)	-	-	643	457	665	845	1,188	1,333	1,409	1,654	2,324	3,174	4,090

Note (1): GDP at 1995 constant price (2): Linear regression equation: Y = a x X + b, a = 4116, b = -8608290, r = 0.94

Table 3.1.6 Total Volume of Salvadorean Trade by All Transport Modes (2005, 2010, 2015)

Unit: million MT

	2005	2010	2015
Imports	7.3	9.6	12.4
Exports	2.5	3.6	4.9
Total	9.8	13.2	17.3

(3) Allocation to Salvadorean Ports

In allocating the entire cargo to be transported by all modes to the Salvadorean ports, the historical trend of their shares is used for the forecast (see Table 3.1.7).

Table 3.1.7 Historical Trend of Salvadorean Trade in Volume and Share by Transport Mode (1997-2000)

Unit: '000 MT

Transport Mode			1997	1998	1999	2000
Imports	Pacific Ports	via Acajutla and Cutuco Ports	1,683	1,849	1,877	2,149
		via Quetzal Port	109	106	165	173
		sub-total	1,792	1,955	2,042	2,322
		Share in Import (%)	40.9%	39.5%	40.6%	41.2%
	Land (via Caribbean Ports) + Buoy		2,573	2,982	2,972	3,292
	Air		16	15	18	16
	Total		4,380	4,953	5,032	5,630
Exports	Pacific Ports	via Acajutla and Cutuco Ports	325	443	405	437
		via Quetzal Port	59	58	89	94
		sub-total	384	500	494	530
		Share in Export (%)	32.3%	37.5%	35.1%	32.1%
	Land + Buoy		788	817	896	1,107
	Air		16	16	18	16
	Total		1,188	1,333	1,409	1,654
Total	Pacific Ports		2,175	2,456	2,536	2,852
	Land (via Caribbean Ports) + Buoy		3,361	3,799	3,868	4,400
	Air		32	31	36	32
	Total		5,568	6,286	6,440	7,284

Source: Estimated by the Study Team based on the data of CEPA, and the Quetzal Port.
Note: The item of "via Quetzal Port" statistically includes not only Salvadorean cargo but also those of Honduras and Nicaragua, though a great portion of cargo is said to be from/to El Salvador (in 2000, 74.4%) and a lesser portion is from/to Honduras (20.0%) and Nicaragua (5.5%). In this Study, except for the data in the year 2000, there are no historical data in terms of breakdown, and hence it was processed as one category as an exceptional case.

It is assumed that the Salvadorean trade cargo currently transported via the Quetzal Port in Guatemala, which consists mostly of containers, will be shifted to the La Unión Port once it is developed from the Quetzal Port. Besides, the Salvadorean trade cargo currently transported via Caribbean ports mainly via the Santo Tomás Port, which also consists mostly of containers, could be also shifted to the La Unión Port. It is also assumed that the Panamax container ships, which are currently allocated in pendulum services and are playing between East Asia and the USA East Coast or between the USA West Coast and Europe via the Panama Canal, will call at the La Unión Port in the future.

According to the result of inter-modal transport cost analysis, the total transport cost comprising sea-borne and land transport costs between the USA East Coast and San Salvador via the La Unión Port is lower than that via the Santo Tomás Port. This is mainly due to operation of larger container ships of Panamax size on the La Unión route and the longer road distance of the Santo Tomás route. The disadvantage of roundabout routes to the USA East Coast via the Panama Canal could thus be eliminated.

Though the estimated transport time via the La Unión Port is longer than that via the Santo Tomás Port by approximately two days, it is not considered to be generally significant if weekly services are provided. Nevertheless, it is assumed in this Study that the Salvadorean trade cargo currently transported via Caribbean ports will be kept intact even after the development of the La Unión Port for the time being, so as to estimate the demand on a conservative basis, keeping this cargo as potential cargo for the La Unión Port on a long-term basis. Thus, the share of the Salvadorean Ports is assumed to be 40% in imports through the target years. In the case of exports, their share is assumed to decline slightly from 32% to 29% from the years 2005 to 2015.

The resulting figures of the total cargo volume via Salvadorean Ports in the macro forecast are 3.7, 4.9 and 6.4 million MT in 2005, 2010 and 2015, respectively.

Table 3.1.8 Results of Macroeconomic Forecast (2005, 2010, 2015)

Unit: million MT

	2005	2010	2015
Imports	2.9	3.8	5.0
Exports	0.8	1.1	1.4
Total	3.7	4.9	6.4

3.1.5 Microeconomic Traffic Projection

(1) Forecast of Local Cargo Volume

In the forecast of cargo volume for the whole country, the projection is made for each commodity item. A correlation analysis is performed for each commodity to obtain best fitted economic indices which include sectorial GDP, total GDP, and population. The details of projection for each commodity are discussed in Appendix E and the results of projected cargo volume of Salvadorean trade are summarized in the Table 3.1.9.

Table 3.1.9 Forecast Salvadorean Overseas Trade Cargo Volume via Salvadorean Ports

(Unit : MT)

Import/ Export	Package Style	Commodity	Actual	Projection (traditional pattern)		
			2000	2005	2010	2015
Import	General Cargo	Miscellaneous	14,452	15,000	15,000	18,000
		Chemical products	15,004	32,000	52,000	78,000
		Iron and steel, and their products	218,558	372,000	555,000	789,000
		Fertilizer in bag	22,579	39,000	39,000	39,000
		Vehicles	10,357	15,000	22,000	33,000
		Nonferrous metal products	6,948	17,000	29,000	45,000
		Cement in bag	3,000	60,000	70,000	80,000
		Sub-total for General Cargo	290,898	550,000	782,000	1,082,000
	Dry Bulk	Cereals including maize flour	751,363	965,000	1,190,000	1,432,000
		Fertilizer	272,666	351,000	351,000	351,000
		Soybean flour	158,623	194,000	209,000	225,000
		Others	8,788	9,000	9,000	9,000
		Sub-total for Dry Bulk	1,191,440	1,519,000	1,759,000	2,017,000
	Liquid Bulk	Diesel oil	202,986	276,000	375,000	494,000
		Gasoline	128,268	166,000	225,000	276,000
		Animal and vegetable fats	65,198	77,000	90,000	107,000
		Soybean oil	19,804	19,000	19,000	19,000
		Alcohol	17,753	18,000	18,000	18,000
		Butane gas	15,086	15,000	15,000	15,000
		Caustic soda	15,015	28,000	43,000	63,000
		Alkane (methane hydrocarbonite)	5,364	5,000	5,000	5,000
		Others	30,965	30,000	30,000	30,000
		Sub-total for Liquid Bulk	500,439	634,000	820,000	1,027,000
	Total for Imports		1,982,777	2,703,000	3,361,000	4,126,000
Export	General Cargo	Miscellaneous	2,782	4,000	2,000	2,000
		Sub-total for General Cargo	2,782	4,000	2,000	2,000
	Dry Bulk	Sugar	256,367	250,000	250,000	250,000
		Sub-total for Dry Bulk	256,367	250,000	250,000	250,000
	Liquid Bulk	Molasses	149,512	160,000	160,000	160,000
		Ethyl alcohol	19,644	19,000	19,000	19,000
		Sub-total for Liquid Bulk	169,156	179,000	179,000	179,000
	Total for Exports		428,305	433,000	431,000	431,000
Grand total			2,411,082	3,136,000	3,792,000	4,557,000

Source: Projected by the study team using the original data from CEPA
Note : Excluding container and LPG and butane gas handled at Punta Gorda in 2000

(2) Forecast of Local Container Cargo Volume

In the first step, the volume of containerizable general cargo in the future is forecast based on the historical trend of the El Salvador-O/D cargoes passing through the Acajutla Port ("via-Acajutla Port Pattern") as shown in Table 3.1.10.

Table 3.1.10 Historical Trends of Total GDP and Volume of Imported General Cargo (Containerizable) in 1991-2000

(Unit : 1,000 MT)

	Actual Record in Statistics										Forecast		
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2005	2010	2015
Total GDP (billion US$)	6.90	7.42	7.97	8.45	8.99	9.14	9.53	9.87	10.20	10.41	12.81	15.47	18.69
Imported General Cargo (1000 MT)	91	85	81	99	101	57	68	115	108	78	119	181	276
Exported General Cargo (1000 MT)	98	119	151	99	108	99	85	47	38	11	32	32	32

Note(1): GDP at 1995 constant price (2): Growth elasticity of Import against GDP = 8.2%/3.3% = 2.50 (1996-2000) (3): Import excluding chemical products (4): The average volume of export in the lst three years (1998 - 2000) is 32,000 MT.

The general cargo estimate is further divided into containerized cargo and break-bulk cargo by multiplying the percentages of containerization in the future (see Table 3.1.11). The percentages of containerization are estimated by applying the logistic curve fitting in the time-series correlation analysis.

Table 3.1.11 Forecast Volumes of Local Container Cargo and Percentages of Containerization in Via-Acajutla Port Pattern (2000, 2005, 2010, 2015)

Local Containers			2000	2005	2010	2015
Volume of Containerizable Cargo in 1000 MT	Imports	General Cargo	78	119	181	276
		Chemical Products	19	40	65	98
		Total	97	159	246	374
	Exports		32	32	32	32
Percentage of Containerization	Imports	General Cargo	82%	88%	92%	94%
		Chemical Products	21%	20%	20%	20%
	Exports		75%	88%	93%	95%
Volume of Containerized Cargo in 1000 MT	Imports	General Cargo	64	105	166	258
		Chemical Products	4	8	13	20
		Total	68	112	179	278
	Exports		24	28	30	30
Number of Containers in 1000 TEUs			15	24	39	60

In the second step, the volume of container cargo in the future is forecast based on the historical trend of the El Salvador-O/D cargoes passing through the Quetzal Port ("via-Quetzal Port Pattern") as shown in Table 3.1.7. The Quetzal Port handled about 110,000 TEUs in 2000 as shown in Table 3.1.12. The container transit volume to other countries through the Quetzal Port is 22,300 TEUs which account for 20% of total containers handled at the port.

Table 3.1.12 Volume of Containers Handled in Quetzal Port

(Unit : TEU)

	1997	1998	1999	2000
Imports	23,900	36,200	35,400	41,100
Exports	27,300	42,200	45,300	46,100
Transit	17,700	19,500	21,200	22,300
Total	68,900	97,900	101,900	109,500

According to the information obtained from Maersk-Sealand, a total of 14,387 TEUs of laden containers (4,348 TEUs of export and 10,039 TEUs of import) originated from or destined to El Salvador are handled by this shipping line in 2000. Since Maersk-Sealand shares about 45% of the total number of containers at the Quetzal Port, it is assumed that the whole volume classified as "transit" in the above table is Salvadorean trade cargo.

In the forecast, the same growth elasticity as the Acajutla case is used. The estimated volumes are 406,000, 618,000 and 940,000 MT in 2005, 2010 and 2015 respectively. In terms of container number, the estimated volumes are 57,000, 87,000 and 132,000 TEUs in 2005, 2010 and 2015 respectively.

The forecast volumes of the Salvadorean trade cargo currently passing via Acajutla and via Quetzal are finally summed up to obtain the forecast potential cargo to be attracted to the Salvadorean ports, once the La Unión Port project is implemented. The forecast volumes are mostly allocated to the La Unión Port.

Table 3.1.13 Forecast Volumes of Local Containers to be Attracted to the Salvadorean Ports due to Traffic Pattern Change

(Currently Via-Acajutla Port Pattern)

Local Containers		2000	2005	2010	2015
Volume of Containerized Cargo in 1000 MT	Imports	68	112	179	278
	Exports	24	28	30	30
	Total	112	140	209	308
Number of Containers in 1000 TEUs		15	24	39	60

(Currently-via-Quetzal Port Pattern)

Local Containers		2000	2005	2010	2015
Volume of Containerized Cargo in 1000 MT	Imports	173	263	401	609
	Exports	94	143	217	330
	Total	267	406	618	940
Number of Containers in 1000 TEUs		22	57	87	132

(Total Volume to Salvadorean Ports in the Future)

Local Containers		2000	2005	2010	2015
Volume of Containerized Cargo in 1000 MT	Imports	241	376	580	887
	Exports	118	171	247	360
	Total	359	547	827	1,248
Number of Containers in 1000 TEUs		37	81	125	192

3.1.6 Comparison of Results of Macroeconomic and Microeconomic Approaches

The comparison of the results of the microeconomic forecast with the results of the macroeconomic forecast is summarized in Table 3.1.14. It is judged that the disparity between the results obtained by the two methods remains within a tolerable range of 10% (1% in 2005, 7% in 2010, and 10% in 2015).

Table 3.1.14 Comparison of Results of the Microeconomic and Macroeconomic Forecast

Unit: 1000 MT

Forecast Volumes of Local Cargo		2000	2005	2010	2015
Microeconomic Approach	Imports	2,224	3,079	3,941	5,013
	Exports	546	604	678	791
	Total	2,770	3,683	4,619	5,804
Macroeconomic Approach	Imports	-	2,923	3,849	4,967
	Exports	-	801	1,082	1,435
	Total	-	3,724	4,931	6,402

3.1.7 Allocation of Local Cargo to La Unión Port

(1) Conventional Cargo

The microeconomic forecast volume of conventional cargo is allocated to the La Unión Port and the Acajutla Port based on the transport cost analysis in which inter-modal transport costs are compared by cargo item and by respective route between the La Unión Port and the Acajutla Port. In the case of the transport via the Acajutla Port, the current characteristics of vessels, origins/destinations of cargoes, cargo lot per vessel and shipping routes obtained by processing the entire year data in 2000 were used.

On the other hand, in the case of the transport via the La Unión Port, it is assumed that Panamax bulkers could be received at the port assuming that the current origin-destinations are the same as those currently observed of the route via the Acajutla Port. In both cases the destination of imports and the origin of exports in El Salvador are set within San Salvador. The operation costs of vessel and onland transportation used for computing the cost index is shown in Appendix E.1.3 and analysis of transportation costs for each commodity is shown in Table 3.1.15.

Table 3.1.15 Cost Comparison of Inter-modal Local Cargo Transport by Cargo Item and Respective Route between via La Unión Port and Acajutla Port

Cargo item	Route	Transport Mode	Distance (km/ nautical mile)	Vessel size in DWT/ TEUs	Cost Index
Cereals	Westwego, Luisiana - La Unión - San Salvador	Truck transport	184	-	52
		Ship transport	2,194	50,000	48
		Total			**100**
	Westwego, Luisiana - Acajutla - San Salvador	Truck transport	95	-	34
		Ship transport	2,295	34,000	75
		Total			**108**
	Difference				**8**
Fertilizer	Antewer- - La Unión - San Salvador	Truck transport	184	-	31
		Ship transport	5,618	43,000	69
		Total			**100**
	Antewerp - Acajutla - San Salvador	Truck transport	95	-	20
		Ship transport	5,719	26,000	101
		Total			**121**
	Difference				**21**
Iron/steel products	Murmansk, Russia - La Unión - San Salvador	Truck transport	184	-	23
		Ship transport	6,898	30,000	77
		Total			**100**
	Murmansk, Russia - Acajutla - San Salvador	Truck transport	95	-	15
		Ship transport	6,999	30,000	70
		Total			**85**
	Difference				**-15**
Raw sugar	Leningrad, Russia - La Unión - San Salvador	Truck transport	184	-	21
		Ship transport	6,898	26,000	79
		Total			**100**
	Leningrad, Russia - Acajutla - San Salvador	Truck transport	0	-	13
		Ship transport	6,999	26,000	87
		Total			**100**
	Difference				**0**
Container	Los Angeles-La Unión - San Salvador	Truck transport	184	-	12
		Ship transport	2,268	4800 TEUs	88
		Total			**100**
	Los Angeles-Acajutla-San Salvador	Truck transport	95	-	8
		Ship transport	2,168	1270 TEUs	97
		Total			**104**
	Difference				**4**

According to the above table, for most cargo items except for iron and steel products, the total costs of transport via the La Unión Port are less than or equal to those via the Acajutla Port, owing partly to the availability of a deeper berth that will enable to receive larger bulkers up to Panamax ones and partly to higher cargo-handling productivity that could be accomplished at the new marginal type wharf of the La Unión Port. Thus, the La Unión Port could attract conventional cargoes from all over the country, and more likely from the Eastern Region.

In the conventional cargo allocation to the La Unión Port, however, only the Eastern Region (including the eastern provinces of the Central Region) is considered to be the hinterland of the La Unión Port for the time being, so as to put the Project on a safe side by conservative estimates, while keeping the Western Region (including the western provinces of the Central Region) as a potential market on a long-term basis. The share of the market in the Eastern Region was assumed to be 30% of the total local market, which is the same share as the population.

There are two exceptional cases in the market share application. The first case concerns the iron and steel products, where the La Unión Port will not have advantage over the Acajutla Port in the market in the Western Region for imported finished products, and even in the market in the Eastern Region for imported half-finished hot-rolled products that are processed at a cold rolling mill in Acajutla. In this case, a 10 % reduction was adopted. The second case concerns the cement which is currently cement imported solely via the Punta Gorda Port. It is assumed that cement handling will be shifted to the new terminal of the La Unión Port.

(2) Container Cargo

1) Local Container Cargo

As to local containers, a transport cost analysis is conducted so as to compare the two cases of transport via-Acajutla Port route and via-La Unión Port route as well as the conventional cargo case. The results show that the La Unión Port could attract local containers from all over the country despite its disadvantage of longer road distance to/from San Salvador. This disadvantage will be largely compensated by the use of larger container ships and more efficient container-handling operations even on the route to the USA West Coast and much more by the route to Asia (see Table 3.1.16).

In the meantime, according to the interview survey, major shipping lines/agents providing services in El Salvador intend to shift their container transport services to the La Unión Port not only from the Acajutla Port but also from the Quetzal Port by assigning larger container vessels up to Panamax size. In this view, it is assumed that most of the local containers will be handled at the La Unión Port except for containers to be transported by general cargo vessels or multi-purpose vessels (including partly container vessels) combined with non-containerized break-bulk cargo.

2) Attraction of Transit Containers to La Unión Port

The new container terminal to be built at the La Unión Port is expected to attract not only Salvadorean local containers but also transit containers destined to or originating from the neighboring countries in Central America. According to the cost analysis shown in Tables 3.1.16 and 3.1.17, on the trans-Pacific routes connecting Asia and America, the La Unión Port will have advantage in the total inter-modal transport costs over the neighboring principal ports, viz the Quetzal Port in Guatemala and the Corinto Port in Nicaragua, wheile on the routes to the USA West Coast, the La Unión Port will have advantage in transport costs only over the San Lorenzo Port in Honduras.

Table 3.1.16 Cost Comparison of Inter-modal Container Transport to/from Neighbouring Countries in C.A. by Route (via La Unión and via Quetzal)

Guatemala					
Trade Partner Area	Route	Transport Mode	Distance (km/n. miles)	Container Capacity of Vessels	Cost Index
USA West Coast	Los Angeles-La Unión-Guatemala City	Truck transport	422	-	21
		Ship transport	2,063	4800 TEUs	79
		Total			100
	Los Angeles-Quetzal-Guatemala City	Truck transport	90	-	7
		Ship transport	2,268	1270 TEUs	83
		Total			89
	Difference				-11
East Asia	Hong Kong – La Unión – Guatemala City	Truck transport	422	-	14
		Ship transport/ direct shipping	8,748	4800 TEUs	86
		Total			100
	Hong Kong – Quetzal-Guatemala City	Truck transport	90	-	4
		Ship transport/ direct shipping	8,543	1270 TEUs	103
		Total			107
	Hong Kong – Los Angeles – Quetzal - Guatemala City	Truck transport	90	-	4
		Ship transport/ transhipment	8,543	1270 TEUs/ 4800TEUs	106
		Total			110
	Difference (Comparison in direct shipping)				7

Table 3.1.17 Cost Comparison of Inter-modal Container Transport to/from Neighboring Countries in C.A. by Route (via La Unión and via Corinto)

Nicaragua					
Trade Partner Area	Route	Transport Mode	Distance (km/n. miles)	Container Capacity of Vessels	Cost Index
USA West Coast	Los Angeles - La Unión -Managua	Truck transport	340	-	19
		Ship transport	2,063	4800 TEUs	81
		Total			100
	Los Angeles -Corinto – Managua	Truck transport	150	-	10
		Ship transport	2,268	1270 TEUs	89
		Total			99
	Difference				-1
East Asia	Hong Kong – La Unión -Managua	Truck transport	340	-	12
		Ship transport	8,748	4800 TEUs	88
		Total			100
	Hong Kong – Corinto – Managua	Truck transport	150	-	6
		Ship transport	8,774	1270 TEUs	107
		Total			113
	Difference				13

The percentage of container traffic of the above countries in overseas trade with Asia represents approximately 25% of the total traffic via the ports on the Pacific Coast, while that with the USA West Coast is said to account for over 50% of the total. Assuming that the former percentage will remain unchanged in the future, it is considered as the traffic attraction by the La Unión Port. Such containers to/from the neighboring countries are called transit containers in the traffic through the La Unión Port. The number of transit containers potentially attracted to the La Unión Port is summarized in Table 3.1.18.

Table 3.1.18 The Number of Containers Potentially Attracted to La Unión Port as Transit Containers from Neighboring Countries in C.A.

(Unit: 1000 TEUs)

Volume of Transit Containers		2005	2010	2015
Corinto Port in Nicaragua	25%	4	6	8
San Lorenzo Port in Honduras	50%	3	4	6
Quetzal Port in Guatemala	25%	34	50	70
Total		40	60	84

3) Summary of Total Volume of Containers Allocated to La Unión Port

The total volume of containers allocated to the La Unión Port is estimated by summing up the Salvadorean local container cargo and transit cargo to/from the neighboring countries excluding the containers handled at the Acajutla Port, estimated at 40,000 TEUs for 2005 - 2015. The resulting container volumes in the target years are shown in Table 3.1.19.

Table 3.1.19 Total Volume of Containers to be Allocated to La Union Port

	2005	2010	2015
Container (TEUs/Year)	121,000	185,000	275,000

(3) Summary of Total Volume of Cargo Allocated to La Unión Port

Table 3.1.20 shows a summary of total cargo estimated to be handled at the Acajutla and La Union Ports. Considering the function and share of both ports, it is clearly observed that the major part of the general and bulk cargoes will continue to be handled at the Acajutla Port, while most of the container cargo is expected to be handled at the La Unión Port.

The total volume of general and bulk cargoes allocated to the La Unión Port is estimated by summing up the Salvadorean local cargo and transit cargo to/from the neighboring countries. The resulting cargo volumes in the target years are 620,200, 720,500 and 831,300 MT in 2005, 2010 and 2015 respectively. While the volume of container cargo of the La Unión Port is estimated at 121,000, 185,000 and 275,000 TEUs in 2005, 2010 and 2015 respectively.

In the forecast, the volume of general and bulk cargoes for the whole country will be double in 2015 from 2.4 million MT in 2000, and most of these cargoes will be handled by the Acajutla Port (see Table 3.1.9). The future cargo volumes expected to be handled by the Acajutla Port are 2,571,300, 3,124,900 and 3,775,800 MT in 2005, 2010 and 2015 respectively.

Table 3.1.20 Forecast Cargo Volume of Acajutla and La Unión Ports

(Unit : MT)

Import/ Export	Package Style	Commodity	Acajutla Port			La Union Port		
			2005	2010	2015	2005	2010	2015
Imports	General Cargo	Miscellaneous	15,000	15,000	18,000	-	-	-
		Chemical products	32,000	52,000	78,000	-	-	-
		Iron and steel, and its products	334,800	499,500	710,100	37,200	55,500	78,900
		Fertilizer in bag	39,000	39,000	39,000	-	-	-
		Vehicles	10,500	15,400	23,100	4,500	6,600	9,900
		Nonferrous metal products	17,000	29,000	45,000	-	-	-
		Cement in bag	-	-	-	60,000	70,000	80,000
		Sub-total for General Cargo	448,300	649,900	913,200	101,700	132,100	168,800
	Dry Bulk	Cereals including maize flour	675,500	833,000	1,002,400	289,500	357,000	429,600
		Fertilizer	245,700	245,700	245,700	105,300	105,300	105,300
		Soybean flour	135,800	146,300	157,500	58,200	62,700	67,500
		Others	9,000	9,000	9,000	-	-	-
		Sub-total for Dry Bulk	1,066,000	1,234,000	1,414,600	453,000	525,000	602,400
	Liquid Bulk	Diesel oil	276,000	375,000	494,000	-	-	-
		Gasoline	166,000	225,000	276,000	-	-	-
		Animal and vegetable fats	77,000	90,000	107,000	-	-	-
		Soybean oil	19,000	19,000	19,000	-	-	-
		Alcohol	18,000	18,000	18,000	-	-	-
		Butane gas	15,000	15,000	15,000	-	-	-
		Caustic soda	28,000	43,000	63,000	-	-	-
		Alkane	5,000	5,000	5,000	-	-	-
		Others	30,000	30,000	30,000	-	-	-
		Sub-total for Liquid Bulk	634,000	820,000	1,027,000	0	0	0
		Total for Imports	2,148,300	2,703,900	3,354,800	554,700	657,100	771,200
Exports	General Cargo	Miscellaneous	4,000	2,000	2,000	-	-	-
		Sub-total for General Cargo	4,000	2,000	2,000	-	-	-
	Dry Bulk	Sugar	190,000	190,000	190,000	60,000	60,000	60,000
		Sub-total for Dry Bulk	190,000	190,000	190,000	60,000	60,000	60,000
	Liquid Bulk	Molasses	150,000	150,000	150,000	10,000	10,000	10,000
		Ethyl alcohol	19,000	19,000	19,000	-	-	-
		Sub-total for Liquid Bulk	169,000	169,000	169,000	10,000	10,000	10,000
		Total for Exports	363,000	361,000	361,000	70,000	70,000	70,000
Grand total		In MT	2,511,300	3,064,900	3,715,800	624,700	727,100	841,200
Container		In TEUs	400	400	400	121,000	185,000	275,000

Source: Projected by the Study Team using the original data from CEPA

3.1.8 Passengers

A total of five (5) passenger ships call at the port in the last 5 years as shown in Table 3.1.21. While the ship is in the port, the passengers visit several tourist places, mainly in the western part of the country by buses.

Table 3.1.21 Record of Passenger Ship Calling at Acajutla (1996-July 2001)

Name of Passenger Ship	Date of Shipcall	Ship Size (GT)	LOA (m)	Number of Passengers
Olvia	13 June, 1996	24,220	193	461
Albatros	30 Dec., 1998	7,478	103	300
Olvia	13 Dec., 1999	15,791	156	506
Stamar	30 Nov., 1999	24,804	185	450
Maxin Gorki	31 July , 2001	15,791	156	547

The tourism activities with passenger ships calling at the Salvadorean ports are very limited. Although there is some expectation to attract passenger ships to the La Unión Port so as to promote tourism in the Eastern Region, it seems too early to work out a concrete plan based on a quantitative forecast of tourists to land from passenger ships.

3.2 Major Port Facilities Requirements

3.2.1 Berth Facility

(1) Number of Shipcalls

1) Container Vessels

The container vessels to call at the La Unión Port is of Panamax type.

According to interviews with shipping lines, it is expected that two container vessels will call at the La Unión Port weekly. It is assumed that this number will be maintained throughout the target years, thus the annual number of container shipcalls is computed as follows: 52 weeks x 2 lines/week x 2calls/line = 208 shipcalls.

The average number of container movements at the port is estimated to be 580 TEUs in 2005 (121,000TEUs/year ÷ 208 shipcalls/year = 580 TEUs/vessel), and it is assumed to increase in the future. Table 3.2.1 shows the average number of container movements and container shipcall in the target years (2005, 2010 2015) for the respective forecast cases.

Table 3.2.1 Average Number of Container Movements per Ship

	2005	2010	2015
Total number of containers to be handled (TEU)	121,000	185,000	275,000
Average container movement per ship (TEU)	580	890	1,320

2) Bulk Carriers

The cargo volume loaded/unloaded per vessel will increase as larger vessels call at the new La Unión Port. It is expected that upon completion of the Port, the size of bulkers will increase, especially these on long routes. The present size of ship calling at the Acajutla Port and the estimated sizes of bulkers for each commodity are tabulated below.

Table 3.2.2 Present and Future Ship Sizes for Bulk Carriers

Commodity	Present Average Ship Size	Estimated Future Ship Size and Shipload (MT)
Iron and steel	30,000 DWT	30,000 DWT (5,000)
Cement	4,000 DWT	4,000 DWT (4,000)
Cereals	34,000 DWT	43~50,000 DWT (40,000)
Fertilizer	26,000 DWT	43,000 DWT (39,000)
Soybean flour	23,000 DWT	43~50,000 DWT (40,000)
Sugar	26,000 DWT	26,000 DWT (23,400)
Molasses	24,000 DWT	24,000 DWT (5,000)

Note : Figures in parentheses ( ) show the estimated shipload per ship

The total number of shipcall is estimated as shown in Table 3.2.3.

Table 3.2.3 Average Number of Shipcalls by Bulk Carriers (2005, 2010, 2015)

Commodity	2005		2010		2015	
	Volume (MT)	Shipcall	Volume (MT)	Shipcall	Volume (MT)	Shipcall
Import Bulk						
Iron and steel	37,200	7	55,500	11	78,900	16
Cement in bag	60,000	15	70,000	18	80,000	20
Cereals	247,500	6	266,700	7	287,400	7
Fertilizer	105,300	3	105,300	3	105,300	3
Soybean flour	58,200	2	62,700	2	67,500	2
Export Bulk						
Sugar	60,000	3	60,000	3	60,000	3
Molasses	10,000	2	10,000	2	10,000	2
Total Shipcalls		**38**		**46**		**53**

3) Car Carriers

The car carriers that currently operate via the Acajutla Port vary in size from 10,000 to 25,000 DWT. The car carriers normally call at many ports and unload a designated number of cars at each port. The current operation system is assumed to be maintained for the future. The average number of cars unloaded at the La Unión Port is assumed to be 300 MT/carrier. The total number of shipcalls by car carriers is estimated as shown in Table 3.2.4.

Table 3.2.4 Average Number of Shipcalls by Car Carriers

	2005	2010	2015
Total volume to be handled in MT (number of cars)	4,500 (3,000)	6,600 (4,400)	9,900 (6,600)
Average number of shipcall	15	22	33

4) Passenger Ships

Currently, the number of shipcalls by passenger ships at the Acajutla Port is about once per year. It is assumed that this frequency of shipcalls will not change in the future and the same number is applied for the La Unión Port.

5) Total Number of Shipcalls

The total number of shipcalls estimated above for each ship type is summarized in Table 3.2.5.

Table 3.2.5 Total Number of Shipcalls at La Unión Port

	2005	2010	2015
Container vessels	208	208	208
Bulk carriers	38	46	53
Car carriers (Ro-Ro)	15	22	33
Passenger ships	1	1	1
Total	262	277	295

(2) Berth Occupancy Rate

The required number of berths is examined considering the characteristics of cargoes and the expected number of shipcalls at the port. It is determined that one (1) container berth, one (1) multi-purpose berth and one (1) passenger berth are required.

1) Container Berth

The container volume to be handled at the La Unión Port is subdivided by size and type as shown in Table 3.2.6.

Table 3.2.6 Container Volume to be Handled at La Unión Port (2010, 2015)

		TEU			BOX		
		2005	2010	2015	2005	2010	2015
Import	Laden	55,396	84,614	125,945	33,752	51,674	76,970
	FCL	(55,212)	(84,330)	(125,509)	(33,642)	(51,503)	(76,707)
	LCL	(184)	(284)	(436)	(110)	(171)	(263)
	Empty	5,006	7,639	11,379	3,263	4,995	7,465
	Total	60,402	92,253	137,323	37,016	56,669	84,435
Export	Laden	18,020	25,007	35,018	11,393	15,551	21,437
	FCL	(17,523)	(24,289)	(33,971)	(11,088)	(15,120)	(20,818)
	LCL	(497)	(718)	(1,047)	(305)	(431)	(619)
	Empty	42,382	67,246	102,305	25,623	41,118	62,998
	Total	60,402	92,253	137,323	37,016	56,669	84,435
Total	Laden	73,416	109,620	160,963	45,145	67,225	98,407
	FCL	(72,736)	(108,619)	(159,480)	(44,730)	(66,623)	(97,525)
	LCL	680	1,001	1,483	415	602	882
	Empty	47,387	74,885	113,684	28,886	46,113	70,463
	Total	120,803	184,505	274,647	74,031	113,338	168,870

Remarks: FCL: Full Container Load, LCL: Less Container Load, Laden=FCL+LCL

In examining the berth occupancy rate, the cargo handling efficiency is assumed as tabulated below.

Table 3.2.7 Cargo Handling Efficiency

	2005	2010	2015
Number of shipcalls	208	208	208
Productivity of crane (box/hr)	20	25	30
Number of quayside gantry crane	2	2	2

The berth occupancy rate can be computed by following equation.

Berth Occupancy Rate = (Total Berth Time)/(365 days x 24 hours)

where,

Total Berth Time (hrs): (No. of Shipcall) x (Berth Time per Vessel)

Berth Time per Vessel (hrs): (Total No. of Container)/[(Container Handling Rate Per berth) x (No. of Shipcall) x (Rate of Operational Time : 0.8)] + 1hr(for Berthing/de-berthing and other break time)

Container Handling Rate (TEU/berth/hr): (Production rate of Crane per hr) x (No. of Crane)

The berth occupancy rate of the Container Berth in 2015 is estimated at 43 % which represents an acceptable level of service.

Table 3.2.8 Berth Occupancy Rate of Container Berth

	2005	2010	2015
Number of container movement (box)	74,031	113,338	168,870
Total berth time (hour/ship)*	12.1	14.6	17.9
Berth occupancy ratio	29 %	35 %	43 %

2) Multi-Purpose Berth

The Multi-Purpose Berth occupancy rates are estimated based on the cargo handling rates and efficiency of the cargo handling system. The berth occupancy rate of the Multi-Purpose Berth in 2015 is assumed to be 35 %, thus it can be said that the berth will have an allowance to accommodate more vessels.

The maximum ship size of 50,000 DWT is assumed to be used for the commodities of cereals and soybean flour in the ultimate time, and next to the largest size of bulk carrier is 43,000 DWT class for fertilizer.

3) Passenger Berth

Passenger ship and car carriers will use the passenger berth. The berthing time for passenger ships is assumed to be two days per call judging from the past pattern of passenger ships calling at the Acajulta Port. The berth occupancy rate of this berth in 2015 is estimated at 3 % only. But service boats such as tugboats and pilot boats will be moored at the passenger berth.

(3) Dimensions of Berths

The characteristics of ships expected to call at the La Union Port are discussed in Appendix E.2. The maximum ship sizes of each type are summarized below.

Table 3.2.9 Characteristics of Vessels to Call at Cutuco Port

	Ship Size	LOA	Breadth	Draft
Bulk carrier	43~50,000 DWT	185 m	32.2 m	11.8 m
Container vessel	55,000 DWT	294 m	32.2 m	13.1 m
Car carrier (RoRo)	25,000 DWT	200 m	32.3 m	8.5 m
Passenger ship	25,000 GT	195 m	27.0 m	8.0 m

For bulk carriers and container vessels, it is required to provide one berth each considering the berth occupancy rate and characteristics of cargoes to be handled.

For car carrier and passenger ships, although they have low utilization rate, separate berths will be provided by the reasons as follows:

1) The berthe occupancy of container and multi-purpose berth will reach a saturated level at 2010 and 2015 year. It is difficult to use these berth commonly with passenger ships and car carriers.
2) At the eastsouth of the container berth the water depth has natural deep so as to accommodate passenger ships and car carriers, without large dredging.
3) By sticking out the dolphin structure tures at the eastsouth revetment, the berth facility can be obtained economically for passenger ship and car carriers.

The berth depth is determined from the sailing draft and keel clearance allowance, while the berth length is determined from the maximum LOA and allowance of mooring lines, which is set at 30° ~ 45° from the face line of the berth as illustrated in Appendix F.

Table 3.2.10 shows the dimensions of the three berths. The 560 m containers berth is aligned for container and multi-purpose berth, and 240 m length of passenger berth is allocated at the eastsouth side of the container berth. In order to allow Container Ships to use the Multi-purpose berth in special cases, the required depth of the berth is adjusted to –14.0m

Table 3.2.10 Dimensions of Berths

	Ship Size	Berth Length (m)	Berth Depth (m)
Container Berth	55,000 DWT	340 m	- 14.0 m
Multi-purpose Berth	50,000 DWT	220 m	- 14.0 m
Passenger Berth	25,000 DWT	240 m	- 9.5 m

3.2.2 Major Onshore Facilities

(1) Open Storage Area for Multi-Purpose Berth

Most of break-bulk cargoes will be directly transferred between ships and silos, storage sheds, etc. by conveyor belt and/or trucks. For iron and steel products, the open yard is required in the Multi-purpose berth. This storage yard is estimated as follows:

Yard for open storage = (Cargo Volume) x (Peak Factor) ÷ (Density of Cargo Storage) ÷ (Storage Efficiency) ÷ (Cycle Time per Year)

Each planning parameter is assumed as follows:

Peak Factor : 1.3

Density of cargo : 1.0 t/m^2

Storage efficiency : 0.5

Cycle Time : 12 times/year

Open storage area = 78,900 MT x 1.3 ÷1.0 t/m^2 ÷ 0.5 ÷ 12 times = 17,000 m^2.

(2) Open Storage Area for Car Carriers

An open storage area for vehicles unloaded from car carriers is required to be located next to the apron on the Passenger Berth. The maximum volume unloaded in 2000 at the Acajutla Port was 941 MT (equivalent to 627 vehicles) and the average was 298 MT (199 vehicles) per year. The car carriers calls at the port in 2015 is 33 which is equivalent to 1.4 calls per month in average. The open storage area for unloaded vehicles is planned to accommodate 650 vehicles (full load of one car carriers).

Open storage area = 650 vehicles x (unit area per vehicle) ÷ (storage efficiency for dead space and passage) = 650 x 14 m^2 ÷ 0.5 = 18,000 m^2.

(3) Buildings

1) Administration Building

The Administration Building planned to accommodate three categories of personnel 1) CEPA administration staff, 2) Government and related office staff, and 3) Container Terminal Concessionaire staff. The Government and related offices include quarantine, meteorology, custom, police, immigration, and banks.

The floor area for ordinary offices is calculated on the basis of the required standard unit floor area of 10 m^2 per person, which is widely adopted in the designing of office buildings in Japan and is the average area of existing offices in the Acajutla Port.

The areas for specific rooms such as auditorium, conference room, cafeteria, first aid, customs, immigration, quarantine and manager rooms are determined in due consideration of their functions and purposes.

The common areas such as corridors, elevator shaft, staircases, toilets, machine rooms, electrical and plumbing piping shafts and such other areas as necessary for the function of the building are determined on the assumption that 35% of the entire floor area is appropriate for the common areas.

The total number of staff to be accommodated in the building is 92. Out of that, 68 staff will be placed in ordinary offices as shown below.

Table 3.2.11 Number of Staff Accommodated in Administration Building

Category of Office	Ordinary Office Room	Special Room Allocation	Total Staff Number
CEPA administration staff	29	9	38
Government and related office staff	10	15	25
Container terminal concessionaire Officers	29	0	29
Total	68	24	92

From the above assumption, the floor area required was computed at 2,550 m^2, as detailed below:

Ordinary Office Area (1) 68 persons x 10 m2/psn. = 680 m^2
Specific Offices and Area (2) 614 (for CEPA) + 365 (for Government Officer) = 979 m^2
Common Areas (3) [(680 + 979)/0.65] x 0.35 = 893 m^2
Total Floor Area (1) + (2) + (3) 2,552 m^2 say 2,550 m^2

Details of the assumed number of staff for each category of office and allocation of specific rooms are presented in Appendix E.

2) Container Freight Station (CFS)

The FCL cargo is currently checked by customs offices at the central customs office in San Salvador or the customs office located at the free trade zone. Only LCL cargo will be examined at the port. Stuffing and un-stuffing of LCL containers will be done at the CFS provided inside the port area. The number and cargo volume of LCL are summarized in Table 3.2.12.

Table 3.2.12 CFS Cargo

Description	2005	2010	2015
(1) LCL Export			
Container in TEU	497	718	1,047
Cargo Volume in MT	6,860	10,120	15,080
(2) LCL Import			
Container in TEU	184	284	436
Cargo Volume in MT	1,750	2,750	4,360
(3) Total LCL			
Container in TEU	683	1,002	1,483
Cargo Volume in MT	8,610	12,870	19,440

The required area for CFS was determined as follows, considering operation of containers and cargo trucks.

- CY side platform for handling container cargo : 4.24 m
- Bay depth of CFS (inside the building) : 30.0 m
- Truck side platform for handling loose cargo : 4.24 m

The CFS bay depth of 30 m is subdivided into the following areas

- Space for loading/unloading of cargo on the container side : 5 m
- Space for cargo handling equipment and passage : 10 m
- Space for cargo storage : 10 m
- Space for cargo loading/unloading on the truck side : 5 m

The area requirement for cargo storage was determined from the following equation.

Area for cargo storage = (CFS cargo volume) x (Dwell Time) x (Peak Factor) ÷ (Density of Cargo) ÷ (Storage Efficiency) ÷ (Operational Day of CFS)

Each planning parameter is assumed as follows:

- Dwell time : 7 days
- Peak Factor : 1.5
- Density of cargo : 1.0 t/ m^2
- Storage efficiency : 0.7
- Operational days of CFS : 365 days

Since the LCL containers is declining in El Salvador very quickly, the future number of LCL containers is uncertain. In order to avoid the risk of over investment for the CFS facility, the required CFS area was computed based on the estimated LCL containers in 2010 and the possibility of future expansion of the building is also taken into consideration in layout planning. The required cargo storage area in 2010 was calculated as follows:

Area for cargo storage = 12,870 MT x 7 days x 1.5 ÷1.0 t/sq.m ÷ 0.7 ÷ 365 days = 530 m^2 (10 m x 53 m).

The length of the CFS building is determined to be 75 m (storage cargo 53m + special cargo storage, passage and office 22 m).

Therefore, the CFS ground floor area was set at 2,200 m^2 (30 x 75m) with 222 m^2 office at the mezzanine level.

3) Maintenance and Repair Shop

The maintenance and repair shop will be provided for checking and repairing of yard equipment to be utilized in the container terminal. Major equipment to be maintained in the building includes top loader, forklift, yard chassis, and yard tractors. The building space shall allow the maintenance of one top loader or forklift and two chassis with head tractor. Aside from the main repair area, an inspection area with pits, washing area, electrical overhaul room, mechanical overhaul room, office space and toilet/washing room shall be provided. The required floor area is determined to be 1,440 m^2 and the size of the building was determined to be 54 m x 24 m having a small mezzanine floor.

[Required Floor Area]

(1st Floor)

Main repair area	850 m^2
Inspection area with pits	144 m^2
Washing area	144 m^2
Electrical overhaul room	36 m^2
Toilet/washing room	54 m^2
Others	68 m^2
Total for 1st floor	1,296 m^2

(Mezzanine floor)

Office	60 m^2
Training room	36 m^2
Others	48 m^2
Total for Mezzanine floor	144 m^2

Since the top loader has dimensions of about 6.5 m high and 6.1 m wide when the attachment is folded, one opening shall be provided to cater for this equipment.

(4) Gate

Given that the port will most likely be operated by different concessionaires, then separate gates shall be provided for the container terminal and the multi-purpose cargo terminal. The lane number of terminal gates is determined within a range of occupancy rate of about 45% in the year 2010. The gates shall accommodate laden container trailers, empty container trailers, loaded/empty trucks and other traffics such as office employees vehicles, visitors, etc.

In determining the number of gate lanes, the following factors were assumed:

1) Peak factor of daily traffic : 1.5

2) Gate operation hour : 16 hours (2 shifts)

3) Service times for each type of traffic : assumed as shown in Table 3.2.13.

Table 3.2.13 Gate Service Time

	Type of Container/Tractor/Chassis	Service Time
(1) Gate In		
Laden	Export FCL	4.0 min
Empty container	Export Empty, Empty for Export LCL	3.0 min
Empty chassis	Receiving Import FCL, Import Empty, and Empty of Import LCL	2.0 min
(2) Gate Out		
Laden	Import FCL	3.5 min
Empty container	Import Empty, Empty for Import LCL	2.5 min
Empty chassis	Return of Export FCL and Export Empty, and receiving Empty of Export LCL	2.0 min

The number of lanes for the container gate is determined to be 6 lanes (3 lanes each for gate-in and gate-out) for the year 2010, and 10 lanes for the year 2015 based on the requirements shown in Table 3.2.14. It is expected that the gate service level will be drastically down in 2010, thus the number of lanes shall be increased after 2010.

Table 3.2.14 Requirement of Container Terminal Gate

Item	2005	2010	2015
1) Gate-In			
Average Daily Traffic of Laden Container	30	41	57
Average Daily Traffic of Empty Container	71	114	174
Average Daily Traffic of Empty Chassis	101	155	231
Average Total Service Time	9.0 hr	13.6 hr	20.3 hr
Peak Factor	1.5	1.5	1.5
Occupancy Rate in 3 lanes for the year 2010	28 %	43 %	-
Occupancy Rate in 5 lanes for the year 2015			38%
2) Gate-Out			
Average Daily Traffic of Laden Container	92	141	210
Average Daily Traffic of Empty Container	9	14	21
Average Daily Traffic of Empty Chassis	101	156	232
Average Total Service Time	9.2 hr	14.0 hr	20.8 hr
Peak Factor	1.5	1.5	1.5
Occupancy Rate in 3 lanes for the year 2010	29 %	44 %	-
Occupancy Rate in 5 lanes for the year 2015			39%

The number of lanes for the cargo terminal gate is determined to be 3 lanes (1 lane for gate-in and 2 lanes for gate-out) as shown in Table 3.2.15.

Table 3.2.15 Required Number of Lanes for Cargo Terminal Gate

Item	2005	2010	2015
1) Gate-In			
Daily Traffic of Loaded Truck	9	9	9
Daily Traffic of Empty Truck	73	87	101
Daily Traffic of Others	21	24	28
Peak Factor	1.5	1.5	1.5
Operational Hour of Gate (hr)	16 hr	16 hr	16 hr
Service Time for Loaded Truck	5 min	5 min	5 min
Service Time for Empty Truck and Others	2 min	2 min	2 min
Occupancy Rate in 1 lane	36 %	42 %	47 %
2) Gate-Out			
Daily Traffic of Loaded Truck	73	87	101
Daily Traffic of Empty Truck	9	9	9
Daily Traffic of Others	21	24	28
Peak Factor	1.5	1.5	1.5
Operational Hour of Gate (hr)	16 hr	16 hr	16 hr
Service Time for Loaded Truck	5 min	5 min	5 min
Service Time for Empty Truck	2 min	2 min	2 min
Occupancy Rate in 2 lanes	39 %	39 %	45 %

(5) Incinerator

In the preliminary discussion with the Technical Committee, CEPA has suggested that the incinerator facility may not be required, as the waste material is generally limited to domestic-type waste and is not expected to produce a significant volume. CEPA invited the Technical Committee members to the Acajutla Port to show the present operation activities of the port and the situation of waste production. The members hinted that the port activity will be similar and that the foreseen volume of solid waste will be minimal. MARN agreed to withdraw the requirement for the establishment of an incinerator at the site.

(6) Other Onshore Facilities

In addition to the above facilities, the following onshore facilities are necessary for the port.

- Storm water drainage system
- Wastewater treatment facility
- Water supply facilities (domestic water supply and water purification)
- Oil separator for the maintenance and repair shop and fuel station
- Power sub-station and distribution system
- Power stand-by generator
- Oil fence

3.3 Terminal Layout Plan

3.3.1 Container Terminal Layout

(1) Comparison for Cargo Handling Systems

There are several container handling systems for container terminal operation. Each system has advantages and disadvantages, thus it is necessary to consider the particular conditions of the respective port development.

Among those systems, the following four (4) systems are commonly applicable for container terminals, therefore these systems are selected for the comparison.

- Straddle Carrier System
- Rubber Tired Gantry Crane System (RTG)
- Reach Stacker System
- Forklift System

The advantages and disadvantages of each system are summarized in Table 3.3.1.

The required container ground slot for each container handling system for laden containers is computed as shown in Table 3.3.2 and the yard layout plans for each system are shown in Figures 3.3.1 to 3.3.4.

Table 3.3.1 Comparison of Yard Handling Systems

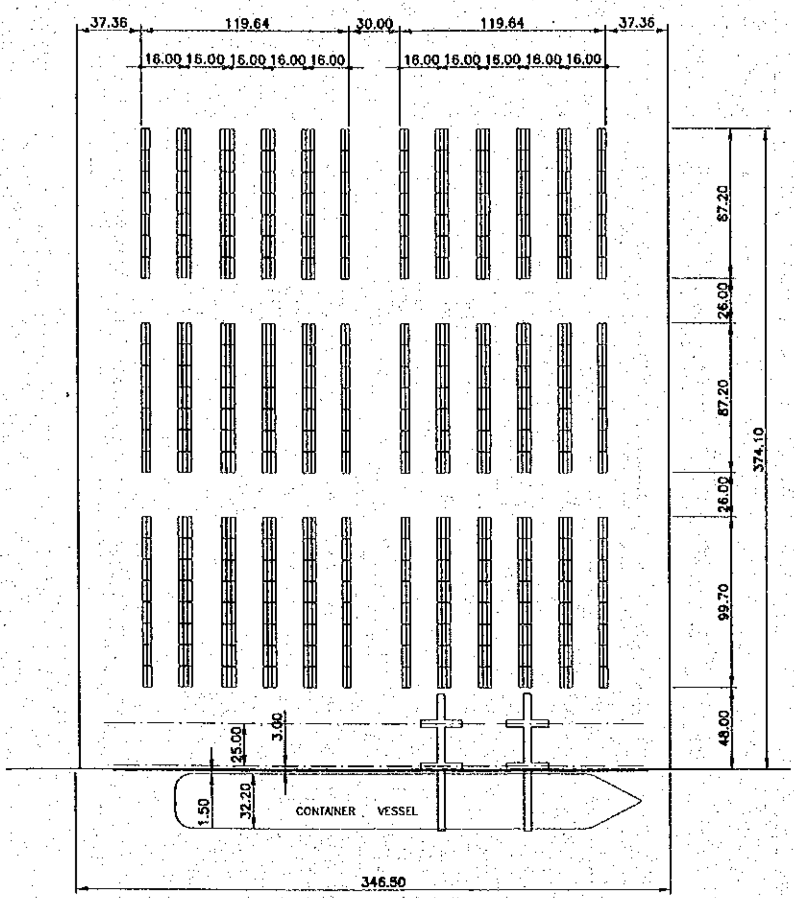
Evaluation Item	Forklift System	Reach Stacker System	Straddle Carrier System	Rubber Tired Gantry (RTG)
Handling Capacity	Small	Slightly small	Normal	Large
Storage Capacity	Small	Slightly small	Normal	Large
Standard Stacking Layer	Import 2, Export 3	Import 2, Export 3	Import 2, Export 3	Import 3, Export 3~4
Initial Investment	Small	Small	Slightly High	High
Adaptability by Several Operators (Stevedore)	Acceptable	Acceptable	Acceptable	Acceptable
Computerization	Difficult	Difficult	Difficult	Suitable
Pavement	All Heavy Pavement	All Heavy Pavement	All Heavy Pavement	Travelling Lanes only Heavy Pavement
Damage of Container	Large	Large	Slightly large	Small
Flexibility of Operation	Flexible	Flexible	Flexible and simple	Small
Required Stacking Area	Huge	Huge	Slightly Large	Small
Preliminary Evaluation	Not Recommended	Not Recommended	For Detailed Comparison	For Detailed Comparison

Table 3.3.2 Comparison of Required Ground Slot for Laden Container by Each Container Handling System

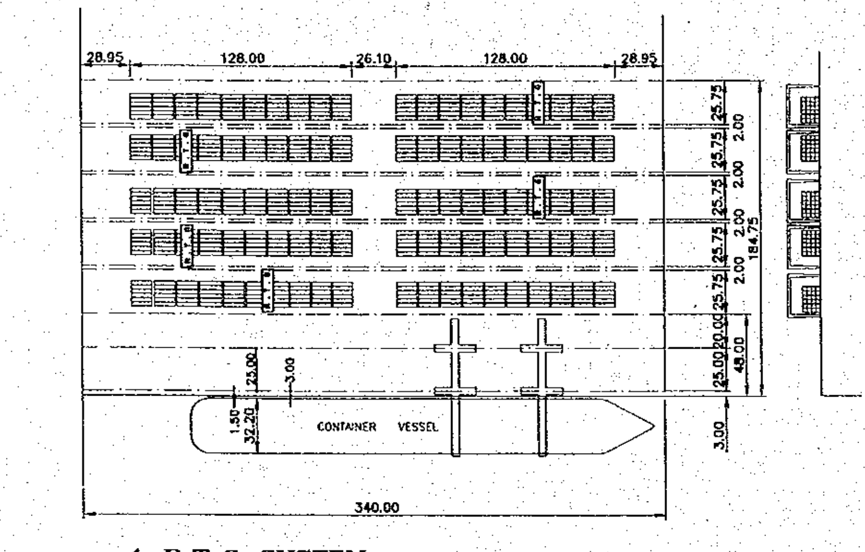
IMPORT	2005				2010				2015			
	Fork Lift	R. Stacker	SC	RTG	Fork Lift	R. Stacker	SC	RTG	Fork Lift	R. Stacker	SC	RTG
Laden Containers (TEU)	55,396	55,396	55,396	55,396	84,614	84,614	84,614	84,614	125,945	125,945	125,945	125,945
Average Dwelling Days	4	4	4	4	4	4	4	4	4	4	4	4
Peak Ratio	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Average Stacked Height	1.5	1.5	1.5	2.0	1.5	1.5	1.5	2.0	1.5	1.5	1.5	2.0
Slot per square meter	0.01540	0.02180	0.04060	0.03650	0.01540	0.02180	0.04060	0.03650	0.01540	0.02180	0.04060	0.03650
Required Area (m2)	34,165	24,135	12,959	10,811	52,184	36,864	19,794	16,513	77,675	54,871	29,463	24,579
Ground Slot Required (TEU)	526	526	526	395	804	804	804	603	1,196	1,196	1,196	897

EXPORT	2005				2010				2015			
	Fork Lift	R. Stacker	SC	RTG	Fork Lift	R. Stacker	SC	RTG	Fork Lift	R. Stacker	SC	RTG
Laden Containers (TEU)	18,020	18,020	18,020	18,020	25,007	25,007	25,007	25,007	35,018	35,018	35,018	35,018
Average Dwelling Days	3	3	3	3	3	3	3	3	3	3	3	3
Peak Ratio	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Average Stacked No. in Slot	2.0	2.0	2.0	2.5	2.0	2.0	2.0	2.5	2.0	2.0	2.0	2.5
Slot per square meter	0.01540	0.02180	0.04060	0.03650	0.01540	0.02180	0.04060	0.03650	0.01540	0.02180	0.04060	0.03650
Required Area (m2)	6,251	4,416	2,371	2,110	8,675	6,128	3,291	2,928	12,148	8,582	4,608	4,100
Ground Slot Required (TEU)	96	96	96	77	134	134	134	107	187	187	187	150

Grand Slot Required (TEU)	**622**	**622**	**622**	**472**	**937**	**937**	**937**	**710**	**1,383**	**1,383**	**1,383**	**1,047**

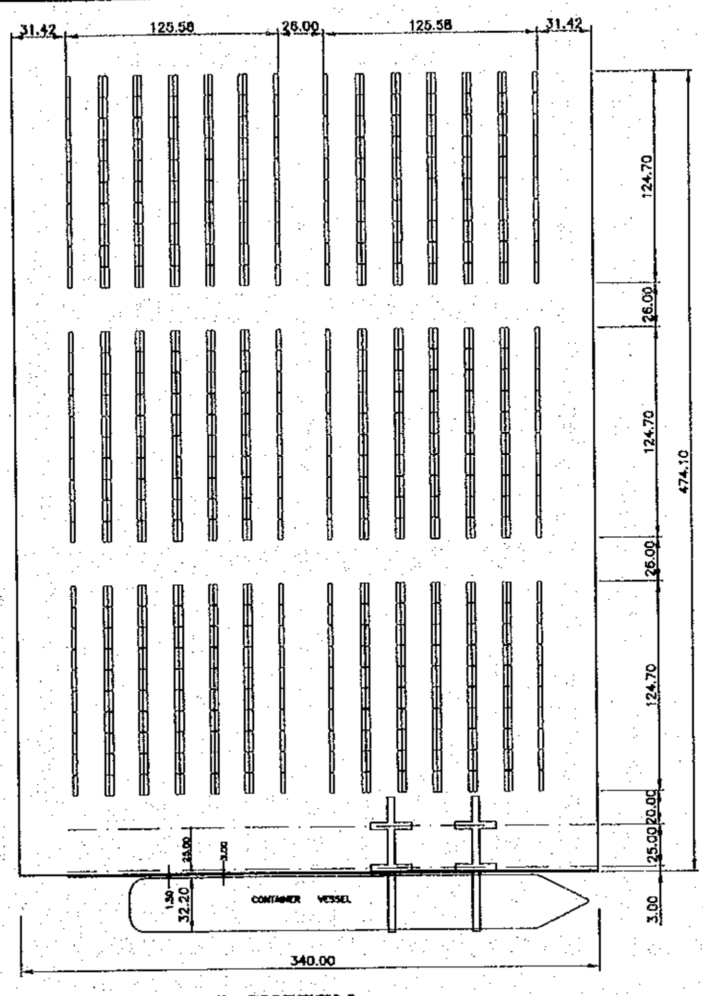


a–2 REACH STACKER SYSTEM
(Ground Slot: 1,408 TEUs)

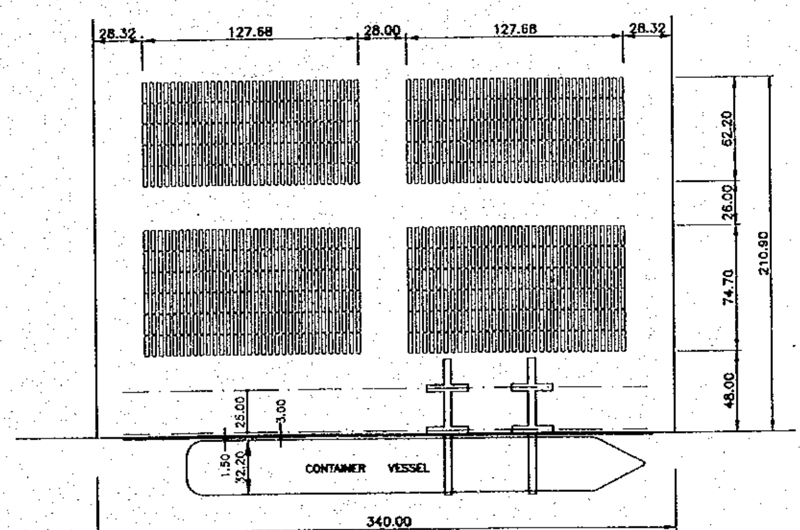


a–1 R.T.G SYSTEM
(Ground Slot: 1,200 TEUs)

Japan International Cooperation Agency (JICA)	Figure	Title
The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.1	CONTAINER ARRANGEMENT (a)



b–2 FORK LIFT SYSTEM
(Ground Slot: 1,440 TEUs)



b–1 STRADDLE CARRIER SYSTEM
(Ground Slot: 1,440 TEUs)

Japan International Cooperation Agency (JICA)	Figure	Title
The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.2	CONTAINER ARRANGEMENT (b)

The Reach Stacker and the Forklift systems require a comparatively larger terminal area, while the Straddle Carrier and the RTG systems require a moderate area.

Presently the Acajutla Port is using the chassis system with straddle carriers in the stacking yard due to the following special port conditions:

- No space can be allocated for the container marshalling near the pier.
- Far distance between the container yard and the pier.
- The number of containers being handled is quite small in comparison with other major container terminals.

It is planned that the La Unión Port will be operated by concessionaires who will be selected before the completion of the container terminal under the strong Government Policy of Privatization. In preparing the proposed container handling system, due consideration shall be given to the container handling system currently applied by concessionaires in major ports. At the present time, the RTG system has become the major container handling system in many countries due to its smaller land requirements.

Taking the above circumstances and conditions into account, a further examination on the Straddle Carrier (SC) System and Rubber Tyred Gantry (RTG) System was made. The examination results are indicated in Table 3.3.3.

Table 3.3.3 Comparison of Rubber Tired Gantry and Straddle Carrier Systems

Description	RTG System	SC System
1. Civil Works	RTG travels on the fixed lane. Hence, only PTG path is required to have heavy-duty pavement.	SC has to travel freely in the terminal area with loaded containers. Hence heavy-duty pavement is required for the whole terminal area resulting in higher pavement cost.
2. Procurement Cost of Container Handling Equipment	Slightly higher	Slightly lower
3. Life Years of Equipment	15 years	15 years (chassis) 10 years (tractor)
4. Maintenance Costs %	14% of procurement cost	29% of procurement cost
5. Computerization	Common to introduce computer system	Difficult to introduce
Evaluation	**Proposed**	**Not Proposed**

The Rubber Tyred Gantry (RTG) System is recommended for the La Unión Container Terminal in consideration of its long service life, low maintenance cost as well as adaptability for the computer management system.

As shown in Figure 3.3.1, a total of 1,200 twenty-feet equivalent ground slot (TGS) will be prepared for laden containers. The number of empty containers to be handled in 2015 will be as much as 114,000 TEUs. The majority of empty containers are export containers which are due to the lower export volume. Considering that the average number of empty container movements per vessel is about 500 TEUs, then an area for 1,000 TEU of empty containers, which is equivalent to two container ship loads shall be reserved in the port. As to the reefer container currently handled in the Acajutla Port, the average number of laden reefer containers unloaded per ship is 41 boxes. Most of loaded reefers are empty. Hence, a total of 64 plugs will be provided in 2-tiers stacking. However, the electrical supply system will be designed to cater for future possible expansion to 96 plugs (50% more) with a 3-tiers stacking system.

For the yard equipment, the following cargo handling equipment will be required in the RTG system terminal by the target year 2015.

Table 3.3.4 Cargo Handling Equipment with RTG System

Equipment	Specification	Required No.
1. Quayside Gantry Crane	40.6t, span 25m	2
2. Transfer Crane (RTG)	40.6t (1 over 4 tiers)	6
3. Reach Stacker or Forklift Truck	40.6t (Reefer etc.)	1
4. Forklift or Reach Stacker	18.0t (Empty container)	3 ~ 4
5. Forklift Truck	1.5t (CFS etc.)	2
6. Yard Tractor Head		8
7. Yard Chassis	40ft or 20ft x 2	12

(2) Terminal Layout Plan

In order to prepare the most appropriate terminal layout plan, the traffic flow both inflow and outflow traffics of containers in the container yard is examined. After a thorough examination of the traffic flow and port related traffic including visitors for document arrangement for shipping and cargo clearance at the Administration Building, the layout of the terminal was prepared (see Figures 3.3.3 and 3.3.4).

According to the terminal layout, a container gate will be provided at the center of the yard which is in a straight line from the access road extended from the Bypass road. All buildings will be placed on landside to keep space for the stacking and marshaling area as much as possible considering flexibility for future modification of yard by possible preference of selected concessionaire. The Administration Building is placed beside the gate, since some drivers may need to access to the Administration Building in case of lack of documentation or identification of certificates.

(3) Sensitivity Study on Required Port Facilities

As discussed in 3.1.7(2) there is uncertainty in future cargo forecast of transit containers from the neighboring countries. Considering such uncertain factors, three (3) lower forecast cases, i.e. the transit container cargo are 70%, 40% and 0% respectively of the base case have also been estimated.

Based on the estimated container cargoes of each lower forecast case, the required port facilities were compared with the base case as shown in Table 3.2.15. As can be seen from the Table, total containers of each case in TEUs differs from the base case, however no difference in container numbers of LCL and reefer is found for all cases. This means that the difference between the base case and the lower forecast cases can be taken from the required container yard areas for laden and empty containers, by which a cost saving in the initial construction cost of each case can also be compared.

The study results indicate that the cost savings of the respective cases are between 0.1% to 0.4% of the estimated total construction cost (total cost for civil and building works, details see Chapter 9 Cost Estimate).

It is therefore recommended that the base case be considered in the design since the cost savings from the lower forecast cases would be a small.

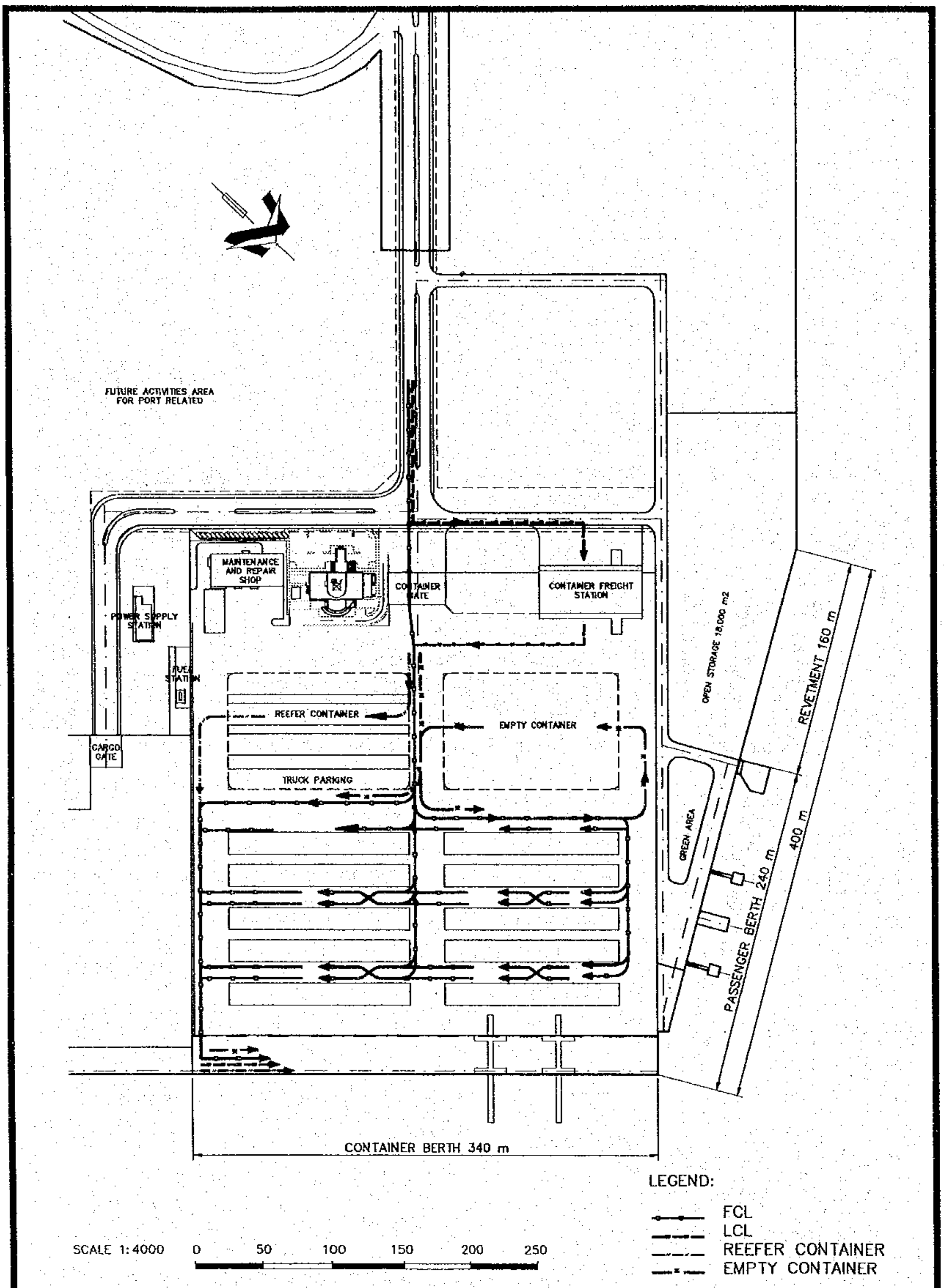
Table 3.3.5 Comparison of Terminal Area Requirement (at Year 2015)

ITEMS	BASE CASE	Lower Forecast		
		Case 1 (70%)	Case 2 (40%)	Case 3 (0%)
1. Containers (TEU)	275,073 (100%)	249,908 (90.9%)	224,743 (81.7%)	191,191 (69.5%)
1.1 Import (TEU)	137,323	124,740	112,158	95,382
- FCL	125,509	113,896	102,285	86,802
- LCL	436	436	436	436
- Empty	11,378	10,408	9,438	8,144
1.2 Export (TEU)	137,750	125,168	112,585	95,809
- FCL	33,971	31,320	28,669	25,134
- LCL	1,047	1,047	1,047	1,047
- Empty	102,732	92,801	82,870	69,628
1.3 Reefer (TEU)	(2,657)	(2,657)	(2,657)	(2,657)
2. Area Requirement				
2.1 Ground Slot (TEU)	1,020	934	840	715
- Import (TEU)	879	796	713	603
- Export (TEU)	149	138	127	112
2.2 Ground Slot (TEU) (Empty)	464	420	376	317
2.3 Required Area (m2)	39,530	35,880	32,220	27,360
- C.Y	28,160	25,590	23,010	19,590
- Empty	11,370	10,290	9,210	7,770
3. Cost Savings (US$)	0	124,061	248,518	413,669
- Yard Paving	0	112,783	225,925	376,063
. Other Associated Cost (10%)	0	11,278	22,593	37,606
Ratio against Total Construction Cost	-	0.1%	0.24%	0.40%

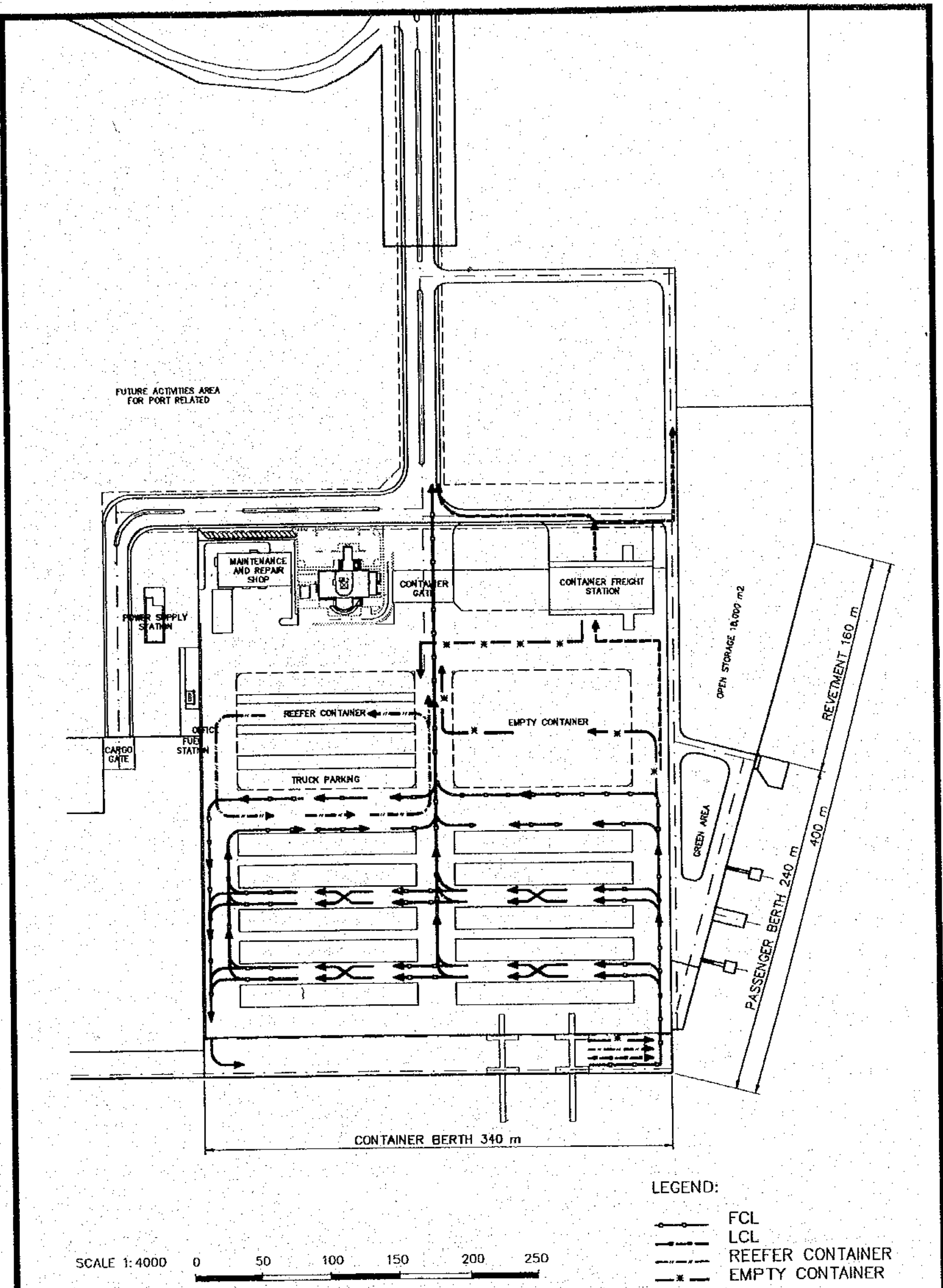
Note : Unit cost used for the cost savings are as follows:

- Container Yard: 35.9 US$/m2 (Average)
- Empty Container Yard: 190 US$/m2 (Gravel paving + Stacking plate costs)

Total Construction Cost: Total Cost for Civil and Building works (US$ 102,545,910)



Japan International Cooperation Agency (JICA)	Figure	Title
The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.3	TRAFFIC FLOW OF CONTAINER CARGO (IN)



Japan International Cooperation Agency (JICA)	Figure	Title
The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.4	TRAFFIC FLOW OF CONTAINER CARGO (OUT)

3.3.2 Multi-Purpose Cargo Terminal Layout

(1) Basis of Planning

It is expected to handle bulk cargoes such as cereal, maize floor, fertilizer, sugar, molasses, iron and steel, and cement in bag will be handled in the Multi-purpose Cargo Terminal. Those commodities are identified by the traffic demand forecast through the transportation cost analysis and economic survey as discussed in Section 3.1. Out of those commodities, fertilizer and cement are currently handled at the Punta Gorda Port and their distribution network is already established, thus these are the most promising commodities to be handled in the terminal. On the other hand, there are uncertain factors for other commodities, even if they were identified as potential cargoes by the traffic demand forecast including the economic justification of transportation cost, since the final decision to use the port is depending on the feasibility study of the port users and their company's policy.

The cargo handling operation in the Multi-purpose terminal is expected to be carried out by a private operator based on the concession agreement. It is considered that the final yard layout plan and arrangement of facilities including cargo handling equipment will be decided by the concessionaire based on the characteristics and volume of cargoes assured with the port users through market research and promotion.

Due to the reason above, the layout plan of the Multi-purpose Cargo Terminal is prepared on a preliminary basis in this Study.

(2) Cargo Handling System

The preliminary study of cargo handling system for the terminal is made based on the estimated commodities and volume identified by the traffic demand forecast. In preparing the preliminary cargo handling scheme, the following points were taken into consideration:

i) Effective handling and sufficient capacity
ii) Low air pollution
iii) Flexible use of equipment
iv) Avoidance of fixed type equipment as much as possible
v) Privatization of cargo handling operation

The sea transportation cost of bulk cargo depends mainly on the size of ships and duration of dwelling time in the port. The cargo handling (loading and unloading) capacity is the most important factor of dwelling time at the port. In selecting the appropriate cargo handling system, an emphasis shall be put on its productivity to minimize the port time of bulkers. The required handling capacity (R) is calculated by the following formula:

$$R = V / (D \times H \times N \times E)$$

Where,

R: Required nominal capacity (t/h)

V: Cargo volume to be handled (t/y)

D: Workable days (d/y)

H: Workable hours (h/d)

N: Number of equipment

E: Efficiency

In examining the features of cargo, size of ships, average cargo volume per ship, and other factors, the recommended cargo handling system with appropriate productivity for each commodity is summarized in Table 3.3.5.

(3) Terminal Layout Plan

Since the Multi-purpose Cargo Terminal is recommended to be operated by a selected concessionaire, the cargo handling equipment and necessary facilities such as office, storage yard arrangement, and other onshore utilities will be provided by the concessionaire and/or partly by the port user. It is therefore intended to provide in this Project a basic infrastructure such as berth, apron paving and gate.

The movement of cargoes in this terminal is simple, since the cargoes are directly loaded/unloaded to/from the trucks or temporarily placed at the storage yard. The cargoes such as cereal, fertilizer, sugar, molasses, and cement are former case, while the iron and their products is later case.

In order to accommodate possible pipelines for liquid cargoes, a utility tunnel with several manholes for outlet valves will be provided under the apron of quaywall. At the eastern side of the terminal, a linear area with 25 m wide will be provided for possible future installation of fixed type cargo handling system such as pipelines and belt conveyor, and utility facilities such as water pipe, firefighting facility, and electric underground cables.

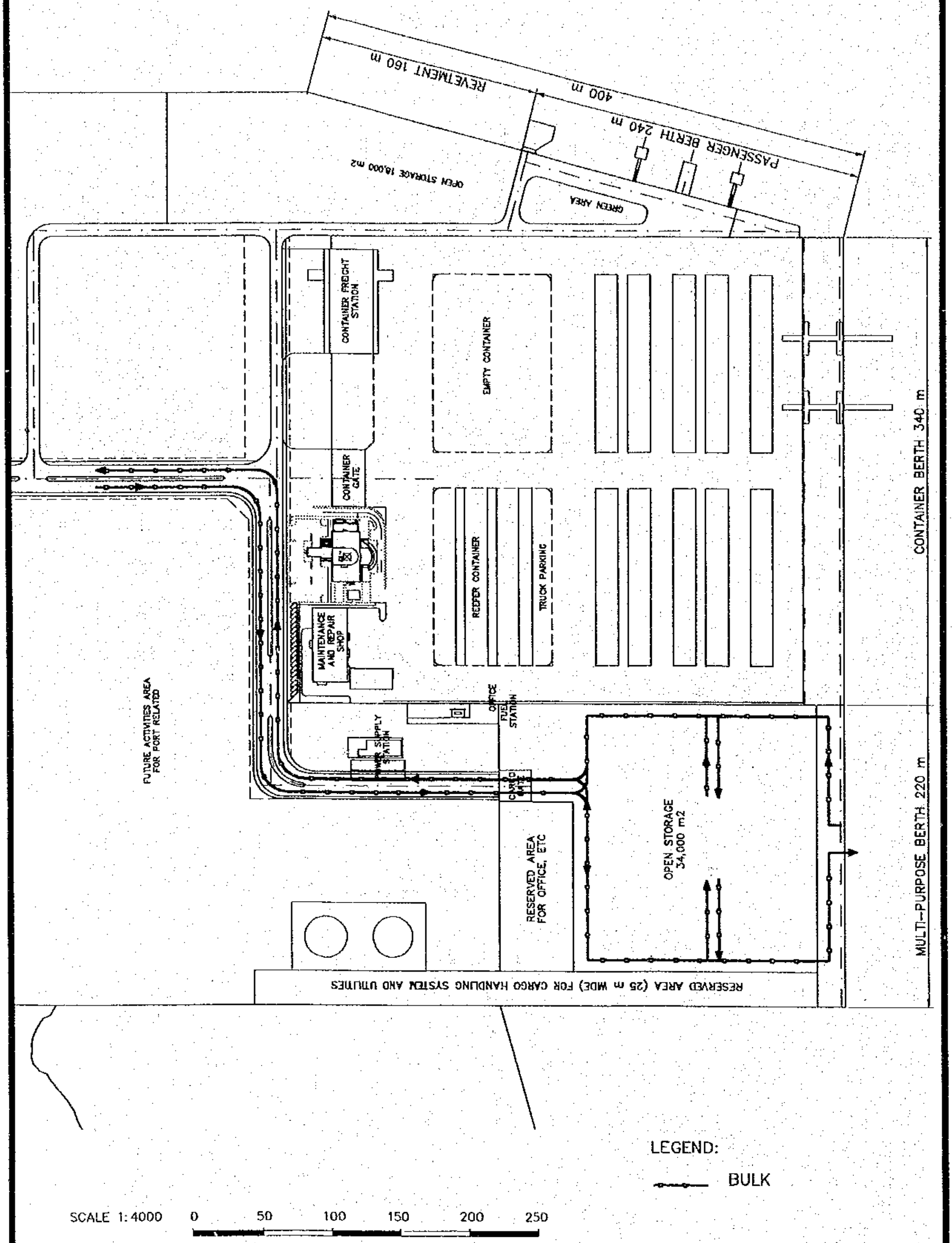
At the most landside area of the terminal, a sufficient space will be provided for the concessionaire to build their facilities including their office (see Figure 3.3.7).

Table 3.3.6 (1) Bulk Cargo Handling System

		Cereal including maize flour and sybean	Fertilizer	Sugar	Iron and steel and their products
Cargo Volume	2010	Cereal including maize flour: 357,000ton Soybean flour. 62,700ton Total. 419,000ton	105,300ton	60,000ton	55,500ton/year
	2015	Cereal including maize flour: 429,000ton Soybean flour. 62,700ton Total. 496,500ton	105,300ton	60,000ton	55,500ton/year
Handling System		From ship : movable rubber tire pneumatic unloader From apron to landside : dump truck	From ship : ship gear with grab bucket From apron to landside : dump truck. A portable hopper will be used for charging the trucks.	To ship : Tire mounted portable ship loader with small hopper From landside : dump truck	From ship : ship gear with hoo and sling
Required Handling Equipment		Movable rubber tire pneumatic unloader	Grab bucket 6m3 Portable hopper 20m3	Tire mounted portable ship loader 100ton/hour, 3units	Slings for heavy cargo
Productivity		Assumed conditions Initial : 90% Cargo efficiency : 0.78 Remain : 10% Cargo efficiency : 0.709 Productivity (ton/hour) P=300 x 0.709 =421to/hour (say400)	Assumed conditions Average gravity: 0.85 Cycle time : 150sec (24 cycles/hour) Bucket efficiency : 0.7 Operation efficiency : 0.8 3 gang per ship Productivity (ton/hour) P=6 x 0.85 x 0.7 x 24 x 0.8 x 3 =205.6 (say 200)	Assumed conditions Loader efficiency : 0.7 Operation efficiency : 0.8 Productivity (ton/hour) P=100 x 3 x 0.7 =210 (say 210)	Assumed conditions Average : one unit cargo 4 tons Average lifting units : 2 units Cycle time : 5 minutes (12 cycles/hour) Operation efficiency : 0.8 Average number of gang : 2.5 Productivity (ton/hour) P=4 x 2 x 12 x 0.8 x 2.5 =192 ton/hour (say190)
Required Day		Required day D=419,700 / (400 x 24 x 0.8) = 55 days	Required day D=105,300 / (200 x 24 x 0.8) = 28 days	Required day D=60,000 / (210 x 24 x 0.8) = 15 days	Required day D=55,500 / (190 x 24 x 0.8) =16 days

Table 3.3.6 (2) Bulk Cargo Handling System

		Vehicle	Cement in bag	Molasses
Cargo Volume	2010	6,600ton/year	70,000ton/year	10,000ton/year
	2015	9,900ton/year	80,000ton/year	10,000ton/year
Handling System		From ship : Self landing on her lamp Vehicles are transported by special vessel (Ro/Ro type)	From ship : ship gear with special big bag (flexible container) and special sling From apron to landside : truck or trailer	It is handled by conventional system by tank lorry through pile line.
Required Handling Equipment		No equipment needed	Tire mounted portable ship loader 100ton/hour, 3units	Sling for heavy cargo
Productivity		Assumed conditions Average tonnage : 1.41ton/vehicle Landing cars : 60 cars per hour Productivity (ton/hour) P=1.41 x 60 =84.6 (say 85)	Assumed conditions Weigh of big bag : 1ton Average number of bag per hook : 6 bags Cycle time : 4 minutes (15 cycles per hour) Number of gangs : 3 gangs Operation efficiency : 0.8 Productivity (ton/hour) P=6 x 15 x 3 x 0.8 =216 (say 210)	Productivity (ton/hour) P=300 ton/hour
Required Day		Required day D=6,600 / (85 x 24 x 0.8) = 5 days	Required day D=70,000 / 210 x 24 x 0.8 = 18 days	Required day D=10,000 / (300 x 24 x 0.8) =2 days



Japan International Cooperation Agency (JICA)	Figure	Title
The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.5	TRAFFIC FLOW OF BULK CARGO

3.3.3 Passenger Terminal Plan

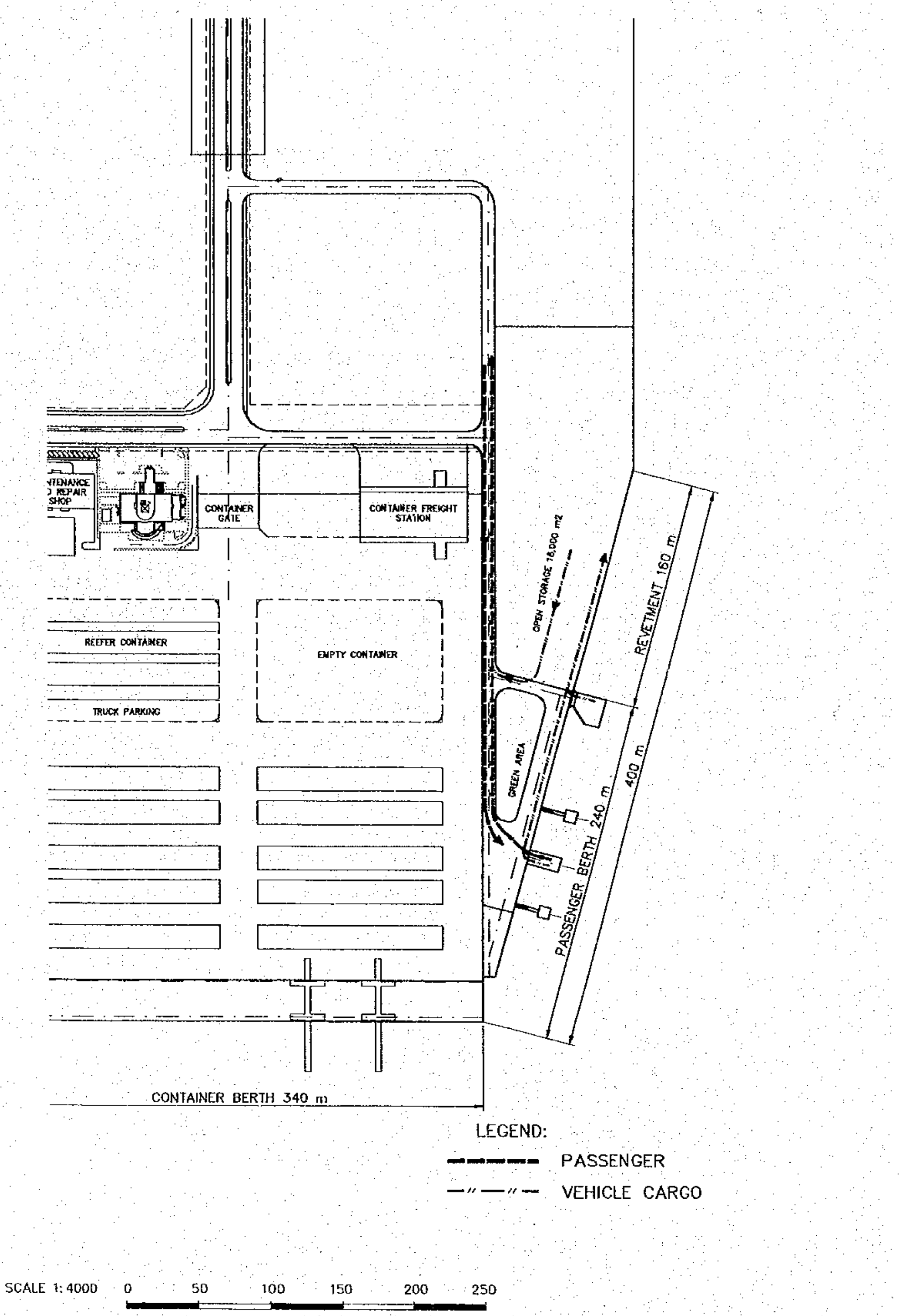
The Passenger Terminal is planned to be located in the western part of the port. This terminal will have the function of accommodating passenger ships and Ro/Ro type car carriers. Considering these ships and the commoditie s to be handled, the berth facility is planned to be of the dolphin type structure since it is a most economical solution. This terminal can be also utilized for mooring tugboats which will be procured under the Project. The water depth in front of the t erminal is naturally deep to accommodate the design ships expected.

In the case of the Acajutla Port, immigration and quarantine inspectors visit passenger ships for inspection and tourist buses receive passengers beside the ships. Hence a special building for passengers is not required. It is assumed that the way of receiving tourist passengers at the La Union Port will be the same way as the Acajutla Port currently applied, thus no passenger building will be provided in the terminal.

For temporary stora ge of unloaded cars, an open storage yard will be placed near the berth. The size of the storage area is determined at 18,000 m^2 to accommodate 650 cars which is the number of cars unloaded per one car carrier. After custom inspection, these cars temporarily stored will be taken out from the port.

The berth line of passenger berth is determined at 75 degrees from the container berth line to keep required area for safety maneuvering and securing the open area of unloaded cars.

A feeder road will be aligned to connect the main port road. The layout plan of the passenger terminal is prepared as shown in Figure 3.3.8.



Japan International Cooperation Agency (JICA)	Figure	Title
The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.6	TRAFFIC FLOW OF PASSENGER AND VEHICLE CARGO

3.3.4 General Terminal Plan

In the JICA F/S Study, the port layouts had been studied for two sites. From the result of the study, the location of the proposed new port had been determined to be located between the existing ports, the Punta Gorda Port and the Cutuco Port.

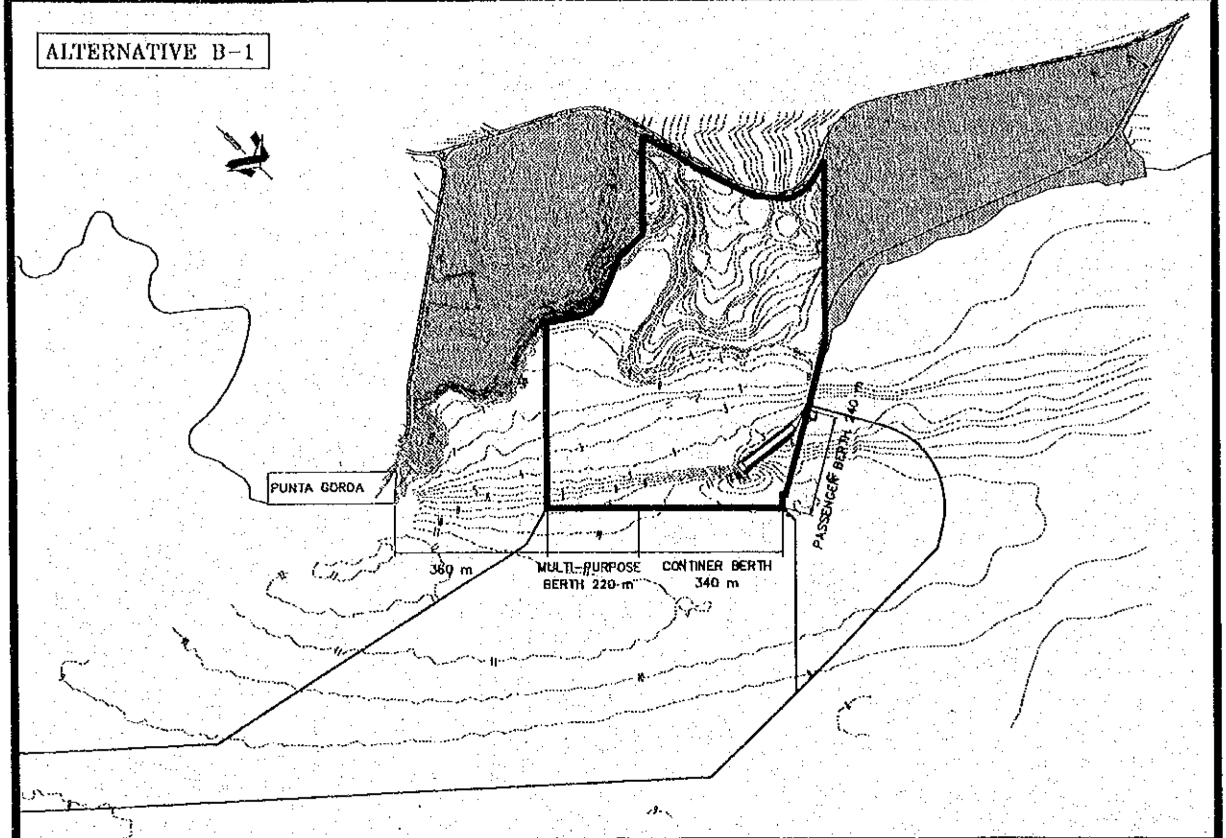
Additional field investigations including bathymetric survey, seismic profiling survey and geological investigation are carried out under this Study. Major findings and changes from the previous JICA F/S Study are summarized below.

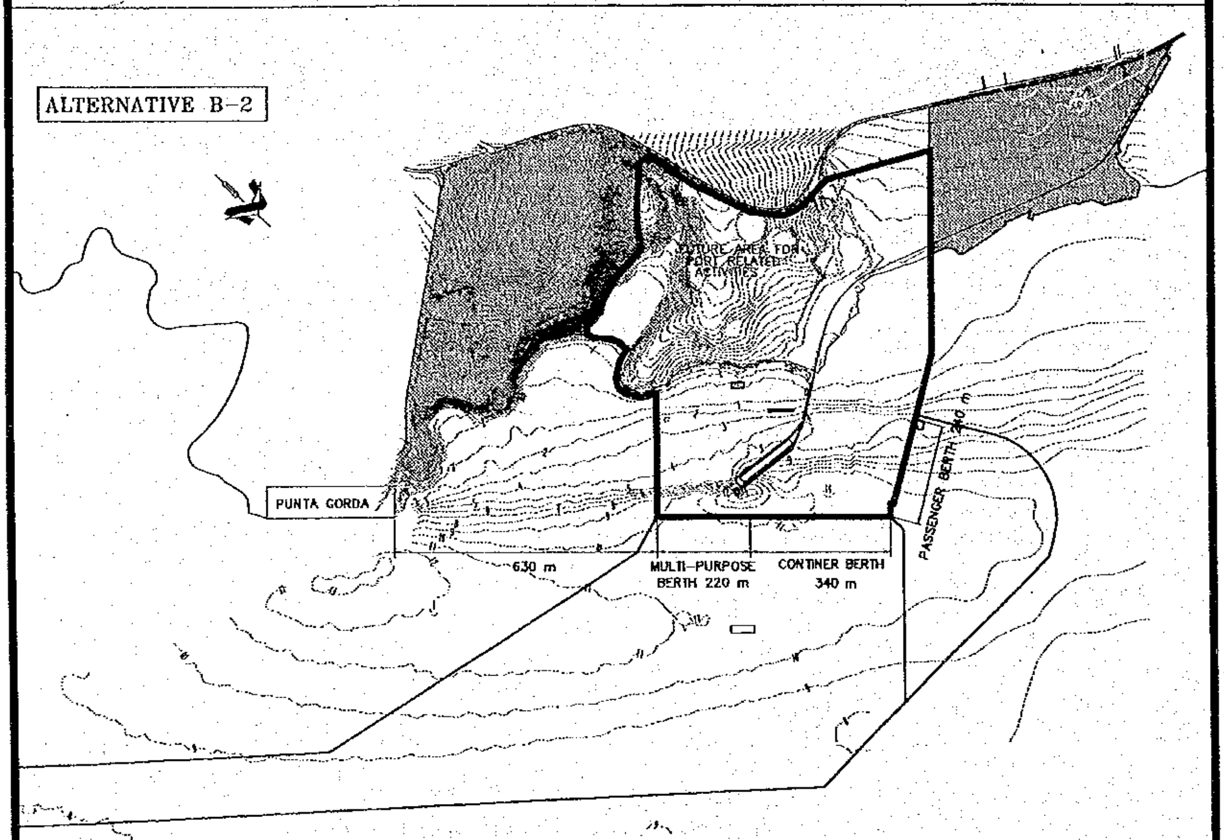
- The soft soil layer under the seabed (average N-value 1 ~ 4) is comparatively thicker toward the Punta Gorda Port with a thickness varying from 2 to 10 m. Existence of this layer will cause higher construction cost for berth structures, reclamation and other relocated port facilities.
- Underneath this soft layer, a gravelly sand layer with an average N-Value of 30 extends at a depth of -20 to -25 m below the Chart Datum (DL). The existence of this continuous layer causes difficulty for pile driving.
- The small hill existing within the CEPA property adjacent to the Punta Gorda Port has a peak of about 50 m high above MSL. The hill is composed mainly of massive Andesite rock covered by top soil having an average thickness of 5 to 8 m only, thus it cannot be considered as a possible source of supply of borrow material for land reclamation.

Taking into consideration the above-mentioned findings, a further examination of the port location is carried out in the vicinity of the selected port site, and two alternatives, Alternatives B-1 and B-2, are formulated as shown in Figure 3.3.9.

Alternative B-1 is the JICA F/S's proposed plan has a distance of 360 m from Punta Gorda, while Alternative B-2 has a distance of 630 m.

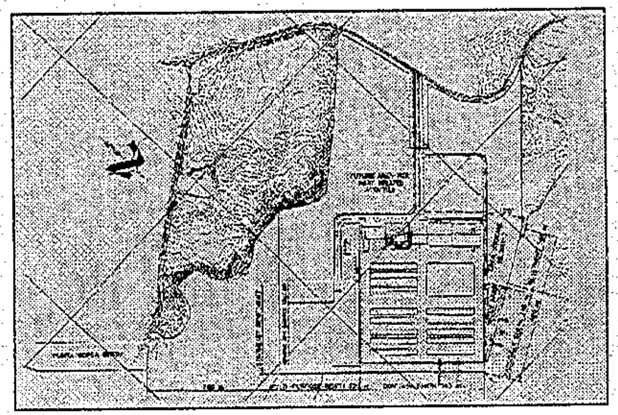
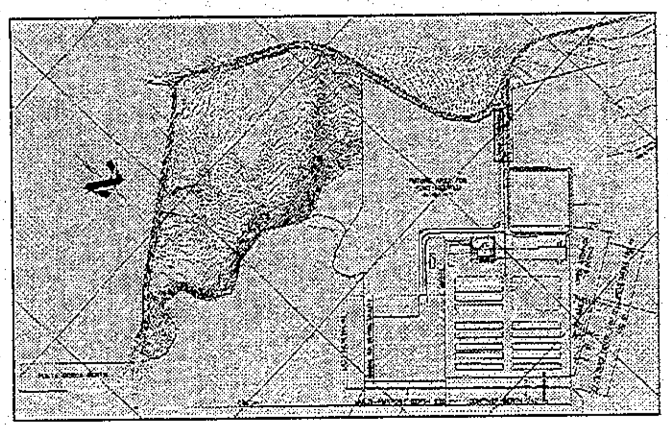
Alternative B-2 is prepared mainly for the purpose of securing a larger port hinterland, since the hill located on the left side of the port is composed of hard rock and it is hard to create an additional port area by cutting the hill. The results of comparison of the two alternative port plans are summarized in Table 3.3.6 and it is recommended to select Alternative B-2 as a final port location (see Figure 3.3.10).

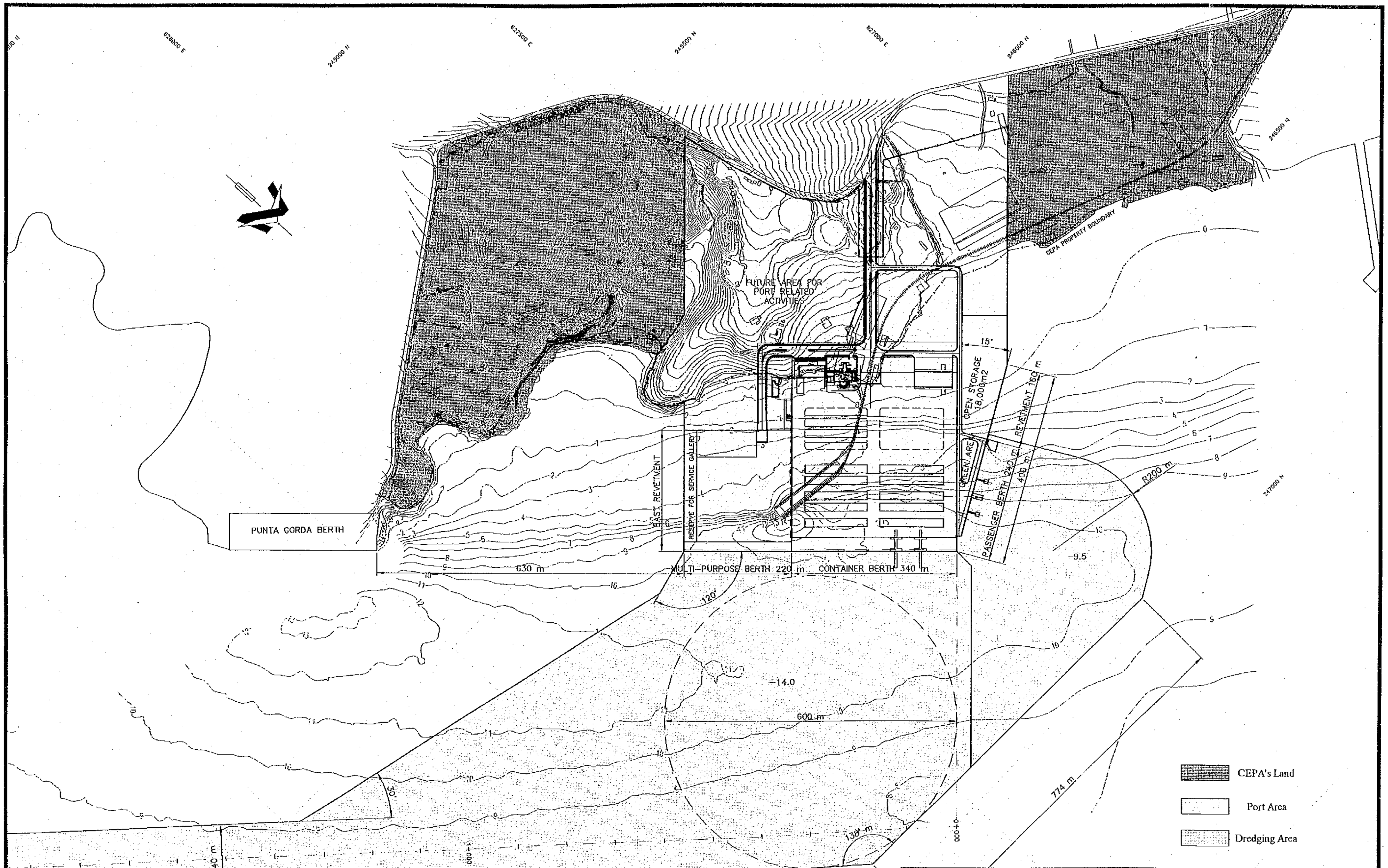




	Japan International Cooperation Agency (JICA)	Figure	Title
	The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.7	ALTERNATIVE PORT LAYOUT PLANS

Table 3.3.7 Comparison of Alternative Port Layout Plans

	ALTERNATIVE PLAN B-1		ALTERNATIVE PLAN B-2	
Plan				
General	- To shorten the Channel length and dredging volume		- To secure larger flat level land behind the port area for the future industrial	
Quantities of Major Items	Dredging of Basin	2,625,000 m3	Dredging of Basin	2,726,000 m3
	Reclamation Area	230,000 m2	Reclamation Area	274,000 m2
	Reclamation Volume	2,511,000 m3	Reclamation Volume	2,460,000 m3
	Revetment	Total 490 m	Revetment	Total 670 m
	Main Berth (excl. Passenger B.)	Total 560 m	Main Berth (excl. Passenger B.)	Total 560 m
Ratio of Cost	1.00	△	0.98	○
Dredging / Maintenance	- Less dredging volume	○	- Larger dredging volume	△
Reclamation	- Larger reclamation volume	△	- Less reclamation volume	○
Environmental Aspect	- Half of green land will be destroyed - Influence to eco-system	△	- Minimizing disturbed of green land - Less influence to ecologies	○
Connection to Bypass road	- Easy to access to Bypass road	○	- Easy to access to the Bypass road	○
Evaluation	△		○	



Japan International Cooperation Agency (JICA)	Figure	Title
The Detailed Design on Port Reactivation Project in La Union Province of the Republic of El Salvador	3.3.8	FINAL PORT LAYOUT