2.9.2 The existing railway transportation network between Tanjung Priok Port (Pasoso station) and Gedebage ICD

(1) Tanjung Priok Port (Pasoso station)

1) Location

Tanjung Priok Port has the most populated hinterland: West Java province and Metropolitan Jakarta, where the scale of economic activities is the largest in the country. Tanjung Priok Port serves as the outlet for this hinterland.

The Pasoso Station is located next to C.T. Berth. The industrial railway track branched from Tanjung Priok Station reaches PERTAMINA oil base. Pasoso Station is located one km from Tanjung Priok Station. It was converted to a container freight station from a marshalling yard due to the improvement of general cargo berths.

Pasoso Station

Tanjung Priok Station

Road Access to Pasoso Station

Jakarta Gudang Station

Source: JICA Study Team

Photo 2.9-1 Freight and Access Facilities in the vicinity of Tanjung Priok

2) Outline of container loading/unloading installation

Existing yard facility in Pasoso Station consists of stabling and operating trucks. One track reaches the general cargo berth which is now used only for transporting heavy machines or locomotives, while another track goes to an empty container depot not in use.

The length of the existing platform was originally 300m, but extended to 600m where two toplifters are operated by Port side operators. The width of the platform is 49m, which is sufficient to handle containers with toplifters. Also, the Station has a warehouse (100m x 40m) suitable for CFS on the platform. Although two container wagon formations are possible at the same time, the actual handling these days seems far below the maximum capacity.

3) Transportation volume from/ to Tanjung Priok Port (Pasoso station)

Transportation volume from/to Tanjung Priok Port, including Pasoso (dealing with container transport) and Jakarta Gudang (dealing with bulk transport) has shown a steady increase since 2004 with an average growth rate of 18%, even though several disadvantages over road transport were reported. This is probably because of the overall development in logistic industry associated with the nation's rapid economic growth.

When it comes to railway container transport, Tanjung Priok – Gedebage freight corridor plays a dominant role in the project area. It was especially true when garment industries in Bandung enjoyed rapid growth in the 1990's. However, container transportation between Tanjung Priok (Pasoso) and Gedegbage dry port was decreased for the last decade[2], as transportation time and tariff are unable to compete with truck transportation. This is largely due to the highway between Jakarta and Bandung, which started operation in 2004, and to chronic traffic congestion between Tanjung Priok Port and Pasoso Station, which makes the total travel time of freight transportation much longer.

As a result, only trains of twice/day were scheduled in the published timetable, but regular operation is actually limited to only once/day because of the lack of transport demand.

Table 2.9-4 Pasoso - Gedebage Freight Train Operation Schedule

Route	Train ID	Dep. Time	Arr. Time	Status as of 2010
Pasoso – Gedebage	2202	02:45	07:23	One of them is not operation
	2204	03:35	08:00	
Gedebage - Pasoso	2201	21:00	01:38	One of them is not operation
	2203	22:00	02:39	

Source: PT. KA

4) Problem of container transportation time on road between Port and Pasoso railway station

At present, it takes 6 hours and half for the operation of freight trains from Tg. Priok to Gedebage Dryport (4 hours and half for travelling from Pasoso to Gedebage plus 2 hours for loading and unloading from/to freight trains to/from trailer trucks). The latter is becoming even worse as the total container handling volume in Tanjung Priok Port increases year by year, which results in a further loss of competitiveness in time against road transport.

(2) Gedegbage inland container depot

1) Location

Gedebage Dryport is located 187 km away from the port of Tanjung Priok and around 10 km east from Bandung Station. Kiaracondon station yard, located 5 km west of Gedebage, was once used as an unloading facility due to the constraint of available space in Gedebage Dryport, but the facility was cleared after a significant decrease in handling volume.

[2] It is noted that freight transport volume in 2009 shows remarkable growth (+37%) over the last year. The reason is yet to be identified.

Gedebage Dryport

Warehouses

Bogie Maintenance Facility

Kiaracondon Yard

Source: JICA Study Team

Photo 2.9-2 Freight Facilities in the vicinity of Gedebage Dryport

2) Outline of container loading/unloading installation

The following infrastructure and equipment are provided in Gedebage inland container depot:

Table 2.9-5 Infrastructures and Facilities of Gedebage Dryport

Infrastructure/Facility	Dimension/Quantity
Land area	3.5 ha
Loading and unloading side track	1 x 240m
CFS for export and import	2 buildings
Warehouse	20m x 15m x 5m
Tractor head	3
Top loader	11
Transtainer	1
Forklift	5

Source: Study Team

3) Cost Comparison between railway transportation and road transportation

The transportation cost per km of loaded containers by railway is in general calculated based on the following unit costs.

- Per Km transportation cost of loaded container by railway
- Per Km transportation cost of empty container by railway
- Average container transportation cost by railway

- Commodity stuffing cost
- Loaded container loading and unloading cost at dry port
- Empty container loading and unloading cost at dry port
- Transportation cost within port
- Container lift-on or lift-off cost at port

The Team cannot present these unit costs in this report, as the information was not provided by relevant authorities. Some reference data is available in the previous JICA Study on Container Transportations (1995), which indicates a transportation unit cost of Rp. 1,125/km for 40-foot container and Rp. 643/km for 20-feet container operated in Pasoso – Gedebage corridor.

Also, unit cost of Rp. 100,000/km per trainset is currently used as a benchmark by a private freight forwarder, which equals Rp. 2,500/km for a 20-feet container provided that one trainset hauls 20 wagons.

These unit costs suggest that the freight transportation cost has become few times more costly over the last 15 years. However, it was also suggested by the private forwarder that freight railway operation still has a slight cost advantage over road transport in general. Freight transport of Tanjung Priok – Gedebage corridor may be able to restore the high potency once the direct access to Tanjung Priok Port is materialized.

4) Other Constraints

Only one stabling track is provided in Gedebage Dryport, mainly due to the land constraint. Taking the travel time and loading/unloading time into account, maximum number of round-trips is estimated to be 5 times per day.

For the main line, single track section from Kiaracondon to Gedebage will face a serious line capacity problem once the corridor serves more traffic. Either double tracking or electric interlocking will be required to increase line capacity.

In addition, Tanjung Priok – Gedebage corridor has a serious constraint in effective length at several locations for overtaking, especially at mountainous areas around Bandung. With existing effective length of 240m, train length cannot be expanded more than 17 freight wagons, i.e. 34 TEUs. It seems unable to extend the effective length due to the limited land space.

2.9.3 Development plan of railway network

(1) Improvement project of direct lead-in railway track to Tanjung Priok quay

Direct rail access from Pasoso to JICT & KOJA quay is scheduled for early implementation (See Figure 2.9-3). However, budget for the project in fiscal year 2010 was cancelled due to the slow progress of land acquisition. Some illegal dwellers still remain on site even now. Taking the strong need for timely completion into account, it is now anticipated to resume the project next year with the Indonesian Government’s budget.

Another problem of the rail access to container terminal is land subsidence. The area from Pasoso to Tg. Priok faced a serious waterlogging problem associated with a heavy flood in Feb 2007. It seems that no particular provisions were made even after the flooding. Given the significant land subsidence problem in north Jakarta and frequent cancellation of train operations in flood season, it is essential to make necessary provisions in its facility plan.

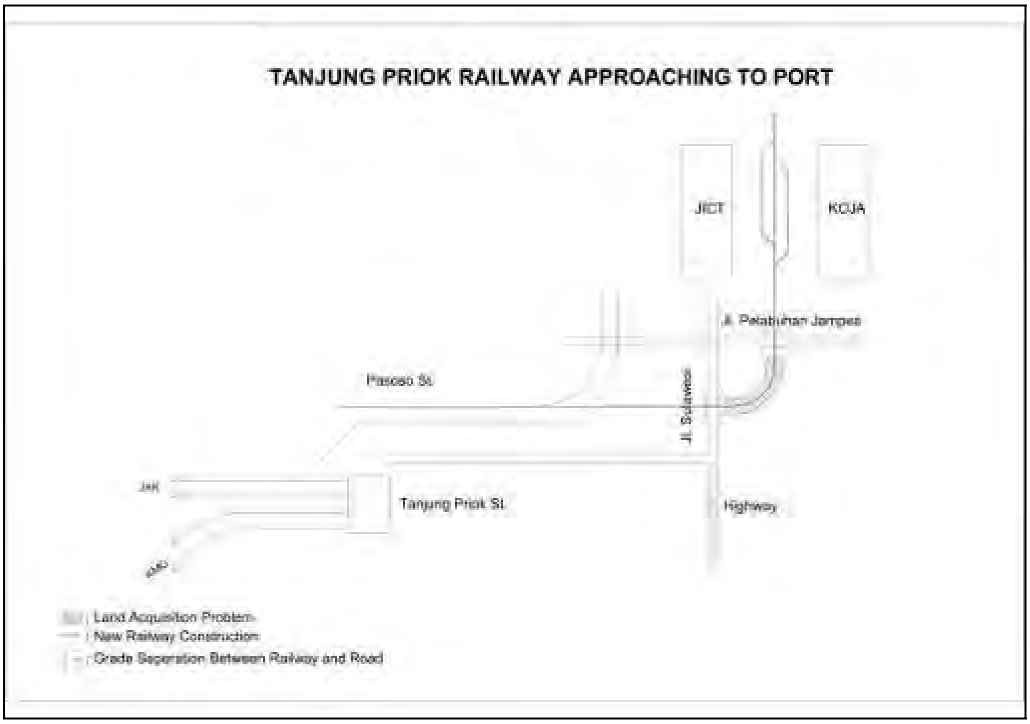


Figure 2.9-3 Tanjung Priok Railway Approaching to JICT & KOJA Quay

(2) Reinforcement of railway facilities

Several reinforcement projects are planned to improve railway facilities and rolling stocks for better passenger and freight train operation. Such projects include:

- Electrification and double-double tracking of Java Main Line to address the operational bottleneck in Manggarai and improve line capacity in Bekasi Line of Jabodetabek Railway and between Bekasi and Cikarang (on-going project by JICA funding)
- Step-by-step electrification and double tracking of the railroads in the vicinity of Bandung area (on-going project by Indonesian Government funding)
- Procurement of diesel locomotives to promote freight train operation in entire Java Island (study is in progress)
- Rehabilitation of Nambe Line to cater for cement transportation from south Jakarta
- Rehabilitation of Bogor – Sukabumi – Cianjur – Padalarang Corridor as an alternative route from Jakarta to Bandung

2.10 Results of Traffic Survey including OD (Origin-Destination) Survey

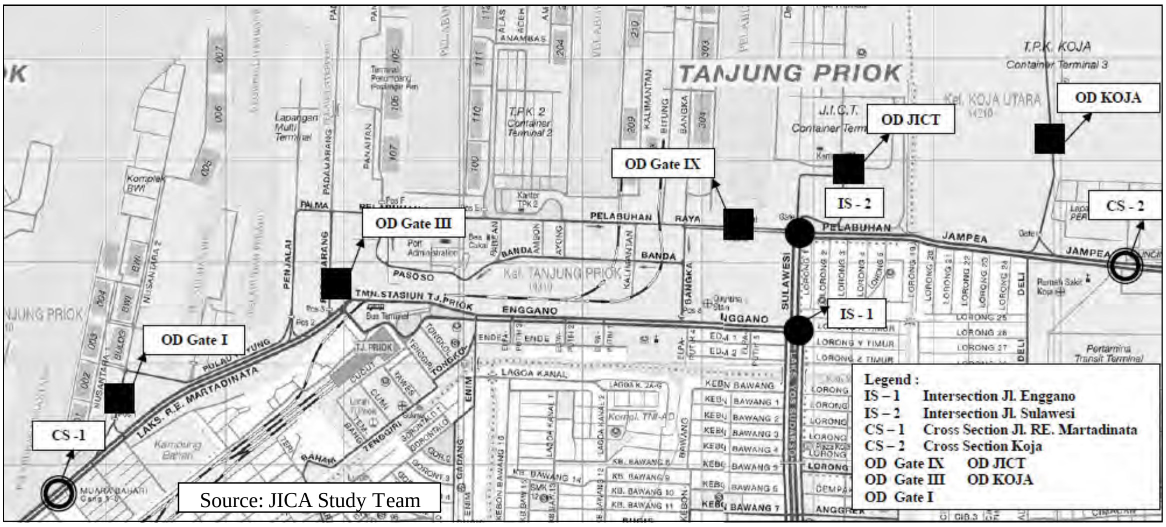
The present traffic conditions through the major access roads are checked and analyzed including directional flows and daily traffic volume by traffic counting surveys and O/D survey. The access roads considered were JL. R.E. Martadinata which goes from Ancol to Tanjung Priok in the western area, Jl. Jampea from the JORR northern extension in the eastern area, and Jl. Sulawesi and Tanjung Priok Interchange in the southern area.

Traffic survey including OD survey was carried out from May 18 to June 12, 2010 at 5 gates of Tanjung Priok port, 2 intersections and 2 cross sections. The schedule and location of gates and intersections in the survey are shown in Table 2.10-1 and Figure 2.10-1.

Table 2.10-1 Implementation Schedule for Traffic Survey

Name of Survey Location	May, 2010															June, 2010												
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13
	M	T	W	Th	F	S	Sn	M	T	W	Th	F	S	Sn	M	T	W	Th	F	S	Sn	M	T	W	Th	F	S	Sn
Vehicle Counting Survey																												
JICT Gate		■	■	■		■																						
KOJA Terminal Gate		■	■	■		■																						
Gate I. Tj. Priok Port									■	■	■		■															
Gate III. Tj. Priok Port									■	■	■		■															
Gate IX. Tj. Priok Port																■	■	■		■								
Intersection-1 Jl. Enggano																							■	■	■		■	
Intersection-2 Jl. Sulawesi																							■	■	■		■	
Cross Section-1 Jl. RE Martadinate																							■	■	■		■	
Cross Section-2 Jl. Jampea																							■	■	■		■	
OD Survey																												
JICT Gate		■	■	■		■																						
KOJA Terminal Gate		■	■	■		■																						
Gate I. and III. Tj. Priok Port									■	■	■		■															
Gate IX. Tj. Priok Port																■	■	■		■								

Source: JICA Study Team



Source: JICA Study Team

Figure 2.10-1 Location of Gates and Intersection of Survey

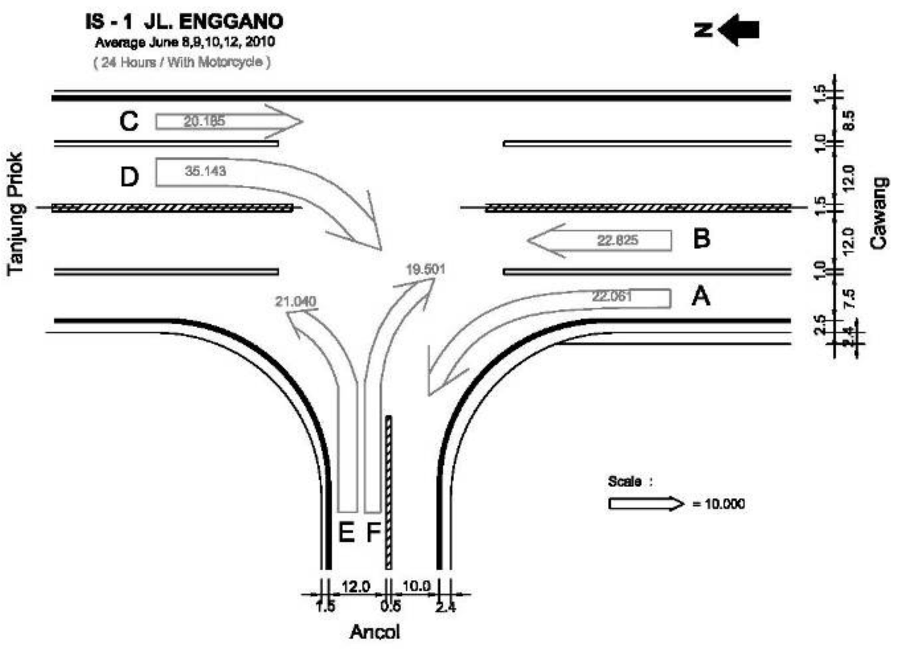
2.10.1 Vehicle Counting Survey

Based on the results of the counting survey, the directional traffic flows of survey days at five gates, two cross sections are shown in Table 2.10-2 and two intersections are illustrated in Figure 2.10-2 and Figure 2.10-3, respectively.

Table 2.10-2 Traffic Flow at Gates and Cross Sections

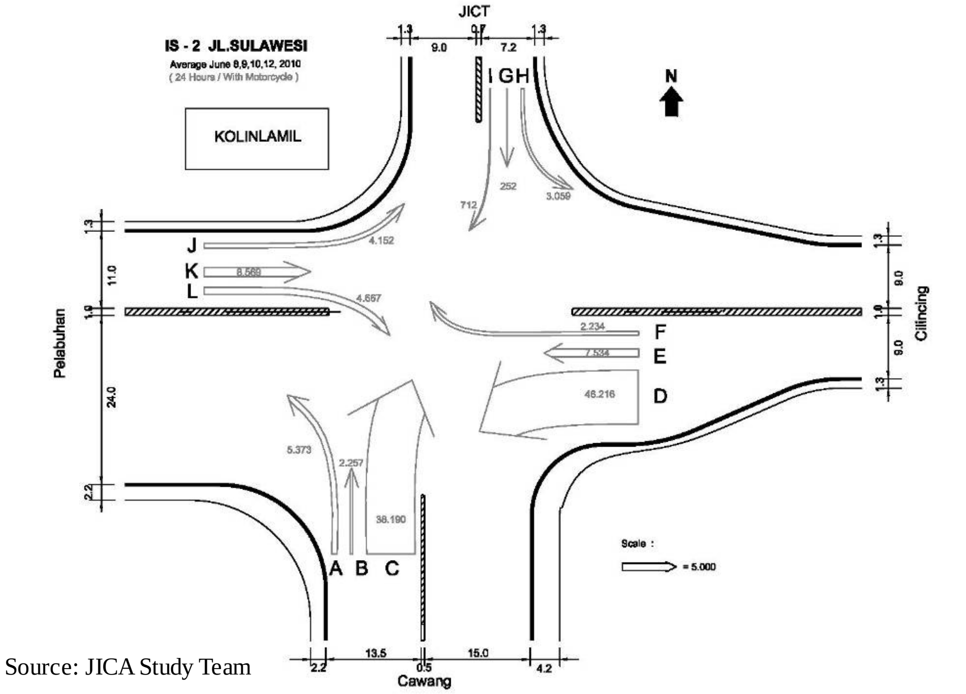
Location	Direction	Tuesday	Wednesday	Thursday	Saturday	Total	Average
JICT Gate	In	3,418	2,937	4,211	4,144	14,710	3,678
	Out	3,175	3,293	3,609	3,234	13,311	3,328
	Total	6,593	6,230	7,820	7,378	28,021	7,005
KOJA Terminal Gate	In	1,360	1,606	1,606	1,661	6,233	1,558
	Out	1,318	1,585	1,631	1,468	6,002	1,501
	Total	2,678	3,191	3,237	3,129	12,235	3,059
Gate I Tanjung Priok Port	In	3,475	3,339	3,664	2,190	12,668	3,167
	Out	4,331	4,386	4,771	2,745	16,233	4,058
	Total	7,806	7,725	8,435	4,935	28,901	7,225
Gtae III Tanjung Priok Port	In	2,660	2,372	2,945	1,514	9,491	2,373
	Out	2,231	2,137	2,526	1,285	8,179	2,045
	Total	4,891	4,509	5,471	2,799	17,670	4,418
Gate IX Tanjung Priok Port	In	12,818	12,262	13,938	9,958	48,976	12,244
	Out	10,543	9,527	9,619	8,302	37,991	9,498
	Total	23,361	21,789	23,557	18,260	86,967	21,742
Cross Section Jl. RE.	Ancol - Tanjung Priok	9,049	9,010	9,738	8,705	36,502	9,126
	Tanjung Priok- Ancol	11,887	11,817	12,189	10,227	46,120	11,530
	Total	20,936	20,827	21,927	18,932	82,622	20,656
Cross Section Jl. Jampea	Cilincing - Tanjung	23,408	22,944	22,647	19,909	88,908	22,227
	Tanjung Priok -	20,586	20,836	20,717	17,252	79,391	19,848
	Total	43,994	43,780	43,364	37,161	168,299	42,075

Note; without Motorcycle veh/day
Source: JICA Study Team



Source: JICA Study Team

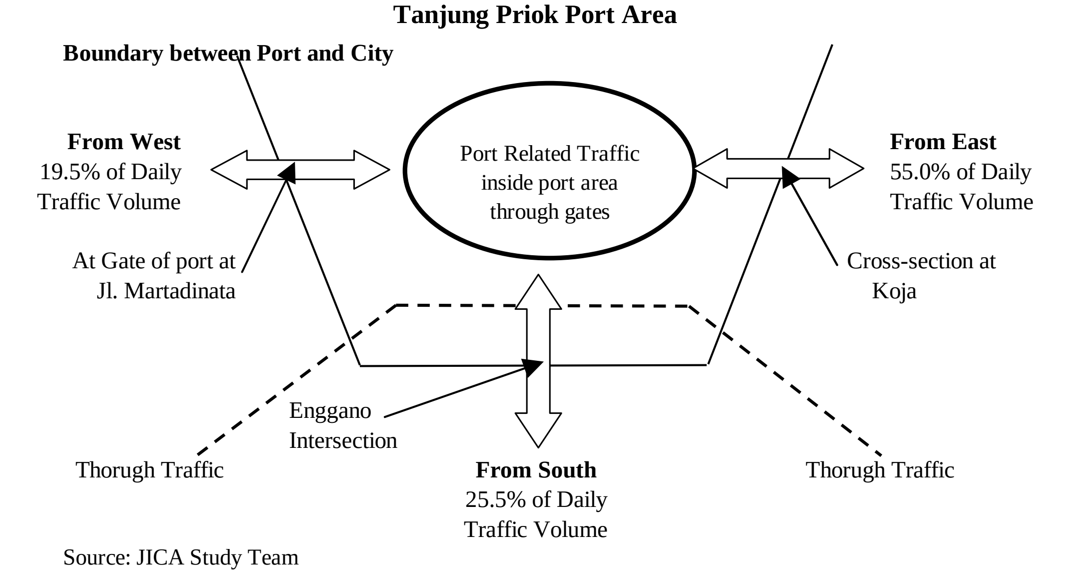
Figure 2.10-2 Intersection-1 Jl. Enggano



Source: JICA Study Team

Figure 2.10-3 Intersection-2 Jl. Sulawesi

The conceptual traffic flows around Tanjung Priok Port area are summarized in the diagram in Figure 2.10-4.



Source: JICA Study Team

Figure 2.10-4 Traffic Flow Diagram around Tanjung Priok Port Area

(1) Daily Traffic Volume (DTV) from Three Directions around the Port

The sectional road traffic was counted as the total daily traffic volume around the Port area as shown in Table 2.10-3.

Table 2.10-3 Average Sectional Road Traffic Volume (veh/day)

Vehicle Type	To/From East	To/From West	To/From South	Total
Motor Cycle	121,959	67,164	57,176	246,299
Sedan, Jeep, Wagon, Kijang	29,798	11,376	16,678	57,852
Mikrolet Angkot	12,895	8,700	6,890	28,485
Small, Medium Bus	2,253	3,927	1,183	7,362
Pick Up, Truck 3/4 Single	5,517	1,945	3,201	10,662
Truck 2 Axle	5,978	1,415	3,204	10,598
Truck 3 Axle	4,038	946	2,280	7,263
Truck 4 Axle and More	11,249	817	2,245	14,311
Container 20 "	6,901	919	2,242	10,061
Container 40 "	7,759	537	2,126	10,422
Total (Without Motor Cycle)	86,386	30,581	40,047	157,014
Ratio	55.0%	19.5%	25.5%	100.0%

Source: JICA Study Team

(2) Port Related Traffic Volume (PRT) and Through Traffic Volume (TTV)

The traffic moving in and out of the port at the 5 gates is considered as the port related traffic. The total traffic volume through the gates per day was 43,449 units, equivalent to 27.7% of the daily traffic volume as shown in Table 2.10-4.

Table 2.10-4 Average Traffic Volume Through gates of Tanjung Priok Port

Vehicle Type	JICT	KOJA	Gate I	Gate III	Gate IX	Total
Motor Cycle	122	383	20,126	16,442	8,291	45,364
Sedan, Jeep, Wagon, Kijang	193	95	2,703	1,770	5,147	9,907
Mikrolet Angkot	0	0	15	18	11	44
Small, Medium Bus	9	1	30	25	64	128
Pick Up, Truck 3/4 Single	116	15	742	482	833	2,187
Truck 2 Axle	8	8	611	422	1,310	2,359
Truck 3 Axle	10	6	454	383	2,182	3,035
Truck 4 Axle and More	2,872	1,357	732	635	6,149	11,745
Container 20 "	1,394	593	1,366	382	2,865	6,598
Container 40 "	2,404	986	573	301	3,183	7,446
Total (Without Motor Cycle)	7,005	3,059	7,225	4,418	21,742	43,449

Source: JICA Study Team

The through traffic from/to the port area unrelated to port activities is estimated from the balance between the total daily traffic around the port and port related traffic through the gates as shown in Table 2.10-5.

Table 2.10-5 Average Daily Traffic Volume of Port Related and Through Traffic in 2010

Vehicle Type	Port Related Traffic Volume (PRT)	Through Traffic Volume Around Port (TTV)	Total
Motor Cycle	45,364	200,936	246,299
Sedan, Jeep, Wagon, Kijang	9,907	47,944	57,852
Mikrolet Angkot	44	28,440	28,485
Small, Medium Bus	128	7,235	7,362
Pick Up, Truck 3/4 Single	2,187	8,475	10,662
Truck 2 Axle	2,359	8,238	10,598
Truck 3 Axle	3,035	4,228	7,263
Truck 4 Axle and More	11,745	2,566	14,311
Container 20 "	6,598	3,463	10,061
Container 40 "	7,446	2,976	10,422
Total (Without Motor Cycle)	43,449	113,566	157,014
Ratio	27.7%	72.3%	100.0%

Source: JICA Study Team

2.10.2 Daily Traffic Volume of Trailer Truck by O/D survey

The O/D survey was carried out for five vehicle types at five gates. The O/D samples collected from the trailer trucks were about 63.8% of the counted traffic volume.

The results of the O/D survey enable the traffic counts to be assigned to one of the following directional flows: 23 zones of origin /destination of trailers indicated by drivers are classified in respective directions by using the main roads from the Tanjung Priok port as shown in Table 2.10-6.

Table 2.10-6 Directional Classification

Direction	Origin /Destination of cargo through major roads
to East	Through Jl. Laks. R.E. Martadinata, Jl. Enggano, to Cilincing area, Bekasi, Eastern Java Provinces, Eastern Jakarta, Eastern Indonesia,
to West	Through Jl. Jampea and Cilincing Access road Western Jakarta, Penjaringan, Pedemariggan, Tangerang city, Banten Province
to South	Through Jl. Laks. Yos Sudarso, Fly over Tollway, Jl. Sulawesi Southern Jakarta, Central Jakarta, Kelapa Gading, Depok city, Bogor City,
Local container depots in north Jakarta	Tanjung Priok-Koja, Trailers moving between Tanjung Priok port area and container depots in the Koja and Cilincing area.

Source: JICA Study Team

The results of the O/D survey of average trailer trucks as directional daily traffic volume are tabulated in Table 2.10-7.

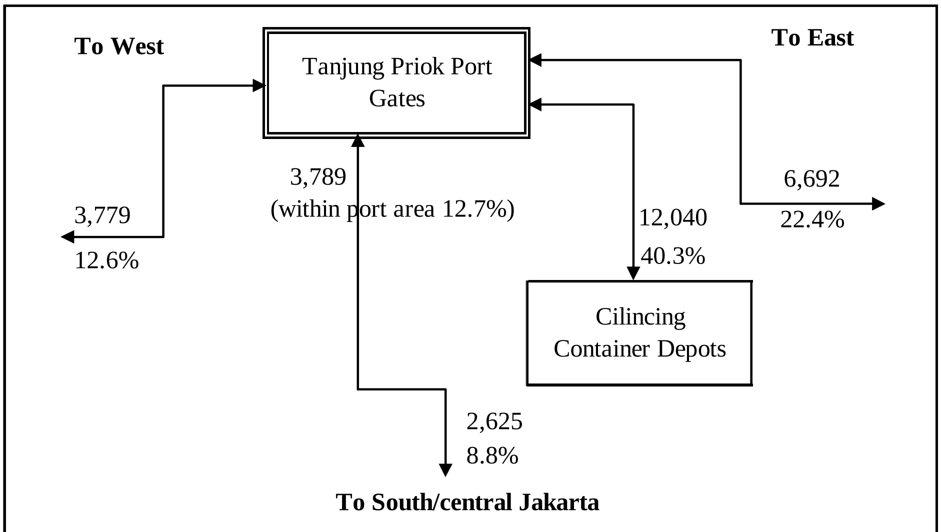
Table 2.10-7 Avergae Trailer Trucks Directional Traffic Volume (veh/day)

Direction	Day				Average	Share (%)
	Tuesday	Wednesday	Thursday	Saturday		
To/from DEPOT	12,708	11,009	14,300	10,144	12,040	40.3%
To/from East	6,756	5,572	7,824	6,617	6,692	22.4%
Within Port area	3,908	3,291	4,415	3,543	3,789	12.7%
To/from South	2,576	2,298	3,067	2,561	2,625	8.8%
To/from West	4,097	3,604	4,234	3,183	3,779	12.6%
Unknown	203	210	207	3,191	953	3.2%
Total	30,249	25,983	34,046	29,240	29,880	100.0%

Source: JICA Study Team

(1) Average Directional Traffic Flows (veh/day) of Trailer /Container

Based on the results of the O/D survey the directional daily traffic flow of trailer trucks is illustrated in Figure 2.10-5. The number indicated means the number of trailers counted coming/going in both directions between Tg Priok and Cilincing container depots:



Source: JICA Study Team

Figure 2.10-5 Average Tractor Trucks Directional Traffic Flow Diagram

From the above directional traffic flows the traffic from/to east is the biggest (6,692 units per day) except Cilincing container depots considering the many container depots and large industrial complex located in the eastern side of the port.

2.11 Results of Interview Survey with Major Consignees/Consignors

2.11.1 Methodology of Interview Survey

Interview survey with major consignees and consignors was conducted by the JICA Study Team during their first visit to Indonesia. The main purposes of the interview survey were as follows;

- To understand outline of their production and logistic activities

- To obtain their comments and opinions on port development and access improvement
- To hear the opinions of business leaders concerning the prospects for Indonesia's economy

Two members from the JICA Study Team visited offices and factories of port users and interviewed executives of the business entities.

2.11.2 List of Interviewees

Manufacturing companies to be interviewed were selected in consideration of both geographical distribution and balance of type of business. Land areas of the interviewee's factory vary in the range of 2 hectares to 20 hectares, and employed workers of the factory fluctuate between 220 and 7,700 as shown in Table 2.11-1.

Table 2.11-1 List of Interviewees

Type of Industry	Location of Factory	Land Area (ha)	Number of Worker
Plastic, Rubber	MM2100, Cibitung	1.8	220
Manufacturing Food & Beverage	Sukabumi, West Java		
Auto mobile	Jakarta, Karawan	12.8	7,700
Auto Mobile, Bicycle and Parts	Jakarta, Karawan, Chikanpec		4,000
Rubber product	Tangerang	5	900
Automobile	Tg. Priok and Bekasi	14	2,600
Textile	Jakarta, Bogor		
Chemical	Cikarang	8.9	1,000
Metal	Tangerang		1,200
Chemical	Tangerang	4.5	250
Music Instruments	Pulogadung, Jakarta		1,500~2300
Non Metal	Jakarta Barat	8	350
Electrinic Equipment	EJIP, Bekasi	20	1,860
Construction machinery	Cilincing, Jakarta	20.6	1,001

Source: JICA Study Team

2.11.3 Selected Opinions and Comments

Opinions and comments during the interviews are summarized below. Some of them are contradictory with each other because each company has its own background in terms of factory' location, type of business, market place and so on.

(1) Issues on land transportation

- In order to avoid traffic congestion, containers are transported from the Tanjung Priok port to our factory in the evening.
- Raw materials and manufactured goods have to be transported during the time period of non commuting time.

- Because of heavy road congestion, it sometimes takes 5~7 hours to transport import containers from the Tg. Priok port to our factory in Cibitun.
- Road congestion cannot be solved easily. Therefore, larger volume of storage is required for our factory to stay in operation.
- Only one round trip can be made between Tangeran and the Tg. Priok port (30 km) while two round trips can be done between Merak to Tangeran (100 km).
- We have not been too seriously affected by traffic jam although sometimes we fall 1～2 hours behind schedule.
- We are annoyed with the daily traffic jams between Karawan and the port, DKI.
- We cannot predict when cargoes will come from the Tg. priok port to our factory because of the traffic congestion.

  When congested, six hours are needed to come to the Tg. Priok port from Bekasi; it usually takes only one hour.

(2) Issues on port transportation

- Although National Single Window (NSW) system exists, original hard copies have to be submitted for the customs clearance.
- Even container vessels are sometimes obliged to wait at anchorage for berthing.
- Containers were moved without our consent from the terminal to an unknown place.
- Because of shortage of infrastructure such as cargo handling equipment, loading and unloading activities are not efficient.
- Port space is lacking for tracking, and existing container handling capacity cannot meet the demand.
- Required time for the custom’s clearance has been gradually improved while original hard copies are still required for the clearance.
- Information Technology has been introduced to port operation, therefore fewer problems occur in the terminal nowadays.
- Pure car terminal does not have enough area for loading operation. Therefore, additional cost is generated for export activities.
- 2 ~ 3 vessels out of 14 ~ 15 vessels per month arrive behind schedule.
- Customs clearance through internet has not been realized.
- Cargo handling equipment for heavy cargo has not been sufficiently provided at the port terminal. Therefore, we are obliged to wait for a long time.
- Expansion of the pure car terminal should be realized as soon as possible.

(3) Logistics in general

- 14-day stock has been stored at main warehouses because sometimes container cargoes cannot be cleared from the port. (Food industry)
- It is necessary for the management to take into account the traffic jam in DKI, and inventory management has to be done taking into consideration the delay of ship arrival and departure due to port congestion.

(4) Location of a new port

- It is desirable that a new container port should be located as near as possible to

Jakarta.

- Location of a new port should be selected from the view point that the new port shall contribute diversion of land traffic.
- Many automobile related industries are located near Bekasi and Karawan. If a container terminal is built at the eastern side from DKI, road congestion between Bekasi and the Tg. Priok would be reduced.
- A new port should be located away from Tg. Priok port from the view points of both reduction of land transport cost and contribution to the alleviation of traffic congestion.
- Location of a new container port should be evaluated from the view point of contributing to decentralization of land traffic.

(5) Prospect for Indonesian economy and others

- Shortages of both power supply and road capacity have been bottlenecks for the Indonesian economic growth, and this is expected to continue in future.
- Higher economic growth rates can be expected for a long period in Indonesia. Many foreign investors have been rushing to Indonesia recently.
- Production in Indonesia has been expanding. Both GDP and purchasing power in Indonesia will continue to grow.

2.12 Review of Laws and Regulations for Environmental and Social Consideration

Existing laws and regulations for environmental and social consideration in Indonesia are reviewed below.

(1) Fundamental Law

Fundamental law for the environment in Indonesia had been first established in 1982 with Law No.4/1982 concerning Environmental Management, which was later revised to Law No.23/1997. The Law No.23/1997 stipulated people’s rights on environment and strengthened regulations for businesses and activities that may cause environmental impact; however, environmental destruction has been going on for many years everywhere in Indonesia. Considering these situations, Law No.32/2009 concerning Environmental Protection and Management has been enacted in September, 2009 and replaced Law No.23/1997.

The newly enacted Law No.32/2009 requires environmental protection and a management plan to utilize natural resources, control of pollution and damage on environment, environmental preservation, management of hazardous and toxic materials/waste and environmental information systems as well as strengthening regulations on environmental permission, supervision and penalties. In light of environmental and social consideration on developmental projects, Law No.32/2009 stipulates that a Strategic Environmental Assessment (SEA) be conducted in addition to Environmental Impact Assessment (EIA) to realize sustainable development. Details of each assessment procedure are described in the following sections.

(2) Strategic Environmental Assessment (SEA)

1) List of Laws and Regulations concerning SEA

Laws and regulations concerning SEA in Indonesia are listed below. Each outline is described in the following sections.

- Decree of the Ministry of Environment No.27/2009 on Guidelines for Implementation of Strategic Environmental Study
- Law No.32/2009 concerning Environmental Protection and Management
- Government Regulation No.10/2010 on Procedures for Change to the Allocation and Function of Forest Areas
- Government Regulation No.15/2010 on Spatial Layout System Arrangement

2) General Concept and the Guideline for SEA Issued as Decree No.27/2009

In general, SEA is defined as a process of environmental assessment for policy, plan and program while EIA is conducted for specific developmental projects. Recently, SEA is getting more and more important worldwide considering the necessity of integrating environmental consideration into the early stage of the developmental planning. In Indonesia, the Ministry of Environment had reviewed the general SEA concept and examined its applicability through several pilot projects before SEA was stipulated in Law No.32/2009. In July 2009, the Ministry of Environment issued Decree No.27/2009 on Guidelines for Implementation of SEA, which was developed as a tool for the government to control environmental impact under the Law No.23/1997.

The Decree No.27/2009 is not aiming to stipulate obligation or responsibility on SEA but directing general concept and steps of SEA in terms of technical aspects. General steps of SEA are described as follows although they can be modified depending on the requirement in each case. Necessity of public consultation on SEA is also described in the Decree No.27/2009.

1.	Screening:	To determine the policy, plan and program are required SEA
2.	Scoping:	To determine the scope of the SEA study
3.	Assessment:	Scientific study, dialogue, consultation and discovery of alternative option
4.	Recommendation:	To contribute to decision-making

3) Stipulation under the Law No.32/2009

After the abovementioned Decree No.27/2009 was issued, Law No.32/2009 was enforced and SEA was legislated. By the new law, central/local government has been obligated to conduct SEA for the following policy, plan and program.

- Long-term development plan (RPJP),
- Medium-term development plan (RPJM),
- National, provincial and regional/municipal spatial plan (RTRW), and
- Policy, plan and/or program that may cause impacts and/or risks to the environment.

The screening criteria for policy, plan and program that may cause impacts and/or risks to the environment will be described in government regulations in the future, according to the Ministry of Environment. As of the year 2010, screening criteria for the port or transportation sector has not been developed. Therefore, SEA for this master plan study on port development is not mandatory at this moment although the effort of implementation is appreciated, according to the Ministry of Environment.

The Law No.32/2009 stipulates that SEA should include at least one of the following analyses;

a. Supportive and carrying capacity of the environment,
b. Estimation of environmental impacts and risks,
c. Performance of service/ecosystem service,
d. Efficiency of utilization of natural resources,
e. Vulnerability and adaptability to climate change, and
f. Resilience and potential of biological diversity.

According to the Ministry of Environment, SEA is a sort of self-assessment for government agencies to adapt their policy into wise decisions. This means SEA is not a process that requires administrative approval.

The law requires involvement of communities and stakeholders into SEA study although the specific procedure has not been stipulated in the law. Further provision on procedures for executing SEA will be stipulated in a government regulation in future.

4) The Other Regulations on SEA

According to the Ministry of Environment, two government regulations which refer to SEA have been developed: one is Government Regulation No.10/2010 on Procedures for Change to the Allocation and Function of Forest Areas and the other is No.15/2010 on Spatial Layout System Arrangement. The first regulation controls alteration of designated forest area and it requires SEA when the alteration has potential of environmental impact or risk.

The second regulation is for spatial planning which is obligated to conduct SEA by Law No.32/2009. It requires analysis of environmental carrying capacity and accommodation capacity thorough SEA study.

5) Pilot Studies of SEA in Indonesia

The Ministry of Environment had conducted pilot studies of SEA before the Law No.32/2009 was issued. Table 2.12-1 shows outline of two pilot studies: one of them is for a specific developmental plan of Padang Bay City, and the other is for a watershed management plan which covers five regions. The types of planning are different between both; however, both examples contain review of upper level plans and regulations, analysis of current environmental conditions, extracting current issues and recommendations.

According to the Ministry of Environment, it was found as the result of the pilot studies that for the case of specific developmental plans such as Padang Bay City project, EIA study is more applicable than SEA study.

Table 2.12-1 Outline of Pilot Studies of SEA

Name of the plan	Development Plan of Padang Bay City in West Sumatera [1]	Watershed management plan in Ciayumajakuning which consists of five regions [2),3)]
Implementation agency	Government of Padang City in West Sumatera	Ministry of Environment
Type of planning	Reclamation plan for developing an integrated tourism area	Watershed management plan
Necessity of SEA	Significant impact may be caused by the mega project.	Recent development in five regions had required a mutual cooperation and efforts of coordinate.
Objective of SEA	To reinforce the process of the developmental planning.	To provide input and feedback for formulation of water policy that covers five regions.
Contents of SEA	1) Review of relevant laws, regulations and upper level plans. 2) Explanation of the idea of the reclamation plan 3) Review of environmental condition and its problems 4) Assessment on the implication of the development a. Extracting activities which may change environment b. Extracting environmental components which may be affected by the activities c. Developing an interaction matrix between above mentioned a and b 5) Identifying the most essential environmental issue that may be caused by the development in light of public opinion 6) Recommendation for mitigating the impacts including possible alternatives	1) Review of environmental condition 2) Identification of issues on water resource management 3) Review of laws and regulations on water resource management 4) Recommendation on water resource management especially on the regulation of protected areas based on the discussions
Methodology of data collection	Secondary data: - Institutional data and publication - Old maps, pictures and photographs Primary data: - Field observation - Map study - Interviews and questionnaires	- Secondary data (summarized in a system-based map) - Observation - Dialogue
Methodology of public involvement	- Focus group discussion - Questionnaire survey - Newspaper clipping	- Multi-party discussions - Discussion with experts - Formal/informal dialogue

Source:1) KLHS Rencana Pembangunan Padang Bay City Sumatera Barat, 2007
2) KLHS Pilot Project Ciayumajakuning (Cirebon, Indramaya, Majalengka & Kuningan), 2007
3) KLHS Ikhtisar Pilot Projects (Ciayumajakuning-Gardang, Cekungan Bandung, Kartamantul, Bima) Final Report, 2009

(3) Environmental Impact Assessment (EIA)

1) List of Laws and Regulations for EIA

Laws and regulations regarding EIA in Indonesia are listed below.

- Law No.32/2009 concerning Environmental Protection and Management
- Government Regulation No.27/1999 on Analysis of Environmental Impacts
- Decree of Head of BAPEDAL No.8/2000 on Public Involvement and Information Disclosure in EIA Process
- Decree of the Ministry of Environment No.11/2006 on Type of Business Plan and/or Activity Requiring EIA
- Decree of the Ministry of Environment No.5/2008 on Works of EIA Appraisal Commission
- Decree of the Ministry of Environment No.6/2008 on License of EIA Appraisal Commission
- Decree of the Ministry of Environment No.8/2006 on Guidelines for EIA

2) Outline of EIA system in Indonesia

EIA in Indonesia is called AMDAL (Analisis Mengenai Dampak Lingkungan), which is stipulated by Law No.32/2009. The specific criteria of the project type and scale which require AMDAL is described in Decree of the Ministry of Environment No.11/2006; the criteria for port, road and rail development are tabulated in Table 2.12-2.

Details of the AMDAL process are described in Government Regulation No.27/1999 on Analysis of Environmental Impacts and Decree of the Ministry of Environment No.8/2006 on Guidelines for AMDAL as well as Decree of Head of BAPEDAL (Environmental Agency) No.8/2000 which stipulates the public involvement and information disclosure on AMDAL. Project proponent shall prepare following documents in the AMDAL process to be approved by AMDAL Commission. Flowchart of AMDAL is shown in Figure 2.12-1.

- KA-ANDAL (Kerangka Acuan Analisis Dampak Lingkungan): terms of reference for ANDAL
- ANDAL (Analisis Dampak Lingkungan): environmental impact assessment report
- RKL (Rencana Pengelolaan Lingkungan):environmental management plan
- RPL (Rencana Pemantauan Linkungan): environmental monitoring plan

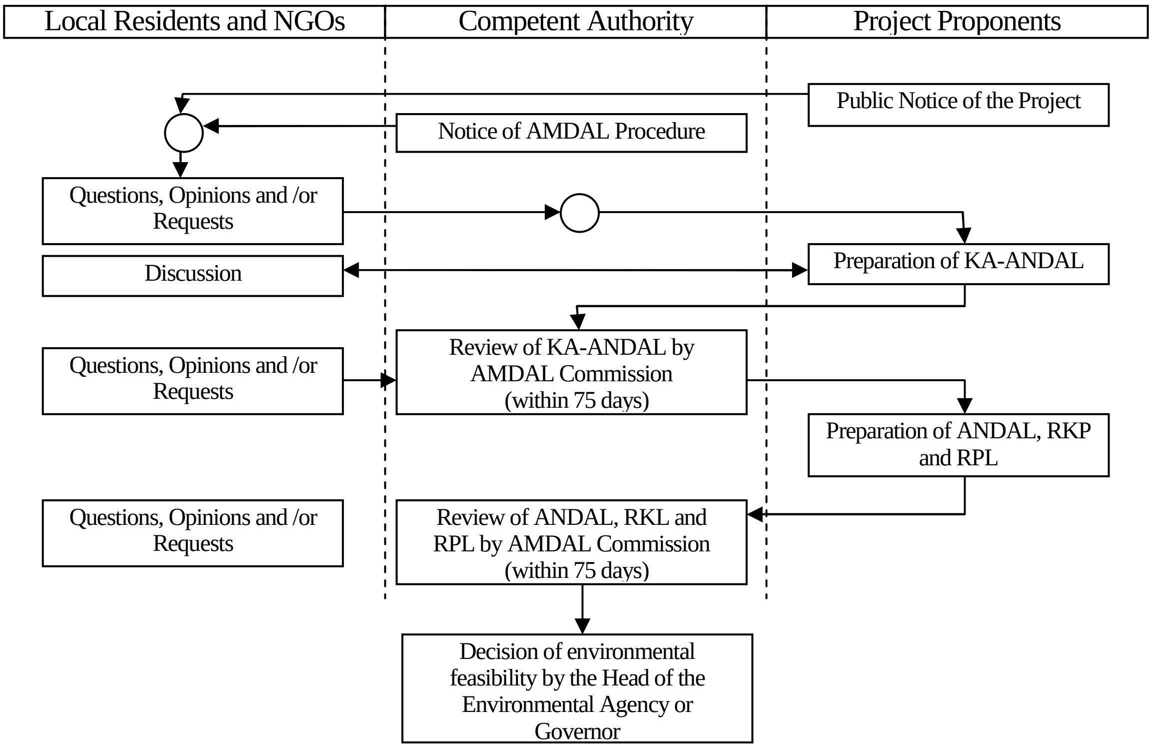
In accordance with the project types, AMDAL Commission is formed in different administrative levels: central government, provincial government and Kabpaten/Kota (see Table 2.12-2). When the project area covers more than one administrative district, the commission is formed under the upper administrative level. In the case of the new container terminal, the international port development plan, the AMDAL Commission will be formed under the central government.

For the projects which do not require AMDAL, project proponents shall prepare UKL-UPL (Upaya Pengelolaan Lingkungan- Upaya Pemantauan Lingkungan): environmental management efforts and environmental monitoring efforts. Law No.32/2009 stipulates that every activity not only with AMDAL but also with UKL-UPL is obligated to have an environmental permit.

Table 2.12-2 Screening Criteria for Requirement of AMDAL (EIA) and Administrative Level of Appraisal Commission (Port, Road and Railway)

Category	Type of Activity		Screening Criteria [1] (Scale/Quantity)	Level of Appraisal Commission[2]
Port	Dredging	Capital dredging	Volume > 500,000 m3	Kabpaten/Kota
		Dredging on rock and/or stone	All	
	Port facility	Jetty with sheet pile or open pile	Length > 200 m or Area >6,000 m2	International port: central government National port and/or regional port: provincial government Local port: Kabpaten/Kota
		Jetty with massive construction	All	
		Break water	Length >200 m	
		Port infrastructure (terminal, warehouse, container yard, etc.)	Area >5ha	
		Mooring buoy	Ship >10,000 DWT	
	Reclamation		Area >25 ha or Volume >500,000 m3	Kabpaten/Kota
Road	Toll road development		Length >5 km	Kabpaten/Kota
	Road development and/or dilation with land acquisition	Big city/metropolitan	Length >5 km or Land acquisition >5 ha	Kabpaten/Kota
		City	Length >10 km or Land acquisition >10ha	Kabpaten/Kota
		Rural area	Length >30 km or Land acquisition > 30 ha	Kabpaten/Kota
	Development of under pass/tunnel		Length >2 km	Kabpaten/Kota
	Development of bridge		Length > 500m	Kabpaten/Kota
Railway	Railway network		Length >25km	Kabpaten/Kota
	Underground railways		All	Kabpaten/Kota
	Terminal development		Area >2ha	Kabpaten/Kota

Source:1) Decree of the Ministry of Environment No.11/2006 on Type of Business Plan and/or Activity Requiring EIA
2) Decree of the Ministry of Environment No.5/2008 on Works of EIA Appraisal Commission



Source: Decree of Head of BAPEDAL No.8/2000 on Public Involvement and Information Disclosure in EIA Process

Figure 2.12-1 Flowchart of AMDAL (EIA)

(4) Land Acquisition

Regulations for land acquisition in Indonesia are listed below.

- President Decree No. 36/2005 on Procurement of Land for Implementation of Development for the Public Interest
- President Decree No. 65/2006 on Changes of President Decree No.36/2005

The Decree No. 36/2005 and No.65/2006 stipulate procedure for acquiring land, buildings, plants and related objects with the land by central/local government for development of public interest. In order to procure the land and related objects, Land Acquisition Committee is established by the mayor or governor or minister depending on the covered regions. Land Acquisition Committee assesses the amount of compensation based on their research and inventory of the land, buildings and so on to be acquired. Compensation is made by money, alternative land, resettlement, combination of these three and the others approved by the concerned parties.

2.13 Identification of Critical Issues in Port Logistics

2.13.1 General

Indonesian economy has been expanding steadily and accordingly international/domestic cargoes handled in Indonesian ports have been increasing rapidly. Total number of laden containers handled in Indonesia was 2.7 million TEU in 2000 and 4.9 million TEU in 2008. The annual growth rate of container cargo is approximately 7.8 %, while annual growth rate of GDP at constant price during the same period is approximately 5 %. Most of these containers are handled in ports in the Greater Jakarta Metropolitan Area, which is the Study Area. Previous sections of this chapter describe the background and current situation of port logistics in the study area. These analyses and related sections of other chapters reveal existing critical issues on port logistics in this area.

2.13.2 Critical Issues facing Ports

(1) Limited Container Handling Capacity

International container throughput of Tg. Priok Port is 2,736 (1,000 TEU) and domestic container throughput is 1,068 (1,000 TEU) in 2009. Total throughput is 3,804 (1,000 TEU). Current capacities of international and domestic container are estimated at approximately 4 million and 2.3 million TEU per annum respectively, or 6.3 million TEU per annum in total. Since container throughput has been increasing rapidly, container volume will exceed the capacity in several years. Demand forecast predicts that total throughput will reach the capacity in 2014.

(2) Limited Dimensions/Scales of Container Facilities

Although large vessels have been deployed in international maritime container transport recently, major container ships which call Tg. Priok Port are rather small vessels with the capacity of 2,000 – 3,500 TEU. This is partially due to the inadequate depth of container terminals. In fact, JICT I and KOJA are major international container terminals but these terminals have quay-walls with the depth of only 11-13.5 m. Deeper quay-walls, water channels and basins shall be required to meet the current enlargement of container ships in international maritime transport.

Storage capacity analysis of container terminals in Chapter 4 reveals that existing total number of ground slots for container storage is inadequate. As a result, container handling in marshaling yard is congested and inefficient. One of the consignees/consigners claims that containers were moved to an unknown place without owner's concurrence. This happened due to the shortage of container yard space. Expanded container terminals are required to meet the customer's requirement of efficient cargo handling.

(3) Insufficient Port Facilities

Besides the container related issues, consignees/consigners point out the following issues in port facilities.

- Shortage of Cargo Handling Equipment particularly heavy duty machines
- Limited Capacity of Car Terminal
- Vessel's Berth Waiting Time, Delay of vessel Arrival/Departure

(4) Inefficient Cargo Handling

Above mentioned issues comprehensively result in inefficient cargo handling and damage the international competitiveness of Indonesian industries.

(5) Insufficient Utilization of IT Technology in Port Procedures

Many consignees/consigners suggest that port entry and CIQ procedures should be simplified and conducted promptly by introducing more IT technologies.

2.13.3 Critical Issues around Port

(1) Poor Road Access to/from Port

There are three major access roads to/from Tg. Priok Port, namely "Harbor Toll Road", "NS-Link" and "Jakarta Outer Ring Road (JORR)". Harbor Toll Road is for westbound traffic from the port. NS-Link is for south bound traffic from the port. This road is partially for east bound traffic from the port, because JORR is not completed yet. Although JORR is originally designated for eastbound traffic from the port, there are some missing roads near Tg. Priok Port. Traffic capacity analysis of toll road in Chapter 4 reveals the following facts:

- Vehicle capacity ratios of "Harbor Toll Road" and "NS-Link" are more than 1.0. It means that the number of vehicles passing through these roads exceed their capacities already. Accordingly heavy traffic congestion takes place everyday.
- Although vehicle capacity ratio of JORR, from port to Cikanpek Toll Road, is less than 0.8, vehicle capacity ratio of Cikanpek Toll Road is more than 0.8. It is obvious that heavy traffic congestion takes place everyday even on Cikanpek Toll Road. This means that a vehicle capacity ratio more than 0.8 is not conducive for smooth vehicle traffic.

Almost all consignees/consigners claim that traffic congestion in the study area should be eased as soon as possible to rationalize and boost their business activities in Indonesia. Following comments from some consignees/consigners were echoed by many:

- Because of heavy road congestion, it sometimes takes 5-7 hours to transport imported containers from Tg. Priok Port to Cibitun.
- Only one (1) round trip can be made a day between Tangeran and Tg.Priok Port, of which distance is 30 km, while two (2) round trips can be made between Merak and Tangeran, even though the distance between two places is 100 km.

There is another plan of JORR II to ease the traffic condition in Jakarta Metropolitan Area. This plan was officially decided to be implemented approximately 10 years ago. However, only little progress has been witnessed due to the delay of land acquisition which should be conducted by public sectors.

(2) Insufficient Utilization of Container Transport by Rail

There are nine (9) operational regions of rail freight transportation in Java Island. Among them, two (2) operational regions, namely DAOP I and II, are located in the Study area. DAOP I carried 89,148 tons of containerized cargo and DAOP II carried 76,140 tons in 2004. In other words, a total volume of 165,288 tons of containerized cargo was carried by rail in 2004. In 2009, DAOP I carried 79,134 tons of containerized cargo and DAOP II carried 49,520 tons, or 128,654 tons in total. Containerized cargo transported by rail has been decreasing by 4.9% per annum for 5 years. Since it can be assumed that average weight of a TEU container is approximately 8 tons, rail transport system carried approximately 16,000 TEU in 2009. Container throughput of Tg. Priok Port is approximately 3.8 million TEU in 2009. It can thus be said container transport by rail does not contribute to container logistics at Tg, Priok Port at all.

From the viewpoint of energy consumption and environmental aspects, container transport by rail should be enhanced more and more.

CHAPTER 3 NATURAL CONDITIONS IN AND AROUND POTENTIAL SITES FOR A NEW CONTAINER TERMINAL

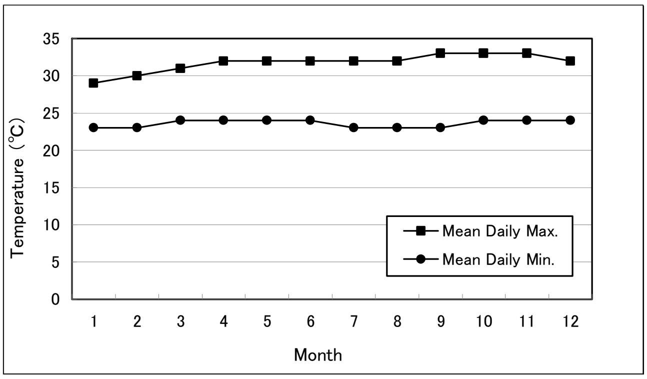
3.1 Meteorological Conditions

The region of the study area is located in the northern part of Java Island facing Java Sea. The area is categorized as a tropical monsoon climate zone.

3.1.1 Air Temperature and Humidity

(1) Air Temperature

Figure 3.1-1 shows mean daily maximum and mean daily minimum temperatures observed at Jakarta. Seasonal variations of temperature are small and the mean daily temperature varies between 23ºC to 33ºC.

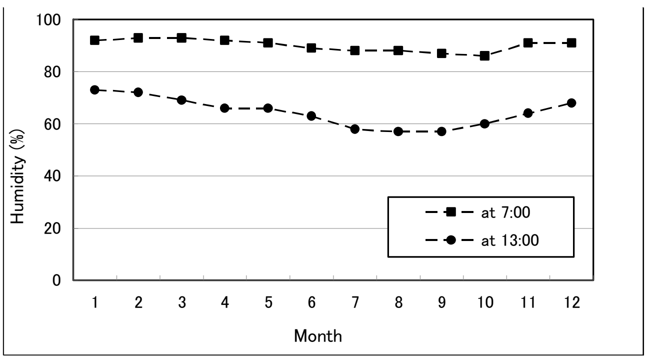


(℃)

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mean Daily Max.	29	30	31	32	32	32	32	32	33	33	33	32
Mean Daily Min.	23	23	24	24	24	24	23	23	23	24	24	24

Source: Indonesian Pilot, Volume I, Second Edition 1996, The hydrographer of the Navy, UK

Figure 3.1-1 Air Temperature at Jakarta



(%)

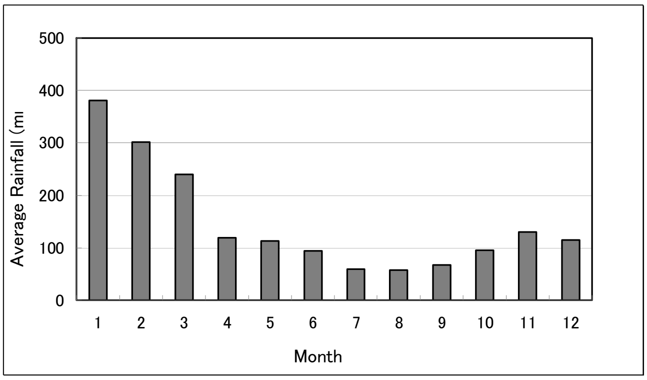
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
at 7:00	92	93	93	92	91	89	88	88	87	86	91	91
at 13:00	73	72	69	66	66	63	58	57	57	60	64	68

Source: Indonesian Pilot, Volume I, Second Edition 1996, The hydrographer of the Navy, UK

Figure 3.1-2 Humidity at Jakarta

3.1.2 Precipitation

Annual total rainfall is about 1,800mm in the Jakarta area. Rainy season in the West Java region is November to March, and the dry season is June to September. Figure 3.1-3 shows monthly precipitation at Jakarta. Monthly rainfall during the rainy season is approximately more than five times during the dry season. January shows the highest monthly rainfall at 381 mm.



(mm)

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Average Rain Fall	381	302	240	119	113	94	59	58	67	95	130	115

Source: Indonesian Pilot, Volume I, Second Edition 1996, The hydrographer of the Navy, UK

Figure 3.1-3 Precipitation

3.1.3 Wind

In general, May to September is the season of the Southeast (SE) monsoon and November to March is the season of the Northwest (NW) monsoon. Winds observation records at 7:00 a.m. and 1:00 p.m. are available at the observation stations. Wind distributions at Jakarta are as shown in Table 3.1-1.

Winds are 50 % calm at 7:00 a.m.; S and SW direction wind is dominant throughout the year. For winds observed at 1:00 p.m., N, NE and NW direction winds are dominant throughout the year and are seldom calm.

Table 3.1-1 Wind Distribution at Jakarta

(%)

(1) Jakarta at 7:00													
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Mean
N	6	5	4	2	2	3	4	3	3	4	4	5	4
NE	4	2	2	2	4	6	5	5	4	3	3	3	4
E	4	3	4	6	10	8	7	9	1	6	6	5	6
SE	5	7	6	9	12	10	13	15	12	13	9	7	10
S	8	10	6	8	7	7	10	12	18	14	13	10	10
SW	11	11	10	5	2	2	3	3	2	5	8	12	6
W	14	10	9	4	1	1	2	2	2	3	5	14	6
NW	6	5	3	1	1	1	1	1	2	2	1	3	2
CALM	42	47	56	63	61	62	55	50	47	50	51	41	52
SUM	100	100	100	100	100	100	100	100	100	100	100	100	100
(2) Jakarta at 13:00													
N	18	18	19	28	22	21	20	33	45	42	33	22	27
NE	3	4	12	29	39	34	32	27	17	17	15	6	20
E	2	2	3	10	18	23	19	13	8	6	7	3	9
SE	1	1	2	2	3	3	4	5	7	5	4	1	3
S	2	2	1	1	1	1	4	2	1	2	1	2	2
SW	7	5	6	5	3	3	6	3	3	4	6	7	5
W	24	28	26	10	5	4	5	4	3	6	13	25	13
NW	42	39	29	14	8	9	8	12	15	17	19	32	20
CALM	1	1	2	1	1	2	2	1	1	1	2	2	1
SUM	100	100	100	100	100	100	100	100	100	100	100	100	100

Source: Indonesian Pilot, Volume I, Second Edition 1996, The hydrographer of the Navy, UK

3.2 Oceanographic Conditions

3.2.1 Tide

According to the harmonic analysis based on the tide observation records obtained during the bathymetric survey carried out in May and June 2010, the Z0, tide type and tidal range at each survey site can be summarized in the table below. The Mixed diurnal tide is dominant in the coastal area except at East Ancol (Tanjung Priok). Tidal ranges are relatively narrow, within 1.0 to 1.2m.

Table 3.2-1 Tidal Conditions at Site of Terminal Development

Site	East Ancol (Tg. Priok)	Marunda/ Bekasi	Cilamaya	Ciasem	Tangerang
Z_0 (cm)	60	63	55	55	59
Tide Type	Diurnal	Mixed, Dominant Diurnal	Mixed, Dominant Diurnal	Mixed, Dominant Diurnal	Mixed, Dominant Diurnal
Tidal Range (m)	1.0	1.2	1.1	1.1	1.2

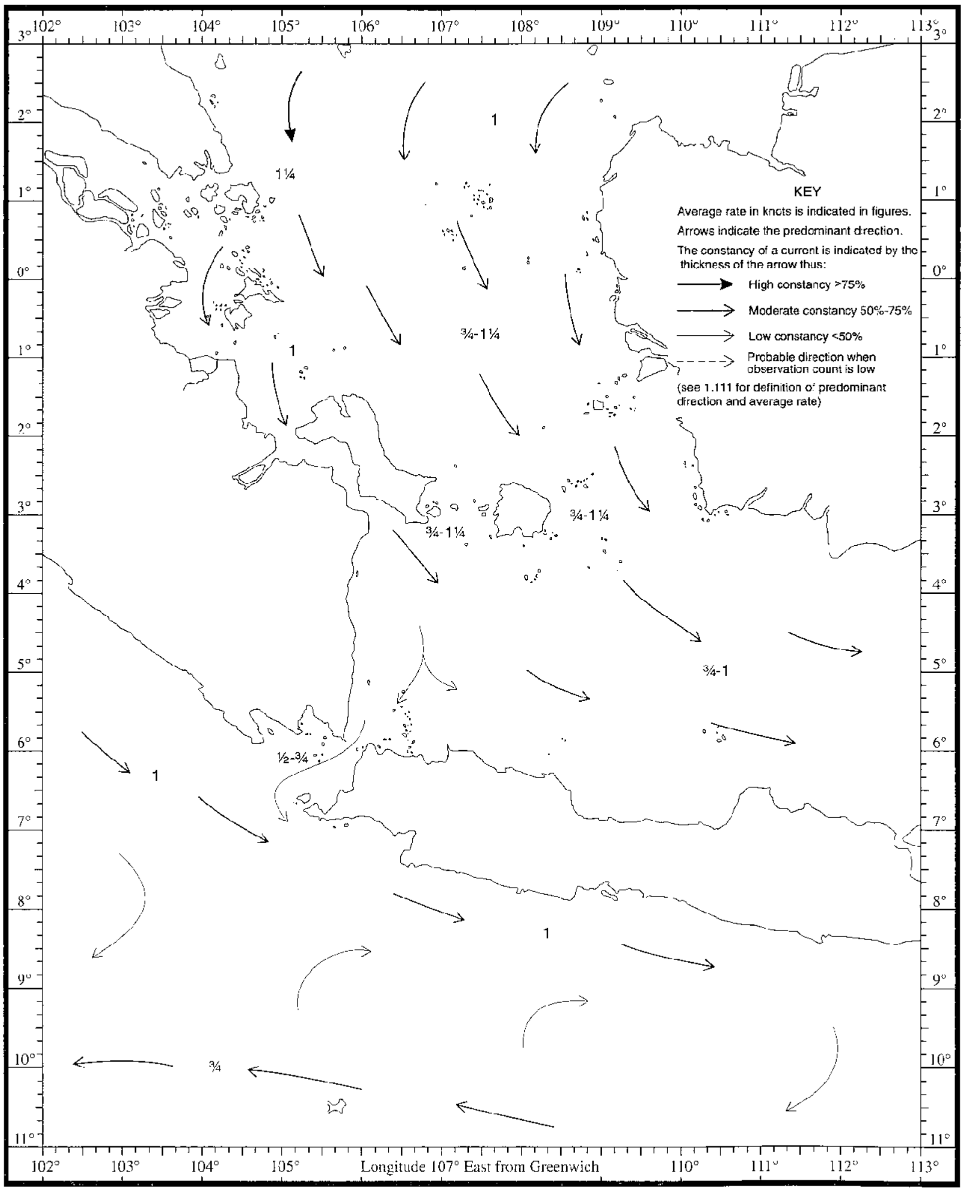
Source: JICA Study Team

3.2.2 Surface Current

Conditions of the surface current in the Java Sea can be found in the Indonesia Pilot (Volume I, Second Edition 1996, Hydrographer of the Navy). According to the Indonesia Pilot, the surface current of the open sea is described as follows.

In the open in Java Sea, the direction of the predominant surface current generally sets in the same direction to which the monsoon wind is blowing. From November to March the currents set ESE in Java Sea with an average rate of between 0.75 to 1.25 knots (0.4 to 0.6 m/sec) as shown in Figure 3.2-1.

Between May and September the direction of the current is reversed with a WNW set in Java Sea with an average rate of about 0.75 knots as shown in Figure 3.2-2. Maximum rates are usually less than 2 knots but on relatively rare occasions, during either monsoon, rates of 3 knots have been recorded. During April and late October to November, the months of transition between the NW and SE monsoons, the currents are usually variable.

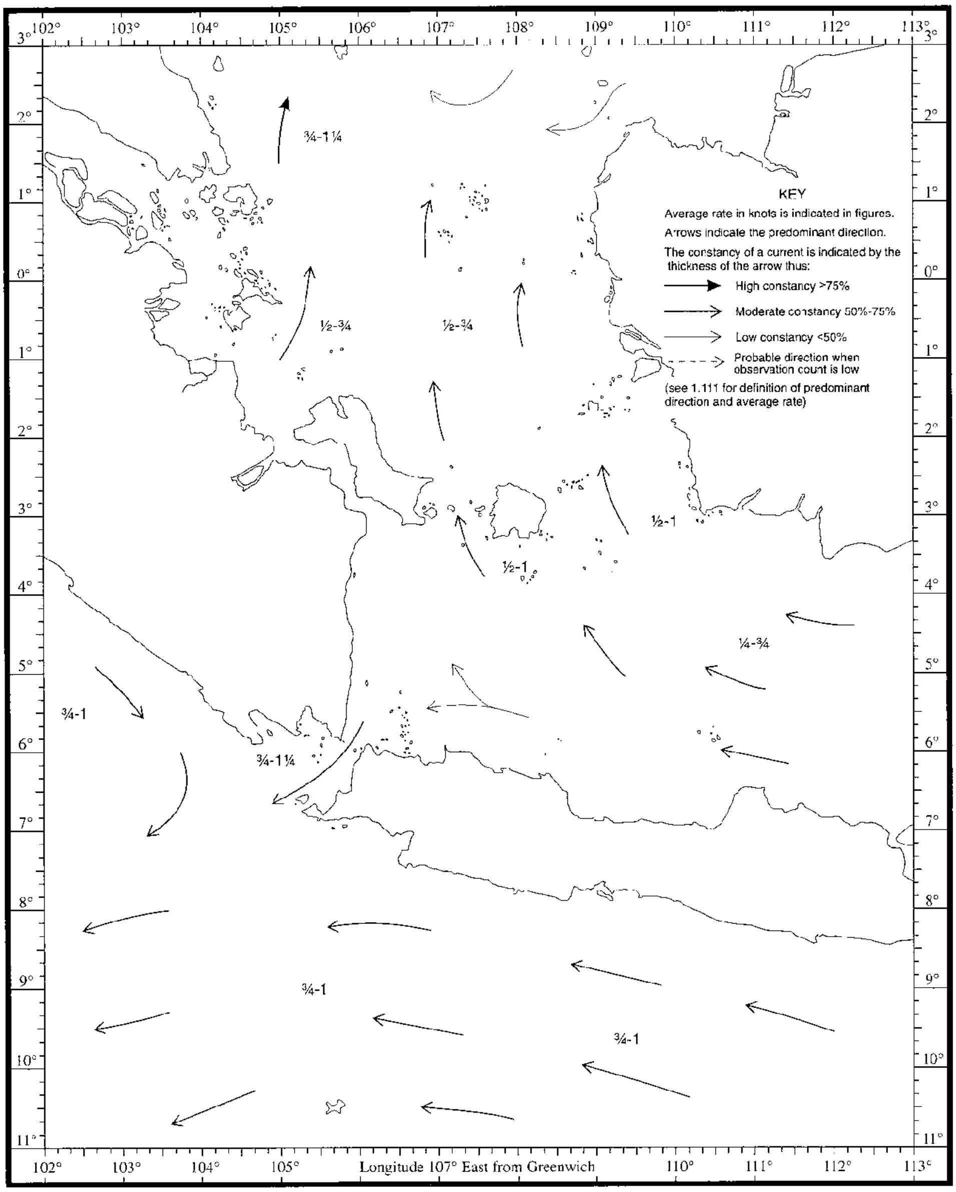


Predominant surface currents NOVEMBER to MARCH (1.111.1)

(1) November to March

Source: Indonesia Pilot Volume I Second Edition 1996, Hydrographer of the Navy

Figure 3.2-1 Predominant Surface Currents



Predominant surface currents MAY to SEPTEMBER (1.111.2)

(2) May to September

Source: Indonesia Pilot Volume I Second Edition 1996, Hydrographer of the Navy

Figure 3.2-2 Predominant Surface Currents

3.2.3 Wave Climate

(1) General

In the Java Sea, waves are generated locally by the wind and can be very variable in direction, especially in the transitional months (April and late October to November) between the NW monsoon (from November to March) and SE monsoon (between May and September). Throughout the year, heights of the sea waves are frequently less than 1 meter.

Since the candidate sites of the new container terminal development are facing the north coast of Java Island, wave conditions are heavy mostly during the NW monsoon season. And the waves from between N and NW are most frequent in January.

Setting the waves to be used for planning and designing in this study, wave occurrence rate at each candidate site and parameters of design waves are estimated by statistical processing and by analyzing wave transformations. Wave data for this analysis were hindcasted in the previous JICA Study (2002 – 2003) using SMB method with five (5) years wind information during 1997 to 2001 observed at Cengkareng Meteorological Station of BMKG (Badan Meteorologi Klimatologi dan Geofisika).

(2) Deep Water Wave at the Objective Site (Base Data)

Since the range of wave generation driven by the sea wind and wave development is relatively small in Java Sea, wave height does not develop so much. Table 3.2-2 and Figure 3.2-3 show the relations between wave heights and its directions based on the wave hindcast data (JICA Study, 2002 – 2003).

It can be found that waves from the range of W to E directions can reach to the coastal area since all the candidate sites are facing the north coast of Java Island facing to the open sea. The most dominant direction of wave is West direction and its occurrence rate is 10.5% while the rates of other directions waves are small, varying from 1.6 to 4.1%. The area is relatively calm since the occurrence percentage of calm wave amounts to 68.5%, and the cumulative percentages of wave height less than 0.5m and 1.0m show 86.6% and 96.9% respectively (refer to Table 3.2-2).

Table 3.2-2 Combined Occurrence of Wave Heights and Wave Directions (Deepwater Wave Off Jakarta)

Dir \ $H_{1/3}$	W	WNW	NW	NNW	N	NNE	NE	ENE	E	Calm	total	Cumu-lative
0.00≦H<0.25	1.011	153	146	182	252	256	218	133	173	32.259	34.783	73.9%
0.25≦H<0.50	1,785	415	432	540	614	699	786	401	303		5,975	86.6%
0.50≦H<0.75	976	223	211	241	200	336	523	379	157		3,246	93.5%
0.75≦H<1.00	620	187	73	62	44	115	238	205	70		1,614	96.9%
1.00≦H<1.25	316	96	41	21	11	45	113	95	38		776	98.6%
1.25≦H<1.50	136	74	11	7	7	16	38	56	13		358	99.3%
1.50≦H<1.75	61	39	6	8	2	5	18	23	6		168	99.7%
1.75≦H<2.00	29	9	3	4	1	4	14	18	2		84	99.9%
2.0≦H<2.5	17	23	3				1	9	2		55	100.0%
2.5≦H<3.0		4						1			5	100.0%
3.0≦H<3.5											0	100.0%
3.5≦H<4.0											0	100.0%
4.0≦H											0	100.0%
total	4,951	1,223	926	1,065	1,131	1,476	1,949	1,320	764	32,259	47,064	100%
	10.5%	2.6%	2.0%	2.3%	2.4%	3.1%	4.1%	2.8%	1.6%	68.5%	100%	100%

Source: JICA Study Team

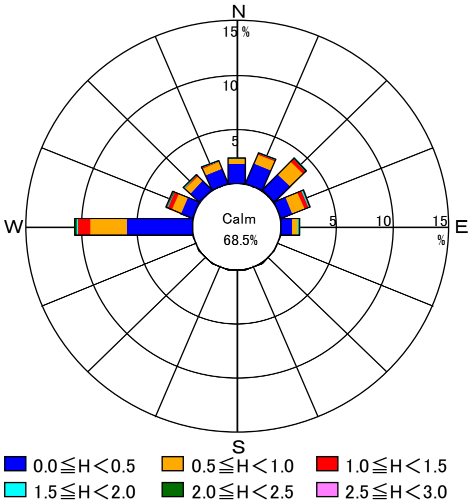


Figure 3.2-3 Combined Occurrence of Wave Heights and Wave Directions (Deepwater Wave Off Jakarta)

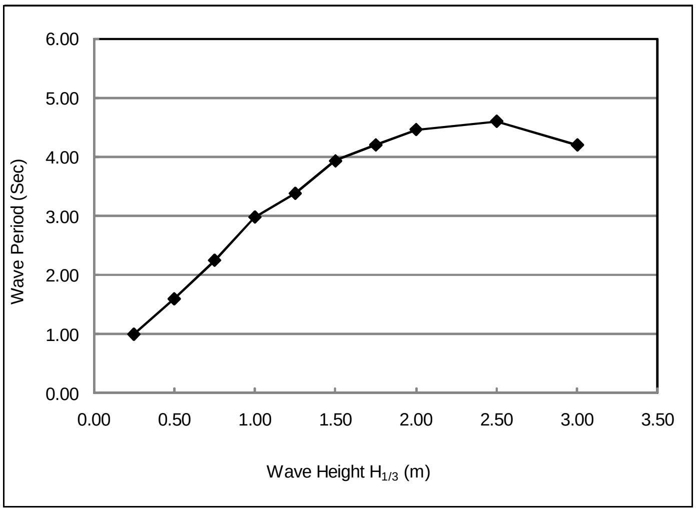
Wave periods of deepwater waves (hindcast) at Jakarta distribute in a narrow range from 1 to 5 seconds as shown in Table 3.2-3. Wave periods less than 3 seconds account for more than 90% of the total occurrence.

The weighted average of wave period is worked out at each rank of wave height in the Table 3.2-3, and the relations between wave height and wave period are as shown in Figure 3.2-4. For waves with a height less than 1.0m, the wave periods are shorter than 3 seconds, however, if the wave height increases more than 1.5m, the corresponding wave periods are about 4 seconds.

Table 3.2-3 Combined Occurrence of Wave Height and Wave Period (Deepwater Wave Off Jakarta)

$T_{1/3}$ (sec) / $H_{1/3}$ (m)	1	2	3	4	5	6	7	8	9	Calm	Total	Rate		weighted average
												Individual	Comulative	
0.00 ≦H< 0.25	2,524									32,259	34,783	73.91%	73.91%	1.00
0.25 ≦H< 0.50	2,382	3,593									5,975	12.70%	86.60%	1.60
0.50 ≦H< 0.75		2,442	804								3,246	6.90%	93.50%	2.25
0.75 ≦H< 1.00		62	1,528	24							1,614	3.43%	96.93%	2.98
1.00 ≦H< 1.25			480	296							776	1.65%	98.58%	3.38
1.25 ≦H< 1.50			38	308	12						358	0.76%	99.34%	3.93
1.50 ≦H< 1.75				134	34						168	0.36%	99.69%	4.20
1.75 ≦H< 2.00				45	39						84	0.18%	99.87%	4.46
2.00 ≦H< 2.50				22	33						55	0.12%	99.99%	4.60
2.50 ≦H< 3.00				4	1						5	0.01%	100.00%	4.20
3.00 ≦H< 3.50											0	0.00%	100.00%	
3.50 ≦H< 4.00											0	0.00%	100.00%	
4.00 ≦H											0	0.00%	100.00%	
Total	4,906	6,097	2,850	833	119	0	0	0	0	32,259	47,064	100.00%	100.00%	
Rate	10.42%	12.95%	6.06%	1.77%	0.25%	0.00%	0.00%	0.00%	0.00%	68.54%	100.00%			
Coumlative Rate	10.42%	23.38%	29.43%	31.20%	31.46%	31.46%	31.46%	31.46%	31.46%	100.00%				

Source: JICA Study Team



Source: JICA Study Team

Figure 3.2-4 Relations between Wave Height and Period

3.3 Wave Conditions at Candidate Terminal Sites

For discussions of (i) harbor calmness, (ii) net operational rate of cargo handling at the berth and number of operational days, (iii) energy of incident waves and others for port planning at each candidate site, wave conditions were studied such as wave height and period, dominant directions, probability of wave occurrence and non-exceeding wave height.

Wave transformation of the deepwater waves (hindcasted at off Jakarta) to the waves at each candidate site of container terminal development was studied considering mainly wave refraction due to coastal bathymetry of the water area.

Wave height ratios at the designated points in front of the candidate site at the water depths -10 m and -15 m are calculated per directions against deepwater wave heights off Jakarta. By using the wave height ratios, probability of wave occurrence and non-exceeding wave height can be estimated for port planning purpose.

3.3.1 Wave Height Ratio

Calculation results of wave height ratios are summarized as shown in Table 3.3-1. In this table, ratio of wave heights at interested points divided by deepwater wave per directions is given. Wave conditions and characteristics are discussed based on the wave height ratio and the incident wave directions as presented in the following sub-section.

Table 3.3-1 Wave Height Ratio

Site	Depth	Wave Directions								
		W	WNW	NW	NNW	N	NNE	NE	ENE	E
East Ancol	10m	0.420	0.585	0.750	0.890	0.890	0.820	0.635	0.450	0.285
	15m	0.480	0.645	0.800	0.910	0.920	0.870	0.715	0.535	0.360
Marunda/Bekasi	10m	0.500	0.660	0.790	0.890	0.775	0.615	0.385	0.230	0.110
	15m	0.540	0.710	0.850	0.960	0.910	0.810	0.625	0.435	0.270
Cilamaya	10m	0.410	0.580	0.740	0.890	0.950	0.980	0.970	0.930	0.860
	15m	0.500	0.670	0.820	0.945	0.980	1.000	0.980	0.950	0.890
Ciasem	10m	0.435	0.610	0.775	0.920	0.970	0.990	0.950	0.875	0.760
	15m	0.490	0.665	0.820	0.940	0.980	0.995	0.980	0.935	0.860
Tangerang	10m	0.465	0.585	0.680	0.730	0.735	0.765	0.705	0.650	0.525
	15m	0.525	0.665	0.760	0.755	0.688	0.675	0.655	0.655	0.565

Source: JICA Study Team

3.3.2 Wave Conditions at Each Candidate Site

(1) East Ancol

Estimated points of the wave height at -10 m and -15 m water depths are as shown in Figure 3.3-1.

Wave height ratios show the lower values (0.3 – 0.5) for the waves from West and East, while the around twice higher values (0.8 – 0.9) are estimated for the North waves.

East Ancol is sheltered from incident waves coming from West and East directions by the coastal topography such as Tanjung Pasir and Tanjung Karawang respectively. However, some incident waves from North directions can reach to East Ancol site directly.

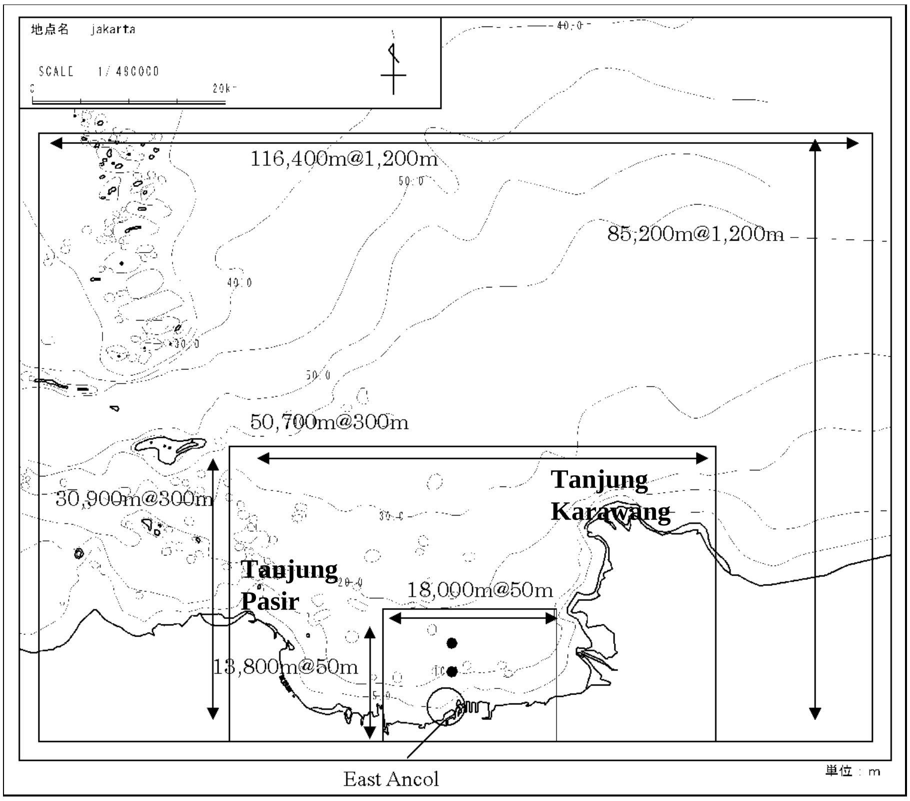
(2) Marunda and Bekasi

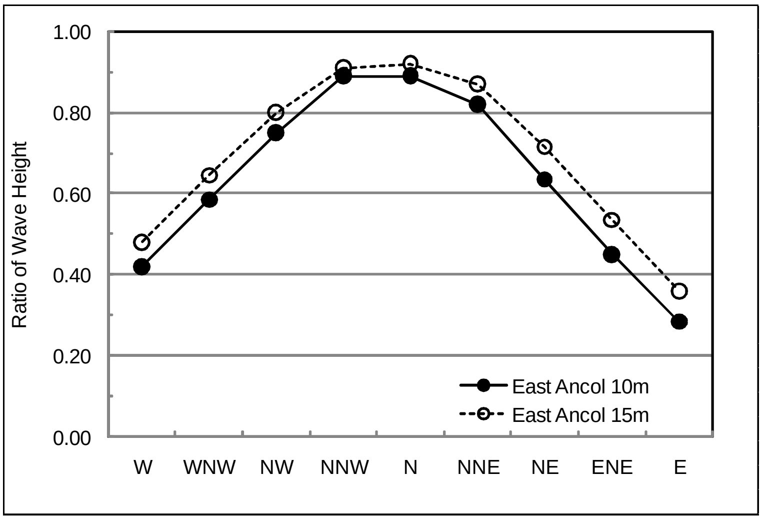
Estimated points of the wave height at -10m and -15m water depths are as shown in Figure 3.3-2.

Wave height ratios show the very low values (0.1 – 0.3) for the waves from East, while the around triple higher values (0.8 – 0.9) are estimated for the North waves.

Western waves approaches to the site after refraction and the lower wave height ratio (0.5 - 0.7) are given.

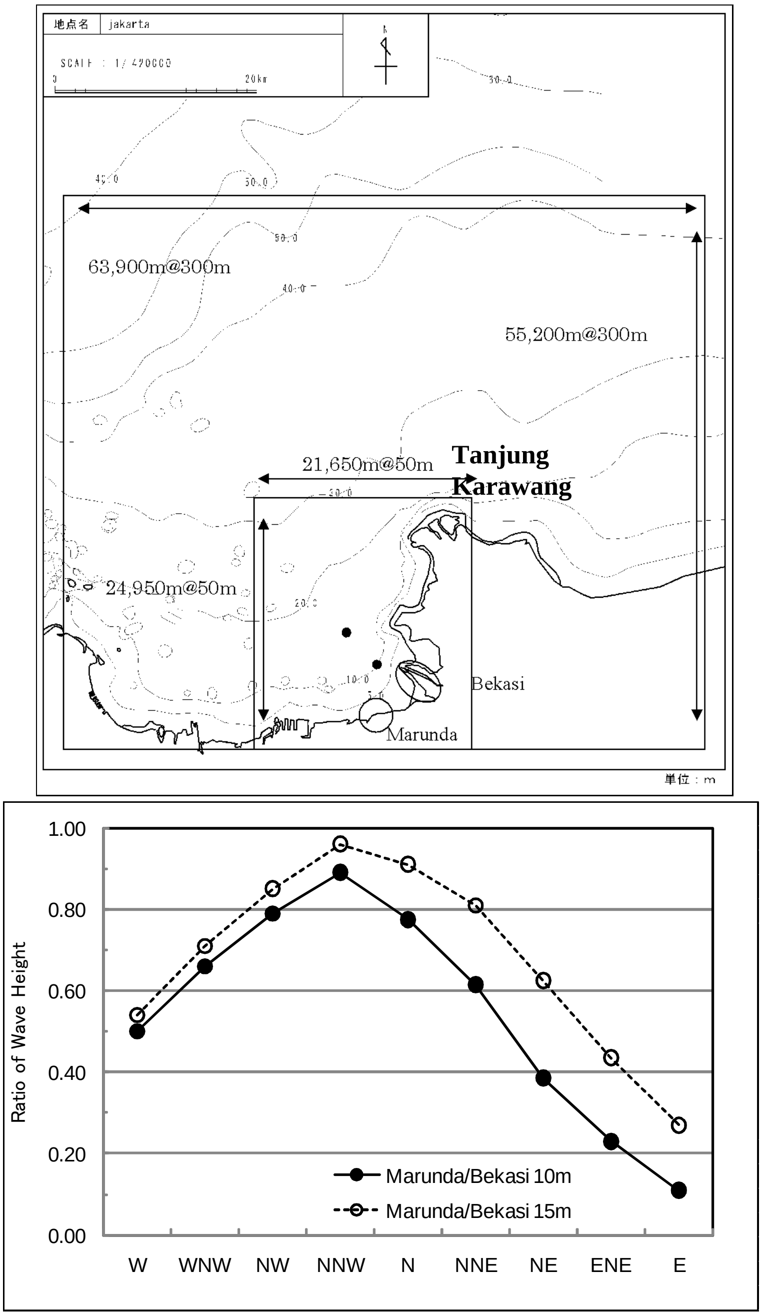
Marunda/Bekasi is sheltered from incident waves from the East direction by Tanjung Karawang, however waves coming from north direction can reach to the Marunda/Bekasi site directly.





Source: JICA Study Team

Figure 3.3-1 Wave Height Ratio at Designated Points (East Ancol)



Source: JICA Study Team

Figure 3.3-2 Wave Height Ratio at Designated Points (Bekasi/Marunda)

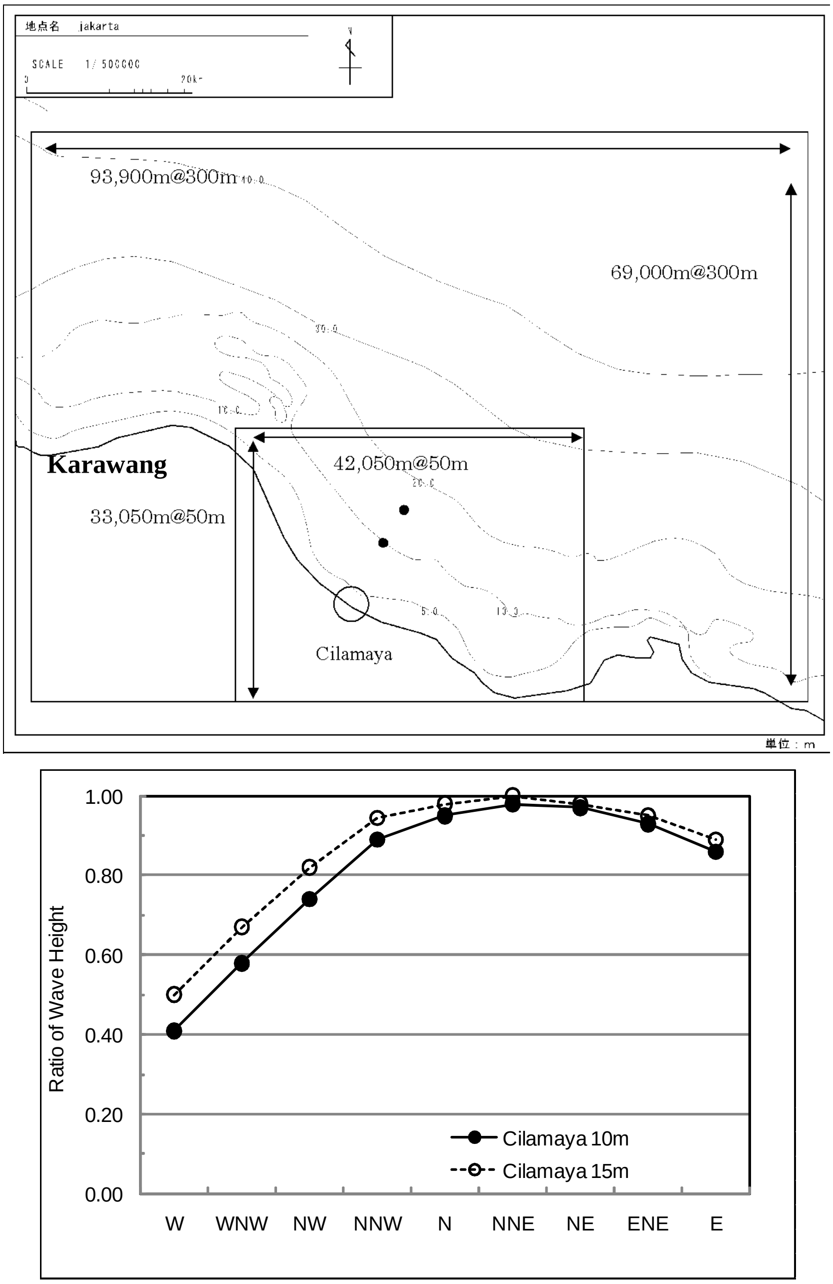
(3) Cilamaya

Estimated points of the wave height at -10m and -15m water depths are as shown in Figure 3.3-3.

The coast of Cilamaya is topographically sheltered from incident waves from West directions, while the coast is directly exposed to the waves from North to Northeast directions.

Higher wave height ratios (0.95 – 1.0) are estimated for the waves ranging from N to NE directions. Eastern waves approaches to the site after refraction but still higher wave height ratios (0.85 - 0.9) are given.

The Cilamaya coast is sheltered by the land area which is protruding toward the seaside east of Tanjung Karawang; accordingly a lower wave height ratio (0.4 – 0.5) is estimated.



Source: JICA Study Team

Figure 3.3-3 Wave Height Ratio at Designated Points (Cilamaya)

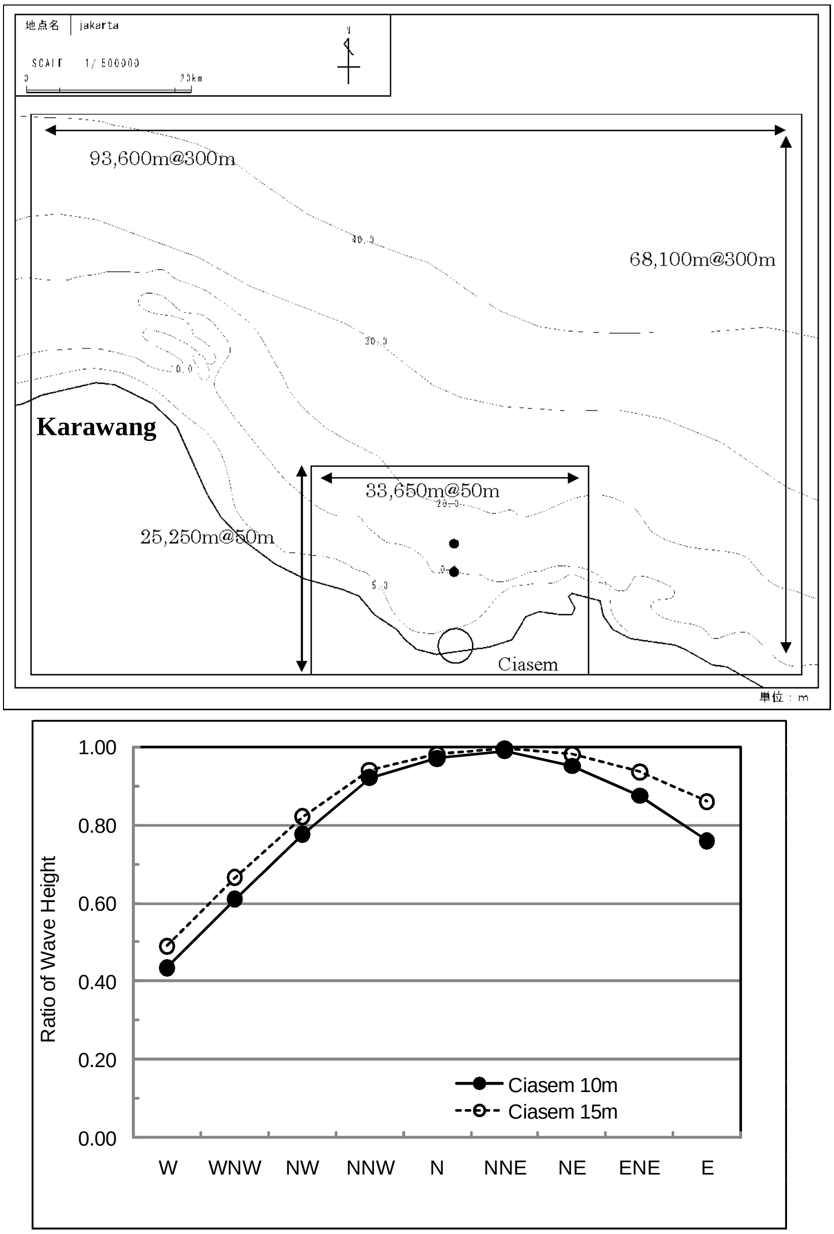
(4) Ciasem

Estimated points of the wave height at -10m and -15m water depths are as shown in Figure 3.3-4.

Characteristics of the coast of Ciasem are almost similar with that of Cilamaya; the coast is topographically sheltered from incident waves from West directions, while the coast is directly exposed to the waves from North to Northeast directions.

Higher wave height ratios (0.95 – 1.0) are estimated for the waves ranging from N to NE directions. Eastern waves approaches to the site after refraction but still higher wave height ratios (0.75 - 0.9) are given.

The Ciasem coast is sheltered by the land area which is protruding toward the seaside east of Tanjung Karawang; accordingly, a lower wave height ratio (0.4 – 0.5) is estimated.



Source: JICA Study Team

Figure 3.3-4 Wave Height Ratio at Designated Points (Ciasem)

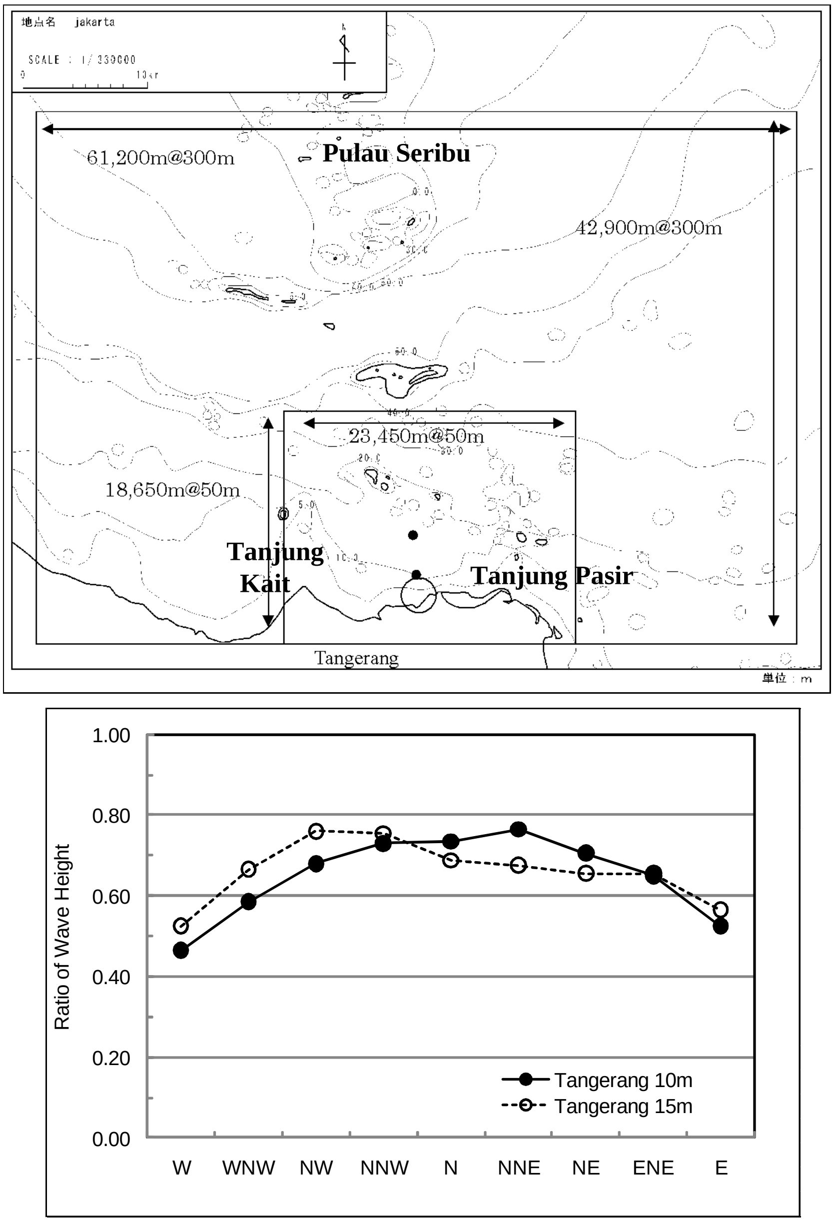
(5) Tangerang

Estimated points of the wave height at -10m and -15m water depths are as shown in Figure 3.3-5.

The designated development site is located at the coast middle of Tanjung Pasir and Tanjung Kait facing the open sea. There are many small islands in front of the Tangerang site and the bathymetry of the sea area has complicated features.

The coast of Tangerang is exposed to almost all the wave directions from the West, North and East. The wave height ratios estimated by wave transformation study ranges from 0.45 to 0.75. The reason for these lower values is thought to be that the waves approach the coast after refraction due to the coastal bathymetry and also because of the wave diffraction effect due to the thousand of small islands in front of the coast.

As for waves incident from North to Northeast, wave height ratio at water depth -15 m is larger than the ratio at water depth -10 m; this is likely due to the diffraction effect by the shallow area near scattered islands off the coast.



Source: JICA Study Team

Figure 3.3-5 Wave Height Ratio at Designated Points (Tangerang)

3.3.3 Probability of wave occurrence and non-exceeding wave height

Based on the wave transformation study on each candidate development site and the analysis mentioned above, probability table of wave height occurrence is given in Table 3.3-2 for each candidate site. And probability of non-exceeding wave height of 0.5 m is presented in Table 3.3-3.

Probability of non-exceeding waves of **0.5 m** height is different according to the conditions at each site. However, the probability of non-exceeding waves of **0.75 m** height is more than 97.5% at all sites, thus there is no major difference among the candidate sites.

Table 3.3-2 Probability of Wave Height Occurrence

Site / $H_{1/3}$(m)	East Ancol		Marunda/Bekasi		Cilamaya		Ciasem		Tangerang	
	10m	15m	10m	15m	10m	15m	10m	15m	10m	15m
0.00≦H＜0.25	90.0%	89.0%	89.8%	87.9%	88.7%	85.1%	88.7%	88.7%	88.7%	86.6%
0.25≦H＜0.50	7.3%	7.6%	7.7%	8.3%	7.2%	9.0%	7.2%	7.2%	7.8%	9.7%
0.50≦H＜0.75	1.9%	2.3%	1.7%	2.6%	2.6%	3.7%	2.3%	2.3%	2.6%	2.5%
0.75≦H＜1.00	0.6%	0.8%	0.7%	0.8%	0.8%	1.3%	1.2%	1.1%	0.6%	1.0%
1.00≦H＜1.25	0.2%	0.2%	0.1%	0.3%	0.4%	0.5%	0.4%	0.3%	0.2%	0.2%
1.25≦H＜1.50	0.0%	0.1%	0.1%	0.1%	0.2%	0.2%	0.1%	0.2%	0.1%	0.1%
1.50≦H＜1.75	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.0%
1.75≦H＜2.00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2.00≦H	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: JICA Study Team

Table 3.3-3 Probability of Non-exceeding Wave Height (H=0.5m)

Site / $H_{1/3}$(m)	East Ancol		Marunda/Bekasi		Cilamaya		Ciasem		Tangerang	
	10m	15m	10m	15m	10m	15m	10m	15m	10m	15m
0.00≦H＜0.25	90.0%	89.0%	89.8%	87.9%	88.7%	85.1%	88.7%	88.7%	88.7%	86.6%
0.25≦H＜0.50	97.3%	96.6%	97.4%	96.2%	95.9%	94.1%	95.9%	95.9%	96.5%	96.3%
0.50≦H＜0.75	99.2%	98.9%	99.1%	98.8%	98.6%	97.8%	98.2%	98.2%	99.1%	98.8%
0.75≦H＜1.00	99.7%	99.7%	99.8%	99.6%	99.4%	99.1%	99.4%	99.3%	99.7%	99.7%
1.00≦H＜1.25	99.9%	99.8%	99.9%	99.9%	99.7%	99.6%	99.7%	99.7%	99.9%	99.9%
1.25≦H＜1.50	100.0%	100.0%	100.0%	100.0%	99.9%	99.9%	99.9%	99.9%	100.0%	100.0%
1.50≦H＜1.75	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1.75≦H＜2.00	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2.00≦H	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: JICA Study Team

3.3.4 Discussions on Threshold Wave Height for Cargo Handling

Threshold wave height for cargo handling operation in a harbor can be referred as given in Table 3.3-4. Considering that vessel size ranges from 500 GT to 50,000 GT (medium- and large sized vessels), **threshold wave height: 0.5 meter** is chosen. Based on the 0.5 m wave height, the non-exceeding wave heights at each site are summarized in Table 3.3-5 below.

Table 3.3-4 Threshold Wave Height for Cargo Handling

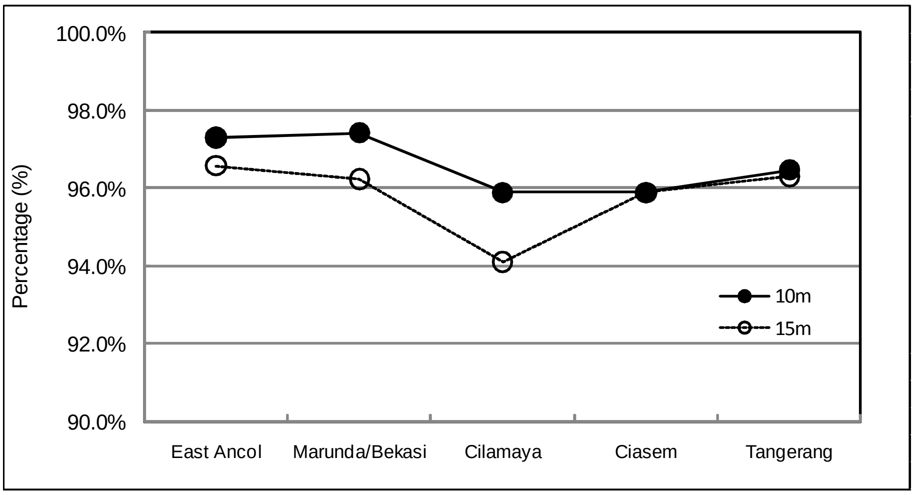
Ship size	Threshold wave height for cargo handling (H1/3)
Small-sized ships (<500GT)	0.3 m
Medium and large sized vessels (500GT<Size<50,000GT)	0.5 m
Very large vessels (>50,000GT)	0.7 to 1.5m

Source: Technical Standards and Commentaries for Port and Harbour Facilities in Japan

Table 3.3-5 Probability Percentage of Non-exceeding Wave Height

(Threshold Wave Height: 0.5 m)

Site \ Water Depth	10m	15m
East Ancol	97.3%	96.6%
Marunda/Bekasi	97.4%	96.2%
Cilamaya	95.9%	94.1%
Ciasem	95.9%	95.9%
Tangerang	96.5%	96.3%



Source: JICA Study Team

The following recommendations for port planning are made based on the wave transformation analysis at the candidate sites..

(1) East Ancol

Non-exceeding percentage of 0.5 m wave height at this site is evaluated at 97.3% (at water depth -10 m) and 96.6% (– 15 m) respectively. The percentages at -10 m and at -15 m depth give the highest at East Ancol and Marunda/Bekasi as well among the candidate sites. This means that the waves are well sheltered by coastal topography at those sites.

To increase the Non-exceeding probability and to achieve 97.5% (operational rate for cargo handling in a harbor), the planning of breakwaters is effective to shelter the incident waves (mainly from the north direction).

(2) Marunda and Bekasi

Non-exceeding percentage of 0.5 m wave height at this site is evaluated as 97.4% (at water depth -10 m) and 96.2% (at -15 m) respectively.

The percentages at -10 m and at -15 m depth give the highest at East Ancol and Marunda/Bekasi as well among the candidate sites. This means that the waves are well sheltered by coastal topography at those sites.

To increase the Non-exceeding probability and to achieve 97.5% (operational rate for cargo handling in a harbor), planning of breakwaters is effective to shelter the incident waves (mainly from the north direction).

(3) Cilamaya

Non-exceeding percentage of 0.5 m wave height at this site is evaluated as 95.9% (at water depth -10 m) and 94.1% (at -15 m) respectively.

Since the waves incident from the North, Northeast and East directions can reach directly to the shore, percentage of non-exceeding waves are relatively low compared with the other candidate sites.

To increase the Non-exceeding probability and to achieve 97.5% (operational rate for cargo handling at harbor), planning of breakwaters is effective to shelter the incident waves (mainly from the north direction).

(4) Ciasem

Non-exceeding percentage of 0.5 m wave height at this site is evaluated as 95.9% both at water depth -10 m and at -15 m.

The directional wave conditions are almost similar with those of Cilamaya.

(5) Tangerang

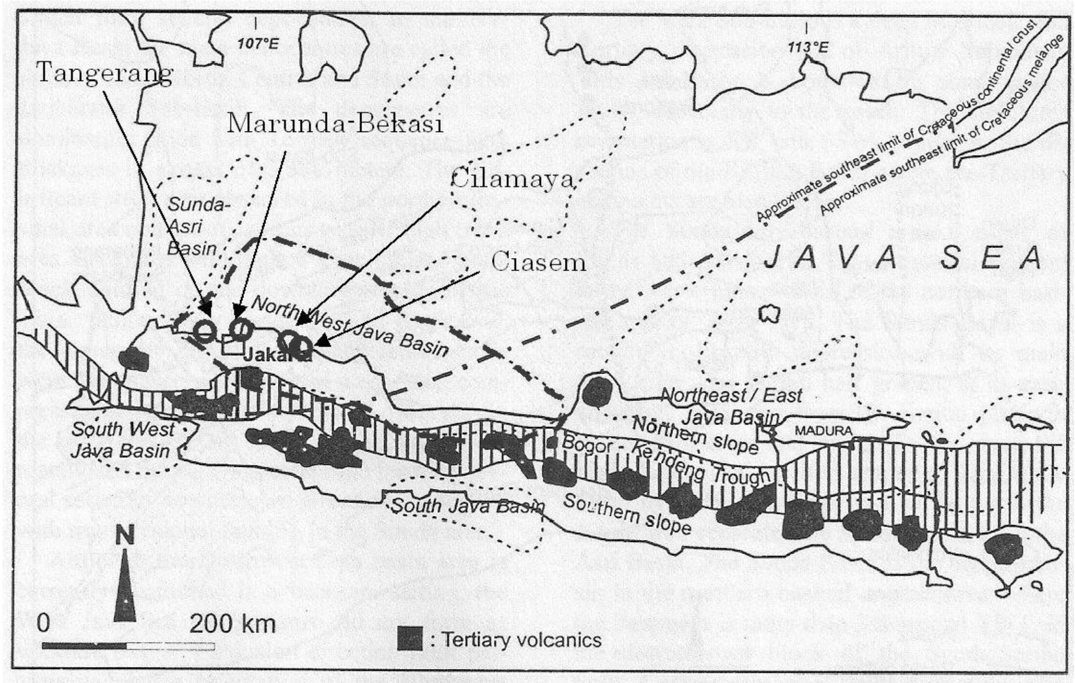
Non-exceeding percentage of 0.5 m wave height at this site is evaluated as 96.5% (at water depth -10 m) and 96.3% (at -15 m) respectively.

To increase the Non-exceeding probability and to achieve 97.5% (operational rate for cargo handling at harbor), planning of breakwaters is effective to shelter the incident waves mainly from West and North directions.

3.4 Topographical Conditions

3.4.1 Geomorphology of the Study Area

West Java region consists of the following three areas in terms of geomorphology; i.e., (i) Southern Slope Area, (ii) Volcanic Area named “Bogor-Kandeng Trough” and (iii) Northern slope, basinal area (refer to Figure 3.4-1). All the candidate sites (Tangerang, Anchol, Marunda-Bekasi, Cilamaya and Ciasem) are located in the Northern basinal area. The area is flatter than the other southern area, which is a steeply mountainous area because of tectonic activities.



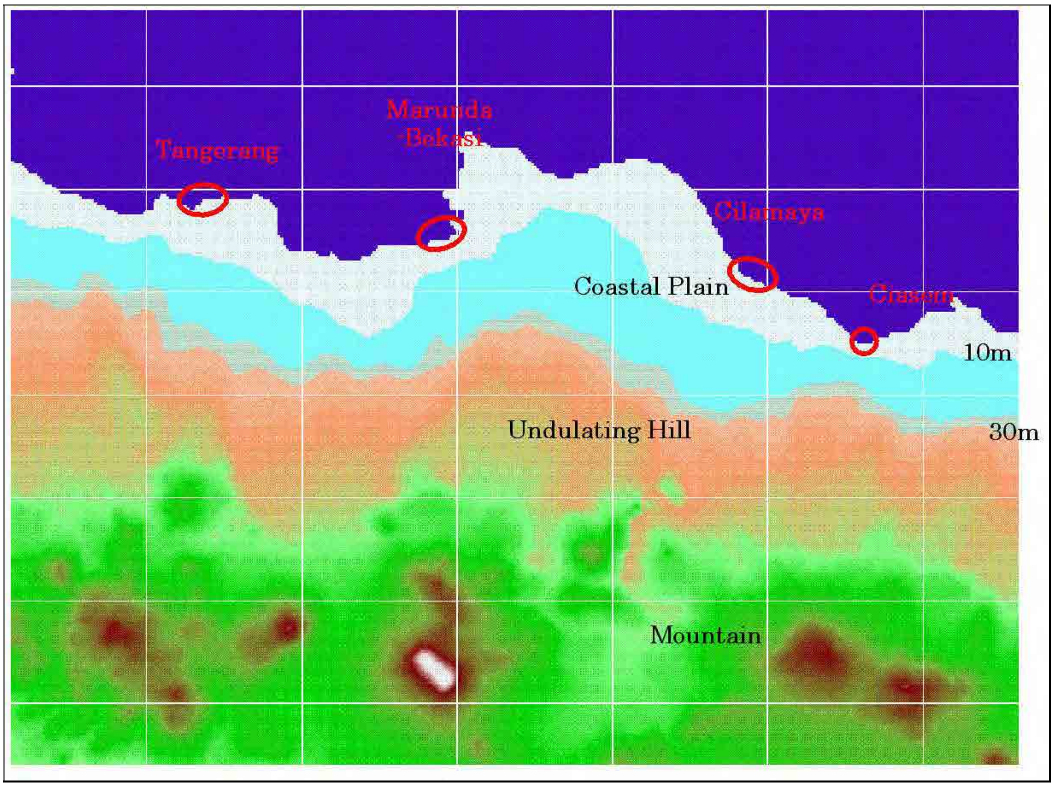
Source: JICA Study Team

Figure 3.4-1 Geological classification map of Jawa island

Viewed from its natural landscape, the morphology of this area can be divided into two units, namely: (i) lower coastal plain with a height of less than 30 m from the sea surface, and (ii) areas of undulating hills with altitude ranging between 30 m and 75 m above sea level.

The undulating hill consists of mainly marine deposit (i.e. clay or silt) and volcanic tuff in Tertiary to early quaternary while the coastal plain consists of marine deposit (i.e. clay or silt) and flood plain deposit carried from upstream hillside.

The coastal plain is called "Delta", which is formed by big and small rivers meandering across the flat plain. The widest Delta spread from Marunda to Ciparage in the width of approximately 50km. Around the river mouth of Ci Tarum River in Bekasi area, traditional pattern of bird's foot delta can be seen. It is said that the delta is formed when the transported soil dominate clay and river stream is fixed. Therefore the pattern also indicates carried soil by river mostly dominate clayey soil.



Source: DEM data of USGS (edited)

Figure 3.4-2 Topographical Map

3.4.2 Topographiy

(1) East Ancol

The location is the north side of Ancol Timur and the area is reclaimed on the shallow water (-4m ~ -5m area) west side of Tanjung Priok Port in recent years. Wharves are constructed along the east side of the reclaimed area; warehouses and open storage area are located behind the wharves. West side of the reclaimed area is a naturally formed shore that developed due to sand accumulation by wave and costal current after the reclamation.

(2) Marunda / Bekasi

The objective area is the coast of Jakarta Bay including the east side of Cakun Drain, east side of Kali Baru Port, to Tanjung Karawang through Muaragembong. The north side of Muaragembong along to Tanjung Karawang is a conservation forest area.

Along the coast between the estuary of Cakun Drain and Kali Blencong is a flat area mostly occupied by a factory and houses. Marunda port lies near the estuary of Kali Blencong. Between Kali Blencong and Sungai Tawar, there is a man-made flood control canal, Banjir Kanal Timur. On the west side of the Canal, there are factories, rice field and wasted/reserved area, and on the east side of the Canal, there are also wasted/reserved area and rice fields. The Muara Tawar Power Station is on the east side of Sungai Tawar. In front of the Station, there is water intake for the power plant with a dyke about 2.8 km off the coast in the north-west directions. An inlet of Jakarta Bay has formed on the west side of the water intake and the coast consists of a marshy land with some fairly high trees.

Coast line of the west side of Sungai Tawar to Muara Gembong is intricate. On the coast, there are several medium to large rivers flowing into Jakarta Bay such as K. CBL, S. Gabah, K. Blancan and Ci Tarum. The area is generally flat, low and marshy. Some areas are wooded.

The planned site for the new terminal is located at the mouth of Muala Peach River, which is about 5 km west from the River Teruson Blubuk, branch of Ci Tarum. Mangroves are found on both sides of the mouth of the Muala Peach River and this area is designated as a preserved forest by the Ministry of Forest. A number of fish catching nets are observed along this coast.

(3) Cilamaya

The area is generally flat and low, and there is a river called Ci Bulan-Bulan near the middle of the candidate site. Fish ponds run down close to the beach on both sides of the river, and rice fields are spread over the area. There are several villages along the shore, which has developed by sand accretion. About 3km west side along the coast of the Ci Bulan-Bulan, Ci Delewek flows into the sea and 5km further another rivers flow into the sea. On the east side of the Ci Bulan-Bulan, fish ponds and rice fields run down close to the beach. This coastal area is designated as Part Development Area by Bappeda of Karawang Regency.

(4) Ciasem

The area is submerged at a high water level and forms a wide open bay, Teluk Belanakan, between the Estuary of Kali Bawah and Ci Asem. Along the coast between these two rivers, Ci Lamaya, Kali Blanakan and other small rivers flow into the sea. The area is generally low, marshy and thickly wooded. The coast line is covered by mangrove and mud. This coast is designated as a preserved forest by the Ministry of Forest; candidate new terminal is planned in this area. Behind the mangrove area, fish ponds are scattered near the coast. There are small fish ports along the river located about 3 km from the estuary of Ci Asem and Kali Blanakan.

(5) Tangerang

The site is low and flat area with muddy beach. There are many fishing grounds off the coast. The area of the candidate site is the coast between Tanjung Kait and Tanjung Burung. Between these two capes, rivers such as Ci Rarab and Ci Tuis and S. Apuran flow into the sea. Sugai Cisadane is the largest and its estuary is Tanjung Burung and Tanjung Pepuloa. The area is mostly flat and between Tanjung Kait to Ci Rarab, some villages are developed close to the coast and between Ci Rarab to Tanjung Burung, marshy and fish ponds are found close to the beach. There are fairly high trees near the coast and some areas along the coast.

3.4.3 Bathymetry

(1) East Ancol

Distance from shoreline to -10m and -15m depth is about 5 km and 7 km respectively. The seabed slope is 1/500 and very gentle slope.

(2) Marunda / Bekasi

Distance from shoreline to -10m depth is about 4~5 km and to -15m depth is about 8 km. The seabed slope is about 1/500. The coastal area between S.Tawar and K. CBL, and between

Muaragembong and K. CBL is very shallow. It is observed that the shore of K CBL estuary has advanced toward the off shore area.

(3) Cilamaya

The seabed is very gentle slope and the contour lines are mostly parallel to the beach. Distances from shoreline to -10 m and -15 m depth are about 5 km and 10 km respectively. Seabed slope is about 1/500 up to about -10 m depth contour line, and between -10 m to -15 m, seabed slope is 1/1000. The area is muddy beach and seabed deposits are mud and fine particles.

(4) Ciasem

Distance from shoreline to -10m depth is about 4~5 km and -15m depth is about 7~8 km. Seabed slope from shore to about -15m water depth is about 1/500. Mud sediment is observed along the shoreline about 500 m to 1000 m toward the off-shore.

(5) Tangerang

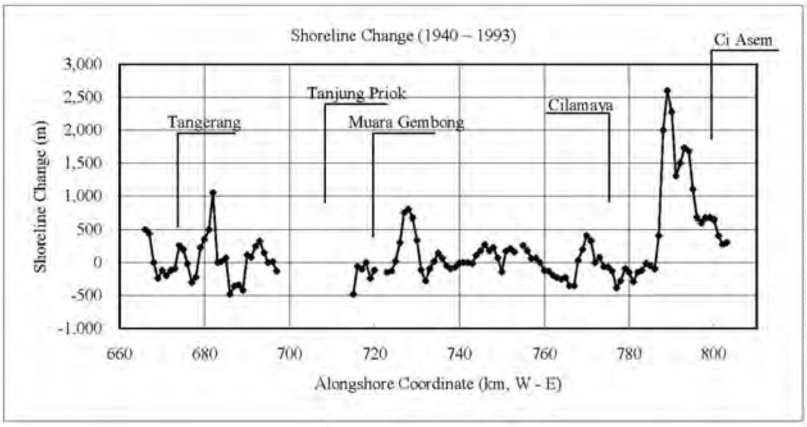
Distance from shoreline to -10 m and -15 m water depths are 4 km and 6 km respectively. The shore is generally gentle with a slope of 1/400. However, scattered islands exist and the contour lines are rather complicatedly formed off the coast of Tangerang.

3.4.4 Shoreline Changes in the Study Area

Tracing analysis of the shoreline changes using ALOS satellite images and archived topographic maps was conducted along the coast of the Study Area (from Tangerang to Ciasem) from the 1940s to the present.

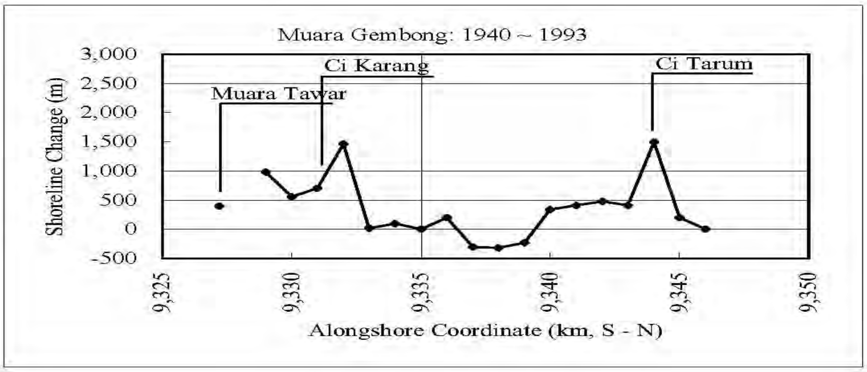
For this purpose, the archived old topographic maps (1940) in the Dutch ruling era, present published maps (1993, BAKOSURTANAL), and the latest satellite images (2009, ALOS satellite) are traced and analyzed covering the northern coast of Java Island including the target candidate sites of the new container terminal development, Tangerang, Tanjung Priok (Ancol Timur), Bekasi/Marunda, Cilamaya and Ciasem.

Alongshore distributions of shoreline changes are extracted and presented in Figure 3.4-3, Figure 3.4-4, Figure 3.4-5 and Figure 3.4-6. And shoreline change maps for the target areas of new terminal development are extracted and presented in Figure 3.4-7 ~ Figure 3.4-11. Major features of the shoreline changes at each target area are extracted as follows.



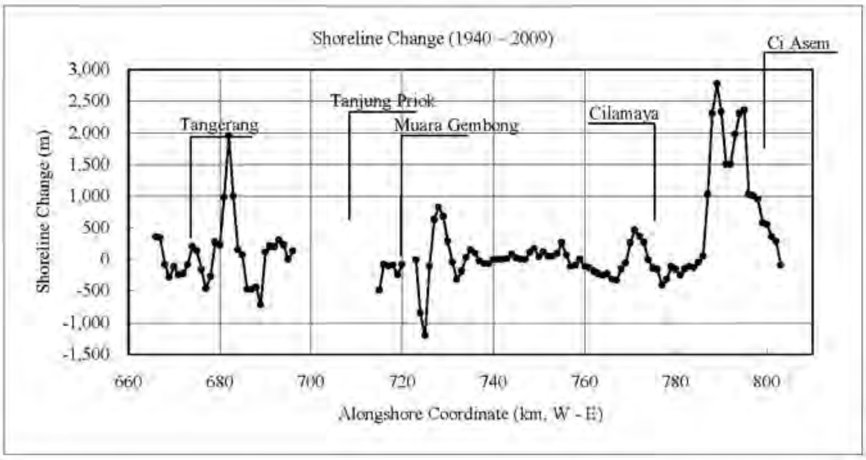
Source: JICA Study Team

Figure 3.4-3 Shoreline Changes along the Coast from Tangerang to Ci Asem: 1940 - 1993



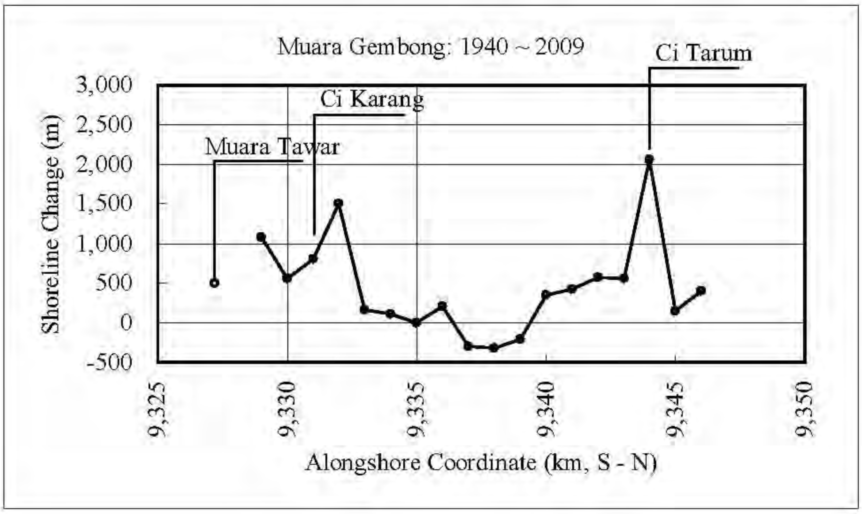
Source: JICA Study Team

Figure 3.4-4 Shoreline Changes along the Coast of Muara Gembong Area: 1940 - 1993



Source: JICA Study Team

Figure 3.4-5 Shoreline Changes along the Coast from Tangerang to Ci Asem: 1940 - 2009



Source: JICA Study Team

Figure 3.4-6 Shoreline Changes along the Coast of Muara Gembong Area: 1940 - 2009

(1) Tanjung Priok and the surrounding Area

The coastal areas from Muara Baru, Tanjung Priok to Marunda are covered by artificial facilities such as port and harbor, fishing harbors, waterfront recreation facilities. Hence, artifact effects on the shoreline change must be taken into consideration in this area (refer to Figure 3.4-7).

Shoreline change can be discerned in the district of Kali Baru (around 1 km east of Tanjung Priok Port). And backward shoreline change of 200 - 500 m is seen in the period of 1940 – 1993 (4 ~ 9 m/year) in this area. This is considered to be affected by the coastal facilities as longshore sediment transport was blocked off by the breakwaters and/or sediment supply was taken away to offshore by maintenance dredging of the harbors.

According to the old archived map of Batavia in 1940, a characteristic shoreline change can be seen in the areas of Muara Baru and Sunda Kelapa, that is, the forward shoreline change at the west side of the training jetty and the backward shoreline change at the east side. It is estimated that the predominant direction of the sediment transport is from west to east in this coastal area.

(2) Bekasi and Muara Gembong Area

The coastal area of Bekasi and Muara Gembong is located in the river-mouth area of Ci Tarum, the river system which has the largest catchment area in West Java Province. This area which borders the eastern end of Jakarta Bay is called Tanjung Karawang (Cape of Karawang). This projecting coast line is evolving and advancing seaward due to clay and silt being carried by the river Ci Tarum. This coastal area shows the significant tendency of forwarding shoreline change (refer to Figure 3.4-8).

According to the readings from the Shoreline Change Map (Figure 3.4-8), the coastline of this coastal area shows an abnormal forwarding shoreline changes as follows.

River-mouth Area	1940 ~ 1993 (53 years)	1993 ~ 2009 (16 years)
Ci Karang	1,000 m (19 m/year)	2,000 m (125 m/year)
Ci Tarum	1,700 m (32 m/year)	500 m (31 m/year)

Dredged soil from Tanjung Priok Port was dumped in front of the Muara Gembong area (refer to Sub-section 5.1.6) until recent years. This is another source of sediment which expedites the big and significant shoreline changes in this coastal area. The shoreline in this area is still advancing seaward. Accretion and silting up in the water area will continue.

(3) Cilamaya Area

As for the northwest portion of the Cilamaya district, significant shoreline changes are seen in the river-mouth area of Ci Wadas (1940 ~ 1993: 200 ~ 400 m; 1940 ~ 2009: 250 ~ 450 m). The yearly rate of shoreline change is estimated at 4 ~ 7 m/year (refer to Figure 3.4-9).

As for the southeastern portion of Muara Ciparage, an obvious backward shoreline change is seen in this area (1940 ~ 1993: -130 ~ -380 m). The yearly rate of shoreline change is estimated at -3 ~ -7 m/year. Shore protection works can be seen on the coast of this area. There was no significant erosion seen in this area for the period 1993 ~ 2009.

Although the districts of Cilamaya and Ci Wadas are included in the large catchment area of the Ci Tarum river system, it is limited to small rivers that have river-mouths in this coastal area. Hence, shoreline change is rather moderate in this area and the coast is relatively stable.

According to the shoreline change around the small jetty in the Fish Landing Site at Muara Ciparage, it is estimated that the predominant direction of the sediment transport is from west to east in this coastal area.

(4) Ci Asem Area

Many large and small rivers and drainage canals flow into the shore of Ci Asem, and three rivers with relatively large catchment area (Kali Bawah, Ci Lamaya, and Ci Asem) have their river-mouths. According to the readings from Shoreline Change Map of this area, the coastlines around the river-mouths show big forwarding shoreline changes as follows. It is an unstable coast where forwarding and backward shoreline changes co-exist in this area (refer to Figure 3.4-10).

River-mouth Area	1940 ~ 1993 (53 years)	1993 ~ 2009 (16 years)
Kali Bawah	2,600 m (49 m/year)	170 m (11 m/year)
Ci Lamaya	1,730 m (33 m/year)	240 m (15 m/year)
Ci Asem	670 m (13 m/year)	280 m (17 m/year)

(5) Tangerang Area

A protruding shoreline change is seen in this coast around the river-mouth area of Ci Sadane (1940 ~ 1993: 500 ~ 1,050 m; 1993 ~ 2009: 480 ~900 m). The yearly rate of shoreline change is estimated to be10 ~ 20 m/year from 1940 -1993 and 30 – 56 m/year from 1993 ~ 2009. The shoreline change is still bigger in recent years (refer to Figure 3.4-11).

In addition to the abnormally big and forwarding shoreline changes observed around the river-mouth area mentioned above, backward shoreline changes are seen on the coast of several 10 km. The change width was 200 to 300 m in the 50 to 60-year period, and the yearly rate of shoreline change is estimated to be 4 m/year.

It is an unstable coast where abnormally big forwarding shoreline around the river-mouth area and relatively moderate backward shorelines co-exist.

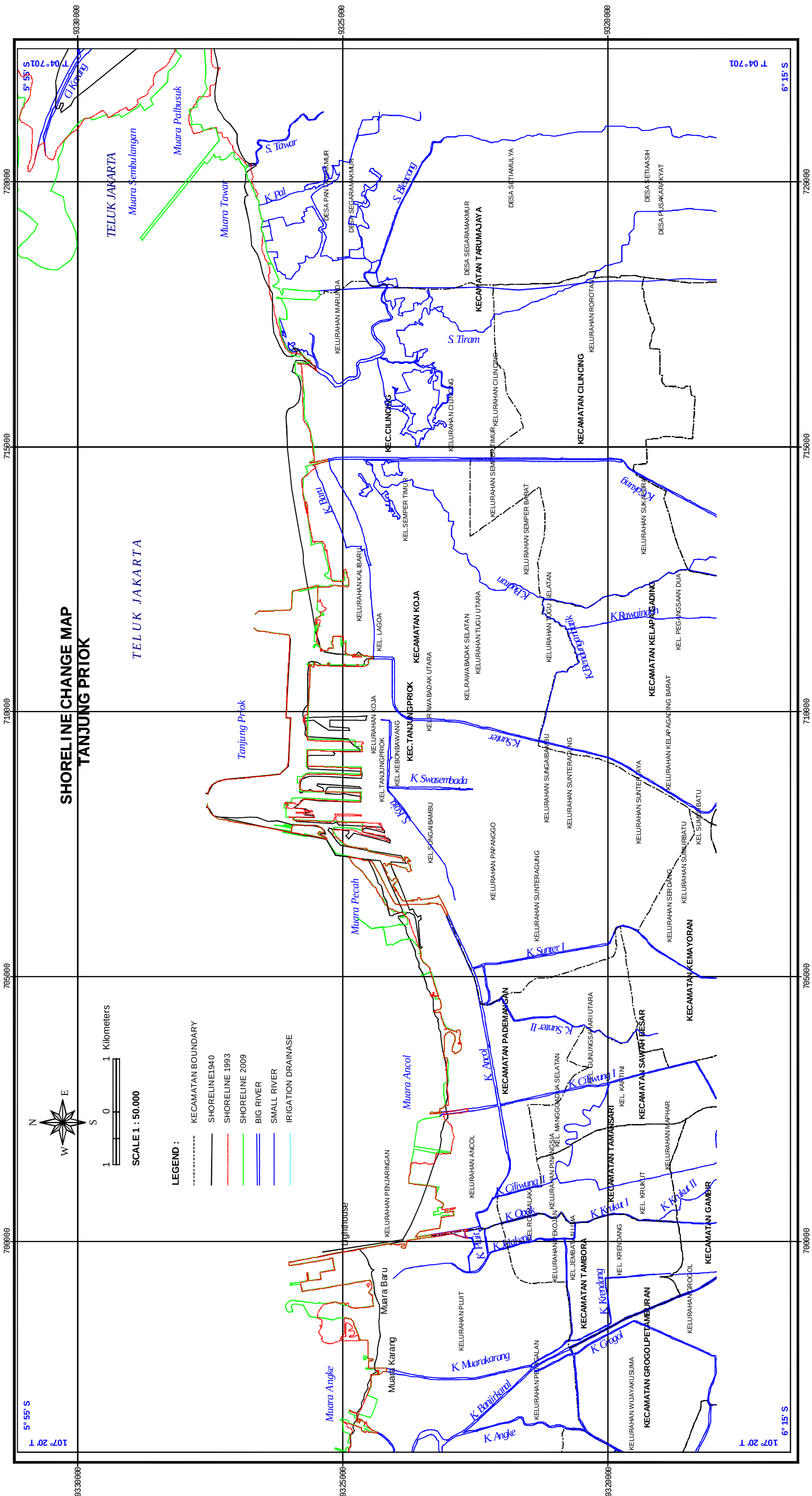


Figure 3.4-7 Shoreline Changes (1940-1993-2009): Tanjung Priok and Surrounding Area

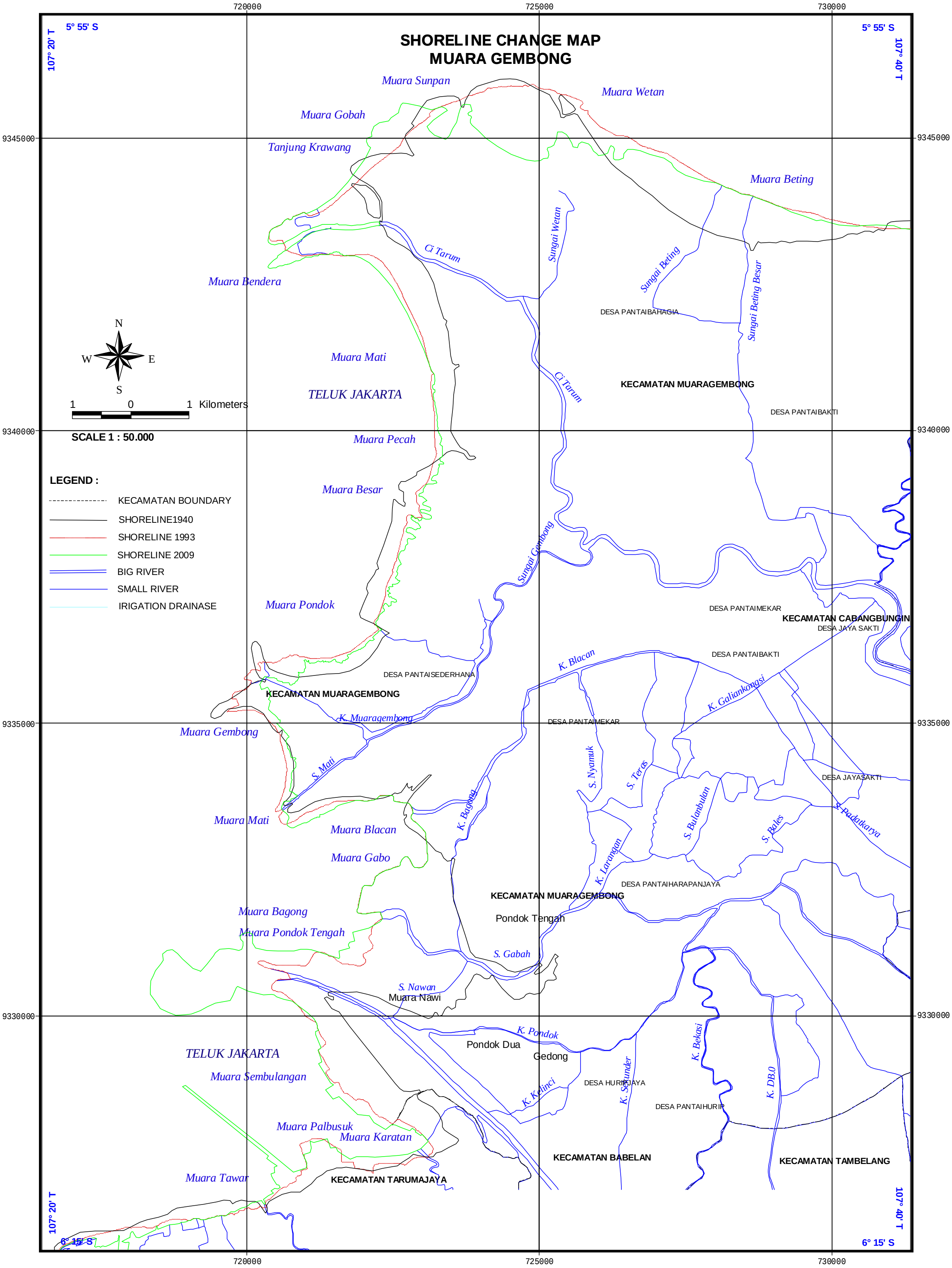


Figure 3.4-8 Shoreline Changes (1940-1993-2009): Bekasi and Muara Gembong Area

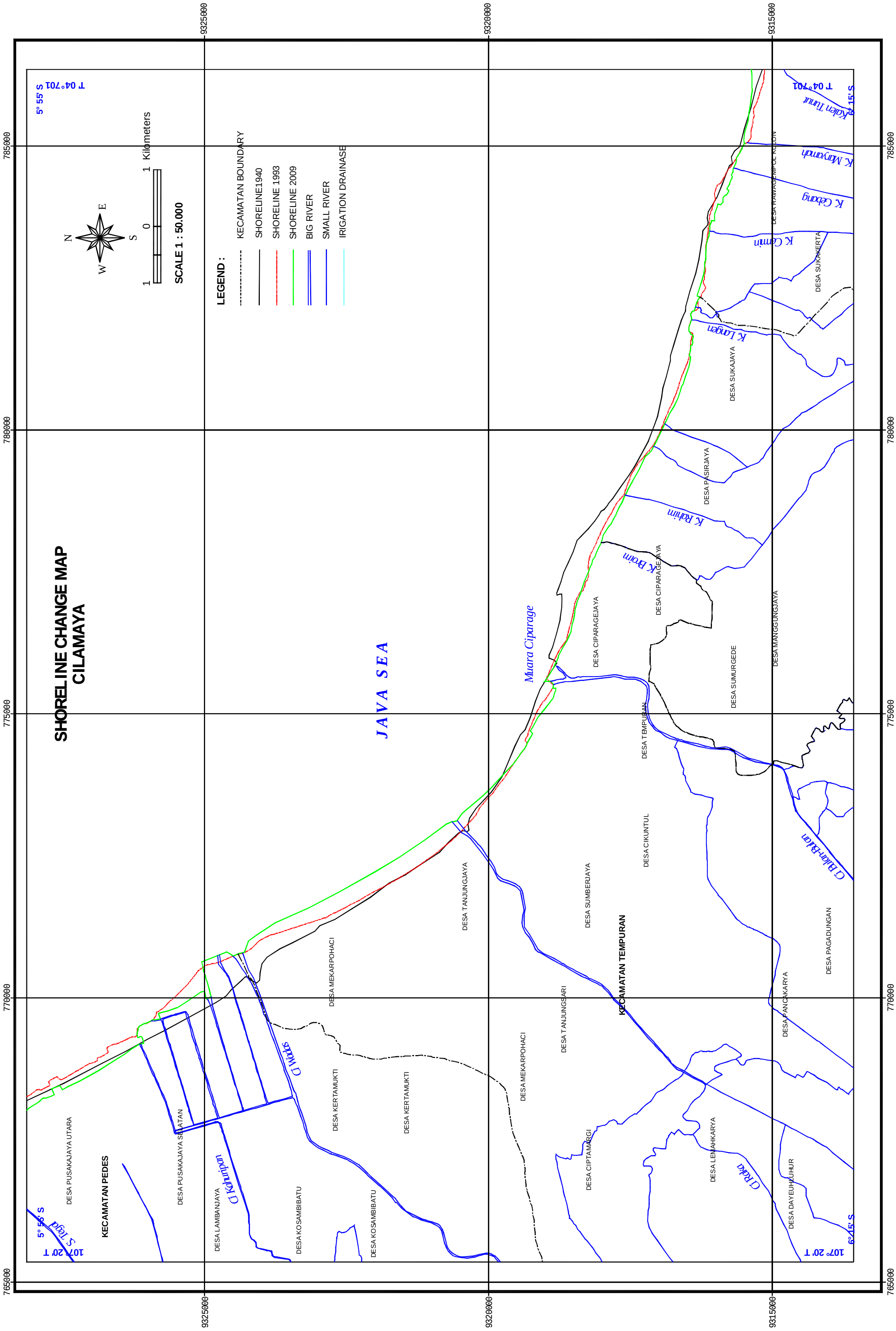


Figure 3.4-9 Shoreline Changes (1940-1993-2009): Cilamaya Area

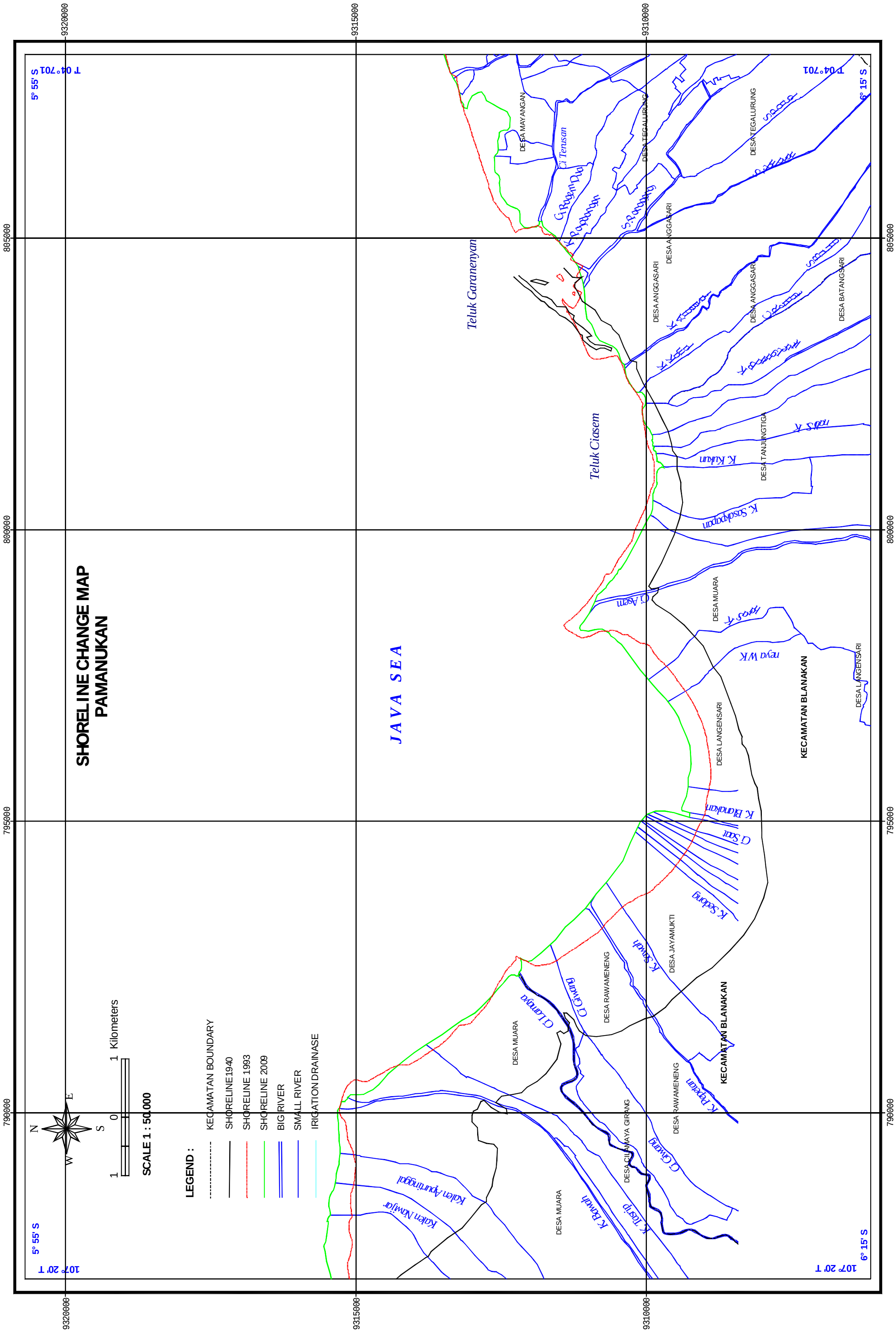


Figure 3.4-10 Shoreline Changes (1940-1993-2009): Ciasem Area

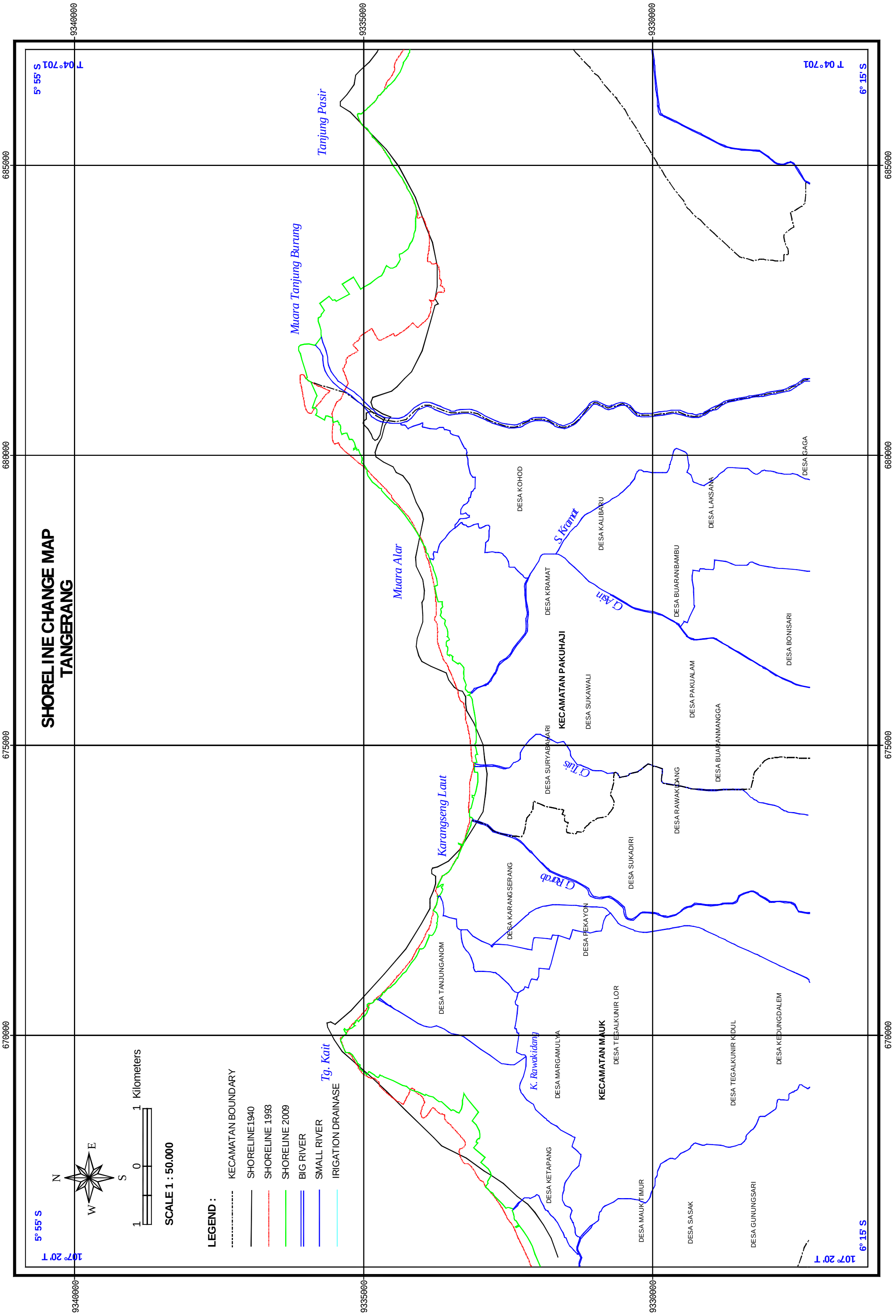


Figure 3.4-11 Shoreline Changes (1940-1993-2009): Tangerang Area

3.4.5 Littoral Sediment Transport

(1) Sediment Property of in Jakarta Bay Area

The following table gives the information on the sediment properties in the Jakarta Bay area surrounding Tanjung Priok Port. The sediment samples were obtained using grab samplers in the river mouth area of Ci Tarum, Bekasi Regency. The minimum, maximum and average properties are presented based on total 24 samples of seabed sediment.

According to the table, median (d50) of article size distribution ranges from 1 – 62 μm, and its average is obtained around 5μm. The main component of the sediment is evaluated as Clay (59 %) with Silt (33 %) on average, while sand portion accounts for only 7 %.

The source origin of the seabed sediment is the river systems which flow into the seashore and make many river mouths along the north coast of Java Island (refer to Figure 3.4-12 and Figure 3.4-13). Sedimentation at seabed is called Siltation. In the siltation process, flocculation of fine materials of clay and silt occurs in the estuary by mixing of river water and seawater.

Table 3.4-1 Size Properties of Seabed Sediment (Bekasi Area)

	d_{50} (μm)	d_{90} (μm)	Clay (%)	Silt (%)	Sand (%)
Minimum	0.9	19.1	16.6	25.1	1.4
Maximum	61.9	158.9	69.9	52.0	43.1
Average	4.9	48.9	59.2	33.1	7.7

Source: Poerbandono, R. Nurdany Magetsari; Identification of Representative Erosion and Accretion Patterns across North Java Coasts on the Basis of Analytical Study of Current and Seabed Interaction, November 2007, Hydrographic Science and Engineering Research Division, Institute of Technology Bandung, ITB Research Program

(2) Dimension of River Systems as Source Origin of Sediment

Large and small rivers have their river mouths on the north coast of Banten and West Java regions in the Study Area.

The major river systems which have river mouths on the coast of Banten and West Java regions are presented in Figure 3.4-13 with the distribution of their catchment areas. Table 3.4-2 gives an abstract of the major river systems on the coast in the Study Area and in relation to the shoreline changes analysis in the previous sub-section.

(i) Muara Gembong and Tanjung Karawang

The river system Ci Tarum is the largest with its catchment area (690, 572 ha) among the rivers in the West Java region. An aerial view of the river mouth of Ci Tarum is presented in Figure 3.4-12.

Ci Tarum transports a massive volume of suspended solids (silt and clay) to the shore causing sedimentation on the coast. The protruding coastline in the areas of Tanjung Karawang and Muara Gembong (refer to Figure 3.4-8) is the coastal topography developed by the sediment from the river mouth of Ci Tarum.

(ii) Cilamaya

As for the coast of Cilamaya (refer to Figure 3.4-9), the shoreline change is evaluated rather moderate in this area. It is understood, as seen in Table 3.4-2, that the catchment areas of the rivers which have their river mouths in the Cilamaya coast are small or minor in their dimension.

(iii) Ciasem

In contrast to Cilamaya, the neighboring coast of Ciasem shows an unstable shoreline change (refer to Figure 3.4-10). Two medium sized river systems (Ci Lamaya and Ci Asem) have river mouths on the coast of Ciasem.

Advancing shoreline changes are seen at the river mouths of Ci Lamaya and Ci Asem, and a large scale shoreline change has taken place on the shore between the two river mouths.

(iv) Tangerang

The river Ci Sadane has the second largest catchment area among the river systems in the Banten province next to the river Ci Ujung (or the 3rd largest in the Banten and West Java regions). A protruding shoreline change is seen in this coast around the river mouth of Ci Sadane (refer to Figure 3.4-11). The yearly rate of shoreline change is estimated to be 10 ~ 20 m/year from 1940 ~ 1993 and 30 ~ 56 m/year from 1993 ~ 2009. The shoreline change is still bigger in recent years.

As seen in the studies and analysis mentioned above, the shoreline changes are proportional to the dimension of the river systems which have their river mouths in the coast. It is understood that the large scale shoreline changes or unstable shoreline changes took place at the river mouth areas of the large or medium scale river systems on the north coast of West Java.

The coasts of the Jakarta Bay area around Tanjung Priok Port and Cilamaya show rather moderate scale shoreline changes, and are evaluated as stable and suitable for port development.

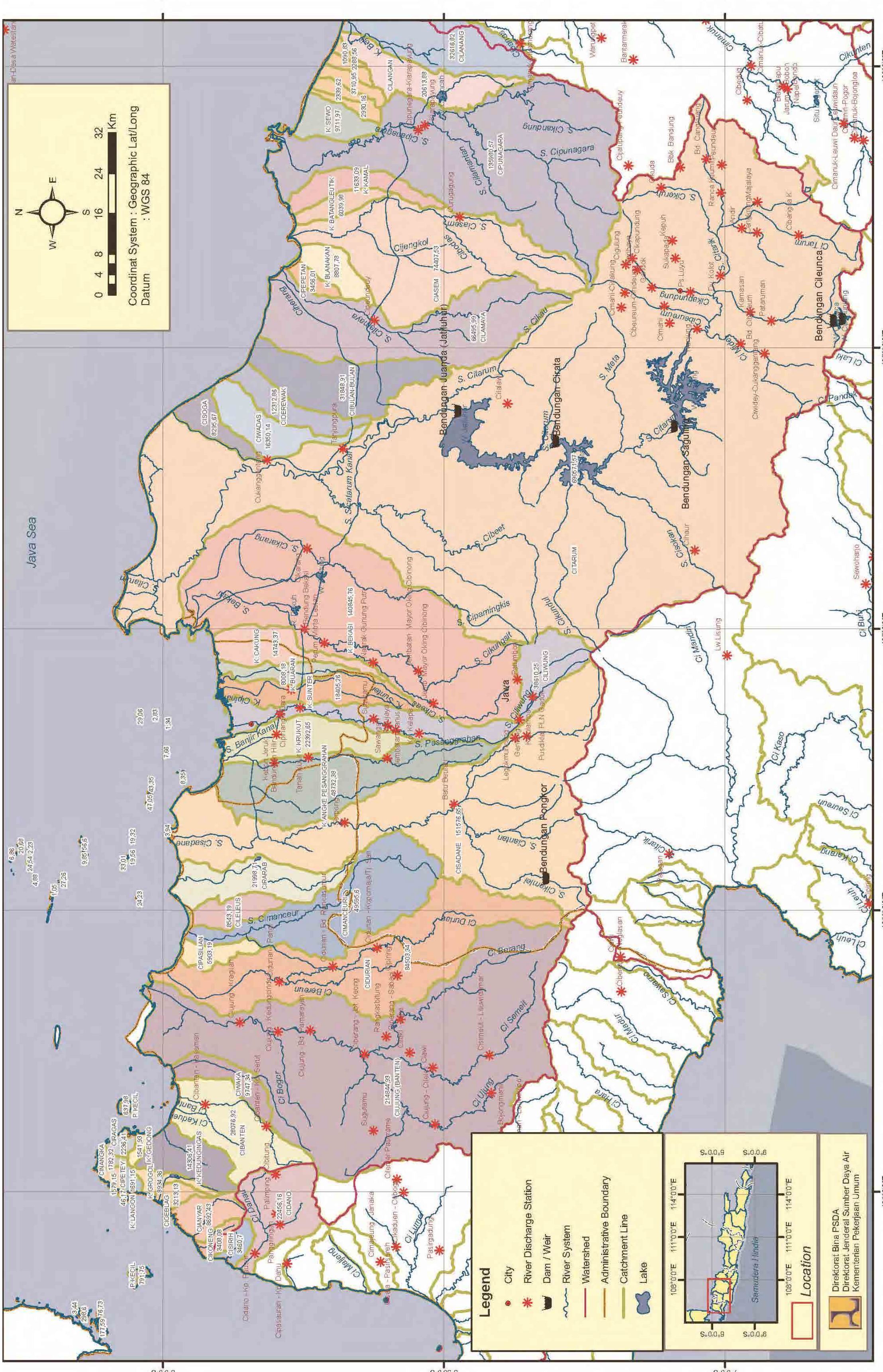
Table 3.4-2 Major River Systems on the coast in the Study Area

Location of River Mouth	Name of River System	Catchment Area (ha)
Jakarta (Tanjung Priok)	Kali Sunter	18,406
	Ci Liwung	38,610
	Kali Angke Pesanggrahan	48,732
Kabupaten Bekasi (Muara Gembong)	Kali Bekasi (Ci Karang)	140,846
	Ci Tarum	690,572
Kabupaten Karawang (Cilamaya)	Ci Soga	8,296
	Ci Wadas	16,350
	Ci Derewak	12,313
	Ci Bulan-Bulan	31,849
Kabupaten Subang (Ciasem)	Ci Lamaya	66,496
	Ci Asem	74,408
Kabupaten Tangerang	Ci Sadane	151,577
	Ci Rarab	21,999
	Ci Durain	84,503

Source: JICA Study Team

Source: Jatiluhur Dam, Jasa Tirta II Public Corporation

Figure 3.4-12 River Mouth of Ci Tarum (Kabupaten Bekasi)



Source: Directorate of Water Resources Management, Ministry of Public Works

Figure 3.4-13 Major River Systems in the Banten and West Java Regions

3.5 Subsoil Conditions

3.5.1 Subsoil Conditions Survey

The subsoil condition survey was conducted to get the actual soil condition both onshore and offshore at each site where new container terminals are planned in Tangerang, Marunda-Bekasi, Cilamaya and Ciasem.

The bore hole locations to collect the sub surface condition around the assumed development area with considering existing bore hole data.

The off shore boring is conducted at MSL-3 m to -8 m by constructing bamboo platform. The onshore boring locations were mainly decided from assumed port locations at each site; the approximate coordinates of bore hole locations were supplied to the contractor.

But the purpose of BH04 of Marunda-Bekasi was to gain data for planning an access road because the equipment cannot presently be mobilized for drilling work along the coastline.

Fifteen exploratory borings at Tangerang, Marunda-Bekasi, Cilamaya, and Ciasem were carried out from a minimum of 18 m to a maximum of 60 m (average 32 m) in drilling length. The locations of the boreholes are shown in the site maps, Figure 3.5-1 to Figure 3.5-4.

Summary of the subsoil conditions survey are shown in Table 3.5-1. The coordinates and the elevation of all the bore holes are given in Table 3.5-2.

Laboratory Tests of samples as specified in the TOR were carried out by the standards designated in Table 3.5-3.

Table 3.5-1 Summary of Subsoil Condition Survey

Area	Borehole No.	Onshore /Offshore	Drilling Length (m)	SPT (nos)	Undisturbed Sampling (nos)	Laboratory Test	
						Physical Test (nos)	Mechanical Test (nos)
Tangerang	BH01	Off Shore	30	20	1	7	1
	BH02	On Shore	30	20	1	10	1
	BH03	Off Shore	39	26	1	12	1
	BH04	On Shore	39	26	1	8	1
Marunda-Bekasi	BH01	Off Shore	30	20	1	10	1
	BH02	On Shore	30	20	1	10	1
	BH03	Off Shore	28	18	1	9	1
	BH04	On Shore	30	20	1	8	1
	BH05	Off Shore	30	20	1	10	1
Cilamaya	BH01	On Shore	60	40	1	20	1
	BH02	On Shore	33	22	1	11	1
	BH03	Off Shore	20	13	1	6	1
	BH04	Off Shore	18	12	-	6	-
Ciasem	BH01	On Shore	28	19	1	8	1
	BH02	Off Shore	27	18	1	8	1
TOTAL			472	315	14	143	14

Source: JICA Study Team

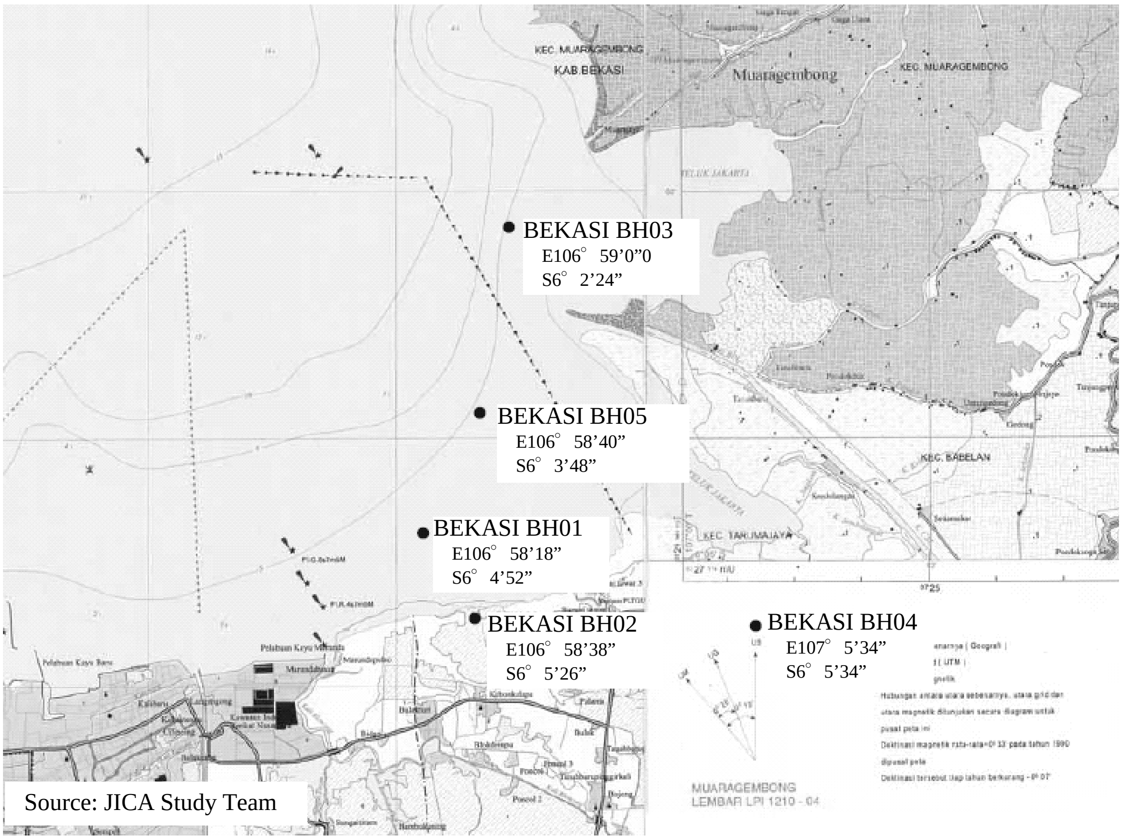


Figure 3.5-1 Borehole Locations in Marunda-Bekasi Area

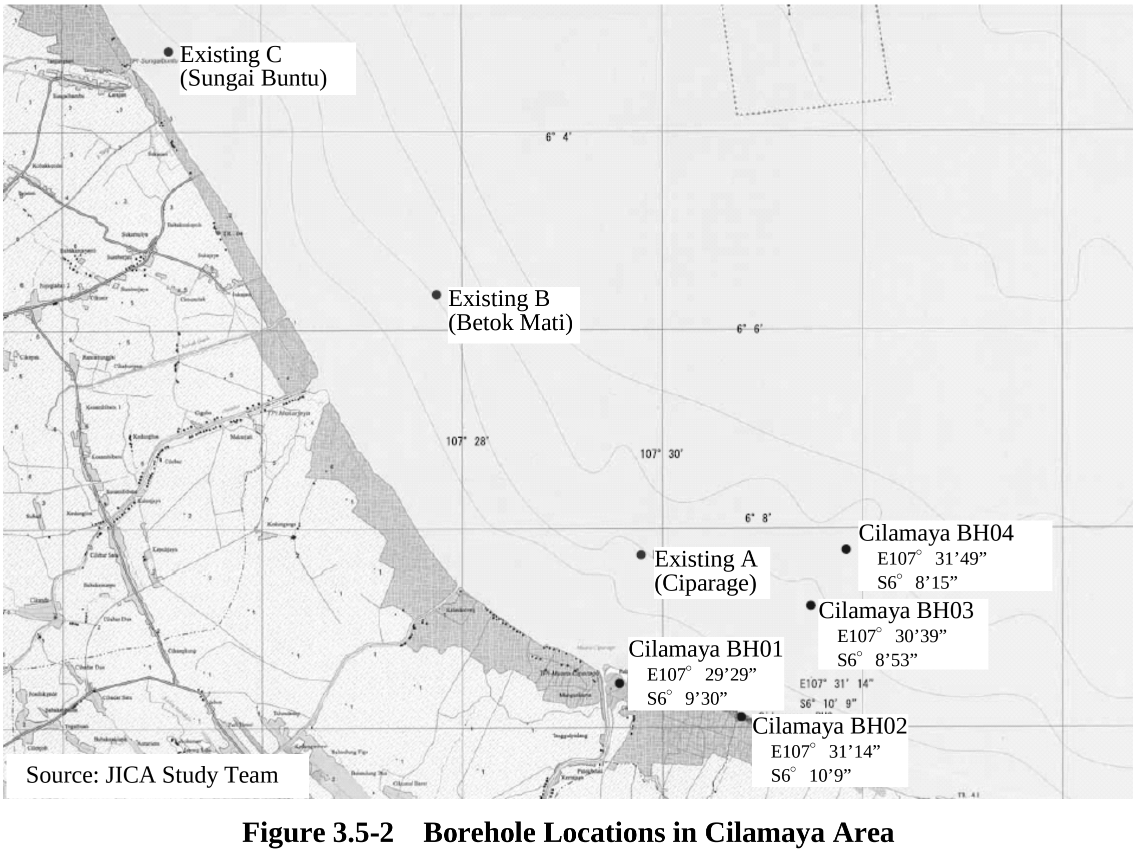
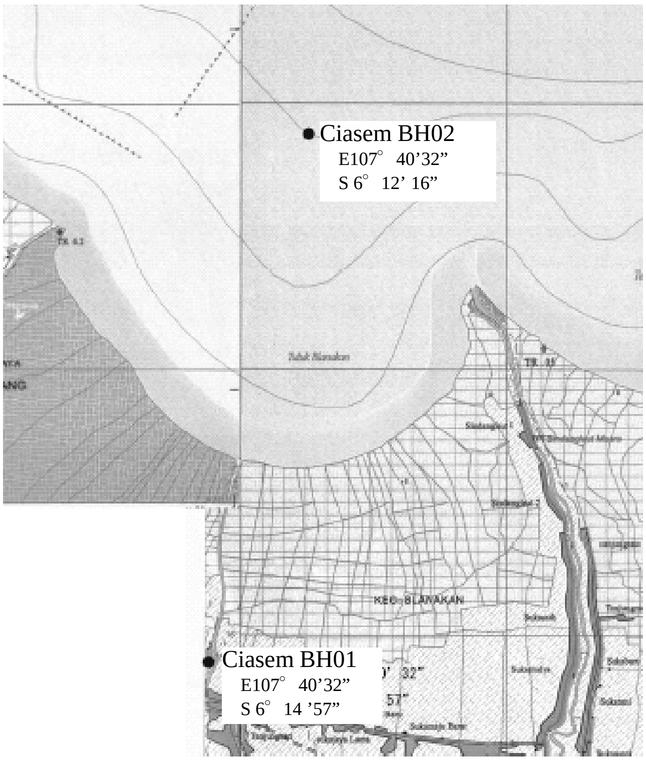
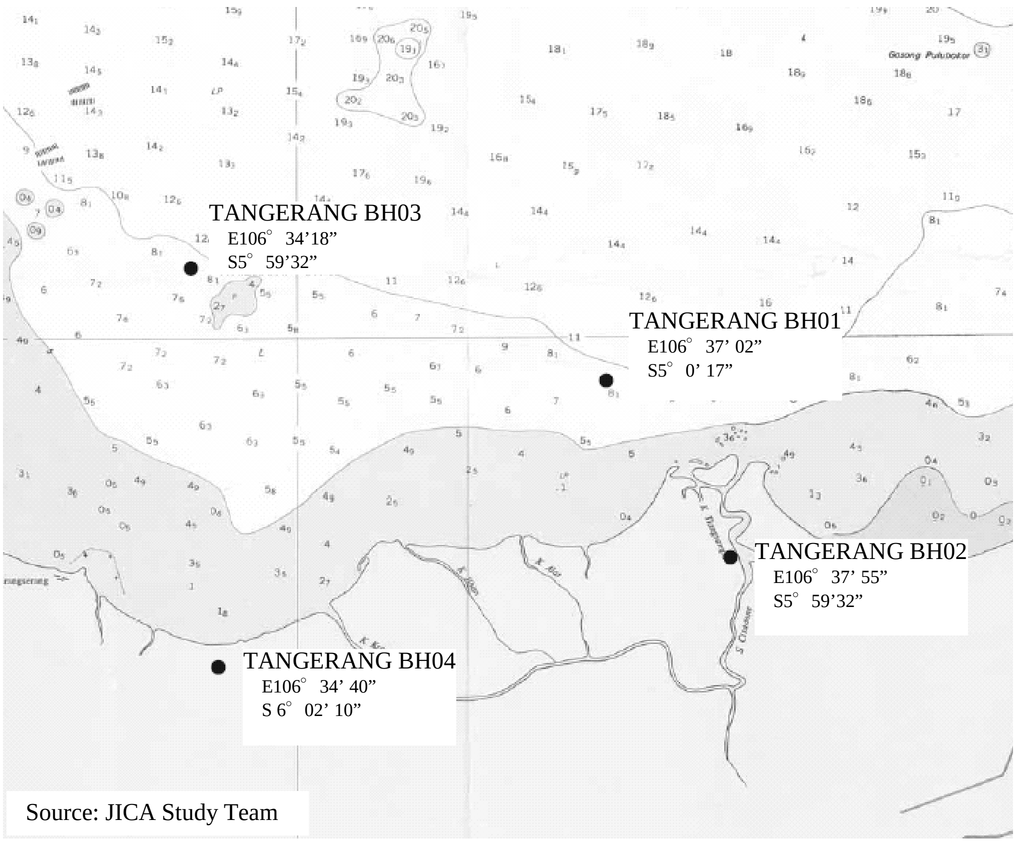


Figure 3.5-2 Borehole Locations in Cilamaya Area



Source: JICA Study Team

Figure 3.5-3 Borehole Locations in Ciasem Area



Source: JICA Study Team

Figure 3.5-4 Borehole Locations in Tangerang Area

Table 3.5-2 Locations and Elevations of Boheholes

Area	Borehole No.	Locations		Elevation (MSL, m)
		Latitude	Longitude	
Tangerang	BH01	S6°0′17 ″	E106°34′178″	-8.0m
	BH02	S6°01′35 ″	E106°37′55″	+0.8m
	BH03	S5°59′32 ″	E106°34′18″	-8.0m
	BH04	S6°01′92 ″	E106°34′67″	+0.6m
Marunda-Bekasi	BH01	S6°4′32 ″	E106°58′0″	-4.7m
	BH02	S6°5′26 ″	E106°58′38″	+2.2m
	BH03	S6°2′24 ″	E106°59′0″	-6.0m
	BH04	S6°5′34 ″	E107°5′34″	+0.4m
	BH05	S6°3′48 ″	E106°58′40″	-3.0m
Cilamaya	BH01	S6°9′30 ″	E107°29′29″	+0.41m
	BH02	S6°10′9 ″	E107°31′14″	+0.21m
	BH03	S6°8′34 ″	E107°31′31″	-4.0m
	BH04	S6°7′48 ″	E107°32′10″	-7.0m
Ciasem	BH01	S6°12′16 ″	E107°40′32″	+0.6m
	BH02	S6°14′57 ″	E107°40′32″	-7.0m

Source : JICA Study Team

Table 3.5-3 Standards of Laboratory tests

Physical tests		Mechanical Tests	
Items	Standard	Items	Standard
Grain Size	ASTM D422-63	Unit Weight	ASTM D7263
Specific Gravity	ASTM D854-10	Unconfined Compression Test	ASTM D2166
Water Content	ASTM D2216	Consolidation Test	ASTM D2435
Atterberg Limit Test (Liquid Limit/Plastic Limit)	ASTM D4318		

Source: JICA Study Team

3.5.2 Subsoil Conditions at Candidate Terminal Sites

(1) Tanjung Priok Port

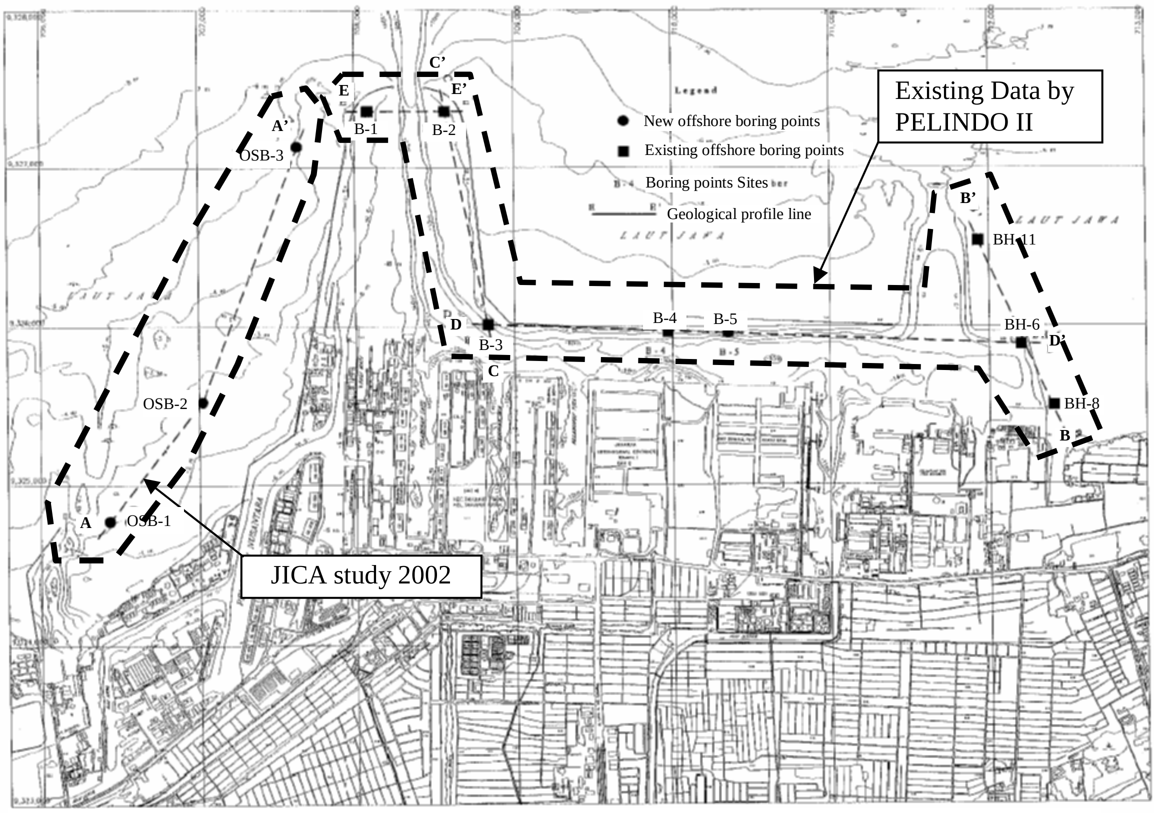
JICA Study Team (2002) carried out a subsoil conditions survey in the Tanjung Priok Port area with exploratory borings and laboratory tests at 3 points, and the report "The Study for Development of Greater Jakarta Metropolitan Ports" presents plenty of information of other subsoil conditions surveys and laboratory tests executed by PELINDO II. The locations of the boreholes in the previous studies are shown in Figure 3.5-5 below.

The subsoil profiles are presented in Figure 3.5-6 – Figure 3.5-8.

According to the JICA Study Report (2003), the subsoil conditions along the breakwater of Tanjung Priok Port were summarized as follows;

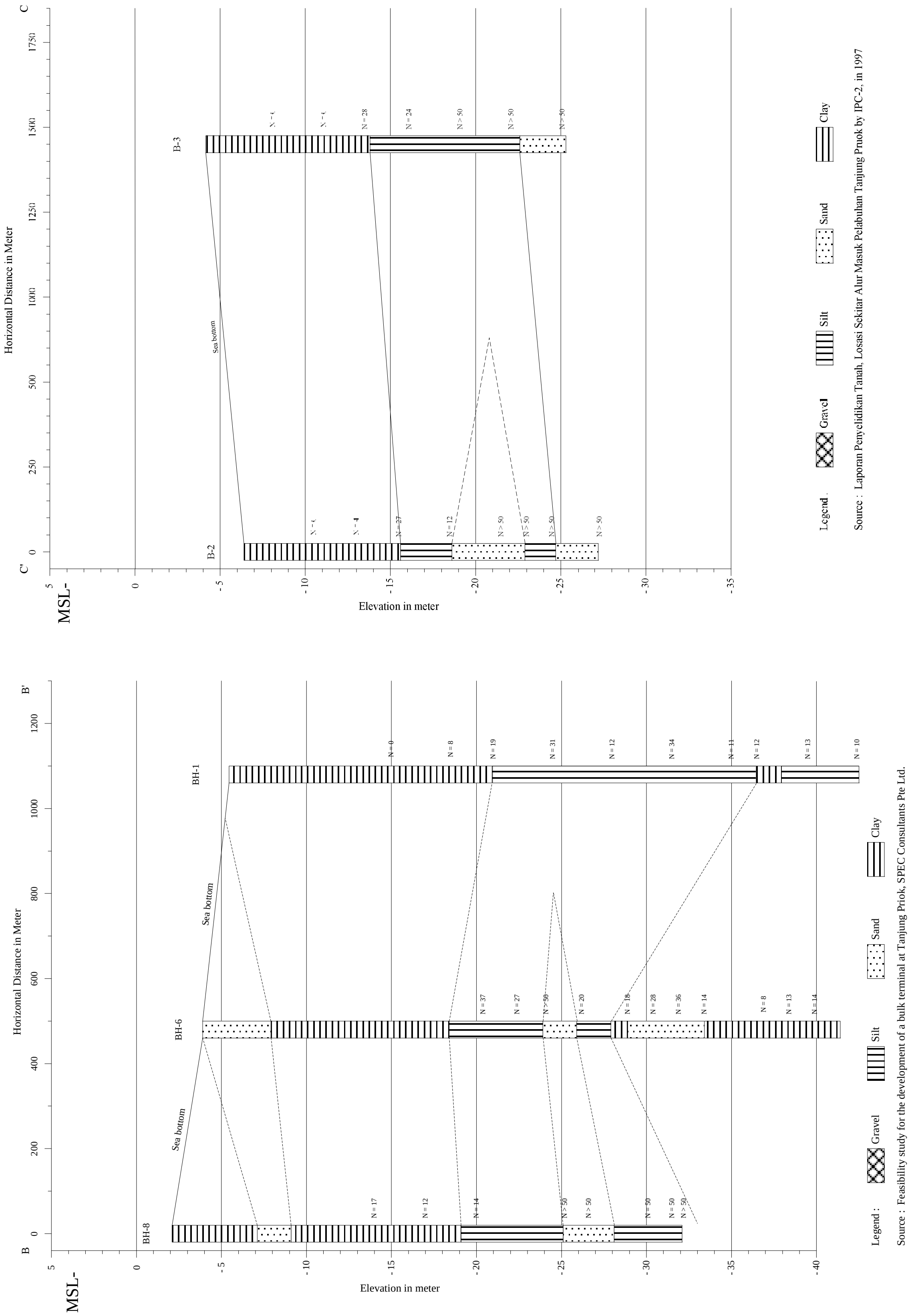
The seabed soils (from the seabed to approximately -35m depth) in front of Tanjung Priok Port from existing bore holes (B-1, 2, 3, 4, 5, 6, 8 and 11) and in the west area of the port from JICA Study in 2002 (OSB-1, 2 and 3) are classified into mainly three layers as follows;

- The first layer is a soft layer, its thickness is approximately 5 m to13 m, and its N-value is approximately 0.
- The second layer is a deposit consisting of volcanic ash in the elevation range of approximately -10 m to -25 m, with N-value of approximately 6.
- The third layer is a deposit consisting of volcanic ash, sand and silts in the elevation range of approximately -20 m to 25 m below, with a N-value of approximately 50 or more than 50.



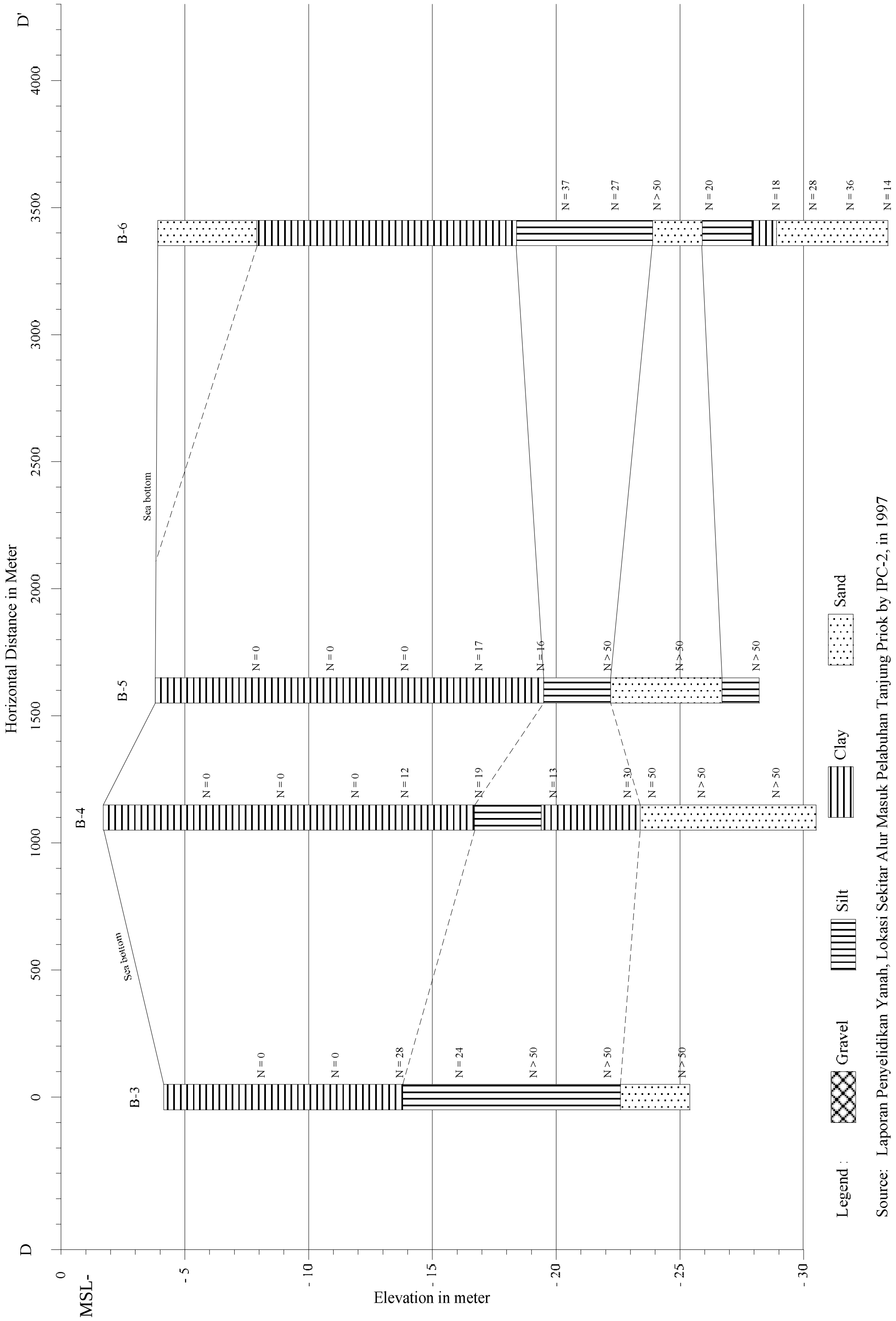
Source: JICA Study for Development of Greater Jakarta Metropolitan Ports, JICA Study Report 2003

Figure 3.5-5 Location Map of Existing Subsoil Conditions Surveys in Tanjung Priok



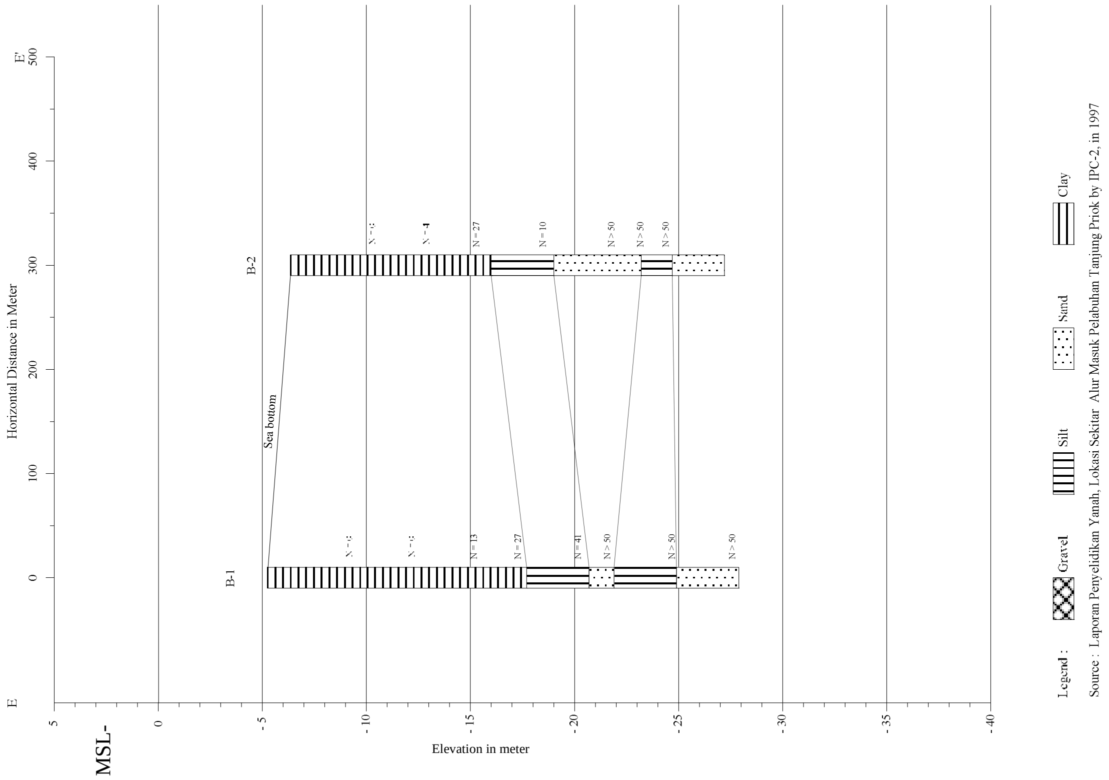
Source: JICA Study report 2003, “The Study for Development of Greater Jakarta Metropolitan Ports”

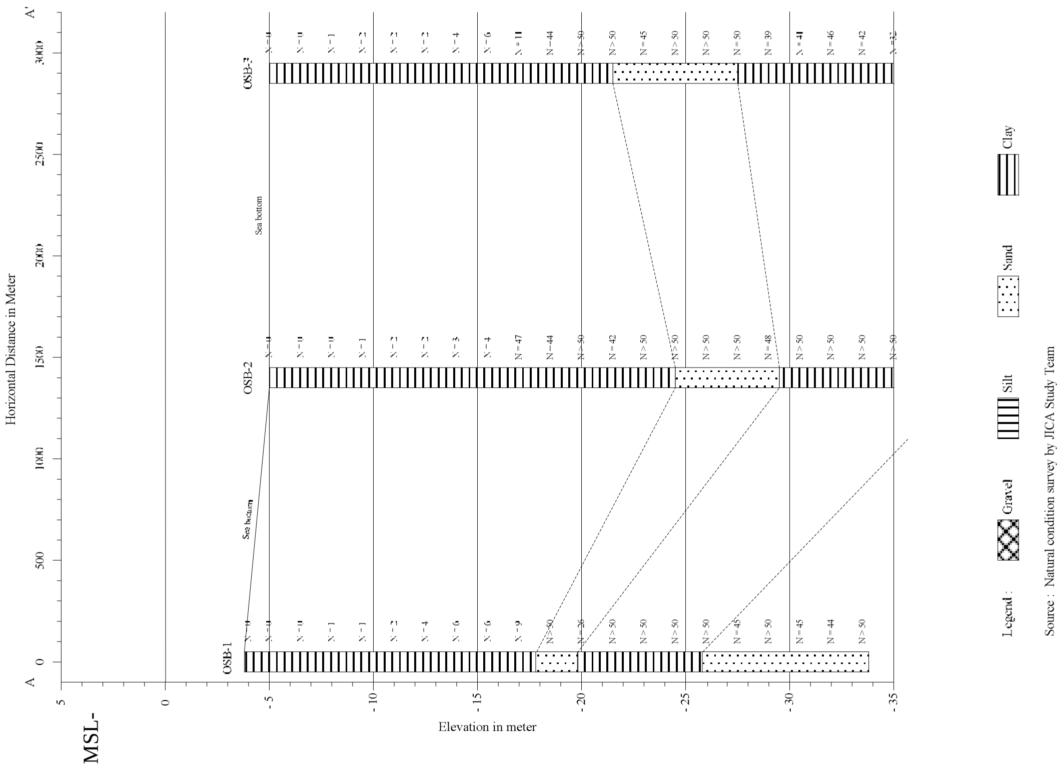
Figure 3.5-6 Subsoil profile in front of Tanjung Priok Port (B-B’ section & C-C’ section)



Source: JICA Study report 2003, "The Study for Development of Greater Jakarta Metropolitan Ports"

Figure 3.5-7 Subsoil profile in front of Tanjung Priok Port (D-D' section)





Source: JICA Study report 2003, "The Study for Development of Greater Jakarta Metropolitan Ports"

Figure 3.5-8 Subsoil profile in front of Tanjung Priok Port (A-A' section & B-B' section)